percent of all precipitation in the continental United States evaporates from soil, vegetation and water surfaces (Howlett & Nutter 1969). Evaporation is a consumptive use of water in that the water is removed from the local regime and never reaches the ground to become overland or subsurface flow. Transpiration is the vaporization of water from living cells of plant tissues. The water for transpiration is supplied by translocation from the roots. Transpiration, then is a process which removes water from the ground water system and reduces net yield from a watershed.
Various types of grasses, shrubs and trees have differing amounts of water demands. Some species, such as willows and cottonwoods require a great deal of moisture while other species, such as grasses do not. Changing the long-term vegetative cover on a parcel will result in a change in the long-term water demand on the watershed.

The effect of vegetation manipulation on watershed yield has been studied by many researchers. Alden R. Hibbert (1965) evaluated 39 studies of the effect of altering vegetation cover on net watershed yield. He found that most watersheds showed a definite response to cover alteration, however, the magnitude of the response varied considerably, indicating the complexity of the problem. In general, there was a first year increase in water yield after clearing. This first year increase however, "invariably began to decline soon after treatment" (Hibbert 1965) Based on his study, Hibbert (1965) made several generalizations:

1. Reduction of forest cover increases water yield.

2. Establishment of forest cover on sparsely vegetated land decreases water yield.

3. Response to treatment is highly variable and for the most part unpredictable.

From the preceeding information, the following general hydrologic impacts can be anticipated from this project.

1. When the existing brush is removed, there will be an immediate reduction in the amount of water lost through interception, evaporation, and transpiration. In areas where the existing vegetation is completely removed, there will be increased runoff due to removal of the brushfield litter. This will result in a short-term increase in water yield, of unknown quantity.

2. In areas now sparsley covered with vegetation, the long-term impacts of establishing forest cover will be a reduction in water yield from that parcel.

3. In areas now well covered with brush, the long-term impact will be a steady decline in water yield, from the first year increase, back to a level close to the original yield.

4. The significance of these changes will depend on the size of the parcel and its relationship to the total watershed. Many of the parcels to be treated are very small with respect to the surrounding watershed. This size relationship may make the short and long term changes in water yield inconsequential in terms of net watershed flow.

No Project Impacts

There will be no change in the existing hydrology. Any benefical impacts due to watershed rehabilitation by this project will not occur.

2. Quality

Water quality in undisturbed stable upland areas is generally excellent. The water is typically "low in dissolved or suspended matter except in flood periods, high in oxygen content and relatively low in temperature" (Stone 1973). Sediment transport, while varying with the seasons, has usually reached an equilibrium level based on climate, soils, slope, ground cover, etc. Any disturbance of the soil or vegetation in an area, can disturb this equilibrium and have an impact on the water quality.

Project Impacts

Water quality problems which may result from the activities associated with this project are; stream sedimentation, temperature changes and herbicide residues.

Removal of ground cover, road building and use of heavy equipment can result in erosion and increased sediment load in adjacent streams. This impact is discussed under the subsection Soils. Sediment entering streams causes turbidity, which may make the water unsuitable for other uses, and clogging of spawning gravels with organic debris or finer particles. Clogging the spawning gravels may drastically effect the survival of Salmon and Steelhead.

Removal of streamside vegetation, which shades the stream from intense solar radiation, may raise the average temperature of the water to levels detrimental to local fish species. This is discussed more fully in the fish section.

Air application of herbicides will inevitably result in a small amourt of drift, even when very carefully done. The amount of drift can however, be reduced to insignificant amounts by observance of approved procedures.

2,4-D has been effectively used for treatment of infestations of water milfoil in reservoirs with no adverse effect on fish or other fauna (Dost 1977). Movement of 2,4-D through the soils within the groundwater system or into surface flows appears to be negligable (Dost 1977, EPA 1977). Any possible drift into surface wat would be at a very low levels and immediately diluted the running water. Short of a disaster on the order of a ray plane crashing into a watercourse, it is extemely unlikely that 2,4-D concentrations of a level sufficient to affect aquatic species or domestic water quality would occur.

