APPENDIX E

DESCRIPTION OF FUELS REDUCTION, SITE PREPARATION, REFORESTATION, RELEASE, AND OTHER PROPOSED TREATMENTS

TREATMENT TYPES

The R5 FEIS Vegetation Management for Reforestation, Vol. 3, Appendix A (p. A-1 through A-21) includes descriptions of vegetation management, planting, and seeding practices (USDA, 1988). Appendix B of that document (p. B-1 through B-5) discusses the role of plant competition and its effects on reforestation. Conifer establishment will not be successful on the affected soils without vegetation management. Available water for planted seedlings will be a critical limiting factor without site preparation and follow-up control of sprouting species and new plants established from seed in the soil, especially bear clover, Ceanothus species and green leaf manzanita.

The R5 FEIS also discusses site preparation techniques, and herbicides considered for use in reforestation activities (Vol. II, p. 2-3 through 2-12; Vol. III, Appendix A, p. A-1 through A-21). Many of the site preparation techniques discussed in that document have been proposed for use on this project.

Harvest Systems and Commercial Harvest are used for tree removal of commercial size material larger than 10 inches in diameter. Trees are severed at the stump using chainsaws or mechanical harvesters. These trees are removed from stands using either ground based skidding systems (tractors, rubber tired skidders or forwarders) or helicopters. Logging systems identified for each stand were based on slopes and road access. Logging systems are identified for all acres whether commercial size trees exist or not, except for areas that did not have trees, such as rock outcrops or brush fields, or areas where design criteria excluded logging equipment such as spotted owl nest sites, research controls, or underburn only. Within uneven-aged management or California spotted owl thin from below areas identified for removal harvest using ground or helicopter logging systems

> **Tractor Logging** - Harvest of commercial size trees using **ground based vehicles** with rubber tires or tracks. These vehicles are often called skidders and are equipped with grapples or cables to transport severed trees or logs to a landing. Tractor logging occurs in areas with road systems and slopes that are consistently less than thirty-five percent slopes. Some short areas over thirty-five percent are treated.
>
> Tractor logging systems create different intensities of soil compaction and displacement. **Tractor skidder systems** create the most compaction and displacement, while **cut-to-length systems** create the least. **Whole tree yarding systems** fall in between tractor skidder and cut-to-length. However, these systems also vary in availability. Tractor skidder systems have been traditionally used for decades and are found across the Sierra National Forest. Only one cut to

length system is currently in operation across the southern Sierra Nevada. It operates on both private and public lands. Whole tree yarding equipment is found more frequently with at least four different operators having operated in the southern Sierra Nevada in the last 5 years. Within sub-watersheds identified with cumulative watershed concerns, such as in the bear-fen6 or prov1 management units, a priority of tractor logging methods is proposed. The priority is to use the logging system with the least soil compaction as the first option in sub-watersheds of concern. This priority is based on the limited supply of cut-to-length systems in the southern Sierra Nevada. Cut-to-length equipment is the first option in stands prescribed for tractor skidding and with cumulative watershed concerns. Whole tree yarding equipment is the second option in stands prescribed for tractor skidding and with cumulative watershed concerns. Tractor skidding equipment is the last option in stands prescribed for tractor skidding and with cumulative watershed concerns. Operationally this means that equipment with the highest priority will be contracted if available. Should the one cut-to-length operator currently in the southern Sierras go out of business and no other equipment be found, then whole tree yarding equipment will be pursued. If cut-to-length or whole tree systems can be contracted then tractor skidder systems will be pursued. It is important to note that the analysis of effects is based on tractor skidder systems.

1. **Tractor Skidder** – Trees are severed with chainsaws and transported (skidded) to log landings (log collection areas) using tractors with rubbers tires or tracts. Logs are partially or completely processed at the stump by chainsaws. Trees are processed into logs using chainsaws to remove limbs and tops and bucked into logs. Logs are then skidded to the landing using tractors. This system has no operational limit on the size of tree that can be removed. This system is proposed for the Kings River Experimental Watersheds, Proveden-1, El-O-Win and Glen Meadow. This system is the last option for use in watersheds with CWE concerns such as those found in bear_fen6 and providen1.

