Letter 15

David Hope
Watershed Science Consultants
103 Doane Street
Santa Cruz CA 95062
salmonsav@sbcglobal.net
707-239-0175

Mr. Allen Robertson
California Department of Forestry and Fire Protection
P.O. Box 944246
Sacramento, CA 94244-2460

Re: Comments on Artesa Vineyard Conversion Draft Environmental Impact Report (SCH# 2004082094)

Dear Mr. Robertson,

15-1

What follows are comments on the Artesa Vineyard Conversion Draft Environmental Impact Report (DEIR) prepared for the Friends of the Gualala River. The emphasis of my comments will be on Biological Resources, Cumulative Effects and Water Quality aspects of this project.

Authors' qualifications

Registered Professional Forester # 2614
Certified Professional Sediment and Erosion Control Specialist #466

20 years -Watershed Manager/ Forester/ Senior Resource Planner
County of Santa Cruz

10 years -Senior Environmental Scientist
North Coast Regional Water Quality Control Board.

I have reviewed over 1,000 Timber Harvest Plans in the field as a member of the State Timber Harvest Review Team and have consulted on THPs as a private forester. I am the sole author of two CESA and ESA Petitions to list coho salmon (*Oncorhynchus kisutch)* as endangered species I have held positions for 30 years that have dealt with evaluation of watershed conditions and the development of mitigations to address both past present and proposed impacts on individual parcels of land and entire watersheds. I have extensive background and experience in all aspects of forestry and logging as I grew up on TPZ lands and my father was an RPF and UC Berkeley Forestry Graduate. I preformed all aspects of timber harvesting for 5 years in Mendocino County and have extensive experience in instream and watershed restoration. I also have on the ground knowledge of the Artesa Vineyard property and the Gualala River Watershed.

Letter 15 Cont'd

It must be first noted

15-2

The entire process that CAL FIRE has taken to get to the Draft Environmental Impact Report for the Artesa Vineyard Project has been long and disconcerting. This past performance is followed by reading the "NOTICE OF AVAILABILITY OF THE FAIRFAX CONVERSION PROJECT ENVIRONMENTAL IMPACT REPORT (SCH# 2004082094)" and seeing "The California Department of Forestry and Fire Protection (CAL FIRE) has **prepared** a Draft Environmental Impact Report (DEIR) to consider the potential environmental effects of approving a Timberland Conversion Permit and Timber Harvesting Plan for the proposed Fairfax Conversion Project." (Bold added). What should be of further concern to the issue of fair and impartial review is later in this same notice Cal Fire has taken upon itself to predetermine this projects effect by stating "All of these impacts were reduced to a less-than-significant level through the implementation of mitigation measures."

This is noted as CAL FIRE made an initial determination that the project could be approved with a negative declaration because it did not pose significant impacts, while "The DEIR found significant impacts related to air quality, biological resources, cultural resources, geology, hydrology, water quality, hazards, transportation and circulation, and noise.". For CAL FIRE to state all the above and not heed the concerns of significant environmental effects noted by other California State resource protection agencies after their review of this proposed project is very problematic.

The Project

15-3

The Artesa Vineyard Project (AVP) is located on Beatty Ridge between Grasshopper Creek and the Wheatfield Fork of the Gualala River, approximately 0.5 to 0.75 miles southeast of the town of Annapolis and five miles east of the Pacific Ocean. This project proposes permanent removal of all trees, stumps and roots throughout 171 acres of mixed redwood and Douglas-fir forest. While 135 acres will be permanent vineyard another 55 acres will consist of lined ponds, a corporate yard, roads and driveways and a graded perimeter with exclusionary fencing.

Significant issues with the evaluation and proposed mitigations.

15-4

This dramatic conversion of a forest is being compared throughout the DEIR to an average timber harvest that allows a forest to grow back again. This comparison and the choice of mitigations appear in numerous places throughout the DEIR. The Forest Practice Rules buffers chosen by the DEIR have been shown to be less than effective for logging and in this case are being used to reduce the impacts of not only forest removal but intensive land conversion and constant human intervention. Additionally studies of past timber harvest are being used to give the impression that water quantity will

Letter 15 Cont'd

15-4 Cont'd

increase. Other issues arise as the DEIR states that no impacts will occur from sedimentation as existing Basin Plan violations will be controlled to nullify the ongoing inputs of at least 10 tons per year of vineyard caused sediment.

15-5

This 190-acre conversion of forest land is a very significant impact as major changes will occur both on and offsite after the conversion of a natural forest into intensively regulated agricultural lands. In the conversion of the land all trees will be cut, all stumps excavated out of the ground and all roots grubbed out of the soils. This process will permanently alter a living system of soils that now regulate water infiltrations so effectively that virtually no rainfall flows overland. Now water infiltrates into the ground while the existing pores and soil pipes regulate water through soils and the matrix mycorrhizae, shallow and deep roots that absorb most nutrients, so that the net effect in the watercourse is the slow and regulated delivery of clear clean water. After conversion no soil pipes few pores and no mycorrhizae will exist, water will not effectively infiltrate and nutrient flushes will be common and intense (Bormann and Likens 1979). Harvey et al. (1980) found onsite no soil mycorrhizae exist after removal of the forest, and this effect extends, extended 25 feet into adjacent, uncut stands. This impact is a very serious impact to water quality and quantity available to buffer trees as the mycorrhizae benefit of root extension and health are lost after the conversion.

15-6

Mycorrhizal fungi increase nutrient uptake in plants by increasing the surface adsorbing area, by excreting compounds that help take up immobile nutrients, or by modifying the soil microflora. Some ectomycorrhizal species, for example, release oxalic acid, which can mobilize phosphorus in calcareous soils where it would otherwise be sparingly soluble. Ectomycorrhizae in particular have been shown to assist in the acquisition of phosphorus, nitrogen, and potassium. Studies on ectomycorrhizae have also shown that they protect their host plants from excessive uptake of copper and zinc in soils high in heavy metals (Marschner, H. and B. Dell. 1994).

Logging and site preparation had the greatest impact on soil organisms. By destroying large pores in the soil (important for oxygen and water movement), soil compaction drastically changes microbial activity. Loss of organic layers of the soil adversely affects ectomycorrhizae, which are primarily in these layers. Additionally "micorrhizal fungi" grow around tree roots. The trees and the fungi are both dependent on each other for certain nutrients. If the tree is cut down, the fungi strands around its roots die. If a new tree is then planted in the same spot, it will not grow as well because the soil now lacks this important fungus. Erosion and loss of topsoil have been shown to result in a loss of mycorrhizae and a decline in site productivity (Amaranthus 1989).

Harvey et al. (1980) found that all soil mycorrhizae in clearcut areas were dead by summer following harvest, except in areas within 15 feet of a living tree. Soil compaction and the disturbance of organic layers of the soil due to logging activities alter soil microbial activity and adversely affect mycorrhizal populations. Logging and site preparation have the greatest impact on soil organisms. By destroying large pores in the soil (important for oxygen and water movement), soil compaction drastically changes

Letter 15 Cont'd

15-6 Cont'd

microbial activity. Erosion and loss of topsoil have been shown to result in a loss of mycorrhizae and a decline in site productivity.

What does the DEIR have to say about this issue?

Soils and Hydrology

"The proposed timberland conversion project is not expected to diminish annual water yield, summer stream flows, or groundwater supplies. Annual water yield and summer stream flows can be expected to increase due to **increase infiltration capacity** of soils and increased groundwater recharge with removal of forest." (Bold underline added)

The simplistic hydrological review of this project treats this permanent conversion as if it were a cable operation clearcut that would be left undisturbed for 50 years to recover. This might occur if one was proposing a standard timber operation, but this conversion will treat the ground in quite a different manner, destroying the capacity of the soil matrix to carry the significantly increased groundfall of rain when the tree canopy is removed, thus making the assumption of increased groundwater worth discussing.

15-7

Soil surface conditions determine whether rainfall will run off as surface flow or whether it will infiltrate and travel through the subsurface. Infiltration capacities for soils in the coastal redwood belt exceed the maximum rainfall intensities so much that overland flow is almost never seen. The only common infiltration limitations in this region result from bedrock outcrops or soil compaction associated with road building, landings (corporate yard), and other constructed surfaces. Over the vast majority of forested landscapes, rainfall infiltrates into the soil and flows through the subsurface to streams via springs. Studies on clearcut logging showed a dramatic increase in subsurface pore water flow and soil pipeflow, which are larger underground pipe like features. An indication of how much more water is generated after a forest is cut was shown as peak soil pipeflow response to clearcutting was increased 400 percent in Casper Creek immediately after logging. These results suggest that the soil pipes are a critical component of subsurface hillslope drainage (E. Keppler 1998).

The AVP project tree removal would greatly increase rainfall on the soil surface but depending on how soils are treated this effect may have dramatically different effects but all will be negative. In areas where all trees are grubbed out increases in groundwater will not occur but nutrient flushes will occur. The loss of soil pipes and compaction of soils will greatly reduce infiltration and surface runoff will be greatly increase. Where trees and roots where not disturbed there will be either serious increases in subsurface pore

Letter 15 Cont'd

pressures, increasing erosion and transportation of soil in soil pipes or collapse and disruption of pipes and subsurface pores resulting in a dramatic increase in overland flow and transport of surface soils. It should be noted that none of these effects were mentioned in the DEIR. All which will result in sedimentation and increase erosion of downstream channels along with an increased input of pesticides and nutrients.

15-7 Cont'd

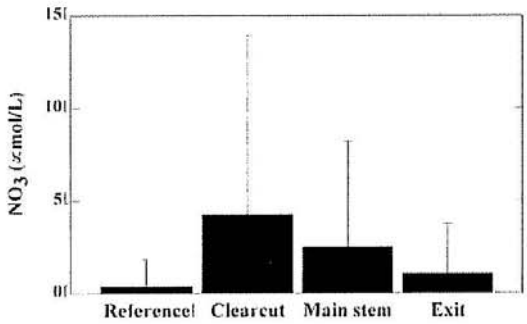
All these impacts are unmitigated by the AVP with the exception of the 1250 feet of Class III watercourse diverted to a pond, which is clearly not adequate to reduce 190 acres of 400% increase in subsurface flow or the great increases in groundfall due to tree loss. The problem with stating that the net effect of the project will be increase groundwater is that it is only accurate if trees are cut and stumps and underground water porosity are maintained, which is the case in the studies cited by the DEIR, but is not the case with this project. Simply stated the AVP will not leave redwood trees stump systems intact nor will it leave most of the ground undisturbed or unroaded and uncompacted, all of which leaves a very different hydrology from the case study used to compare the impacts of this project.

Water Quality

As mentioned few nutrients are lost from healthy forest ecosystems directly to stream channels. These systems are very efficient at recycling nutrients. Young forests rapidly soak up nutrients from the soil as they grow (Bormann and Likens 1994, Scoles and others 1996). The sudden removal of vegetation through conversion, however, will increase the nutrient transport to streams by increasing leaching and erosion of soils (Scoles and others 1996).

15-8

Additionally with the loss of canopy and deep root systems, more rain will fall directly on soils, roads, driveways and the corporate yard increasing the leaching of soil nutrients which is magnified by the lack of deep root uptake capacity. It is well documented that clearcuts/conversions increase the outflow of nutrients from forest soils (Knight et al. 1985), which promulgate algae blooms and degraded water quality. With the additional use of fertilizers, herbicides, fungicides, and nemicides combined with loss of deep roots to trap and recycle this increased input to groundwater, this conversion will seriously degrade water quality (Bormann and Likens 1979, Kimmins 1987, Maser 1994).



Letter 15 Cont'd

15-8 Cont'd

Figure 6— Cumulative effects of nitrate concentrations (mean±standard deviation) in stream waters of the North Fork, Caspar Creek experimental watershed (Dahlgren 1998).

Removal of canopy or disturbance to the forest floor allows rainfall to directly impact soils which leads to soil displacement and transport of soil to the stream channel. Additionally alteration of riparian vegetation can also increase nutrient loadings to streams and allow chemical (e.g., pesticides, fertilizers) and biological (e.g., bacteria) contaminants associated with land-use practices to enter the stream. This purposed vineyard will completely alter the underlying hydrology delivering significant nutrient and agricultural compounds effectively into the 303d listed water bodies.

Confusion over impacts and mitigation

15-9

The AVP conversion must be viewed as lands where existing surface tree canopy will be removed and subsurface drainage will be permanently disturbed and will never be reestablished forests, not other less drastic changes. But by all accounts in the DEIR this site will be treated as though they are forest that will recover. "The timber harvesting activities on the site would adhere to the California Forest Practice Rules and are described in detail in a Timber Harvest Plan (THP) prepared for the applicant by a state-licensed Registered Professional Forester (RPF). The actual logging would be performed by a state-certified Licensed Timber Operator (LTO)." None of the Forest Practice Rules are designed to deal with anything other than standard forest operations. This all begs the question of why is CALFIRE the lead agency in a forest removal project. The Forest Practice Rules were never designed to account for the total and permanent removal of a forest in its guidelines.

Sediment offsets

15-10

The gullies mentioned on the property are existing ongoing human caused sediment inputs that were noted by Regional Water Quality Control Board (RWQCB). "OEI identified three additional locations where gully erosion exist on the project site under current conditions. Project mitigation for erosion at these sites will be implemented to correct inadequate drainage conditions and erosion, thereby reducing mean annual sediment yield by 10.6 to 13.3 t/yr for the low and high range estimates, respectively."

These anthropogenic sources of sediment were noted by past inspections by agency staff and no effort has been taken to correct this known pollution of a "303d Impaired Waterbody". These poor land practices should have been corrected, but were allowed to exist for 4 years in violation of the Basin Plan. The lack of treatment of these existing sediment sources indicates poor land management practices by the landowner. The work to control these gullies and drainage does not require permits and in most cases and is considered as standard maintenance of roads and drainage features. In the intervening period these controllable man made sediment sources have allowed (by their own calculations) from 40 to 60 tons of sediment to be delivered to watercourses that can not be retrieved. No credit can be taken for sediment reduction by sediment from human

Letter 15 Cont'd

15-10 Cont'd

caused sediment source. This is not the background condition, lest landowners create prior significant problems to offset any proposed project. The net production off the property must be considered in light of what the land would naturally produce (minus manmade gullies and roads). Therefore the net production for the project of is still 11 tons per year.

15-11

The bold text items from the DEIR are anthropogenic sources of sediment and are not considered background. The DEIR list these as "Voluntary **Mitigation of Existing Erosion".**

"The estimated net increase in sediment yield from proposed vineyard areas with the incorporation of sediment basins is approximately 11 t/yr (OEI, 2007; Table 1)".

1. Elimination of a degraded ATV trail under power lines caused by unauthorized site users. This will redeveloped as vineyard and drainage within Unit 1.

2. Rock armored outfall on an Annapolis Road culvert outside the vineyard. Hand placed rock armor will mitigate and prevent further enlargement of a small channel scour area in an area with negligible tributary area from roadside drainage.

3. Seepage control in abandoned skid road that has eroded and formed a semi-naturalized channel. A subsurface intercept drain will be placed in or near the perimeter vineyard avenue to minimize saturation-based gully enlargement below the reservoir site.

4. Groundwater and seepage control in an existing gully. A subsurface intercept drain will be placed in or near the perimeter vineyard avenue to minimize saturation-based gully enlargement downslope in a normally dry Ordinary Water reach below Unit 2.

5. Groundwater and seepage control in a second existing gully. A subsurface intercept drain will be placed in or near the perimeter vineyard avenue to minimize saturation-based gully enlargement downslope in a normally dry Ordinary Water reach below Unit 2.

6. Abandoned skid trail repairs below Unit 5. An overgrown and gullied skid trail will be shaped and outsloped. Surface water will be diverted from the entering the site by shaping and periodic rolling dips or water bars installed to prevent accumulation of surface runoff on the trail.

7. Roadside ditch dewatering and armoring. Surface runoff from the SE corner of Unit 8 will be routed through detention basins to a more appropriate swale location. An existing roadside ditch will be armored.

Most of the 7 listed erosion sources are listed as "voluntary sediment control measures" are again listed as items that the landowner has in its magnanimity decided to control.

Letter 15 Cont'd

15-11 Cont'd

Excepting for the water discharged by the Annapolis Road culvert these are all maintenance of existing man caused erosion sources.

The statement "The vineyard improvements are expected to reduce erosion potential over existing conditions which would be a benefit to steelhead trout. Therefore, with mitigation measures presented in the OEI (2007) report and summarized above, impacts to aquatic resources from erosion and sedimentation would be less than significant." This statement from the DEIR is clearly not supported and steelhead resources are harmed by past inputs and will continue to be harmed by 10 to 11 tons per year of man caused sediment.

Forest Edge Effect Myth

Science indicates that the forest edge created by conversions bears little resemblance to edges of natural forest openings typified by gradual transitions and high levels of available cover (Rosenburg and Raphael 1986). Research has discovered that hard edges left behind by conversions make nesting birds more susceptible to predators than more gradual natural edges (Ratti and Reese 1988, Rufenacht and Knight 2000). High-contrast edges interfere with migrations and dispersal of some salamanders (deMaynardier and Hunter 1998). Rufenacht and Knight (2000) found that 22% of bird species in forests that used only edge habitats surrounding natural openings were not found along conversion opening. Hard edges created by conversions allow light and wind to penetrate into the adjacent forest, causing changes in forest microclimate in terms of sunlight, temperature, but it is the plant community that changes too.

15-12

Clearcut/conversion Edge Effects

Conversions and road building dissect forests, creating edges around the perimeter of disturbances that result in changes in local climate, soil moisture, and diversity of plants and wildlife. Air and soil temperatures, wind speed, and amount of sunlight are significantly higher for edges than for forest interiors, and soil and air moisture are substantially lower in edge environments (Chen et al. 1993, Vaillancourt 1995). This can affect plant productivity. Because conversion edges are especially vulnerable to strong winds, edge areas experience windthrow along manmade forest edges (Chen et al. 1992, Vaillancourt 1995). Because of changes to the forest microclimate, species composition of forest understory is significantly different in edge areas than in interior forests (Vaillancourt 1995, Dillon 1998). As a result of fundamental ecological changes rendered by edge creation, stands immediately adjacent to roads or convesrions lose their interior forest characteristics.

Historically, wildlife managers believed that edges enhanced wildlife habitat (e.g., Leopold 1933). Modern research, however, reveals a number of negative ecological consequences due to increasing forest edge: Edge areas experience higher rates of nest predation (Paton 1994, Rufenacht and Knight 2000) and nest parasitism (Paton 1994) for songbirds. Doherty and Grubb (2002) concluded that a consequence of forest fragmentation is an increase in edge habitat, contributing to increased nest destruction by

Letter 15 Cont'd

15-12 Cont'd

many edge-favoring species who join cowbirds in parasitism, as deleterious edge effects impact the reproductive success of forest-dwelling songbirds. Cowbird nest parasitism occurred in 48% of nests and declined with increasing distance from the forest edge according to Brittingham and Temple (1983). Brown-headed cowbirds avoid mature forests (Carter and Gillihan 2000), Brown-headed cowbirds commonly utilize cut-over areas within forests (Crompton 1994). King et al. (1998) found that nest-predation rates for Ovenbirds (*Seiurus aurocapillus)* in a heavily forested landscape were higher near clearcut edges than in the interior forest.

