Appendix I

Approaches to Impact Avoidance, Minimization, and Mitigation through the Application of County Conservation Programs and BMPs

Introduction/Purpose

The purpose of this Appendix is to support the Hydrology and Water Quality Section (4.11) of the Napa General Plan Update EIR by providing greater detail on current Napa County procedures, ordinances and regulations, and how they work together to avoid impacts and provide mitigation to reduce identified impacts. More specifically this Appendix discusses impact avoidance, reduction, and mitigation through the application of existing Napa County protective ordinances, as well as, how Beneficial Management Practices specific to vineyard development and operation reduce hydrologic and water quality impacts. To present this information, this Appendix is organized into three primary sections:

Section 1 presents existing Napa County protective ordinances and Conservation Regulations. Details are provided on what these ordinances and regulations are and how they avoid impacts and protect natural resources such as soil, fish, wetlands, or streams.

Section 2 of this Appendix presents Beneficial Management Practices (BMPs) that are suitable and appropriate to use as impact avoidance and mitigation measures as related to impacts described in the EIR document. Details are provided to describe the BMP and also the mitigation benefit that the BMP provides.

Section 3 of this Appendix presents current and documented vineyard environmental impact studies. In presenting these case studies, Block 3 actually integrates and demonstrates how the protective ordinances and Conservation Regulations described in Block 1 and the BMPs described in Block 2 have actually been used in the planning and management of recent vineyard projects in Napa County. While the scale of analysis involved in a countywide EIR as needed for the General Plan Update is broader in extent than any of these individual projects; such individual project case studies are excellent snapshots (or 'building blocks') for the type of projects that would occur through the implementation period of the General Plan Update.

Much of the focus of these ordinances, regulations, BMPs, and case-studies is centered on ways to avoid, reduce, and minimize erosive impacts from vineyard development which can lead to increased sediment erosion, transport and deposition to downstream waters (such as the Napa River). The goal of this appendix is to demonstrate that the successful application of such measures has been clearly documented and demonstrated locally in Napa County.

In discussing erosion and sediment control it is also important to reference the parallel regulatory process of the Napa River Watershed Sediment TMDL that is currently underway. This process is described in the Hydrology and Water Quality Section (4.11) of the EIR and not further discussed in this appendix. However, the approaches described in this appendix will similarly be important in efforts to comply with the standards set forth in the TMDL.

1. Napa County Ordinances, Conservation Regulations, and other Programs

1.1 Napa County Conservation Regulations (Chapter 18.108)

Napa County Code 18.108 includes conservation regulations such as requirements for standard erosion control measures, provisions for intermittent or perennial streams, and requirements for use of erosion hazard areas. This section of the code also defines streams and provides setbacks for grading and land clearing for agricultural development.

The general purpose of the Conservation Regulations is to ensure the continued long-term viability of county agricultural resources by protecting county lands from excessive soil loss (i.e., surface erosion, soil particle detachment and movement) which if unprotected could threaten local water quality and quantity and lead ultimately to loss of economic productivity (18.108.010) and possible decreased water quality in receiving waters.

Napa County Code

The following pertains to stream setbacks and tree and riparian vegetation protection provisions excerpted from Napa County Zoning Code, namely the Conservation Regulations, Chapter 18.108.

Section 18.108.100 – Erosion Hazard Areas; Vegetation Preservation and Management

Napa County Code 18.108.100 may require the following conditions when granting a discretionary permit for activities on slopes greater than 5 percent:

- Existing vegetation shall be preserved to the maximum extent feasible. Vegetation shall not be removed if necessary for erosion control or preservation of habitat for threatened or endangered species.

- An approved erosion control plan (ECPA) permit or grading permit is required for the grading associated with the removal of trees or tree stands measuring six inches in diameter (dbh) or larger. Replacement of removed protected trees located outside of the approved project boundary may be required. Trees to be avoided by project activities shall be protected through fencing or other methods during construction.

Section 18.108.025 – General Provisions, Intermittent/Perennial Streams

This section of the County code establishes stream setbacks for earthmoving activities and grading for all new developments, including agricultural and residential developments, and for replanting of existing vineyards when replanting occurs outside of the existing vineyard footprint and when the project would require a grading permit pursuant to the California Building Code. Under Section 18.108.030 a stream means any of the following:

- A watercourse designated by a solid line or dash and three dots symbol on the largest scale of the United States Geological Survey maps most recently published, or any replacement to that symbol.
- Any watercourse which has a well-defined channel with a depth greater than 4 feet and banks steeper than 3:1 (horizontal to vertical bank ratio) and contains hydrophilic (i.e. water adapted) vegetation, riparian vegetation or woody vegetation including tree species.
- Those watercourses listed in Resolution No. 94-16 and incorporated herein by reference.

Setbacks included in the Code range from 35 to 150 feet and are dependent on the slope of the terrain parallel to the top of bank of the stream, with wider setbacks required on steeper slopes. Where the outboard dripline of upper canopy vegetation is located outside the setback required by the slope steepness, the setback will extend to the outboard dripline. Re-vegetation of portions of the streamside setbacks may be required as a part of an erosion control plan.

Section 18.108.027 – Sensitive Domestic Water Supply Drainages

This section of the County code requires the maintenance/preservation of 60% tree canopy cover and 40% of shrubby and herbaceous cover present as of 1993 as part of land uses involving ground disturbance in sensitive domestic water supply drainages.

Ground-disturbing activities in the County's Domestic Water Supply Drainages are only allowed to take place during the dry season, between April 1 and September 1 of each year. Installation of winterization measures may take place during other times of the year, but must be in place by September 15 of any given year.

Napa County's Domestic Water Supply Drainages include the entire watershed areas associated with the following reservoirs (not sure where these acreages came from, revised acreages are from most recent GIS drainage layer):

- Kimball Reservoir Drainage
- Rector Reservoir Drainage
- Milliken Reservoir Drainage
- Bell Canyon Reservoir Drainage
- Lake Hennessey Drainage including Friesen Lakes
- Lake Curry Drainage
- Lake Madigan Drainage

In these Sensitive Domestic Water Supply Drainages concentration of runoff will, wherever feasible, be avoided. Those drainage facilities and outfalls that unavoidably must be installed are required to be sized and designed to handle the runoff from a one-hundred-year storm event without failure or unintentional bypassing. If a project will increase delivery of sediment or other pollutants from a drainage into a public water supply (reservoir) by more than 1% on an individual project basis or by more than 10% on a cumulative basis, the project will not be approved until a public hearing on the matter has been held and a use permit has been issued. A geotechnical report specifying the depth and nature of the soils and bedrock present and the stability of the area potentially affected by the project or project runoff is required for any project located in a Sensitive Domestic Water Supply Drainage.

Section 18.108.070 – Erosion Hazard Areas–Use Requirements

This section of the code stipulates that uses permitted within erosion hazard areas, those portions of land having slopes over five percent (5%), must include temporary and/or permanent erosion control measures in conformance with the County's National Pollution Discharge Elimination System (NPDES) General Permit on file with the state (i.e., a suite of Best Management Practices to eliminate, control and or minimize sediment/soil particle detachment and transport). The section further requires erosion control plan approval for agricultural earthmoving activity on lands having slopes greater than 5%, and establishes grading deadlines (i.e., a winter shutdown period).

Additionally, this section, together with Chapter 18.108.100, limits the removal of vegetation in erosion hazard areas to only that necessary to accommodate the proposed project, sets conditions for the preservation and/or replacement of trees in excess of six inches in diameter, and requires projects to have no adverse affect on sensitive, rare, threatened of endangered plants or animal or their habitats as designated by state or federal agencies with jurisdiction, and mapped on the County's environmental sensitivity maps.

Section 18.108.075 – Requirements for Structural Erosion Control Measures

This section establishes erosion control requirements for structural developments (anything built or constructed on, above, or below the surface of the land), and requires the submission of Evidence of Erosion Control Measures, and the incorporation of such measures in all applicable building, grading, septic, or other required plans or plot plans submitted for County approval. This section of the County Code is carried out through the NPDES program administered through the Napa County Department of Public Works.

Section 18.108.135 – Oversight and Operation Requirements

Maintenance and monitoring is a requirement of any erosion control plan and is the ultimate responsibility of the property owner. Section 18.108.135 requires that maintenance and monitoring be implemented for any erosion control plan and includes the following components:

- Implementation of the ECP measures must be overseen by the preparer of the ECP.
- The property owner must provide weekly inspections of the control measures between

October 1st and April 1st of each year, as well as during rainfall events, to assure the measures are installed properly and are effective in controlling offsite sediment transport, and to implement whatever actions are needed to keep them functioning properly.

- The property owner must implement a permanent, on-going self-monitoring program of the groundcover conditions and erosion control facility operations. The groundcover monitoring shall conform to the NRCS standards for determining rangeland conditions.

- The property owner must submit to the County an Annual Erosion Control Plan Operation Status Report that specifies the groundcover conditions and how the erosion control measures are operating. The report shall specify the proposed management and cultural measures to be used the following year to return or maintain the ground cover in optimal condition and any other remedial actions necessary to restore the disturbed areas in such a manner to minimize erosion and resultant sedimentation.

Specific actions are required under Napa County Code 18.108.135 in the event of existing or pending erosion control measure failures. These actions include:

- Issuance of notification to the County;
- Implementation of temporary measures to stabilize the situation;
- Modification of the temporary measures, if necessary, within 24-hours of receipt of County comment on the adequacy of temporary measures;
- Submit an engineered plan for measures needed to permanently correct the problem within 96 hours of the discovery;
- Submit a plan for clean-up of the damage done with and engineer's estimate of the cost of cleanup;
- Submit, if necessary, a modified plan and cost estimate for the problem within 48 hours of receipt of County comments on the adequacy of the plan;
- Pay the County the cost of review within 48 hours of request;
- Post a security in the amount of 100 percent of the total cost to correct the problem and cleanup the damage;
- Insure the final correction and cleanup plans are implemented within 96 hours of its approval.

Finally, to assure the erosion control measures are adequately in place, the County may perform annual inspections of the project site, after the first major storm event of each winter and until the project has been completed and stable for three years. During these inspections, County staff may require that remedial actions be implemented where non-functioning or ineffective measures are identified. Additionally, once the project has been deemed complete, random site inspections by County staff may also occur with the same consequences.

1.2 Reviewing Departments and Agencies

The **Conservation and Division** of the Napa County Conservation, Development and Planning Department (CDPD) is charged with administration of the Conservation Regulations. The agency checks Plans for completeness and, when satisfied that an application has all the required elements of a complete Plan, collects the Plan check fees from the applicant and refers the Plan to one of its consultants, or the Napa County Resource Conservation District (RCD), for technical review.

- ***Agricultural Projects***

  The Conservation Division of CDPD is charged with reviewing agricultural erosion control plans (ECPAs) for their compliance with applicable sections of the Conservation Regulations. The RCD reviews all ECPAs and some replants for their technical adequacy to control erosion and runoff.

RCD's role in the implementation of the Conservation Regulations is limited to that of technical review of the proposed erosion control plans, and has no regulatory authority. Plans are reviewed by a Plan Review Committee that considers the applicants' proposals, staff reports and recommendations before arriving at a decision to find a plan technically adequate for erosion control. The Committee's findings represent the official position of the District, but the applicant has the right to appeal that position to the full RCD Board of Directors. A final administrative appeal may be made to the Napa County Board of Supervisors.