2. **Whole Tree Yarding** – Trees are severed at the stump using mechanized harvesters that hold and cut trees. Trees are laid in bunches. Trees (limbs, tops and boles) are transported to log landings using tract or rubber tired tractors (skidders). Trees are processed at the landing were a de-limber removes branches, tree tops and bucks the trees into logs. Landings are typically larger than the tractor skidder system to accommodate the large volume of limbs and tops. Soil compaction is typically less than the tractor skidder system. Since trees can be manipulated after severing from the stump, bunches can be staged/bunched to reducing the number of trips by skidders. In addition, trees ride along the tops reducing soil displacement. This yarding system is limited to trees less than 24 inches. This system is used in areas were tractor skidding is prescribed and tree removal is dominated by trees less than 24 inches. Examples include Glen-Mdw1

and El-O-Win1. This system will not be used in the Kings River Experimental Watersheds to comply with the research design. This system is proposed as the second option for use in watersheds with CWE concerns such as those found in bear_fen6 and providen1.

3. **Cut-to-length** – Trees are severed at the stump using mechanized harvesters and processed into logs at the stump. Limps and tops are cut and trees bucked into logs using mechanized harvesters. Limbs and tops remain in the forest to be treated with fuels treatments. Logs are transported from the stump to landings using forwarders that carry logs fully suspended in bunks. Soil compaction is typically less than any other skidding systems because forwarders carry logs across limbs and tops on the forest floor deposited from tree processing. This yarding system is limited to trees less than 22 inches. Forwarders are typically limited to slopes less than 25 percent or areas without broken or uneven terrain. This system is typically in short supply for projects because of the one local operator with this equipment. The CTL system is proposed as the first option for use in watersheds with CWE concerns such as those found in bear_fen6 and providen1.

Helicopter Logging - Harvest of commercial size trees using helicopters to lift logs to landings. Logs are moved from the stump to landing with little or no soil disturbance. Helicopter logging takes place in areas with slopes that typically exceed thirty-five percent. Helicopter logging is proposed with tractor bunching and with out.

Helicopter with Tractor Bunch - Harvest of commercial size trees using tractor logging to gather logs in bunches. Logs are then lifted to the landing using helicopters. This logging system is used in areas with slopes amenable to tractors, but with limited road access. Tractors reduce the flight time for helicopters and lower logging costs by increasing efficiency of helicopter time and eliminating road cost.

Commercial harvest - Removal of trees larger than ten inches dbh from the forest to log landing and then transported for processing. Areas identified as commercial are those areas that have trees larger than ten inches.

No commercial harvest - Areas with out trees larger than ten inches in diameter, such as rock outcrops, brush field or sapling size plantations are identified as “no commercial harvest”.

Harvest Prescriptions identify treatment parameters and methods of tree removal that are part of the purpose and need. These harvest prescriptions define the conditions for tree removal of treatments. Each harvest prescription defines the tree sizes and structural limitations for tree removal. The California spotted owl study prescription follows the 2001 Sierra Nevada Forest Plan Amendment Defense and PAC prescription. The uneven-aged management strategy follows the uneven-age prescription proposed by

Rojas (2004) for the Kings River Project.

1. **California Spotted owl Study, Thin < 6**"- Thin from below up to a diameter of six inches. Tree removal is limited to hand methods. Underburning is allowed. This prescription occurs within 500 feet of current nest site locations identified by the Kings River Spotted Owl Demographic study or in stands with canopy cover between 40 to 50 percent.

2. **California Spotted owl Study, Thin < 10"-**Thin from below up to a diameter of ten inches. This prescription is for plantations and natural stands within spotted owl PACs. Young saplings and pole size trees dominate these portions of stands.

3. **California Spotted owl Study, Thin < 20"-** Thin from below up to a diameter of 20". Maintain canopy cover in stands over 50 percent cover. Maximum canopy cover reduction of 20 percent. Mechanically treat up to 75 percent of a stand.

4. **Uneven-aged management strategy** – Tree removal occurs in all diameters generally less than 35" to conform to a J-curve. The J-curve describes a distribution of trees with declining numbers of trees with increasing tree size. Regeneration is achieved in groups. Groups are created in 10 percent of stands capable of supporting conifers. Regeneration groups are generally less than 3 acres. However, regeneration group area will vary based on the area of existing openings or age cohort. Group size may occasionally exceed 3 acres due to difficulty in measuring area during field layout.

5. **Uneven-aged management strategy, plantation**- Plantations within stands identified for treatment using the uneven-aged strategy.

