3.7 HYDROLOGY AND WATER QUALITY

3.7 HYDROLOGY AND WATER QUALITY

Introduction

This section of the EIR describes the existing drainage pattern and water resources for the project site and the Gualala River Watershed, and evaluates potential impacts of the project with respect to surface water resources, groundwater resources, and flooding. The hydrology and water quality impact analysis is based primarily on the O'Connor Environmental *Hydrologic Analysis, Artesa Fairfax THP and Conversion*[1] (Draft EIR Appendix M); the O'Connor Environmental *Erosion Analysis, Artesa Fairfax THP and Conversion*[2] (Draft EIR Appendix N); and the West Yost & Associates *Fairfax Timberland Conversion and Vineyard Development Project – Final Hydrologic Evaluation*[3] prepared for the proposed project ("Hydrologic Evaluation"; Draft EIR Appendix O). Additional sources include the Erickson Engineering *Erosion Control and Mitigation Plan*[4] ("ECP"; Draft EIR Appendix D); the NCRM *Timber Harvesting Plan, Fairfax Conversion*[5] ("THP"; Draft EIR Appendix E); and the Sonoma County *General Plan*[6] and *General Plan EIR*[7].

Environmental Setting

The following setting information provides an overview of the existing hydrologic conditions within the project site and surrounding Gualala River Watershed region.

Regional Location

The Gualala River watershed flows into the Pacific Ocean near the Town of Gualala, approximately 114 miles north of San Francisco and 17 miles south of Point Arena. The Gualala River drains approximately 300 square miles, or 191,145 acres, of mostly mountainous and rugged terrain in Sonoma and Mendocino Counties. The land use within the watershed is predominantly timber production, and also includes grazing, orchards and vineyards, and rural residential development. Approximately 34 percent of the Gualala River watershed is owned by timber companies, namely Pioneer Resources, Gualala Redwoods, and Mendocino Redwood Company. Unstable geology and high precipitation rates, typical of the Mendocino coast, make the region susceptible to high natural erosion and erosion caused by different land use practices.

Project Location

The project site is located within the South Fork Gualala River watershed, on Beatty Ridge, a broad flat ridge between Grasshopper Creek to the north and the Wheatfield Fork of the Gualala River to the south. Elevation on the project site ranges from 660 to 860 feet above sea level. The watercourses located within the property boundary are

mainly the headwater portions of these larger drainages. The majority of the project area (approximately 174 acres) is located within the Annapolis CAL Watershed. Flows within this watershed area enter Patchett Creek, which then flows into the Wheatfield Fork of the Gualala River. The Wheatfield Fork eventually flows into the South Fork of the Gualala River. Approximately 14 acres of the project site lie within the Grasshopper Creek CAL Watershed, and approximately two acres lie within the Little Creek CAL Watershed. Flows within these two northern watershed areas drain into Grasshopper Creek, which then drains to Buckeye Creek and then the South Fork of the Gualala River.

California Department of Water Resources (DWR) geologic mapping shows that northwestern Sonoma County sits atop the Coastal Belt Franciscan Formation, with smaller ridge-top areas capped by the marine sandstone, siltstone, and conglomerate of the Ohlson Ranch Formation. The Ohlson Ranch Formation occurs only in northwestern Sonoma County, and is as thick as 160 feet in places. Based on site surveys conducted in conjunction with the development of the ECP, the majority of the project area appears to have an Ohlson Ranch Formation substrata situated atop the underlying Coastal Belt Franciscan Formation. The Ohlson Ranch Formation is considered water-bearing, while the Coastal Belt Franciscan Formation is not considered water-bearing. In locations where these two formations meet, water tends to move laterally along the plane of contact.

Field observations were conducted for the O'Connor Hydrologic Analysis of the site hydrogeology. The analysis found that the geologic contact between the Ohlson Ranch Formation and the underlying Franciscan Formation dips gently but distinctly to the east. The groundwater gradient likely parallels the slope of the geologic contact, which is generally parallel to the surface topography. Therefore, groundwater flows are generally from west-northwest to east-southeast, towards Patchett Creek (Pg. 9, O'Connor Hydrologic Analysis).

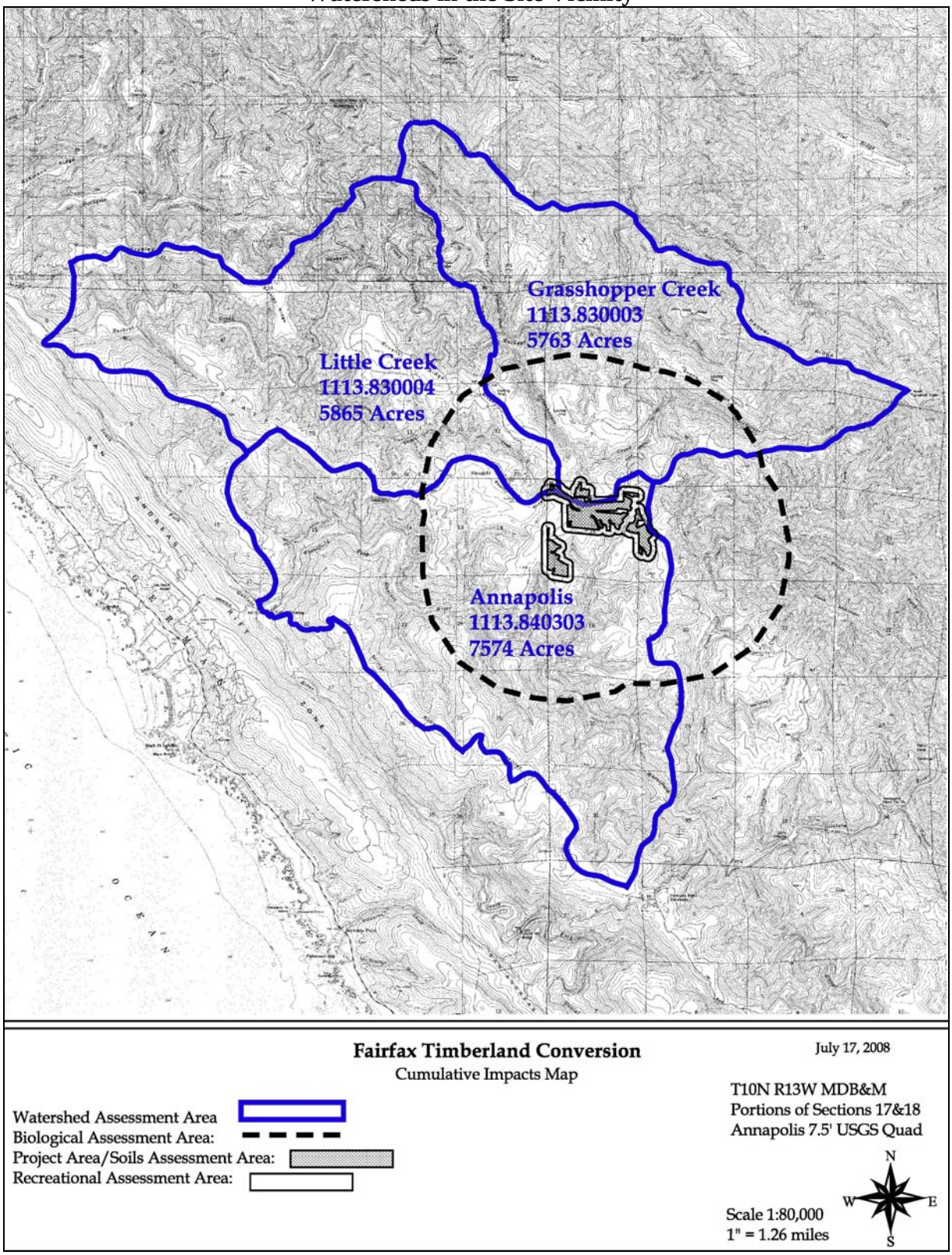
Watercourses

Article 6 of the California Forest Practice Rules[8] classifies waterways into four categories:

- Class I: (1) Domestic supplies, including springs, onsite and/or within 100 feet downstream of the operations area and/or (2) Fish always or seasonally present onsite; includes habitat to sustain fish migration and spawning.