In April of 1994, the Board of Supervisors passed an amendment to the Ordinance, which specified that RCD staff may recommend field modifications to approved Erosion Control Plans, with CDPD staff providing actual approval of field modifications. Field modifications are minor modifications to an approved Plan which do not increase the amount of erosion predicted from a project, and do not alter the erosion control strategy of the approved Plan. Any proposed changes to an approved Plan which either increase its erosion potential, or alter the strategy by which erosion control is achieved, must be approved by way of a formal Plan Revision, requiring a separate submittal with an additional filing fee to the County, and a separate consideration by an RCD Review Committee. Given adequate mitigating measures, these major changes might be approved, but not as field modifications.

1.3 Voluntary Vineyard Certification Programs

Fish Friendly Farming® for the Napa Valley

The Fish Friendly Farming (FFF) program is a voluntary certification program for grape growers who implement land management practices that restore and sustain aquatic habitat and improve water quality. The goals and objectives of the program include:

- Ensure compliance with all local, state and federal environmental regulations
- Implement Beneficial Management Practices (BMPs) and promote sustainable agriculture

and ecosystems

- Improve water quality and aquatic habitat
- Implement restoration and soil erosion control projects
- Expand community awareness of responsible management practices by grape growers.

Development of the FFF program for the Napa watershed was initiated by Napa Valley's agricultural community and involved an 18-month collaborative effort between local grape growers and representatives from government agencies and environmental organizations. The result of this effort was the creation of a workbook of Beneficial Management Practices (BMPs) with a farm plan template. The workbook and accompanying workshops are the centerpiece of the program and assist landowners in evaluating natural features on their farms, assessing current management practices, and implementing improved practices.

A final step of the FFF program is the certification of the farm conservation plan by the National Marine Fisheries Service, Department of Fish and Game, and the Regional Water Quality Control Board. The grower, in conjunction with the program technical director, presents the farm plan to the certification team. The certification team visits the farm and discusses the site and farm plan implementation timeline with the grower. Each farm plan is certified based on completeness and accuracy in describing the resources and current practices of the farm, the needed BMPs, and the implementation timeline. All certification visits are set up in cooperation with the landowners and at no time does anyone have opened authorized access to private land. Once certified, the grower receives a letter from each of the certifying agencies that recognizes the grower's commitment to improve water quality and habitat values. The grower can display the FFF logo and advertise their certification at tasting rooms and other venues in conjunction with the FFF marketing program (www.fishfriendlyfarming.org).

The program is operated by a non-profit organization, The California Land Stewardship Institute, whose mission is to help public and private landowners implement land management practices and ecological restoration projects for the long-term benefit of the environment. The Fish Friendly Farming program began in the Russian River watershed in 1997 and started in the Napa river watershed in 2000. The local partner in Napa is the Napa County Resource Conservation District. Currently, approximately 18,000 acres (including 9,000 vineyard acres) are participating in the program in Napa County.

2. Recommended Beneficial Management Practices

This section describes Vineyard Beneficial Management Practices. These are common practices that are commonly applied to vineyard development for minimizing impacts to the environment during land preparation, operation and maintenance. Vineyard BMPs are implemented to provide erosion control and seek to ensure no degradation in soil or water quality. Vineyard BMPs also are used to minimize both impacts to flora and fauna and cumulative impacts within the watershed, including downstream of the vineyard site. Determining which BMPs are applicable varies from site to site. Several BMPs are commonly used in concert with each other to minimize soil loss, erosion, and water quality impacts. The impact analysis utilized the Universal Soil Loss equation to predict changes in soil loss and erosion from potential vineyard conversation scenarios. Factors such as slope length, slope gradient, cover crop management and erosion control procedures factor into the equation. The BMPs described below seek to minimize changes to these factors such that soil loss is minimized and in some cases potential improved from exiting conditions. It important to note that these Vineyard BMPs are in use throughout grape growing areas of California and represent a high standard of operation and management. The hydraulic modeling for the General Plan was conducted on a broad scale and thus is limited in the extent of which these site specific practices can be modeled on a macro scale.

Table A-I.1 lists the BMPs applied in Napa County (Table 4.11-2 from the DEIR).Section 2 provides a brief description of each of the BMPs listed in the table, including the mitigation benefit. These descriptions use information from the Napa County Resource Conservation District, the Southern Sonoma County Resource Conservation District Vineyard Beneficial Management Practices manual, and the Fish Friendly Farming Environmental Certification Program for Napa County.

The Napa County Vineyard BMPs and their intended benefits have been separated into six main categories: site preparation, cover crop, slope protection, runoff control, sediment retention, and roadways.

Table A-I.1 (Table 4.11-2 in the DEIR)
Beneficial Management Practices Applied in Napa County*

SITE PREPARATION	COVER CROP			SLOPE PROTECTION	RUNOFF CONTROL		SEDIMENT & NUTRIENT RETENTION	ROADWAYS
Chiseling & Subsoiling	Temporary (Tilled The Following Spring)		Fast Growing Grasses	Straw Mulch	Backsloped Terraces and Avenues		Straw Mulch	Waterbars
Land Reclamation			Legumes	Jute Netting	Cross-slope Diversions		Straw Wattles	Roadside Ditches
			Fertilizer and Soil Amendments, per analysis	Synthetic Erosion Control Blankets	Drop Inlets		Straw Bale Dikes	Ditch Turnouts
	Permanent	Tilled Annually	Fast Growing Grasses	Mulch	Underground Outlets (storm drains)		Silt Fences	Crushed Rock Mulch
			Legumes		Grassed Waterways		Sediment Basins	
			Fertilizer and Soil Amendments, per analysis		Armored Ditches		Outsloped Benches	
		Non-Tilled	Annuals (self-seeding)		Waterbars and Rolling Dips		Gravel Filters	
			Perennials, native and non-native		Energy Dissipators	Rock Slope Protection	Vegetated Buffer Strips	
						Level Spreaders (earth, rock, or pipe)	Nutrient Management Planning	
							Integrated Pest Management	
						Attenuation Basins	Stream Setbacks	
					Underground Pipe with Drop Inlets			
					Flexible Pipe Drop			
					Diversion Ditch			
					Perforated Pipes			

**Napa County Resource Conservation District and Napa County Fish Friendly Farming Program*

2.1.1 Site Preparation BMPs

Chiseling & Subsoiling
Chiseling and subsoiling is the loosening of the soil with a minimum of mixing to break up restrictive layers below normal plow depth that inhibit water movement or root development. The purpose of chiseling and subsoiling is to improve water and root penetration and aeration.

Mitigation Benefit: **Increases soil infiltration to reduce runoff and sediment and nutrient transport.**

Land Reclamation
Land reclamation is treatment of inplace materials to reduce downslope movement. The slope stability treatment can be via slope reduction, increasing internal strength, or external restraints. Slope reduction can be accomplished by grading and shaping to eliminate critical slopes within the slide area. Increasing internal strength can be achieved by reducing moisture content of the slide material, removing or replacing the slide material, incorporating an admixture to the slide material, or compacting it to decrease the tendency to slide. External restraints include buttresses, bulkhead retaining walls, piling, tieback anchors, and gabions. Slide repairs should not be attempted without geotechnical or other appropriate, professional consultation.

Mitigation Benefit: **Stabilizes slopes to reduce sediment loss.**

2.12 Cover Crop BMPs

Cover crops are either temporary or permanent. Temporary cover crops are used to quickly establish a ground cover soon after construction and typically do not re-seed themselves. Permanent cover crops can re-seed to provide permanent protection to topsoil layers from wind and soil erosion.

Temporary cover crops are seeded after land preparation, creating a dense cover of plants to directly protect soil layers from rain-strike erosion and surface flows, to hold the soil with dense fibrous roots, and to improve infiltration. Cover crops can be grasses alone or a combination of grasses, legumes, and natural vegetation. Cover crops should be seeded in September to provide protection from winter rain. Temporary cover crops are tilled the spring following construction.

Permanent cover crops continue to protect topsoil from water erosion by dissipating the energy of falling raindrops, reducing velocity and quantity of runoff, and trapping sediment, in addition to protecting against wind erosion. Properly chosen and managed permanent cover can even produce a net increase in topsoil annually by allowing the formation of topsoil from underlying subsoil and decomposing organic matter to exceed soil loss through erosion and mineral uptake by plants. Plant species vary according to specific site needs. Permanent cover crops such as fast growing grasses and legumes should be tilled annually; annual and perennial cover crops can be maintained on a no-tilled basis. Grasses, depending on the type, provide short-term soil stabilization for disturbed areas during project construction and can serve as long-term permanent soil stabilization for disturbed areas. Seed mixes should provide both overstory (e.g., oats and barley) and understory (e.g., clover and blando brome) protection. Legumes such as clovers, medics, and vetch (RCD) provide soil nitrogen, and are capable of rapid and vigorous establishment. However, legumes do not normally grow well in cold weather (i.e. until late winter or early spring, and are generally not be relied upon for early season erosion protection).

Cover crops were the only BMP simulated in the model used for the EIR analysis of sediment erosion (soil loss) that can be directly linked to the model outputs concerning soil loss/erosion in regards to future vineyard conversions. The model shows how varying cover crop effectiveness can mitigate potential soil loss impacts of vineyard development. The soil erosion calculation is based on the Universal Soil Loss Equation (USDA, 1994, DHI, 2006). The equation calculates the soil erosion based on the rainfall erosivity factor, the soil erodibility factor, the slope length factor, the slope gradient factor, the crop management factor, and the erosion-control factor.

The cover crop parameter ("C factor") was the only parameter in the soil loss equation assumed to change with proposed vineyard development. The C factor represents the ratio of soil loss under a given crop to soil loss produced from having no crop (e.g., bare soil).

Three different cover crop levels were applied to proposed project scenarios. Table A-I.2 shows the different levels of cover crop and their implications for BMP effectiveness.

TABLE A-I.2 COVER CROP C-FACTORS APPLIED TO EIR SEDIMENT EROSION ANALYSIS

Cover Crop	Napa County Cover Crop C-Factor		
	0.2	**0.088**	**0.046**
Percent Cover	40%	60%	70%
Mitigation Description	No BMPs applied	Existing/average cover crop conditions	Excellent cover crop established and maintained

The sediment erosion model was run under the three varying C Factor values (DHI, 2006). To examine the quantitative mitigation benefits of cover crop BMP application, sediment yield results for all scenarios were averaged by evaluation area. Table A-I.3 shows how application of a cover crop can reduce sediment yields. ***The table shows that increasing the percent cover of the cover crop (i.e. decreasing the C Factor) reduces the predicted sediment yield.*** The greatest reductions in sediment yield occur in the Valley Floor and West Hills evaluation areas; the least reductions occur in Berryessa and Suisun evaluation areas.

TABLE A-I.3 CHANGES IN SEDIMENT YIELD PREDICTED BY THE MODEL DUE TO C FACTOR ADJUSTMENT

Evaluation Area	Reduction in Total Sediment Yield (% Change) from 0.2 C-Factor, Averaged by Evaluation Area	
	C Factor 0.088	C Factor 0.046
Valley Floor	33	46
West Hills	23	32
East Hills	13	18
Carneros	38	52
MST	24	33
American Canyon	11	16
Berryessa	3	4
Suisun	6	8

It is important to note that Table A-I.3 only summarizes the changes in sediment yield as regards to C Factor adjustment. This discussion does not attempt to compare modeling scenarios or discuss acceptable or unacceptable total changes in sediment yield under projected future conditions. This independent analysis seeks to quantitatively describe the potential mitigation benefits of cover crop BMP application, within the limits of the existing Napa County watershed model.

