Napa River & Sonoma Creek Vineyard General Permit Monitoring Plan

July 15, 2020
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Introduction

In 2017, the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) adopted Order No. R2-2017-0033 (Water Board 2017) to implement the sediment Total Maximum Daily Loads (TMDLs) for the Napa River and Sonoma Creek watersheds. A TMDL is a regulatory term defined in the Clean Water Act as a plan to restore impaired waters. This order, referred to by the Water Board as the “Vineyard General Permit”, applies to vineyard properties within the Napa River and Sonoma Creek watersheds (Figure 1).

The Vineyard General Permit requires a Monitoring Plan and a Monitoring Results Report to evaluate streambed conditions and best management practice (BMP) effectiveness on vineyard properties subject to the Order (see Attachment E of the WDRs). Streambed condition monitoring involves evaluating the condition of streambed substrates in channel reaches that provide spawning habitat for steelhead and/or salmon to evaluate attainment of total maximum daily load (TMDL) number targets for sedimentation. BMP effectiveness monitoring entails evaluating implemented BMPs in their ability to prevent soil erosion and sediment delivery to streams. The WDRs specifically require monitoring of three types of BMPs: 1) groundcover, 2) unpaved roads on hillslope vineyards, and 3) bed and bank erosion on hillslope vineyards. In the following sections, an approach to each of these four monitoring requirements is provided.

There are two ways for vineyard owners/operators to satisfy these monitoring requirements: 1) individually - on a property specific basis, or 2) by participating in a group water quality monitoring program. The Napa and Sonoma County Farm Bureaus (Farm Bureaus) are coordinating a group water quality monitoring program for vineyard property owners/operators to join. The Vineyard General Permit requires that such groups develop and submit plans describing their proposed methods to monitor fine sediment concentrations to the Water Board by July 15, 2020.

At the request of the Farm Bureaus, the Napa County Resource Conservation District (Napa RCD) prepared this document to provide a framework for future monitoring, data analysis, and reporting. This document contains contributions by the following organizations: Napa County Resource Conservation District, Sonoma Resource Conservation District, Wine Institute, Napa County Farm Bureau, Sonoma County Farm Bureau. Napa RCD and the organizations listed above have worked closely with staff of the California Regional Water Quality Control Board San Francisco Bay Region (Water Board) over the period of several years to develop this plan.

Upon approval, this plan will be implemented over the next several years, as described in the sections below. By July 15, 2023, a report that presents and analyzes monitoring results shall be submitted for review and approval to the Water Board.
Figure 1. Vineyard properties within the Napa River and Sonoma Creek watersheds
Section 1: Napa River and Sonoma Creek Streambed Monitoring Plan

Prepared by:

Napa County Resource Conservation District

1.1 Background

The Vineyard General Permit was issued to implement the sediment Total Maximum Daily Loads (TMDLs) for the Napa River and Sonoma Creek watersheds. A TMDL is a regulatory term defined in the Clean Water Act as a plan to restore impaired waters. The permit requires monitoring of streambed substrate conditions in channel reaches that provide existing and/or potential spawning habitat for steelhead and/or salmon to evaluate attainment of TMDL numeric targets for sedimentation. The Vineyard General Permit specifically lists the following potential monitoring metrics: 1) spawning gravel permeability, 2) streambed scour 3) pool filling, and 4) substrate composition (see Attachment E of the Vineyard General Permit).

In the years since the sediment TMDLs were first issued, streambed permeability and scour monitoring has been extensively conducted in the Napa River watershed (NCRCD 2009, NCRCD 2015, NCRCD 2018). Results from these efforts have demonstrated that in-situ measurements of gravel permeability and streambed scour are inherently variable with a high degree of error. Thus, these metrics are poor indicators of streambed condition and are not suitable for monitoring attainment of TMDL targets. In 2018, the Napa RCD and Water Board conducted a pilot study to test whether bulk sediment sampling was a feasible and cost-effective method (NCRCD 2019). This study demonstrated that bulk sediment sampling provided a more direct and repeatable measure of streambed condition than gravel permeability and therefore will be the focus of this monitoring plan.