Mitigation Measures

Measures to reduce erosion and stream sedimentation are discussed in the Soils section. In addition, a buffer strip a minimum of 50-100 feet wide will be left along all watercourses as required by law or as recommended by the Department of Fish and Game. This will serve to mitigate both sediment and temperature problems. The buffer strip will function as a filter for all incoming overland flow, reducing the sediment load and subsequent turbidity problems.

The buffer strip also eliminates the potential for temperature increases in the water. Maintaining existing vegetation along stream channels will continue to protect the stream from solar radiation and avoid temperature changes in the water.

A buffer strip 100' to 500' wide will also be established around all streams for herbicide application to reduce the potential for herbicide drift into open water. Other drift control measures are discussed in the Air Quality section.

No Project Impacts

There will be no change in existing water quality.

B. SOILS

Soil is the basic resource in a forest, serving as a medium for plant growth, storing mineral nutrients and water for plants. Soil can be defined as the aggregate of weathered minerals and decaying organic matter which covers the earth in a thin layer (Dodge et al. 1974). It is formed from the interaction between the underlying parent rock, climate, vegetation, organisms and time. Due to the very long period required for soil formation, this resource is generally considered nonrenewable. Once damaged or lost through erosion, reclamation can be expensive and lengthy if possible at all. By protecting the integrity of the soils during reforestation and future logging operations, the long term productivity of the land can be insured.

Most forest soils in California are residual soils; developed in place from the underlying parent rock without the addition of materials other than organic matter (Dodge, et al. 1974). The physical and chemical properties of these soils is therefore dependent on the parent rock. The ability of a soil to withstand signficant damage is dependent on the soil type, depth, slope, climate and season of activity as well as the methods and equipment used. All of these factors must be considered prior to any field activity on a particular site. Several soil responses to reforestation operations are of concern for this project. They will be discussed below along with potential impacts and mitigation measures.

1. Erosion and Mass Movements

Erosion is defined as the detachment and transportation of soil materials by erosive agents - wind, water and ice (Dodge, et al. 1976). Soils vary in succeptibility to erosion. Attempts have been made to correlate erodibility with partical size and parent material. In general, silt loams have been found to be the most erosive, and heavy particled sandy soils the least erosive (Musgrave 1974). Soils formed from acid, igneous rock (granites) are more erosive than soils derived from basalt (Andre and Anderson 1961). Soils at higher elevation are more erosive than similar soils at a lower elevation (Willen, 1965).

Mass movements includes all large, coherent movements of soil, earth, and rock under the influence of gravity. Factors leading to slope failure are:

1. Parent geologic rock
2. Structure and orientation of bedrock in relation to slope

3. Soil characteristics
4. Soil moisture content
5. Precipitation
6. Vegetation
7. Hydrology
8. Slope aspect
9. Slope gradient. (Dodge, et al. 1976)

These factors are interrelated and most slope failures are due to the interaction of two or more of these factors.

Erosion and mass wasting have been major problems with timber operations in the past. Road building and heavy machinery operations on mountainous lands can result in increased sedimentation, slope failure and removal of topsoil.

Project Impacts

A minor amount of road building will be necessary for this project. Most of the parcels have adequate access, and any road building will in most cases be restricted to lengths of ¼ to ½ mile. The roads built will be temporary to allow equipment access, and will be removed when the work is complete.

Road cuts have been found to be the greatest source of erosion resulting from timber harvesting (Dyness 1967). When roads are built in areas of stable topography on gentle to moderate slopes, few probems result (Stone 1973). Most erosion problems from road building are due to careless soil movement during construction and/or building in areas of unstable ground, especially on moderately to steeply sloping lands (Stone 1973).

Some erosional effects are immediately apparent; washing of cut and fill areas, surface erosion of the road itself etc. These effects are generally at a maximum, for smaller roads, during and immediately after construction, and decline rapidly with time (Stone 1973).

