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UCCE Ranch Water Quality Planning

Instructor's Guide and Lesson Plan

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Acknowledgments

This publication and associated resources are the culmination of decades of research and delivery of educational programs to advance management practices that protect water quality and support grazing livestock operation viability. To the ranchers, resource agency representatives, and collaborators involved in this research and education, thank you for your contributions and leadership in the past and the future. Particular recognition goes to Drs. Jim Clausen and Mel George for initiating the original partnership and program, Drs. Kenneth W. Tate and Robert Atwill for the body of research they have contributed, and to Drs. Stephanie Larson and Royce Larsen and Advisor John Harper for piloting the first shortcourse education programs with participating ranchers. Additionally, the presenters in this publication's corresponding educational and instructional videos are thanked for their contributions to future education.

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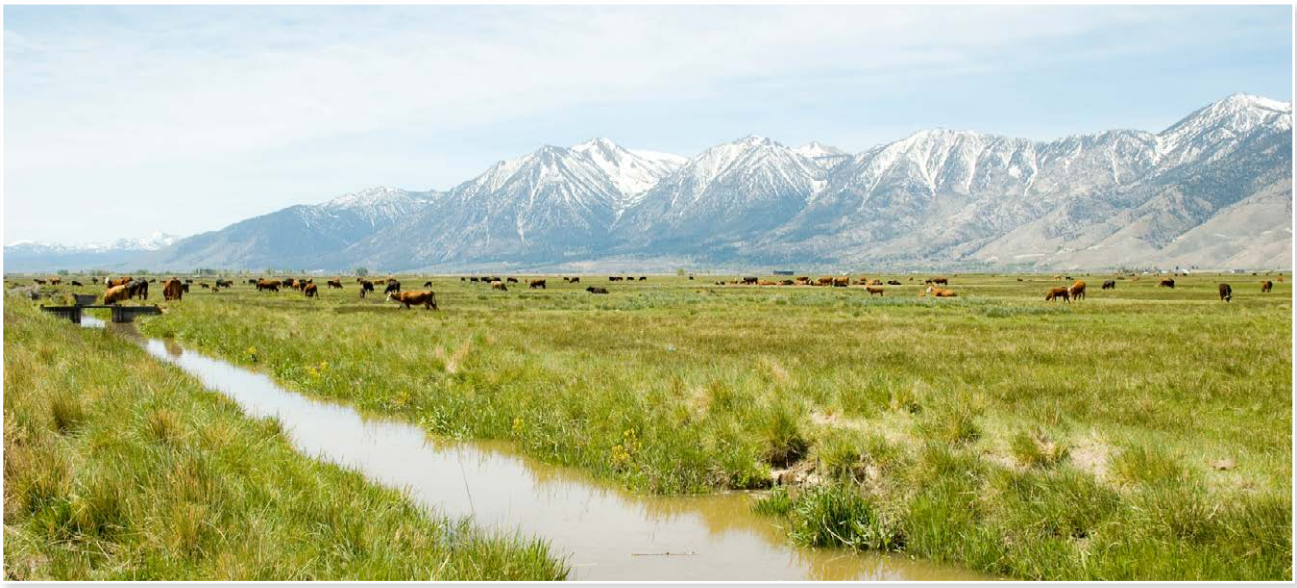


Ranch Water Quality Planning Instructor's Guide and Lesson Plan

Morgan Doran, UC Cooperative Extension (UCCE);
Michael Lennox, Olivet Ranch; and **David Lewis**, UCCE

Background and Origin

This Ranch Water Quality Planning Instructor's Guide and Lesson Plan (RWQP Guide) is an updated version of an original curriculum developed in 1995 by UC Cooperative Extension (UCCE) and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), with financial support from the California State Water Resources Control Board. Like the former curriculum, this updated guide and lesson plan provides a scientific overview of water quality, specifically for livestock operations, but with a wealth of new information discovered since the curriculum was first written. Another update is the provision of materials in an electronic format, including embedded video presentations on pertinent ranch water quality topics and step-by-step instructions on how to complete a ranch water quality plan (RWQP) by utilizing the RWQP Template worksheets.

This RWQP Guide is intended for extension professionals, watershed organization staff or volunteers, and the livestock ranching community. The goal is to provide an objective, adaptive framework and blueprint for organizing short course–type education programs that enable ranchers to complete RWQPs.

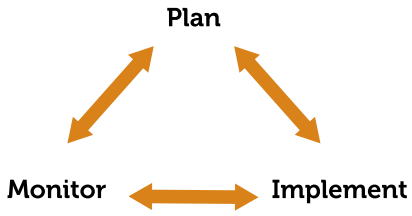
Completed RWQPs should support grazing land managers to 1) effectively comply with water quality regulations and 2) implement strategies and access resources that facilitate on-ranch stewardship. The main water quality issues covered in this RWQP Guide pertain to potential nonpoint source pollution concerns including pathogens, nutrients, and sediment—as well as functioning riparian or stream areas, as required by existing water quality regulations and policies. The RWQP Guide also facilitates ranch goal setting and action planning to address operational infrastructure and business needs. Before using this RWQP Guide, it is important to thoroughly read and understand the following sections:

- Background and Origin
- Using the RWQP Instructor's Guide and Lesson Plan

These sections provide context, intended use, and suggestions for adapting this RWQP Guide in California.

The RWQP facilitates a stewardship process and includes a quality control feedback mechanism that involves monitoring of previously completed conservation practices and riparian restoration efforts; this process allows future projects to be identified and priorities to be set. Decisions to preserve, conserve, and restore sensitive locations on ranches and to improve water quality are serious decisions for landowners, with long-term consequences, and are not taken lightly.

Stewardship Process



The RWQP Template presented in this RWQP Guide consists of a series of worksheets that collectively make up the RWQP. The worksheets were developed through a partnership of representatives from resource agencies, industry groups, regulatory staff, and UCCE. The process built upon Conservation Plans from the NRCS, UCCE Ranch Water Quality Planning Short Courses, and Resource Conservation Districts. The RWQP Template was approved by the California Regional Water Quality Control Board (San Francisco Bay Region) for use in conditional waiver regulatory programs in the Tomales Bay, Napa River, and Sonoma Creek watersheds. However, the RWQP Template should be considered one example for the RWQP format and can be modified to satisfy specific regulatory programs and producer needs. The RWQP Template worksheets provide a framework for rancher completion of the RWQPs, project planning, and monitoring that may be required in a regulatory program.

Using the Ranch Water Quality Plan (RWQP) Instructor's Guide and Lesson Plan

There is no one-size-fits-all approach for how to present ranch planning materials. Success is determined by gauging the attendees' understanding and acceptance of material presented. The process is best implemented in an adaptive manner that tailors the program to emphasize issues and partnerships specific to the local area and to the priorities of the local ranching community. This approach gives local agencies and participating ranchers an opportunity to work together in guiding the RWQP process and to take ownership of the outcomes. The RWQP Guide offers many opportunities for ranchers and landowners to insert their own experiences into the program. A desired outcome of this RWQP Guide is for ranchers to self-manage the prioritization of stewardship and conservation for their ranches and understand and apply tools to manage soil, vegetation, water, and other ranch resources to achieve their multiple objectives. Important steps in this communication process are introduction, exploration, sharing, processing, generalizing, and applying the new material learned by setting the priorities for a specific ranch.

The RWQP Guide presents ranch water quality planning in a step-by-step approach that begins with basic water quality topics and implications of applicable regulatory programs. Once a basic understanding of water quality is achieved, the RWQP Guide advances through more specific ranch water quality issues, practices, and planning modules that follow the order of topics in the RWQP Template. This RWQP Guide is intended to be flexibly applied and adapted to fit other ranch water quality planning efforts.