Negative impacts of edges on wood frogs and some salamanders extend 80 to 115 feet into the forest from edges (deMaynardier and Hunter 1998). Increases in avian nest predation and parasitism extend 165 feet (Paton 1994) to 250 feet (Vander Haegen and DeGraaf 1996) into uncut forests from edges. Dillon (1998) found edge effects on understory vegetation composition extend 260 feet into the forest. Edge effects for large mammals may be much greater – Edge and Marcum (1985) demonstrated a decrease in elk use within a mile of open roads. Other various effects include changes in climate or other physical factors; changes in biota due to increases in aggressive edge-adapted species; and increased rates of invasion of noxious weeds.

Forest Fragmentation: Effects on ecosystems

15-13

The cumulative effects of vineyard conversion and timber harvest in the watersheds nearby are a very serious impact that is understated by the DEIR. Human caused fragmentation of a forest has effects that are far reaching and result in dysfunctional habitat islands that soon fail to sustain themselves. The change from a continuous forest with a few natural disturbances to a landscape with isolated remnants of undisturbed forest degrades habitats by many methods. The first is easy to understand as small fragments of forest have limited shelter and food to carry wildlife which leads to starvation and limited shelter will either cause direct predation or movement out of the habitat if possible.

The principle of biogeography recognizes that smaller habitat fragments experience more population extinctions, and the distance to other suitable habitat patches will limit recolonization in the future if the habitat recovers (MacArthur and Wilson 1963). The other issue for other large isolated sites is if populations do survive they are subject to inbreeding and its unfavorable effects (Schaeffer and Kiser 1993). The reason for this issue is that forest-adapted animals often live in metapopulations that are divided into sub-populations between which individuals can emigrate and immigrate. While open–country or generalist species form wide ranging contiguous populations (Beauvais 2000), all species that form metapopulations are subject to local extinctions by fragmenting forests and are especially in danger as floods fires or other random events stress the limited habitat (Wilcox and Murphy 1985).

A local example is the American marten in the Pacific Northwest, which has suffered widespread population extinction due to forest fragmentation (Buskirk and Ruggiero

Letter 15 Cont'd

1994). Fragmentation has also been linked as a major contributor to insect extinctions (Schaeffer and Kiser 1993). Extinctions caused directly by fragmentation continue for years after the fragmentation event (Tilman et al. 1994).

In general, with the increase in fragmentation, forest interior species decrease, edge species increase, and generalist species show little change (Rosenburg and Raphael 1986, Bender et al. 1998). Specialist species are poorly adapted to colonizing new habitats, and are the first to succumb to fragmentation as a result (Tilman et al. 1994). Territorial species having large home ranges, such as martens, goshawks, and forest owls need large tracts of mature forest containing less than 25% of unsuitable habitat (such as conversions or young stands). Bakker and Van Vuren (2003) state that forest-associated species in fragmented landscapes must traverse potentially inhospitable gaps in an effort to move between habitat patches, Keller (1987) demonstrated that fragmentation had significant negative impacts on interior-forest birds such as red-breasted nuthatch, brown creeper, and hermit thrush. Struempf et al. (2000) found that most passerine birds nested in interior locations greater than 300 feet from the forest edge.

15-13 Cont'd

- Neimala et al. (1993) has shown that fragmentation adversely impacts insect fauna.
- Flowering plants have lower diversity in fragmented habitats, and seed production for flowering plants may be depressed in fragmented areas because of the lower diversity of pollinating insects (Jennersten 1988, Rathcke and Jules 1993, Spira 2001).

Many wildlife species require interior forest habitats or show strong preferences for them.

Examples are:

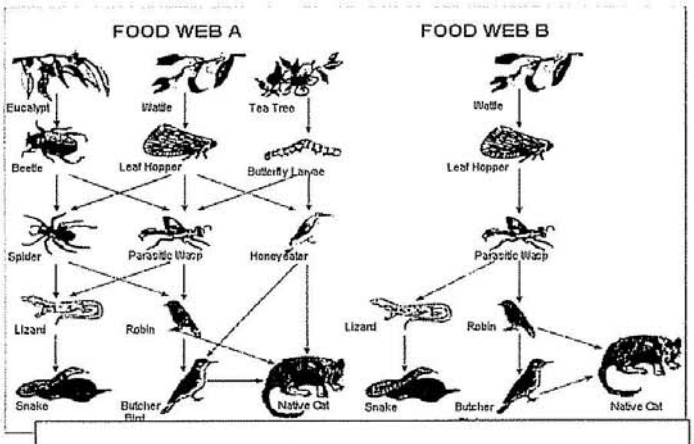
- Northern goshawk (Reynolds et al. 1983, Squires and Ruggiero 1996, Graham et al. 1999).
- Red-breasted nuthatch (Keller and Anderson 1992, Carter and Gillihan 2000, Rufenacht and Knight 2000, Hansen and Rotella 2000)
- Brown creeper (Keller and Anderson 1992, Crompton 1994, Hansen and Rotella 2000, Carter and Gillihan 2000).
- Yellow-rumped warbler (Keller and Anderson 1992, Crompton 1994, Carter and Gillihan 2000); mountain chickadee (Keller and Anderson 1992, Carter and Gilliahn 2000); ruby-crowned kinglet (Carter and Gillihan 2000, Ruefenacht and Knight 2000)
- American marten (Buskirk 1994, Romme et al. 1992)
- Red-backed vole (Romme et al. 1992); red squirrel (Romme et al. 1992, Bakker and Van Vuren 2003)
- Wood frog (deMaynardier and Hunter 1998).

And Marbled Murrelet.

Letter 15 Cont'd

15-13 Cont'd

The AVP DEIR preparers should consider the two food webs shown in the diagram. The arrows point from the organism that gets eaten to the one that eats it. These food webs are highly simplified compared with food webs in real ecosystems, but they still illustrate a key difference between more diverse and less diverse ecosystems. Food web B represents a situation with very low biodiversity, where at some levels the food path involves only a single type of organism. Food web A represents a more diverse ecosystem with, as a result, many more alternative feeding pathways. The loss of biodiversity is always a serious issue, not only because the organisms that have become extinct represent a loss for genetic diversity that reduces possibilities for useful benefit and ethical reasons, but also because the organisms that remain have become more vulnerable (exposed) to extinction in the future. Take away the leaf hopper in Food Web B and the whole system collapses, not so with the Food Web A.



Source: Adapted from Steve Malcolm: 'Biodiversity is the key to managing environment', *The Age*, 16 August 1994.

Letter 15 Cont'd

Buffers

Conversions Effect on the Riparian Zone

15-14 Conversions cause alterations in aquatic ecosystems or riparian processes, including changes in sedimentation, stream temperatures, hydrologic regimes, channel structures, floodplain processes, amounts of woody debris, aquatic plant production, terrestrial litter inputs, and invertebrate, fish and wildlife populations. These interactions have been evaluated and synthesized in several major symposia, reports and books (Krygeir and Hall 1971, Iwamoto et. Al. 1978, Newbold et.al. 1986, Murphy et. al. 1986, Salo and Cundy 1987, Raedeke 1988, Murphy and Koski 1989, Meehan 1991, Nauman 1992, Peterson et. Al. 1992, FEMAT 1993 Murphy 1995). These Reports provide detailed reviews of the effects of forest practices on aquatic ecosysems and variation in watersheds and ecological responses across the Pacific Northwest." (Kohm and Franklin 1997).

All onsite wildlife will be removed and migration of forest related wildlife that has already been impacted by other nearby vineyard conversions will be greatly restricted, and these serious changes are given only light mention and dismissed. Well that is not sufficient and what follows is a detailed reasoning to show the regulatory body why this has not been done by the DEIR.

15-15 The previous discussion on fragmentation of habitat is given first to set the stage for what a buffer from the conversion needs to consider for the level of protections required for protection of species. Here we discuss what a true buffer alone must posses to be effective. As here again the DEIR shows a lack of true scientific investigation to develop appropriate buffers that represent the site and the resources that are to be protected. The buffers for the AVP are chosen based on generalized Forest Practices Rule standards instead on any logical attempt to size buffer to account for site conditions or biological resources to be protected. Additionally the chosen buffers from the Forest Practice Rules are not appropriate as they are buffers for average timber harvest that again do not take into account that a forest will not grow back. Additionally these Forest Practice Act buffer distances are for temporary protection of the stream bank and do not consider impacts to functioning riparian corridors. Pesticides and herbicide discussion states that any likely problems will be muted by proper use and handling and again uses buffers not designed for pesticide use. Cal Fire forest practice standards are clearly not designed for herbicides, pesticides use near streamside environments.

15-16 Riparian habitat supports over three quarters of the amphibians and half of the reptiles in California (Warner and Hendrix 1984). Cederholm (1994) has suggested that maintenance and protection of riparian ecosystems can only be accomplished by first defining riparian areas from a functional perspective, meaning what species and functions must the ecosystem support, then design the widths to protect those species , and then maintain buffers around these ecosystems. The riparian zone itself must be protected to insure both its' survival and its' properly functioning condition for all wildlife. "If the

Letter 15 Cont'd

goal is to maintain natural microclimatic conditions within the riparian zone as well as large wood for nurse logs and nutrient contributions-conditions that are essential for long-term (decades to centuries) maintenance of natural species composition and production of riparian vegetation as well as a number of wildlife species-then buffers need to be substantially wider (MANTECH 1996).

15-16 Cont'd

Riparian zones are in and of themselves very important habitats and they should not be looked at as only buffering agents for radical changes in their neighboring forested landscapes. If a riparian zone is next to a conversion it must be protected against the impacts and it must be more robust to mitigate for the additional impacts. This is due to the fact that many of the features of a riparian corridor and its ability to function as a migration corridor are completely disrupted by conversions; shading and moisture control ; large wood for streams for fish and downed wood supplyfor amphibians; filtering/buffering of sediment and nutrients that are greatly increased by conversions.

It must be stated again riparian corridors are greatly dependent on and have a symbiotic relationship with forests and therefore they cannot be expected to function without the other, Oddly enough, although riparian zones need to be viewed as multidimensional ecosystems, when considering differing widths necessary for protection of a stream, the effectiveness of riparian buffers can be best evaluated within the context of specific protection goals and needs of dependent wildlife. Designed protections within the riparian zone are often do not consider the nearby forest canopies or canopy removal levels proposed by timber harvests. For example, riparian standards designed to protect only salmonid habitats with a lightly harvested forest stand near the riparian zone, would differ substantially from standards to protect all riparian dependent species, including amphibians, birds, mammals, and reptiles and fisheries from a conversion of a forest.

The DEIR states "Riparian habitats and the associated aquatic species, including the foothill yellow-legged frog, are the primary area of concern on the project site with regard to potential adverse impacts from pesticide use. The project site contains both Class II and III drainages. Many aquatic species are very sensitive to pesticides, and as shown in Table 3.8-2, pesticides that may be used on the project site are highly toxic to aquatic species. However, the Class II and Class III watercourses on-site would be protected by Watercourse and Lake Protection Zones (WLPZs), as per Forest Practice Rules guidelines. WLPZ buffer widths are designated according to side slope. For Class II watercourses with side slopes under 30 percent, the buffer is 50 feet; for those with side slopes between 30 and 50 percent, the buffer is 75 feet; and for those with side slopes greater than 50 percent, the buffer is 100 feet. For Class III watercourses with a side slope less than 30 percent, the buffer is 25 feet, and for those with slopes greater than 30 percent, the buffer is 50 feet. In addition, all Class III watercourses near conversion areas would be protected by variable Equipment Exclusion Zones (EEZs) ranging in width from 25 feet to 50 feet. Trees and brush will not be removed from any portion of the WLPZs or EEZs."

15-17

9 chemicals known to be toxic to fish will be used in this operation. Without deep root systems these chemicals will easily soak down below vine roots to the lower groundwater

Letter 15 Cont'd

zone and be delivered via minimum depth 30 inch deep permanent trench drains proposed.

It is unfortunate that here we are using streamside habitats and riparian areas as buffers for serious conversion of forests and activities that will deliver many impacts to the riparian corridor and the watercourse. Riparian zones in forested environments are not as effective at maintaining themselves or providing benefits to their dependent plants, birds, retiles, amphibians, or mammals without an adjoining forest. Forests provide a buffer for riparian zones as they provide shelter to the riparian zone from winds and excess solar exposure. Forests in turn supply large woody debris for riparian benefit, protection from open land predators and control of climate and moisture while improving the function of the riparian corridor as a habitat corridor for migration.

Removal of the forest from neighboring riparian zones will destroy this interrelationship and limit ability of the riparian zone to function. The relationship of the forest to the riparian zone can be simply thought of as The forest vastly improves the function and utility of the riparian corridor. Without the forest the landscape becomes simplified One of the hidden damages is biodiversity loss from patch conversions. Biodiversity is the key to managing the environment, an ecosystem that retains, a wide variety of living things (biodiversity) is much more likely to adapt to human-caused environment change than is one that has little (Malcolm 1994).

15-17 Cont'd

Poorly planned land use practices disrupt/impair key environmental variables and ecological processes that will in turn impair the ability of stream and wetland systems to perform key water quality functions and provide beneficial uses. Projects on land can significantly influence watershed processes, including the transport and storage of water, sediments, nutrients, organisms, and other chemicals and materials, which directly affect the water quality of streams and wetlands and other aquatic habitats. In turn if forests are removed the reliance on the riparian zone by the remaining wildlife can and will overload that habitat and very likely lead to a total collapse of both the riparian and aquatic environments. A limited riparian buffer with no adjoining timberlands is a perfect example of a poorly planned land use practice that will severely impact the streamside habitat and the adjoining wetland and aquatic habitat.

Specific recommendations for buffer widths can only be made with a clear definition of riparian management goals and protections. If the goal is to maintain only *instream* processes over a few years, then a no touch protected riparian buffers of 200 to 300 feet will maintain 90%-100% of most key functions, including shading, LWD recruitment (excluding trigger trees, upslope wood and upchannel wood), small organic litter inputs, nutrient regulation, and (unchannelized or unroaded) sediment control for surface erosion in the riparian zone (MANTECH 1996). This is not afforded by 30 to 100 foot buffers.

However, an instream process-oriented management approach can only be effective in the short term, as the riparian zones are not self maintaining and can not survive at a given width without the buffering effects of a forest, nor are they alone robust enough to provide functioning habitat for wildlife. Riparian zones must be afforded protection, in

Letter 15 Cont'd

15-17 Cont'd

effect they need their own buffer, which in fact acts like the original forest next to a riparian zone.

The Issue

Research today is giving us and understanding of how wide-ranging the impacts of conversions are, and more precisely how severe onsite impacts are to remaining habitat. Small patches provide poorer habitat than contiguous areas because of edge effects, which can diminish effective habitat area by as much as two tree-lengths into a stand (FEMAT 1993).). Large-scale empirical studies all show that fragmentation has major documented effects that cause degradation of habitat quality within fragments. There is good reason to be cautious of any claim that (riparian) corridors or the spatial configuration of remaining habitat can compensate for the overall loss of habitat (Harrison and Brunha 1999). Conversions make the nearby terrestrial habitats and wildlife more dependent on a robust and even larger undisturbed habitat riparian habitat.

But it must be reiterated that any recommended buffer widths for nutrient and pollution control on lands must be tailored to specific site conditions, including slope, degree of soil compaction, vegetation characteristics, and intensity of land use. For the goal of maintaining instream processes over a the short term, a fully protected riparian buffer of approximately one site potential tree or 200 to 300 feet will likely maintain 90% plus of the key functions, Any timber harvest within established riparian zones further diminishes the capacity of the riparian zone to provide all of the functions of LWD recruitment, microclimate protection, shading nutrient buffering and all other functions of the riparian zone (MANTECH 1996).

15-18

Riparian zones that have not been disturbed by land-use activities provide the greatest level of protection for aquatic habitats and should generally not be disturbed until a significant percentage of riparian areas across the landscape has been restored (MANTECH 1996). Removal of canopy or disturbance to the forest floor allows rainfall to directly impacts soils which leads to soil displacement and transport of soil to the stream channel. Alteration of riparian vegetation can also increase nutrient loadings to streams and allow chemical (e.g., pesticides, fertilizers) and biological (e.g., bacteria) contaminants associated with land-use practices to enter the stream (MANTECH 1996).

Undisturbed forests with adjoining riparian vegetation can effectively remove nutrients and other dissolved materials as they are transported through the riparian zone by surface or near-surface water movement. However, the relationship between buffer width and filtering capacity is less well understood than other riparian functions. Those studies that have been published indicate substantial variability in the effectiveness of buffer strips in controlling nutrient inputs (reviewed in Castelle 1992; Johnson and Ryba 1992). These characteristics are existing vegetation, quantity of organic litter, infiltration rate of soils, slopes, and other site-specific characteristics. Therefore specific studies need to be conducted on the lands to be converted to determine buffer width, not depending on generalized setback designed for other purposes.

Letter 15 Cont'd

Buffer discussions to date by the Board of Forestry have only considered if the watercourse edge is protected from forest removal, no attempt has been made to consider how much impact forest removal makes on the riparian corridor. Never have discussions considered the larger impact of conversions on wildlife or wildlife corridors and how fragmentation of habitat by clearcutting brings about the need for even larger buffers. Using Riparian Corridors to buffer the impacts of forest removal on watercourses ignores the critical wildlife values of the riparian zone itself. Therefore using a standard Forest Practice Act buffer width is totally inappropriate.

15-18 Cont'd

To simplify the impacts of forest removal by naming a short distance were you think impacts stop is pure folly. Woodland riparian zones can not function properly without a nearby forest, just as a stream can not function without neighboring riparian corridor. In order for riparian buffers/corridors to be fully functional the DEIR must define the beneficial uses associated with a functional forest, riparian zone and aquatic community and then set the buffer to accommodate all these elements. Riparian zones are in fact the zone of direct interaction between terrestrial and stream systems, you can not just remove the forest and say this remaining strip of land will function by itself, buffer silt and pesticides and maintain itself with out its neighboring forest.

With the removal of the neighboring forest, riparian vegetation is seriously compromised. This proposed forest removal will significantly alter shade to stream channels, contribution of large woody debris and small organic matter to streams, all not mitigated for in this DEIR. Controls of sediment inputs will not be successful if bare soils exist near insufficient buffers. Roads, tilled and compacted soil and trench drains will increase sediment and nutrient inputs from surface erosion and subdrains. A comprehensive look at soils and slope are a minimum necessary step in creating sufficient buffers for this impact.