On the other hand, mass movements due to road building may not occur for several years after construction; until a series of heavy storms saturates the soils or drainage facilities become overloaded. When soil is scooped out of a slope, the spoil is commonly used for fill areas or simply dumped over the side. These cut and fill areas adjacent to roadways are frequently the site of slump and other mass movements. Dyrness (1967) found that 72% of all mass movements during the winter storms occured in connection with roads even though roads and rights-of-way, composed only 1.8% of the total area.

Heavy equipment operations for brush removal disturbs the soil, removes surface litter and reduces soil permeability by compaction. If improperly done, bush raking or blading can remove signficant amounts of topsoil.

The period of greatest erosion hazard on areas compltely cleared of vegatation is the first winter, after site preparation has exposed the soil and prior to revegetation. Heavy winter rains on the exposed soil can cause excessive erosion. Subsequent years should show a steady decline in the amount of erosion as the planted trees became established and the understory vegetation returns.

Mitigation Measures

Mitigation of the possible negative impacts of mechanical site preparation and road building on the soil will be by advance planning and compliance with the Forest Practices Act (Appendix A).

Advance planning will involve identification of problem soils and slopes, using the soil survey if available, and consultation with the Soil Conservation Service. Once hazardous areas are known, site clearing activities or road building, can avoid these areas or take special measures in these areas.

General mitigation measures will include:

1. Construction and mechanical site clearing activities scheduled for work largely during the dry season when soil damage will be at a minimum.

2. The use where possible, of the tomahawk for brush clearing. The tomahawk is equipped with large ballon tires to minimize soil compaction, and leaves the chipped brush in place to serve as a ground covering mulch to prevent soil erosion.

3. Planning roads and trails as efficiently as possible to eliminate unnecessary disturbance, while keeping the grade within prudent limits.

4. Design and implementation of adequate drainage facilities; waterbars, energy dissipators etc. where necessary to channel or dispurse expected surface flow.

5. Reseeding all exposed slopes with grass or conifers.

6. Removal or "putting to bed" of all roads built in high hazard areas before the winter rains. Since planting activities the following spring will be labor intensive, not requiring heavy equipment, the number of roadways can be reduced.

7. Close supervision of all phases of the project will be provided by CCC work crew leaders and representatives of CDF and SLC.

Other specific mitigation measures are contained in the Forest Practices Act (Appendix A).

No Project Impacts

There will be no impacts on soil erosion due to the no-project alternative, except the loss of any beneficial effect which would result from the project. Where the soil is presently well covered with brush this will be minimal. Where the land is presently sparsely vegetated, the long term soil stabalizing effect of conifer establishment can be significant especially on the steeper, more unstable slopes.

2. Soil Microorganisms and Soil Fertility

Soil fertility is of vital importance to sustained forest land productivity. Any significant reduction in fertility due to reforestation or timber harvest techniques will defeat the long term objectives of the project.

Soil fertility is a complex attribute, derived from the interaction of soil microorganisms, underlying parent rock, and rate and type of organic matter available. Microorganisms in the soil; bacteria, actinomycetes, molds, algae and protozoa, are essential elements of a fertile living soil. These organisms convert unassimilable minerals and plant humus into carbon dioxide and assimilable plant nutrients (Bollen 1959).

Project Impacts

Reforestation activities which may have an impact on soil fertiltiy and microorganisms include mechanical site clearing and resulting erosion, burning, and herbicide use.

Mechanical site clearing can decrease soil fertility by compaction and reduction in permeability, with subsequent reduction in aeration for the soil microbes. Plants also may have difficulty reestablishing themselves in dense soils of low porosity. Removal of litter and variable amounts of topsoil by blading where the use of the tomahawk is not feasible, will remove the source of slow release of nutrients which originates in the decomposition of litter. This loss of nutrients is generally a short-term impact however, as the planted seedlings become established and the understory vegetation returns, an adequate supply of litter becomes once again available.

<u>Burning of slash</u> and brush can result in a reduction in the numbers and variety of microorganisms in the soil, as well as the loss of the nitrogen contained in the burned material to the atmosphere. An increase in soil Ph is also associated with burning of brush residue.