Mitigation Benefit: **Provides soil stabilization to reduce sediment yield, reduce runoff velocities, and promotes rainfall infiltration.**

Straw Mulch

Straw mulch protects the soil surface from the impact of raindrops, preventing soil particles from becoming dislodged. Straw mulch is typically used for erosion control on disturbed areas until soils can be prepared for permanent vegetation and can provide protection if cover crops cannot be seeded and established prior to winter rains. Straw mulch is also used in combination with temporary and/or permanent seeding strategies to enhance plant establishment. In some soil types, straw mulch can reduce susceptibility to cover crop seedling death from “frost heave.” Straw mulch consists of a uniform layer of straw, derived from wheat, rice, or barley, spread over the surface of the soil and, sometimes punched in with a studded roller or straw “crimper”, or anchored with a tackifier stabilizing emulsion.

Mitigation Benefit: **Provides short-term soil stabilization to reduce sediment loss, pending establishment of the cover crop.**

2.1.3 Slope Protection BMPs

Jute Netting

Jute netting can be used as a biodegradable erosion control mat used in conjunction with seeding as well as to hold straw mulch in place. Jute is a natural fiber made into a yarn that is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which are typically secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Mitigation Benefit: **Stabilizes slopes to reduce sediment loss, pending establishment of vegetative cover, reduces sheet flow velocities, minimizes gullying and promotes rapid revegetation of slopes**

Synthetic Erosion Control Blankets

Non-biodegradable erosion control blankets are used to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, matting may be used to stabilize soils until vegetation is established. They include plastic netting, synthetic fiber with netting, and bonded synthetic fibers. They are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable, photodegradable, and synthetic fibers is used to construct erosion control blankets.

Mitigation Benefit: **Provide long-term slope and drainage channel stabilization to reduce sediment loss.**

Mulch

Hydraulic mulch consists of applying a mixture of shredded wood fiber or a hydraulic matrix, and a stabilizing emulsion or tackifier with hydro-mulching equipment, which temporarily protects exposed soil from erosion by raindrop impact or wind. Hydraulic mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

Mitigation Benefit: **Provides short-term soil stabilization through reduction of rainfall impact, moisture retention and promotes revegetation to reduce sediment loss.**

2.1.4 Runoff Control BMPs

In-sloped, or Back-sloped, Terraces and Avenues
Terraces are embankments or combinations of cut and filled benches, constructed across a slope at a suitable spacing to control erosion by diverting surface runoff instead of permitting it to flow uninterrupted downslope. Graded benches generally have a reverse slope of 1 foot or more and a minimum width of 8 feet. Terrace faces should not be steeper than 1.5 horizontal to 1 vertical. (Out-sloped terraces do not divert runoff, but slow runoff rate and reduce sediment delivery by facilitating deposition where runoff slows, when crossing the flat area of the terrace.)

Mitigation Benefit: **Reduce overland flow velocities, overall slope gradients and sediment yield to receiving waters.**

Cross-slope Diversions
Cross-slope diversions are channels constructed across a slope with a supporting ridge on the lower side. Diversions are used to intercept runoff and carry it at a non-erosive velocity to a stable, protected site, preventing surface water from entering vineyards and causing erosion damage. Diversions are typically laid out at 2-5% gradients, roughly perpendicular to up- and down-slope vineyard rows.

Mitigation Benefit: **Divert surface flow to reduce excessive runoff to vineyard areas, reduces flow velocities and runoff travel times and reduces sediment delivery to drainage receiving waters.**

Energy Dissipaters
Energy dissipaters are placed at the end of a water transmitting apparatus, designed to reduce the velocity, energy, and turbulence of discharged water.

Rock Slope Protection
Rock riprap is used at pipe outlets to minimize the energy of the concentrated pipe flow at the outfall before runoff is discharged into receiving waters. Rock riprap is typically keyed in below the existing grade, to provide a permanent foundation for the outfall. Rock slope protection should not be installed at slopes greater than 1.5H:1V.

Level Spreaders (T-Spreaders)
A level spreader is a device used to disperse concentrated runoff uniformly over the ground surface as sheet flow. The purpose of this practice is to convert concentrated, potentially erosive flow to sheet flow and release it uniformly over a stabilized area or filter strip. The resultant sheet flow enhances pollutant filtering and runoff infiltration and reduces the potential for erosion. Level spreaders are relatively low cost structures designed to release small volumes of water safely. Level spreaders can also be applied as outlets for diversion structures. A typical level spreader consists of a long, slotted pipe or rock sluice, laid out on contour from a T-section, attached to the pipe outlet.

Another type of level spreader is an excavated depression constructed at “zero percent” grade across a slope. The depression can be lined with crushed rock and/or stabilized with an appropriate grass mixture.

Attenuation Basins
Attenuation basins are facilities constructed through filling and/or excavation that provide temporary storage of runoff during storm events. Outlet structures from these basins are designed to emulate pre-project flow levels. Attenuation basins may be designed to also provide sediment retention, thus providing both stormwater quality and quantity management.

Mitigation Benefit: Prevents erosion at outlet points by reducing flow velocity, energy and turbulence at pipe outlets before discharge to receiving waters.

Drop Inlets
A drop inlet spillway is an overfall structure in which the water drops through a vertical riser connected to a discharge conduit. Drop inlets are typically connected to an underground pipe network, which discharges runoff to controlled outlets, such as detention/retention ponds or energy dissipater.

Mitigation Benefit: Collect surface flow to reduce overland flow erosion and sediment yield to drainage receiving waters.

Grassed Waterways
Grassed waterways (also called "bioswales") are natural or constructed waterways, usually broad, shallow, and covered with erosion-resistant grasses, to convey surface water downslope. Grassed waterways are used in vineyards with gentle slopes (less than 12%) to convey stormwater in areas of concentrated flow, such as swales. They are applied in areas with seasonal short-term water flow and are generally planted with perennial deep-rooted grasses. Grassed waterways slow overland flow velocities, trap suspended sediment, filter out vineyard chemicals, and increase soil infiltration.

Mitigation Benefit: Provide a natural, stabilized waterway that increases soil infiltration to reduce runoff.

Armored Ditches
Armored ditches are natural or constructed waterways lined with rock riprap or gravel to convey surface water down high-gradient drainage ways that are potentially erosive. The rock armoring minimizes soil erosion and provides long-term waterway stabilization.

Mitigation Benefit: Provide a stabilized waterway that decreases potential channel erosion and increases runoff infiltration.

Check Dams/Flexible Pipe Drop
Flexible pipe drops consist of a small section of flexible plastic pipe set in a barrier made of sacks of concrete. The stack of concrete sacks temporarily ponds surface flows and directs the flow into the pipe and to the next downhill stack and pipe. The practice creates a stair-step of small impoundments through small swales and gullies. These impoundments slow runoff travel

time, reduce flow velocities, collect sediments, and avoid gully erosion. This drainage practice can be installed in small swales where the flows are relatively small.

Mitigation Benefit: **Convey and control surface flow downslope to reduce overland flow erosion and sediment yield to drainage receiving waters.**

Diversion Ditch
Diversion ditches are used across the top contour of the site to intercept runoff and move it away from the developed slope, thereby reducing the total amount of water moving downslope. They can also be used mid-slope between vineyard areas. Runoff is diverted to an underground outlet or other facility designed to accommodate the flow volume.

Mitigation Benefit: **Collects and conveys surface flow to receiving waters reducing channel erosion, overland flow and gullying.**

Infiltration Trenches/Perforated Pipes
Perforated drainage pipe or rock-filled trenches are installed below the soil's surface to intercept and redirect excessive surface or shallow sub-surface flow.

Mitigation Benefit: **Disperse surface flow across slope to reduce overland flow erosion to drainage receiving waters.**

2.1.5 Sediment & Nutrient Retention BMPs

Sediment laden runoff is responsible for transporting nutrients, pesticides, and herbicides to receiving drainages. Nutrients need to be absorbed through chemical bonding or vegetative uptake. Most of the modern pesticides and herbicides break down quickly from ultraviolet degradation, absorption, and/or hydrolysis. These processes take time so preventing or delaying delivery of these elements to receiving waters is key to minimizing their environmental impact. The following BMPs can reduce the amount of sediment that is delivered to drainages and can provide areas and opportunities for the absorption of nutrients and the breakdown of pesticides and herbicides. Thus, these BMPs can mitigate impacts caused by excessive sedimentation, nutrient and pesticide/herbicides loading.

Straw Wattles
Straw wattles or fiber rolls are designed to slow runoff on slopes. Straw wattles are porous, allowing water to filter through fibers and trapping sediment. Straw wattles are long tubes stuffed with straw, ranging from 6 to 12 inches in diameter. Wattles are installed on contour, keyed and staked. They do not reduce slope length, but slow and spread runoff, encourage deposition and infiltration, and prevent rill formation

Mitigation Benefit: **Reduce runoff and sediment delivery.**

Straw Bale Dikes
A straw bale dike is a temporary sediment barrier constructed of straw bales, located downslope of a disturbed area or around a storm drainage inlet. The purpose is to prevent sediment

transport from disturbed areas by trapping sediment and also to prevent transported sediment from being discharged to a specific point, such as a storm drain inlet.

Mitigation Benefit: **Reduce sediment delivery to drainage receiving waters.**

Silt Fences

A silt fence is made of a pervious geotextile filter fabric that has been stretched across and attached to supporting posts and entrenched, or dug into the soil, and sometimes backed by a plastic or wire mesh for support. The silt fence detains sediment-laden water, promoting sedimentation behind the fence. Silt fence dikes offer temporary velocity control and have the advantage of being lightweight, portable, and often reusable; the expected life of a sediment fence is generally six months.

Mitigation Benefit: **Reduce sediment delivery to drainage receiving waters.**

Sediment Basins

A sediment basin is a temporary basin formed by excavation or by constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is discharged.

Mitigation Benefit: **Typically provides some runoff peak attenuation and reduces sediment delivery to drainage receiving waters, providing the opportunity for nutrient absorption and breakdown.**

Gravel Filters

Gravel filter is washed and graded sand and gravel aggregate placed around a drain or well screen to prevent the movement of fine materials from the aquifer into the drain or well. The coarse aggregate acts as a buffer, trapping finer particles. Gravel filters are often used in conjunction with straw bale dikes around a storm drain inlet.

Mitigation Benefit: **Reduce sediment delivery to drainage receiving waters.**

Vegetated Buffer Strips

Buffer strips are vegetated areas, either existing or created, that slow water by overland flow through vegetation and reduce erosion and runoff velocities. They are often used to separate roads, vineyards, development, or construction sites from sensitive receiving areas such as streams, wetlands, and lakes. Buffer zones provide critical wildlife habitat adjacent to streams and wetlands, as well as assist in controlling erosion, especially on unstable steep slopes. A seasonal vegetative buffer strip in agricultural areas may consist of a crop of close-growing grasses, legumes, or small grains grown in a strip or band, primarily for seasonal protection against wind and water erosion during periods when primary crops do not furnish adequate cover. Seasonal buffer strips provide short-term plant cover and are generally grown in the interval between main crops. Permanent buffer strips provide long-term plant cover for several years and are managed as natural stands without tillage. Permanent buffer strips are typically applied at vineyard peripheries, usually between the vineyard block and any adjacent waterway. Buffer strips also function as filters for chemicals in surface runoff.