Matters to Consider for Proper Buffer Width

15-19

The sizing of riparian buffers is dependent on many factors including local climatic conditions, topography, geology, native vegetation community and the relationship between this existing functioning system and any neighboring forest or native vegetation community. Not the set limits that are generally given under the Forest Practice Rules. If an EIR is intended to deal with the impacts of a conversion then a full and complete analysis of the afore mentioned factors must be completed. These factors set what is the relationship of the native riparian to a future health and related nearby conditions that are affected by development and possible future and features of the riparian area. The width and characteristics of a proper buffer need to factor in for both location, dependent wildlife and then for the existing conditions proposed changes to the neighboring lands.

If the AVP buffers are truly intended to protect the stream and insure an intact and functional riparian corridor exists near the proposed vineyard then the width of the buffer would have a "leave zone" outside of the buffer that would protect a robust self maintaining riparian corridor of a width commensurate with the goal is to maintain

Letter 15 Cont'd

15-19 Cont'd

natural microclimatic conditions within the riparian zone as well as large wood for nurse logs and nutrient contributions-conditions that may be essential for long-term (decades to centuries) maintenance of natural species composition and production of riparian vegetation as well as a number of wildlife species. If that were ever the goal of the AVP, then buffers need to be substantially wider than 30 feet to 100 feet.

Buffers *Depth of Edge Influence*

Just how far from the vineyard will effects of forest conversion intrude? Much scientific study has been done regarding Depth of Edge Influence, measuring the distance that ecological impacts from edge effect extends into the neighboring forest. Vaillancourt (1995) studied Depth of Edge Influence on forest and found the following distances for climate and ecological impacts:

- 300 feet for temperature Ledwith 1996, FEMAT 1993
- 165 to 450 feet for humidity Ledwith 1996, FEMAT 1993
- 100 to 165 feet for sunlight intensity
- 100 to 165 feet for tree density
- 100 to 165 feet for canopy cover
- 65 to 100 feet for wind-throw (blow down of trees vulnerability to wind).

15-20

Rudolph and Dickson (1990) reported amphibian and reptile populations were significantly lower in aquatic habitats with narrow buffer widths (<30 meters) than those with wider buffer strips due to greater shading (i.e., less solar radiation and lower air temperatures) and open understory vegetation. In addition to these functions that directly influence aquatic habitats, riparian areas are critical habitats for a variety of terrestrial and semiaquatic organisms and serve as migration or dispersion corridors for wildlife species (FEMAT 1993). Many of these benefits derive from the availability of water and unique microclimates in these zones. Long-term conservation of salmonids requires protecting not only the immediate functions that riparian vegetation provides, but the ecological conditions within the riparian zone needed to maintain natural vegetation communities (e.g., soil productivity, microclimate) as well. Baker and Dillon (2000) concluded from numerous studies that the typical depth of edge influence for vegetation effects was 200 feet, regardless of location. Harvey et al. (1980) as mentioned found negative effects to soil mycorrhizae, extended 25 feet into adjacent, uncut stands. Mills (1995) found that mycorrhizal truffles were significantly less plentiful within 50 feet of the edge, and red-backed voles were less abundant within 150 feet of the edge.

Negative impacts of edges on wood frogs and some salamanders extend 80 to 115 feet into the forest from edges (deMaynardier and Hunter 1998). Increases in avian nest predation and parasitism extend 165 feet (Paton 1994) to 250 feet (Vander Haegen and DeGraaf 1996) into uncut forests from edges. Dillon (1998) found edge effects on understory vegetation composition extend 260 feet into the forest. Edge effects for large

Letter 15 Cont'd

mammals may be much greater – Edge and Marcum (1985) demonstrated a decrease in elk use within a mile of open roads.

15-20 Cont'd

A functional definition and view of riparian zones and stream networks will provide a basis for making management decisions within the context of full drainage basins. The conceptual framework developed by Gregory, et al, and Lamberti, et al, using ecosystem and basin geomorphology perspectives could provide a useful point to begin from (Gregory e. al., 1991, Lamberti et.al. 1991)

Buffers and Windthrow

15-21

The buffer widths chosen the AVP must also take into consideration blowdown. Trees within riparian buffers that are immediately adjacent to clearcuts have a greater tendency to topple during windstorms than trees in undisturbed forests. Extensive blowdown can affect aquatic ecosystems in a number of ways, recruitment of large wood pieces that are key to maintaining channel stability and that provide habitats for vegetation and wildlife within the riparian zone. In addition, soil exposed at the root wads of fallen trees may be transported to the stream channel, increasing sedimentation. Other riparian functions, including shading, bank stabilization, and maintenance of riparian microclimates may also be affected. Rhodes et al. (1994) suggest that buffers need to extend to a distance of two site-potential tree heights (or > 91 m) to protect riparian buffers from windthrow; however, local site conditions dictate vulnerability of stands to windthrow and appropriate buffer widths would vary accordingly (MANTECH 1996).

Microclimate wind and solar radiation

15-22

With forests in mind we can now look at what is the proper size of the riparian zone when we consider what it needs to do for the stream, what is the size of the riparian zone when it must maintain itself/function by itself. In riparian zones near a clearcut in the Mad River changes in air temperature and relative humidity were found up to the 150 meters into the riparian corridor. This indicates that buffer widths greater than 150 meters may affect riparian microclimate (Ledwith 1996). *Chen (1991)* recorded changes in air temperature, relative humidity, and wind velocity up to 240 meters into an upland forest from the edge of a clearcut, while solar radiation, soil temperature, and soil moisture were influenced up to 90 meters.

Fish-bearing streams are influenced not only by the condition of adjacent riparian areas, but conditions of upstream reaches as well, including Class III and Class II streams. Sediments generated from unprotected upstream reaches are transported and deposited downstream, filling pools and decreasing channel stability. Removal of large trees from headwater areas may reduce recruitment of wood to downstream areas. Temperature increases caused by canopy removal in small streams can also affect downstream reaches. Because these influences of land management propagate downstream, protection of riparian zones Class III and Class II watercourses is also needed to maintain salmonid habitats.

Letter 15 Cont'd

15-22 Cont'd

For the goal of maintaining instream processes over a the short term, a fully protected riparian buffer of approximately one site potential tree or 200 to 300 feet will likely maintain 90% plus of the key functions, including shading, near stream LWD recruitment, small organic litter inputs, nutrient regulation, and sediment control (for surface erosion in the riparian zone only). But this does not mean that the riparian zone is healthy and able to sustain itself or maintain the wildlife that is dependent on it.

Establishing a buffer width necessary to maintain a functioning riparian ecosystem is the critical question, not what width of riparian buffer is necessary to protect a stream from a conversion. Decreased riparian widths increase direct and indirect solar radiation into the riparian zone which increase air temperature and decrease relative humidity in that area (Ledwith 1996). If we do not protect the integrity of the riparian zone by designing it to be too small we risk changes in microclimate conditions that alter riparian ecosystem function. If any aspect of the riparian corridor is altered only slightly beyond the tolerance levels of terrestrial riparian flora and fauna, these species may perish or be forced to find other habitats forcing competition for limited habitat. *Rudolph and Dickson (1990)* reported amphibian and reptile populations were significantly reduced in all aquatic habitats neighboring buffer widths of 100 or less, compared to nearby wider buffer strip. This was due to due to the greater shading (i.e., less solar radiation and lower air temperatures) and robust understory vegetation within the wider riparian buffers.

Smaller riparian buffers have been proven to increase evapotransporation rates and raise air temperature which all can contribute to lowering groundwater tables and soil moisture content. This may prematurely dry up intermittent streams, depriving flora and fauna of an important water source during the dry season (Ledwith 1996). Increased solar radiation and air temperature may also raise the water temperature in a stream to sublethal or lethal levels for resident aquatic life.

Letter 15 Cont'd

15-22 Cont'd

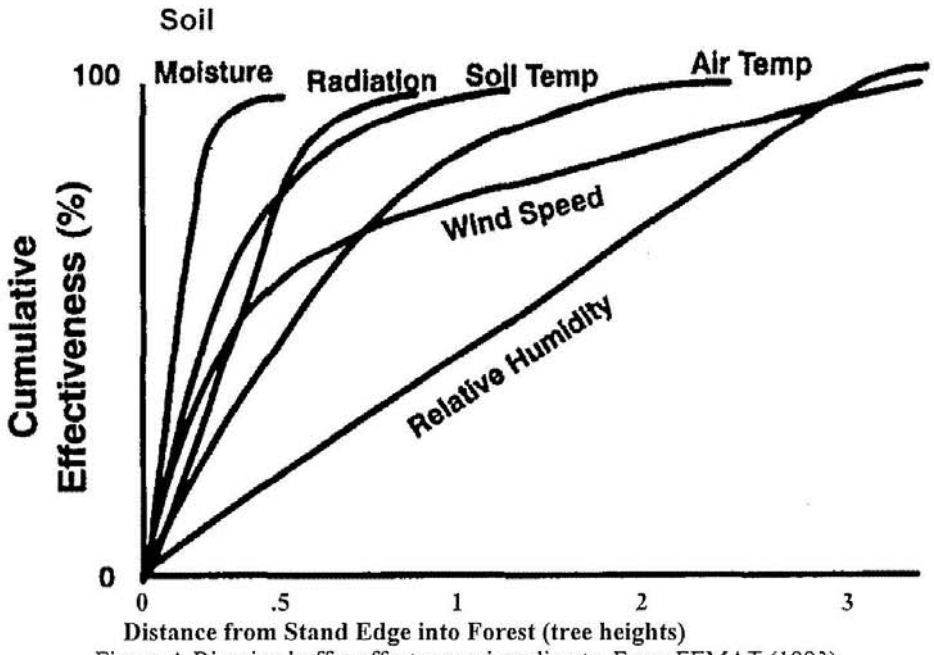


Figure A Riparian buffer effects on microclimate. From FEMAT (1993).

Figure A indicates that buffer widths needed to protect most physical aspects of a riparian corridor is in the range of 600 to 900 feet.

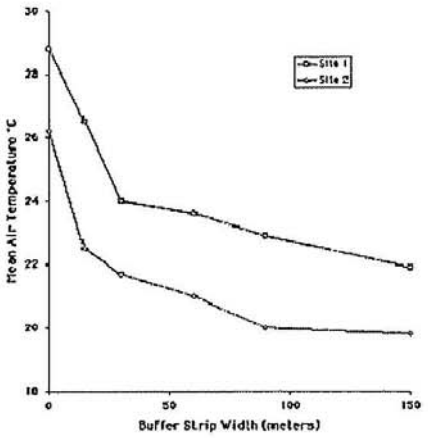


Figure 1. Change in Mean Air Temperature in a Stream Riparian Zone with Varying Buffer Widths during the Study Period Ledwith 1996.

Letter 15 Cont'd

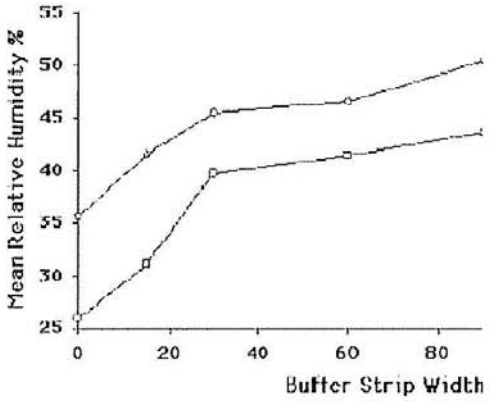


Figure 2. Change in Mean Relative Humidity in a Stream Riparian Zone with Varying Buffer Widths during the Study Period Ledwith 1996.

15-22 Cont'd

The microclimatic conditions within the riparian zone are drastically altered by conversions. This change can has long-term impacts to a variety of critical ecological processes within that effect the integrity of riparian ecosystems. FEMAT (1993) presented very useful curves showing the distance and effect of microclimatic variables relative to distance from stand edges into forests (Figure A). These curves suggest that buffers need to be extended an additional one-to-two tree heights outside of the riparian zone to maintain natural levels of soil moisture, solar radiation, and soil temperature within the riparian zone and even larger buffers (up to three tree heights) to maintain natural air temperature, wind speeds, and humidity. The FEMAT (1993) recommendations were based on studies in upland forests in the Cascades (Chen 1991), but their applicability to riparian zones in this region was confirmed by Ledwith 1996.

15-23

The long-term productivity of riparian habitats are critically tied to and affected by management in adjacent upland forests. Germination of many types of vegetation are tied to decaying logs in the riparian zone because they retain moisture and tend to shed leaf litter that can bury seedlings (reviewed in Harmon et al. 1986). An important riparian function of maintenance of moist soil refugia for amphibians and other animal and insects is also critically dependent on downed wood and rotting logs in forests. Nutrients and organic matter in riparian forests are also dependent on large downed wood. Large downed wood is also a significant source of the total nitrogen, potassium, and phosphorous found on the forest floor. Maser et al. 1988 found that about 30% of all soil organic matter in two old-growth Douglas-fir forests was contained in downed trees of 500 years age or older. Sollins et al. (1981) found that proportion of soil organic matter

Letter 15 Cont'd

15-23 Cont'd

from LWD was four-fold higher than in other forms of forest litter. These studies and more suggest that long-term integrity of riparian are dependent on retention and recruitment of large wood to the forest floor from within the riparian zone and adjacent uplands. Maintaining recruitment of wood to the riparian zone (not just the stream channel) would require extending buffer zones beyond the edge of the defined riparian zone (MANTECH 1996).

None of the aforementioned considerations have been made by the DEIR in considering buffers for the conversion of forest and the permanent installation of vineyards, fencing, roads, cooperate yard and other facilities associated with this operation. All of which is a very important omission in this DEIR. Placing a vineyard next to a construction yard or previously developed site might allow this DEIR to be sufficient but placement within a forested environment is quite a different issue.

Biological Resources

15-24

The DEIR states "To ensure that the proposed project does not result in adverse effects to fisheries, the proposed project has been designed to ensure that the project results in a decrease in sedimentation." The information provided by this report shows that this is not supported by facts or on the ground conditions. The DEIR states "In addition, mitigation has been included in the proposed project to ensure that monitoring of water quality is conducted to ensure that the estimated net decrease in sedimentation occurs. Therefore, the proposed project's incremental contribution to the cumulative impact would not be cumulatively considerable." There will be a constant input of sediment from these ongoing agricultural practices that must be mitigated within the project. Standard maintenance on roads and skid trails to remove the footprint of man will only give the property its background sediment production rate and can not be considered as an offset for poorly controlled agriculturally produced sediment.

Removal of the forest and destruction of the existing forest ecology will disrupt groundwater infiltration and soil root interactions will itself greatly increase sediment production and nutrient inputs to the stream, all unaccounted for in the DEIR. Adding ongoing sediment nutrient and pesticide inputs from the vineyard operations is again another source of impacts to water quality that has not been mitigated. Therefore the following statement in the DEIR is unsupported "Furthermore, as pointed out in Impact Statements 3.4-8 and 3.4-11 of Chapter 3.4, Biological Resources, the proposed project has the potential to enhance downstream conditions by reducing erosion and increasing summer base flow. Therefore, the proposed project would not only avoid adverse impacts to fisheries, but could also result in beneficial impacts related to sedimentation and summer base flow. For these reasons, the proposed project's incremental contribution to cumulative impacts to fisheries in the Gualala River watershed would not be cumulatively considerable, and the project would have a *less-than-significant* impact on fisheries."

Letter 15 Cont'd

The following statement from the DEIR is also unsupported as the violations of the Basin Plan for having not maintained drainage on the property from roads and skid trials would be required for cleanup by the North Coast Regional Water Quality Control Board and is not dependent on this project.

Chapter 1 – Introduction, Scope, and Summary of EIR (Page 1 – 17)

15-25 "Furthermore, the No Project Alternative would not result in the long-term reduction of sedimentation from the project site, as would occur with the proposed project."

The following quote from the DEIR should be seriously reconsidered as conversion of a forest is a far more serious impact than acquiring property that is already disturbed or less desirable but looking at existing grasslands for vineyards as the loss of canopy impacts can be avoided.

Offsite Alternative (Pg 1-18)

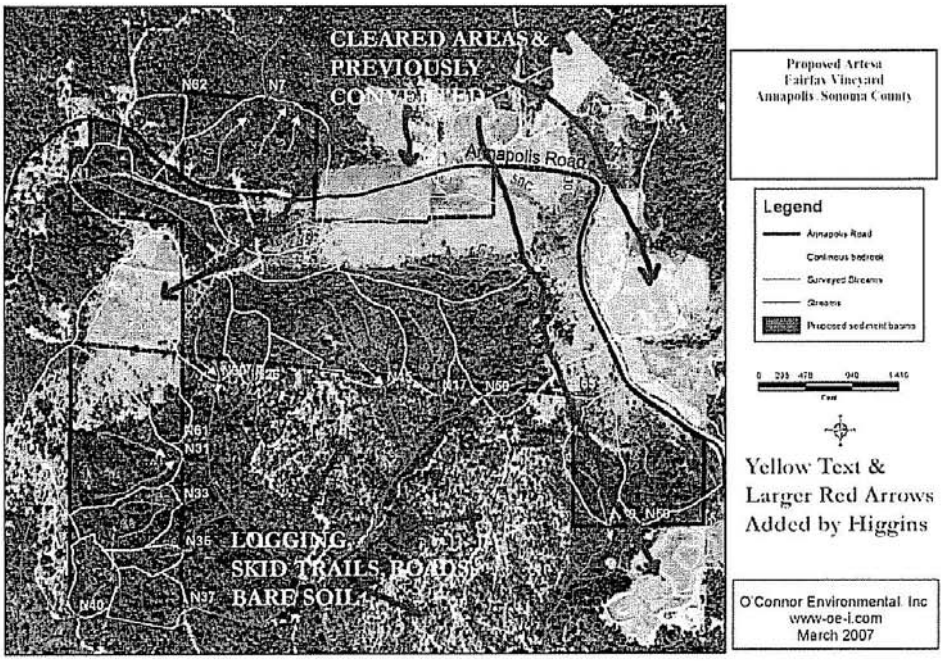
15-26 "However, site-specific surveys of an alternate site would be required to definitively state that impacts associated with the Offsite Alternative would be substantively less than the proposed project."

Letter 15 Cont'd

15-26 Cont'd

The excerpt from the DEIR is one of the most serious misstatements in the DEIR, as the majority of the headwaters of Patchett Creek have been block for wildlife corridors as is evidenced by the accompanying areal photograph provided by O'Conner and further edited by Higgins. The Cleared areas on the areal photo are conversion to vineyard that have deer exclusion fencing at this time and the black outlined areas will be converted to the Artesa Vineyard Project. This clearly shows this last vineyard and fencing will create a virtual wall blocking off animal migration in this upper watershed. This is a very significant impact to wildlife migration and mitigations are required in the DEIR.