These effects are greatest under areas of intense burning where complete destruction of organic matter and total loss of nitrogen can occur (Moore and Norris 1947). In areas of intense burning, it can take as long as 14 months for the micro-flora to return to pre-burn levels (Wright and Bollen 1961). When slash and brush is piled in windrows and then burned, hard burn generally occurs beneath the windrows. However, this effect is restricted to a small percentage of the total area.

When the broadcast burning method is used, the entire area generally receives a light burn with few areas of hard burn. This has a lessened impact on soil microorganisms and nutrient supply. Light burning removes mainly the fresh litter and light slash which contains most of the nitrogen (Moore and Norris 1974). Periodic light burning has been found to result in an increase in organic material; a redistributing, not reduction, of organic materials in the soil profile (Moore and Norris 9174). This may result from increased rates of nitrogen fixation due to the increase in Ph or the decomposition of the roots of plants rather than the tops (Wells 1971, in Moore and Norris 1974).

Burning of chaparral brush plants can create or intensify a water repellent soil layer, just below the soil surface. This water repellent layer appears to be due to organic substances in chapparal brush plants and litter, which vaporize during a fire then migrate downward to cooler levels in the soil, and condense, forming a water repellent layer 2 to 4 inches thick (Debano 1966). The formation of a water repellent layer in the soil can reduce infiltration and result in increased overland flow and erosion.

This effect is more pronounced on course textured soils than on finer soils (Debano and Rice 1973). The intensity of the burn affects the depth at which the water repellent layer forms as well as its thickness. A high temperature burn will result in the formation of a thicker, deeper water repellent layer than cooler burning conditions (Debano and Rice 1973).

The formation of water repellent soils will be of the most concern where brush is piled and burned, because higher temperatures and more complete oxidation typically occur with this type of burning. However, the effect will be restricted to a small portion of the entire area.

Broadcast burning typically results in lower temperatures at or near the soil surface. Broadcast burning may result in the formation of a water repellent soil horizon but the layer is generally thinner and closer to the surface (Debano and Rice 1973).

Herbicide: The application of 2,4-D by plane will inevitably result in an unknown percentage of the herbicide being deposited on the soil. Much of the 2,4-D will be intercepted by the target brush but it is impossible to prevent all of the herbicide from reaching the soil surface.

The 2,4-D will be broken down by photodecomposition, oxidation, hydrolysis and other reactions (Crosby 1972), as well as digestion by soil microorganisms (Martin and Ervin 1970). This decomposition will take place within one to three months (Norris, 1966).

Mitigation Measures

1. Heavy equipment work will be done largely during the dry season to reduce soil compaction.

2. Burning will be done only under under controlled conditions. Where the pile and burn method of brush disposal is used, a water repellent layer may form in the soil under the burn area, and the microflora populations will be reduced. Mitigation measures are not possible for these impacts; however, the area of impact will be restricted to a small percentage of the total parcel.

3. Wherever possible, the tomahawk will be used to clear brush. This will eliminate any long term loss of nutrients due to complete brush removal.

No Project Impact

There will be no change on existing soils.

C. AIR

The forest, under natural conditions is the source of various types of emissions. CO_2 and terpenes (photochemically reactive materials similar to important olefins in auto exhaust) are given off by living trees; and the decay of forest litter is the source of CO_2, ammonia, methane and other hydrocarbons (Cramer 1974). These emissions react with NO_2 in the atmosphere to produce minute particulates which may result in a blue haze. Although these natural emissions are released in significant amounts, they are generally well dispersed (Cramer 1974).

Project Impacts

Activities of this project which may result in an impact on air quality originate primarily in the site preparation phase. These activities are; herbicide application, brush burning, use of heavy equipment and other vehicles and site clearing.

Herbicide Application

Aerial application of herbicide will result in a short term impact on air quality, while the 2,4-D is actually being applied. The 2,4-D will be diluted in an oil or water carrier to insure even application, and sprayed on the brush. The droplets will not remain in the air for any appreciable length of time but fall to the earth within a few minutes.