1.2 Monitoring Approach

The composition of spawning gravel, particularly the abundance of fine sediment, is often evaluated in spawning habitat assessment and monitoring projects to determine the quality of spawning habitat (Schuett-Hames et al 1996). For this monitoring program in the Napa and Sonoma watersheds, fine sediment concentrations will be determined by collecting bulk sediment samples directly from the streambeds at multiple sites over multiple years. The material will be sorted into standard size classes in the field, and the finest material will be sent to a laboratory for further processing and analysis. Field sampling methods, data analysis, and reporting metrics will be based on previous pilot studies by the Napa RCD and existing literature and protocols - primarily the Washington Department of Natural Resources Forest Practices Division’s Method Manual for the Salmonid Spawning Gravel Composition Survey (Schuett-Hames et al 1999).
1.2.1 Monitoring Timeline

Figure 2 provides a proposed timeline by which site selection, sample collection, data analysis, and reporting will be conducted. The Vineyard General Permit stipulates that monitoring results be reported to the Water Board by July 2023. Following the two initial monitoring events in 2021 and 2022, a four-year period with no monitoring is proposed to:

- allow sediment supply reduction efforts (i.e. implementation of vineyard BMPs) to take effect;
- allow high flow events to transport and sort sediments and approach equilibrium; and,
- assess and adjust the methods, number of sites, or other aspects of the program as needed.

<table>
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<th>Task</th>
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<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
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<td>Jan</td>
<td>July</td>
<td>Jan</td>
<td>July</td>
<td>Jan</td>
<td>July</td>
<td>Jan</td>
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<tr>
<td>Bulk Sediment Sampling Fieldwork</td>
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<td>Data Analysis &amp; Reporting</td>
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</tbody>
</table>

**Figure 2.** Timeline for site selection, sampling fieldwork, data analysis, and reporting.

1.2.2 Site Selection

Reconnaissance surveys will be conducted in the Napa River and Sonoma Creek to identify potential sampling sites. Surveys will be conducted in the mainstem channels of the Napa River and Sonoma Creek, and tributaries will be excluded. Ideally, surveys will be completed during the first rainy season of the study under typical winter baseflow conditions when the channels are fully wetted, and potential salmonid spawning habitat is inundated. The surveys will be done on foot or by kayak by a team of professionals with experience in salmonid biology and fluvial geomorphology. The purpose of the surveys will be to generate a pool of potential sites that:

- are located within the accessible geographic range for steelhead and/or Chinook salmon
- contain potential salmonid spawning habitat (i.e. riffle crest or adjacent gravel bar);
- are accessible by vehicle or a short hike; and,
- have cooperative landowners who grant permission for access.
Geographic coordinates of each potential site will be recorded and mapped using GIS software. From the pool of all potential sites, a total of 32 will be selected for the Napa River watershed and 20 will be selected for the smaller Sonoma Creek watershed. Additionally, a small number of backup sites, perhaps 5-10, will also be identified in case some of the primary sites need to be dropped from the study. An effort will be made to distribute the sites within each watershed to attain a representative range of channel geometry (i.e. confined vs. unconfined), riparian buffer width, and watershed area (i.e. stream power). An example of a potential monitoring site in the Napa River is shown in Figure 3.

Figure 3. Potential streambed monitoring site located at a riffle crest in the Napa River.

1.2.3 Channel Slope Surveys

All sites must have a minimum channel slope of 0.002 (0.2%) to ensure that sampling does not occur within a reach that could be naturally transitional between gravel- and sand-bedded. In rivers and streams worldwide, there often is an abrupt transition from a gravel-bedded to a sand-bedded channel that is a function of a rapid reduction in shear stress (Lamb and Vendetti, 2016). As a general rule of thumb, where the channel slope is less than 0.001 (0.1%) the streambed would be expected to be sand-bedded (Parker, 2008).
To measure the local channel slope at each potential site, longitudinal surveys will be conducted prior to sampling. The total survey distance at each site should be at least ten times the bankfull channel width. The survey will extend approximately the same distance upstream and downstream of the sampling site. A field tape will be stretched along the approximate thalweg of the channel, and streambed elevations will be measured using a surveyor’s level and stadia rod along the tape. Measurements will be collected at selected breaks in slope, or at a minimum spacing of 100 feet when slope is unchanging. The surveys will start and end at topographic high points in the streambed (i.e. riffle crests). Local channel slope will be calculated by dividing the difference in elevation by the total surveyed distance. If the slope is determined to be less than 0.2%, the site will be excluded from the study.