3.4-3 Impacts pertaining to loss of wildlife corridors.	LS	*3.4-3 None required*



15-27

Serious deficiencies exist in the evaluation of impacts of this propose conversion and therefore mitigations were either not chosen or severely under designed to offset the impacts of this project.

Sincerely

Letter 15 Cont'd

References

Aars, J. and R.M. Ims. 1999. The effect of habitat corridors on rates of transfer and interbreeding between vole demes. Ecology 80:1648-1655.

Albright, Jeffrey S. 1992. Storm runoff comparisons of subsurface pipe and stream channel discharge in a small, forested watershed in northern California. Arcata,CA: Humboldt State Univ.; 118 p. M.S. thesis.

Alexander, R.R. 1967. Windfall after clearcutting on Fool Creek. USDA Forest Service Res. Note RM-92, 11 pp.

Allred, W.S. and W.S. Gaud. 1994. Characteristics of ponderosa pines and Abert squirrel herbivory. Southw. Nat.39:89-90.

Amaranthus, M. P. and D. A. Perry. 1994. The functioning of ectomycorrhizal fungi in the field: linkages in space and time. Plant and Soil 159: 133-140.

Amaranthus, M. P., R. M. Rice, N. R. Barr and R. R. Ziemer. 1985. Logging and forest roads related to increased debris slides in southwestern Oregon. Journal of Forestry 83: 229-233.

Andrén, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: A review. *Oikos* 71:355-366.

Anthony, R. G., G.A. Green, E.D. Forsman and S.K. Nelson. 1996. Avian abundance in riparian zones of three forest types in the Cascade Mountains, Oregon. *Wilson Bull* 108:280-291.

Aplet, G.H. 2000. A landscape approach to managing southern Rocky Mountain forests. Pp 361-376 *in* Knight, R.L.,

Askins, R.A. and M.J. Philbrick. 1987. Effect of changes in regional forest abundance on the decline and recovery of a forest bird community. Wilson Bull. 99:7-21.

Backiel, A. and R.W. Gorte. 1992. Clearcutting in the national forests. Congressional Research Service Report for Congress CRS 92-607 ENR.

Baker, W.L. and G.K. Dillon. 2000. Plant and vegetation responses to edges in the southern Rocky Mountains. Pp 221-245 *in* Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Baker, W.L. and R.L. Knight. 2000. Roads and forest fragmentation in the southern Rocky Mountains. Pp. 97-122 *in* Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Letter 15 Cont'd

Bakker, V.J. and D.H. Van Vuren. 2003. Gap-crossing decisions by the red squirrel, a forest-dependent small mammal. *Cons Biol.* 18(3):689-697.

Bartelt, P.E., C.J. Orde and K. Long. Unpublished report. Effects of logging on the reproduction of the wood frog (Rana sylvatica) in Wyoming.

Bascompte, J. and R.V. Solé. 1996. Habitat fragmentation and extinction thresholds in spatially explicit models. J. Anim. Ecol. 65:465-473.

Beauvais, G.P. 2000. Mammalian responses to forest fragmentation in the central and southern Rocky Mountains. Pp. 177-199 *in* Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Bender, D.J., T.A. Contreras and L. Fahrig. 1998. Habitat loss and population decline: A meta-analysis of the patchsize effect. Ecology 79(2):517-533.

Berryman, A.A. 1986. Forest Insects: Principles and Practice of Population Management. New York, NY: Plenum Press, 279 pp.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. Stream Temperature and Aquatic Habitat: Fisheries and Forestry Interactions. In: Salo, E.O. and T.W. Cundy, eds. Streamside Management: Forestry and Fishery Interactions. Institute of Forest Resources University of Washington, Seattle,

Belt. G. H., J. O'Lauglilin, and T. Merrill. 1992. Design of forest riparian buffer strips for protection of water quality: analysis of scientific literature. Report No. 8. University of Idaho; Idaho Forest, Wildlife and Range Policy Group; Moscow.Washington. 57:191-232.

Bevers, M. and C.T. Flather. 1999. Numerically exploring habitat fragmentation effects on populations using cellbased coupled map lattices. Theor. Pop. Biol. 55:61-76.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. In: Meehan, W.R., ed. Influences of Forest and Rangeland Management onSalmonid Fishes and Their Habitats. American Fisheries Society Special Publication. 19(4):83-138.

Bormann, F. H. and G. E. Likens. 1979. *Pattern and Process in a Forested Ecosystem.* Springer-Verlag, New York. 253 pp.

Bormann, F.H.; Likens, G.E. 1994. Pattern and process in a forested ecosystem: disturbance, development, and the steady state based on the Hubbard Brook ecosystem study. New York: Springer-Verlag. 253 p.

Bormann, F. H., G. E Likens, Fisher D.W. and Pierce R.S. 1968. Nutrient Loss Accelerated by Clear-Cutting of a Forest Ecosystem. Science Vol. 159 pp. 882-884

Letter 15 Cont'd

Bormann, F. H. and G. E. Likens. 1979. Pattern and Process in a Forested Ecosystem. Springer-Verlag, New York. 253 pp. Cornelissen, J.H.C. 1996. An experimental comparison of leaf decomposition rates in a wide range of temperate plant species and types. Journal of Ecology. 84:573-582.

Brittingham, M.C. And S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? BioScience 33:31-35.

Broderson, J.M. 1973. Sizing Up Buffer Strips to Maintain Water Quality. M.S. Thesis. University of Washington, Seattle, Washington.

Bull, E.L. 1983. Longevity of snags and their use by woodpeckers. Pp 64-67 in Davis, J.W. and G.A. Goodwin. 1983. Snag habitat management: Proceedings of the symposium. USDA Forest Service Gen. Tech. Rept. RM-99, 226 pp.

Bury, R. B. (1983). "Differences in Amphibian Populations in Logged and Old Growth Redwood Forest." Northwest Science.

Buskirk, S.W. and L.F. Ruggiero. 1994. American marten. Pp. 7-37 *in* Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, S.W. Lyon, L. Jack, and W.J. Zielinski. 1994. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the Western United States. *USDA Forest Service General Technical Report RM-254.*

Buskirk, S.W. 1992. Conserving circumboreal forests for martens and fishers. Conservation Biology 6(3):318-320.

Carter, M.F. and S.W. Gillihan. 2000. Influence of stand shape, size and structural stage on forest bird communities in Colorado. Pp. 271-284 in Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.CBD- Convention on Biodiversity- http://www.cbd.int/default.shtml

Castelle, A. J., C. Conolly, M. Emers, E.D. Metz, S. Meyer, M. Witter, S. Mauerman, T. Erickson, and S. Cooke. 1992. Wetland Buffers: Use and Effectiveness. Washington State Department of Ecology, Olympia, Washington.

Cederholm, C. J. 1994. **A** suggested landscape approach for salmon and wildlife habitat protection in western Washington riparian ecosystems. Pages 78-90 ***in*** **A.** B. Carey and C. Elliott, editors. Washington Forest Landscape Management Project Progress Report. Washington Department of Natural Resources, Olympia, Washington.

Cerovski, A., M. Gorges, T. Byer, K. Duffy, and D. Felley, eds. 2001. Wyoming Bird Conservation Plan, Version 1.0. Wyoming Partners in Flight. Wyoming Game and Fish Department, Lander, WY.

Chambers, C.L., W.C. McComb and J.C. Tappeiner II. 1999. Breeding bird responses to three silvicultral treatments in the Oregon Coast Range. *Ecol. Appl.* 9:171-185.

Letter 15
Cont'd

Chapin, T.G., D.J. Harrison, and D.M. Phillips. 1997. Influence of landscape pattern on habitat use by American marten in an industrial forest. *Conserv. Biol.* 12(6):1327-1337.

Chapin, T.G., D.J. Harrison, and D.M. Phillips. 1997. Influence of landscape pattern on habitat use by American marten in an industrial forest. Conserv. Biol. 12(6):1327-1337.

Chen, J.T. 1991. Edge Effects: Microclimatic Pattern and Biological Responses in Old-growth Douglas-fir Forests. Ph.D. Dissertation, University of Washington, Seattle, Washington.

Chen, J., J.F. Franklin and T.A. Spies. 1992. Vegetation responses to edge environments in old-growth Douglas-fir forests. *Ecol. Appl.* 3(2):387-396.

Chen, J., J.F. Franklin and T.A. Spies. 1993. Contrasting microclimates among clearcut, edge, and interior of oldgrowth Douglas fir forest. *Ag. For. Meteor.* 63:219-237.

Cline, S.P. and C.A. Phillips 1983. Coarse woody debris and debris-dependent wildlife in logged and natural riparian zone forests – a western Oregon example. Pp. 33-39 in Davis, COP II/9- Annex to decision II/9 Statement on Biological Diversity and Forests From the Convention on Biological Diversity to the Intergovernmental Panel on Forests http://www.cbd.int/decisions/default.aspx?dec=II/9

Corbett, E. S., and J. A. Lynch. 1985. Management of streamside zones on municipal watersheds. Pages 187-190 ***in*** R. R. Johnson, C. D. Zieball, D. R. Patton, P. F. Folliott, and R. H. Hamre, editors. Riparian ecosystems and their management: reconciling conflicting uses. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Corn, P. S. 1994. What we know and don't know about amphibian declines in the West. Pages 59-67 in W. W. Covington and L. F. DeBano, editors. Sustainable ecological systems: implementing an ecological approach to land management. USDA Forest Service, Rocky Mountain Range Experiment Station, Ft. Collins, Colorado.

Crompton, B.J. 1994. Songbird and small mammal diversity in relation to timber management practices in the northwestern Black Hills. M.S. Thesis, Univ. of Wyoming, 202 pp.

Cronan, C. S., J. C. Conlan and S. Skibinski. 1987. Forest vegetation in relation to surface water chemistry in the North Branch of the Moose River, Adirondack Park, N.Y. Biogeochemistry 3:121-128.

Croonquist and Brook 1991. Effects of Habitat Disturbance on Bird Communities in Riparian Corridors. Journal of Soil and Water Conservation 48(1):65-70.

Croonquist, M.J. and R.P. Brooks. 1991. Use of avian and mammalian guilds as indicators of cumulative impacts in riparian-wetland areas. *Environmental Management* 15:701-714.

Letter 15 Cont'd

Cumins, K.. D. Botkin, H. Regier. M. Sobel, and L.Talbot. 1994, Status and future of salmon of western Oregon and northern California: management of the riparian zone for the conservation and production of salmon. Draft Research Report. The Center for the Study of tlie Environment, Santa Barbara, California.

Cunningham, J.B., R.P. Balda and W.S. Gaud. 1980. Selection and use of snags by secondary cavity-nesting birds of the ponderosa pine forest. USDA Forest Service Res. Paper RM-222, 15 pp.

Dahlgren Randy A. 1998 Effects of Forest Harvest on Stream-Water Quality and Nitrogen Cycling in the Caspar Creek Watershed General Technical Report PSW-GTR-168-Web.

Darling, N., L. Stonecipher, D. Couch, and J. Thomas. 1982. Buffer Strip Survival Survey. Hoodsport Ranger District, Olympic National Forest, Oregon.

DeBano. 1994. Sustainable ecological systems: Implementing an ecological approach to land management. USDA Forest Service Gen. Tech. Rept. TM-247, 363 pp.

DellaSala, D.A., D.M. Olson and S.L. Crane. 1995a. Ecosystem management and biodiversity conservation: Applications to inland Pacific Northwest forests in Everett, R.L. and D.M. Baumgartner, eds. 1994. Ecosystem Management in Western Interior Forests: Symposium Proceedings (Spokane, WA 1994). Pullman, WA: Washington State University.

de Maynadier, P.G. and M.L. Hunter, Jr. 1998. Effects of silvicultural edges on the distribution and abundance of amphibians in Maine. *Conserv. Biol.* 12:340-352.

de Montigny, L.E. and G.F. Weetman. 1989. The effects of ericaceous plants on forest productivity. Pp 83-90 *in* Titus, B.D., M.B. Lavigne, PF. Newton and W.J. Meades, eds. The silvics and ecology of Boreal Spruce. *For. Can. Inf. Rep. N-X-271,* St. Johns, Newfoundland, *in* Mallik, A.U. 2003. Conifer regeneration problems in boreal and temperate forests with ericaceous understory: Role o disturbance, seedbed limitation, and keystone species change. *Critical Rev. in Plant Sci.* 22(3&4):341-366.

deMoor Emily 2004 The Effects of Clear-cutting on Soil and Groundwater Nitrate Pools on Martha's Vineyard Department of Biology, Brown University, Providence, RI.

Diaz, N. and D. Apostol. 1992. Forest landscape analysis and design: A process for developing and implementing land management, objectives for landscape patterns. USDA Forest Service publications R6 ECO-TP-043-92, 95 pp.

Dillon, G.K. 1998. Effects of road edges on vegetation structure and composition in Rocky Mountain conifer forests.MA Thesis, University of Wyoming, 64 pp.

Dillon, P. J., L. A. Molot and W. A. Scheider. 1991. Phosphorus and nitrogen export from forested stream catchments in Central Ontario. Journal of Environmental Quality 20:857-864.

Letter 15 Cont'd

Dodd, C.K. and B.S. Cade. 1998. Movement patterns and the conservation of amphibians breeding in small, temporary wetlands. Conserv. Bio. 12:331-339.

Dodd, C. K., and L. L. Smith. 2003. Habitat destruction and alteration: historical trends and future prospects for amphibians. Pages 94-112 in R. D. Semlitsch, editor. Amphibian Conservation. Smithsonian Institution, Washington.

Doherty, P.F. Jr. and T.C. Grubb, Jr. 2002. Nest usurpation is an 'edge effect' for Carolina chickadees *poecile carolinensis. Jour. Of Avian Biol.* 33:77-82.

Duguay, J.P. P.B. Wood and G.W. Miller (2000). Effects of timber harvests on invertebrate biomass and avian nest success. Wildl. Soc. Bull. 28. Pp. 1123-1131 in Duguay, J.P., P. Bohall Wood and J.V. Nichols. (2001). Songbird abundance and avian nest survival rates in forests fragmented by different silvicultural treatments. Cons. Biol. 15(5):1405-1415.

Duguay, J.P., P. Bohall Wood and J.V. Nichols. (2001). Songbird abundance and avian nest survival rates in forests fragmented by different silvicultural treatments. Cons. Biol. 15(5):1405-1415.Eaglin, G.S. and W.A. Hubert. 1993. Effects of logging and roads on substrate and trout in streams of the Medicine Bow National Forest, Wyoming. N. Am. J. Fish. Manage. 13:844-846.

Edge. W.D. and C.L. Marcum. 1985. Movements of elk Cervus elaphus in relation to logging disturbances. J. of Wildl.Manage. 49(4):926-930.

Erman, D.C., J.D. Newbold, and K.B. Roby. 1977. Evaluation of Streamside Bufferstrips for Protecting Aquatic Organisms. California Water Resources Center, University of California, Davis, California. Contribution Number 16.

FAO. 1999. State of the World's Forests, 1999. Third edition. Food and Agriculture Organization of the United Nations, Rome, 1999. http://www.fao.org/forestry/FO/SOFO/SOFO99/sofo99-e.stm

FEMAT (Forest Ecosystem Management Assessment Team).1993. Forest ecosystem management: an ecological, economic, and social assessment, Report of the Forest Ecosystem Management Assessment Team. U.S. Government Printing Office 1993-793-071. U.S. Government Printing Office for the U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Land Management, and National Park Service; U.S. Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service; and the U.S. Environmental Protection Agency.

FEMAT. 1993. Forest ecosystem management: an ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team.

Forman, R.R.R. and M. Godron, 1981. Patches and structural components for a landscape ecology. BioScience 31(10):733-740.

Letter 15 Cont'd

Franklin, J.F. 1993. Preserving biodiversity: Species, ecosystems, or landscapes? Ecol. Appl. 3:202-205.

Franklin, J.F., D.R. Berg, D.A. Thornburgh and J.C. Tappeiner. 1997. Alternative silvicultural approaches to timber harvesting: Variable retention harvest systems. Pp. 111-139 in Kohm, K.A. and J.F. Franklin eds. 1997. Creating a Forestry for the 21st Century: The Science of Ecosystem Management. Island Press. Washington, D.C., 475 pp.

Franzeb, K.E. and R.D. Ohmart. 1978. The effects of timber harvesting on breeding birds in a mixed-coniferous forest. Condor 80:431-441.

Frissell, C.A. and D. Bayles. 1996. Ecosystem management and the conservation of aquatic biodiversity and ecological integrity. J. Am. Water Res. Assn. 32:229-240.

Fuller, R. D., D. M. Simone and C. T. Driscoll. 1988. Forest clearcutting effects on trace metal concentrations: Spatial patterns in soil solutions and streams. Water, Soil and Air Pollution 40:185-195.

Gram, W.K, P.A. Porneluzi, R.L. Clawson, J. Faaborg, and S.C. Richter. 2003. Effects of experimental forest management on density and nesting success of bird species in Missouri Ozark Forests. *Cons. Biol.* 17(5)1324-1337.

Gilliam, J. W., and R. W. Skaggs. 1988. Natural buffer areas and drainage control to remove pollutants from agricultural drainage waters. Pages 145-148 ***in*** **J.** A. Kusler, M. Quaninien, and *G.* Brooks, editors. Proceedings of the national wetland symposium: mitigation of impacts and losses, held 8-10 October 1986. ASWM Technical Report 3. Association of State Wetlands Managers, Berne, New York.

Gregory, S.V., F.W. Swanson, W.A. McKee and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. BioScience 41:540-551.

Grumbine, R.E. 1990. Viable populations, reserve size, and federal lands management: a critique. Conserv. Biol. 4:127-132.

Hansen, A.J. and J.J. Rotella. 2000. Bird responses to forest fragmentation. Pp. 201-219 in Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Hanski, I. 1999. Metapopulation ecology. Oxford University Press:i-ix, 1-313

Hargis, C.D. and J.A. Bissonette. 1997. Effects of forest fragmentation on populations of American marten in the intermountain West. Pp. 437-451 *in* Proulx, G., H.N. Bryant and P.M. Woodard, eds. 1997. *Martes*: Taxonomy, Ecology, Techniques, and Management. Edmonton, Alberta, Canada: Provincial Museum of Alberta, 14 pp.

Letter 15 Cont'd

Harr, R.D. and R.L. Fredriksen. 1988. Water quality after logging small watersheds within the Bull Run watershed, Oregon. *Water Res. Bull.* 24:1103-1111.

Harrison, R.L. 1992. Toward a theory of inter-refuge corridor design. Conserv. Biol. 6(2):293-295.