Burning

Some of the sites will require one of the two possible burning operations to dispose of the unwanted brush. Brush will be either piled in windrows by machine and then burned, or burned in place (broadcast burning) without piling. Burning brush by either method will result in a short term negative impact on air quality by the release of unknown quantities of carbon monoxide, carbon dioxide, hydrocarbons and particulates.

The use of burning as a method of brush disposal will involve making tradeoffs with other environmental considerations. For example:

If the brush is not burned, but left standing after being killed by the application of 2,4-D, access for reforestation planting is very difficult and the dry standing brush creates the hazard of an uncontrolled fire occuring at a later date. An uncontrolled fire would have a much greater impact than the prescribed burning as it would probably cover a much larger area and would occur without consideration of atmospheric conditions.

The choice of burning methods involves further consideration of environmental tradeoffs.

Broadcast burning is generally a cooler burning fire with less complete oxidation. This results in more emissions than the pile and burn method. However, using the broadcast burning method decreases the potential for the formation of nonwettable soil horizons and decreases soil compaction and disturbances by eliminating the use of heavy equipment to pile the brush.

By piling and burning the brush, the amount of emissions are reduced and less residue remains because of the higher burning temperatures and more complete oxidation (Fritzen et al. 1970). The potential for the formation of nonwettable soils is increased but the effect is confined to a small percentage of the entire area. Site preparation may be more complete with this method.

Heavy Equipment Operations

In some instances, site preparation and reforestation operations will require the use of trucks, tractors, bulldozers, etc. This will result in the short term impact on air quality resulting from vehicle emissions. The use of this equipment will also unavoidably create a short term dust nuisance.

Site clearing

Site clearing where the use of the tomahawk is not feasible, will expose the soil to wind erosion during the time between clearing and planting. After tree planting, portions of the soil will remain exposed to wind erosion until either covered by litter or the native grasses return to stabilize the soil.

Mitigation Measures

1. Many application methods are used to control drift; "aerial spraying is stopped when windspeeds exceed 6 miles per hour,...flying speed is limited to 45 or 50 mph, and flying height is generally 30 to 45 feet above the vegetation. With conventional

spray booms, drift is also controlled by the use of a nozzle and orifice size that will produce the largest droplet compatible with coverage and desired effect on vegetation (Gratowski and Stewart 1973).

A variety of carrier additives are also available to control drift. The addition of thickeners or foaming agents to the carrier, has the effect of increasing droplet or bubble size which reduces the time the herbicide remains in the air and therefor the potential distance traveled.

2. The Air Resources Board determines permissive-burn or no-burn conditions daily for each air basin in the State. Their decision is based on meteorlogical conditions and the ambient air quality. Burning for brush disposal will be done only on permissive burn days as announced by the Air Resources Board, and will be closely supervised by the CDF and/or USFS representatives.

3. All power equipment, vehicles, and aircrafts used for this project will be properly maintained and provided with the required smog control devices to reduce emissions.

No Project Impacts

There will be no change in existing conditions.

D. VEGETATION

Project Impacts

The most common type of vegetation to be affected by this project is brush. Various species of manzanita, ceanothus and sagebrush generally occupy most of these sites, along with annual grasses, and scattered hardwoods and conifers. This is a subclimax vegetation assemblage and the general intent and effect of this project is to hasten the succession to timber species on selected portions of each parcel. Under undisturbed conditions, natural succession can take many years. By removing the brush and planting the desired conifers, the cycle is speeded up considerably.

There will be a short-term reduction on species diversity resulting from this project. All competing vegetation will be removed from the site prior to seedling planting in areas where hand clearing methods are not feasible. There may be a follow up application of herbicides within 2 years after planting to suppress reinvading brush. After the follow up herbicide application however, the brush and grasses will gradually reestablish themselves as part of the plant community. After an intermediate period of brush and conifers sharing the site, the conifers will gradually become dominant, reducing the sunlight available to understory vegetation. The brush will gradually disappear and be replaced with more shade tolerant species. In areas where timber is not established; rocky areas, poor soils, steep slopes, openings left by seedling failure, or areas left untreated for environmental reasons, the brush will remain.