1.3. Monitoring Methods

At each site, a suitable sampling area will be identified near the thalweg of the channel with favorable substrate size and topography for salmonid spawning. A crew of two people will excavate a sample of the substrate using a shovel. Excavated material will be placed into several 5-gallon plastic buckets. Samples will be collected to a depth of approximately 20 cm below the existing streambed. The lateral dimensions of the sampled area will be determined by the amount of sample needed, which is dependent on the size of the largest clast (i.e. individual particle) in the sample (Schuett-Hames et al 1999). A sufficient volume of sediment will be collected to ensure that the largest clast represents less than five percent of the total sample mass. Typically, an area of approximately one square meter will need to be excavated.

If the site contains flowing or standing water in the thalweg where the sample is to be collected, the sample will be collected from the nearest dry area on the adjacent gravel bar (Figure 4). Professional judgment will be used to ensure that the sampling location on the bar is located in the active streambed where a salmonid could potentially spawn at higher flows and that the substrate composition appears similar to that of the wetted portion of the channel. Alternatively, a barrel or McNeil sampling device may be driven into the substrate and used to isolate the excavation area from the surrounding water.

Once collected, the sample material will be spread out on plastic tarps and allowed to dry on-site for several days (Figure 5). If rain is forecast during the drying time, the sample may be transported elsewhere to dry indoors. After the collected material is thoroughly dry, the entire sample will be sieved in the field using a portable sieve. Previous studies by the Napa RCD and Water Board have found the SS-35 Rocker manufactured by Gilson Company Inc. to be an effective portable sieve for processing streambed material in the field.

The following size sieves will be used to sort the sample material in the field: 64 mm, 45 mm, 32 mm, 22 mm, 16 mm, 11 mm, and 8 mm. The screened material in each size class will be placed into separate labeled plastic buckets. Once the entire sample is sieved, each size class
will be weighed (± 0.01 kg) using a digital field scale (Figure 6). All field sieving and weighing will be done on a plastic tarp to avoid losing any material during the procedure. The portion of the sample that passes through the 8 mm sieve will be spread out on a tarp such that a representative subsample can be obtained for laboratory analysis (Figure 7). Previous studies in the Napa River have found that a subsample of approximately 3 to 5 kg of this material is sufficient. The subsample will be carefully transferred to plastic bags, labeled, and weighed. Subsamples will be sent to a specialized laboratory for fine-grain sieving into the following size classes: 5.6 mm, 4 mm, 2.8 mm, 2 mm, 1.4 mm, 1 mm, and less than 1 mm.

Figure 4. Collecting a sample from the bar immediately adjacent to the channel thalweg.
Figure 5. Freshly collected sample material laid out on a tarp to dry.
Figure 6. Weighing individual size class samples after field sieving.

Figure 7. Collecting a subsample of <8mm material for laboratory analysis.

1.4 Data Entry, Analysis, and Reporting

1.4.1 Data Entry

The Napa RCD has developed a standard data entry form for use with a field tablet computer (Figure 8). The data form is in Microsoft Excel format, and provides real-time calculations of sample statistics that assist the field crew with ensuring data quality. The data entry form can also be printed and completed by hand if a field tablet is not available.

Geo-spatial field data will be collected with a GIS application such as Collector, developed by ESRI. The GIS application will be used to record the geographic locations and other details (e.g. landowner information, landmarks, access instructions, etc.) about each site. These data will be stored in GIS file format, which can be easily converted for use in other mapping applications, such as Google Earth.

Topographic survey data will be collected in a Microsoft Excel spreadsheet or comparable application.
1.4.2 Data Analysis

The following statistics will be calculated for each sample:

\[ d_{16} = \text{the grain size diameter at which 16\% of the sample is finer} \]

\[ d_{50} = \text{the median grain size diameter, at which 50\% of the sample is finer} \]

\[ d_{84} = \text{the grain size diameter at which 84\% of the sample is finer} \]

\[ d_g = \text{geometric mean diameter, } d_g = (d_{84} * d_{16})^{0.5} \]

\[ s_g = \text{geometric sorting coefficient, } s_g = (d_{84}/d_{16})^{0.5} \]

\[ sk = \text{geometric skewness coefficient, } sk = [\log_{10}(d_g/d_{50})]/[\log_{10}(s_g)] \]

Particle size distribution charts (Figure 9) will be produced according to the size classes provided in Table 1 (Wentworth 1922).