- Class II: (1) Fish always or seasonally present offsite within 1,000 feet downstream and/or (2) Aquatic habitat for nonfish aquatic species; excludes Class III waters that are tributary to Class I waters.

Figure 3.7-1
Watersheds in the Site Vicinity



- Class III: No aquatic life present; watercourse showing evidence of being capable of sediment transport to Class I and II waters under normal high water flow conditions after completion of timber operations.

- Class IV: Man-made water courses, usually downstream, established domestic, agricultural, hydroelectric supply, or other beneficial use.

The proposed timber conversion area does not contain any watercourses, and Class I watercourses are not present on the project site. However, several Class II and III watercourses exist on the project site, adjacent to the conversion area (See Figure(s) 3.7-2 and 3.7-3). In general, the watercourses have a gentle gradient and shallow channels, and contain flowing water only seasonally. Furthermore, the streams are generally stable with varying amounts and types of streamside vegetation, with a large majority of the areas having a canopy cover greater than 70 percent. The Class II watercourses contain limited amounts of aquatic habitat with some pool structure and large woody debris. The Class III watercourses contain limited large woody debris, little or no pool structure, and no aquatic habitat. Stream channel characteristics are discussed extensively in the project THP (see Appendix E to this DEIR), and on pages 32-46 of the Hydrologic Effects Analysis (see Appendix L to this DEIR).

Water Quality

The West Yost Hydrologic Evaluation notes that surface water quality in the Gualala River watershed has been adversely affected by sedimentation resulting predominantly from the effects of past and current timber harvesting activities, and associated road construction. Water quality issues including sedimentation, water temperature, organic debris, chemical contamination, and peak flow effects are addressed through the California Forest Practice Rules requirement for assessment of cumulative watershed effects. The above listed aspects of water quality, as pertaining to the proposed project, are discussed below.

<u>Water Quality: Erosion and Sedimentation</u>

Runoff from the proposed vineyard site flows to the Gualala River, which is currently on the federal Clean Water Act (CWA) Section 303(d) list due to impairment and/or threat of impairment to water quality by sediment. Activities that have contributed to the sedimentation of the watershed have been described in detail in the Gualala River Total Maximum Daily Load for Sediment (U.S. Environmental Protection Agency [USEPA], 2001); the Gualala River Watershed Assessment Report (North Coast Watershed Assessment Program, 2002); and the KRIS Gualala Project (Klamath Resource Information System, 2003). The beneficial uses impaired by excessive sediment in the Gualala River are primarily those associated with the River's salmonid fishery (USEPA 2001).

The project THP notes that the project site is currently experiencing gully erosion from past farming and grazing practices (see Figure 3.7-3, Comment Points labeled "1" through "7").