Fuel Reduction Treatments are used to lower the volume of flammable brush and slash in the general forest or wildland urban interface and provide a measure of protection from wildfire. Fuel burning occurs in conjunction with tree removal and with out tree removal. **Fuel burning** treatments reintroduce fire as a process into the landscape. Actual protection levels will depend on vegetative response and invasion following the fuel or any subsequent site preparation treatments. Proposed fuels reduction will involve using prescribed fire in specific areas throughout the project area, thinning of some overstocked plantations, uneven-aged management, thinning from below and construction of Defensible Fuel Profile Zones (DFPZ).

1. **Hand pile** - thinning slash or material felled by chainsaw is piled by hand labor for burning.

2. **Tractor Pile** - bulldozers are equipped with a brush rake and pile woody debris for burning. Tractor piling is limited to slopes under 35 percent.

3. **Crushing -** bulldozers are used to breakdown standing brush (dead or alive) to facilitate entry into an area previously choked with standing vegetation. This treatment is used to prepare a site for broadcast burning of fuels, where the fuel continuity will allow a more complete burn.

4. **Lop and Scatter -** consists of removing trees with chain saws or lopping shears and cutting up the debris into small pieces that are scattered in a manner that does not promote hot or sustained fire through the area and encourages decomposition.

5. **Mastication/Shredding -** a mastication cutting head is typically mounted on articulating arm on a track-laying low-ground pressure vehicle. The equipment is able to treat vegetation on slopes up to 35-45 percent while having little ground impact. The debris is left on the ground where it rapidly decomposes and provides erosion protection while it is decomposing, or it is burned after it has had time to dry out.

6. **Gross yard- (whole tree yarding) -** removal of treetops and limbs to landings. Slash in the forest is reduced through the removal of tree tops and limbs by leaving the crown attached to the upper most logs. Log and crown are removed from the forest and piled at landings. This treatment can result in large piles of slash in landings as well as large landings.

7. **Broadcast Burning** - prescribed burning (goals set for flame length, intensity and timing of application) of an area where the whole area is treated by fire. This type of burning is either completed in the fall or spring when fuel moistures are low enough to carry fire and still be within prescription parameters. Burning can only be initiated on "Burn Days" designated by the State Air Quality Control Board.

8. **Underburning -** is a prescribed burn under an existing canopy of trees (hardwood or softwood) designed to reduce live and dead vegetation. This type of burning is also completed in the fall or spring when fuel moistures are low enough to carry fire and still be within prescription parameters. Underburning differs from broadcast burning as it has cooler temperatures to protect overstory vegetation. Burning can only be initiated on "Burn Days" designated by the State Air Quality Control Board.

9. **Pile Burning -** Piles created by hand labor or tractors are burned. Usually kraft paper is used to protect an ignition point so piles can be burned in nearly any kind of weather. Pile burning is known to be of a higher intensity than broadcast burning and therefore produces less particulate matter. Burning can only be initiated on "Burn Days" designated by the State Air Quality Control Board.

10. **Jack pot Burning -** is a prescribed burn in brush field areas that have been masticated. This type of burning is used to consume concentrations of fuels. Jackpot burning differs from pile burning in that areas are larger than discreet piles. It may resemble many piles burned at once. Jackpot burning is similar to underburning in that cool burns are completed to protect remaining trees.

11. **Fire line -** construction of areas that create a break in fuels used to control fire. Areas are scraped to mineral soil removing all organic material. The width of fire line varies from 2 feet around hand piles to 6 feet around tractor piles. Fire lines are used to contain fuel-burning treatments (underburns, pile burns, jackpot burns, and broadcast burns) when natural barriers to fire are lacking.

12. **Grapple Piling –** Use of an track-laying low-ground pressure excavator with a with a thumb and claw, typically mounted on articulating arm. . This machine is capable picking up created slash or other material to pile on slopes up to 35-45%.

Site Preparation Treatments in **plantations, brush fields** and **regeneration groups** are used to reduce competing vegetation prior to planting of conifer seedlings. Effective site preparation treatments should consider whether or not a competing plant would sprout from its root system. Removing the above ground vegetation of sprouting plants is only a short-term treatment.

1. **Mechanical methods** use heavy equipment and/or manual labor to clear an area of obstructing material. Resprouting vegetation often grows back in a few years when these methods are used.

    a. **Tractor piling** involves using heavy equipment to scrape slash and other debris into piles for burning.

    b. **Mastication/Shredding** - a mastication cutting head is typically mounted on articulating arm or a track-laying low-ground pressure vehicle. The equipment is able to treat vegetation on slopes up to 35-45 percent while having little ground impact. The debris is left on the ground where it rapidly decomposes and provides erosion protection while it is decomposing, or it is burned after it has had time to dry out.