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Figure 8. Example data entry form in Microsoft Excel.
Table 1. Particle size class definitions

<table>
<thead>
<tr>
<th>Size Class</th>
<th>Particle Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand (and finer)</td>
<td>less than 2</td>
</tr>
<tr>
<td>Very Fine Gravel</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Fine Gravel</td>
<td>4 - 8</td>
</tr>
<tr>
<td>Medium Gravel</td>
<td>8 - 16</td>
</tr>
<tr>
<td>Coarse Gravel</td>
<td>16 - 32</td>
</tr>
<tr>
<td>Very Coarse Gravel</td>
<td>32 - 64</td>
</tr>
<tr>
<td>Cobbles (and larger)</td>
<td>greater than 64</td>
</tr>
</tbody>
</table>

Source: Wentworth 1922

Figure 9. Example particle size distribution chart.

1.4.3 Reporting

Reports will be prepared and distributed in electronic format (i.e. Adobe pdf) to the Water Board and other stakeholders. At a minimum, the following three reports will be prepared:

July 2022 - Technical memo with the following components:

• Summary of Year-1 monitoring results
• Discussion of lessons learned and plans for Year-2 monitoring
• Recommendations for modifications to the methods or program

July 2023 - Full report with the following components:

• Summary of all monitoring activities to date
• Discussion of monitoring results relative to TMDL targets and General Permit objectives
• Review of previous monitoring findings, trends, and changes observed
• Discussion of lessons learned and recommendations for future monitoring

July 2027 - Full report with the following components:

• Summary of all monitoring activities to date
• Discussion of monitoring results relative to TMDL targets and General Permit objectives
• Review of previous monitoring findings, trends, and changes observed
• Discussion of lessons learned and recommendations for continued monitoring

References


Section 2: BMP Effectiveness - Groundcover

Prepared by:
Common Futures LLC and The Wine Institute

2.1 Summary

This document describes a study to be completed and included as part of the Group Monitoring Plan required under SF Bay Regional Water Quality Control Board Order R2-2017-033. This study seeks to address the BMP Effectiveness study requirement for the soil erosion in the farm area performance standard.

The Order requires a “Ground Cover Survey” or “alternative approaches” to estimating percent ground cover (e.g. NDVI) and further specifies that the Monitoring Results Report should evaluate “attainment of the Performance Standard for soil erosion within the Farm Area”, for example through use of the universal soil loss equation (USLE) or the revised universal soil loss equation (RUSLE). The Order additionally specifies that “other analytical approaches to evaluate attainment of the Performance Standard also may be proposed”. (Order, p. E-5)

The study described below will satisfy the Order’s requirement through use of the Water Erosion Prediction Project (WEPP), a widely accepted, validated, process-based model for estimating sediment transfer in a variety of circumstances. WEPP will be used to predict soil erosion rates at a selection of vineyard sites, representing a sampling of scenarios for annual precipitation, ground surface slope, soils series and other relevant factors. Model predictions will then be compared to soil loss tolerance rates (‘T’) to evaluate attainment of the Performance Standard for soil erosion in the Farm Area.

2.2 Background – WEPP Model

WEPP is a long-established model designed to capture all relevant physical details governing hillslope and small watershed erosion. The model was originally developed to replace the Universal Soil Loss Equation (USLE) for certain applications, and has been continuously refined for a variety of contexts since its creation (Flanagan et al. 2007).

Spatially, WEPP is organized around the concepts of hillslope, which represent units with homogeneous vegetation on the landscape. Processes considered in hillslope profile model applications include rill and interrill erosion, sediment transport and deposition, infiltration, soil consolidation, residue and canopy effects on soil detachment and infiltration, surface sealing, rill hydraulics, surface runoff, plant growth, residue decomposition, percolation, evaporation, transpiration, snow melt, frozen soil effects on infiltration and erodibility, climate, tillage effects on soil properties, effects of soil random roughness, and contour effects including potential overtopping of contour ridges. The Crop Growth model in WEPP is based on the EPIC model and is designed to simulate changes in both crops and residue as well as rangelands. It is based on the daily accumulated heat units, with water and temperature stress adjustments and can be
used with both annual and perennial crops. It predicts a suite of variables including canopy cover and height, root development and biomass production. The biomass may be removed as part of the harvest or remain as surface residue. The residue component is allowed to decompose and can be managed through parameter choices focused on impacts of tillage, burning, removal or amendment.

In addition to these factors, WEPP can incorporate a variety of management options (e.g. tillage) into the crop growth model. The residue decomposition component in WEPP keeps track of three residue types, each of which may have different decomposition parameters. The decomposition component partitions total residue mass at harvest into standing and flat components based upon harvesting and residue management techniques.