Harvard Medical School Biodiversity: Its Importance to Human Health, Center for Health and the Global Environment2003.
http://chge.med.harvard.edu/publications/documents/Biodiversity_v2_screen.pdf

Harvey, A.E., J.M. Geist, G.I. McDonald, M.F. Jurgenson, P.H. Cochrance, D. Zabowski and R.T. Meurisse. 1994. Biotic and abiotic processes in eastside ecosystems: The effects of management on soil management on soil properties, processes, and productivity. *USDA Forest Service Gen. Tech. Rept. PNW-GTR-323,* 71 pp.

Harvey, A.E., M.F. Jurgenson and M.J. Larsen. 1981. Organic reserves: Importance to ectomycorrhizae in forest soils of western Montana. *For. Sci.* 3:442-445.

Harvey, A.E., M.F. Jurgenson and M.J. Larsen. 1980. Clearcut harvesting and ectomycorrhizae: survival of activity on residual roots and influence on a bordering forest stand in western Montana. *Can. J. For. Res.* 10:300-303.

Heemsbergen D. A M. P. Berg, M. Loreau, J. R. van Hal, J. H. Faber, H. A. Verhoef Biodiversity Effects on Soil Processes Explained by Interspecific Functional Dissimilarity. Science 5 November 2004: Vol. 306. no. 5698, pp. 1019 - 1020
DOI: 10.1126/science.1101865

Hejl, S.J., R.L. Hutto, C.R. Preston and D.M. Finch. 1995. Effects of silvicultural treatments in the Rocky Mountains.Pp. 220-244 *in* Martin, T.E. and D.M. Finch, eds. 1995. Ecology and Management of Neotropical Migratory Birds. New York, NY: Oxford University Press, 489 pp.

Herren, V.A. 1994. Boreal owl mating habitat in Wyoming's Sierra Madres. M.S. Thesis, University of Wyoming, 51 pp.

Herren, V., S.H. Anderson and L.F. Ruggiero. 1996. Boreal owl mating habitat in the northwestern United States. J.Raptor Res. 30(3):123-129.

Hershey, T.J. and T.A. Leege. 1976. Influences of logging on elk on summer range in north-central Idaho. Pp. 73-80 inHieb, S.R., ed. 1976. Proceedings of the Elk-Logging-Roads Symposium, December 16-17, 1976, Moscow, Idaho. Forestry, Wildlife and Range Experimental Station, University of Idaho, Moscow, ID.

Hessburg, P.F. and B.G. Smith. 1999. Management implications of recent changes in spatial patterns of interior Northwest forests. Pp. 66-78 in McCabe, R.E. and S. Loos, eds. 1999. Trans. 64th. Amer. Wildl. Nat. Res. Conf., Wildlife Management Institute, Washington, D.C.

Letter 15 Cont'd

Hornbeck, J. W., C. W. Martin, R. S. Pierce, F. H. Bormann, G. E. Likens and J. S. Eaton. 1986. Clearcutting northern hardwoods: Effects on hydrologic and nutrient ion budgets. Forest Science 32:667-686.

Hornbeck, J. W. and W. T. Swank. 1992. Watershed ecosystem analysis as a basis for multiple-use management of eastern forests. Ecological Applications 2:238-247.

Hornocker, M.G. and H.S, Hash. 1981. Ecology of the wolverine in northwestern Montana. Can. J. Zool. 59:1286-1301.

Hutto, R.L. 1995. Composition of bird communities following stand-replacement forest in northern Rocky Mountain (USA) conifer forests. Conserv. Biol. 9:1041-1058.

Hutto, R.L. and J.S. Young 1999. Habitat relationships of landbirds in the Northern Region, USDA Forest Service. USDA Forest Service Gen. Tech. Rept. RMRS-GTR-32, 72 pp.

Iverson, G.C. and B. Rene. 1997. Conceptual approaches for maintaining well-distributed, viable wildlife populations: A resource assessment. Pp 1-23 in Julin, K.K., comp. 1997. Assessments of wildlife viability, old-growth timber volume estimates, forested wetlands, and slope stability, USDA Forest Service Gen. Tech. Rept. PNW-GTR-392, 57 pp.

Iwamoto, R. N., E. O. Salo, M.A. Madej, and R.L. McComas. 1978 Sediment and water quality: A Review of Literature, including a suggested approach for water quality criteria. EPA 910/9-78-048, U.S. EPA Region X. Seattle, WA: U.S. EPA

Jennersten, O. 1988. Pollination in Dianthus deltoids (Caryophyllaceae): Effects of habitat fragmentation on visitation and seed set. Conserv. Biol. 2:359-366.

Johns, B.W. 1993. The influence of grove size on bird species richness in aspen parklands. Wilson Bull. 105:256-264.

Jones, D.J, D.M. Durall and J.W.G. Cairney. 2003. Ectomycorrhizal fungal communities in young forest stands regenerating after clearcut logging. New Phytologist 157:399-422.

Jones, J. A. and G. E. Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resources Research 32: 959-974.

Jurgensen, M. F., A. E. Harvey, R. T. Graham, D. S. Page-Dumroese, J. R. Tonn, M. J. Larsen and T. B. Jain. 1997. Impacts of timber harvesting on soil organic matter, nitrogen, productivity, and health of inland Northwest forests. Forest Science 43: 234-251. Jones, J. A. and G. E. Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resources Research 32: 959-9

Karraker N.E. and H.H. Welsh, Jr. Long-term impacts of even-aged timber management on abundance and body condition of terrestrial amphibians in Northwestern California

Letter 15 Cont'd

Pacific Southwest Research Station, U.S. Forest Service, 1700 Bayview Drive, Arcata, CA 95521, USA Department of Wildlife Management, Humboldt State University, Arcata, CA 95521, USA 74.

Kaufmann, M.R., W.H. Moir and W.W. Covington. 1992. Old-growth forests: What do we know about their ecology and management in the Southwest and Rocky Mountain regions? Pp. 1-11 in Kaufmann, M.R., W.H. Moir and R.L. Bassett. 1992. Old-Growth forests in the Southwest and Rocky Mountain Regions – Proceedings of a workshop. USDA Forest Service Gen. Tech. Rept. RM-213, 200 pp.

Keiter, R.B. 2000. Law, policy, and forest fragmentation in the southern Rocky Mountains. Pp. 401-430 in Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Keller, M.E. 1987. The effect of forest fragmentation on birds in spruce-fir old-growth forests. PhD Thesis, Univ. of Wyoming, 90 pp.

Keller, E. A., and F. J. Swanson. 1979. Effects of large organic material on channel form and fluvial processes. Earth Surface Processes 4:361-380.

Kelsey, H. M. 1980. A sediment budget and an analysis of geomorphic process in the Van Duzen River basin, north coastal California, 1941-1975. Geol.Soc. Amer. Bull., Part II, 91:1119-1216.

Keppeler, Elizabeth and David Brown., Subsurface Drainage Processes and Management Impacts http://www.fs.fed.us/psw/publications/documents/gtr-168/04keppeler.pdf Impacts General Technical Report PSW-GTR-168-Web

Keppeler, Elizabeth, Jack Lewis, Thomas Lisle Effects of Forest Management onStreamflow, Sediment Yield, and Erosion, Caspar Creek Experimental Watersheds 2005, Forest Service, Pacific Southwest Research Station, Arcata, CA 95521

Keppeler, Elizabeth T. The Summer Flow and Water Yield Response to Timber Harvest General Technical Report PSW-GTR-168-Web.

Kimmins, J. P. 1987. *Forest Ecology*. Macmillan Publishing Company, New York. 531 pp.

King, D.I., R.M. DeGraaf and C.R. Griffin. 1998. Edge-related nest predation in clearcut and groupcut stands. Cons. Biol. 12. Pp. 1412-1415 in Duguay, J.P., P. Bohall Wood and J.V. Nichols. (2001). Songbird abundance and avian nest survival rates in forests fragmented by different silvicultural treatments. Cons. Biol. 15(5):1405-1415.

Knight, D.H., T.J. Fahey and S.W. Running. 1985. Water and nutrient outflow from contrasting lodgepole pine forests in Wyoming. *Ecol Monogr.* 5:29-48.

Letter 15 Cont'd

Knight, D.H. and W.A. Reiners. 2000. Natural patterns in southern Rocky Mountain landscapes and their relevance to forest management. Pp. 15-30 in Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Knight, D.H. 1987. Ecosystem studies in the subalpine coniferous forests of Wyoming. Pp. 235-242 in Troendle, C.A.,

Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Knight, D.H., T.J. Fahey and S.W. Running. 1985. Water and nutrient outflow from contrasting lodgepole pine forests in Wyoming. Ecol. Monogr. 5:29-48.

Koehler, G.M. and K. B. Aubry. 1994. Lynx. Pp. 74-98 in Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski. 1994. The Scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. USDA Forest Service Gen. Tech. Rept. RM-254, 184 pp.

Kohm, K. A,. and J. F. Franklin. 1997. Creating a Forestry for the 21st Century. The Science of Ecosystem Management. Island Press, Covelo CA. Chapter 5, pg. 69-85.

Krygeir, J. T. and J. D. J Hall. 1971. Forest Land use and stream environment. Proceedings of a symposium. Corvallis, OR: College of forestry and Department of Fisheries and Wildlife, Oregon State University.

Kubin, E. 1998. Leaching of nitrate nitrogen into the groundwater after clearfelling and site preparation. The Finnish Forest Institute, Muhos Research Station, Kirkkosaarentie 7, FIN-91500 Muhos, Finland Boreal Env. Res. 3: 3–8. ISSN 1239-6095

Lawrence, G. B. and C. T. Driscoll. 1988. Aluminum chemistry downstream of a whole-tree-harvested watershed.Environmental Science and Technology 22:1293-1299.

Leak, W. B. and C. W. Martin. 1975. Relationship of stand age to streamwater nitrate in New Hampshire. USDA Forest Service Research Note NE-211, Upper Darby, PA. 5 pp.

Ledwith, Tyler. 1996. The Effects of Buffer Strip Width on Air Temperature and Relative Humidity in a Stream Riparian Zone , Six Rivers National Forest, Eureka, CA.

Leopold, A. 1933. The conservation ethic. Journal of Forestry. 31:634-641.

Likens G. E., Bormann F. H. and Johnson N. M. (1969) Nitrification: Importance to Nutrient Losses from a Cutover Forested Ecosystem. Science 163, 1205-1206

Likens, G. E., F. H. Bormann, N. M. Johnson and R. S. Pierce. 1967. The calcium, magnesium, potassium and sodium budgets for a small forested ecosystem. Ecology 48:772-785.

Letter 15 Cont'd

Likens, G. E., F. H. Bormann, N. M. Johnson, D. W. Fisher and R. S. Pierce. 1970. Effects of forest cutting and herbicide treatment on nutrient budgets in the Hubbard Brook watershed-ecosystem. Ecological Monographs 40:23-47.

Lynch, J.A, E.S. Corbett, and K. Mussallem. 1985. Best Management Practices for Controlling Nonpoint Source Pollution on Forested Watersheds. Journal of Soil and Water Conservation. 40:164-167. Malcolm, Steve 1994 Australia: 'Biodiversity is the key to managing environment', *The Age*, 16 August 1994.

MacArthur, R.H. and E.O. Wilson. 1963. An equilibrium theory of insular biogeography. Evolution 17:373-387.

MacArthur, R.H., and Wilson, E.O. 1967. The theory of Island Biogeography. Princeton University Press, Princeton.

Mangel, M., L.M. Talbot, G.K Meffe, M.T. Agardy, D.T. Alverson, J. Barlow, D.B. Botkin, G. Budowski, T. Clark, J. Cooke, R.H. Crozier, P.K. Dayton, D.L. Elder, C.W. Fowler, S. Funtowicz, J. Giske, R.J. Hoffman, S.J. Holt, S.R. Kellert, L.A. Kimball, S. Ludgwig, K. Magnusson, B.S. Malayang III, C. Mann, E.A. Norse, S.P. Northridge, W.F. Perrin, C. Perrings, R.M. Peterman, G.B. Rabb, H.A. Regier, J.E. Reynolds III, K. Sherman, M.P. Sissenwine, R.D. Smith, A. Starfield, R.J. Taylor, M.F. Tillman, C.Toft, J.R. Twiss, Jr., J. Wilen, and T.P. Young. 1996. Principles for the conservation of wild living resources. Ecol. Appl. 6(2):338-362.

MANTECH 1996 The ManTech Report 21TR-4501-96-6057 December 1996 *An Ecosystem Approach to Salmonid Conservation* Brian C. Spence Gregg A. Lomnicky Robert M. Hughes Richard P. Novitzki.

Marschner, H. and B. Dell. 1994. Nutrient uptake in mycorrhizal symbiosis. Plant and Soil. Springer Netherlands; Volume 159, Number1/Feb., 1994 Pp. 89-102.

Marsh, D. M., and P. C. Trenham. 2001. Metapopulation dynamics and amphibian conservation. Conservation Biology 15:40-49.

Martin, C. W. 1979. Precipitation and streamwater chemistry in an undisturbed forested watershed in New Hampshire. Ecology 60:36-42.

Martin, C. W., D. S. Noel and C. A. Federer. 1985. Clearcutting and the biogeochemistry of streamwater in New England. Journal of Forestry 83:686-689.

Maser, C. 1994. *Sustainable Forestry: Philosophy, Science and Economics*. St. Lucie Press, Delray Beach, Florida. 373 pp.

Maser, C., R. F. Tarrant, J. M. Trappe. and J. F. Franklin. 1988. From the forest to the sea: a story of fallen trees. General Technical Report PNW-GTR-229. U.S. Department of Agriculture, Forest Service. Pacific Northwest Research Station, Portland, Oregon. Published in cooperation with the U.S. Department of the Interior, Bureau of Land Management and the U.S. Department of Labor.

Letter 15 Cont'd

McCune B, - Lichen Communities as Indicators of Forest Health Volume 103, Issue 2 (June 2000). The Bryologist. Article: pp. 353–356.

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. Van Sickle. 1990. Source Distances For Coarse Woody Debris Entering Small Streams in Western Oregon and Washington. Canadian Journal of Forest Research. 20:326-330.

Mech, S.G. and J. G. Hallett. 2001. Evaluating the effectiveness of corridors: A genetic approach. Conserv. Biol. 15(2):467-474. Mills, L.S. 1995. Edge effects and isolation: Red-backed voles on forest remnants. Conserv. Biol. 9(2):395-403.

Meehan, W.R., ed. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. Special publication no. 19 Bethesda, MD: American Fisheries Society.

Megahan, W. F. 1972. Subsurface flow interception by a logging road in mountains of Central Idaho. pp. 350-356 in Watersheds in Transition. Proceedings of a symposium on "Watersheds in Transition." S. C. Csallany, T. G. McLaughlin and W. D. Striffler, eds. Fort Collings, Colorado. June 19-22, 1972. AWRA. Urbana, Illinois.

Mengel et al. (1996) "Forest Fragmentation – How Clearcutting Decimates Healthy Ecosystems."

Mladenoff, F.J., M.A. White, J. Pastor and T.R. Crow. 1993. Comparing spatial pattern in unaltered old-growth and disturbed forest landscapes. Ecol. Appl. 3(2):294-306.

Moir, W.H. and Bassett, R.L. 1992. Old-growth forests in the Southwest and Rocky Mountain Regions: Proceedings of the workshop. USDA Forest Service Gen. Tech. Rept. RM-213, 213 pp.

Murphy. M. L. 1995. Forestry impacts on freshwater habitat of anadromous salmonids in the Pacific Northwest and Alaska-Requirements for protection and restoration. Decision Analysis Series Number 1, U.S. Department of Commerce, National Oceanic and Atmospheric Administration. National Marine Fisheries Service. Coastal Ocean Program. Juneau. Alaska.

Murphy, M.L., J. Heifetz., S.W. Johnson, K.V. Koski, and J. F. Thedinga. 1986. Effects of clearcut logging with and without buffer strips on juvenile salmonids in Alaskan streams. Canadian Journal of Fisheries and Aquatic Sciences 3:1521-1533.

Murphy, M. L., and Koski K. V. 1989. Input and depilation of woody debris in Alaska streams and implications for streamside management. North America Journal of Fisheries Management 9:427-436.

Letter 15 Cont'd

Naiman, R.J., H. Décamps and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. Ecol. Appl. 3:209-212.

Naiman, R.J., T. J Beechie, L.E. Benda, D. R. Berg, P.A. Bisson, L.H. MacDonald, M.D. O'Conner, P.L. Olson and E.A. Steel. 1992 Fundamental elements of ecologically healthy watersheds in the Pacific Northwest Coastal Ecoregion. In Watershed management: Balancing sustainability and environmental change, ed R.J. Nauman. New York: Springer-Verlag.

Newbold J. D., D.C. Erman, and K. B. Roby 1980. Effects of Logging on microinvertibrates in streams with and without buffer strips. Canadian Journal of Fisheries and Aquatic Sciences 37:1076-1085.

Noble, D.L. and F. Ronco. 1978. Seedfall and establishment of Engelmann spruce and subalpine fir in clearcut openings in Colorado. *USDA Forest Serv. Res. Paper No. RM-200, in* Selmants, P.C. and D.H. Knight. 2003. Understory plant species composition 30-50 years after clearcutting in southeastern Wyoming coniferous forests. *For. Ecol. and Mgmt.* 185:275-289.

Nordyke, K.A. and S.W. Buskirk. 1991. Southern red-backed vole, Clethrionomys gapperi, populations in relation to stand succession and old-growth character in the central Rocky Mountains. Can. Field-Nat. 105(3):330-334.

Noss, R.F. 1983. A regional landscape approach to maintain diversity. *BioScience* 33(11):700-706.

Noss, R.F. 1987. Protecting natural areas in fragmented landscapes. *Natural Areas Journal* 7(1):2-13.

O'Laughlin, J. , and G. H. Belt. 1994. Functional approaches to riparian buffer strip design. Western Forester 27: 12-14.

Paton, P.W.C. 1994. The effect of edge on avian nest success: How strong is the evidence? *Conserv. Biol.* 8(1):17-26.

Perault, D.R. and M.V. Limolino. 2000. Corridors and mammal community structure across a fragmented, old-growth forest landscape. Ecol. Monogr. 70:401-422.

Peterson, N., A. Hendry, and T.P. Quinn. 1992 Assessment of cumulative effects on salmonid habitat: Some suggested parameters and target conditions. TFW-F3-92-001. Olympia, WA: Department of Natural Resources.

Pierce, R. S., J. W. Hornbeck, C. W. Martin, L. M. Tritton, C. T. Smith, C. A. Federer, H. W. Yawney. 1993. Whole-tree clearcutting in New England: Manager's guide to impacts on soils, streams and regeneration. USDA Forest Service General Technical Report NE-172, Radnor, PA. 23 pp.

Letter 15 Cont'd

Potvin, F. and L. Breton. 1997. Short-term effects of clearcutting on martens and their prey in the boreal forest of western Quebec. Pp. 452-474 in Proulx, G., H.N. Bryant and P.M. Woodard, eds. 1997. Martes: Taxonomy, Ecology,Techniques, and Management. Edmonton, Alberta, Canada: Provincial Museum of Alberta, 14 pp.