Figure 3.7-2
Onsite Streams

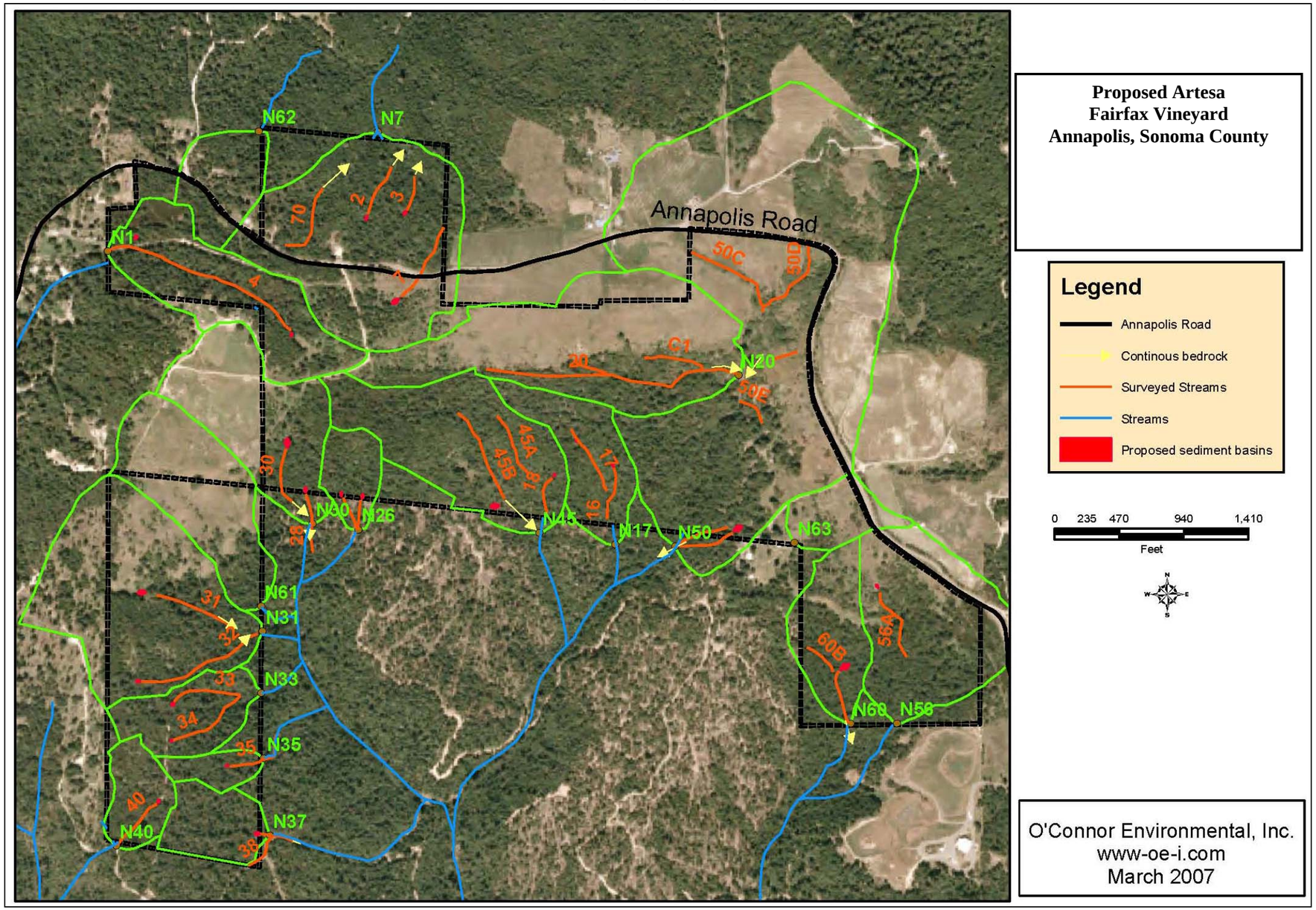
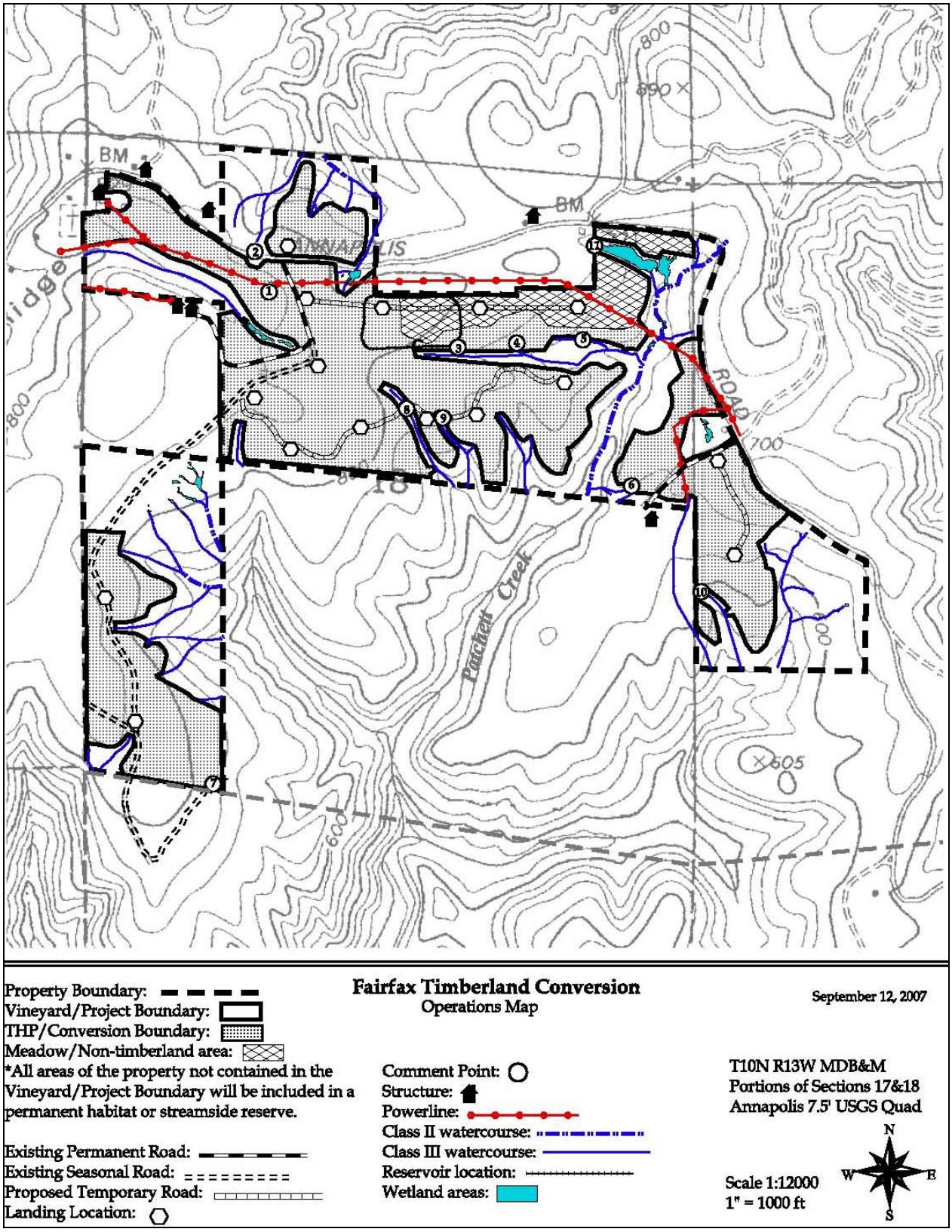


Figure 3.7-3
Onsite Stream Classifications



Gualala River Watershed TMDL for Sediment

As required by the CWA, a total maximum daily load (TMDL) assessment for sediment was completed for the Gualala River watershed in late 2002. The information in the TMDL document was developed based on the North Coast Regional Water Quality Control Board (Regional Board) *Gualala River Watershed Technical Support Document for Sediment* (TSD). At present, Regional Board policy set forth in "TMDL Implementation Policy for Sediment Impaired Receiving Waters (Resolution No. R1-2004-0087)." Mitigation and monitoring provisions proposed for this project are consistent with this policy, however, the Regional Board will review the proposed project and could require additional permit conditions. Formal review by Regional Board staff typically occurs after CEQA is complete.

Although land use practices such as agriculture, grazing, and rural residential development have been implicated as sediment sources in the project area, both the TSD and the TMDL documents identify road construction associated with logging as the primary cause of sediment problems in the Gualala River Watershed. In general, the studies determined that natural sediment sources currently account for approximately one-third of the total sediment delivered to the Gualala River, while two-thirds of the sediment is human-caused. Furthermore, the analysis showed that road-related erosion is the major portion of the human-caused erosion, and that higher road density in a given area results in greater sediment loading from roads.

The Regional Board TSD also addressed the potential for sedimentation due to viticulture. Viticulture was determined to not be a major contributing factor to sediment loads in the Gualala River watershed; however, viticulture and the associated clearing of vegetation are likely to increase surface erosion through exposure of bare earth to rainfall and runoff. Observations made by Regional Water Board staff in conjunction with the TSD development show that conservation practices used in viticulture (cover cropping, buffer strips, terracing, etc.) have variable effects on erosion prevention.

After identifying the major contributors to sediment water quality impairments in the Gualala River watershed, the TSD and TMDL documents outline proposed load allocations from each major contributing sources that would be necessary to reduce the total loading to meet the loading capacity. Based on the information presented in these documents, the loading capacity estimate is 125 percent of the natural load. This corresponds to a natural load of 380 tons/mi^2/yr and an anthropogenic load of 95 tons/mi^2/yr when applied to the estimated sediment load. The allocated anthropogenic sediment load (95 tons/mi^2/yr) is equivalent to an 88 percent reduction of the current estimated anthropogenic sediment load (810 tons/mi^2/yr). The current estimated loads and proposed load allocations from each major contributing source provided in the TMDL document are shown in Table 3.7-1.

Table 3.7-1
Sediment Source Load Allocations for the Wheatfield Fork of the Gualala River Watershed

Sediment Source	Current Load, tons/mi^2/yr	Load Allocation, tons/mi^2/yr
Natural Mass Wasting*	180	180
Streambank Erosion*	200	200
Road Related Mass Wasting	310	56
Road-Stream Crossing Failures	40	5
Road Related Gullies	210	8
Road Related Surface Erosion	120	7
Skid Trail Surface Erosion	20	5
Other Harvest Related Activity	110	14
Total	1,190	475

* Natural Source of Sediment

Source: RWQCB 2001, as included in the O'Connor Environmental, Inc. Erosion Analysis, May 2008.

Applying these rates to the Patchett Creek watershed (1.76 mi^2) yields mean annual natural sediment inputs and human-caused inputs of 669 tons and 1,426 tons, respectively. The total estimated erosion rate for Patchett Creek using this method is about 2,090 t/yr. This is roughly 3 to 4 times greater than the erosion rate estimated using data specific to Patchett Creek.