Complete documentation of the model algorithms and assumptions is at https://www.ars.usda.gov/midwest-area/west-lafayette-in/national-soil-erosion-research/docs/wepp/wepp-model-documentation/. It includes detailed chapters related to each of the key features, including Plant Growth, Residue Decomposition and Management, and Erosion.

2.3 Study Design

Vineyard community stakeholders have contracted with the Corvallis, Oregon-based geospatial services and analysis firm Common Futures to conduct the study. Throughout the process, Water Board staff has been informed and engaged in the study design and execution, to ensure that this effort is in line with the Order’s group monitoring plan requirements.

The study can be divided into three basic phases:

**Phase 1: Develop watershed-scale model and estimated annual sediment loads - COMPLETE**

Common Futures, working with UK-based firm Crop Performance Limited, employed publicly-available datasets to develop the WEPP model for applications in the Napa River watershed. Upon the recommendation of Water Board staff, the model was run on three sub-watershed study areas: Carneros Creek, Upper Milliken Creek, and Lower Milliken Creek (Sarco Creek). Primary inputs into the model included: (1) elevation maps, (2) land cover maps, (3) soils maps, and (4) climate data, including local stream discharge data. Additional model inputs included parameters files for the land uses and soils used in the study. Crop parameter values were also developed using ‘best estimates’ and other work.

Hydrologic response of the model was tested by comparing modeled results to available stream discharge observations, and the model was seen to acceptably capture key observations. Net Annual Sediment Load (MT/ha/yr) was estimated at the watershed scale for each of the study areas (for all land surfaces, not just vineyards), and compared to soil T-factors from the NRCS SSURGO soil survey dataset.

This work was completed in the period October 2017 – May 2018. The preliminary results of this initial modeling effort will be included in the final Group Monitoring Report.
**Phase 2: Testing model results for vineyard applications using artificial rainfall study data - COMPLETE**

This second step was completed to evaluate the model’s performance in predicting erosion on vineyard sites as compared to field data from hillslope vineyards in the watershed. At the suggestion of Water Board staff, Common Futures utilized results from a study in *Hydrological Processes* entitled, “Rainfall runoff and erosion in Napa Valley vineyards: effects of slope, cover and surface roughness” (Battany and Grismer, 2000). Battany and Grismer used artificial rainfall to simulate a series of precipitation events at a selection of Napa Valley vineyard sites, then quantifiably measured total sediment loss from the experiments.

Common Futures used the WEPP interface to develop an initial model, using equivalent storm patterns, slope, cover, and soils to Battany and Grismer, then developed scripting code to modify model parameters, run the model code, and pull out key model results for further analysis. These scripts were designed to automatically allocate and run individual hillslope models that corresponded to each of the plots measured by Battany and Grismer.

The WEPP model acceptably captured the magnitude of erosion rates, as well as the key observed relationship between percent cover and erosion rates identified in Battany and Grismer.

This work was completed in December 2019 – January 2020. The results of this validation effort will be included in the final Group Monitoring Report.

**Phase 3: Further validation, finer spatial scale, and individual site assessments – ONGOING (estimated completion date: July/August 2020)**

This final phase focuses on validating the model, then using the more detailed hillslope version of WEPP to assess performance on individual properties. Common Futures is utilizing existing satellite imagery, in conjunction with grower datasets and a grower survey, to develop and ground truth satellite-derived cover estimates and other parameters relevant to the WEPP model output. This involves the procurement of available images at appropriate spatial scales, as well as the development of algorithmic relationships between spectral indices (developed from the images) and data characterizing percent cover during the period after harvest. Relationships between available data and calculated spectral indices will be developed and subsequently used to characterize percent cover across the extent of vineyard properties participating in the group monitoring effort.

The validated model will then be used to estimate soil loss rates on a sample of vineyard blocks and parcels, representing a variety of slopes and soil types. The model analysis in this third phase will incorporate heterogeneity in the vineyard property and a more detailed flow pathway analysis consistent with the General Permit expectations. Results from these analyses will be used to make observations about how different variables interact (e.g. slope, soil type,
percent cover, precipitation rates) across the permit area, with potential applications in Farm Plan development and verification.

Final model outputs will be compared to T factors and thereby used to evaluate attainment of performance standard for the Soil Erosion in the Farm Area, thus satisfying the permit requirements for this portion of the BMP Effectiveness study.

This work is in progress and anticipated to be completed by July/August 2020.

