1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to outline the methodology used to identify potential areas for vineyard development on Preservation Ranch, develop preliminary vineyard layouts, develop a suitable water supply to meet anticipated irrigation needs, evaluate site hydrology, and identify suitable BMPs to be used to develop erosion control plans under the County of Sonoma Vineyard Erosion and Sediment Control Ordinance (VESCO).

2.0 BACKGROUND

2.1 Site Description

Premier Pacific Vineyards (PPV) is the manager of several affiliates that collectively own an approximate 19,300 acre property that currently consists of +/- 162 recognized legal parcels. The property, known as Preservation Ranch (Property/Project), is located near the Town of Annapolis in Northwestern Sonoma County, California. PPV seeks to develop vineyards on a small portion of the Property, with the balance managed for sustainable commercial timber production, wildlife preserves, and habitat restoration. PPV will be applying to Sonoma County (County) for a rezoning, conditional use permit (or development agreement), and voluntary merger of the existing 160 parcels down to 63 parcels. The Project will also include applications to the California Department of Forestry and Fire Protection (CDF) for a timber conversion permit and associated timber harvest plan(s). Preparation of the EIR will require close coordination between PPV, Sonoma County and CDF, as well as other involved State and federal agencies.

2.2 Locations, Slope, Soils and Geological Setting

Regionally, the Property is located northwest of Healdsburg within the Gualala River watershed and just west of some of Sonoma County's most desirable wine country. The Property accounts for approximately ten-percent of the entire Gualala River watershed, or about 30 square miles out of a watershed total of 298 square miles. The Property is generally bounded by the Sonoma Mountains to the east; Mendocino County to the north; the town of Annapolis and the Pacific Ocean to the west; and, the Russian River to the south. The Russian and Gualala Rivers are prominent landscape features in much of this part of the County.

Over 25 different soil types are present on the property, with the predominant soils within the potential vineyard sites being Josephine Loam, Goldridge Fine Sandy Loam, Laughlin Loam, Empire Loam, and Maymen Gravelly Sandy Loam. The Goldridge and Laughlin soil types are considered "highly erodible" under the VESCO ordinance, while the other soils are considered "less erodible."

2.3 LIDAR Mapping

Detailed mapping of the property was necessary to identify viable vineyard sites, evaluate environmental impacts and design the infrastructure required to support the farming operations. The Preservation Ranch property was mapped using Light Detection and Ranging (LIDAR) technology on in November 2004. The LIDAR data was obtained by PPV and processed into a digital terrain model by UC Berkeley. LIDAR mapping is a new technology for developing digital terrain models. LIDAR measures the distance to an object by emitting timed pulses of light, usually from a fixed wing aircraft, and measuring the time between emissions and reception of reflected pulses. The measured time pulses are then converted to a distance. LIDAR is a cost effective method for developing Digital Terrain Models (DTMs) for large areas and has been used in the timber industry to obtain true ground elevations through tree canopies and brush. LIDAR can penetrate some conifer canopies, but has mixed results penetrating heavy broad leaf tree canopies such as the Tan Oak found on the Preservation Ranch property.

The mapping criteria for LIDAR flight was as follows:

1. 50% overlap with first return data density of at least 1 per square meter (the density of laser pulse first returns, for the combined swaths, shall average at least one first return per square meter and be no worse than 0.5 first returns per square meter at the 95th percentile, exclusive of areas of open water);

2. Cross-stitching, i.e., not just parallel flights;

3. Scan angle < 40 degrees;

4. No bare earth data gaps other than that due to vegetation or structures;

5. No artifacts due to GPS tracking of plane;

6. No systematic and large artifacts due to filtering strategy (chopping off ridges, for example);

7. Provide the raw point cloud and the filtered xyz points in ASCII format, as well as the Digital Elevation Models (DEMs) in Environmental Systems Research Institute (ESRI) grid or export format, or in USGS DEM format.

Approximately 15% of the property was also mapped using traditional aerial photography. The aerial mapping was performed at a scale of 1 inch = 100 feet and a 2 foot contour interval. The LIDAR mapping was compared against the aerial mapping and found to have as good or superior accuracy.

Both the aerial and LIDAR mapping was based on NAD 83 state plane coordinates and NGVD 1929 vertical Datum.

3.0 IDENTIFICATION OF POTENTIAL VINEYARD SITES

Approximately 1,860 acres on the property has been identified as suitable for vineyard development. The 1,860 acres is a gross acreage and includes: avenues, reservoirs, shops, etc.

The process of identifying potential vineyard sites began with information provided by the previous owner and their consultant North Coast Resource Management (NCRM). PPV used the information provided by NCRM, along with a detailed digital terrain model (DTM) of the property, as a starting point for evaluating the potential vineyard sites in the field. The sites were identified as viable or not viable. Winzler & Kelly further evaluated the viable sites in the field and flagged the boundary in the field.

3.1 Sites Identified by Previous Owner Using USGS

North Coast Resource Management identified areas for potential vineyard development based on a maximum ground slope of 30%, roadway access, and a minimum vineyard block size of 12 acres. United States Geological Survey (USGS) mapping with 40 foot contour interval was used to determine slope. NCRM identified approximately 212 potential vineyard sites totaling 2,400 acres on Preservation Ranch.

3.2 Evaluation of Potential Vineyard Site

Premier Pacific Vineyards (PPV) staff evaluated in the field the suitability of each of the potential vineyard sites identified by NCRM. The criteria included existing road access, slope (maximum 38%), soils, geometric shape (minimum width of 200 feet), location, and proximity to sensitive resources. In addition, new areas suitable for vineyard development that were discovered in the field were added to the list of potential vineyard sites. Each vineyard site was then categorized as viable for vineyard development or not viable. The vineyard sites categorized as viable were forwarded to Winzler & Kelly for further evaluation, mapping, and flagging in the field.

The maximum slope was limited to 38% because of the erosive soils and the practical difficulties of farming on steeper slopes. The intended limit was 40%, but 38% was used in the field to be conservative. Most of the potential vineyard sites are along ridge tops where the slopes are generally mild (less than 10 to 15%) along the ridge line and become increasingly steep as you move down the slope. Typically the grade breaks along the ridge is dramatic and easy to discern in the field. The average slope of most of the vineyard sites varies between 5% and 15%, making the majority of the “level II authorized vineyard planting” under the Sonoma County VESCO ordinance. The potential vineyard acreage by ground slope is shown below in Table 1. Note that actual gross acreage to be developed is 1,861 acres due to reductions for environmental constraints.

Table 1 – Potential Vineyard Acreage

% Ground Slope	Acreage
0 to 10	325.0
10 to 20	490.5
20 to 30	520.5
30 to 38	557.6
Total Acreage	1,893.5

3.3 Development of Slope Maps Using LIDAR

The first step in further defining potential vineyard sites on the property is to prepare slope maps and determine areas with slopes suitable for planting. Winzler & Kelly developed slope maps using the LIDAR DTM for each of the potential vineyard blocks identified by PPV. The slope maps were prepared at a scale of 1”=200 feet with 10 foot contour intervals. Sub meter contour mapping is available, but was not used for clarity. All areas with slopes of less that 38% were shaded to identify potential vineyard ground. A desk top exercise was performed using

AutoCAD and GIS to develop a boundary perimeter of a potentially feasible vineyard based on the established criteria. The perimeter maps for each vineyard block were made available for review by Preservation Ranch personnel prior to beginning the flagging work in the field. The perimeter line included points with coordinate values, spaced at approximately 100’ intervals, to assist the field personnel in navigating the heavy timber and brush to verify the topography and slope.