Road-Related Mass Wasting

Road-related mass wasting (landslides) is allocated fifteen percent of their current estimated delivery. In order to attain this allocation, the TSD recommends that landowners in high road density areas decommission some roads, as reasonable. The TSD and TMDL documents show road densities in the Annapolis Watershed and Grasshopper Creek Watershed at approximately 6.1 and 6.5 miles per square mile, respectively. Compared to other watersheds within the Gualala River Basin, these densities are higher than average.

Stream Crossing Failures

Stream crossing failures are allocated ten percent of their current estimated delivery. Minimizing fill volumes and eliminating diversion potential would greatly reduce the volume of sediment delivered to streams.

Road-Related Gullies

Road-related gullies are allocated five percent of their current estimated delivery. According to the TSD, most existing gullies can be easily de-watered by changes in road drainage, although some pre-existing gullies are anticipated to remain.

Road-Related Surface Erosion

Sediment delivery associated with road surface erosion is allocated five percent of current estimated delivery. As recommended in the TSD, reducing the amount of road runoff reaching watercourses (hydrologic connectivity) can effectively limit delivery of sediments generated by road surface erosion. A hydrologically connected road increases the intensity, frequency, and magnitude of flood flows and suspended sediment loads in the adjacent stream, and can result in destabilization of the stream channel. Hydrologic connectivity is both an easily determined and easily correctable parameter that can result in immediate reductions in sediment yields associated with road surface erosion when corrected.

Mitigation measures such as outsloping, installation of rolling dips and increased frequency of ditch relief culverts are recommended in the TSD to reduce hydrologic connectivity of roads and streams. Where the hydrologic connection of roads and streams cannot be eliminated, the TSD recommends mitigation by appropriate road surfacing and limiting use of those roads during wet weather.

Skid Trail Surface Erosion

Skid trail erosion is allocated seventeen percent of the estimated load for the assessment period (1978-2000). The TSD states that most current practices are already reducing delivery rates from the planning period average. Increased use of suspension cable and helicopter yarding and a reduction in skid trail stream crossings has reduced rates of sediment delivery attributed to skid trails. Additional reductions are possible by slash packing and decommissioning skid trails in areas near watercourses.

Other Harvest-Related Activity

Other harvest-related sediment delivery is allocated fourteen percent of the current estimated delivery. However, much of the current estimated delivery is attributed to legacy problems associated with pre-Forest Practice Rules management. The TSD states that mass wasting associated with landings and skid trails can be significantly reduced by avoiding unstable areas and decommissioning landings.

Studies on the Caspar Creek Experimental Watersheds, located at Jackson State Forest in Mendocino County, indicate that the quality of management planning and implementation strongly influences sediment production from timber harvesting activity. Studies showed that clear-cut timber harvesting in the North Fork of Caspar Creek in the 1990s, conducted under the then-current California Forest Practice Rules, resulted in 2.4

to 3.7 times less sediment production than selective logging in the South Fork Caspar Creek prior to implementation of Forest Practice Rules. The earlier South Fork harvest experiment included extensive road building, and the relatively high rate of sediment production was attributed to landslides related to roads, skid trails and log landings. In contrast, harvested areas in the more recent North Fork experiment had landslide rates comparable to what was found in the surrounding unlogged areas. Significant increases in suspended sediment yield were measured in small tributary streams in the North Fork experiment, however, these increases were not observed in the mainstem North Fork Caspar Creek except in the reach downstream of a single landslide from a steep hollow in a clearcut unit. Increased sediment yields were attributed to channel erosion associated with peak flow increases in clearcut tributary watersheds. Other erosion sources such as surface erosion from harvest units appeared to be insignificant.

Soil Loss

The project site contains two soils where vineyards are proposed (See Figure 3.7-2). The vineyard soils are Goldridge fine sandy loam, 15-30 percent slope (GdE) and Hugo very gravelly loam, 30-50 percent slopes (HkF). The predominant soil type in the area is Goldridge fine sandy loam. Goldridge soil has a shallow subsurface horizon that can impede infiltration and generate surface runoff under rainfall rates of approximately 0.2 to 0.6 inches/hour (in/hr) once the relatively thin surface horizon is saturated. The runoff potential for this soil type varies from medium to very rapid and the hazard of erosion ranges from moderate at low slope to high at elevated slopes. The Goldridge Series soils are defined as "highly erodible soils" in the Sonoma County Vineyard Erosion and Sediment Control Ordinance.[9] In contrast, Hugo soils are deeper and more porous, and would only be expected to generate surface runoff under rainfall rates greater than 0.6 in/hr, which rarely occurs in the project area.

Field observations conducted by O'Connor Environmental in early 2002 were consistent with the above descriptions. The Goldridge soils were observed to have a shallow water table and showed clear evidence of significant surface runoff, including rill and gully formation, particularly on the lower portions of the hillslopes. The Hugo soils did not appear to generate surface runoff except in Class III stream channels mapped on the project site.

As noted in the O'Connor Hydrologic Analysis, the project site contains existing roads, and experiences sheet, rill, and gully erosion associated with past agricultural practices. O'Connor Environmental utilized the Revised Universal Soil Loss Equation-2 (RUSLE2) to develop a quantitative estimate of erosion rates by surface processes for the proposed vineyards, existing vineyards on adjacent properties, and existing grasslands. The erosion rates were then used to conduct a sediment source analysis for the Patchett Creek watershed to evaluate the potential changes in water quality resulting from the proposed project. The input parameters were rainfall/runoff factor, soil erodibility factors, length-slope factors, vegetative cover factors, direction of vineyard row in relation to the slope, and erosion control practice factors.

In existing forest and grassland areas, the low and high range erosion rates were determined in relation to the assumed slope length over which runoff could flow. In forest areas, slope lengths of 200 feet and 500 feet were evaluated. In grassland areas, slope lengths of 100 feet and 300 feet were evaluated. Existing vineyard areas, which were characterized by review of aerial photographs and road-side observations, by O'Connor Environmental, were conservatively evaluated only for a 200-foot slope length. Therefore, the Non-project Vineyard estimates should be considered as a high range estimate.

Table 3.7-2 shows the low and high estimates of existing sediment yields in the Patchett Creek drainage within the project area as predicted by RUSLE2. Figure 3.7-4 shows the current vegetative cover and soils types for the project area; and Figure 3.7-5 shows the vineyard in relation to the Patchett Creek Watershed analysis area.

Table 3.7-2
Existing Sediment Yield Conditions

Cover Type	Drainage Type	Area acres (sq. mi.)	Low Estimate tons/year (t/sq. mi./yr)	High Estimate tons/year (t/sq. mi./yr)
Non-project Vineyard	Natural	34.3 (0.054)	17.4 (322)	17.4 (322)
Grassland	Natural	73.3 (0.114)	58.7 (515)	77.7 (682)
Forest	Natural	240 (0.375)	0.28 (0.75)	0.30 (0.80)
Total			**76.4 (141)**	**95.4 (176)**

Source: O'Connor Environmental, Erosion Analysis, May 2008.

As can be seen from the above table, the vast majority of the sediment production for the project area draining into Patchett Creek comes from existing vineyards and grasslands.