In view of the limited size of the parcels in relation to adjacent undisturbed areas, and the fact that the entire parcel will not be cleared and planted in most cases, this impact can be regarded as minor.

There will be substantial population reductions among the target brush and grass species from this project, since the objective of this project is their replacement with conifers. The brush will not be eliminated completely however, but will gradually return and become a minor rather than dominant species at the site. No mitigation measures are possible for this impact.

Non-target species which may be affected by this project are; existing conifers or hardwoods on the site, vegetation on neighboring land, riparian vegetation and vegetation within the buffer strips.

Possible impacts on these plants will originate in herbicide use, burning activities and mechanical site preparation.

Herbicide

Air application of 2,4-D, even when done as accurately as possible, will result in some herbicide drift onto non-target vegetation. The amount and impact of drift can be minimized by using approved methods of application but not eliminated completely. 2,4-D is a broad spectrum herbicide, and affects many species: shrubs, forbs, conifers and grasses.

Mitigation Measures

The air application of 2,4-D will be done according to established guidelines (Appendix B) by certified commercial applicators. Buffer strips will be observed around streams to protect riparian vegetation, and along property lines. Adjacent owners will be notified prior to herbicide application. Methods of reducing herbicide drift are discussed in the Air Section.

It is anticipated that drift will be minimal and losses among non-target species held to within acceptable limits.

Burning

Controlled burning will be used to dispose of cleared and/or sprayed brush. Anytime fire is used in the field, the potential exists for its escape from control and burn adjacent areas. If this were to occur, the losses in non-target vegetation could be substantial.

Mitigation Measures

All burning will be done under controlled conditions. A permit is required from the Department of Forestry for all range improvement burns. A representative from the Department of Forestry will visit the site, and determine under what conditions a safe burn can be conducted. The forestry representative will then write up these conditions as permit terms, and later inspect the site to check compliance. When the permit terms have been met, a permit is issued. During the burning operation, experienced fire fighting crews, with necessary equipment, will be standing by to insure adequate control.

Additional guidelines for forest burning are contained in Appendix A.

Mechanical Site Preparation

Mechanical site work, if carelessly done, can result in uprooting or damage to non-target vegetation. In sensitive environmental areas it may not be possible to use mechanical equipment with the precision necessary to protect these species.

Mitigation Measures

In areas of special environmental concern, mechanical clearing methods will not be used. Hand grubbing and scalping will be used where necessary. If hand clearing methods are inadequate to protect a particularly sensitive environment, that area will be avoided or the parcel dropped from the project.

No Project Impacts

There will be no hastening of the natural succession of brush to conifers. It may take from 50-100 years for conifers to become established on parcels which are capable of natural reseeding. In the larger areas which have been burned or logged with no seed trees left standing, the parcels may remain permanent brushfields.

E. WILDLIFE

Those portions of the school lands parcels selected for reforestation support a subclimax vegetation assemblage, consisting primarily of various types of brush. Open brushfields typically support a larger deer population than dense coniferous forests because the young brush sprouts form a large part of their diet.

In addition to deer, brush fields may also support a larger variety of small mammals due to the diversity of food and cover supplied by the low growing brush.

Project Impacts

Alteration of the density and type of vegetation on a site will inevitably result in a change in the wildlife patterns.

This project will generally have a minimum impact on the deer and other large mammals. The parcels are small in relation to the surrounding acreages, most of which consist of similar vegetation. The larger animals, deer, bear, skunk, etc. will continue to have access to large areas in their original (untreated) condition if the surrounding areas are not populated to capacity. Territories may shift somewhat, but no significant population decline is expected among these species.

In some areas, the deer habitat will be enhanced by this project. In those areas where the existing browse is old and degenerate, sprouting is reduced, and generally out of the deer's reach. When cut or burned back, the brush produces increased basal shoots, increasing the quantity and availability of the browse. During site preparation of areas of planned reforestation patches, decadant brush may be deliberately cut or burned back in other areas not scheduled for reforestation. This will rejuvenate the existing browse to the benefit of the deer. In other areas, where desireable browse species are to be removed for reforestation, other areas, not suitable for timber establishment will be cleared and planted to browse.