Riparian zones, the vegetated region adjacent to streams and wetlands, are thought to be effective at intercepting and controlling nitrogen loads entering water bodies. Buffer width may be positively related to nitrogen removal effectiveness by influencing nitrogen retention through plant sequestration or removal through microbial denitrification.

Jones & Stokes Associates conducted a literature review of buffer strip studies for their "Stream Setback Technical Memo" (JSA, 2002). They found that buffer strips could effectively remove sediments, nutrients and fecal coliform from surface runoff, preventing delivery to downstream waters. The literature review found that buffers anywhere from 33 ft to 400 feet would accomplish the required filtration. Specifically, the Stream Setback technical memo states "the bulk of the data suggests that buffers between 50 feet and 100 ft wide are generally appropriate for filtration of sand and silt on moderate slopes. Higher slopes and finer materials will increase the necessary width of the buffer. All of the data suggest that buffer width be tied to soil type ad slope." The memo also found that sediment filtration buffers might have significant mitigation benefits in low-order intermittent or ephemeral headwater streams because those streams represented the major conduits of sediment delivery to the channel network.

A study conducted in Napa County examined the effectiveness of three separate riparian buffer zones in the removal of nitrogen from surface flow (Jones, 2001). Surface water samples and physical measurements were taken near the Mümm winery outside of the town of Napa, CA. The samples showed a decrease in nitrogen concentration from the top of the buffer zone to the edge of the nearby stream. Analysis of the data indicated a strong relationship between buffer width and nitrogen removal. The study found that riparian buffer zones of 5m or more were effective at nitrogen removal (45%) from the vineyard surface runoff.

A study by the EPA on riparian buffer width and nitrogen removal effectiveness surveyed peer-reviewed scientific literature containing data on riparian buffers and nitrogen concentration in streams and groundwater of riparian zones to identify causation and trends in the relationship between buffer width and nitrogen removal capacity (Mayer et al., 2006). The literature review concluded:

- Riparian buffers are vegetated zones adjacent to streams and wetlands that represent a best management practice (BMP) for controlling nitrogen entering water bodies.
- Current research indicates that riparian buffers of various vegetation types are effective at reducing nitrogen levels in groundwater and streams.
- Buffer width is only one factor controlling nitrogen removal effectiveness.
- Subsurface removal of nitrogen in riparian buffers is often high, especially where conditions promote microbal denitrification
- Riparian buffers are a single component of comprehensive watershed management plans, which must also include point source and non-point source control of nitrogen.

Proper design, placement, and protection of buffers are critical to buffer effectiveness. To maintain maximum effectiveness, buffer integrity should be protected against soil compaction, loss of vegetation, and stream incision. Maintaining buffers around stream headwaters will likely be most effective at maintaining overall watershed water quality while restoring degraded riparian zones, and stream channels may improve nitrogen removal capacity.

Mitigation Benefit: **Reduce flow and sediment yield to drainage receiving waters, provides a nutrient sink to absorb excessive nutrients, traps pesticides and herbicides allowing time for decay and absorption.**

Nutrient Management Planning

Nutrient management planning aims to optimize crop yield and quality, minimize fertilizer input costs and protect soil and water. The principles include:

- applying fertilizer only to make up the difference between what nutrients exist on-site and what is required to achieve the target yield, and
- ensuring that the added nutrient is available to the crop.

Good yield forecasting relies on understanding how crops respond to fertilizer under different conditions. First, the amount of nutrient to be added is established. Second, the appropriate type of product has to be chosen. Third, nutrient additions should be placed as close to the growing plant as possible without damaging the crop. The greater the distance between the plant and the fertilizer, the greater the chance that it will be lost before it can be taken up. Effective placement depends on the formulation of the fertilizer, the crop, soil properties, moisture conditions and the equipment used. From a water quality perspective, fertilizers that cannot be reached by the roots of a crop are at risk of being lost to surface or ground water. Finally, the nutrients have to be applied at the right time, as close as possible to the time that crops need the nutrient. Generally, crops require the greatest amounts of nutrients at the times of fastest growth and seed production. Some nutrients, if applied too early in the season, may be transported out of the root zone with runoff or infiltrating water prior to the time of peak demand.

Mitigation Benefit: **Reduces nutrient loss to receiving waters by balancing crop requirements with fertilizer application.**

Integrated Pest Management (IPM)

Integrated Pest Management (IPM) refers to a system of managing pests through a wide variety of management practices and control measures that are environmentally sound and economically feasible. The main objective of this BPM is to use, where possible, farming practices that reduce pesticide delivery to downstream waters in lieu of chemical controls. IPM seeks to keep the population density of pest species below the level that causes economic loss. It is also an important step in blocking the development of pesticide resistance.

IPM systems have three important components, which include:

- Information collection: identification and monitoring of pests and disease
- Threshold identification: action and economic thresholds
- Control measures: physical, cultural, biological and chemical controls

Control measures should be a combination of physical, cultural, biological and chemical controls, and include:

- Physical control measures include barriers, traps, trap crops, tillage, fire, grazing, mowing and adjusting planting location or timing to destroy or evade pests.
- Cultural control measures include farming practices used to reduce persistent pest problems. These activities include using crop rotations, fertilizer practices, cultivation, sanitation and seeding practices (e.g. seed quality, rate, timing. and depth) to decrease the vulnerability of the crop to persistent pest problems.
- Biological control measures refer to the use of beneficial living organisms (predators, parasites, insects, diseases) to regulate or suppress pest organisms. Biological control can be achieved either by encouraging natural pest enemies, or by introducing and releasing natural enemies.
- Chemical control measures involve the use of conventional pesticides and other chemicals for pest control. When chemicals are used, an attempt should be made to ensure that the chemicals are:
    - specific to the pest species being controlled and therefore non-toxic to beneficial species;
    - used at the lowest recommended label rate;
    - alternated with other chemical modes of action and control measures to help prevent resistance;
    - quickly broken down in the environment;
    - handled, stored and applied in a safe manner; and
    - applied following manufacturer's recommendation for health and environmental protection

Mitigation Benefit: **Employs where possible physical and cultural farming practices that reduce pesticide/pollutant delivery to receiving waters, instead of purely chemical control measures**

2.1.6 Roadway BMPs (Vineyard Avenues)

Unpaved roads, by nature of their topography and design, can, if not properly managed, contribute heavily to water quality problems. Roads typically have increased rates and concentrations of runoff. Uncontrolled this can lead to excessive hillside erosion and sediment delivery to receiving waters. Vineyard avenues are unpaved roads, and erosion from avenues could contribute to polluted runoff, or nonpoint source pollution.

Water Bars

Waterbars are narrow bermed structures built across the roadway. They are constructed by forming a ridge, or a ridge and channel combination, diagonally across the sloping roadway, and may be shallow or deep depending on the need and anticipated runoff volumes. They can be used to divert water and prevent erosion on long, sloping roads. Waterbars should be constructed low enough for traffic to pass over but high enough to direct runoff flow off the road. They should be installed at about a 30-degree angle down slope, and direct flow to a protected outfall point, i.e. an energy dissipater, drop inlet, or into permanently vegetated vineyard areas.

Mitigation Benefit: **Reduce overland flow and erosion on roads and sediment yield to drainage receiving waters.**

Roadside Ditches

Ditches are used to convey water from storm runoff to an adequate outlet without causing erosion or sedimentation. They collect and disperse surface water in a controlled manner. A good ditch requires shaping and lining (using the appropriate vegetative or structural material) and maintenance. Constructed properly, ditches will remove runoff quickly and reduce seepage into the road subgrade. Well-designed ditches provide an opportunity for sediments and other pollutants to be removed from runoff water before it enters surface waters or groundwater. Ditches work by controlling, slowing and filtering road runoff through vegetation or rock lining. Efficient removal of runoff from the roadway will help preserve the roadbed and banks.

Mitigation Benefit: **Concentrate flow away from roadway and reduce sediment yield to drainage receiving waters.**

Ditch Turnouts

Turnouts are extensions of ditches that direct water to filtering areas. There must be adequate outlet protection at the end of the turnout area, either a structural (rock) or vegetative filtering area.

Mitigation Benefit: **Concentrate flow away from roadway and reduce sediment yield to drainage receiving waters.**

Crushed Rock Mulch (for roads)

Crushed rock mulch serves the same purpose as straw mulch, except it is used for erosion control on surfaces such as roads or vineyard avenues where vineyard operation traffic makes cover crop maintenance difficult or impossible (where heavy traffic impedes cover crop growth). Crushed rock and gravel may be needed to keep the road surface from washing out during rainfall and runoff.

Mitigation Benefit: **Provides short-term soil stabilization to reduce sediment loss from roads.**

This section provided descriptions of recommended Napa County beneficial management practices. If appropriately applied on a site-specific basis, maintained properly, and monitored for long-term viability, these BMPs will mitigate on-site and downstream impacts from surface runoff and sediment and nutrient delivery.

3. Existing Vineyard Impact Studies

Several technical studies have been completed that evaluate pre- and post-vineyard conditions in Napa County. Technical studies required by the County demonstrate how proposed BMPs in the erosion control plans (ECPA) can mitigate potential impacts of vineyard development on surface runoff and sediment loss that could result in decreased water quality in receiving waters. As described above these case studies present current typical vineyard projects and provide good representation for the types of future projects that would occur through the implementation of the General Plan Update. The descriptions below seek to present how these projects utilized local County ordinances or regulations or incorporated BMPs (as described above) in avoiding, reducing, and mitigating environmental impacts.

It is important to note that each ECPA was designed to be site-specific, with the County and the RCD tailoring erosion control measures and mitigations to each proposed vineyard site. BMPs must be applied with consideration of the site location within the individual watershed, and, further, within the County. An ECPA developed for one site cannot be arbitrarily applied to another site. The selection and application of BMPs vary depending upon project size and description, and geographic location. Provided below are summaries of four projects in varying areas of the County.

3.1 Artesa Vineyards, Rector Creek, Napa River Watershed

Project Details

The project site is located in the south-central region of Napa County, north of Foss Valley, off Soda Canyon Road nearly eight miles east of the intersection with Silverado Trail. The purpose of the Artesa Vineyard project is to develop additional 66 acres of vineyards (in 12 blocks) on a 183-acre parcel. There are about 38.8 acres of existing vineyard on the parcel. The addition of the new vineyard would bring the total vineyard area up to approximately 104.8 acres, which is about 57% of the parcel. The parcel is located in the uppermost portion of the Rector Creek watershed (a Sensitive Domestic Water Supply Drainage), which has a drainage area of approximately 10.5 square miles. The parcel drains into Rector Creek, a perennial stream, which eventually drains into Rector Reservoir.

The project site is located on moderately sloping upland hills varying in slope from 0 percent to 30 percent, with an average slope, within the vineyard blocks, of 12 percent. Elevation ranges from approximately 1,350 feet above mean sea level (amsl) to 1,575 amsl.

The Artesa Vineyards #01226-ECPA included the following erosion control measures:

Temporary BMPs:

- **Silt fences and straw bale dikes** would be installed. Rock barriers may be substituted for silt fences.

Permanent BMPs:

- A **no-till cover crop** would be used on all vineyard blocks and avenues, which would be seeded before September 1, with Molate fescue at 8 lbs/acres, Mokelumne fescue at 7 lbs/acres, and Idaho Fescue at 8 lbs/acres. Fertilizer would be applied with a 16-20-0 at 200 lbs/acre. A 75 percent cover crop would be established.
- **Water bars** would be constructed on vineyard avenues to reduce runoff velocities and divert any concentrated surface flows of vineyard avenues and into drop inlets or vegetated vineyard areas.
- **Straw mulch**, at a rate of 1.5 tons/acre, would be applied to areas over 5 percent slope.
- Any areas of cover crop that have less than 75 percent cover would be seeded and mulched annually until 75 percent cover is reached.