Water Quality: Water Temperature

According to the Regional Water Quality Control Board (RWQCB) steelhead trout are found in the lower reaches of Patchett Creek commencing about 4,800 feet downstream of the project area. Steelhead trout are not able to migrate above this point as there is an impassable area to further upstream reaches.[10] Water temperature is an important habitat characteristic when considering habitat quality for steelhead trout downstream of the project site. Steelhead trout optimal egg and fry incubation temperatures range from 48°F to 52°F (Moyle, 2002). Optimal temperatures for fry and juvenile rearing range from 45°F to the mid-60s. Thermal stress in juvenile steelhead trout occurs at temperatures exceeding this range, which can promote disease and reduce growth.

Figure 3.7-4
Project Area Vegetation and Soils

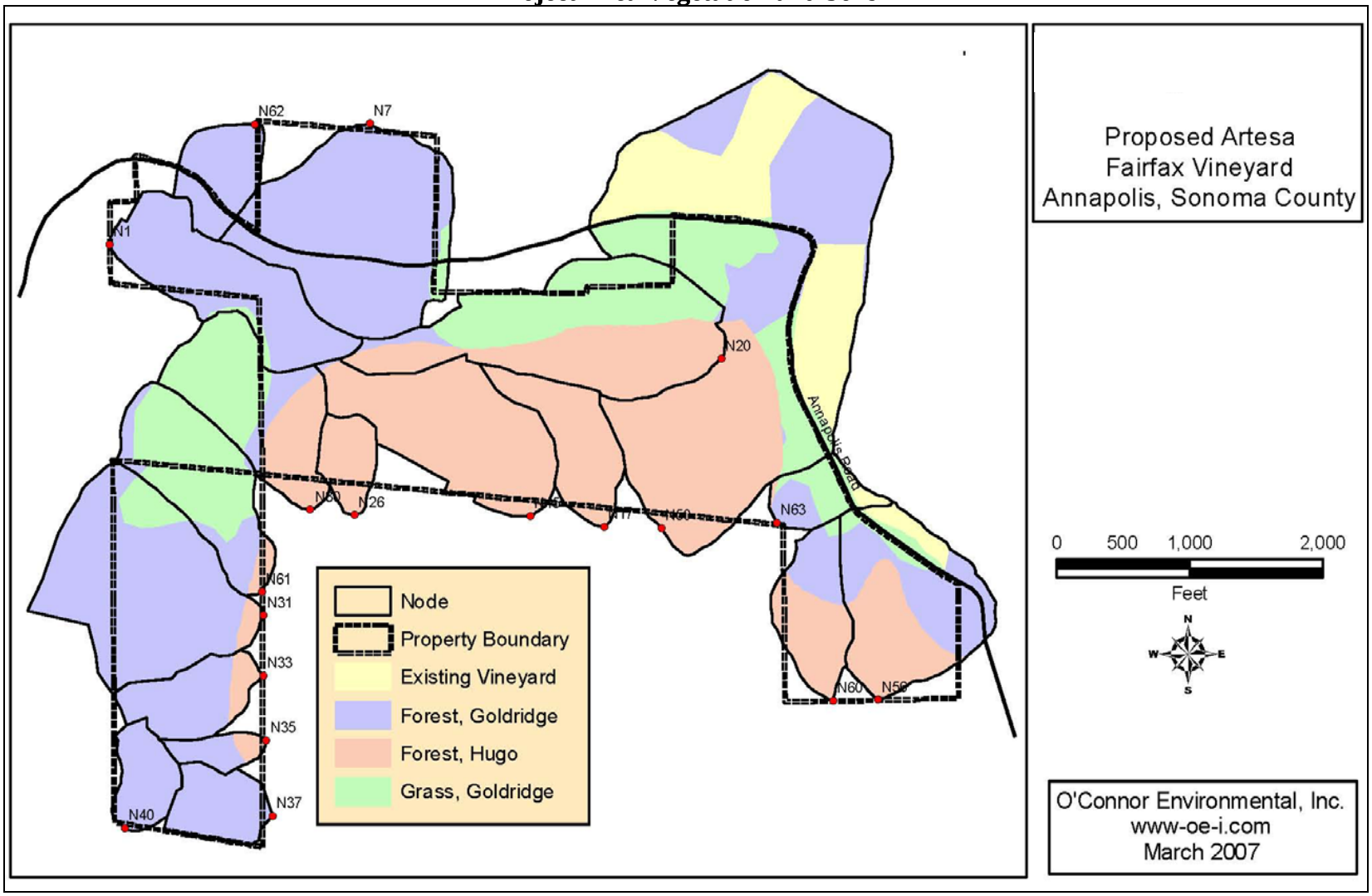
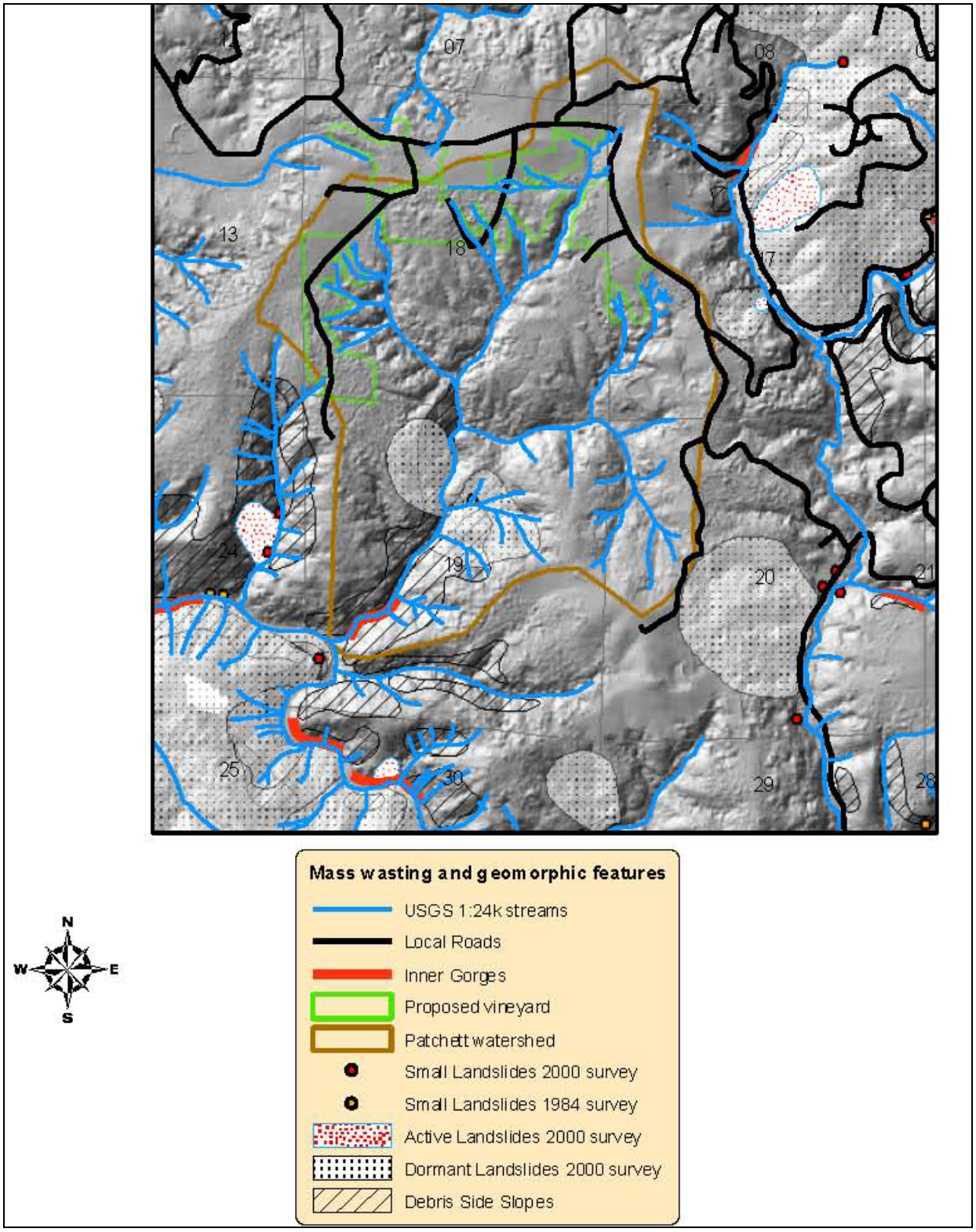