2. **Chemical methods** employ the use of a herbicide to control competitive vegetation. Resprouting of competitive vegetation from roots is usually minimal after proper herbicide application.

    a. **Glyphosate herbicide** - liquid herbicide (Accord®) at 3-6 percent and a wetting agent (R11®) at 1 percent is applied from backpack sprayers along with a food grade color dye to the vegetation. The colored dye allows applicators to see what they have treated so duplicated applications are not made to the same vegetation. This type of hand application is considered a directed spray, in that a four to ten percent solution of herbicide is used and applied only to the target species that would compete with the conifer seedlings to be planted. This type of application can be used to treat grass species in the early spring, or brush species like bear clover, manzanita, and ceanothus in the early to mid summer. Extensive resprouting is usually eliminated with this type of treatment.

3. **Manual Methods –** hand grubbing or scalping to mineral soil with hoes or similar tools prior to planting or in a radius around the planted seedling.

    a. **Handpile** - thinning slash or material felled by chainsaw is piled by hand labor for burning

    b. **Thin and removing damaged small trees** involves the felling of unwanted trees, either with a chain saw or a machine feller, for burning in place or in preparation for piling.

Planting Treatments - hand planting of bare-root or container stock ponderosa pine, Jeffrey pine, sugar pine red fir, and white fir at various composition levels.

1. **Planting** - species composition is determined by the species removed and historic conditions. The goal for planting species composition is to return to the mix of species that existed in 1850. An exception to the species mix goal is allowed for sugar pine, which is at high risk for white pine blister rust. Due to its susceptibility to this disease, all planting of sugar pine should not represent more than a nominal amount of the total planting, unless rust resistant planting stock is available from the Tree Improvement Program.

   Planting usually is highly uniform and results in approximately 300-400 seedlings per acre due to unplantable sites resulting from rock outcrops, tree stumps, brush covered areas and other obstructions. More trees are planted that are actually needed to stock a stand due to genetic variation in the seed available. Future selection of trees in precommercial thinning would retain those trees that are best adapted to the site. Those trees that are less adapted would be expressing this trait with reduced overall growth or actual mortality.

2. **Replanting or Inter-planting** - is prescribed after release treatments to improve the stocking levels of stands where mortality has occurred. An opportunity exists to improve species composition, increase the number of age classes, and improve stocking levels by planting trees within openings of seedlings or even in between existing seedlings. Acreage listed for interplant treatments is total stand acres (gross) not the net acreage receiving the individual tree planting.

3. **Reforestation Group Planting** – planting in openings for regeneration of shade intolerant species during site preparation in stands identified for uneven-aged management. Ten percent of each stand capable of supporting confers is placed in groups. Existing canopy openings created from insect attack, past fire or damage are targeted for these groups

Release Treatments for reforestation groups and plantations occur after tree planting and is for the control of vegetation that is competing with planted or naturally generating trees, including noxious weeds that are present or have re-invaded the site after site

preparation treatments. To be effective, release treatments need to remove vegetation effectively for a five-foot radius round each tree. See reforestation release chart which displays the criteria used (figure 1).

1. **Mastication/Shredding** - similar to shredding for site preparation, a cutter head is used to masticate competing vegetation while avoiding the planted seedlings. This type of treatment is limited by equipment width and seedlings must be tall enough for an operator to see them above the competing vegetation. Resprouting will occur after this treatment.

2. **Hand cutting of brush** is used in existing plantations to cut large brush plants. Cutting is accomplished using chainsaws or loppers. Severed brush is cut into small section to lay in proximity of the soil or piled.

3. **Hand/Manual Release** – hand grubbing or scalping a radius around the planted seedling with hand tools to mineral soil. Resprouting can occur if the burl or rhizome is left behind.

    a. **One application** is used in areas where brush seedlings and grass are controled with one treatment. Area dominated by white leaf manzanita or whitethorn seedlings are typical of this treatment.

    b. **Two applications** are used were young sprouting brush or seedlings require multiple entries to reduce cover below 20 percent. Also used in areas were initial treatment controls brush and subsequent treatments are needed to control grasses and forbs**.**