3.4 Field Verification of Topography & Definition of Vineyard Boundaries

The steep terrain and heavy cover required that the topography be confirmed in the field. Winzler & Kelly used survey grade GPS equipment to confirm the topography and define the vineyard boundary in the field. Field personnel navigated to the pre-calculated points on the perimeter line and examined the terrain to confirm the topography. In most cases the pre-calculated point was close to where the slope break beyond 38% occurred. If the actual break point looked correct at this location, the Survey Team collected and stored a new point at this location. If the actual break point differed from the calculated break point, the Survey Team moved to the field determined break point and collected and stored the point. Additional points were taken of drainages and other features found in the field to enhance the mapping. Field notes were taken at all points to document why the location was selected and any unique features associated with the point.

The field data was then brought back into the office and the perimeter of the potential vineyard block adjusted to reflect the actual field conditions.

The Survey Teams also collected elevation data at select points using survey grade GPS equipment. The data was used to compare to the elevation data on the 2 foot contour maps to act as a ground truthing of the LIDAR developed contour maps.

3.5 Flagging Boundary in the Field

Blue and white flagging was hung from trees and brush at inter-visible locations along the field verified vineyard boundary. If no trees or brush were present then 4’ survey lath was driven into the ground and flagged. Blue and pink flagging was used in amended areas to make people aware of perimeter revisions in the field.

3.6 Class I & II Forest

Sonoma County recently adopted a new ordinance that prohibits agricultural cultivation on Site Class I and II timberland, if a timberland conversion is required. Site Class is based on the height a Redwood or Douglas-fir grows in 100 years. Site Class can be determined for trees younger than 100 years using Site Class graphs. California Forest Practice Rules, Title 14 of California Code of Regulations, Article 4, 1060 defines site class. A Redwood tree that grows over 155 feet or a Douglas-fir tree that grows over 164 feet in 100 years is Site Class II. A Redwood tree that grows over 180 feet or a Douglas-fir tree that grows over 194 feet in 100 years is Site Class I. Trees have been measured within the conversion units and age and height are determined and compared to the Site Class graphs. The average site class determines site class for an area with similar growing site.

All potential vineyard sites within Site Class I and II forest have been eliminated from the potential vineyard acreage.

3.7 Landslide Data

Landslides on Preservation Ranch were mapped in the field by a professional geologist. The landslide was classified as active, dormant, or ancient. The definition of each type of landslide is outlined below:

1. Active or Recently Active - areas of unstable ground with relatively recent/"fresh" geomorphic features such as ground cracks, hummocky topography, exposed soils, abrupt gradient breaks and/or disrupted vegetation, typically recent to 50 years old

2. Dormant - areas of quasi-stable ground, with eroded and subdued geomorphic features, no exposed soils, somewhat re-vegetated but typically with different type or density, typically greater than 50 to several hundreds of years old

3. Ancient - typically large scale landslide; areas of relatively stable ground, typically characterized by large, broad and deep landslides with highly eroded and subdued geomorphic features, re-vegetated with similar type and density, typically several hundreds to several thousands of years old.

The decision on the type of landslides that are suitable for potential vineyards depends on the owner’s tolerance for risk, the cost of improving the stability of the slide, and the slides impact on farming practices. As an initial starting point, dormant and ancient landslides are assumed to be suitable for potential vineyards and active landslides have been removed from the potential vineyard acreage. During vineyard development it may be feasible to improve stability and farm over some of the active landslides. Generally, active landslides will be avoided to reduce potential water quality issues due to erosion.

3.8 Streams

The California Forest Practice Rules requires Watercourse and Lake Protection Zones (WLPZ) or buffers to ensure the beneficial uses of water, native aquatic and riparian species, and the beneficial functions of the riparian zones are protected. The stream classification and proposed buffers are as follows:

- Class I Streams have presence of fish, and require a 200 foot buffer.
- Class II Streams and Springs have the presence of aquatic animal life during a portion of the year, and require a 100 foot buffer.
- Class III Streams are capable of moving sediment to a Class I or Class II watercourse, and require a 25 foot buffer on <30% slopes and 50 foot buffer on +30% slopes.

The proposed buffers exceed those required under the California Forest Practice Rules.

No grading operations will occur in the vicinity of Class I and II streams. Class I and II streams will be protected in accordance with CDF forest practice rules and other regulatory requirements. Class III streams will be evaluated in the field and may be filled and farmed over depending on the depth of the top soil, soil type, slope, stream stability, and height and width of the stream channel. The limits of farming on the Class III streams will be staked and surveyed using GPS in the filed.

3.9 Breakdown of Potential Vineyard Acreage

The vineyard boundary flagged in the field represents the outer perimeter of the vineyard development. A buffer beyond the outer vineyard boundary will be included in the timber harvest, but not included in the timber conversion. In order to determine the net plantable acreage, it is necessary to remove the acreage that will not be planted; including Class I Landslides, Class I and II streams, shops, reservoirs, and vineyard avenues.

The following provides a breakdown of the gross potential vineyard acreage (excluding perimeter buffer) flagged in the field minus Class I & II forest, landslides and stream buffers:

Vineyard Acreage (Flagged in Field)	2,100 acres
Class I & II Forest	24 acres
Minus Landslides (Active)	35 acres
Minus Streams Buffers (Class I and II)	67 acres
*Minus Streams Buffers (Class III)	113 acres
Gross Vineyard Acreage	**1,861 acres**

*Class III buffer limits have not been determined

Shops, reservoirs and avenues typically take up 15% of the gross developable vineyard acreage. The net plantable acreage for the property is estimated as follows:

Gross Vineyard Acreage	1,861 acres
Minus Shops, Reservoirs, Avenues	281 acres
Net Plantable Acreage	**1,580 acres**

Perimeter buffers are planned around each of the potential vineyard blocks. The buffers will fall outside of the vineyard perimeters flagged in the field. In general, the buffers will be 30 feet wide along the north perimeter of the vineyard and 75 feet on the east, west and south perimeter of the vineyard. These areas will remain in timber production and managed using selective harvesting.

The Forest Management Plan addresses the timber conversion required to develop the vineyards.

3.10 QA/QC

The mapping products developed were reviewed for quality and accuracy. The flagging effort was reviewed periodically in the field by Winzler & Kelly and PPV personnel to ensure the established protocol was being followed. Our field Survey Team leader reviewed the final vineyard perimeter maps to ensure the points set in the filed were connected properly.

4.0 VINEYARD LAYOUT

Winzler & Kelly prepared preliminary vineyard development plans for each potential vineyard site. The plans included preliminary vineyard layout plan, preliminary slope map and soil ripping plan, and preliminary drainage plan.