This RWQP Guide is divided into six modules and nineteen lesson plans that provide suggested approaches for an iterative, sequential, step-by-step process in developing and implementing an RWQP education program (table 1). Keep in mind that the RWQP Guide content may not address all water quality issues and concerns in all geographic regions and may require additional material or modifications by a professional with knowledge of locally specific issues. Below are descriptions of the topics addressed in the six modules.

- **Module 1** (Lesson Plan 1) is an introduction to the RWQP process, which includes an opportunity to network with partnering organizations and regulatory agency staff representatives, understand the regulatory landscape, and review the short course timeline and workshop dates.
- **Module 2** (Lesson Plans 2–5) provides context for and origins of nonpoint source pollution regulation and the current state of knowledge for on-ranch water quality management.

- **Module 3** (Lesson Plans 6–9) covers overall orientation to the RWQP Template worksheets, which can be adapted to the participants' specific watershed and any existing regulatory programs. It also covers the development and documentation of ranch information, goals, ranch maps, and water quality assessment. Any modifications made to the RWQP Template should be finalized prior to starting Module 3.
- **Module 4** (Lesson Plans 10–13) addresses water quality and conservation management aspects of the RWQP Template worksheets to help ranchers document previously implemented projects and practices and take the critical step of setting priorities for future conservation practice implementation.
- **Module 5** (Lesson Plans 14–16) concludes the instruction provided through RWQP Template worksheets with a discussion of the monitoring components necessary to maintain the RWQP.
- **Module 6** (Lesson Plans 17–19) suggests field workshops to visit on-the-ground examples of water quality management issues and constraints common to California ranches. The field workshops are good opportunities to review, practice, and reinforce the use of the RWQP Template worksheets and learn about conservation practices and materials.

Table 1. List of training modules, lesson plans, topics, and time allocations.

Module and lesson plan	Topic	Allocated time/ lesson plan
Module 1 — Introduction to RWQP Process (1.0–2.5 hours)		
Lesson Plan 1	Where and when RWQPs are needed	1.0–2.5 hours
Module 2 — Ranch water quality regulations and current science (5.0–7.5 hours)		
Lesson Plan 2	Nonpoint source water quality regulations	1.0–1.5 hours
Lesson Plan 3	Current science of rangeland watershed and nutrient management	1.5–2.0 hours
Lesson Plan 4	Rangeland hydrology, soil characteristics, sediments, and maps	1.5–2.0 hours
Lesson Plan 5	Pathogens and practices for water quality management	1.0–2.0 hours
Module 3 — Starting an RWQP (2.5–3.5 hours)		
Lesson Plan 6	Orientation to RWQP Template and property information	30–40 min.
Lesson Plan 7	Ranch goals	30–40 min.
Lesson Plan 8	Pasture inventory	30–40 min.
Lesson Plan 9	Pasture and stream assessment	1.0–1.5 hours
Module 4 — Planning, prioritizing, and documenting water quality practices (2.5–3.5 hours)		
Lesson Plan 10	Completed water quality projects	40–60 min.
Lesson Plan 11	Future water quality projects	40–60 min.
Lesson Plan 12	Setting project priorities	45–60 min.
Lesson Plan 13	Mapping ranch resources	30–40 min.
Module 5 — Monitoring (2.0–3.5 hours)		
Lesson Plan 14	Pasture use records	20–40 min.
Lesson Plan 15	Monitoring with visual inspections and photographs	50–60 min.
Lesson Plan 16	Monitoring residual dry matter	40–90 min.
Module 6 — On-ranch workshops (6–12 hours)		
Lesson Plan 17	Ranch roads	2.0–4.0 hours
Lesson Plan 18	Stream and gullies	2.0–4.0 hours
Lesson Plan 19	Pastures	2.0–4.0 hours

A more complete view of the modules, lesson plans, and time allocations are presented in table 1 to help plan and schedule a series of workshops. Although the modules and lesson plans are organized in a sequential manner, specific module components and lesson plans can be delivered in various combinations during single workshops and field tours. Adapting and customizing the timing of presented information is recommended to make delivery efficient and of interest to attendees—and to effectively connect concepts to the RWQP Template worksheets. This is especially true of the timing and scheduling of the field workshops (Module 6) to correspond with seasonal conditions and with the presentation of concepts in the other modules. Leadership for adapting the RWQP Guide to local watershed and ranching conditions should come from partnering organizations and ranch community leaders. Additionally, an informal workshop facilitator who is locally and professionally respected by most attendees is very important for maintaining continuity across informational speakers and building confidence in the program over the course of workshops and field days.

Lesson Plan Format

Each lesson plan follows a set structure of providing information and guidance intended to enable deployment of an RWQP program by someone, or some agency, that is not necessarily an expert in ranch water quality issues. When planning RWQP workshops and field days using this RWQP Guide, the education program planner can strictly adhere to the lesson plans, but should feel at liberty to modify the lesson plans to address specific issues in the local area and utilize speakers and resources that are available and can contribute more locally relevant information and support for the ranching community.

The format for each lesson plan in this RWQP Guide provides information and guidance in each of the following areas.

- Goals/Overview—Lesson plan goals and overall purpose
- Learning Objectives—Specific lesson plan objectives to be covered
- Introduction/Hook—Importance and relevance of lesson plan information
- Materials/Speakers—Identification of supporting materials and speakers
- Time Allocated—Amount of time to budget for workshop or field day program
- Procedures/Activities/Strategies/Questions—Step-by-step guide for lesson delivery
- Conclusion/Self-assessment—Lesson's concluding thoughts that support objectives
- Resources—Identification of available resources for participants
- Next Steps/Lessons—Homework and preparation for next workshop or field day

Presentations

The video presentations embedded in this RWQP Guide provide a scientific understanding of and instruction on various topics important to ranch water quality. They are meant to be incorporated into workshops and classes with ranchers and landowners as the intended audience. In the lesson plans, the videos are described as educational, meaning that they are intended to improve the audience's understanding of the topic—or as instructional, meaning that they are intended to demonstrate how to complete a specific RWQP Template worksheet or monitoring activity. Video topic order is based on previous experience in delivering RWQP education programs (table 2). Depending on resources and time available, the workshop organizer may wish to combine or expand on topics and invite in-person presenters instead of, or in addition to, the use of the embedded videos. Each video is accessed by clicking the hyperlinked text in table 2, or the hyperlinked text in each lesson plan. Most of the educational videos have a short (or preview) version and a longer (full) version. The preview videos provide the audience a summary of each topic. The full-version videos provide a comprehensive understanding with background information and, in some cases, supporting evidence. The preview videos are not intended to be used as substitutes for the full versions.

Table 2. List of video presentation topics, presenter names, and the corresponding lesson plan.

Video Number	Title/ Subject	Lesson Plan #	Presenter
1	Introduction to the RWQP Instructor's Guide		David Lewis and Morgan Doran, UCCE
2	Overview of Water Quality and Grazing Management	1	Morgan Doran, UCCE
3	Grazing Water Quality Partnership • Preview • Full version	1	Dan Macon, UCCE
4	California Grazing Systems	2	Josh Davy, UCCE
5	Water Quality Policy Overview	2	David Lewis, UCCE
6	Science of Grazing Management and Water Quality • Preview • Full version	3	Ken Tate, UCD
7	Nutrient Dynamics and Water Quality on California Rangelands • Preview • Full version	3	Randy Dahlgren, UCD
8	Streamflow Generation in California Rangelands • Preview • Full version	4	Toby O'Geen, UCD
9	Fate and Transport of Sediment • Preview • Full version	4	Toby O'Geen, UCD
10	Drought Management • Preview • Full version	4	Leslie Roche, UCD
11	Rangeland Management of Waterborne Pathogens from Livestock and Wildlife • Preview • Full version	5	Rob Atwill, UCD
12	Public Lands Grazing and Water Quality • Preview • Full version	5	Leslie Roche, UCD
13	Management Options to Reduce Pollutants in Runoff from Irrigated Pastures • Preview • Full version	5	Tracy Schohr, UCCE ANR Video
14	Ranch Water Quality Plan Worksheets Overview	6	David Lile, UCCE
15	Property Information—Worksheet 1	6	Devii Rao, UCCE
16	Ranch Goals—Worksheet 2	7	Stephanie Larson, UCCE
17	Pasture Inventory—Worksheet 3	8	Rebecca Ozeran, UCCE
18	Pasture Assessment—Worksheet 4	9	Fadzayi Mashiri, UCCE

Continued on next page

Table 2. List of video presentation topics, presenter names, and the corresponding lesson plan, continued.