Purser, M. D. and T. W. Cundy. 1992. Changes in soil physical properties due to cable yarding and their hydrologic implications. Western Journal of Applied Forestry 7: 36-39.

Raedeke, K. J. ed. 1988. Streamside management: Riparian wildlife and forestry interactions. Contributions No. 59 Seattle: University of Washington, Institute of Forest Resources.

Rathcke, B. and E.S. Jules 1993. Habitat fragmentation and plant-pollinator interactions. Current Science 65"273-277.

Ratti, J.T. and K.P. Reese. 1988. Preliminary test of the ecological trap hypothesis. J. Wildl. Manage. 52(3):484-491.

Reed, R.A., J. Johnson-Barnard and W.L. Baker. 1995. Fragmentation of a forested Rocky Mountain landscape, 1950- 1993. Biol. Conserv. 75:267-277.

Reed, R.A., J. Johnson-Barnard and W.L. Baker. 1996. Contribution of roads to forest fragmentation in the Rocky Mountains. Conserv. Biol. 10(4):1098-1106.

Reifsnyder, W.E. and H.W. Lull. 1965. Radiation Energy in Relation to Forest Science. Washington D.C. USDA-FS Technical Bulletin 1344.

Reynolds, H.G. 1966. Use of natural openings in a ponderosa pine forest of Arizona by elk, deer and cattle. USDA Forest Service Research Note RM-66, 4pp.

Reynolds, R.T. 1983. Management of western coniferous forest habitat for nesting accipiter hawks. USDA Forest Service Gen. Tech. Rept. RM-102, 7 pp.

Reynolds, R.T. and B.D. Linkhart . 1987a. Fidelity to territory and mate in flammulated owls. Pp. 234-238 in Nero,

Rhodes. J. J., D. A. McCullough, and F. A. Espijosa Jr. 1994, A coarse screening process for potential application in ESA consultations. National Marine Fisheries Service, Portland, Oregon.

Ripple, W.J. and E.J. Larsen. 2001. The role of postfire coarse woody debris in aspen regeneration. West. J. Appl. For. 16(2)61-64.

Rodrick, E. and R. Milner. 1991. Management Recommendations for Washington's Habitats and Species. Washington Department of Wildlife, Seattle, Washington

Letter 15 Cont'd

Rogers, P. 1996. Disturbance ecology and forest management: a review of the literature. USDA Forest Service General Technical Report INT-GTR-336. Ogden, UT: Department of Agriculture, Forest Service, Intermountain Research Station, 16 pp.

Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Romme, W.H., M.L. Floyd, D. Hanna and J.S. Redders. 2000. Using natural disturbance regimes as a basis for mitigating impacts of anthropogenic fragmentations. Pp. 377-400 in Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Romme, W.H., D.W. Jamieson, J.S. Redders, G. Bigsby, J.P. Lindsey, D. Kendall, R. Cowen, T. Kreykes, A.W. Spencer and J.C. and J.C. Orgeta. 1992. Old-growth forests of the San Juan National Forest in southwestern Colorado. Pp. 154-165 in Kaufmann, M.R.,

Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Rosenburg, K.V. and M.G. Raphael. 1986. Effects of forest fragmentation on vertebrates in Douglas-fir forests. Pp. 263-272 *in* Verner, J., M.L. Morrison and C.J. Ralph, eds. 1986. Wildlife 2000: Modeling Habitat Relationships of Terrestrial Vertebrates: Based on an International Symposium Held at Stanford Sierra Camp, Fallen Leaf Lake, CA, 7-11 October, 1984, 496 pp.

Rothacher, J. 1971. Regimes of streamflow and their modification by logging. Pages 40-54 in Krygier, J. T., and J. D. Hall, eds., Forest Land uses and the Stream Environment. Oregon State University, Corvallis, Oreg.

Rudolph, D.C., and J.G. Dickson. 1990. Streamside Zone Width and Amphibian and Reptile Abundance. The Southwest Journal. 35(4):472-476 Rosenburg, K.V. and M.G. Raphael. 1986. Effects of forest fragmentation on vertebrates in Douglas-fir forests. Pp. 263-272 *in* Verner, J., M.L. Morrison and C.J. Ralph, eds. 1986. Wildlife 2000: Modeling Habitat Relationships of Terrestrial Vertebrates: Based on an International Symposium Held at Stanford Sierra Camp, Fallen Leaf Lake, CA, 7-11 October, 1984, 496 pp.

Ruefenacht, B. and R.L. Knight. 2000. Songbird communities along natural forest edges and forest clear-cut edges. Pp. 249-269 *in* Knight, R.L., F.W. Smith, S.W. Buskirk, W.H.

Ruefenacht, B. and R.L. Knight. 2000. Songbird communities along natural forest edges and forest clear-cut edges. Pp. 249-269 in Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Letter 15 Cont'd

Ruefenacht, B. and R.L. Knight. 2000. Songbird communities along natural forest edges and forest clear-cut edges. Pp. 249-269 *in* Knight, R.L., F.W. Smith, S.W. Buskirk, W.H.

Ruggiero, L.F., D.E. Pearson and S.E. Henry. 1998. Characteristics of American marten den sites in Wyoming. *J. Wildl. Manage.* 62(2):663-673.

R.W., R.J. Clark, R.J. Knapton and R.H. Hamre. 1987. Biology and conservation of northern forest owls. USDA Forest Service Gen. Tech. Rept. RM-142, 309 pp.

Salo, E. D. and T.W. Cundy eds. 1987 Streamside Management: Forestry and Fisheries Interactions. Contributions no. 57 Seattle, WA: Institute of Forest Resources, university of Washington.

Schaeffer, K.J. and S.L. Kiser. 1993. Hypotheses concerning population decline and rarity in insects. Pp. 78-84 *in* Covington, W.W. and L.F. DeBano. 1994. Sustainable ecological systems: Implementing an ecological approach to land management. *USDA Gen. Tech. Rept. RM-247,* 363 pp.

Schowalter, R.D. 1993. An ecosystem-centered view of insect and disease effects on forest health. Pp. 189-195 in Covington, W.W. and L.F. DeBano. 1994. Sustainable ecological systems: Implementing an ecological approach to land management. USDA Gen. Tech. Rept. RM-247, 363 pp.

Scoles, S; Anderson, S.; Turton, D ; Miller, E. 1996. Forestry and water quality: a review of watershed research in the Ouachita Mountains. Circ. E–932, water quality series. Stillwater, OK: Oklahoma State University, Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources. 29 p.

Scott, V.E. and J.L. Oldemeyer. 1983. Cavity-nesting bird requirements and response to snag cutting in ponderosa pine. Pp. 19-23 in Davis, J.W. and G.A. Goodwin. 1983. Snag habitat management: Proceedings of the symposium. USDA Forest Service Gen. Tech. Rept. RM-99, 226 pp.

Selmants, P.C. 2000. Understory species composition 30-50 years after clearcutting in coniferous forests of southeastern Wyoming. *M.S. Thesis,* Univ. of Wyoming, 103 pp.

Selmants, P.C. and D.H. Knight. 2003. Understory plant species composition 30-50 years after clearcutting in southeastern Wyoming coniferous forests. *For. Ecol. and Mgmt.* 185:275-289.

Shepperd, W. D, D. Binkley, D.L. Bartos, T.J. Stohlgren and L.G. Eskew, compilers. 2001. Sustaining aspen in western landscapes: symposium proceedings; 13-15 June 2000; Grand Junction, CO. Proceedings RMRS-P-18. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 460 pp.

Sidle, R. C. (1986) Groundwater accretion in unstable hillslopes of coastal Alaska. In: Conjunctive Water Use (ed. by S. M. Gorelick)(Proc, Budapest Symp., July 1986), 335-343. IAAS Publ. no. 156.

Letter 15 Cont'd

Sierra Nevada Ecosystem Project (SNEP). 1997. Status of the Sierra Nevada: The Sierra Nevada Ecosystem Project, D.C. Erman, ed. U.S. Geological Survey Digital Data Series DDS-43.

Simberloff, D. and J. Cox. 1987. Consequences and costs of conservation corridors. Conserv. Biol. 1(1):63-71.

Singer, F.J., L.C. Zeigenfuss, and L. Spicer. 2001. Role of patch size, disease, and movements in rapid extinction of bighorn sheep. Conserv. Biol. 15:1347-1354

Smith, F.W., S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Smith, H.C., N.I. Lamson and G.W. Miller. 1989. An esthetic alternative to clearcutting? J. of Forestry 87. Pp. 14-18 in Duguay, J.P., P. Bohall Wood and J.V. Nichols. (2001). Songbird abundance and avian nest survival rates in forests fragmented by different silvicultural treatments. Cons. Biol. 15(5):1405-1415.

Sollins, P., and F. M. McCorison. 1981. Nitrogen and carbon solution chemistry of an old growth coniferous watershed before and after cutting. Water Resources Research 17: 1409-1418.

Spackman, S.C. and J.W. Hughes. 1994. Assessment of Minimum Stream Corridor Width for Biological Conservation: Species Richness and Distribution along Mid-Order Streams in Vermont, USA. Biological Conservation. 71(3):325-332.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, OR. (Available from the National Marine Fisheries Service, Portland, Oregon.)

Spira, R.P. 2001. Plant-pollinator interactions: A threatened mutualism with implications for the ecology and management of rare plants. Natural Areas Journal 21:78-88.

Squires, J.R. and L.F. Ruggiero. 1996. Nest site preference of northern goshawks in south central Wyoming. J. Wildl. Manage. 60:170-177.

Stahelin, R. 1943. Factors influencing the natural restocking of high altitude burns by coniferous trees in the Central Rocky Mountains. *Ecology* 24(1). Pp. 19-30 *in* Selmants, P.C. and D.H. Knight. 2003. Understory plant species composition 30-50 years after clearcutting in southeastern Wyoming coniferous forests. *For. Ecol. and Mgmt* 185:275-289.

Steinblums, I.J. 1977. Streamside Buffer Strips: Survival, Effectiveness, and Design. M.S. Thesis. Oregon State University, Corvallis, OR. 181 pp.

Letter 15 Cont'd

Steventon, J.D. (draft only research working paper). Harvesting patterns, fragmentation, and historic landscape patterns in sub-boreal forests of the Prince Rupert Forest region. Report of the Prince Rupert forest Region, British Columbia, 35 pp.

Struempf, H.M., D.M. Finch, G. Hayward and S. Anderson. 2000. Predicting nest success from habitat features in aspen forests of the central Rocky Mountains. Pp. 165-181 in

Sturtevant, B.R., J.A. Bissonette, J.N. Long and D.W Roberts. 1997. Coarse woody debris as a function of age, stand structure, and disturbance in boreal Newfoundland. Ecol. Appl. 7. Pp. 702-712 in Duguay, J.P., P. Bohall Wood and J.V. Nichols. (2001). Songbird abundance and avian nest survival rates in forests fragmented by different silvicultural treatments. Cons. Biol. 15(5):1405-1415.

Sullivan, R.P., R.A. Lautenschlager and R.G. Wagner. 1999. Clearcutting and burning of northern spruce-fir forests: Implications for small mammal communities. J. Appl. Ecol. 36(3):327-344.

Swank, W.T. 1988. Stream chemistry responses to disturbance. In: Swank, W.T.; Crossley, D.A., eds. Forest hydrology and ecology at Coweeta. New York: Springer-Verlag: 339–357.

Swank, W.T., L.F. DeBano and D. Nelson. 1989. Effects of timber on soils and water. USDA Forest Service Gen. Tech. Rept WO-55.

Swank, W.T.; Vose, J.M. 1994. Long-term hydrologic and stream chemistry responses of Southern Appalachian catchments following conversion from mixed hardwoods to white pine. In: Landolt, Ruth, ed. Hydrologie kleiner Einzugsgebiete: Gedenkschrift Hans M. Keller. Beitrage zur Hydrologie der Schweiz 35. Bern, Schweizerische: Schweizerische Gesellschaft fur Hydrologie und Limnologie: 164–172.

Swanson, F. J., J. L. Clayton, W. F. Megahan and G. Bush. 1989. Erosional processes and long-term site productivity. pp. 67-81 in Maintaining the Long-Term Productivity of Pacific Northwest Forest Ecosystems. D. A. Perry, R. Meurisse, B. Thomas, R. Miller, J. Boyle, J. Means, C.R. Perry, R. F. Powers, eds. Timber Press, Portland, Oregon.*

Swift, L.W., Jr. 1988. Forest access roads: design, maintenance, and soil loss. In: Swank, W.T.; Crossley, D.A., Jr., eds. Forest hydrology and ecology at Coweeta. New York: Springer Verlag.

Taylor, D.L. 1973. Some ecological implications of forest fire control in Yellowstone National Park. Ecology 54:1394-1396.

Thomas, J.W., D.A. Leckenby, M. Henjum, R.J. Pederson and L.D. Bryant. 1988. Habitat-effectiveness index for elk on Blue Mountain winter ranges. USDA Forest Service Gen. Tech. Rept. PNW-GTR-218, 25 pp.

Thomas et al. 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team.

Letter 15 Cont'd

Thompson, I.D. 1994. Marten populations in uncut and logged boreal forests in Ontario. J. Wildl. Manage. 58(2):272-280.

Tilman, D., R.M. May, C.L. Lehman and M.A. Nowak. 1994. Habitat destruction and the extinction debt. *Nature* 371:65-66.

Trappe, J.M. and R. J. Molina. 1989. Long-term forest productivity and the living soil. pp. 36-52 in Maintaining the Long-Term Productivity of Pacific Northwest Forest Ecosystems.

USDA and USDI. 1994c. Standards and guidelines for management of habitat for late-successional and old-growth forest related species with the range of the northern spotted owl. USDA and USDI. Portland, Oregon.

U.S. Department of Agriculture Natural Resources Conservation Service. 1996. Virginia conservation practice standard: riparian forest buffer. U.S. Department of Agriculture Natural Resources Conservation Service -Virginia Riparian Forest Buffer 391-1. Richmond, Va.

Vaillancourt, D.A. 1995. Structural and microclimactic edge effects associated with clearcutting in a Rocky Mountain forest. *M.S. Thesis,* Univ. of Wyoming, 57 pp.

Van Dyke, F.G. Bocke, H.G. Shaw, B.B. Ackerman, T.P. Hemker and F.G. Lindzey. 1986. Reactions of mountain lions to logging and human activity. J. Wildl. Manage. 50:95-102.

Van Sickle, J. and S.V. Gregory. 1990. Modeling Inputs of Large Woody Debris to Streams from Falling Trees. Canadian Journal of Forest Research. 20:1593-1601.

Vander Haegen, W.M. and R.M. DeGraaf. 1996. Predation on artificial nets in forested riparian buffer strips. *J. Wildl. Manage.* 60:542-550.

Veblen, T. 2000. Disturbance patterns in southern Rocky Mountain forests. Pp. 31-54 in Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W.L. Baker, eds. 2000. Forest Fragmentation in the Southern Rocky Mountains, Boulder, CO: University Press of Colorado, 474 pp.

Vitousek, P. M. 1977. The regulation of element concentrations in mountain streams in the northeastern United States. Ecological Monographs 47:65-87.

Vitousek, P.M. and W.A. Reiners. 1975. Ecosystem succession and nutrient retention: A hypothesis. BioScience 25:376-381.

Vitouseq, P.M., J.D. Aber, R.W. Howarth, G.E. Likens, P.A. Matson, D.W. Schindler, W.H. Schlesinger, D. G. Tilman. 1997. Human Alteration of the Global Nitrogen Cycle: Sources and Consequences. Ecological Applications 7 (3): 737-750.

Letter 15 Cont'd

Vitouseq, P.M., J.R. Gosz, C.C. Grier, J.M. Melillo, and W.A. Reiners. 1982. A comparative analysis of potential nitrification and nitrate mobility in forest ecosystems. Ecological Monographs 52 (2): 155-177.

Vitouseq, P.M. and P.A. Matson. 1985. Disturbance, Nitrogen Availability, and Nitrogen Losses in an Intensively Managed Loblolly Pine Plantation. Ecology 66 (4): 1360-1376.

Von Ahlefeldt, J. and C. Speas. 1996. Biophysical and historical aspects of species and ecosystems. *Unpublished report of the Medicine Bow National Forest,* 247 pp.

Wallin, D.O., F.J. Swanson, D. Marks, J.H. Cisssel and J. Kertis. 1996. Comparison of managed and pre-settlement landscape dynamics in forests of the Pacific Northwest, USA. For. Ecol. Mgmt. 85:291-309.

Wilcox, B.A. and D.D. Murphy. 1985. Conservation strategy: The effects of fragmentation on extinction. American Naturalist. 125:9 pp.

Wilson, L. G. 1967. Sediment removal from flood water by grass filtration. Transactions of the American Society of Agricultural Engineers 10:35-37.

Wilson, S.M. and A.B. Carey. 2000. Legacy retention versus thinning: Influences on small mammals. Northwest Science 74:15 pp.

Young, J.S. and R.L. Hutto. 1999. Habitat and landscape factors affecting cowbird distribution in the northern Rockies. Pp. 41-51 in M.L. Morrison, L.H. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn and T.D. Rich eds. 1999. Research and management of the brown-headed cowbird in western landscapes. Studies in Avian Biology 18: 11 pp.

Zanette, L. (2001). Indicators of habitat quality and the reproductive output of a forest songbird in small and large fragments. J. of Avian Biol. 32(1)38-46.

Ziemer, R.R., "Roots and the Stability of Forested Slopes," IN: Symposium on Erosion and Sediment Transport in Pacific Rim Steeplands, Int. Assoc. Hydrol. Sci. Pub. 132, 1981, pp. 343-357.

LETTER 15: DAVID HOPE – WATERSHED SCIENCE CONSULTANTS

Response to Comment 15-1

The commenter lists his qualifications and does not address the adequacy of the DEIR.

Response to Comment 15-2

The comment does not address the adequacy of the DEIR.

Response to Comment 15-3

The comment is an introductory paragraph and does not address the adequacy of the DEIR.

Response to Comment 15-4

The comment does not directly address the adequacy of the DEIR, but rather presents some observations of the information contained in the DEIR. Please see Responses to Comments 15-5 through 15-27 for responses to specific concerns raised by the commenter.

Response to Comment 15-5

The commenter asserts that the Fairfax Conversion project would permanently and adversely affect soil hydrologic properties through removal of roots and elimination of soil pores large and small. These potential changes are evaluated in the DEIR hydrologic analysis which predicts increases in peak runoff. Changes in the physical soil characteristics that affect hydrologic properties are also evaluated in the DEIR. Grape vines, vineyard cover crops, and drainage control measures are expected to substantially maintain the hydrologic properties of the conversion area. Substantial root penetration of the soil by grape vines, vegetative biomass to detain surface runoff, and runoff control measures provided for in the Erosion Control Plan would serve to help compensate for losses of forest canopy and root biomass.