4.1 Perimeter Buffer (Special Timber Management Areas)

Perimeter buffers are planned around each of the potential vineyard blocks. The buffers will fall outside of the vineyard perimeters flagged in the field. In general, the buffers will be 30 feet wide along the north perimeter of the vineyard and 75 feet on the east, west and south perimeter of the vineyard. The buffer width was determined using solar data for the sun altitude angle at latitude 39 degrees and minimizing shading of the edges of the vineyard between mid March and late September. The buffers will be included in the initial Timber Harvest Plan, but not in the timber conversion. The buffers will be managed using selective harvesting and Tan Oak control.

4.2 Vine Row Direction

The vineyards will be configured with the vine rows running north 45 degrees east on slopes less that 10% and generally up and down the slope on slope greater than 10%. The vine rows will be spaced at 1.6 to 1.8 meter intervals and the vines within the rows at 1.0 meter intervals.

4.3 Avenues

Vineyard avenues provide access and a corridor for the backbone irrigation and drainage facilities. Drip irrigation systems are effective for a distance of approximately 350 feet from the irrigation main, therefore the vineyard avenues are spaced at a maximum distance of 700 feet (350 feet in each direction).

4.4 Reservoirs

The proposed project plans to build approximately 24 new 10 to 49 acre-foot reservoirs on the property. All water for vineyard irrigation for this project will be supplied by the reservoirs only. The use of the reservoirs is intended to eliminate the need for well or groundwater development for vineyard irrigation purposes. The irrigation demand for the vineyards will be approximately 6 inches per year. Surface runoff from a portion of vineyard will be collected in a drainage system and flow by gravity to the reservoirs. The reservoirs have been sited based on the ability to collect water by gravity, geographic constraints, and in the vicinity of drainages where reservoir overflow can discharge to a stable stream channel. Geotechnical investigations will be required to determine the final reservoir locations. The reservoir will act as storage for irrigation; provide detention to mitigate peak runoff from the vineyard, and sedimentation ponds.

Water for irrigation will be pumped and or flow by gravity from the reservoirs through irrigation mains located within the vineyard avenues. Depending on the configuration of the various vineyard blocks, water distribution pipelines will be installed in the access roads to irrigate remote vineyard blocks. Drip irrigation will be used.

All reservoirs are sized and configured to be exempt from State Department of Dam Safety jurisdiction.

4.5 Streams

No grading operations will occur in the vicinity of Class I and II streams. Class I and II streams will be protected in accordance with CDF forest practice rules and other regulatory requirements. Class III streams may be filled and farmed over depending on the depth of the top soil, soil type, slope, stream stability, and height and width of the stream channel. Tributary drainage upstream of the proposed vineyards will be directed into a culvert following the same alignment of the filled Class III stream and discharged to a stabilized outlet on the downstream end of the vineyard. Subsurface drainage will be installed to stabilize the fill and collect subsurface water that collects in the drainage. The fill within the Class III streams will be keyed or benched into the subsoil depending on the soil conditions and slope.

5.0 WATER SUPPLY

5.1 Rainfall and Runoff Data

The National Oceanic and Atmospheric Administration (NOAA) and the Sonoma County Water Agency (SCWA) have both developed isohyetal graphs depicting the approximate annual average rainfall in the vicinity of Preservation Ranch. The NOAA shows the annual average rainfall in the vicinity of the property to be approximately 60 inches, based on a period of 39 years (1931 to 1970). The SCWA shows the annual average rainfall in the vicinity of the property to be 70 inches, based on a period of 111 years (1872 to 1983). For the purpose of this document, we will be conservative in using an average annual rainfall of 60 inches for water supply estimates and 70 inches per year for hydrology estimates.

The NOAA also has an isohytel graph depicting the mean annual runoff in the vicinity of Preservation Ranch. The mean annual runoff is approximately 24 inches, based on a period of 39 years (1931 to 1970). The NOAA runoff of 24 inches per year and a mean annual rainfall of 60 inches, results in a 40% runoff factor. The SCWA does not have an isohytel graph depicting runoff in inches per year, but rather has a graph showing runoff coefficients based on land use and average ground slope. The runoff coefficient is 45% for vegetated areas with an average slope of 20%. This is consistent with the NOAA data. The SCWA methodology does not differentiate between natural forest and vineyard conditions.

For the purposes of designing the collection system, the criteria was to collect sufficient runoff from within each potential vineyard site to meet the irrigation demand.

5.2 Reservoir Sizing

The criterion for sizing the reservoir includes four components: irrigation demand, evaporation losses, seepage, and operational storage for detention when the reservoirs are at capacity. The irrigation demand is 6 inches per year. Vineyard drip irrigation systems are typically 85 to 95 percent efficient. The average annual evaporation loss is approximately 40 inches according to the NOAA and California Department of Water Resources (DWR). The seepage rate will vary depending on the soil types and the type of reservoir liner used.

The reservoirs will include operational storage for detention to mitigate the increased runoff anticipated from converting from forest to vineyard. The operational storage pool will be on top of the irrigation pool. Outlet weirs will be sized to limit the outflow to approximate the predevelopment flow rate.

5.3 Collection System

The drainage collection system is sized for a 100-yr storm event in accordance with the Sonoma County Water Agency (SCWA) Flood Control Design Criteria Manual (1983). The collection system directs surface flow water to the reservoirs for irrigation storage and detention and provides a structural BMP to mitigate erosion. For the purposes of designing the collection system, the criterion was to collect sufficient runoff from within each vineyard site to meet the irrigation demand.

The SCWA Flood Control Design Criteria Manual uses the rational formula for determining runoff tributary areas less than 640 acres. The potential vineyard sites on Preservation Ranch are typically located on ridge tops and the use of the rational method for estimating runoff within the vineyard is appropriate.

6.0 VINEYARD SITE HYDROLOGY

The peak storm runoff from vineyard land is typically greater than that of forest for a given storm event. Mature forests typically have a large canopy and significant buildup of duff on the ground which slows down runoff. The use of diversion structures and cover crops on vineyards can be used to reduce erosion and slow down runoff.

The plan for Preservation Ranch calls for vineyard development on the ridgelines. This is advantageous because the slopes are typically low and the drainage shed is limited to the vineyard itself. Vineyard development will be restricted to slopes of 38% or less.

Peak runoff flows and volume for existing and post project conditions have been estimated using the Soil Conservation Service (SCS) Method.

6.1 Comparison of Existing Forest and Developed Vineyard Condition

The potential vineyard sites on the property are dominated by existing forest. The forest is typically made up of Tan Oak and scattered Douglas fir trees. The SCS Curve Number (CN) for forest within the project area is 63. The SCS Curve Number for vineyard is estimated to be 70. An HEC-1 analysis was performed to compare the peak flow and runoff volume for a typical 10 acre vineyard block for both existing forest and vineyard conditions. The analysis evaluates the 2-yr 24 hr, 10-yr 24 hr, and 100-yr 24 hr storm with a Type 1A rainfall distribution. Ground slopes of 10%, 20%, and 30% were evaluated and found to not have a significant impact on the results. The results are summarized in tables 2 & 3 below:

Table 2 – Comparison of Peak Flow Runoff for Typical 10 acre Vineyard Block

Storm	Forest (CFS)	Vineyard (CFS)	Peak Flow Increase (%)
2-yr, 24 hr	6	8	33
10-yr, 24 hr	10	13	30
100-yr, 24 hr	21	25	20

Table 3 – Comparison of Runoff Volume for Typical 10 acre Vineyard Block

Storm	Forest (ac-ft)	Vineyard (ac-ft)	Runoff Increase (%)
2-yr, 24 hr	2	3	50
10-yr, 24 hr	4	5	25
100-yr, 24 hr	7	8	15

The results indicate that peak flow runoff and runoff volumes will increase as a result of the vineyard development. Peak flow runoff from the developed vineyard is estimated to increase between 20% and 33% and runoff volume is expected to increase between 15% and 50% depending on the design storm. In order to mitigate the increase in peak runoff and runoff volume, a portion of each developed vineyard will be routed through a reservoir to attenuate runoff.