Video Number	Title/ Subject	Lesson Plan #	Presenter
19	Stream Temperature • Preview • Full version	9	Ken Tate, UCD
20	Riparian Grazing Management • Preview • Full version	9	Ken Tate, UCD
21	Stream Assessment—Worksheet 5	9	Theresa Becchetti, UCCE
22	Completed Projects—Worksheet 6	10	Laura Snell, UCCE
23	Future Water Quality Projects—Worksheet 7	11	Julie Finzel, UCCE
24	Sediment Delivery Inventory And Monitoring	12	ANR Video
25	Mapping Ranch Facilities—Worksheet 8	13	Matthew Shapero, UCCE
26	Pasture Use Records—Worksheet 9	14	Brook Latack, UCCE
27	Monitoring—Worksheet 10	15	Jeff Stackhouse, UCCE
28	Guidelines for Residual Dry Matter on Coastal and Foothill Rangelands in California	16	ANR Video
29	Ranch Road Storm-Proofing • Preview • Full version	17	Bill Birmingham, Napa RCD

Module 1.
Introduction to RWQP


Photo: Michael Lennox

Module 1 introduces participants to the RWQP process. The intent is for education program organizers to orient ranchers to the purpose of the RWQP and to the planned series of workshops and field days for their areas and specific watersheds. Flexibility is provided to make changes to meet local needs. Lesson Plan 1 is designed to relay the integrated objectives of sustainable ranching, viable farms, and compliance with any water quality regulations. This session is intended to build camaraderie among watershed landowners and neighbors. Keep in mind that participants who may be required to complete RWQPs to comply with regulations are not expected to embrace water quality policies or paperwork. Conveying an understanding of policies and of which agencies and organizations offer resources to ranchers is a realistic objective at this early stage in the process. Much of the effort in the early stages will focus on the "why" questions (Why are there water quality regulations? Why are there grazing water quality issues?) and how regulatory compliance can be accomplished through the RWQP process.

Lesson Plan 1.
Where and When are RWQPs Needed?

Goals/Overview:

This first lesson is an overview offering reasons for and benefits of having an RWQP. In some cases ranchers and landowners must develop an RWQP to be in compliance with a water quality regulatory program, while others may voluntarily develop a plan to demonstrate their proactive approach to addressing and documenting work to enhance water quality. The RWQP Template worksheets were created to comply with specific regulatory programs, and were designed to be used as a grazing and project management tool that can benefit any grazing operation, regardless of regulatory actions.

If there is a regulatory program in place or in development, landowners and ranchers can often be included in guiding the local regulatory process and compliance mechanisms through engagement opportunities that Regional Water Quality Control Boards may offer, along with agricultural organizations. Existing regulatory programs and partnerships in other regions that have functioned well provide examples from which to create programs in newly regulated watersheds. Building on an existing regulatory framework allows more opportunities to incorporate approaches that improve aspects of ranch management beyond water quality.

Learning Objectives:

1. Learn the current situation with water quality regulations and how the RWQP will help ranchers and landowners comply with regulations, if applicable, and enhance water quality.
2. Understand UCCE's history with RWQPs and the NRCS's history with conservation planning in California and the United States.
3. Learn about development of voluntary ranch water quality short courses in California during the 1990s.
4. Become familiar with the definition of total maximum daily load (TMDL), impaired waterbodies, and implementation plan approaches for a specific watershed. Details of TMDLs and the Clean Water and Porter Cologne Acts will be covered in Lesson Plan 2.
5. Understand components of the RWQP, some of which may be required for compliance in a regulatory program and some of which may be optional.
6. Discuss and differentiate natural, historical, and current management impacts on water quality and how each may be treated by the regulatory agency.
7. Understand how an RWQP's components, scope, and schedule will depend on roles, partners, relationships, resources, and so on.

Introduction/Hook:

- Review and discuss the role and benefits (ecosystem services) of managed livestock grazing for grassland diversity, wildlife, and reducing wildfire risks, as well as its utilization of forage fiber for producing meat and other consumer products.
- Find local examples of how ranchers and landowners have benefited or could benefit from having an understandable methodology and plan for addressing water quality issues that can also help them improve other aspects of ranch management.

Materials/Speakers:

- Provide handouts of proposed and/or pertinent regulations.
- Invited speaker from Regional Water Board staff to explain regulations and be available for questions.
- Provide example of binders or other materials provided from other RWQP programs in California (Tomales Bay or Napa/Sonoma watersheds).
- Educational video: "Overview of Water Quality and Grazing Management" (7 minutes).
- Educational video: "Grazing Water Quality Partnership" (8 minutes).

- Food and beverages: Snacks and coffee/tea suffice during introductory meetings.

Time Allocated:

Allow 1 to 2.5 hours (30 minutes for presentations and 20 to 90 minutes for questions). Times are flexible to allow participants to articulate frustrations or confusion and to get as many questions answered as possible—while starting to build relationships with resource agency staff.

Procedures/Activities/Strategies/Questions:

- Welcome; attendees introduce themselves.
- Ascertain what percentage of attendees are landowners, livestock managers, and/or agency staff.
- Explain and discuss the purpose and goals of the program. The purpose of some programs may be to help ranchers create RWQPs to comply with a specific regulatory action. Other programs may be voluntary efforts to create RWQPs to preempt regulatory actions.
- Consider having Regional Water Board staff explain their board's approach to water quality on grazing lands and the status of any regulatory actions.
- Present video: "Overview of water quality and grazing management."
- Share stories of local storm and erosion events that attendees remember or know.
- Discuss importance of setting realistic goals to have successful water quality improvements. Briefly review any relevant case studies: 1) No single practice fixes water quality all at once; 2) Numerous practices implemented and improved upon over time have been successful in restoring watershed functions (20 minutes).
- Present video: "Grazing Water Quality Partnership."
- Allow extra time for plenty of questions from ranchers.
- Introduce the local conservation partnership that offers support for agricultural producers and consists of staff from agencies (for example, NRCS, resource conservation districts (RCDs), UCCE, Farm Bureau, consultants, land trusts, and so on).
- Briefly describe grants and cost-share programs available to local ranchers and how an RWQP will help make grants more accessible.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Understand how water quality regulations may impact local ranchers, as well as who needs to comply and why.
- Understand how engagement in the RWQP process and conservation partnerships can open doors to resources for local ranchers to improve water quality and animal production.
- Brainstorm other high-priority questions that require clarification.
  - Filing of plans on ranches.
  - Obligations of landowners and lessees.
  - Required conservation practices, if any. Many people ask if all streams need exclusionary fencing to be in compliance.