The greatest wildlife impact will be on the local small birds, mammals, etc. which may not be able to shift their territories as readily as the larger species (Zeiner, Dave). Initially there may be substantial reduction in their numbers as a result of site preparation activities. As the seedlings become established and the understory vegetation returns, these small animals will also become reestablished by colonizing from adjacent areas. Some species now present on the sites will probably never regain their former population levels however, reflecting the subordination of the brush to timber. Other species, more adapted to the coniferous forest environment and not now present on these parcels, will also colonize the area as the seedlings grow and create the appropriate environments. As conifers become dominant and the forest canopy reduces sunlight, the brush will gradually disappear and be replaced by more shade tolerant vegetation. The subclimax wildlife species dependent on the brush for cover and food will also decrease and the climax forest wildlife species will increase. In areas where timber is not established due to poor site conditions or seedling failure, the brush and associated wildlife will remain.

Mitigation Measures

1. Deer browse will be enhanced by cutting back or replacement planting where possible.
2. Sensitive wildlife areas will be avoided. (See Parks and Endangered Species section).
3. No mitigation is possible for the small wildlife species change which will result from the change in vegetation.
4. The edge effects will be maximized as a result of planting in islands or strips as required by environmental and site conditions.

No Project Impacts

The no project alternative will eliminate the beneficial impacts of the project on wildlife, particularly deer. If the existing browse has become too degenerate to be useful to the deer, no positive change will occur. Deer populations could be expected to be reduced due to the decrease in available browse.

F. FISH RESOURCES

Small forest streams are an important factor in the State's fishery resources. The clear, cool, fast moving headwater streams are favored spawning grounds for trout and salmon.

Project Impacts

Headwater streams are generally sensitive to the environmental changes which result from forest projects. In the past, damage or destruction to stream channels and spawning grounds by heavy equipment movements, erosion and residue accumulation has been one of the most serious problems with forest projects. These problems can be controlled, however, by adequate planning and avoidance of sensitive areas.

Stream siltation is one of the most important impacts of any forest project on fish resources. Sediment clogging the spawning gravels reduces the circulation near the eggs, increasing the carbon dioxide and toxic waste product concentration which are normally carried away by the circulating water. Continued stream sedimentation can cover the spawning gravels entirely, eliminating the fishery resource completely.

The removal of timber and brush along stream channels, can expose the water to increased radiation from the sun, raising the average temperature of the water. Most fish have well defined temperature tolerances and a change in average temperature can cause a change in the species present in the stream or the elimination of all species. The effect can include off-site impacts on downstream fish resources.

The application of herbicides by air can result in small amounts of 2,4-D deposited on the streams and lakes. 2,4-D is not readily leached from the soil and carried in surface runoff or groundwater flow, therefore the only significant risk to fish resources from the spraying of 2,4-D is drift from actual spraying operations (Dost 1977).

Mitigation Measures

Erosion and stream sedimentation will be controlled by observance of the Forest Practices Act (Appendix A). Where a high erosion hazard exists adjacent to a stream, that area will be avoided.

Debris accumulation and temperature changes due to bank clearance will be mitigated by leaving a 50-100 ft. wide buffer strip around stream channels. No site preparation will be done within the buffer zone. This has been shown to be an effective method of protecting the integrity of the stream (Brown 1973).

During aerial spraying of 2,4-D, a buffer strip 100 to 500 feet wide will be left around every stream channel to prevent accidental drift onto the open water. Additional drift control measures are discussed in the Air Section.

A representative of the California Department of Fish and Game will be member of the team which will visit each site and determine what treatment will be necessary and feasible. Their recommendations for fish protection will be incorporated into the final plan for each parcel. It is felt that this procedure will guarantee the greatest level of protection of the fishery resources.

No Project Impact

There will be no impact on existing fish resources.