Additional hydrologic analysis of a single vineyard site known as Evans 1.0 utilizes the Rational Method to evaluate pre- and post-development peak flow runoff, and the Haestad Quick TR-55 to estimate hydrograph runoff volumes. Refer to Appendix B, "*Hydrology Study of Existing and Future Conditions*" for additional information on the methodology and summary of hydrologic conditions. Refer to Appendix D, Hydrology and Hydraulics Map, for tables comparing pre- and post-development peak flow runoff for the drainage subareas within the proposed Evans 1.0 vineyard development. Similar increases to the Peak Flow Runoff and Runoff Volume were determined using this methodology.

6.2 Hydrologic Mitigation Measures

There are basically two ways to mitigate increased runoff from vineyards; detention (holding some of the runoff and releasing it over a longer period of time) and increasing the time of concentration (time it takes the water to flow across the site).

6.2.1 Reservoir Detention

Peak runoff during storm events can be attenuated by using the reservoirs as detention ponds. A portion of the runoff from the vineyard sites will be routed through the reservoirs to limit peak runoff. The HEC-1 analysis shows that approximately 1 acre foot of detention storage would be required for every 10 acres of vineyard developed. Attenuation of peak flows will limit the erosion potential of tributary streams.

Outlet weirs will be sized to limit the outflow to approximate the predevelopment flow rate.

6.2.2 Time of Concentration

1. The time of concentration can be increased by the use of cover crops and mulch to increase the amount of time it takes runoff to leave the vineyard.

2. The time of concentration can also be increased by routing runoff parallel to the slope to reduce velocities and increase travel time. The routing can be done with swales and underground storm drain collection systems.

7.0 EROSION CONTROL

7.1 General

The surface soils on Preservation Ranch are one of the key requirements for developing a world class vineyard. The following is a shopping list of management practices that can reduce and/or manage the amount of erosion and soil loss from vineyard development. Erosion control will be accomplished by a combination of soil conservation, erosion control structures, farming practices, and maintenance. The majority of the management practices are common “Best Management Practices” for vineyard development and are in accordance with the County of Sonoma Vineyard Erosion and Sediment Control Ordinance (VESCO).

7.2 Structural BMPs

The following is a list of erosion control structures typically incorporated into a vineyard erosion control plan:

1. Infield diversion swales will be used to limit slope length and thereby limit soil loss to a sustainable rate. The infield diversions would be crossed sloped at three to five percent.

2. An underground storm drain collection system will be used to carry concentrated flows off the vineyard to the reservoirs or existing drainages. The reservoirs will provide both detention and as siltation basins. The storm drain collection system will be sized to handle peak flows from a 100-year storm event.

3. Storm drain pipe and ditch outlets will be lined with riprap to prevent scour.

4. Peak runoff during storm events will be attenuated by the detention ponds. Attenuation of peak flows reduces the amount of erosion occurring in the existing drainages.

5. Rock check dams will be used in inverts of roadside drainage ditches to reduce velocity and trap sediment.

6. Temporary erosion control measures include silt fence to control discharges of sediment into adjacent areas until permanent vegetation is established. Silt fence retain 85 percent of the soil by weight.

7. Permanent all weather rock roads can be established and graded to drain into the storm drain collection system.

8. Drainage outfalls will be stabilized to prevent erosion and trap sediment. Temporary measures would be removed as appropriate upon establishment of permanent grass cover crop.

Erosion control blankets or straw can be placed on disturbed areas until permanent cover crops are established.

7.3 Farming Practices

Proper farming practices can drastically reduce the amount of erosion from the vineyard. The following outlines typical farming Best Management Practices:

1. A cover crop can be established to achieve 70 to 80 percent cover.

2. Use of non-tilled cover crop of self-reseeding annuals between vine rows including Barley, Blando Brome, Crimson Clover, Zorro Fescue, and annual Rye Grass to achieve 70 to 80 percent cover. In late spring, the cover crop is mowed and chopped and the mulch allowed to remain on the ground surface.

3. Weed and erosion control under the vines using mulch or pumice.

4. Before October 15, all disturbed areas not otherwise protected by other measures should be revegetated with a seed mix that consists of Barley, Blando Brome, Crimson Clover, and Zorro Fescue at the rate of 35 pounds per acre. Straw mulch should be applied at an adequate rate (typically two tons per acre) to achieve a surface cover that will protect the soil surface until the seeded area can establish itself.

5. A 30-foot wide buffer zone should be established around the vineyard perimeter with a cover crop. This traffic tolerant cover crop will act as an additional sediment trap surrounding the vineyard.

7.4 Maintenance

Maintenance is the key to any erosion control plan. The following outlines typical vineyard maintenance procedures:

1. After the first heavy rain of the season, the erosion control measures should be inspected for deficiencies. Rock check dams, straw bales, silt fencing, ditches or other items added as necessary to ensure that the sediment and erosion control measures remain effective.

2. After heavy rains, ditches and swales should be inspected for excessive erosion and repaired, as required, to prevent further erosion.

3. Sediment will be removed form sediment traps and sediment retention ponds on a regular basis before sediment levels reach maximum levels. The sediment will be redistributed onto the vineyard.

4. Permanent storm drain inlets and piping should be regularly inspected for plugging that might occur due to leaves, debris or sediment, and will be cleaned out regularly.

7.5 Soil Conservation

Incorporating cover crop management practices into vineyard developments is a vital component for minimizing soil detachment and transport into sediment impaired water courses. The United States Department of Agriculture (USDA) has developed two models, the Universal Soil Loss

Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE2) that predict soil loss from agricultural lands, and can be utilized for estimating soil loss from a vineyard environment. These models are commonly used as a planning tool to provide guidance to crop management practices where soil loss is likely to occur.

7.5.1 USLE

The USLE is not designed to model more sophisticated management practices such as vegetated buffer strips and terracing, which act to detain sediment before it leaves the project area. For this reason, a more detailed analysis was conducted using the RUSLE2 model. The next sections describe the RUSLE2 model, the methodology employed and the results of the RUSLE2 analysis.