Stream setbacks:

- **Setbacks from streams** ranged from 20 feet to 65 feet.
- The presence of 20 to 65 feet of stream setback areas between the vineyard blocks and onsite streams would also likely entrap applied fertilizers before leaving the site in the event that significant runoff does occur following an application.
- These stream setbacks would also facilitate increased water filtration through seepage, reducing potential impacts to the streams from chemicals.

Integrated Pest Management

- Pesticide use on the project site would be minimized to the extent possible and pesticide transport and storage would follow all applicable regulations.
- The vineyard workers would be trained annually in the usage, storage and handling of all the chemicals used onsite.
- Pesticide storage and mixing area would be established at a distance from all project site drainages and wetlands, and there would be no disposal of pesticides or other hazardous materials on the project site.

Avoidance Areas:

- Several environmentally sensitive areas were identified during studies undertaken during the design of the project and ECPA. The ECPA was designed to avoid these areas and the **avoidance areas** were expanded to have setback areas included.

During the **winter shut-down period** (September 15 to April 1), no earthmoving or grading work is permitted by the County.

Technical Analysis

Hydrologic Assessment

A hydrologic assessment was conducted by West Yost & Associates for Environmental Science Associates (ESA, March 2005) for the Artesa DEIR. The analysis was conducted to determine peak runoff flows to the Rector Creek Reservoir using the NRCD United States Department of Agriculture (USDA) Technical Release 55 (TR-55). Time of concentration and peak runoff flows for existing and post-project conditions were estimated using the graphical peak discharge method from the TR-55 model.

According to the hydrologic evaluation, the TR-55 model analysis showed that neither the time of concentration nor the curve number within the sub-watershed area would change within the proposed project; "therefore, the resulting peak discharge would also not change with the proposed project. This conclusion is primarily based on the small amount of acreage developed with respect to that of the sub-watershed" (66 acres out of 1,422 acres).

The hydrologic evaluation also stated that individual vineyard block areas will have increased curve numbers due to vineyard development, but that "deep ripping and soil conditioning that will occur in conjunction with vineyard development will improve the infiltration potential of the onsite soils."

Erosion, Sedimentation, and Sediment Budget Assessment

The Artesa Vineyards Expansion Project technical report (Trso, 2005) presented the results of an erosion, sedimentation, and sediment budget assessment that evaluated future and cumulative impact conditions on hillslopes and stream channels in the project area. The technical report evaluated the feasibility and effects of the Artesa Vineyards Erosion Control Plan (Lincoln AE, 2005), which proposed erosion/sediment yield control measures (or Beneficial Management Practices – BMPs) including: straw bale dikes, silt fences, and straw much. A permanent 75 percent no-till cover crop would be installed in all proposed vineyard blocks. Based on the evaluation of ground cover under the current and future conditions, the technical report concluded that the surface erosion and soil loss would be significantly reduced in the long-term due to the development of thicker soils and the installment of a permanent 75% no-till cover crop. It was assumed that soil ripping and discing would create thicker soils, increasing soil infiltration and changing runoff characteristics. To further lessen the potential for surface erosion, and to increase fine sediment trapping, all vineyard avenues would be seeded and covered with straw mulch. All post-project calculations assumed that the modeled conditions were those of 3+year-old vineyards. The calculations also assumed that during the first three years, when the soil was not yet fully mature, erosion would be minimized by using straw mulch in all areas (i.e. vineyard avenues, vinerows, and in between vinerows) and reapplied annually as necessary.

The technical report also concluded that the proposed silt fences would successfully disperse sheetflow erosion that could develop within proposed vineyard blocks, especially the blocks with convergent topography. The ECP proposed silt fences to be installed near and along vineyard avenues, which would parallel the proposed stream setback corridor boundaries at the downslope end of proposed blocks. The erosion control measures would be maintained year-round (i.e., permanent), including during the storm season. The ECP proposed that winterization measures would be installed by September 15 of each year in accordance with Chapter 18.108.027 – Sensitive Domestic Water Supply Drainages of the Napa County Code.

The technical report also concluded that the unchanneled colluvial/alluvial valley of the Costa Fork East Creek below an existing vineyard block would function as natural sediment detention. According to the technical report, unchanneled valleys naturally form over thousands of years by trapping significant amounts of sediment supply from upper watersheds, effectively acting as natural local sediment supply buffers. The technical report estimated sediment-trapping efficiencies of the proposed erosion control BMPs to account for their mitigation potential on future conditions.

The technical report estimated erosion and sediment delivery processes for the Artesa property as well as for the entire North and East Creek watersheds to assess the on-site and downstream future and cumulative impacts of the project on erosion and sediment yield. To quantify erosion/sedimentation on-site under the current conditions and the off-site sedimentation potential due to proposed vineyard expansion on the Artesa property, a spatially-explicit sediment budget was developed. The sediment budget provided a vineyard block-specific and grain-size specific account of erosion, sediment load, yield and storage. To provide a watershed-scale framework for the evaluation, the watershed-average current background sediment loading was determined through a Rector Reservoir sediment accumulation analysis. The data used to estimate the watershed sediment budgets included: (1) the current and future conditions sediment budgets for the Artesa property and (2) the current and future conditions sediment budgets for the properties outside the Artesa property within the North and East Creek watersheds.

The technical memo found that the total average rate of soil loss from the site under the current conditions was ~3 tons/acre-yr. According to the technical memo, the proposed Artesa vineyard expansion would result in an estimated 24% decrease in soil loss. Regarding sediment transport, the analysis estimated the proposed vineyard expansion would decrease total sediment yield by 23.8 tons/yr (10% decrease) to the mainstem Rector Creek from the North and East Creek watershed Artesa properties. Even without the additional ECP measures, a decrease in sediment yield could be achieved through the installation of a permanent 75 percent no-till cover crop alone; however, this decrease would be less pronounced, especially in the early stages of the vineyard development.

The sediment budget developed for the assessment showed that the erosion control measures (BMPs) proposed in the Erosion Control Plan would reduce total erosion on the Artesa property by 23.9% and total sediment yield off the Artesa property by 10.5% on average after the vineyard blocks are planted. The technical report concluded that if the Artesa Vineyards Erosion Control Plan were implemented as proposed, there would be no additional sediment generated by the proposed conversion of approximately 60 acres of chaparral and limited grassland, and no off-site (i.e., downstream) impacts to sediment yield.

Findings

The DEIR made the following conclusions about the proposed project, with complete implementation of the Artesa ECPA:

- Due to the relatively small acreage proposed for development (66 acres out of total watershed area of 1,422 acres), post-project peak runoff flow rates would be unchanged from existing conditions,
- The proposed Artesa vineyard expansion would result in an estimated 24% decrease in soil loss; and,
- Regarding sediment transport, the proposed vineyard expansion would decrease total sediment yield by 23.8 tons/yr (10% decrease) to the mainstem Rector Creek from the North and East Creek watershed Artesa properties.

3.2 Gallo Vineyards, Pope Creek, Putah Creek Watershed

Project Details

The 221.5 acre-project parcel is located in Pope Valley, approximately fourteen miles northeast of St. Helena. The project parcel includes three existing reservoirs, two residences, and an existing barn and sheds. The site would encompass approximately 53.7 acres of new vineyard divided into five blocks. Bartelt Engineering prepared the Erosion Control Plan Application (ECPA) (Bartelt, 2004) that is analyzed in the Gallo Agricultural Vineyard Erosion Control Plan Draft Initial Study/Mitigated Negative Declaration (IS/MND). The ECPA for the proposed vineyard described erosion control measures that would be installed on the site prior to vineyard development as well as throughout the life of the vineyard. The measures would be comprised of grading activities onsite occurring on slopes greater than 5 percent and installation of the designed ECPA features. The vineyard would use existing access roads and develop vineyard avenues.

The BMPs proposed in the ECPA include **55-foot to 65-foot stream setback buffers, straw wattles and/or bales, water bars with rock energy dissipaters, straw mulch, erosion control blankets, drop inlets and below-ground storm drains and agricultural subdrains, and a permanent no-till cover crop to attain an 80 percent cover after three years.** Also, the ECPA prescribed a schedule for implementation of BMPs as follows:

- All major grading shall be winterized if not completed before October 15
- All permanent and temporary sedimentation/detention devices shall be installed before October 1
- Between October 15 and April 1, all paved areas will be kept clear of dirt, sediment, and debris
- All BMPs installed to prevent sediment from leaving the project site will remain in operation during the rainy season (October 15 through April 1)

A permanent cover crop with an 80 percent vegetative cover would be planted through the entire vineyard area and would be maintained to minimize sheet and rill erosion. The permanent cover crop would be mowed after seed heads had matured to ensure germination. An 18-inch spray strip beneath the vines would receive herbicide spraying for weed control. The ECPA states there would be no discing, ripping, or other tillage in these areas once the permanent cover crop has been planted.

Technical Analysis

The impacts of the proposed Gallo Vineyards were analyzed in the Gallo Agricultural Vineyard Erosion Control Plan Draft IS/MND and the supporting Technical Appendix, both prepared by Environmental Science Associates (ESA, 2005). The technical appendix is a supporting document addressing hydrology and geologic conditions and resource issues for the IS/MND. The technical appendix included storm runoff estimates and soil loss data derived through use of the TR-55 hydrology model and the Universal Soil Loss Equation (USLE)

Hydrologic Assessment

The TR-55 hydrology model was used to estimate pre- and post-project peak flow rates for the project site. **Table A-I.5** below shows the results from the modeling. Three water supply reservoirs are prominent existing features on the project site. Elevations at the project site range from 1000 feet above mean sea level (amsl) in the southern portion of the site to approximately 750 feet amsl in the north. The site slopes toward the northeast, draining into Pope Creek.

To determine the magnitude of the impact from developing the vineyard, the DEIR used a watershed (or drainage) area-based approach. Five primary drainage areas were delineated for the project site: the Sun Lake drainage, the wetland drainage, the reservoir 1 drainage, the reservoir 2 drainage, and the reservoir 3 drainage. These five watersheds drain separate areas.