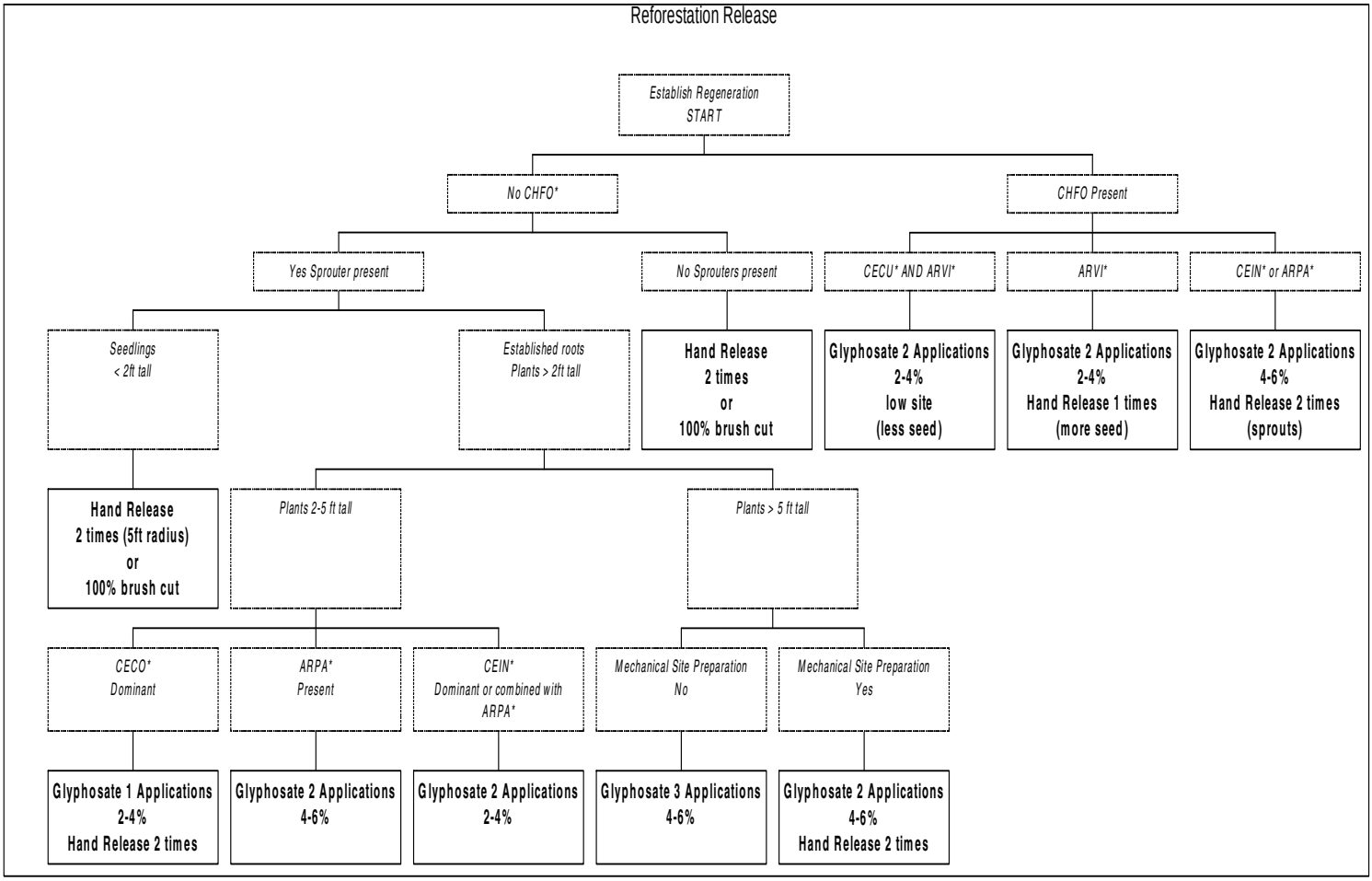
4. **Glyphosate herbicide** - liquid herbicide (Accord®) at 2-6 percent and a wetting agent (R-11®) at 1 percent is applied from backpack sprayers along with a food grade color dye to the vegetation to be treated. The colored dye allows applicators to see what they have treated so duplicated applications are not made to the same vegetation. This type of hand application is considered a directed spray, in that less than 10 (2-10) percent solution of herbicide is used and applied only to the target species. This type of application can be used to treat grass species in the early spring, or brush species like bear clover, manzanita, and ceanothus in the early to mid summer. Extensive resprouting is usually eliminated with this type of treatment.

    a. **One application** is typically used with species (whitethorn) that sprout but whose roots are controlled with one application of glyphosate. Subsequent manual release treatments are used to control brush seedlings. Brush is often shredded or tractor piled to reduce the size of plants and make subsequent chemical treatments more effective.

    b. **Two applications** are typically used for species that sprout prolifically from roots or rhizomes and where grass invades following treatment. Bear clover, deer brush and green leaf manzanita are example of prolific sprouters.

    c. **Two + applications** is used in stands with complexes of large sprouting deer

brush, green leaf manzanita or bear clover. These areas are also prone to the invasion of grasses. These large root systems may take up to two applications of glyphosate to control and application as a one follow up to control grasses.