Resources:

George, M., S. Larson-Praplan, J. Harper, D. Lewis, and M. Lennox. 2011. California's Rangeland Water Quality Management Plan: An update. Rangelands. February: 20–24. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalespathogens/Calif.Rng.WQMP.2011.pdf

Larson, S., K. Smith, D. Lewis, J. Harper, and M. George. 2005. Evaluation of California's rangeland water quality education program. Rangeland Ecology & Management 58(5). https://ucanr.edu/sites/UCCE_LR/files/180937.pdf

San Francisco Bay Regional Water Quality Control Board. 2007. Tomales Bay pathogen TMDL, TMDL implementation, grazing waver program. https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalesbaypathogenstmdl.html

San Francisco Bay Regional Water Quality Control Board. 2017. Conditional waiver program for grazing operations in the Napa River and Sonoma Creek watersheds. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/grazing/

Next Steps/Lessons:

- Consider when erosion occurred on your ranch and why.
- Find previously completed conservation plans or ranch plans.
- Plan how to adapt calendar and RWQP Guide to local needs.

Module 2.
Ranch Water Quality


Photo: Suzanne Paisley

Module 2 is intended to introduce water quality regulations, summarize the current science of rangeland water quality, explore the importance of soil types and stability for water quality, and review management practices to improve water quality on rangelands. Allow adequate time to review previous lesson plan components and remind attendees of the RWQP's purpose as an ongoing process (for example, to facilitate and maintain a mutual understanding of specific watershed regulations that balance water quality improvements with long-term ranch viability). Remind attendees that maintaining water quality on their ranches is an ongoing process and that this RWQP Guide helps organize an appropriate RWQP for regulatory compliance and resource management—all of which enhances ranch sustainability and viability.

Concurrently, when Module 3 begins, a final version of the RWQP Template should be ready with any adaptations or modifications that may be necessary to address local concerns. In some cases, approval of the RWQP Template may be required by relevant regulators where regulatory compliance programs are in place. It is always helpful and strongly suggested to pilot-test the RWQP Template with a few patient producers before providing the final RWQP Template to participants during Lesson Plan 6.

Lesson Plan 2.
What are Nonpoint Source (NPS) Water Quality Regulations?

Goals/Overview

Explain the background of California grazing systems and water quality regulations on rangelands, and explain how nonpoint source pollution policies compare to point sources regarding historical priorities.

Learning Objectives:

1. Understand the different grazing systems in California.
2. Understand the historical timeline of water quality regulations in the United States since 1970.
3. Contrast point sources of pollution to nonpoint sources regarding timeline of watershed management.
4. Learn about potential rangeland pollutants found in some California waterways.
5. Learn general concepts of the rainfall-runoff process regarding the way in which potential pollution sources on ranches move downstream.
6. Classify four common types of erosion—sheet, rill, gully, and streambank.
7. Understand the impact of common rangeland pollutants in local watershed(s) on water quality and aquatic fauna. Discuss other sources in the watershed briefly.
8. Explain the preliminary plan for conservation partner agencies to provide ranch maps (soil, topographic, and aerial versions) of grazing land and properties to interested attendees.

Introduction/Hook:

- Discuss general land use changes over previous century and impacts of specific large storm events on agricultural production of a region or county, and possible land use impacts on water quality. Describe changes in human population densities and multiple or cumulative uses of surface water.

Materials/Speakers:

- Historical aerial photos of watershed, region, and/or ranch comparing circa 1970s to present. Google Earth often has comparable imagery from the 1990s.
- Educational video: "California Grazing Systems" (8 minutes).
- Speaker and facilitator of discussions—possibly UCCE Livestock Range Advisor or other range manager and/or UCCE Watershed Management Advisor.
- Educational video: "Water Quality Policy Overview" (17 minutes).
- Invite Water Board staff to be available to further explain regulations.
- Provide example of binder with RWQP from Tomales Bay or Napa/Sonoma watersheds.
- Food and beverages—snacks and coffee/tea will suffice; however, consider resources or donations available to provide local food examples.

Time Allocated:

Allow 1 to 1.5 hours (25 minutes for presentations and 20 to 40 minutes for questions and reviewing waiver regulations). Times are flexible to allow participants space to get to know each other better, engage in some "small talk," and build relationships with resource agency staff.

Procedures/Activities/Strategies/Questions:

- Welcome; attendees introduce themselves.
- Give attendees an opportunity to ask questions on previously covered topics.
- Present video: "California Grazing Systems."
- Describe the grazing system(s) in the local area, season of use, and water quality implications.
- Present video: "Water Quality Policy Overview."

- Compare and contrast sources of sediment, nutrients, pathogens, or other water quality concerns from specific or generalized ranches (20 minutes).
- Ask for examples of historic point and nonpoint sources of pollution from the watershed.
- Cover activity reviewing historical maps and aerial photos of watershed (20 minutes).
- Discuss large changes in watershed over time and contemplate if types of erosion or other pollution sources have changed.
- Discuss observations of attendees around their ranches following large rainfall events.
- Allow sufficient time to review and answer all questions regarding water quality regulations (20 to 30 minutes).
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Have participants reflect upon the rainfall-runoff process with anecdotal stories of large storm events.
- Participants should consider ranch locations that may be potential sources of pollution.

Resources:

Barry, S., W. King, S. Larson, and M. Lennox. Opportunities to sustain "greener" farming: Comparing impacts of water quality regulations in two catchments: Lake Taupo (NZ) and Tomales Bay, California (USA). 2010. Proceedings of the New Zealand Grassland Association 72:17–22. https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalespathogens/TomalesNewZealandBarry.pdf

George, M. R. 1995. Nonpoint sources of pollution on rangeland. Fact sheet no. 3. Rangeland Watershed Program, UCCE and Natural Resources Conservation Service. https://ucanr.edu/sites/UCCE_LR/files/180590.pdf

Gerstein, J. M., D. J. Lewis, K. Rodrigues, J. M. Harper, and J. Kabashima. 2006. State and Federal Approaches to Control of Nonpoint Sources of Pollution. Oakland: UC Agriculture and Natural Resources Publication 8203. https://anrcatalog.ucanr.edu/pdf/8203.pdf

State Water Resources Control Board. n.d. Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program. https://www.waterboards.ca.gov/water_issues/programs/nps/docs/plans_policies/nps_iefs.pdf

Next Steps/Future Lessons

- Ask participants to think about sites on their ranches and if and when pollution sources may potentially connect to water bodies (that is, after how much rainfall do ditches and streams lose clarity and become turbid?).
- Have participants think about historical pasture productivity changes that may have resulted from the three types of erosion.
- Suggest participants view previews for videos 6 and 7 prior to Lesson Plan 3.

Lesson Plan 3.
Current Science of Rangeland Watershed and Nutrient Management

Goals/Overview

Provide overview of rangeland water quality science to understand how grazing and livestock management practices can degrade and enhance water quality.

Learning Objectives:

1. Understand the watershed science of working rangelands.
2. Review the potential sources of pollution on a ranch.
3. Learn the sources, fate, and transport of pathogens and nutrient pollutants on grazing lands.
4. Understand water quality risks associated with areas of bare soil and high manure concentrations and their connectivity to waterways.
5. Learn how the science has changed over last 50 years, emphasizing the importance of rangeland water quality science in understanding the fate and transport of water pollutants and practices that can enhance water quality.
6. Compare and contrast pros and cons at sites where livestock grazing has been removed.

Introduction/Hook:

- Since water quality is seldom measured enough to quantify long-term changes, have participants consider how water quality has changed over time and recovered from historic land use. Given the benefits of livestock grazing for preventing wildfire and maintaining grassland diversity, what else can be done to improve water quality and the viability of the local ranching community?
- Discuss previously held assumptions that have resulted in unintended negative consequences to water quality (for example, impacts from channeling streams, draining farm fields, or oak woodland management on long-term pasture production).