TABLE A-I.5
EXISTING AND PROPOSED PEAK DISCHARGE RATES FROM GALLO DEIR (ESA, 2005)

	EXISTING CONDITIONS						
	Area	**Peak Discharge (cfs)**					
	(acres)	**2-YR**	**5-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
Sun Lake Drainage[a]	8.6	1.7	3.7	5.2	7.1	8.7	10
Wetland Draingage[b]	15.5	2.2	5.3	7.7	11	13.7	16
Reservoir 1 Drainage	37.4	2.8	8.7	13.7	20.3	25.9	30.8
Reservoir 2 Drainage	6.2	0.6	1.8	2.7	3.9	4.9	5.8
Reservoir 3 Drainage[b]	362.9	65.4	133.6	185.2	252.8	307.9	354.5
	PROJECT CONDITIONS						
	Area	**Peak Discharge (cfs)**					
	(acres)	**2-YR**	**5-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
Sun Lake Drainage	8.6	3.4	5.9	7.7	9.9	11.7	13.2
Wetland Draingage	15.5	4.7	8.7	11.7	15.5	18.5	21
Reservoir 1 Drainage	37.4	7.2	15.2	21.2	29.2	35.7	41.2
Reservoir 2 Drainage	6.2	1.8	3.4	4.5	6.1	7.3	8.3
Reservoir 3 Drainage	362.9	68.8	138.5	191.1	259.7	315.3	362.5
	CHANGE: EXISTING VS. PROJECT CONDITIONS						
		Change in Peak Discharge (cfs) Under Project Conditions					
		2-YR	**5-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
Sun Lake Drainage	8.6	*1.7*	*2.2*	*2.5*	*2.8*	*3*	*3.1*
Wetland Draingage	15.5	*2.5*	*3.4*	*3.9*	*4.5*	*4.8*	*5.1*
Reservoir 1 Drainage	37.4	*4.4*	*6.5*	*7.6*	*8.9*	*9.8*	*10.4*
Reservoir 2 Drainage	6.2	*1.2*	*1.6*	*1.9*	*2.2*	*2.4*	*2.5*
Reservoir 3 Drainage	362.9	*3.3*	*4.9*	*5.8*	*6.9*	*7.4*	*8.1*
	PERCENT CHANGE: EXISTING VS. PROJECT CONDITIONS						
		Change in Peak Discharge (%) Under Project Conditions					
		2-YR	**5-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
Sun Lake Drainage	8.6	*100*	*59*	*48*	*39*	*34*	*31*
Wetland Draingage	15.5	*114*	*64*	*51*	*41*	*35*	*32*
Reservoir 1 Drainage	37.4	*157*	*75*	*55*	*44*	*38*	*34*
Reservoir 2 Drainage	6.2	*200*	*89*	*70*	*56*	*49*	*43*
Reservoir 3 Drainage	362.9	*5*	*4*	*3*	*3*	*2*	*2*

The results of the TR-55 analysis suggested that peak runoff rates would increase under project conditions. For the **Sun Lake Drainage Area**, the proposed vineyard portion of this drainage area is small compared to the entire Sun Lake drainage area. The increase in runoff emanating from the vineyard block in this drainage area is likely negligible considering the capacity of Sun Lake (274 acre-feet) and the size of its watershed compared to the predicted increase in runoff. For the **Wetland Drainage Area**, the TR-55 analysis indicated increases in peak flow rates ranging from 2.5 cfs for the 2-year event to 5.1 cfs for the 100-year event. This drainage only has a small section of defined channel above the wetland. Thus, most of the runoff upstream would occur as sheet flow or shallow concentrated flow and channel instability or incision issues will likely not be of concern. Additionally, the wetland itself will serve, to some degree, to attenuate such a predicted increase in runoff. The **Reservoir 1 Drainage Area**, totaling 37.4 acres, is characterized by a long and narrow incised valley that is very confined. The TR-55 analysis indicated increases in peak flow rates ranging from 4.4 cfs for the 2-year event to 10.4 cfs for the 100-year event. Such an increase in flow is moderate (i.e., not negligible) considering the size of the drainage area. The **Reservoir 2 Drainage Area** is a small (6.2 acres), concave hillslope area draining directly into the relatively large (3.0 acres of surface area) Reservoir 2. The TR-55 analysis for this drainage area indicated increases in peak flow rates ranging from 1.2 cfs for the 2-year event to 2.5 cfs for the 100-year event. The **Reservoir 3 Drainage Area** totals 362.9 acres that is large compared to the area of proposed vineyard blocks that would fall within this drainage (13.3 acres). The TR-55 analysis for this drainage area indicates increases in peak flow rates ranging from 3.3 cfs for the 2-year event to 8.1 cfs for the 100-year event.

While increases in peak flows were predicted for all modeled sub-drainages, the technical appendix stated that most of the runoff would occur as sheet flow or shallow concentrated flow and channel instability, bank erosion or incision issues will likely not be of concern (ESA, 2005). Additionally, existing the three on-stream water storage reservoirs would serve to attenuate predicted increases in runoff. Also, the ECPA proposed the establishment of out-sloped terrace benches, which would slow runoff and protect against erosive flow velocities. In addition, certain areas would be graded to flatter slopes, cross-sloped diversions would be placed, and pipes installed to divert water to existing reservoirs. According to the technical appendix, the combination of the above proposed BMPs are "very conservative given the small drainage area and should be more than adequate to attenuate the predicted increase in flow. Such increases in storm runoff are not expected to cause any kind of effect considering the relative size of the contributing watershed and the cumulative runoff generated under existing conditions from the areas not part of the proposed project" (ESA, 2005).

Sediment Yield Assessment

The USLE was used to predict pre- and post-project sediment loss. The USLE uses five factors to determine the amount of erosion: R (energy of precipitation), K (soil erosiveness), LS (calculated from slope length and slope steepness), C (cover crop), and P (practice). The primary value in the USLE that changes from existing conditions to the project is C, cover crop. Consequently, the reduced soil loss directly reflects the changes in the C or cover value.

The existing conditions are grasslands and interspersed woodland with a 75 percent cover for a C value ranging from 0.039 to 0.042. The C value for a vineyard with 80 percent cover crop is 0.022, a decrease in the C value of approximately 50 percent. Within the USLE this decrease in C value results in a similar decrease in soil loss and reflects the importance of cover in controlling erosion in vineyards. Additional reductions in soil loss result from the reduced water flow path and trapping of sediment by terrace benches and cross slope diversions proposed in the ECPA.

The USLE results show that the total soil loss from the project site will be reduced from 235 tons per year under existing conditions to 108 tons per year under vineyard conditions, a 54% reduction. This decreased soil loss is a result of the change in cover crop and the erosion control measures that reduce the water travel distance down slope. These site-specific BMPs proposed in the ECPA reduce erosion and sediment delivery on approximately 23 acres of the total 53.7 acres of proposed vineyard block.

Findings

The IS/MND stated that implementation of the BMPs outlined in the ECPA would ensure that potential impacts associated with soil erosion, soil loss and subsequent sedimentation remain less than significant.

- Citing the proposed features of the ECPA, the required monitoring and maintenance, and the ability of the four reservoirs to attenuate flow increases, and thus prevent cumulative downstream effects, the IS/MND concluded that “the estimated increases in runoff as a result of the proposed project are considered to be less than significant with regards to channel stability and erosion.”
- The USLE results show that the total soil loss from the project site will be reduced by 54% with implementation of the proposed Gallo vineyards and associated ECPA.

3.3 Saintsbury Vineyards, Carneros Creek, Napa River Watershed

Project Details

The impacts of the proposed Saintsbury Vineyards were analyzed in the Saintsbury Vineyards Draft Environmental Impact Report, prepared by Environmental Science Associates (ESA, 2006). A total of 67 acres of new vineyard blocks were proposed at the project site, located in the Carneros Creek watershed, a tributary to the Napa River draining 9 sq. miles comprised of a narrow valley in the southwestern portion of the Napa River watershed.

In general, proposed earthmoving and grading at the project site would consist of clearing of existing grassland down to bare soil, removing large rocks and roots, and the shaping and ripping of soil to a depth of approximately 30 to 36 inches. Vineyard avenues would be graded and the land smoothed in preparation for the implementation of the ECPA.

Additionally, the proposed project would repair and replant two on-site gullies, as well as stabilize active landslides on vineyard blocks 5, 10, and 11. Landslide stabilization measures would include the installation of surface and/or subdrainage infrastructure above and within the upper portion of the landslide masses and the construction of one or more buttresses within the slide.

Temporary BMPs:

- The final pass with tillage equipment during site preparation would be performed across slopes to prevent water from channeling downhill during the first winter after development.
- Straw bale dikes would be installed downslope of vineyard areas to intercept runoff and reduce the migration of sediment through the first winter after planting, after which they may be removed.

- Straw mulch would be applied to all disturbed areas at a rate of 3,000 lbs/acre prior to October 15 of the first year of construction.

Permanent BMPs:

- To control surface water runoff from vineyard areas, **surface drainage pipelines, drop inlets, diversion ditches, sediment traps, and rock level spreaders** would be installed as shown on the plan map and described in the specifications. Unless otherwise specified, gravity outlets will be installed at the outlet of each pipeline.
- **Waterbars** will be installed on vineyard avenues to reduce runoff velocities and divert concentrated flow off of vineyard avenues and into vegetated areas. Waterbars will be installed each fall on slopes exceeding 15 percent at intervals of 100 feet apart.
- **Straw bale sediment traps** will be installed at drop inlets to help settle out sediment from stormwater runoff from the vineyard areas prior to downstream discharge.
- A **permanent cover crop** strategy would be utilized within vineyard blocks 3 and 20 beginning the third year after development. These vineyard areas would be disced after April 1st the first three years following development to facilitate planting and establishment of vines. These areas would be seeded with dwarf barley at 120 pounds/acre (broadcast) or 60 pounds/acre (drilled), or with an approved alternate seed mix, and straw mulched prior to October 15th of the year of construction and the subsequent two years. In the fall of the third year the permanent cover crop would be generated by seeding with dwarf barley at 60 pounds/acre. An alternative cover crop seed mix may be used upon prior approval from Napa County Resource Conservation District (RCD). In subsequent years all rows would be mowed only, and would not be disced. A ground cover of 70 percent would be maintained.
- Existing vegetative cover within block 7B would not be disturbed, except for periodic mowing. Holes for vines would be augered, established vines would be hand watered, if necessary. However, dry-farming techniques would be used as the preferential method.
- The existing vegetative cover crop within block 2 would be preserved and cultivated to provide adequate cover crop throughout the vineyard area.
- An **annually tilled cover crop** strategy would be utilized within all remaining vineyard blocks. The cover crop would be generated using dwarf barley and applied by broadcast seeding at a rate of 120 pounds/acre during the first year. In subsequent years, the cover crop shall be applied by drilling at a rate of 60 pounds/acre. An alternative cover crop may be used upon prior approval from the RCD.
- The permanent cover crop would be managed each year such that any areas which have less than 70 percent vegetative cover would be reseeded and mulched to maintain 70 percent ground cover.
- Vineyard avenues and any additional disturbed areas would be seeded, mulched, and maintained using the Zorro fescue/Blando brome/clover mix. Avenues on slopes exceeding 15 percent and having less than 70 percent cover prior to the rainy season would be straw mulched each year.
- Concentrated stormwater would be avoided to the extent possible. Outlets would be equipped with **energy dissipators** and/or level spreads as necessary.

Stream setbacks

- As required by the County's Conservation Regulations, minimum **setbacks from streams** range from 55 feet to 65 feet. The presence of 20 to 65 feet of stream setback areas between the vineyard blocks and onsite streams would also likely entrap applied fertilizers before leaving the site in the event that significant runoff does occur following an application.
- These stream setbacks would also facilitate increased water filtration through seepage, reducing potential impacts to the streams from chemicals.

Integrated Pest Management

- Pesticide use on the project site would be minimized to the extent possible and pesticide transport and storage would follow all applicable regulations.
- The vineyard workers would be trained annually in the usage, storage and handling of all the chemicals used onsite.
- Pesticide storage and mixing area would be established at a distance from all project site drainages and wetlands, and there would be no disposal of pesticides or other hazardous materials on the project site.

Avoidance areas

- The ECPA was designed to **avoid several environmentally sensitive areas** including perennial and intermittent drainages, active landslides, and areas of soilcreep.

In terms of runoff control, the DEIR stated that the principal effect of the proposed erosion control measures was to increase surface roughness (i.e., ability to introduce more friction, thereby slowing the velocity of surface water movement and increasing the travel time), enhance the potential for infiltration, and increase or replace the vegetative cover over the cleared areas of the hillside.