The extent and function of such soil pipes has not been widely studied in the region, but was investigated at Caspar Creek in coastal Mendocino County by Albright (1991)[34] and Ziemer (1992)[35]. These sites were located in topographically defined swales with slopes ranging from 30 to 70% and drainage areas of about 2 to 3 acres. The field component of the hydrologic assessment (Appendix M, page 34, Table 7) evaluated headwater drainages including swales above Class III channel heads for evidence of flow in subsurface soil pipes. Field observations did not suggest that soil pipes were a common hydrologic feature at the project site. OEI has observed in study areas elsewhere in the Coast Range that where evidence of such features exists, they are typically located within the extent of the Class III channel network, as well as

[34] Albright, J.S. (1991) Storm Hydrograph Comparisons of Subsurface Pipe and Stream Channel Discharge in a Small, Forested Watershed in Northern California, MS Thesis, Humboldt State University, December 1991, 118 p.
[35] Ziemer, R.R. (1992) Effect of logging on subsurface pipeflow and erosion: coastal northern California, USA. In Walling, D.E. (ed.) Erosion, Debris Flows and Environment in Mountain Regions, Proceedings of the Chengdu Symposium, July 1992, IAHS Publication No. 209, pp 187-197.

further upslope in swales with discontinuous bed and banks, swales without defined channel bed, and banks or frequent sinkholes interconnected by pipes. Most of the Project conversion area is located on planar and divergent slopes, with gradients typically less than 30%. While soil pipes may be present, there is no substantial evidence that they are widespread in areas subject to conversion.

It is also important to clarify the commenter's erroneous statement that "In the conversion of the land all trees will be cut, all stumps excavated out of the ground and all roots grubbed out of the soils." As noted in the Fairfax Conversion DEIR and throughout this Final EIR, the Fairfax Conversion project includes the preservation in perpetuity of approximately 151 acres of streamside conservation areas (i.e., forested areas).

Response to Comment 15-6

The Fairfax Conversion project includes the preservation in perpetuity of approximately 151 acres of streamside conservation and forested areas. In these areas, no soil profile disturbance will occur, and no mycorrhizal fungi will be disturbed or removed. The existing soilborne floristic community is expected to remain intact, and may benefit from edge effects, with greater sunlight penetration into the forest margins.

For the remainder of the property, conversion of 173 acres from open grassland and forest to vineyard with permanent vegetative cover crop is planned. The vineyard soil profile will be disturbed as little as possible during site conversion, so as to maintain optimal viticultural conditions. No-tilled vineyard floor management in particular develops a stable, climax community soil flora/fauna, much like any other vegetative community. Mycorrhizal fungi are found in nearly all soils with vegetative ground cover. Some 90% of plant families and 80+% of species of plants studied, both native vegetation and perennial and annual crops, have mycorrhizal fungi associated with their root systems (Wang, B.; Qiu, Y.L. (2006). "Phylogenetic distribution and evolution of mycorrhizas in land plants," *Mycorrhiza* **16** (5): 299–363). These soil organisms play a vital role in nutrient uptake by plants. Arbuscular mycorrhizae, in particular, are important in improving phosphorus uptake in many species of plants; therefore, it is unreasonable to suggest that any agricultural operation would have a long-term negative effect on plant health.

Numerous studies have demonstrated that the approximately 30-year-old studies cited by the commenter are not entirely accurate with respect to their findings. For example, while the soil mycorrhizal species composition may be altered by conversion from forest, it is by no means lost (cf. http://ecommons.library.cornell.edu/handle/1813/2179). Some studies have even found essentially no difference in mycorrhizae populations after conversion from forest to annual pasture crops (Picone, C. (2000), "Diversity and Abundance of Arbuscular–Mycorrhizal Fungus Spores in Tropical Forest and Pasture," *Biotropica*, **32**: 734–750. doi: 10.1111/j.1744-7429.2000.tb00522.x). Given the long-lived perennial nature of vineyards, even less impact on the soil microbial community should be expected than what is observed in pasture.

Even in soils that have been fumigated, which is not planned for the Fairfax property, mycorrhizal fungi recolonize plant roots quickly. Fumigated soils with and without

innoculations of mycorrhizae were colonized within 15 months (http://www.ajevonline.org/cgi/content/abstract/34/2/117). In the Fairfax property, there will be surface soil disturbance, but not fumigation, so re-establishment of soil mycorrhizal populations is expected quickly.

The commenter makes the claim that "This process will permanently alter a living system of soils that now regulate water infiltrations so effectively that virtually no rainfall flows overland." A review of the site shows numerous drainages over the property that carry overland flow. It is incorrect to suggest that any overland flow on the property is the result of the conversion and subsequent loss of mycorrhizae.

Response to Comment 15-7

The commenter's premise that the hydrologic assessment is "simplistic" and based only on comparison with the forest harvest effects studies at Caspar Creek follows from a quote attributed to the DEIR. The quote does not occur in the DEIR under the heading "Soils and Hydrology" as represented by the commenter, and is misleading in the context presented in the comment. The particular passage quoted is from Appendix J, *Fisheries Assessment*, under the heading "Conclusions" pertaining to project impacts on steelhead trout. The commenter is referred to DEIR Appendix M, *Hydrologic Analysis,* which addresses potential hydrologic effects of the project; in particular, the following statement found under the heading "Summary":

> The proposed timberland conversion project is not expected to diminish annual water yield, summer stream flows, or groundwater supplies. The most applicable research available strongly suggests that annual water yield and summer stream flows can be expected to increase owing to decreases in evapotranspiration processes associated with removal of forest vegetation. Soil and geologic conditions are such that infiltration to the water table is not expected to decrease, and is more likely to increase. Off-site groundwater supplies are unlikely to be affected because of the prevailing groundwater flow gradient toward Patchett Creek and away from existing wells. Peak flow increases are expected to occur in some ephemeral and intermittent channels draining the project area, creating limited potential for accelerated erosion; no significant increases in erosion are expected to occur. (DEIR, Appendix M, page 59)

The commenter refers to subsurface flow increases resulting from timber harvest observed in a set of natural soil pipes studies at Caspar Creek, and asserts that the project would either reduce the extent and function of these features where conversion exists causing increased surface runoff and would increase the flow to these features where forest is retained. The existence and abundance of such features in the project area is not discussed by the commenter, and is speculative. The extent and function of such soil pipes is not well known in the region. The field component of the hydrologic assessment (Appendix M, page 34, Table 7) evaluated headwater drainages including swales above Class III channel heads for evidence of flow in subsurface soil pipes. Field observations did not suggest that soil pipes were a common hydrologic feature at the project site. OEI has observed in study areas elsewhere in the Coast Range that where evidence of such features exist, are typically located within the extent of the Class III channel network. Consequently, substantial evidence does not exist indicating that soil pipes, if present at the project site, would be located in areas subject to conversion.

The commenter suggests that putative flow increases in soil pipes via subsurface flow paths will result from the project. This presents a logical inconsistency in the commenter's position because water infiltration to the subsoil is required to increase, implying that the project will not reduce infiltration rates. The commenter also asserts that the project will significantly increase surface runoff while reducing water infiltration to the subsoil. The commenter's hypothetical scenario of project impacts is inconsistent, and the suggestion that subsurface flow in soil pipes will be impacted is not substantiated. The DEIR does in fact predict peak flow increases and annual flow increases from the project site, and identifies processes that would tend to increase infiltration and groundwater as well as processes that would tend to decrease infiltration and groundwater. It was concluded that the net effect is not expected to result in a significant change. Monitoring of Class III stream channels is proposed in Mitigation Measure 3.7-3(b) to further evaluate the potential effects of anticipated peak flow increases.

Response to Comment 15-8

The commenter asserts that conversion would result in significant increases in nutrient export from the project site by "leaching and erosion of soils." The commenter further asserts that reduction or loss of "deep root systems" and the loss "deep root uptake capacity" would increase nutrient export from the site, along with exposure of soils to erosion and reduction of riparian vegetation. In fact, the potential soil erosion at the project site would be controlled during the construction phase under terms of the Storm Water Pollution Prevention Plan (SWPPP) and the Erosion Control Plan, which includes a grass cover crop along with other erosion control measures (cf. DEIR Mitigation Measure 3.7-2(a-i)). The commenter's claims that the project would allow direct impact of rainfall to erode soils, that riparian vegetation would be altered, and that chemical and biological contaminants would be allowed to enter streams are unsubstantiated and ignore the proposed project's extensive effort to prevent just such occurrences. For example, as noted in above responses, substantial amounts of riparian vegetation are being preserved on-site through the perpetual preservation of 151 acres of currently forested streamside areas.

The commenter cites several studies regarding effects of timber harvest on plant nutrients in streams, and provides a graph pertaining to nitrogen export following timber harvest in the redwood region (Dahlgren 1998) at Caspar Creek in Mendocino County. The commenter fails to note conclusions drawn by Dahlgren's study pertaining specifically to redwood forest ecosystems:

> Stream-water nitrate concentrations were increased after clearcutting, especially during storm events with high stream-discharge volumes; however, fluxes in stream waters were relatively low compared to results from other forest ecosystems. Immobilization of nutrients by the rapid regrowth of redwood stump sprouts appears to make this ecosystem relatively resilient to nutrient loss by leaching after harvest. The elevated nitrate concentration in streams draining clearcut watersheds was substantially decreased at downstream sampling points. By the time the stream left the experimental watershed, nitrate concentrations were near those of the nonperturbed reference watersheds. (USDA PSW-GTR-168, p.53)

The release of nutrients that can be measured in forest streams following timber harvest is a short-term response that diminishes with time and downstream. Vineyard vegetation, both cover

crops and grape vines, as well as undisturbed forest and riparian vegetation along the vineyard perimeter, are expected to take up available plant nutrients and to reduce potential export of nutrients from the project site. As noted by Dahlgren (1998) in the quote above, most of the nutrient export would occur during periods of storm runoff when potential impacts on the aquatic ecosystem are relatively small.

Furthermore, regarding the commenter's concluding statement that the project would deliver significant agricultural compounds effectively into 303d listed water bodies, the DEIR includes an analysis of the potential use of agricultural chemicals on-site. As noted on page 2-22 of the DEIR, the applicant intends to use integrated pest management (IPM) in the maintenance of the vineyard. As noted on page 3.8-27 of the DEIR, in addition to the use of IPM, the Fairfax Conversion project will be enrolled in the Fish Friendly Farming Program. This certification program, which is run by the non-profit California Land Stewardship Institute, supports the development of environmentally friendly land management practices that meet the high environmental standards required to improve conditions for salmon and trout downstream. One of the primary goals of the Fish Friendly Farms program is to limit chemical use in order to reduce impacts on fish species. When the program is completed, the site will be certified through the National Marine Fisheries Service, California State Regional Water Control Board, and the County Agricultural Commissioner.[36] The applicant will also be enrolled in the California Association of Winegrape Growers' Sustainable Winegrowing Program, through which chemical use is reduced through the implementation of Beneficial Management Practices. Thus, CAL FIRE and the applicant are drawing on the knowledge of the local scientific, environmental and regulatory communities, and working cooperatively with them to ensure that the proposed project minimizes the use of agricultural chemicals and impacts to aquatic wildlife to the maximum extent practicable.

[36] The Fish Friendly Program involves several steps. First, Owners or managers of vineyards voluntarily enroll their property in the Fish Friendly Farming (FFF) program. Secondly, through a series of mandatory workshops, each farmer will work with the FFF program staff to complete a Farm Conservation Plan for their property. The Farm Conservation Plan inventories and evaluates natural resources and practices on the entire property, not just agricultural lands. This approach assures a comprehensive program to achieve environmental quality and improvement. Following the workshops, the FFF program provides professional one-on-one technical assistance to each landowner/manager to complete the Farm Conservation Plan. This allows for all sediment sources and stream and river riparian corridors and water sources to be evaluated by an ecologist or other scientist. Various projects such as creek restoration and revegetation, water supply facility retrofit, road repair, and erosion site repair are identified in the Plan as well as the documentation of environmentally friendly management practices such as the use of cover crops or no-till practices. As a result, each Farm Conservation Plan is completely unique to each site. Thirdly, when the Farm Conservation Plan is completed the site is certified through a third party review of the property and the Plan. The certification team is made up of the National Marine Fisheries Service, California State Regional Water Control Board, and the County Agricultural Commissioner. Subsequent to certification, the farmer takes steps to implement the actions and projects identified in the Farm Conservation Plan. Simple changes in management practices are given a shorter time frame for implementation, while larger projects such as restoration or road repair have longer time frames. CLSI continues to work with the owner to cost-share implementation of major projects. In addition, the farmer annually documents actions through photo-monitoring. After 5-7 years, a certified site goes through the process of re-certification, to ensure that the designated actions have been implemented and to update the Farm Conservation Plan if needed.

Protection of Aquatic Environments and Sensitive Plant Species

Loading, mixing, and rinsing operations would be conducted a minimum of 500 feet from the Horkelia Preserve, as well as ponds, streams, wetlands, wells and other aquatic environments. A minimum 25-foot buffer shall be maintained between the targeted spray area and aquatic environments and the Horkelia Preserve. All spraying will be conducted downwind from aquatic environments and the Horkelia Preserve. In fact, the existing and proposed (i.e., created wetlands) on-site aquatic features located closest to proposed vineyard blocks are those features nearest vineyard Unit 4 and 5a. The area between open water and proposed vines is over 0.6-acre, with maximum, minimum, and average offsets between open water and vine rows of 107 feet, 33 feet, and 62 feet, respectively. Unit 5a is separated from the existing and proposed aquatic features by a driveway and two fences, with the distance between open water and vines being about 60-65 feet.

The vineyard plants are dormant from perhaps November through budbreak in April. Under dormancy, spraying operations would not be expected to occur in late fall or winter, with the exception of an herbicide spray in mid-winter (Dec/Jan) for early season weed control. This will be done with a Roundup-type product with no POEA surfactants. As is standard, safe and prudent practice, herbicides are never sprayed when there is a forecast of rain for 48 hours or more, or when there is standing water in the area to be sprayed. The product is directed at the low-growing vegetation near ground level from a height of approximately 12 inches above the ground, so the chances of drift are absolutely minimal. If deemed necessary, early season fungicides and a second herbicide spray would occur at early shoot growth (April-May). Most potential sprays are fungicides and occur from May-July, at which point in time most of the on-site aquatic features would be dry. Any other pesticide application would almost certainly be a spot treatment (not over the entire property) and only in response to an economically significant pest. See also Response to Comment 7-9 for an updated discussion of the potential use of agricultural chemicals on the project site.

Response to Comment 15-9

The project applicant is seeking the issuance of a Timberland Conversion Permit from CAL FIRE; this would enable the applicant to proceed with harvesting 154 acres of the overall 324-acre project site in accordance with the Timber Harvest Plan prepared for the project – also subject to CAL FIRE review and approval. As a result, CAL FIRE is the appropriate lead agency for the Fairfax Conversion project.

In addition, the commenter's assertion that, by all accounts the DEIR treats the site as though it would be reforested is ambiguous. As noted in above responses, the hydrologic and sediment analyses prepared for the proposed project by O'Connor Environmental evaluated both pre-project – existing – conditions and post-project conditions. For example, O'Connor Environmental used the rational runoff method to determine the current peak flow at the project boundaries resulting from a two year storm of a 15-minute duration. These locations are where concentrated and/or dispersed runoff would be routed by the vineyard drainage system.

Response to Comment 15-10

Gullies that may have begun as a result of road construction or road drainage are not necessarily controlled merely by permitted road drainage improvements as the commenter suggests. The larger gullies on the site that produce most of the erosion were initiated decades ago, and could require substantial grading work and/or stream course alteration to control. Typically, this type of work requires permits and/or jurisdictional determinations from agencies including California Department of Fish and Game, RWQCB and US Army Corps of Engineers.

These gullies have naturalized and are now considered semi-stable permanent Class III waterways by resource agency staff, and are not located within the vineyard development work area. The applicant has no intention of disturbing these historic pre-ownership features, and so no grading or drainage permits will be sought.

Minimizing potential for further future erosion within these gullies within the preserved and set-aside areas will be facilitated remotely in two ways. First, sheet flow collection for reservoir recharge in upslope vineyard areas will reduce the volume and intensity of runoff within the gullied downslope areas. Second, a passive seepage interception drain will be incorporated locally in nearby upslope vineyard drainage and piping trenches to enhance gully bank stability by minimizing lateral migration of excessive water through the soil profile. This localized subdrain system will control nuisance amounts of water, and is not a significant contributor to the upland sheet flow collection system used to recharge the irrigation reservoir. In any event, the DEIR states that project implementation will conform with applicable regulatory requirements, including those relating to erosion and water quality (DEIR, p. 1-50 through 1-67). The proposed erosion control work is consistent with TMDL implementation policy of the North Coast RWQCB (Resolution R1-2004-0087).

The erosion assessment of the DEIR in Appendix N quantitatively evaluates sediment sources found in the project area under existing conditions and under proposed project conditions. Sediment sources considered part of the natural background sources are defined consistent with the Gualala TMDL Technical Support Document (NCRWQCB 2001). Sediment sources that are proposed for control are man-caused erosion sites, which is the approach taken in all TMDL implementation plans to date.

Response to Comment 15-11

Within the Gualala watershed, stream flow regimes, depth, width, temperature, and sediment loading have changed over time and are linked to previous and current land use developments. The literature available in the KRIS Gualala database strongly supports a "cause and effect" relationship between watershed development and changes in the aquatic habitat and fish species composition. It must be emphasized, however, that the magnitude of perturbations to the aquatic ecosystem resulting from previous, and potentially improper, development in the watershed that led to significant changes in habitat conditions are not associated with this project. CEQA does not require the Fairfax Conversion project to mitigate for past practices. Notwithstanding the above, it is important to recognize that it is the combination of past and current land use practices that has created the current environmental conditions within the watershed. These current environmental

conditions serve as the baseline conditions for the project hydrology and erosion analyses. Erosion processes and rates in the Patchett Creek watershed have been comprehensively assessed in the DEIR in Section 3.7, *Hydrology and Water Quality*, and DEIR Appendices M and N, including off-site vineyards and commercial forest land in the Patchett Creek watershed (see Chapter 2, *Revisions to the DEIR Text*, of this Final EIR for the changes made to Chapter 3.7 of the DEIR and the Hydrologic and Erosion Analyses prepared for the project since the release of the DEIR for public review). Erosion processes and rates were analyzed in the sediment TMDL framework developed by the North Coast Regional Water Quality Control Board, and potential project effects on erosion and sedimentation in the Patchett Creek watershed were quantitatively analyzed in relation to the TMDL desired future conditions to evaluate proposed mitigation.