Materials/Speakers:

- Review historical aerial photos of watershed, region, and/or ranch comparing circa 1970s to present. Google Earth often has comparable imagery from the 1990s (15 minutes).
- Invited speaker would be someone with knowledge in rangelands, watersheds, and water quality, potentially from UCCE, the NRCS, or RCDs.
- Educational video: "Science of Grazing Management and Water Quality" (16 minutes).
- Educational video: "Nutrient Dynamics and Water Quality on California Rangelands" (16 minutes).
- Consider extending availability of Water Board staff to review and further explain regulations. This can be helpful to attendees who missed previous meetings, while increasing confidence in and support of this extension program.
- Provide example of binder with RWQP from Tomales Bay or Napa/Sonoma watersheds.
- Provide attendees handouts of pertinent resources.
- Food and beverages—snacks and coffee/tea suffice during introductory meetings.

Time Allocated:

Allow 1.5 to 2 hours (45 minutes for presentations and 30 minutes for questions, with time to review regulations).

Procedures/Activities/Strategies/Questions:

- Welcome; attendees introduce themselves.
- Review historical maps and aerial photos for changes over multiple decades of specific ranches or interesting areas of the watershed (for example, well-known landslide or gully formation and recovery).

- Review observations of attendees around their ranches following large rainfall events.
- Present video: "Science of Grazing Management and Water Quality."
- Ask participants to give examples of sources of pollution and how they have changed since the 1970s.
- Present video: "Nutrient Dynamics and Water Quality on California Rangelands."
- Discuss large changes to specific ranches in watershed over time and contemplate if types of erosion or other pollution sources have changed.
- Compare and contrast fate and transport of pathogens and nutrients in rangeland watersheds (20 minutes).
- Provide sufficient time to go over new and old questions about regulations (10 to 20 minutes).
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Have participants consider if and when pollution sources may potentially connect hydrologically. Asking how much rain must fall for a stream to lose clarity and become turbid, or how hydrologic connectivity has changed over the years on the ranch, can be helpful in this discussion.

Resources:

Barry, S., R. Larson, G. Nader, M. Doran, K. Guenther, and G. Hayes. 2011. Understanding Livestock Grazing Impacts: Strategies for the California Annual Grassland and Oak Woodland Vegetation Series. Oakland: UC Agriculture and Natural Resources Publication 21626. https://anrcatalog.ucanr.edu/pdf/21626.pdf

Bedell, T. 1995. What is a watershed? Fact sheet no. 4. Rangeland Watershed Program, UCCE and Natural Resources Conservation Service. https://ucanr.edu/sites/UCCE_LR/files/180570.pdf

Bush, L. 2006. Grazing handbook: A guide for resource managers in Coastal California. Santa Rosa, California: Sonoma Resource Conservation District. https://carangeland.org/images/GrazingHandbook.pdf

George, M. 1995. Management measures and practices. Fact sheet no. 9. Rangeland Watershed Program, UCCE and Natural Resources Conservation Service. http://rangelandarchive.ucdavis.edu/files/244732.pdf

George, M., S. Larson, J. Harper, D. Lewis, and M. Lennox. 2011. California's Rangeland Water Quality Management Plan: An Update. Rangelands. February: 20–24. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalespathogens/Calif.Rng.WQMP.2011.pdf

Hudson, T. D. 2008. Livestock management and water quality. Pullman: Washington State University Extension. http://pubs.cahnrs.wsu.edu/publications/wp-content/uploads/sites/2/publications/eb2021e.pdf

Rissman, A. R., and N. F. Sayre. 2011. Conservation outcomes and social relations: A comparative study of private ranchland conservation easements. Society and Natural Resources 0:1–16. https://doi.org/10.1080/08941920.2011.580419

Next Steps/Future Lessons:

- Ask participants to bring old maps of ranch to next meeting.
- Suggest that participants view previews for videos 8, 9, and 10 prior to Lesson Plan 4.

Lesson Plan 4.
Rangeland Hydrology, Soil Characteristics, Sediments, and Maps

Goals/Overview

Understand rangeland hydrology and soil erosion concepts and how they affect water quality. Practical applications of these concepts include the effects of organic matter on pasture production, water quality, soil texture, stability in rain events, and water infiltration. Participants should be able to evaluate areas on a ranch with respect to infiltration, vulnerability to erosion, and hydrologic connectivity from compacted soil areas.

Learning Objectives:

1. Understand the importance of soil for water quality management and pasture production.
2. Understand hydrologic connectivity resulting from compaction and the rainfall-runoff relationships previously discussed.
3. Review the fate and transport of common rangeland pollutants and "hydrologic connectivity."
4. Understand different types of erosion, sediment sources, and fate and transport of sediments.
5. Gain ability to locate areas without infiltration and delineate where runoff goes.
6. Become comfortable using resources online and drawing on experts within conservation partnerships to assist with assessing and evaluating individual ranch water quality challenges.

Introduction/Hook:

- Review any historical maps participants bring to share.
- Provide tools for learning about soil properties at individual ranches, such as UC Davis Soils Web apps and USDA-NRCS resources.

Materials/Speakers:

- Consider the amount of detail to be covered in workshop portion compared to field day components and when that will occur. This topic may be completely covered during a field day if electronic resources are available.
- Have internet interface available for laptop to demonstrate online tools such as NRCS Web Soil Survey. Use GIS, Google Earth, or other aerial photos with soil layers from UC Davis Soils Web application.
- Invited speaker would be someone with knowledge in soil science, potentially from UCCE, NRCS, or an RCD.
- Educational video: "Streamflow Generation in California Rangelands" (32 minutes).
- Educational video: "Fate and Transport of Sediment" (28 minutes).
- Educational video: "Drought Management" (15 minutes, depending on local issues).
- Water Board staff invited to learn about program and continue to build relationships with landowners.
- Provide example of binder with RWQP from Tomales Bay or Napa/Sonoma watersheds; review maps produced for specific ranches and go over soils map details, scale, and uses.
- Provide attendees handouts of pertinent resources.
- Food and beverages—snacks and coffee/tea suffice during introductory meetings.

Time Allocated:

Allow 1.5 to 2 hours (60 minutes for presentations and 30 minutes for questions).

Procedures/Activities/Strategies/Questions:

- Review any recent observations of attendees around their ranches following rainfall events.
- Discuss important soil properties, using county soil survey, with examples of specific map units common to participants' ranches.
- Discuss measuring rainfall and connections to streamflow generation.

- Present video: "Streamflow Generation in California Rangelands"
- Present video: "Fate and Transport of Sediment."
- Review geologic maps and landforms common to certain soil series within watershed.
- Compare and contrast fate and transport of sediments in rangeland watersheds.
- Present video: "Drought Management on California Rangelands" (depending on local issues).
- Discuss legacy soil erosion issues and expectations for handling legacy sites in RWQP.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Have participants identify where and when a majority of erosion occurred over last 50 years.
- Have them consider if vegetation cover and productivity passively healed in eroded areas or if active management was needed.

Resources:

Lewis, D. J., K. W. Tate, J. M. Harper, and J. Price. 2001. Survey identifies sediment sources in North Coast rangelands. California Agriculture 55(4):32–37. https://escholarship.org/uc/item/1nh5291b

Natural Resources Conservation Service. 2001. Rangeland Sheet 9. Rangeland Soil Quality—Water Erosion. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051599.pdf

Natural Resources Conservation Service. 2020. Web Soil Survey. https://websoilsurvey.nrcs.usda.gov/app/

O'Geen, A. T., R. Elkins, and D. Lewis. 2006. Reducing Runoff from Irrigated Lands: Erodibility of Agricultural Soils, with Examples in Lake and Mendocino Counties. Oakland: UC Agriculture and Natural Resources Publication 8194. https://anrcatalog.ucanr.edu/pdf/8194.pdf

UC Agriculture and Natural Resources. 2020. SoilWeb: An online soil survey browser. https://casoilresource.lawr.ucdavis.edu/gmap/

Next Steps/Future Lessons:

- Participants should consider the effectiveness of previously completed conservation practices on their ranch.
- Participants should consider how practices have changed sediment delivery, pasture productivity and ranch viability.
- Suggest that participants view previews for videos 11, 12, and 13 prior to Lesson Plan 5.