Figure 3.7-5
Patchett Creek Watershed



Water temperature data analyzed for the NCWAP (2002) indicate that the Gualala River has major water temperature problems for cold water fish species such as steelhead trout. Few tributaries have cooler temperatures where steelhead trout can survive during the summer months. Water temperature data for Patchett Creek was not available for this review although Higgins (2003) states "it is likely that Patchett Creek flow provide potential islands of cool water near their mouths for juvenile steelhead trout in their lower reaches."

Because water temperature concerns revolve primarily around effects to coldwater fish species, the impacts are discussed in the Biological Resources chapter of the Draft EIR (Impact Statement 3.4-12).

Water Quality: Organic Debris

The project THP states that organic debris in a watercourse can have either positive or negative effects, depending on the size and stability of the material. Smaller, fine organic debris can have a negative impact on aquatic habitat if present in large amounts. However, large woody debris (LWD) are an important component of a healthy functioning watershed, providing storage and metering of sediment within streams, and thereby reducing potential scour and downcutting of the stream channels. LWD also provide important in-stream habitat for salmonid species; a lack of LWD in Class I waters has been identified as a limit on salmonid habitat function.

In years past, the removal of LWD from watercourses was believed to aid fish passage, and to this end, the Department of Fish and Game (DFG) engaged in stream clearance work in the Gualala River watershed for over 20 years. The removal of LWD took place mainly during the 1960s and 1970s, and the amount of LWD removed from the Gualala River during these years by stream clearance projects has not been quantified.

The THP notes that a moderate amount of LWD is present in watercourse channels on and adjacent to the project site from historic logging 30 or more years ago, as well as from windfalls and fallen snags. However, the watercourses in the vicinity of the plan area exhibit little evidence of capacity to move LWD to higher order waters. The stream channels on the property have gentle gradients and do not experience flows sufficient to transport LWD, indicating that LWD on the subject property is more likely to serve as a natural bank stabilization mechanism than as future, downstream dependent species habitat.

The Gualala River watershed, in which the project area lies, is classified as a Threatened or Impaired (T or I) watershed. Consequently, Section 916.9 of the California Forest Practice Rules apply in the project area. These rules require a 150-foot wide WLPZ designation around Class I waters, as well as stating that along each 330-foot length of Class I watercourse, at least 10 of the largest diameter trees present that have the capacity to fall into the watercourse be retained permanently. The Rules require a minimum 50- to 100-foot wide WLPZ designation around Class II watercourses, and a 25- to 50-foot Equipment Limitation Zone (ELZ) along Class III streams depending on side slope. The Rules also require that within the first 75 ft. (as measured from the watercourse) of the WLPZ, 85 percent overstory shade canopy be retained and within the next 75 ft. of the WLPZ 65 percent overstory canopy be retained. These two

requirements translate to a very high level of tree retention along Class I waters. Class I watercourses do not exist on or immediately adjacent to the project site.

In addition, the Forest Practice Rules require that the Licensed Timber Operator (LTO) on the project site avoid the following activities during timber operations:

(1) Place, discharge, or dispose of or deposit in such a manner as to permit to pass into the waters of the state, any substance or materials, including, but not limited to, soil, silt, bark, slash, sawdust, or petroleum, in quantities deleterious to fish, wildlife, beneficial functions of riparian zones, or the quality and beneficial uses of water; and

(2) Remove water, trees or large woody debris from a watercourse or lake, the adjacent riparian area, or the adjacent flood plain in quantities deleterious to fish, wildlife, beneficial functions of riparian zones, or the quality and beneficial uses of water.

Water Quality: Chemical Contamination

Groundwater in the Annapolis area has been characterized as being sodium bicarbonate water of excellent quality, and the DWR publication entitled "California's Groundwater Bulletin 118: Annapolis Ohlson Ranch Formation Highlands Groundwater Basin" notes that analyses of one water supply well in the basin indicated a total dissolved solids (TDS) level of 260 mg/L (DWR 2004).

Evidence of contaminated surface water or groundwater has not been documented on the project site as of this writing (September 2008). However, the project site at one time contained an apple orchard. Chemical hazards on agricultural sites can include petroleum products, pesticides, soil amendments, and fertilizers. The use of such chemicals is common in vineyard development and operation, and residues from the chemicals may enter waterways or groundwater through the actions of wind, water, and gravity. The California Department of Pesticide Regulation (DPR) regulates agricultural chemical applications, in part to reduce the risk of adverse impacts to water bodies. Additionally, as required by the Forest Practice Rules, THPs must include a discussion of potential chemical contamination in relation to the cumulative watershed effects of proposed timber harvesting activities.

In addition, concerns have been raised regarding the potential for water contamination emanating from the old sawmill site and/or the vehicles and garbage illegally dumped nearby. The project forester, project engineer, and Raney staff visually inspected that portion of the site, and a nearby segment of Patchett Creek, in wet conditions on March 31, 2005. Evidence of hazardous materials in or entering Patchett Creek, which was flowing strongly at the time, was not observed.

Water Supply

Surface Water

The proposed vineyard would be irrigated through the use of stormwater runoff captured by a collection system and stored in a 73-acre foot reservoir. The West Yost Hydrologic Evaluation

estimates average annual precipitation in the Annapolis area at 60 to 70 inches, while annual evaporative losses have been estimated at 40 inches per year.

Groundwater

The proposed project also includes a small drinking water well for vineyard employees. Domestic water supplies in the Annapolis area are provided by groundwater pumping. DWR data indicates that wells in the Annapolis area tapping the Ohlson Ranch Formation have reported yields of two to 36 gallons per minute (gpm) with drawdowns ranging from 30 to 125 feet (DWR 1975). Long-term hydrographs or other groundwater trend data are unavailable for the area (DWR 2004).