Planting and maintenance of a cover crop, as opposed to a condition of bare ground between vine rows, encourages infiltration, slows down runoff, limits surface erosion, and filters out some of the eroded soil (and any attached chemicals) in the event of particle detachment. The cover crop is proposed to cover at least 70 percent of the area comprising the proposed vineyard blocks; any areas of cover crop that have less than 70 percent cover would be seeded and mulched annually until adequate cover is established. The planting and fostering of a cover crop is intended to stabilize and cover the cleared soil between vineyard rows.

Technical Analysis

Hydrologic Assessment

The DEIR performed a TR-55 hydrologic analysis on pre- and post-project peak flow rates. Data used for the model included regional rainfall records, watershed areas, approximate channel dimensions, and land-cover characteristics (under both existing and project conditions). Model results for the existing condition were validated by comparison to local stream flow records for Carneros Creek. **Table A-I.6** below shows the results from the modeling for two individual subbasins, S_W3 and S_W4a, the only subbasins that showed increases in peak runoff rates due to the proposed project, and the three outlet locations. The three outlets are successive points in the watershed, with the Reach 2

Outlet being upstream of the Reach 5 Outlet, which is upstream of Outlet 1, the most downstream outlet point for the cumulative watershed drainage area.

TABLE A-I.6
EXISTING AND PROPOSED PEAK DISCHARGE RATES FROM SAINTSBURY DEIR (ESA, 2006)

	Peak Discharge (cfs)					
	2-YR	**5-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
S_W3	14.41	36.03	52.68	75.03	92.27	109.74
S_W4a	16.62	39.3	56.54	79.49	97.12	114.92
Reach S2 Outlet	47.44	124.93	184.79	265.54	328.13	391.77
Reach 5 Outlet	76.05	190.34	277.99	395.34	485.76	577.15
Outlet 1	308.07	780.03	1147.1	1638.01	2018.4	2404.94
	Peak Discharge (cfs)					
	2-YR	**5-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
S_W3	16.2	38.61	55.7	78.49	95.99	113.67
S_W4a	18.49	41.95	59.6	82.97	100.84	118.84
Reach S2 Outlet	50.96	130.02	190.75	272.38	335.31	399.22
Reach 5 Outlet	79.68	195.53	284.04	402.23	493.11	584.76
Outlet 1	310.44	783.55	1151.32	1643.08	2023.91	2410.92
	Change in Peak Discharge (%) Under Project Conditions					
	2-YR	**5-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
S_W3	12	7	6	5	4	4
S_W4a	11	7	5	4	4	3
Reach S2 Outlet	7	4	3	3	2	2
Reach 5 Outlet	5	3	2	2	2	1
Outlet 1	1	0	0	0	0	0

The DEIR runoff analysis showed that only basins S_W3 and S_W4a had increases in runoff. These individual subbasin increases thus produced concomitant increases in the peak runoffs predicted for the 3 outlet locations of the model. However, the resulting percent change at the downstream outlet for the entire watershed (Outlet 1) is within the range described by the DEIR sensitivity analysis. Therefore, according to the significance criteria of the DEIR, the magnitude of the estimated change in runoff was considered negligible, so no impact was predicted due to runoff from either a channel stability or drainage structure (flooding) capacity standpoint (ESA, 2006). Further, the DEIR found that adherence to the required maintenance and monitoring activities would help to ensure that all features of the ECPA retained their capacity and functionality.

Erosion and Sedimentation Assessment

For the Universal Soil Loss Equation (USLE) calculations, ESA adopted a methodology whereby soil erosion and related sediment delivery to streams is divided among the drainage basins within the project site. The amount of soil loss would vary with the gradient and length of the path of soil traveling in a drainage basin. Soil may also get transported from one location to the other on a slope without flowing into any waterway.

The sediment yield analysis predicted the proposed project would cause an increase in sediment delivery to the local streams over existing conditions of approximately 4.95 tons or 6.9 percent. Therefore, additional erosion control measures were proposed as part of the DEIR to reduce the total sediment delivery to approximately those under existing conditions. To maintain the sediment delivery indicated by the analysis, a mitigation measure was required to reduce the sediment delivery by approximately 6 tons for the project site.

The mitigation measure (MM 4.5-1, ESA, 2006) revised the ECPA to include additional temporary and permanent erosion control measures, including slope length interruptions such as cross slope drains in consultation with the RCD and Napa County. These additional erosion control measures would be applied to the vineyard blocks in drainage area W11 and/or to other vineyard blocks to reduce sediment delivery by approximately 6 tons.

With the proposed mitigation, total site sediment delivery would remain approximately the same as under existing conditions. Therefore, the DEIR determined that the indicated soil erosion would not cause a substantial depletion in the agricultural resource.

Findings

- The DEIR concluded that converting grassland and pasture to operational vineyards would result in a less than significant increase in the volume and rate of runoff conveyed by onsite drainages.
- Sediment carried by the channel is derived either from the hillside or the channel itself. The DEIR concluded that, with mitigation, no increase in sediment delivery from the hillslopes to the channel would occur as a result of the project.

3.4 Mondavi Vineyard, tributaries to Napa River southeast of Napa, Napa River Watershed

Project Details

The 160-acre project site is located in a predominantly agricultural area of unincorporated Napa County, southeast of the City of Napa. Erosion control measures for the proposed vineyard are outlined in the ECPA for the Mondavi property.

Proposed BMPs:

- **Surface drainage mainlines** would be installed to control surface runoff by collecting runoff at low points throughout the project area and transporting it to protected outlets. Pipelines would be constructed of solid corrugated polyethylene pipe and cutoff collars would be installed in surface drainage mainlines with slopes of 6 percent or greater.
- **Drop inlets** would be located at the upgrade end of surface drainage mainlines. A grate would be installed over the top of each inlet to trap trash and debris fro entering drainage pipes.
- **Gravity outlets** would be installed at the outlet of all pipelines that discharge into excavated channels, sediment basins, or other naturally occurring channels.
- **Diversion ditches** would be used to control surface water runoff.
- **Water bars** would be constructed along roadways where necessary to divert concentrated surface flows off of vineyard avenues and into drop inlets or vegetated vineyard areas.
- **Straw bale sediment traps** would be constructed to remove sediments from surface water runoff and would be installed upstream of drop inlets.
- **Rock sediment basins** would be installed to capture sediment in stormwater runoff.

Other measures included insloped avenues separating vineyard blocks, straw mulch, rock slope protection at pipeline outlets, and rock level spreaders to disperse concentrated flows and reduce channelization and associated erosion and sediment transport.

Vegetative erosion control measures would consist of the seeding and management of a no-till cover crop and straw mulch, which would be installed between vinerows and disturbed areas outside the vineyard blocks.

Technical Analysis

The Robert Mondavi Properties Vineyard Draft Environmental Impact Report (DEIR) prepared by EDAW (EDAW, 2004) analyzed the impacts of the proposed vineyards.

Hydrologic Assessment

The DEIR incorporated a hydrologic analysis that modeled pre- and post-project runoff conditions. Table A-I.7 shows the existing and project condition estimated peak flow rates.

TABLE A-I.7
EXISTING AND PROPOSED PEAK DISCHARGE RATES FROM MONDAVI DEIR (EDAW, 2004)

	EXISTING CONDITIONS			
	Peak Discharge (cfs)			
	2-YR	**10-YR**	**25-YR**	**100-YR**
Upper Reach, Central Creek	14.7	38.5	53.1	74.9
Lower Reach, Central Creek	33.4	86.3	119.4	167.6
South Creek	32.8	78	106.5	150.8
	PROJECT CONDITIONS			
	Peak Discharge (cfs)			
	2-YR	**10-YR**	**25-YR**	**100-YR**
Upper Reach, Central Creek	16.2	42.5	58.2	81.9
Lower Reach, Central Creek	33.6	85.8	118.5	165.7
South Creek	35.7	85.3	116.2	164.5
	PERCENT CHANGE: EXISTING VS. PROJECT CONDITIONS			
	Change in Peak Discharge (%) Under Project Conditions			
	2-YR	**10-YR**	**25-YR**	**100-YR**
Upper Reach, Central Creek	*10.2*	*10.4*	*9.6*	*9.3*
Lower Reach, Central Creek	*0.6*	*-0.6*	*-0.8*	*-1.1*
South Creek	*8.8*	*9.4*	*9.1*	*9.1*

Results of the hydrologic modeling indicated that areas of vineyard would not contribute greater volumes of water to nearby creeks than existing open rangelands in the project area, but rather contribute less runoff volume. This was deemed likely the result of the greater absorbance capacity of tilled vineyard soils, which are amended with absorbent mulch and compost, have dense inter-row vegetation, and are not subject to compaction from cattle. Also, though peak flow rates did increase for some recurrence interval flows, the DEIR found that the increases would not be sufficient to cause significant flooding at any susceptible locations. The DEIR also concluded that implementation of the ECPA would reduce runoff from the vineyard by slowing surface water travel time and allowing for additional infiltration into the groundwater.

Erosion, Sedimentation, and Sediment Budget Assessment

The erosion and sedimentation analysis for the DEIR examined both sediment production and sediment yield estimates for the proposed project. ***Sediment production*** is comprised of sheet erosion, rilling, and gullying, all of which are generated by overland flow during rainfall events. ***Sediment yield*** is the total amount of sediment that leaves a given area or basin over a period of time. Erosion control BMPs to be implemented in conjunction with the proposed project were incorporated into the modeling and analysis of projected future sediment production and yield. USLE calculations and field observations at nearby vineyards, indicated that the erosion control BMPs would successfully disperse sheetflow and eliminate the potential for substantial sheetflow erosion.

With regard to sediment production (the sediment predicted to be ***generated on site***), the analysis showed an increase on the project site by 23% for the portion of the project site in the Central Creek watershed, and by 75% for the portion in the South Creek watershed. This resulted in predicted total increases of 62.3 tons/year and 51.4 tons/year of sediment production for the Central and South Creek watersheds respectively.

However, with regard to sediment yield (the sediment that is actually predicted to ***leave*** the project site), the DEIR found that USLE calculations of soil erosion showed a reduction in post-project sediment yield compared to existing conditions. The net change in sediment yield with implementation of the project would be a 2% reduction in total sediment yield to the mainstem of the Napa River from both project watersheds. The reduction in sediment yield reflected the trapping capacities of the proposed erosion control measures in combination with the hillside and creek channel sediment retention. The reduction in sediment yield were assumed valid only if the erosion control measures were maintained frequently and functioning property.

Surface Water Quality Analysis

The Mondavi EIR proposed mitigation measures that would improve and limit nutrient loading to nearby surface waters including the Napa River. These included:

- Riparian buffers: all vineyard blocks would be arranged to allow a minimum of 75 feet between the edge of the vineyard and a stream channel. The riparian buffer would slow surface runoff, capture phosphorus-laden sediment, and allow for biological conversion of nitrate to nitrogen gas.
- Mulching and planting of a cover crop, both of which would help to reduce nutrient inputs to surface and groundwater by reducing surface flow from cropped row.
- Measures to limit the required fertilization and irrigation volumes:
    - The project will fertilize through a drip irrigation system. This greatly reduces the volume of fertilizer required by applying fertilizer directly to the roots rather than broadcast spraying the entire vineyard with fertilizer
    - Determine the amount of fertilizer and irrigation to be applied based on site-specific soil testing and/or petiole analysis, and plant requirements. Soils are tested for nitrogen and phosphorus to determine when and how much fertilizer is needed
    - Apply fertilizer during late spring and summer. In general, grapes only require fertilizer applications during the late spring and summer when site surface runoff is at a minimum
    - Use organic fertilizers such as compost, compost tea, or manures, which enhance soil quality through adding organic matter, improving soil structure, and increasing populations of soil microorganisms.