Lesson Plan 5.
The Good, the Bad, and the Ugly—Pathogens and Practices for Water Quality Management

Goals/Overview:

Understand which pathogens are important in rangeland systems, the prevalence of pathogens in livestock and wildlife, and management practices to reduce pathogen pollutants in water bodies. Provide a specific emphasis on science-based management practices that are relatively easy to understand and implement.

Learning Objectives:

1. Know the primary waterborne pathogens attributed to livestock grazing activities and how they move across the landscape.
2. Understand the water quality risks associated with livestock densities, especially in areas with direct hydrologic connectivity to water bodies.
3. Understand the benefits of common ranch management practices that improve water quality and forage utilization (for example, locating water and supplement sites).
4. Gain ability to consider multiple conservation practices as alternative options to treat a particular site or pasture.
5. Encourage participants to remember that no single conservation practice fixes water quality. For example, exclusionary fencing is not required for all waterways and should be used only where problems exist that cannot be alleviated with other practices.
6. Review common management techniques and conservation practices that increase range production and improve water quality.
7. Compare and contrast water quality improvement practices that treat surface runoff downstream, such as buffers and filter strips, versus practices that work on the pasture itself, such as grazing management, supplement and water trough locations , and cross-fencing.

Introduction/Hook:

- Discuss practical maintenance issues of previously completed conservation practices and general ranch maintenance practices that improve water quality and economic returns. Discuss how practices have been documented in an RWQP.
- Provide sources of funds (NRCS, grants through RCDs, and so on) for implementing conservation practices.

Materials/Speakers:

- Invited speaker to cover the fate and transport of pathogens, such as UCD Veterinary Medicine Specialist or UCCE Watershed Management Advisor, Rangeland Hydrology Specialist, and/or Livestock Range Advisor.
- Educational video: "Rangeland Management of Waterborne Pathogens from Livestock and Wildlife" (31 minutes).
- Educational video: "Public Lands Grazing and Water Quality" (13 minutes, depending on local issues).
- Educational video: "Management Options to Reduce Pollutants in Runoff from Irrigated Pastures" (30 minutes, depending on local issues).
- Invited speaker covering historical ranch photos of sites or pastures that improved vegetation cover or structure and discuss why. This could be an engineer, ecologist or hydrologist working on local ranches—UCCE Watershed Management Advisor, Rangeland Hydrology Specialist, and/or Livestock Range Advisor.
- Invite NRCS and/or RCD staff to discuss technical and cost-share assistance programs that are available.
- Water Board staff invited to continue learning about program and building relationships with landowners.
- Provide example of binder with RWQP from Tomales Bay or Napa/Sonoma watersheds.

- Provide attendees handouts of pertinent resources.
- Food and beverages—snacks and coffee/tea may still suffice; however, as tension over regulation subsides and relationships strengthen, consider starting to provide a lunch or dinner to attendees, agency staff, and conservation partners, depending on resources.

Time Allocated:

Allow 1 to 2 hours (30 to 75 minutes for presentations and 20 to 40 minutes for discussions/questions).

Procedures/Activities/Strategies/Questions:

- Welcome; attendees introduce themselves.
- Review information from prior topics and provide time for discussion and questions.
- Present video: "Rangeland Management of Waterborne Pathogens from Livestock and Wildlife."
- Present video: "Public Lands Grazing and Water Quality" (depending on local issues).
- Present video: "Management Options to Reduce Pollutants in Runoff from Irrigated Pastures" (depending on local issues).
- Discuss lessons learned from previously completed projects and practices. Consider what conservation practices or stewardship efforts have been successful on your ranch or on others to improve water quality. Also consider whether the site needs more work.
- What types of projects on your ranch would you like assistance to fix and which do you prefer to do yourself? Are there certain sites needing technical and/or monetary help?
- Ask for examples of water quality fixes of ranch sources of pollution from the watershed.
- Review historical maps and aerial photos of watershed that depict changes in vegetation resulting from specific projects or practices.
- Discuss large changes in ranch productivity over time and contemplate if treating types of erosion or other pollution sources also improved or impacted ranch viability.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Have participants reflect upon both successes and failures to find lessons learned from previously completed restoration projects or conservation and water quality practices.
- Ask participants if and how treating types of erosion or other pollution sources also improves or impacts ranch viability.

Resources:

Briske, D. D., ed. 2011. Conservation Benefits of Rangeland Practices: Assessment, Recommendations, and Knowledge Gaps. Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/?cid=stelprdb1045811

George, M., D. Bailey, M. Borman, D. Ganskopp, G. Surber, and N. Harris. 2007. Factors and Practices that Influence Livestock Distribution. Oakland: UC Agriculture and Natural Resources Publication 8217. https://anrcatalog.ucanr.edu/pdf/8217.pdf

Hudson, T. D. 2008. Livestock management and water quality. Pullman: Washington State University Extension. http://pubs.cahnrs.wsu.edu/publications/wp-content/uploads/sites/2/publications/eb2021e.pdf

Lewis, D., M. Lennox, N. Scolari, L. Prunuske, and C. Epifanio. 2011. A half century of stewardship: A programmatic review of conservation by Marin RCD & partner organizations (1959–2009). Prepared for Marin Resource Conservation District by UC Cooperative Extension. http://ucanr.org/sites/Grown_in_Marin/files/138393.pdf

Macon, D. 2002. Grazing for change: Range and watershed management success stories in California. Sacramento: California Cattlemen's Association. http://www.carangeland.org/images/Grazing_for_Change.pdf

Napa County Resource Conservation District. n.d. Slow it. Spread it. Sink it! A landowner's guide to beneficial stormwater management. https://naparcd.org/wp-content/uploads/2014/06/Slowit_Spreadit_Sinkit.pdf

Natural Resources Conservation Service. 2012. Introduction to waterborne pathogens in agricultural watersheds. Nutrient management technical note no. 9. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=32935.wba

Prunuske, L., C. Choo, M. Jensen, and H. Appleton. 2007. Groundwork: A handbook for small-scale erosion control in coastal California. 2nd ed. Marin Resource Conservation District and Marin County Stormwater Pollution Prevention Program. http://www.marinrcd.org/wp/wp-content/uploads/2014/01/Groundwork-A-Handbook-for-Small-Scale-Erosion-Control-in-Coastal-California.pdf

Roche, L. M., L. Kromschroeder, E. R. Atwill, R. A. Dahlgren, and K. W. Tate. Water quality conditions associated with cattle grazing and recreation on national forest lands. PLOS One 8(6):e68127. https://doi.org/10.1371/journal.pone.0068127

Next Steps/Future Lessons:

- Ask participants to consider the future project sites or pastures they previously intended to improve and brainstorm current potential objectives given the information discussed.

Module 3.
RWQP Template—Resources

The lesson plans in Module 3 begin the process of completing the first worksheets in the Ranch Water Quality Plan (RWQP) Template. The RWQP Template is a detailed and flexible approach to completing a ranch plan for water quality management. Before delivering Module 3 lesson plans, preparation is necessary by reviewing and adapting the RWQP Template to locally relevant conditions and regulations. Seek a review of the revised template by appropriate landowners, conservation partners, and Water Board staff (if necessary). To adapt the Template, some sections and forms may be removed if not applicable, or other sections could be expanded or modified to fit local needs. Complete this process BEFORE starting Module 3 so participants have their entire RWQP Template at the beginning of Lesson Plan 6. This will allow participants to take the Template to familiarize themselves with the individual worksheets, formulate ideas for the plan, and prepare questions about an RWQP for their specific property. Consider whether some participants will prefer an electronic format of their RWQP and provide them flash drives or other form of electronic files that contain the Template and resources. The workshop organizer should also consider if and how the RWQP Template could be integrated with other ranch or conservation planning documents currently used by participants.