Wells and Surface Water Diversions

North Coast Resources Management (NCRM) received from the County of Sonoma Permit and Resource Management Department a listing of wells and surface water diversions within a 1,000 ft radius of the project site. These wells and diversions were plotted on a topographic map by O'Connor Environmental to help evaluate potential impacts of the project. Two small water supply systems were also noted on Annapolis Road. The approximate locations of the parcels and systems are shown in Figure 3.7-6. The wells, diversions, and water supply systems are listed in Table 3.7-3. Most of the wells are located west or northwest of the project area, with one County of Sonoma well (located at the Transfer Station) located to the southeast.

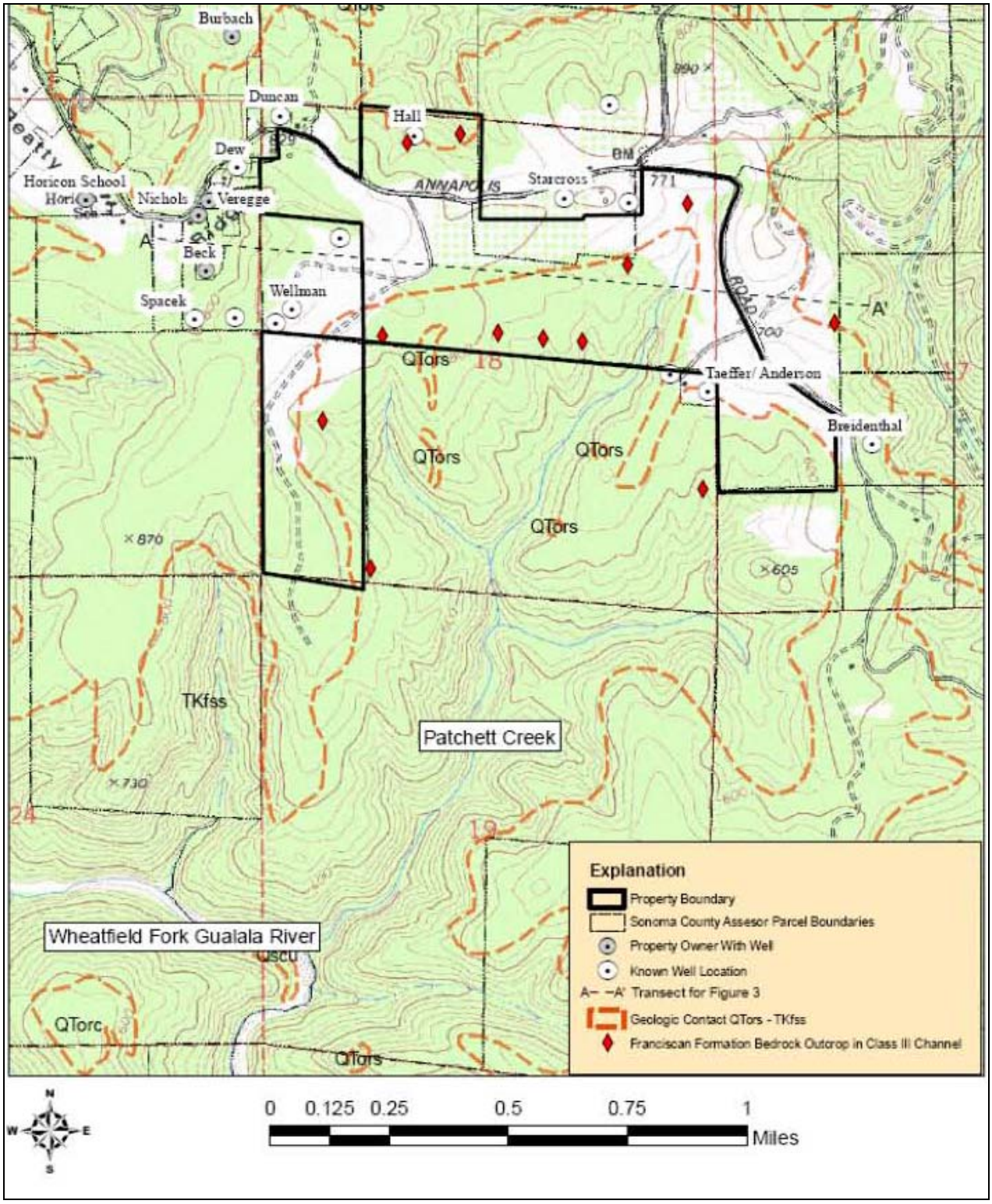
Table 3.7-3
Project Area Well Sites

Assessor's Parcel Number	Type	Parcel	Address
122-100-008	Well	Burbach	35158 Annapolis Rd.
122-110-012	Well	Nichols	35411 Annapolis Rd.
122-110-016	Well	Veregge	35369 Annapolis Rd.
123-010-011	Creek Diversion	Campbell	35180 Annapolis Rd.
123-030-004	Well	County of Sonoma	33551 Annapolis Rd.
123-040-011	Well	Beck	35401 Annapolis Rd.
122-140-006	Small Water System	Horicon School	35555 Annapolis Rd.
123-040-10	2 Wells	Spacek	35405 Annapolis Rd
123-040-017	2 Wells	Taeuffer/Anderson	34175 Annapolis Rd
123-040-037	Well	Breidenthal	33700 Annapolis Rd
123-040-033	3 Wells	Starcross Community	34500 Annapolis Rd
123-040-023	3 Wells and creek diversion[1]	Wellman	PO Box 6 Annapolis
123-040-180	Spring	Hall	34910 Annapolis Rd
123-040-013	Well	Duncan	N/A
122-110-006	Well and creek diversion	Dew	35337 Annapolis Rd

[1]"Red Fern Creek" may have several wells in its drainage.

Source: O'Connor Environmental Hydrologic Analysis, May 2008.

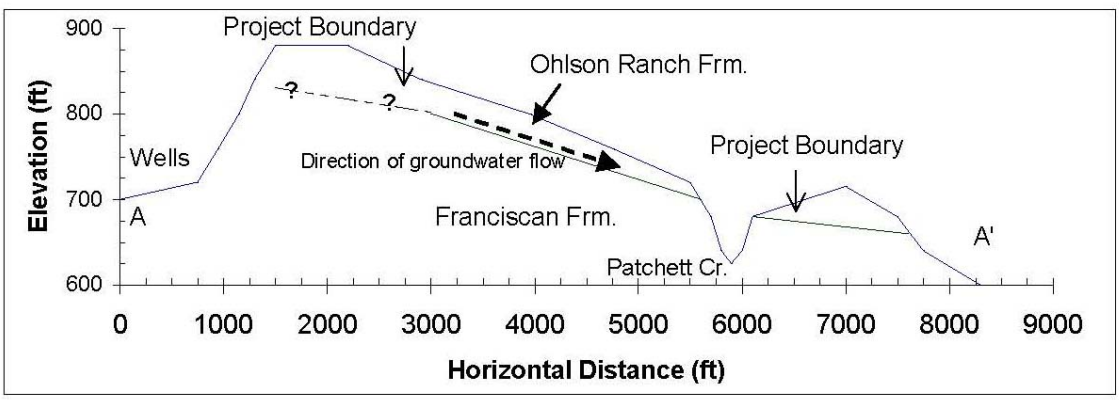
Figure 3.7-6
Well Locations



Note: Site map showing features pertaining to hydrogeology. Red diamonds locate field observations of outcrops of Franciscan Formation bedrock in Class III channels. The dashed red line indicates the approximate boundary for the Ohlson Ranch and Franciscan Formations.