G. ENDANGERED SPECIES

Flora

A large number of rare and endangered plants occur in California. To compile the available information on these rare plants into a useable reference system for land use planning, an inventory of rare and endangered vascular plants was prepared as a seven year project by the California Native Plant Society. This inventory rates the status of rare plants for the following categories; rarity, endangerment, vigor, and general distribution. The files and maps for this project are maintained by the California Native Plant Society in Davis, and are available, by appointment, for review.

All parcels selected for treatment under this project, will be checked against those files. If a rare plant is found on a parcel, special mitigation measures will be employed. These mitigation measures will include:

1. Consultation with representatives from the California Resources Agency and California Department of Fish and Game.

2. No vegetation manipulation or other activities in the area of occurrence except those which clearly would enhance the survival potential of the rare plant.

3. Establishment of a buffer strip around the area of occurrence.

4. Abandonment of the site if it is considered necessary for adequate protection.

5. No herbicide spray in or near the area of occurrence.

Fauna

California has 49 threatened forms of fish and wildlife; species which are now in danger of extinction or which are likely to face this danger within the foreseeable future.

In 1970 the California Endangered Species Act was passed which defined rare and endangered wildlife and gave the Fish and Game Commission the authority to determine which animals in California are rare and endangered. Since then a number of other bills have been passed, on both the State and Federal level, to inventory and protect endangered species.

To protect endangered species on this project, a representative of the Fish and Game Commission will be a member of the team which visits each site and designs the specific program for each site. At the Crossroads, a report on California's endangered and rare fish and wildlife prepared by the Department of Fish and Game, will also be referred to. If a rare or endangered species is found to be at the site, special mitigation measures will developed to protect it. If adequate mitigation measures cannot be designed to protect the species and continue the project at that site, then that site will be eliminated from the project.

H. PUBLIC HEALTH

Project Impacts

Herbicides

2,4-D is a phenoxy herbicide closely related to Silvex and 2,4,5-T. 2,4-D does not contain dioxin (TCDD) as a contaminent, however, and has not been a subject of the recent controversy regarding TCDD and its persistence in the environment.

Many studies have been done to determine the toxicity of 2,4-D and its degradation in the environment. Frank N. Dost, in 1977, prepared a review of the literature of phenoxy herbicides and TCDD for the USDA Forest Service. EPA has also published a review of forest chemicals and their relation to water quality. In view of the fact that no new information has been presented on the hazards of the use of this herbicide, it is not necessary to repeat their efforts. Therefore, a literature review will not be attempted in this report.

Most of the available literature deals with the effects of concentrated amounts 2,4-D on laboratory animals, and have little similarity to field conditions.

During the actual application of 2,4-D in the field, the herbicide is diluted in an inert carrier, and then diluted still further by spraying over a biomass of 25 to 35 tons per acre.

"The rather low toxicity of the phenoxy herbicides seems to present little danger of affecting the health of humans or other mammals. The greatest risk is to applicators or others handling the concentrated materials. The dilution in mixing and the low rates of application in forest and rangeland use practically eliminate any risk to the health of the public when the materials are used in accordance with the label instruction" (Dodge 1974).

Accidental poisonings have occured, several from spilling the material on the hands and arms and then neglecting to wash it off. Workers poisoned this way experienced neural damage and partial paralysis but no deaths occured. The accidental poisonings have not occurred under operational field conditions, but appear to be due to gross mishandling of the material (Nost 1977). General symptoms of 2,4-D intoxication include nausea, fatigue and extended vomiting. Severe poisoning can result in death, paralysis, pain and swelling in effected areas and general neural damage.

Mitigation Measures

2,4-D will be applied at recommended rates by certified operators. Buffer strips 100' to 500' wide will be established around streams and other sensitive environmental area.

Burning

Whenever burning is used as a method of brush control, the potential exists for the fire to escape and present a public health hazard. The fire hazard is greatest for the crew conducting the burn operations and responsible for its control.

Mitigation Measures

All burning will be done under controlled conditions with the guidance of the Department of Forestry. Burning will be done on days when atmospheric conditions present the most favorable conditions for fire control. Experienced fire fighting crews will be standing by with equipment to insure containment.

No Project Impacts

There will be no public health impact from the no project alternative.