The lesson plans in Module 3, as with those in Modules 4 and 5, are focused on completing specific Template worksheets and are generally shorter than prior lesson plans. Module 3 starts with an orientation of the RWQP Template and then provides information and instruction on how to complete six worksheets that serve as a record of property information and water quality assessments.

Due to the nature of the lesson plan content, the lesson plans in Modules 3 and 4 are best conducted in an indoor class venue. Module 5 lesson plans can be conducted as indoor class sessions or integrated into the field workshops described in Module 6. The lesson plans in Module 6 provide specific guidelines for field workshops that guide participants through ranch visits of three important water quality management areas common to many California ranches (that is, roads, gullies/streams, and pastures), with potential treatment options in addition to discussing technical design specifications.

Lesson Plan 6.
Orientation of RWQP Template and Property Information

Goals/Overview:

Gain an overview of the RWQP Template worksheets and understand how to complete the first Template worksheet.

Learning Objectives:

1. Gain a general understanding of the RWQP Template worksheets and the flexibility to change worksheets to suit local conditions and specific issues.
2. If a regulatory program is in place, understand which RWQP Template worksheets are necessary for compliance.
3. Communicate the need for attendees to decide who will take responsibility for completing the Template, or divide tasks or worksheets between landowner, tenant, or manager.
4. Communicate potential benefits of completing an RWQP, such as organizing ranch history and future projects, in addition to compliance with water quality regulations.
5. Review benefits of well-managed livestock grazing.

Introduction/Hook:

- Options are available for how landowners and lessees decide to complete their individual RWQPs and who will be responsible for paperwork.
- Completing the RWQP is less daunting than it might seem, especially with the instruction provided in this series.

Materials/Speakers:

- Invited speaker and facilitator of discussion would be someone with knowledge in overall ranch management and planning from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Ranch Water Quality Plan Worksheets Overview" (5 minutes).
- If Water Board staff is in attendance, consider need for further explanations of regulations or regulatory programs.
- Provide copies of RWQP Template. If still in draft stage, provide specific timeline to completion.
- Instructional video: "Property Information—Worksheet 1" (6 minutes).
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 30 to 40 minutes (20 minutes for presentation and 20 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Present video: "Ranch Water Quality Plan Worksheets Overview."
- Discussion of fears, worries, and concerns regarding questions and problems with RWQP Template, process, or approach.
- Share experiences from other watersheds and how RWQP Templates helped to consider, identify, and organize future project opportunities.
- Present video: "Property Information—Worksheet 1."
- Give participants a homework assignment to complete (Property Information—Worksheet 1) and ask them to think about their ranch goals in anticipation of Ranch Goals—Worksheet 2.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Ask participants if the approach and flexibility of the RWQP Template feel realistic and appropriate.

- Encourage participants to decide who (owners, ranch managers, tenants) is responsible for completing an RWQP and submitting forms for applicable regulatory programs.

Resources:

Barry, S., W. King, S. Larson, and M. Lennox. 2010. Opportunities to sustain "greener" farming: Comparing impacts of water quality regulations in two catchments: Lake Taupo (NZ) and Tomales Bay, California (USA). Proceedings of the New Zealand Grassland Association 72:17–22. https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalespathogens/TomalesNewZealandBarry.pdf

Next Steps/Future Lessons:

- Consider existing locations or projects on a ranch that benefit water quality.
- Encourage participants to discuss previous ranch goals with other ranch managers or owners to understand which were completed successfully or have been replaced by new priorities.
- Participants may need to consult with involved family members and other interested parties to develop ranch goals.

Lesson Plan 7.
Ranch Goals

Goals/Overview:

Know the importance of setting short- and long-term ranch goals that help guide ranch operations, develop priorities, and identify ranch management practices that can meet multiple ranch goals. Ranch goals create a foundation on which to build your RWQP. These goals should be broader than water quality and should capture factors such as production capacity, conservation, profitability, sustainability, quality of life, ranch succession, land use changes, and so on. Although some goals may not be directly related to water quality, the process of identifying ranch goals will help identify possible connections between water quality goals and other ranch goals.

Learning Objectives:

1. Understand types of goals common to California ranches and how goals motivate actions on a ranch.
2. Gain ability to discuss and decide upon priority goals with pertinent family members or other stakeholders.

Introduction/Hook:

- Discuss stories when goals were not realistic for various ranch projects or conservation practices.
- Water quality goals are often already part of the broad set of goals that motivate actions on a ranch, although such goals may not be commonly acknowledged as ranch goals.

Materials/Speakers:

- Invited speaker could be a UCCE Livestock Advisor or other speaker familiar with ranching operations and goals that motivate ranchers.
- Instructional video: "Ranch Goals—Worksheet 2" (5 minutes).
- Have printed copies of Ranch Goals—Worksheet 2 from RWQP Template available.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 30 to 40 minutes (20 minutes for presentation and 10 minutes for question/answer).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Present video: "Ranch Goals—Worksheet 2."
- Introduce goal-setting practices, such as SMART (specific, measurable, achievable, realistic, timely) goals. (See the SMART goals guide in this lesson plan's resources section.)
- Discuss "shoot-for-the-moon" goals that are difficult to achieve or unrealistic for their situation, but create long-term motivation.
- Brainstorm pertinent goals for individual ranches in small-group discussion and share with larger group once completed (15 minutes).
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Ask participants to reflect upon unusual or surprising goals from individual ranches or family members.
- Have participants share stories of the process used to develop their goals.

Resources:

Roche, L. M., T. K. Schohr, J. D. Derner, M. N. Lubell, B. B. Cutts, E. Kachergis, V. T. Eviner, and K. W. Tate. 2015. Sustaining working rangelands: Insights from rancher decision making. Rangeland Ecology & Management 68(5):383–389. https://doi.org/10.1016/j.rama.2015.07.006

University of California. n.d. SMART goals: A how-to guide. https://www.ucop.edu/local-human-resources/_files/performance-appraisal/How%20to%20write%20SMART%20Goals%20v2.pdf

Next Steps/Future Lessons:

- Provide participants with copies of or access to the publications "Guidelines for Residual Dry Matter on Coastal and Foothill Rangelands in California (#8092)" and the SoilWeb in order to become familiar with these resources prior to Lesson Plan 8.

Lesson Plan 8.
Pasture Inventory

Goals/Overview:

Learn how to complete the Pasture Inventory—Worksheet 3 of the RWQP and understand the importance of characterizing pasture units for helping meet production, grazing management, and water quality goals. Acknowledge that existing pasture inventory documents or grazing management plans can be incorporated into the RWQP instead of creating a new document or form.

Learning Objectives:

1. Understand a working naming convention for similar management units or individual pastures.
2. Develop a basic understanding of residual dry matter (RDM) management and minimum RDM guidelines and their relevance to water quality.
3. Learn how to identify the pasture unit characteristics in Worksheet 3, including soil, slope, percent woody vegetation cover, and minimum RDM.
4. Gain ability to find expected RDM based on location, slope, and woody vegetation.
5. Review fundamentals of RDM—definition, water quality importance, variability across ranch soil type, and annual precipitation.
6. Discuss reasons for creating resource management units within a ranch based on the need for specific resource objectives. Sometimes pasture units don't coincide with the desired resource management units.