O'Connor Environmental conducted field observations of outcrops of the Franciscan Formation at the project site, in combination with hydrogeologic maps and descriptions, to reveal the general hydrogeologic character of the site. The geologic cross-section in Figure 3.7-7 defines the approximate boundaries of the aquifer and the likely groundwater gradient underlying the project site. The Ohlson Ranch Formation is probably < 50 ft thick under the project area, and the geologic contact between the Ohlson Ranch Formation and the underlying Franciscan Formation dips gently but distinctly to the east. Owing to the high specific capacity of the Ohlson Ranch Formation and the low permeability of the underlying Franciscan Formation, a perched water table forms in the Ohlson Ranch Formation. The groundwater gradient most likely parallels the slope of the geologic contact, which is in turn generally parallel to the surface topography. Almost all of the project area is underlain by this sloping shallow aquifer. Groundwater flows are generally from west- northwest to east-southeast, toward Patchett Creek. The geometry of the aquifer and the location of the contact between the Franciscan and the Ohlson Ranch Formations to the west are uncertain. Even if the geologic contact west of the project site dips to the west, the geometry of the rock formations under the project site is relatively well-defined, and groundwater from the project site would still be expected to flow to the east-southeast.

Figure 3.7-7
Geologic Cross-Section



Water Balance

During the growing season, vineyard evapotranspiration is expected to be less than evapotranspiration that would occur from the existing vegetation. Limited data are available for actual evapotranspiration from forests in a Mediterranean climate. (Unsworth, Phillips et al. 2004) measured evapotranspiration from different components of an old-growth Douglas-fir—Western Hemlock stand at Wind River, Washington in the interior Cascade Range near the Columbia River. For the months of June and July 1999, they measured mean daily evapotranspiration of about 2.3 mm with a standard deviation of 0.6 to 0.7 mm. They also found evidence indicating that the forest vegetation is capable of drawing soil moisture into the root zone from greater depth in the soil. For comparison, the North Fork Caspar Creek water balance estimated evapotranspiration for the period June to September of about 2.7 mm/day, a value similar to that measured in the Cascades. Finally, an estimate based on professional opinion was developed in response to our inquiry regarding redwood forest evapotranspiration

rates by Oregon State University Professor Emeritus Dick Waring (personal communication, February 2005). He estimated average transpiration during the summer of about 3 mm/day, or about 90 mm/month for a 50-80 year old forest with a leaf area index of between 5 and 10. Maximum mean daily potential evapotranspiration was about 3 mm/day at North Fork Caspar Creek in the month of July.

Growing season evapotranspiration for grapevines and irrigation requirements for vineyards has been measured in California by (Williams 2001). He calculated that in a Paso Robles (Central Coast region) vineyard during a 126 day irrigation season in 2000 growing season that average water use was about 2.3 mm/day, with a maximum of 3.3 mm/day. Total water use was equivalent to 11.2 inches. Williams (2001) also found that the yield of grapes declined relatively little when irrigation rates were reduced below plant evapotranspiration rates. For example, when irrigation was reduced to half of calculated evapotranspiration, harvest yields from four vineyards and two cultivars ranged from 70 to 96% of yield (mean = 84%) compared to vines irrigated at 100% of the evapotranspiration rate. At irrigation rates of one-fourth calculated evapotranspiration, harvest yields ranged from 61 to 92% with a mean of 74% compared to fully-irrigated vines. These findings demonstrate that vines cultivated with modest applications of water produce viable crops; many viticulturists have found that vines that are stressed in their growing environment produce high quality wines.

The proposed vineyard project has been planned with irrigation applications of about 0.3 ft, equivalent to 3.5 inches or about 90 mm (Erickson Engineering, 2002). Given the likely soil moisture available and the findings regarding vineyard irrigation by Williams (2001), the proposed vineyards would likely use substantially less water than the existing vegetation. Consequently, based on likely water use by native vegetation and vineyards, the proposed project would tend to increase soil moisture and ground water percolation.

Summary

Comparisons between existing forest vegetation and anticipated vineyards with respect to hydrologic effects of vegetation indicate decreased evapotranspiration is likely under project conditions, both in the growing season and the rainy season. During the rainy season, reduced interception losses are expected to be about 10% to 20%, which represents a net gain to water delivered to the soil surface for infiltration and percolation.

<u>Fog Drip</u>

The interception of fog by forest canopy during summer and fall months, and subsequent delivery of that water to the ground, is known as fog drip. Due to the proposed project's location on a moderate-elevation, forested ridgetop five miles inland from the coast, the project site is subject to fog drip. A USDA Forest Service study conducted on the Caspar Creek Experimental Watersheds range in 1998-1999, and presented at the Redwood Region Forest Science Symposium in Rohnert Park by Elizabeth Keppeler in March 2004, indicates that fog drip makes a highly variable, but hydrologically insignificant, contribution to groundwater and baseflow processes in the coastal redwood/Douglas-fir forest type at Caspar Creek.

Peak Runoff Flows and Reduced Summer Flows

West Yost & Associates evaluated peak flows within the Patchett Creek Watershed and O'Connor Environmental evaluated peak flows at the project's boundaries.

Peak Runoff Flows

West Yost & Associates

Peak storm flows were estimated at two locations (Nodes) on the Patchett Creek as shown on Figure 3.7-8. Node 1 is located just below the second major confluence on Patchett Creek (estimated to be approximately 4,800 feet downstream from the vineyard discharge point), where the creek is described as having a very steep section that "blocks the migration of salmonids," according to the RWQCB PH1 report (Erickson March 26, 2002). The tributary area at this node is 830 acres. Below this location Patchett Creek would be defined as a Class I watercourse. Node 2 is defined as the confluence of the Patchett Creek and the Wheatfield Fork of the Gualala River.

Estimated peak flows for existing conditions are provided for Node 1 and Node 2 in Tables 3.7-4 and 3.7-5, respectively. Methods used are described under the heading "Methods of Analysis-Peak Runoff Methodology" later in this document. It should be noted that this approach was selected because it allows development of a quantitative estimate of project effects on peak runoff. Other methods for predicting peak flow (e.g. US Geological Survey NFFv3.2 program, or unit area runoff estimates from US Geological Survey gage data), for the area of interest produce substantially lower estimates of peak flow. Such methods, however, are empirically based and cannot be used to estimate project effects on runoff rates. Similarly, rational runoff methods used for the smaller-scale project area runoff analysis may tend to overestimate peak flows. Despite the differences between empirical estimation techniques and the peak runoff techniques used in these analyses, the techniques used are appropriate for the intended use: developing quantitative estimates of the likely percentage of change in peak flow under project conditions. An estimate of peak flow using one such approach is shown in Tables 3.7-4 and 3.7-5 for reference.

O'Connor Environmental

O'Connor Environmental conducted a hydrologic analysis using 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 (See Figure 3.7-2 for node locations), assumed to be equivalent to a 2-year recurrence interval flow event. Flows with a 2-year recurrence interval have a probability of occurrence of 0.50 in any single year. These locations are where concentrated and/or dispersed runoff would be routed by the vineyard drainage system. Under existing conditions peak flows were estimated to range from 1.8 cfs at Node 35 to 68.0 cfs at Node 50 (See Table 3.7-6).