7.5.2 RUSLE2 Model Development

Version 2 of the Revised Universal Soil Loss Equation retains the empirical structure of the USLE in combination with process based equations to provide an effective combination of robustness and accuracy in a user friendly computer program. Unlike the USLE, RUSLE2 is capable of modeling the detachment and deposition of sediment on hillsides with uneven slopes. Additionally, RUSLE2 estimates interrill and rill erosion, sometimes referred to as sheet-rill erosion. RUSLE2 uses factors that represent the effects of soil erodibility, topography, climatic erosivity, cover management, and support practices to compute erosion rates. RUSLE2 uses a system of equations that call parameter values from the RUSLE2 database containing the factors listed above. The parameter values describe a site-specific condition, and are used to estimate erosion. RUSLE2 is most commonly used to guide conservation planning, inventory erosion rates over large areas, and estimate sediment production on upland areas. The RUSLE2 program was developed under the leadership of the USDA Agricultural Research Service (USDA 2003). The objective of this analysis was to utilize the RUSLE2 Model to predict soil loss under pre and post vineyard development conditions on Preservation Ranch. Developing the model required detailed information for each of the four main factors affecting interill and rill erosion.

7.5.2.1 Climate

The intensity and duration of rainfall is the most important climatic characteristic that drives interill and rill erosion processes, and can vary greatly from one location to another. Similar to the Rainfall/Runoff Factor used in the USLE model, RUSLE2 computes an erosivity R-value that is based on rainfall intensity/duration. Unlike USLE, the RUSLE2 database contains R-values that have been previously calculated by the USDA. Selecting the appropriate R-value requires knowing the annual rainfall for the point of interest within the appropriate County of California. Orographic affects greatly influence the variability of rainfall intensity and duration throughout Preservation Ranch, as well as the mean annual rainfall depth. To determine a representative mean annual rainfall depth, NOAA Isopluvial maps of the Preservation Ranch area were utilized. A mean annual rainfall depth of 58-inches was determined, and the corresponding R-value was computed in RUSLE2.

7.5.2.2 Soils

Utilizing the Sonoma County Soil Survey Soils Map with the proposed vineyard boundaries, the four most dominant soils that represent a wide range of erodibility characteristics were selected to be modeled in RUSLE2. These soils include Goldridge Fine Sandy Loam (GdE), Hugo Loam

(HhF), Josephine Loam (JoE, JoF, JoG), and Suther Loam (StF, StF). The RUSLE2 database contains each of these soil types found at varied slopes, and were inputted into the RUSLE2 model.

RUSLE2 modeling of the Laughlin Loam (LgE, LgF, LgG) soils was conducted at a later date and is included as Appendix A.

7.5.2.3 Land Use

RUSLE2 provides powerful modeling capabilities because it is land use independent, and can model a wide range of land uses. Land uses account for the activities that occur on the hillside of interest and include the crop type and crop management techniques. The USDA has compiled many land use templates that represent a wide range of crop management practices throughout many agricultural regions of California and the United States. These land use templates are stored within the RUSLE2 database and can be located based on geographical regions referred to as Crop Management Zones (CMZ). Within each CMZ, the USDA has made available (via the RUSLE2 database), land use templates that represent the type of crop and common crop management practices specific to the zone. For example, the CMZ that encompasses Sonoma County contains many vineyard cover crop templates that have been developed over years of field studies and monitoring records collected by the USDA-NRCS. The vineyard cover crop templates contain a high level of detail, but are specific to the crop management and operations of the vineyard for which the monitoring was conducted on. Based on the preferred vineyard management and operations proposed for vineyard development on Preservation Ranch, RUSLE2 land use templates were developed. The land use templates developed specifically for the proposed Preservation Ranch vineyards represent the crop management practices that have been proposed to date.

Three land use templates were developed in RUSLE2 and represent the proposed vineyard development and management practices. The templates will represent a vine row, an alley that will receive three mowings per year, and another alley that will receive one mowing per year. These templates were developed using USDA-NRCS templates for an established permanent vineyard cover crop in CMZ 45, however minor alterations were made to each template to better represent the proposed management practices specific to Preservation Ranch. The RUSLE2 templates are based on a one year cycle.

7.5.2.4 Proposed Vineyard Alley Land Use Template

The proposed vineyard alleys will be planted by means of a drill with 50 lbs/acre of a winter barley seed at a width of 4.5-feet. After the first rain of the season, the barley will begin to grow on the assumed date of November 15th, the same day the 1-year time period begins in RUSLE2. Following November 15th, a series of operations shown below in Table 10 represent the proposed vineyard management.

Table 10 – RUSLE2 Land use template developed for the proposed vineyard alleys that will receive 3-mowings per year.

Date	RUSLE2 Operation	Vegetation	Yield (lb/ac)	Type of External Residue Added	Computed Cover from Additional (%)	Surface Residue Added (lb/ac)
11/15	Begin Cover Crop Growth	Barley, annual winter vineyard cover crop	4,300[1]	NA	NA	NA
12/1	Leaf Drop from Grape Vines	(From Grape Vine)	NA	Leaves	13	580[2]
1/1	Prune Grape Vines	(From Grape Vine)	NA	Vine Prunings	9.3	400[2]
4/15	Shredder, flail or rotary mower	Barley, annual winter vineyard cover crop	NA	Cut Barley	72	2300[1]
5/15	Shredder, flail or rotary mower	Barley, annual winter vineyard cover crop	NA	Cut Barley	49	1200[1]
6/15	Shredder, flail or rotary mower	Barley, annual winter vineyard cover crop	NA	Cut Barley	36	800[1]
10/15	Harvest	NA	NA	NA	NA	NA

- Alley Width = 4.5-feet
- Alley planted with winter barley at a rate of 50 lbs/acre
- Annual Barley residual sums to 4,300 lbs/acre/year

NA – not applicable for the proposed date and operation
[1] – McGourty, G., S. Tylicki, J. Price and J. Nosera. 2006
[2] – McGourty, G. 2006

The proposed cover crop management requires that every other alley receives three mowings per year, with the alternate receiving only one. Table 11 below represents the alley that will receive a single mowing in June.

Table 11 – RUSLE2 Land use template developed for the proposed vineyard alleys that will receive 1-mowing per year

Date	RUSLE2 Operation	Vegetation	Yield (lb/ac)	Type of External Residue Added	Computed Cover from Additional (%)	Surface Residue Added (lb/ac)
11/15	Begin Cover Crop Growth	Barley, annual winter vineyard cover crop	4,300[1]	NA	NA	NA
12/1	Leaf Drop from Grape Vines	(From Grape Vine)	NA	Leaves	13	580[2]
1/1	Prune Grape Vines	(From Grape Vine)	NA	Vine Prunings	9.3	400[2]
6/15	Shredder, flail or rotary mower	Barley, annual winter vineyard cover crop	NA	Cut Barley	91	4,300[1]
10/15	Harvest	NA	NA	NA	NA	NA

- Alley Width = 4.5-feet
- Alley planted with winter barley at a rate of 50 lbs/acre
- Annual Barley residual sums to 4,300 lbs/acre/year

NA – not applicable for the proposed date and operation

[1] – McGourty, G., S. Tylicki, J. Price and J. Nosera. 2006
[2] – McGourty, G. 2006

7.5.2.5 Proposed Vineyard Vine Row Land Use Template

The proposed vine row management involves applying a post-emergence spray on the vine row twice in a one year time period to minimize barley and weed growth. Because of the modeling limitations in assigning a single vegetation type in a template, RUSLE2 is unable to account for the rainfall energy dissipation occurring from the bare vines above the vine row. However, the prunings from the vines are included in the template and added as additional ground cover. The bare pruned vines that would account for a very small portion of energy dissipation during a rainfall event are not reflected in the model. Table 12 below represents the proposed vine row used in the RUSLE2 model.