2.4 Project Team

Common Futures LLC is a Corvallis, Oregon-based consulting firm engaging with clients to apply state of the art spatial analysis and modeling tools to improve sustainability of managed and natural systems. Project consultants John Bolte and Kellie Vache have a combined 40 years of experience in spatial analysis and modeling of a variety of hydrological and ecological processes and systems, including extensive experience in agricultural systems analysis, soil erosion assessment and the WEPP model employed in this project.

References


Section 3: BMP Effectiveness - Unpaved Roads on Hillslope Vineyards

Prepared by:

Napa County Resource Conservation District, Sonoma Resource Conservation District, and Pacific Watershed Associates

3.1 Introduction

This Plan was prepared by a team of technical and professional staff from Napa County and Sonoma Resource Conservation Districts (RCD) and Pacific Watershed Associates (PWA), hereafter referenced as “Technical Team”.

The goal of the Plan is to answer the question: Are the BMPs that are commonly prescribed to achieve the Performance Standards effective at doing so? The road-related Performance Standards defined in the WDRs are: (1) achieving ≤ 25% hydrologically connected roads across all unpaved road mileages on vineyard properties; (2) reducing diversion potential at culverted stream crossings; and (3) reducing plug potential at culverted stream crossings. Specified BMPs include: rolling dips, water bars, critical dips, and trash barriers or deflectors (also referred to as trash racks).

3.2 Road BMP Monitoring Plan

The draft Road Monitoring Plan has three main elements: (1) BMP Selection, (2) Site Selection, and (3) Implementation Timeline

The final Road Monitoring Plan will include: (1) clear objectives; (2) an outline of repeatable protocols and methodologies; (3) a monitoring schedule clearly defining dates and/or qualified events that trigger monitoring; and (4) identification of approved reference(s) readily accessible by monitors that provide rainfall totals during storm events. The proposed outline for each phase includes consideration of these elements.

3.2.1 BMP Selection

The Technical Team identified many BMPs that may be implemented to meet the road-related Performance Standards in the Vineyard General Permit. The comprehensive list of BMPs are presented below and categorized as either Road Surface Drainage BMPs (those that disconnect road runoff from delivering to streams) or Stream Crossing BMPs (those that reduce culvert plug potential or diversion potential). The Technical Team recommends that monitoring be performed on BMPs that will most commonly be used to achieve the WDRs performance standards, which are presented in bold in the lists below.

Road Surface Drainage BMPs:

- Rolling Dip
• **Waterbar**
• Ditch Relief Culvert
• Outsloping
• Insloping
• Crowning

*Stream Crossing BMPs:*

• BMPs that reduce diversion potential
  • **Critical Dip**
  • Overflow culverts on deep fill crossing structure
• BMPs that reduce plug potential
  • **Trash Rack/Barrier/Deflector**
  • Flared inlet

BMPs will be monitored only if they have experienced a 5-year or greater recurrence interval peak discharge, which is a storm event that produced ≥ 10,000 cfs at the US Geological Survey Napa River near St. Helena gauge.

### 3.2.2 Site Selection

The Technical Team hypothesizes that the environmental and cultural factors listed below may contribute to the current effectiveness of road BMPs.

**Environmental:**

• **Geology (X geologic units)**
• **Road surface type (gravel vs. grass vs. native)**
• Native hillslope gradient (5-30% vs. >30%)
• Average road gradient (5-12%, 12-22%, >22%)
• Average annual rainfall (delineate categories based on data set used)
  o Precipitation data recorded will be obtained from the National Weather Service by entering the site zip code at [http://www.srh.noaa.gov/forecast](http://www.srh.noaa.gov/forecast) to determine if the project has experienced a 5yr storm event or greater.
• Number of significant storm events (>5-year-storm) that BMP has experienced

**Cultural:**

• **Traffic (high, moderate, low, or no use. Year round vs. dry season only)**
• **Quality of maintenance by land manager (low, mod, high)**
• Implementation oversight (landowner vs. RCD vs. PWA vs. other/unknown)
• Heavy equipment operator (landowner vs. experienced contractor vs. other/unknown)

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1 Final selection of Geologic Units included will be at request and delineation by Water Board staff.
Although site selection should be carried out to ensure that BMP effectiveness may be evaluated in a variety of environmental and cultural contexts, it is likely to be cost-prohibitive to identify a sufficient sample size of sites that represent the full suite of factors that we may be interested in studying. Therefore, the Technical Team recommends that monitoring be conducted such that the influence of the factors in bold on BMP effectiveness may be evaluated. The Technical Team determined the items in bold are likely to have strong influence on BMP effectiveness AND it is somewhat likely that the monitoring group will be able to find sufficient sample size of at least one of the BMPs to evaluate the factor’s influence. It is important to note that the number of BMPs available to monitor will vary according to BMP. Based on preliminary investigation of the Technical Team’s combined project database, rolling dips and water bars are much more abundant on the landscape than critical dips and trash racks.