The figure above displays the criteria used to determine the appropriate release treatment for reforestation. Sprouting species are bear clover, green leaf manzanita, deer brush, buck brush, and whitethorn. The percentage range following glyphosate application indicates the application rate. * CHFO=bear clover, ARVI=white leaf manzanita, ARPA=green leaf manzanita, CEIN=Deer brush, CECO=whitethorn, CECU=buck brush.

Thinning, remove damaged trees, and remove brush is the process of removing some of the conifers and brush in areas that are overstocked, to stop brush from encumbering tree growth, and to remove trees damaged during logging. The healthiest and best growing trees are left untouched and the poor growing or suppressed trees are removed. Brush is removed concurrently while thinning trees. This promotes faster growth and better health in the remaining trees. Thinning also reduces fire intensity and slows fire spread by reducing the available fuel to sustain fire and breaking up the continuity of the canopy. Mechanical and manual thinning methods are both proposed. Mechanical

thinning consists of shredding or mechanical tree removal, while manual thinning employs hand cutting with lop and scatter techniques.

1. **Mastication/Shredding** employs a cutting head, typically mounted on an articulating arm attached to a tracked vehicle, to masticate woody vegetation and slash. The debris is left on the ground where it rapidly decomposes and provides erosion control while it is decomposing, or it is gathered into piles and burned after it has had time to dry out.
2. **Mechanical thinning** - trees are severed using a tracked machine with a cutting head. Trees or brush are bunched for removal to a landing for disposal or left in the forest for latter piling or burning.
3. **Hand thinning** consists of removing trees with chain saws or lopping shears and piling or scattering the debris in open areas for later burning.

Defensible Fuel Profile Zone (DFPZ) Construction consists of various tree removal, fuel reduction, site preparation, planting, herbicide release, and thinning treatments. The end result of these efforts is to create a shaded fuelbreak by establishing open to moderately dense canopy cover. Construction and maintenance of the DFPZs is accomplished through implementation of uneven-aged management. Canopy density is maintained at the lower end of the target canopy density for DFPZ stands. A program of stand underburns and release treatments in plantations and regeneration groups will be used to maintain favorable understory conditions. Specific treatments for each of the DFPZ stands are in the prescription database.

Noxious Weed Control proposes the use of herbicide application and manual methods to eradicate the infestations present and also for any new infestations resulting from implementation of other activities within this project. This will be accomplished by both broadcast spray (area-wide) and directed (plant specific) spray.

1. **Ground Glyphosate herbicide -** liquid herbicide (Accord®) at 3-6 percent and a wetting agent (R-11®) at 1 percent is applied from backpack sprayers along with a food grade color dye to the vegetation to be treated. The colored dye allows applicators to see what they have treated so duplicated applications are not made to the same vegetation. This type of hand application is considered a directed spray, in that a three to six percent solution of herbicide is used and applied only to the target species. This type of application can be used to treat grass species such as cheat grass in the early spring, or later sprouting species such as tocolote in the early to mid-summer.

2. **Weed Wrench** – is a hand tool much like a bumper jack used to remove large noxious weed plants. The weed wrench is used to pull out root and stem. The weed wrench is used in combination with chemical spray. This treatment alone is only effective for plants large enough to attach a chain and in infestations of only a few plants. Smaller plants, seedlings or infestations beyond half a dozen individuals will be eradicated using directed spray of glyphosate.

3. **Hand Pulling** – is used to eradicate noxious weeds with shallow rooting systems (bull thistle) and small isolated infestations. Hand pulling and chemical application will be used in combination to eradicate noxious weed populations.

Other Necessary Procedures combined with the Proposed Action

1. **Seed Collection -** Forest Service seed collection procedures are detailed in the Tree Improvement Master Plan for the California Region (Kitzmiller, 1976). The Base Level program will apply to the majority of the project area.