Table 12 – USLE2 Land use template developed for the proposed vineyard vine rows.

Date	RUSLE2 Operation	Vegetation	Yield (lb/ac)	Type of External Residue Added	Computed Cover from Additional (%)	Surface Residue Added (lb/ac)
11/15	Begin Barley Growth	Barley, annual winter vineyard cover crop	4,300[1]	NA	NA	NA
12/1	Leaf Drop from Grape Vines	(From Grape Vine)	NA	Leaves	13	580[2]
12/15	Post Emergence Sprayer	Barley, annual winter vineyard cover crop	NA	Killed Barley	43	1,000[1]
12/16	Begin Barley Growth	Barley, annual winter vineyard cover crop	4,300[1]	NA	NA	NA
1/1	Prune Grape Vines	(From Grape Vine)	NA	Vine Prunings	9.3	400[2]
2/1	Post Emergence Sprayer	Barley, annual winter vineyard cover crop	NA	Killed Barley	43	1,000[1]
2/2	Begin Weed Growth	Weeds	3,000[1]	NA	NA	NA
6/15	Adjacent Alley Mowing	Barley, annual winter vineyard cover crop	NA	Cut Barley (from allies)	36	2,300[1]
10/15	Harvest	NA	NA	NA	NA	NA

- Vine Row Width = 18-inches
- Adjacent alleys planted with winter barley at a rate of 50 lbs/acre
- Annual Barley and Weed residual sums to 4,300 lbs/acre/year

NA – not applicable for the proposed date and operation
[1] – McGourty, G., S. Tylicki, J. Price and J. Nosera. 2006
[2] – McGourty, G. 2006

7.5.2.6 Pre Vineyard Development Land Use Template

RUSLE2 is commonly used in predicting soil loss under both pre and post development conditions. Developing a single land use template that will accurately predict soil loss and is representative of the diverse coniferous, deciduous and grassland vegetation cover of Preservation Ranch is difficult. Because of this, a land use template developed by the USDA-

NRCS for an established 30-year old deciduous hardwood forest located in the Napa Valley CMZ was utilized for comparison purposes only. The parameters shown below in Table 13 are contained within the RUSLE2 land use template.

Table 13 – RUSLE2 Template for a 30-year established hardwood stand developed for the Napa Valley region (USDA 2006).

Date	RUSLE2 Operation	Vegetation	Yield (lb/ac)	Type of External Residue Added	Cover from Additional (%)	Surface Residue Added (lb/ac)
4/1	Begin Growth	Established Hardwoods	100,000	NA	NA	NA
11/1	Add Mulch	NA	NA	Leaves/Grass	95	12,000

NA – not applicable for the proposed date and operation

7.5.2.7 Topography

Unlike USLE, RUSLE2 has the ability to model soil loss from a non-uniform slope, where both soil detachment and deposition can occur. Because there are an infinite combination of complex convex-concave profiles and slope lengths that represent the topography of Preservation Ranch, the RUSLE2 analysis utilized uniform slope profiles with varied slope lengths. For slopes of 10% and less the proposed vineyard planting consists of contour cultivation (vineyards planted perpendicular to the overland flow path) as shown below in Figure 1. The proposed alley and vine row dimensions used in the RUSLE2 model are also shown below. It should be noted that RUSLE2 requires a horizontal slope length dimensioning.

Slopes greater than 10% will be planted “up and down the slope” (parallel to the overland flow path) as shown below in Figure 2. The proposed alley and vine row dimensions used in the RUSLE2 model are also shown below.

7.6 RUSLE2 Pre and Post Vineyard Development Soil Loss Results

Utilizing the templates discussed above, the RUSLE2 model was simulated under pre and post vineyard development conditions for slopes of 5 to 40 percent in increments of 5 percent and with slope lengths of 250, 500, and 750-foot lengths. The RUSLE2 results are contained below in Table 14 for each of the four soil types.

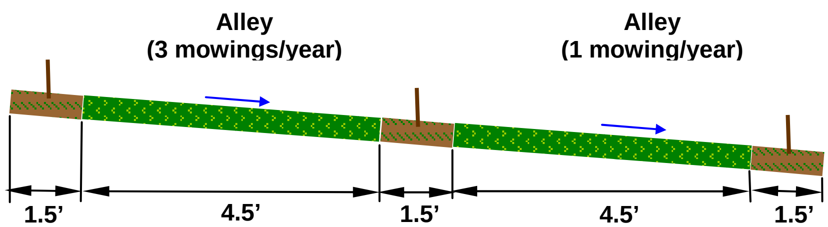

Figure 1. Hillside profile view of proposed vineyard including 4.5-ft wide alleys and 1.5-ft wide vine rows planted “contour cultivation” on hillside slopes less than or equal to 10%.

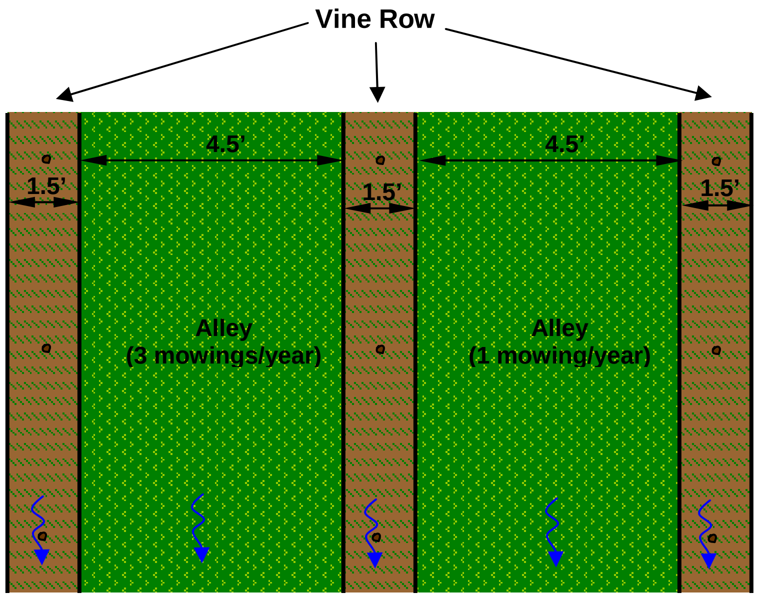

Figure 2. Plan view of proposed vineyard including 4.5-ft wide alleys and 1.5-ft wide vine rows planted "up and down" hillside slopes greater than 10%.

The RUSLE2 results consistently predict an increase in soil loss from pre to post vineyard development conditions. However, the results do not exceed the USDA Tolerance (T) Factor listed in Table 4 above, and previously discussed. The RUSLE2 post development soil loss results for Hugo Loam, Josephine Loam, and Suther Loam soil types are very similar to one another, and are consistently greater than the results of the Goldridge Fine Sandy Loam. Because of the predicted increase in soil loss as a result of the proposed vineyard development, RUSLE2 was utilized to investigate a variety of soil conservation practices.