3.2.3 Implementation Timeline

The Technical Team proposes three phases over which the monitoring protocol will be developed, tested, reviewed, revised, and finally implemented.

Phase 1 (Approximately 6 months)

- Develop BMP database (e.g. Table 1)
- Finalize the selected subset of existing BMPs to monitor as part of Phase 1 Pilot Project
- Develop data form to assess current conditions of BMPs and collect selected information (by BMP type). Proposed fields on the data form may include:
  - BMP Description (location, dimensions, material, structural integrity, etc.)
  - Length of hydrologically connected road draining to BMP feature
  - Distance between each BMP features (frequency of spacing) along left and/or right hydrologically connected road approaches
  - Current length of hydrologically connected road to stream crossings (distance from last BMP structure to stream crossing)
  - Does the BMP treatment (feature) still exist?
  - Does the BMP appear to have been installed/constructed as per approved industry standards?
  - Is the BMP currently functioning as intended? Why or why not?
  - Document current deficiencies of BMP (i.e. stream diversion, plugged culvert, ineffective hydrologic disconnection, etc.) and recommendations for improvement
  - Photopoint (for representative sample)
- Obtain Landowner Agreement/site access to conduct pilot monitor project for subset of existing treatments
- Conduct field assessment(s) whereby qualified professional(s) evaluate BMPs utilizing the data form and execute monitoring of Pilot Project.
• Summarize monitoring data from Pilot Project and present results to Water Board and stakeholders
• Based on group review and input, modify protocol(s) for Phase 2

Phase 2 (Approximately 18 months)
• Adapt and revise data form and protocol(s) based on lessons learned from Phase 1
• Identify additional BMP treatments, local variables and geologic unit combinations that may not yet be represented in Phase 1 Pilot Project dataset but are recommended for inclusion
• Identify additional sites where BMP monitoring can fulfill identified deficiencies
• Conduct a second season of field assessments whereby qualified professional(s) evaluate BMPs to satisfy data gaps identified from Phase 1

Phase 3 (Approximately Spring – Summer 2023)
• Summarize data from Phase 2 and present draft results to Water Board and stakeholders
• Prepare and submit final monitoring report for Pilot Project
3.3 Example Sample Set for Pilot Project

The Technical Team has compiled a monitoring database composed of road sediment reduction projects that have taken place over the past 15 years that RCDs that have been sponsored or managed by Napa County RCD, Sonoma RCD, or PWA. The combined RCD database contains georeferenced BMP locations, with some exceptions.

Table 1. Number of existing BMP treatments in Napa River and Sonoma Creek watershed in RCD and PWA combined road project database.

<table>
<thead>
<tr>
<th>Geology</th>
<th>Reduce Plug Potential</th>
<th>Reduce Diversion Potential</th>
<th>Reduce Hydrologic Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Francisca Melange and Sheared Serpentinite</td>
<td>0</td>
<td>29</td>
<td>161</td>
</tr>
<tr>
<td>Sedimentary</td>
<td>0</td>
<td>1</td>
<td>128</td>
</tr>
<tr>
<td>Sonoma Volcanics Flow</td>
<td>0</td>
<td>1</td>
<td>114</td>
</tr>
<tr>
<td>Sonoma Volcanics Tuff and Ash Flow</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other Hard Rock</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Number of existing BMP treatments in Napa River and Sonoma Creek watershed and other watersheds in Sonoma County in RCD and PWA combined road project database.