Additionally, the Mondavi EIR Hydrologic Evaluation included a Water Quality Review and suspended sediment sampling (Appendix C, HSI, 2003). To determine potential impacts from the vineyard pollutant load to downstream waters, sediment samples were collected from both downstream of the project site and downstream of two existing, well-established vineyards in Napa County. The selected sites had slope and cover characteristics similar to the proposed project. It was assumed that sediments discharging from existing vineyards would have similar contaminant concentrations to the runoff that would be expected from the Mondavi project. The suspended sediment samples were tested for organochlorine and organophosphorus pesticides, chlorinated herbicides, semi-volatile organic compounds, copper, and sulfate.

The results found that the only contaminants detected were copper and sulfate, but results for those constituents indicated that the concentrations were well below background concentrations for soils for the Napa region. None of the other contaminants were detected at or above EPA thresholds—all other listed contaminants were not detected at or above the reporting limit for samples collected at the existing vineyard sites as well as the Mondavi site.

Findings

- Though peak flow rates are predicted to increase for some recurrence interval flows, the DEIR found that the increases would not be sufficient to cause significant flooding at any susceptible locations.
- The DEIR also concluded that implementation of the ECPA would reduce runoff from the vineyard by slowing surface water travel time and allowing for additional infiltration into the groundwater.
- While ***sediment production*** on the project site was predicted to increase, ***sediment yield*** from the project site to adjacent waters was predicted to decrease.
- The net change in ***sediment yield*** with implementation of the project would be a 2% reduction in total sediment yield to the mainstem of the Napa River from both project watersheds.
- The reduction in sediment yield reflected the trapping capacities of the proposed erosion control measures in combination with the hillside and creek channel sediment retention.
- With the implementation of mitigation measures for nutrient loading, the Mondavi project would reduce impacts from the delivery of pesticides and nutrients to downstream waters.

4. Conclusion

The purpose of this appendix is to provide support and more detail to the findings of the DEIR that declare impacts to the hydrologic and water quality conditions in Napa County drainages can be mitigated to a less than significant level. The findings are based on the foundation of three tiers: the current and proposed County Ordinances and Review process; discussion and analysis of current standards of practice and vineyard management; and presentation and summarization of recently conducted site specific analyses of vineyard conversion and nutrient management programs.

County ordinances and review process provide general guidelines and extensive review of vineyard development projects. The county review process can mandate the implementation of site-specific Beneficial Management Practices and performance standards that each project must meet. Vineyard development applicants benefit from site-specific review and the experience of the RCD, the CDPD and its technical consultants. One of the strengths of the Napa County Conservation Regulations implementation has been that it recognizes the innate limitations of "modeling protocols," using them as one of many tools to evaluate proposed vineyard practices. Imposing either a strict interpretation of modeling results or a limited set of "BMPs" as a building code for agricultural development and management will stifle the creativity and "progressivism" that has marked Napa County viticulture.

The BMP descriptions and discussion is intended as an expanded glossary of the most common BMPs, their design intent, and their effects rather than a compendium of specifications, installation guidelines, and construction details. The appendix demonstrated the wide range of design and management techniques that can be applied to vineyard development. BMPs are focused on reducing accelerated runoff and soil loss as well as specifying how fertilizers and pests are managed in vineyard areas. Within the description of individual BMPs, additional studies were presented that demonstrate the effectiveness of BMPs such as vegetated buffer strips, riparian setbacks, and cover crop management.

The hydrology and water quality impact analysis of the EIR was based on review of baseline topographic, hydrologic, groundwater, and water quality conditions (see Napa County BDR); and consideration of the Napa County General Plan Update and local area plans. The EIR provided a programmatic analysis of potential impacts resulting from implementation of the General Plan Update based on existing conditions and outlines measures to avoid, reduce, and mitigate where necessary potential environmental impacts. The impact analysis considered drainage, flooding, water quality and groundwater issues. Two key portions of the methodology used to evaluate impacts in the EIR included:

- Conducting a hydrologic modeling analysis to simulate conditions under current conditions and four vineyard development scenarios under future conditions that could occur under the General Plan Update Alternatives under evaluation and help identify the type and degree of potential impacts (see **Appendix H**);

- Identification of BMPs and other measures that are typically applied under sub-basin and site-specific conditions for projects through implementation of Napa County

Conservation Regulations (County Code Chapter 18.108) that have been demonstrated to avoid, reduce, and mitigate impacts suggested by the impacts description and the modeling information.

Detailed surface water/groundwater, water quality, and sediment erosion models of Napa County were developed. These models provided a tool to simulate current and future water resource conditions and evaluate how hydrologic conditions may change under different land use conditions. In addition, several additional modeling studies were conducted beyond the baseline described in the Napa County BDR to simulate project and alternatives conditions and evaluate their potential impacts (see **Appendix H**).

This Appendix provided descriptions of existing and standard BMP approaches that are used to mitigate potential vineyard development related impacts, and documents how BMP implementation can achieve avoidance, reduction, and mitigation of significant impacts. Specifically, the recommended BMPs will mitigate the following significant impacts from the Hydrology & Water Quality Impacts section of the EIR to ***less than significant*** for all alternatives:

Impact 4.11.3 Continued agricultural and resource development (e.g., timber harvesting and mineral resources extraction) land uses under the proposed General Plan Update could result in an increase in sediment and nutrients in downstream waterways.

Impact 4.11.7 Land Use and development under the proposed General Plan Update would result in alterations to existing drainage patterns. Such changes would increase erosion, both in overland flow paths and in drainage swales and creeks.

Impact 4.11.8 Land Use and development under the proposed General Plan Update would result in alterations to existing upland drainage patterns. Such changes would increase erosion, both in overland flow paths and in drainage swales on hillsides.

Table A-I.4 shows which BMP categories from the section above can be used to mitigate which specific hydrology and water quality impacts.

TABLE A-I.4 HYDROLOGY & WATER QUALITY IMPACTS MITIGATED BY BENEFICIAL MANAGEMENT PRACTICES

BMP Category	**Impact 4.11.3** Continued agricultural and resource uses could result in an increase in sediment and nutrients in downstream waterways	**Impact 4.11.7** Changes to drainage patterns leading to increased runoff and streambank erosion	**Impact 4.11.8** Changes to drainage patterns leading to increased runoff and hillside erosion
SITE PREPARATION	**X**	**X**	**X**
COVER CROP	**X**	**X**	**X**
SLOPE PROTECTION	**X**	**X**	**X**
RUNOFF CONTROL		**X**	**X**
SEDIMENT & NUTRIENT RETENTION	**X**	**X**	**X**
ROADWAYS		**X**	**X**

For Impact 4.11.3, where continued agricultural and resources uses could result in an increase in sediment and nutrients in downstream waterways, Site Preparation, Cover Crop, Slope Protection and Sediment & Nutrient Retention categories of BMPs would employ the appropriate palette to slow and detain surface runoff on-site, prevent hillside and channel erosion that would result in sediment delivery, and provide areas for nutrient filtration.

For Impacts 4.11.7 and 4.11.8, where changes to drainage patterns may lead to increased runoff and streambank and hillside erosion, all the discussed categories would mitigate any potential impacts by using a combination of BMPs to slow surface runoff (e.g. planting cover crops and roughening soil surfaces), control drainage via features on-site including roadways, and increasing infiltration of runoff to below ground.

The recommended Beneficial Management Practices, as described in this section and according to cited studies of BMP applications, would effectively mitigate impacts to hydrology and water quality. The judicious application, maintenance and monitoring of these BMPs would reduce impacts from erosive runoff volumes, sediment delivery, and nutrient and pesticide contamination of downstream waters associated with vineyard development.

The power of these techniques lies within the ability to use and combine multiple BMPs, designed uniquely and specifically for each site so that they have a combined mitigation effect. For example, management practices such as maintaining a good cover crop, constructing adequate drainage and erosion control features, and maintaining drainage setbacks combined with a chemical application management program can significantly reduce site specific and watershed wide impacts.

This appendix also presented existing studies and analysis of four proposed vineyard developments that included CEQA documents and the supporting technical analyses. These reports evaluated the combination of numerous BMP strategies incorporated into development and management plans. The studies concluded that significant impact mitigation would occur when all project features of the proposed ECPAs and BMPs are taken into account. The watershed wide modeling and the technical analysis completed for these sample projects are consistent and show that potential impacts to soil loss and water quality degradation due to modern existing vineyard development and management activities can be mitigated with the application of well-designed Beneficial Management Practices.

This appendix has demonstrated that impacts to drainage and water quality from proposed future County vineyard development can be mitigated to levels of less than significant for all proposed Napa County General Plan Update alternatives through the application of the County permit process and adoption of comprehensive, site-specific Beneficial Management Practices.

References

Berkshire Regional Planning Commission, Winter 2001. *The Massachusetts Unpaved Roads BMP Manual, A Guidebook on How to Improve Water Quality While Addressing Common Problems.*

California Land Stewardship Institute. *Farm Conservation Plan Template—Element II.* Fish Friendly Farming Environmental Certification Program-Napa and Solano Counties.

California Stormwater Quality Association, 2003. *California Stormwater BMP Handbook, Section 3. Erosion and Sediment Control BMPs.*

Environmental Science Associates, 2005. *Technical Memorandum Hydrology and Geology Gallo Vineyard Erosion Control Plan Initial Study.* Draft Technical Appendix

Environmental Science Associates, 2005. *Artesa Vineyards #01226—ECPA Project, Draft Environmental Impact Report SCH #2004032094.*

Environmental Science Associates, 2006. *Saintsbury Vineyards #01259—ECPA Project, Draft Environmental Impact Report.*

EDAW, 2004. *Robert Mondavi Properties Vineyard Draft Environmental Impact Report, #99323-ECPA, SCH#2003032132*

Jones, D. 2001. *Nitrogen Removal as a Function of Slope, Width, and Percent Plant Cover of Riparian Buffer Zones.* UC Berkeley, Final Project. Department of Chemistry

Jones & Stokes, 2002. *Stream Setback Technical Memo***.** Prepared for Napa County Conservation Development & Planning Department

Locke, Juliane Poirier, 2002. Napa Sustainable Winegrowing Group. *Vineyards in the Watershed: Sustainable Winegrowing in Napa County.*

Napa County Resource Conservation District. *Napa River Watershed Owner's Manual: An Integrated Resource Management Plan.* First Edition.

Napa County Resource Conservation District, 1982. *Developing a Hillside Vineyard.*

Mayer, P.M., S.K. Reynolds, M.D. McCutchen, and T.J. Canfield. Riparian buffer width, vegetative cover, and nitrogen removal effectiveness: A review of current science and regulations. EPA/600/R-05/118. Cincinnati, OH, U.S. Environmental Protection Agency, 2006.

Southern Sonoma County Resource Conservation District, 1993. *Vineyard Management Practices: An Environmental Approach to Development and Maintenance.*

Sonoma County Grape Growers Association. *Best Management Practices for Agricultural Erosion and Sedimentation Control.*

Trso, Martin, R.G., 2005. *Erosion & Sedimentation Assessment, Artesa Vineyards Expansion Project, #01226-ECPA Napa County, California, Final Technical Report*.