Table 14 – RUSLE2 Computed Soil Loss at Varied Hillside Slopes and Slope Lengths for Pre and Post Vineyard Development Conditions (tons/acre/year)

Goldridge Fine Sandy Loam (GdE)

Slope Length (ft)	5% Contour		10% Contour		15% Up Down		20% Up Down		25% Up Down		30% Up Down		35% Up Down		40% Up Down	
	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines
250	0.0038	0.2	0.0062	0.36	0.0093	0.59	0.012	0.8	0.015	1	0.017	1.2	0.019	1.4	0.021	1.6
500	0.004	0.21*	0.0065	0.39*	0.0097	0.65	0.012	0.89	0.015	1.1	0.017	1.4	0.02	1.6	0.022	1.8
750	0.0041	NA	0.0066	NA	0.0098	0.69	0.013	0.94	0.016	1.2	0.018	1.4	0.02	1.7	0.022	1.9

Hugo Loam (HhF)

Slope Length (ft)	5% Contour		10% Contour		15% Up Down		20% Up Down		25% Up Down		30% Up Down		35% Up Down		40% Up Down	
	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines
250	0.0056	0.28	0.0092	0.51	0.014	0.83	0.018	1.1	0.021	1.4	0.025	1.7	0.028	2	0.031	2.2
500	0.0058	0.3*	0.0095	0.55*	0.014	0.91	0.018	1.2	0.022	1.6	0.026	1.9	0.029	2.2	0.032	2.4
750	0.006	NA	0.0097	NA	0.014	0.96	0.019	1.3	0.022	1.6	0.026	2	0.029	2.3	0.032	2.5

Josephine Loam (JoE, JoF, JoG)

Slope Length (ft)	5% Contour		10% Contour		15% Up Down		20% Up Down		25% Up Down		30% Up Down		35% Up Down		40% Up Down	
	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines
250	0.0055	0.28	0.009	0.51	0.013	0.82	0.017	1.1	0.021	1.4	0.024	1.7	0.028	2	0.03	2.2
500	0.0057	0.29*	0.0093	0.55*	0.014	0.89	0.018	1.2	0.022	1.6	0.025	1.9	0.028	2.1	0.031	2.4
750	0.0059	NA	0.0095	NA	0.014	0.95	0.018	1.3	0.022	1.6	0.025	1.9	0.029	2.2	0.032	2.5

Suther Loam (StF)

Slope Length (ft)	5% Contour		10% Contour		15% Up Down		20% Up Down		25% Up Down		30% Up Down		35% Up Down		40% Up Down	
	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines	Forest	Vines
250	0.0056	0.28	0.0092	0.51	0.014	0.86	0.018	1.2	0.021	1.5	0.025	1.8	0.028	2.1	0.031	2.4
500	0.0058	0.30*	0.0095	0.56*	0.014	0.96	0.018	1.3	0.022	1.7	0.026	2	0.029	2.3	0.032	2.6
750	0.006	NA	0.0097	NA	0.014	1	0.019	1.4	0.022	1.7	0.026	2.1	0.029	2.4	0.032	2.7

[1] Max slope length of 450-feet was used in 5% slope model simulation only. 500-foot slope length exceeded RUSLE2 modeling capabilities for contour planting at 5% slope.

NA - Cross slope modeling capabilities exceeded in RUSLE2, results not available

7.6.1 Soil Conservation Techniques

There are multiple methods used in preventing soil loss and minimizing sediment delivery from developed vineyard areas. RUSLE2 provides the capabilities of simulating these various soil conservation techniques commonly used in vineyard management. For this analysis, the two more common techniques investigated within RUSLE2 were vegetated barriers and gradient terraces. Vegetated barriers are planted on the contour and consist of the same slope as the uniform hillside slope, and can range in widths. RUSLE2 assumes the vegetated barriers are established and have a yield of 6,000 lbs/acre/year. A ryegrass or fescue variety would have a similar yield, which is greater than the proposed barley cover crop yield of 4,300 lbs/acre/year. Vegetated barriers induce soil deposition, but do not terminate the overland flow path. Conversely, gradient terraces intercept runoff to concentrated areas and disconnect overland flow path lengths. A new flow path length begins at the outer edge of the terrace, at the same location where overland flow originates. In RUSLE2, a gradient terrace consists of an adverse front slope that terminates the overland flow path and is considered to be infinitely thin. RUSLE2 has been developed to model gradient terraces as an infinitely thin component because RUSLE does not have the capabilities of hydrologically predicting overland flow runoff rates required to adequately size gradient terraces. Essentially, the intercepted overland flow would be concentrated in an open channel ditch situated on the inboard side of the adverse sloped terrace and conveyed to a drop inlet collecting the intercepted overland flow and discharging it to a detention storage facility. Both the gradient terraces and the drop inlets would have to be sized accordingly.

RUSLE2 modeling capabilities allow for a range of gradient terrace slopes to be modeled. Cursory RUSLE2 model simulations that included varying the gradient terrace slope indicated that slopes over 0.5% provided little to no deposition on the terraces. Conversely, gradient terrace slopes less than 0.5% slope did result in significant deposition on the terrace. Because gradient terraces with slopes less than 0.5% would be extremely difficult to maintain, gradient terraces slopes of 0.75% were utilized for the modeling purposes.

7.6.2 Development of Vineyard Soil Conservation Practices in RUSLE2

Using the two soil conservation techniques described above (vegetated barriers and gradient terraces), a variety of vineyard soil conservation practices were investigated in RUSLE2. For slopes of 5, 20, and 40 percent, slope lengths of 250, 500, and 750-feet, nine conservation practices were modeled to determine the effectiveness of each in preventing soil loss and minimizing sediment delivery. As previously discussed, performing model simulations for each soil conservation practice under all slope length combinations and for each of the four soil types would have been unnecessary at this stage in the planning process. Because of this, only one soil type was used in the model simulations, and was selected to be Josephine Loam because of its high prevalence on the Preservation Ranch and its erodibility characteristics that are representative of a majority of the Preservation Ranch soils. Using the two soil conservation techniques described above, seven vineyard soil conservation practices were simulated in RUSLE2 to provide planning and development assistance and include:

1. Do nothing
2. 10-foot wide vegetated barrier planted on the contour at bottom of slope
3. 10-foot wide vegetated barrier planted on the contour at bottom and mid-slope

4. 0.75% gradient terrace at bottom of slope
5. 0.75% gradient terrace at bottom and mid-slope
6. 10-foot wide vegetated barrier planted on the contour at mid-slope, and 0.75% gradient terrace placed at bottom of slope
7. 10-foot wide vegetated barrier planted on the contour at bottom of slope, and 0.75% gradient terrace placed at mid-slope

Utilizing the land use templates representing the proposed vineyard, each soil conservation practice was simulated for a wide range of slope and slope length combinations using the Josephine Loam soil type. The results of the RUSLE2 model and a comparison of the performances of the seven soil conservation practices are shown below in Table 15. The computed soil loss accounts for the total rate of soil (tons/acre/year) that becomes detached and is transported down gradient on the RUSLE2 modeled hillside. Soil deposition is defined in RUSLE2 as the portion of soil loss that is transported down gradient that becomes deposited on the modeled hillside slope, and is also represented in units of tons/acre/year. The difference between the soil loss rate and soil deposition rate is the sediment delivery rate, or the computed soil that exits the RUSLE2 modeled hillside slope and is represented in tons/acre/year.