The Base Level Program is a low intensity effort aimed at maintaining the genetic base and quality of all forested land while striving for gains in volume growth of up to 10% to meet immediate reforestation needs. Seed collection to ensure genetic diversity is built into Forest Service seed collection procedures and can be referenced to the "Tree Improvement Master Plan", and "Managing Genetic Diversity in a Tree Improvement Program" (Kitzmiller, 1990).

2. In conjunction with the baseline program, the Rust Resistant Sugar Pine program is selecting sugar pine trees for resistance to Blister Rust. This disease can eliminate non-resistant sugar pine seedlings and saplings from planting sites where blister rust occurs. The Region's Rust Resistance program allows for testing of trees and retains those trees that are proven to be resistant for cone collection. Sowing of seed and outplanting would be similar to procedures used in the baseline program, except for the selection process and testing for rust resistance.

Road Treatments

1. **Road maintenance -** Roads listed in as needing ‘maintenance’, indicate that the road is passable in its current condition but is needed for access to the project. Some maintenance may be needed prior to project completion, including repair of damage from wet weather planting traffic.

2. **Road reconstruction -** Roads listed as needing ‘reconstruction’; indicate that the road is impassible without work to restore access. Activities would include rock and log removal, grading, and brush clearing. Plugged culverts may also be cleared. This type of reconstruction does not change the road standard or intended access and does not trigger the need for road analysis.

Discussion of Stream Classifications: Flow Regimes, Riparian Conservation Areas (RCAs), Stream Classes, Streamside Management Zones (SMZs) and Riparian Management Areas (RMAs)

The SNF uses several different schemes to identify different kinds of streams and stream-associated management areas.

Flow Regime

The system most widely used and familiar to the public is based on flow regime, and classifies streams as perennial, intermittent or ephemeral.

Perennial streams flow year-round. Intermittent streams usually stop flowing during some portion of the year; the length of time that an intermittent stream flows varies depending on the precipitation received in its watershed each year. Ephemeral streams generally flow only during snowmelt or in direct response to precipitation events, and are dry more often than not.

Classifying a stream as perennial, intermittent or ephemeral helps describe the character of the stream, the types of aquatic life that it might support, the type of landforms that are likely to be associated with it, and the general character of its riparian area. For example, perennial streams are more likely to be larger streams with abundant and/or sensitive aquatic species, and to have floodplains with wider bands of riparian vegetation. Ephemeral streams are more likely to be steep channels with either very narrow riparian zones or no associated vegetation that is characterized as riparian.

Riparian Conservation Areas (RCAs)

Riparian Conservation Areas are a land allocation established in the SNFPA ROD (2004). Within the areas designated as RCAs, specific sets of Desired Conditions and Standards and Guidelines apply. RCA areas are designated using the following definitions.

Table 1 - Widths and definitions of RCAs

Feature Type	RCA Width
Perennial Streams	300 feet on each side of the stream, measured from the bank full edge of the stream
Seasonally Flowing Streams (includes ephemeral streams)	150 feet on each side of stream, measured from the bank full edge of the stream
Streams in Inner Gorge	Top of inner gorge
Special Aquatic Features (fens, bogs, springs, seeps, lakes, ponds, wetlands, etc.) or Perennial Streams with Riparian Conditions extending more than 150 feet from edge of streambank or Seasonally Flowing streams with riparian conditions extending more than 50 feet from edge of streambank.	300 feet from edge of feature or riparian vegetation, whichever width is greater
Other hydrological or topographic depressions without a defined channel.	RCA width and protection measures determined through project level analysis

Stream Classes, SMZs and RMAs

Stream Classes are established in the Soil and Water Conservation Handbook (FSH2509.22), Sierra NF Supplement 1 (1989). Stream Class is used to determine the width of the Streamside Management Zone (SMZ), which is a zone managed primarily to protect and maintain water quality, site productivity, channel stability, wildlife habitat, and riparian vegetation. These widths are described in Table 2.

Table 2. Streamside Management Zone formula.

Stream Class	Width of the SMZ
I	100 feet plus 3 feet for each percent side slope above 30%
II	75 feet plus 3 feet for each percent side slope above 30%
III	50 feet plus 3 feet for each percent side slope above 30%
IV	25 feet plus 3 feet for each percent side slope above 30%
V	No special protection required

RMAs apply to all perennial features, and the width is always 100 feet measured horizontally. Within SMZ/RMAs mechanical activities such as self-propelled ground skidding and equipment piling of slash is generally prohibited. A minimum groundcover density of 50% during winter months is also mandated.