While page 3.7-69 of Section 3.7, *Hydrology and Water Quality*, of the DEIR states that the sedimentation basins (and the reservoir collection system) reduce the predicted increase in sediment yield by about two-thirds, leaving an estimated net increase at the project area boundary of approximately 11 tons per year, an increase of 12 to 14 percent, the commenter fails to recognize the significant statement that follows:

> Additional reductions in sediment yield by erosion mitigation designed to repair and control gully erosion at five sites in the project area is expected to reduce erosion rates by at least 21 t/yr (low range estimates) to 31 t/yr (high range estimates). These estimated sediment savings result in net decreases in sediment yield under project conditions of 10 to 21 t/yr.

Now that the Erosion Analysis for the project has been revised for reasons discussed in Chapter 2 of this Final EIR, the following changes to the above text on page 3.7-69 of the DEIR have been implemented (see Section 3.7, Hydrology and Water Quality, of Chapter 2 of this Final EIR for a listing of the changes):

> As shown in Table 3.7-20, the sedimentation basins (and the reservoir collection system) reduce the predicted increase in sediment yield of about 5 to 7 t/yr to a net decrease of about 8 to 13 t/yr~~by about two-thirds,~~. There is ~~leaving~~ an estimated net ~~increase~~ decrease at the project area boundary draining to Patchett Creek of approximately ~~11 tons per year, an increase of~~ 10~~12~~ to ~~14~~13 percent. Additional reductions in sediment yield by erosion mitigation designed to repair and control gully erosion at five sites in the project area is expected to reduce erosion rates by at least ~~21~~ 16 t/yr (low range estimates) to ~~31~~ 27 t/yr (high range estimates). These estimated sediment savings result in net decreases in sediment yield under project conditions of ~~10~~ 24 to ~~21~~ 39 t/yr.

Please see Response to Comment 12-7 for a detailed discussion of the state of the art Best Management Practices (BMPs) that will significantly control both project erosion and mobile sediment contribution to downstream environments, as well as specific mitigation measures identified in the DEIR to avoid and/or minimize impacts to water quality and quantity.

In addition, see Response to Comment 15-10.

It should also be noted here that the list and description of erosion mitigation sites on pages 2-9 and 2-18 of the Project Description chapter have been revised in Chapter 2, *Revisions to the DEIR Text*, of this Final EIR given the field observations made by project team and agency staff

during the pre-harvest inspection (PHI) on-site. Specifically, erosion mitigation site 7 was determined to be located on an adjacent parcel and not in the project area during the PHI; therefore, the originally proposed seventh erosion mitigation site is not available for the proposed project. The removal of erosion mitigation site 7 has now been accounted for in the updated Erosion Analysis for the Fairfax Conversion project, dated February 2011, and attached to this Final EIR as Appendix A. The changes to the Erosion Analysis as a result of the removal of the seventh erosion mitigation site, as well as the reduction in the vineyard net acreage since the release of the DEIR for public review, are presented in Chapter 2 of this Final EIR in Section 3.7, *Hydrology and Water Quality*.

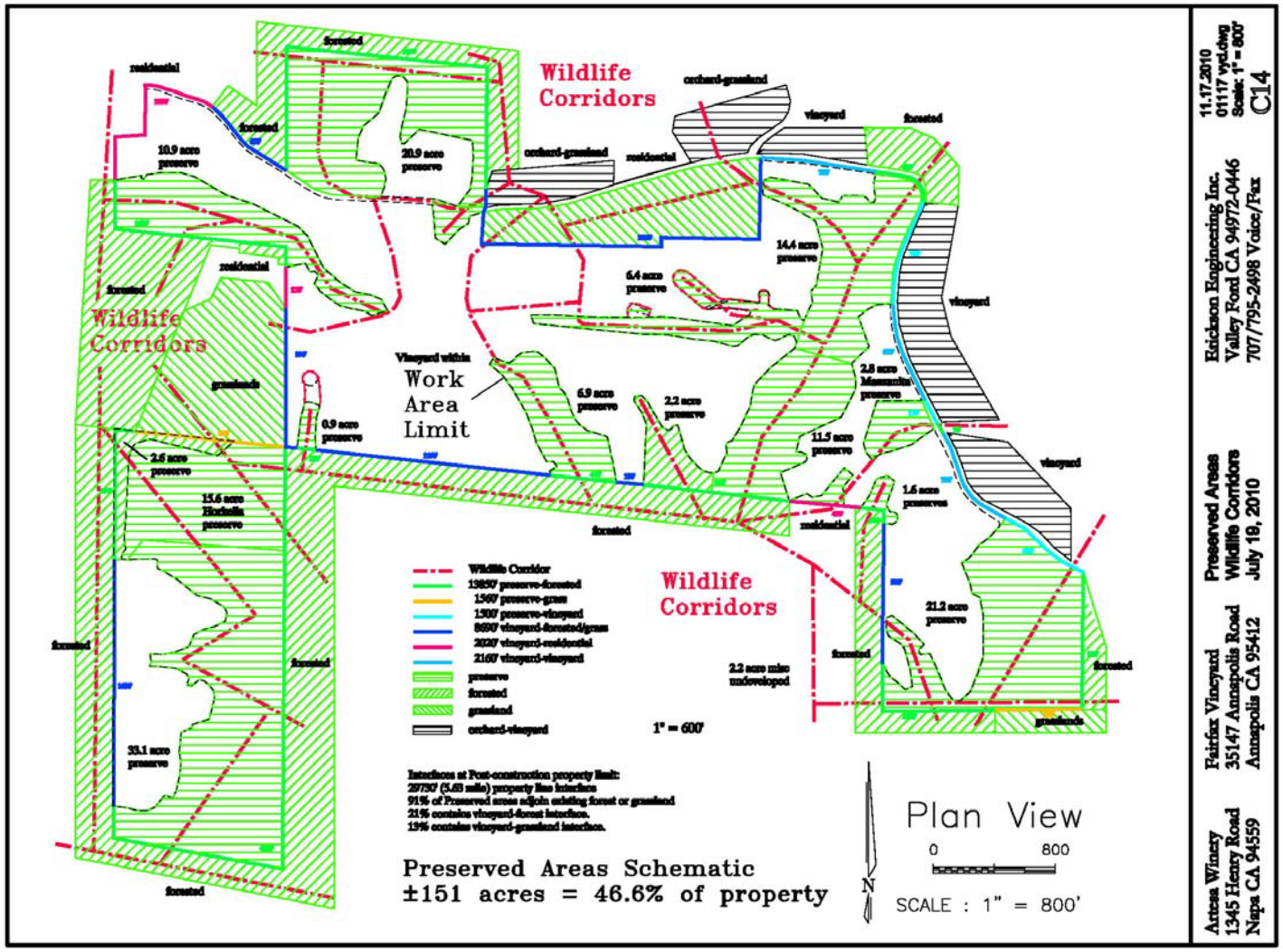
Response to Comment 15-12

The commenter appears to employ an oversimplified outlook on the conditions on the project site once timber harvesting and vineyard development occur. The commenter makes no mention of an aspect of the project whereby approximately 151 acres of currently forested streamside areas would be preserved in perpetuity. As illustrated in Figure 3-6, *Project Preserve Areas*, contiguous stretches of currently forested habitat on-site would remain post-harvest and post-vineyard development.

It should also be noted that the project site is not a continuous forest, rather it occurs in an existing mosaic of habitats including annual grassland, a former orchard that is now annual grassland, and forest/woodland that is primarily dominated by tan oak, with smaller remnant stands of Douglas fir and redwoods. The project site forest is already significantly disturbed by past human activities, and does not constitute a contiguous forest. An important consideration is that the forested habitat that occurs on the project site was clear cut approximately 50 to 60 years ago. The north end of the project site was planted to apples in the late 1800s and was tended as an apple orchard until the 1950s or 1960s. Also, there are residences located on all sides of the project site, except to the south, where existing second growth and cut forested habitats remain. There is also an existing olive orchard immediately north and an existing vineyard immediately east of the project site. Finally, the community of Annapolis occurs immediately west of the project site. Thus, the project site is not in a pristine or undisturbed setting and it should not be characterized as such.

The setting of the project site is an important consideration, because special-status species that are protected pursuant to CEQA and are associated with larger stands of native forested habitat are largely missing from the project site. In addition, with the exception of Columbian black-tailed deer, large mammals are also absent from the project site. In fact almost all wildlife species that have been observed on the project site are common species found throughout northern California. While foothill yellow-legged frog, a species of special concern, is found seasonally in Patchett Creek on the project site (see DEIR), this creek is completely protected within minimum 100-foot buffers that on average extend approximately 208 feet on the project site. This frog and its habitat, which includes the stream zone and a very narrow band of upland immediately adjacent to the wetted stream zone, are completely protected on the project site.

Figure 3-6
Project Preserve Areas



Response to Comment 15-13

The commenter infers that the project will modify "a contiguous forest with few natural disturbances to a landscape with isolated remnants of undisturbed forest…" The commenter concludes that modification of such habitat constitutes a cumulative impact on the landscape. The project site is not a pristine forested habitat; rather it is a habitat that has already been significantly disturbed by human activity over the last 150 years. (See also Response to Comment 15-12.) In addition, the proposed project preserves approximately 46.6 percent of the existing habitat on the project site, including 98.4 percent of habitats associated with tributaries. In consideration of other surrounding land uses, and the extensive forested habitats that remain both locally and regionally, the proposed project is occurring in a region where those wildlife species that could not survive in fragmented habitats would have left the area many years ago. Resident wildlife species that constitute top-of-the-food-chain predators have especially been affected by man's activities in the vicinity of the project site over the last 150 years and are largely absent from the landscape.

Note the above responses regarding top trophic level predators and the already highly fragmented condition of the project site. The commenter states: *Specialist species are poorly adapted to colonizing new habitats, and are the first to succumb to fragmentation as a result (Tilman et al. 1994). Territorial species having large home ranges, such as martens, goshawks, and forest owls need large tracts of mature forest containing less than 25% of unsuitable habitat (such as conversions or young stands).* As iterated above, in almost all cases the referenced specialist species are not found on the project site owing to man's activities and heavy disturbance that has extended over the last 150 years. Many of the species Mr. Hope presents as examples of species that do not do well in fragmented habitats do not occur on the project site because it already constitutes a highly disturbed and fragmented project site. Examples No. 1, 5, 7, 8, 9, and 10 above do not occur on the project site and there are no records for these species for many miles from the project site. Example Number 9 does not occur in the western United States. Examples Numbers 2, 3, 4, 5 and 6 are common species found in many locations in California and the Pacific Northwest. Comments prepared by Mr. Hope regarding forest fragmentation, while factual, do not apply to the proposed project site. The proposed project will not result in forest fragmentation that would/could be regarded as significant adverse impacts pursuant to CEQA.

Response to Comment 15-14

Please see Response to Comment 15-12. All onsite wildlife will not be "removed by the project." The proposed project includes preservation of 46.6 percent (151 acres) of all existing habitats on the project site. The proposed project also preserves 98.4 percent of all tributaries and immediately adjacent uplands. It should also be noted that the project site does not support classic riparian habitats; rather, woodland/forest plant communities are associated with tributaries that are largely consistent with surrounding hillside forests/woodlands. Those wooded habitats associated with streams that are most like riparian habitats are 100 percent preserved within the projects site (see Figure 3-6, Preserved Areas/Wildlife Corridors map, dated July 19, 2010).

Response to Comment 15-15

The project site is a highly disturbed site that has been farmed, ranched, or used to harvest timber over the last 150 years. No special-status species with the exception of the foothill yellow-legged frog occur on the project site (See Response to Comment 15-12 regarding this frog). The project site has been well studied by biologists now for almost 10 years. Wildlife use of the project site is well understood as is the flora of this site. The setbacks that are established for tributaries are in conformance with the regulations that protect these resources and are appropriate for the project site. This project site is not old growth forest or some other late seral stage plant community. It is a parcel of land that has been greatly modified by human activity over the last 150 years. In many cases, the tributary setbacks exceed the setback distances required by regulations, which demonstrates that setbacks were not established in a vacuum. Buffers were established based upon appropriate protection zones for the resources being protected. Both the RWQCB and CDFG were very instrumental in ensuring that setbacks follow the regulatory requirements but also exceed regulatory requirements where key biological resources were deemed worthy of protection by regulatory and project biologists.

In addition, contrary to the commenter's statement, protection provided for stream courses on the project site is not temporary; rather, it is permanent. Approximately 46.6 percent of the project site, including 98.6 percent of all tributaries on the project site, will be permanently protected via deed restrictions. Also, the riparian habitat associated with Patchett Creek on the project site would not be considered a "functioning riparian corridor." Over most of its length on the project site, the plant community associated with Patchett Creek consists of species that are remarkably consistent with the forest adjacent to the stream channel. The southern reach of Patchett Creek is completely surrounded by second growth north coast coniferous forest (dominated by tan oak), which is not considered riparian vegetation per Holland[37]. Similarly, the remaining channels on the project site are ephemeral tributaries that do not support riparian vegetation, aquatic vegetation, or wildlife with aquatic life stages. The only "riparian habitat" that occurs on the project site occurs along the northern reach of Patchett Creek. It is a weakly formed riparian community represented mostly by interior live oaks (*Quercus wislizeni*), California hazelnut (*Corylus cornuta* var. *californica*), and a few California bay laurels (*Umbellularia californica*). This habitat occurs along the west side of Patchett Creek and follows up a side tributary east towards Annapolis Road. This habitat does not form even close to a continuous riparian canopy, and thus would not be considered a functioning riparian corridor.

Regardless, all of the riparian habitat in Patchett Creek will be preserved (100 percent). In total, there is an 11.2 acre set-aside over this portion of the project site to protect the upper reach of Patchett Creek and its riparian habitat. This preserved area is shown in the Preserved Areas/Wildlife Corridors map dated July 19, 2010, and on the revised Vineyard Plan dated May 24, 2010. Within the 11.2 acre set-aside, between Annapolis Road and the first tributary entering Patchett Creek from the west, average creek buffer widths from the top-of-banks of Patchett Creek will be a minimum of 100 feet and will average 154 feet from top-of-bank on the west side

[37] Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. Nongame-heritage program, California Department of Fish and Game, Sacramento, CA., 156 pp.

of the creek and 216 feet from top-of-bank on the east side of the creek. Between the first tributary and the second western tributary further to the south, average setbacks on Patchett Creek will be 126 feet to the west and 243 feet to the east.

CEQA requires that potentially significant or significant impacts to stream channels be addressed, as they are afforded protection pursuant to the U.S. Army Corps of Engineers, Regional Water Quality Control Board, California Department of Fish & Game, Sonoma County, and CALFIRE. The DEIR assessed the potential impact of the proposed vineyard project to stream channels in full compliance with the buffer requirements for each of these agencies. All significant or potentially significant adverse impacts are mitigated by the proposed project to levels regarded as less than significant.

For the commenter's pesticide concerns, refer to Response to Comment 15-17.

Response to Comment 15-16

Please see Responses to Comments 15-8, 15-15, and 15-17.

Response to Comment 15-17

The first correction here is that there are no existing or proposed tile drains or groundwater capture systems in the vineyard water development plan.

Secondly, in response to the commenter's statement that 9 chemicals known to be toxic to fish will be used in this operation, please see Response to Comment 7-9.

Furthermore, as noted in above responses, substantial amounts of riparian vegetation are being preserved on-site through the perpetual preservation of 151 acres of currently forested streamside areas. Adequacy of proposed buffer widths is addressed in detail in Response to Comment 1-12.

Response to Comment 15-18

Please see Response to Comment 15-15.

Response to Comment 15-19

Please see Response to Comment 15-15.

Response to Comment 15-20

Please see Response to Comment 15-15.

Response to Comment 15-21

The forest that would remain within the preserve areas following vineyard development will be in considerably large blocks. A selective harvest of trees that leaves single trees spaced widely

apart renders trees more susceptible to blow down than what is proposed for the Fairfax Conversion project site. The heavy cuts on the adjacent Mendocino Redwood Company (MRC) timberlands are similar to what is proposed for the Fairfax Conversion project site; and these cuts have not resulted in blow down on the Fairfax property, which is directly adjacent to those harvests. This indicates that trees remaining in large clumps/blocks are not subject to blow down in this area. In addition, the timber stand remaining in the preserve area following harvest is a relatively uniform young stand of healthy trees which would be less likely to blow down than an older decadent stand of trees of varying sizes.

Response to Comment 15-22

Please see Response to Comment 15-17.

Microclimatic changes due to riparian zone harvesting are not relevant to the project. All of the riparian habitat on the project site (100 percent) will be preserved. In total, there is an 11.2 acre set-aside to protect the upper reach of Patchett Creek and its riparian habitat. No Class III tributary on the project site supports riparian vegetation. Rather, these tributaries support forested habitats that are non-distinguishable from the remainder of the second growth forested community on the project site.

Response to Comment 15-23

Please see Responses to Comments 15-13 and 15-15. The 151-acre streamside preservation area on-site would retain a substantial amount of downed wood and rotting logs that the commenter suggests are important for many ecosystemic factors.

Response to Comment 15-24

Please see Responses to Comments 15-8 and 15-11.

Response to Comment 15-25

The No Project Alternative discussion in the Fairfax Conversion DEIR rightly notes the resource topics for which impacts would be less than those identified for the proposed project. The No Project Alternative analysis does not directly or indirectly make the claim implied by the commenter that conversion of a forest is less serious than acquiring property that is already disturbed or less desirable. The No Project Alternative analysis is simply noting the fact that there are existing erosion sites on the property that would not necessarily be removed if the proposed project were not to be implemented.

Response to Comment 15-26

The comment expresses concern that wildlife would be blocked at the headwaters of Patchett Creek. The figure referenced in the comment points to unforested areas and labels the areas as "cleared areas and previously converted." The comment states that the areas are "conversion to vineyard that have deer exclusion fencing at this time, and the black outlined areas will be

converted to the Artesa Vineyard Project." However, the areas discussed are not vineyards; nor are they fenced with deer exclusion fencing. Two properties northeast and east of the project site are vineyards and are separated by an open forested area. The property to the west of the project site is an open field which is part of a private residence. To the north of the project site is the Starcross Monastic Community, which consists of grasslands, residential housing and two small olive groves. The southeastern property is occupied by the County Refuse Transfer Station. Cattle fencing, not deer exclusion fencing is used on these non-vineyard properties, allowing wildlife to freely migrate through.

In addition, 58.6 percent of the project site, as outlined in black on the commenter's figure, would be preserved. Figure 3.4-4 of the DEIR clearly indicates the layout of the preserved areas within the project site, including a significant wildlife corridor along Patchett Creek. The Vineyard and Wildlife Fencing Schematic included in Response to Comment 22-11 illustrates that deer exclusion fencing would only surround individual vineyard units, not the entire site. Thus, deer and other wildlife would be able to freely traverse the vineyard areas along the wildlife corridors indicated in the plan.

Response to Comment 15-27

The comment is a concluding statement. See responses to above specific comments.