Table 15 – RUSLE2 Model Simulations using Soil Conservation Practice Techniques using Josephine Loam. Soil Loss and Soil Delivery rates in (tons/acre/year)

Slope	5% (contour cultivation)		20% (up/down cultivation)		40% (up/down cultivation)		Soil Conservation Practice
Slope Length	Soil Loss	Sediment Delivery	Soil Loss	Sediment Delivery	Soil Loss	Sediment Delivery	
250-ft	0.28	0.28	1.10	1.10	2.20	2.20	1
	0.27	***0.09***	***1.10***	***0.40***	***2.30***	***0.79***	2
	0.27	***0.09***	0.96	0.42	1.80	0.80	3
	0.28	0.28	1.10	1.10	2.10	2.10	4
	0.26	0.26	1.00	1.00	2.00	2.00	5
	0.28	0.28	0.96	0.83	1.90	1.70	6
	0.26	0.26	1.00	0.71	2.10	1.40	7
500-ft[1]	0.29	0.29	1.20	1.20	2.40	2.40	1
	0.29	***0.10***	***1.30***	***0.47***	***2.50***	***0.87***	2
	0.29	***0.10***	1.00	0.44	2.00	0.88	3
	0.29	0.29	1.20	1.20	2.40	2.40	4
	0.28	0.28	1.10	1.10	2.20	2.20	5
	0.29	0.30	1.10	0.91	2.10	1.80	6
	0.28	0.28	1.20	0.79	2.40	1.60	7
750-ft	NA		1.30	1.30	2.50	2.50	1
			1.30	***0.49***	***2.50***	***0.91***	2
			1.10	0.46	2.20	0.93	3
			1.30	1.30	2.50	2.40	4
			1.20	1.20	2.30	2.30	5
			1.10	1.95	2.20	1.80	6
			1.30	0.83	2.60	1.70	7

(Yellow) RUSLE2 Model results indicating the lowest computed soil loss rate relative to results for all other soil conservation practices for the slope length/slope combinations

(Cyan) RUSLE2 Model results indicating the lowest computed sediment delivery rate relative to results for all other soil conservation practices for the slope length/slope combinations

BOLD RUSLE2 Model results indicating highest deposition rates relative to all other soil conservation practices for the slope length/slope combinations

[1] Max slope length of 450-feet was used in 5% slope model simulation only. 500-foot slope length exceeded RUSLE2 modeling capabilities for contour planting at 5% slope.

NA – contour cultivation modeling capabilities exceeded in RUSLE2, results not available

To better understand the results presented in Table 15, Tables 16 and 17 below were provided to present the soil conservation practice that resulted in the lowest soil loss and sediment delivery rates for each slope and slope length combination. Additionally, RUSLE2 model results for the existing forested land cover and the proposed vineyard development with no soil conservation practices have been provided for comparison purposes.

Table 16 – RUSLE2 predicted soil loss for forest, vineyard development with no soil conservation practices (SCP), and vineyard with soil conservation practice (SCP) that yielded the lowest soil loss rate for Josephine Loam soil type (lbs/acre/year)

Slope	5%				20%				40%			
	Soil Loss (tons/ac/yr)			SCP	Soil Loss (tons/ac/yr)			SCP	Soil Loss (tons/ac/yr)			SCP
Slope Length	Forest	Vineyard No SCP	Vineyard w/ SCP		Forest	Vineyard No SCP	Vineyard w/ SCP		Forest	Vineyard No SCP	Vineyard w/ SCP	
250-ft	0.0055	0.28	0.26	5 or 7	0.017	1.10	0.96	3 or 6	0.030	2.20	1.80	2
500-ft[1]	0.0057	0.29	0.28	5 or 7	0.018	1.20	1.00	3	0.031	2.40	2.10	6
750-ft	NA				0.018	1.30	1.10	3	0.032	2.50	2.20	6

[1] Max slope length of 450-feet was used in 5% slope model simulation only. 500-foot slope length exceeded RUSLE2 modeling capabilities for contour planting at 5% slope.

NA – contour cultivation modeling capabilities exceeded in RUSLE2, results not available

Table 17 – RUSLE2 predicted sediment delivery for forest, vineyard development with no soil conservation practices (SCP), and vineyard with soil conservation practice (SCP) that yielded the lowest soil loss rate for Josephine Loam soil type (lbs/acre/year)

Slope	5%				20%				40%			
	Sediment Delivery (tons/ac/yr)			SCP	Sediment Delivery (tons/ac/yr)			SCP	Sediment Delivery (tons/ac/yr)			SCP
Slope Length	Forest	Vineyard No SCP	Vineyard w/ SCP		Forest	Vineyard No SCP	Vineyard w/ SCP		Forest	Vineyard No SCP	Vineyard w/ SCP	
250-ft	0.0055	0.28	0.09	2 or 3	0.017	1.10	0.40	2	0.030	2.20	0.79	2
500-ft[1]	0.0057	0.29	0.10	2 or 3	0.018	1.20	0.44	3	0.031	2.40	0.87	2
750-ft	NA				0.018	1.30	0.46	3	0.032	2.50	0.91	2

[1] Max slope length of 450-feet was used in 5% slope model simulation only. 500-foot slope length exceeded RUSLE2 modeling capabilities for contour planting at 5% slope.

NA – contour cultivation modeling capabilities exceeded in RUSLE2, results not available

It should be noted that initial RUSLE2 model simulations were performed using the proposed barley cover crop planted at 50 lbs/acre for vegetated barriers. As previously mentioned, the barley cover crop would result in a yield of 4,300 lbs/acre/year, less than the RUSLE2 default vegetated barrier yield of 6,000 lbs/acre/year which would be more similar to rye-grass or fescue. A range of barley planted vegetated barrier widths and spacing was investigated in RUSLE2, and the results indicated that there was no significant sediment savings relative to not using a soil conservation practice. This suggests that vegetated barriers will only be effective if grass vegetation yielding a minimum of 6,000 lbs/acre/year is utilized.

Conclusion

The results of the RUSLE2 modeling efforts that incorporated a variety of soil conservation practices can be used in guiding the planning and development of the proposed vineyard. The results clearly indicate that decreasing the overland flow path can greatly reduce soil loss. Based on this, it is recommend that gradient terraces be incorporated where the topography allows and where possible, the runoff diverted in the storm drain collection system to the irrigation reservoir or sedimentation basins. Where development of gradient terraces is impractical, the use of vegetated barriers with the appropriate grass vegetation can induce deposition and decrease the sediment delivery rate. An additional soil conservation practice that was not modeled in RUSLE2 includes the use of wood chips for mulching vine rows. This practice would increase both the rainfall energy dissipation and the ground cover, while minimizing the soil detachment.