<table>
<thead>
<tr>
<th>Geology</th>
<th>Reduce Plug Potential</th>
<th>Reduce Diversion Potential</th>
<th>Reduce Hydrologic Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Francisca Melange and Sheared Serpentinite</td>
<td>0</td>
<td>61</td>
<td>424</td>
</tr>
<tr>
<td>Sedimentary</td>
<td>0</td>
<td>39</td>
<td>570</td>
</tr>
<tr>
<td>Sonoma Volcanics Flow</td>
<td>0</td>
<td>0</td>
<td>130</td>
</tr>
<tr>
<td>Sonoma Volcanics Tuff and Ash Flow</td>
<td>0</td>
<td>4</td>
<td>142</td>
</tr>
<tr>
<td>Other Hard Rock</td>
<td>0</td>
<td>2</td>
<td>49</td>
</tr>
</tbody>
</table>

3 The database also includes georeferenced locations, where known, and other considerations including watershed, slope gradients, rainfall, etc.
Section 4: BMP Effectiveness - Bed and Bank Erosion on Hillside Vineyards

Upon review of the Vineyard General Permit, Attachment E (Monitoring and Reporting Requirements), published literature detailing bioengineering BMPs for bed and bank erosion in upland and streambank contexts, and discussions with professionals who have implement such BMPs, watershed stakeholders have determined that the effectiveness of BMPs for bed and bank erosion that would be prescribed as part of the farm planning process has been clearly demonstrated. Therefore, no additional effectiveness monitoring for such BMPs should be required.

Background and rationale leading to determination that additional effectiveness monitoring of bed and bank erosion BMPs should not be required:

1. Vineyard General Permit, Attachment E (Monitoring and Reporting Requirements) provides the Executive Officer of the San Francisco Bay Regional Water Quality Control Board with the authority to modify any/all of the monitoring and reporting requirements as necessary and appropriate.

2. The following published literature provides detailed guidance regarding design, construction, and maintenance of soil bioengineering BMPs implemented to treat eroding gullies and/or other unstable hillslopes and channels to ensure that they are effective.

   Biotechnical and Soil Bioengineering Slope Stabilization – A Practical Guide for Erosion Control (Gray and Sotir, 1996), has been cited in 1075 peer-reviewed journal articles. This publication provides detailed and specific guidance regarding soil bioengineering techniques and methods.

   Cost Effective and Sustainable Road Slope Stabilization and Erosion Control (National Academy of Sciences, 2016) through review of case studies, published research, and expert practitioner interviews demonstrates how soil bioengineering techniques can be used to effectively control gully and shallow landslide erosion.

   Groundwork – A Handbook for Small-Scale Erosion Control in Coastal California (Marin RCD, 2007) provides a layperson’s guide to gully erosion control using soil bioengineering techniques. This guidebook summarizes the knowledge gained by technical staff working at the Marin RCD and Prunuske Chatham, Inc. over almost four decades of work implementing gully and channel erosion control projects on agricultural and open space lands in Marin County. Groundwork Identifies under what conditions (e.g., gully activity, head-cut height, drainage area) it is reasonable to try to implement DIY techniques (e.g., gully reshaping with hand tools, revegetation projects, willow wattles, brush mattresses, willow walls, etc.), how to correctly construct and maintain these projects, and when you need consult a qualified professional for more challenging or complex problems.


A Soil Bioengineering Guide for Streambank and Lakeshore Stabilization, Ch.5 Soil Bioengineering Techniques (Army Corps of Engineers/Conservation Corps) is a technical guide for streambank and lakeshore stabilization techniques using principles of bioengineering. https://static1.squarespace.com/static/5154ba3ae4b0feb1eb188610/t/525efc01e4b0f5b115bb671f/1381956609048/chapter5.pdf

3. Based on discussions with technical professionals and review of the literature, it is not likely that conducting additional monitoring and assessment as part of the group monitoring plan - to evaluate the performance of soil bioengineering BMPs implemented to control gully erosion - would contribute to a significant improvement in their performance.

4. The permit also requires property specific field surveys and photo points to monitor locations where hillslope vineyard discharge into actively eroding gullies and/or other unstable areas. The required field surveys must be conducted at a minimum at least once every five years, and also following a peak discharge ≥ to 10,000 cubic feet per second as measured at the USGS gage on the Napa River near St. Helena. Therefore, individual BMPs implemented as result of permit will be closely monitored.

5. The permit also requires that a Qualified Professional review and verify the Farm Plan to confirm that upon implementation it would be expected to meet all applicable performance standards for discharge including those for Bed and Bank Erosion. Farmers also are required to report annually the status of their property as related to achievement of the performance standards, and problems encountered. Water Board staff also have the authority to inspect all properties subject to the permit. Therefore, instances of significant bed and bank erosion on vineyard properties will be identified, and well documented, rigorous treatment plans will be developed, and implementation of such plans will be closely tracked.
References