Assigning RCAs and SMZs

The RCA and SMZ widths are defined using maps, applying a set of assumptions, and field checking.

Mapping is based on the SNF stream coverage. This layer includes the 'blue line' streams from USGS 7.5 minute topographic maps as well as 'crenulated streams', which were defined based on contour crenulation on those topographic maps. A channel was inferred if the angle of a bend in a contour line was at a defined angle or smaller. Using this method, relatively small channels (most ephemerals and probably all intermittents) were included in the coverage. Additional information can be found in Maxwell et al. (1995, p.46).

Next, each stream segment is assigned a Strahler (1957) stream order. In the Strahler system, two streams of the same order are required to make a stream of the next higher order. That is, two 2nd order streams produce a 3rd order stream, while the confluence of a 1st and 2nd order stream still results in a 2nd order stream. First order streams are defined for this exercise as the smallest stream shown on the SNF GIS coverage.

The final step is to assign a stream class based on the stream order. The following assumptions apply to this method. Project level analysis would improve the accuracy of the assumptions based on GIS data.

<u>Assumptions for delineating RCAs and SMZs</u>

1. All order 1 stream channels are ephemeral. Per the SNFPA ROD (2004), seasonally flowing streams include ephemeral channels with defined channel or evidence of scour. In reality, not all order 1 streams are likely to be channels with defined scour, so this should be a conservative estimate.
2. All order 2 channels are intermittent. Again, this assumption is presumed to be a conservative estimate.

3. Perennial streams include all channels order 3 and higher. While this may seem to be a conservative estimate for initiation of perennial flow, field experience has shown many first and second order channels as perennial.
4. Springs, lakes, and meadows on the SNF GIS coverage are correct.
5. SMZ widths are based conservatively as:
    a. Order 1 streams = Class IV streams (25 feet)
    b. Order 2 streams = Class II streams (75 feet)
    c. Order 3 + streams = Class I streams (100 feet)
    d. Meadows, Lakes, Springs = Class I (100 feet)
6. RCA widths are based conservatively as:
    a. Order 1 and 2 streams = Seasonal (150 feet)
    b. Order 3 + streams = Perennial (300 feet)
    c. Meadows, Lakes, Springs = Perennial (300 feet)

Table 3. Summary of relationship between feature types, RCA widths, Stream Classes, SMZ Widths, RMA Widths, and Stream Orders (and other GIS data).

<table>
<tr><th>Feature Type</th><th>RCA Width</th><th>Stream Class</th><th>SMZ Width</th><th>RMA Width</th><th>Corresponding GIS Layer Stream Order</th></tr>
<tr><td>Perennial Streams</td><td>300 feet</td><td>I *</td><td>At least 100 ft</td><td>100 feet</td><td>3+</td></tr>
<tr><td rowspan="4">Seasonally Flowing Streams</td><td rowspan="4">150 feet</td><td>II</td><td>At least 75 ft</td><td rowspan="4">N/A</td><td>2</td></tr>
<tr><td>III</td><td>At least 50 ft</td><td>-</td></tr>
<tr><td>IV</td><td>At least 25 ft</td><td>1</td></tr>
<tr><td>V</td><td>None required</td><td>-</td></tr>
<tr><td>Streams in Inner Gorge</td><td>Top of inner gorge</td><td colspan="4">Varies</td></tr>
<tr><td>Special Aquatic Features (fens, bogs, springs, seeps, lakes, ponds, wetlands, etc.)</td><td rowspan="3">300 feet</td><td>N/A</td><td>N/A</td><td rowspan="2">100 feet</td><td>Either identified on GIS layers (meadows, springs, lakes), or identified in the field</td></tr>
<tr><td>Perennial Streams with Riparian Conditions extending more than 150 feet from edge of streambank</td><td rowspan="2">I</td><td rowspan="2">At least 100 ft</td><td rowspan="2">Either identified as ‘meadows’ in GIS, or differentiated in the field.</td></tr>
<tr><td>Seasonally Flowing streams with riparian conditions extending more than 50 feet from edge of streambank</td><td>N/A</td></tr>
</table>

* Class I streams are not always perennial. Intermittent streams with certain characteristics can also be Class I.

References

Maxwell, J.R., C.J. Edwards, M.E. Jensen, S.J. Paustian, H. Parrott, and D.M. Hill. 1995. A Hierarchical Framework of Aquatic Ecological Units in North America (Nearctic Zone). GTR-NC-176.

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