Introduction/Hook:

- Attributing natural resource characteristics to pasture units can be helpful in validating existing pasture unit divisions and rethinking different divisions that align with natural resource management and pasture production characteristics.
- Share unusual names of pastures, historical anecdotes, and limiting factors to production in each.

Materials/Speakers:

- Invited speaker and facilitator of discussion would be someone with knowledge in overall ranch management and planning from UCCE, NRCS, RCD, or other relevant organization.
- Water Board staff can be available to review and further explain regulations and history.
- Instructional video: "Pasture Inventory—Worksheet 3" (14 minutes).
- Bring copies of RWQP Template with extra copies of Pasture Inventory—Worksheet 3.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 30 to 40 minutes (15 minutes for presentations and 15 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Share unusual pasture names and various management objectives, limiting factors, problems, and so on.
- Explain the fundamental purposes and aspects of RDM and its relevance to water quality. Refer to the publication "Guidelines for Residual Dry Matter on Coastal and Foothill Rangelands in California (#8092)."
- Advise participants that RDM will be covered in more detail in Lesson Plan 15.
- Present video: "Pasture Inventory—Worksheet 3."
- Discuss RDM variability within and between pastures while comparing grazing management, slope, and woody vegetation cover.
- Review maps and aerial photos of specific pastures on ranch.

- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Ask participants to reflect upon existing pasture management and water quality problems that could compromise ranch viability.
- Suggest that participants consider if and how more pastures or subdividing existing pastures could assist in livestock management.

Resources:

Bartolome, J. W., W. E. Frost, N. K. McDougald, and M. Connor. 2006. California Guidelines for Residual Dry Matter (RDM) Management on Coastal and Foothill Annual Rangelands. Oakland: UC Agriculture and Natural Resources Publication 8092. http://anrcatalog.ucanr.edu/pdf/8092.pdf

Guenther, K., and G. Hayes. 2008. Monitoring annual grassland residual dry matter: A mulch manager's guide for monitoring success. 2nd ed. Brewster, Washington: Wildland Solutions. http://www.wildlandsolutions.com/rdm/

Next Steps/Future Lessons:

- Ask participants to consider limiting factors to production within each pasture and when they started to occur; brainstorm options to remedy problems.
- Suggest that participants view previews for videos 19 and 20 prior to Lesson Plan 8.

Lesson Plan 9.
Pasture and Stream Assessment

Goals/Overview:

Understand how to assess pastures and streams for potential and actual water quality impairments and use Worksheets 4 and 5 of the RWQP Template to record assessed conditions.

Learning Objectives:

1. Understand the set-up of self-assessment forms to be used across an entire ranch by listing specific pasture locations where water quality concerns occur.
2. Understand what each question is referring to in stream and pasture assessments.
3. Gain ability to describe the cause of any water quality concerns—current, historical, and/or natural.
4. Learn the importance of stream temperature as a water quality concern.
5. Know the fundamental aspects of riparian grazing management practices that address water quality concerns.

Introduction/Hook:

- Compare and contrast historical and natural examples of water quality concerns in order to ascertain if water quality concerns are caused or exacerbated by current livestock management.
- Pasture and stream assessments present opportunities to highlight ranch conditions that are beneficial for water quality and areas that need improvement.

Materials/Speakers:

- Show numerous photos of potential problem areas that depict or explain the intent of each question from Worksheets 4 and 5.
- Invited speaker and facilitator of discussion would be someone with knowledge in rangeland and watershed management from UCCE, NRCS, RCD, or other relevant organization.
- Bring a few extra copies of the RWQP Template.
- Provide extra copies of the Pasture Assessment—Worksheet 4, and Stream Assessment—Worksheet 5.
- Instructional video: "Pasture Assessment—Worksheet 4" (13 minutes).
- Educational video: "Stream Temperature" (12 minutes).
- Educational video: "Riparian Grazing Management" (15 minutes).
- Instructional video: "Stream Assessment—Worksheet 5" (7 minutes).
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 70 to 90 minutes (50 minutes for presentation and 15 to 30 minutes for question/answer).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Introduce participants to Worksheets 4 and 5 and the groups of questions on each worksheet.
- Present video: "Pasture Assessment—Worksheet 4."
- Discuss the questions on Worksheet 4 so that attendees understand how to answer questions on their ranches. Go through each very slowly. Consider dividing into small groups for discussion purposes so everyone feels comfortable articulating their confusion about individual assessment questions.
- Discuss stable waterfalls versus unstable headcuts that need monitoring and/or need to be fixed.
- Present video: "Stream Temperature."

- Present video: "Riparian Grazing Management."
- Present video: "Stream Assessment—Worksheet 5."
- Emphasize in various ways that monitoring with visual inspections (Worksheet 10) should address and support the questions in these two assessment worksheets.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- As participants think about conducting pasture and stream assessments on their ranches, some questions they should consider include:
  - How large are bare-soil areas on ranch?
  - Where are the largest ones located and when do they connect to waterways (that is, after how much rainfall)?
  - Where is current livestock management exacerbating a potential problem or hindering the natural processes for vegetation to reestablish?
  - Are the largest unstable locations caused by natural and/or historical causes?

Resources:

Pellant, M., P. Shaver, D. A. Pyke, and J. E. Herrick. 2005. Interpreting Indicators of Rangeland Health. Version 4. Technical Reference 1734-6. Denver: U.S. Department of the Interior, Bureau of Land Management, National Science and Technology Center. https://www.blm.gov/documents/national-office/blm-library/technical-reference/interpreting-indicators-rangeland-health

Ward, T. A., K. W. Tate, and E. R. Atwill. n.d. Visual Assessment of Riparian Health. Oakland: UC Agriculture and Natural Resources Publication 8089. https://anrcatalog.ucanr.edu/pdf/8089LR.pdf

Next Steps/Future Lessons:

- Have participants considered previously completed work to control erosion or other conservation practices on their ranches or their neighbors' ranches? Did projects successfully meet objectives and do they need more work or maintenance?
- Ask participants if previously completed conservation practices increased or reduced pasture productivity and ranch viability and addressed water quality concerns.

Module 4.
RWQP Template—Conservation Projects and Practices

The important process of adaptive management is simplified to focus stewardship efforts on planning and implementing successful water quality improvement projects. First, previously completed projects and practices are evaluated for long-term effectiveness (Lesson Plan 10). Then, future project sites and pastures are listed, with potential options for specific conservation practices considered, and rough cost estimates (Lesson Plan 11). Prioritizing tools and approaches are provided that combine water quality improvements with increasing production and reducing maintenance (Lesson Plan 12). Once priorities are set, planned projects can be separated between small projects for near- or short-term implementation and long-term opportunities to fix large contaminant sources caused by historical and/or natural factors. Cost-share assistance is often necessary to repair the larger projects that are typically more costly, such as eroded gullies. Ranch mapping (Lesson Plan 13) can be an exciting exercise for participants eager to have high-quality and useful maps of their ranch property. Resources from partnering agencies (NRCS and RCD) will be very helpful in printing maps for participants.

Lesson Plan 10.
Completed Water Quality Projects

Goals/Overview:

Understand how to document and evaluate completed projects. Explain the history of stewardship efforts on ranches and encourage critical feedback.

Learning Objectives:

1. Learn how to evaluate previously completed water quality projects for their success in meeting water quality objectives.
2. Understand the process to complete Worksheet 6, starting with water quality concerns listed for each site, pasture, or similar management area.
3. Understand how to use Completed Projects—Worksheet 6 to catalog previous water quality improvement efforts.
4. Evaluate the short- and long-term effectiveness of specific conservation practices previously completed in the watershed and across California to apply lessons for planning future projects.

Introduction/Hook:

- Share stories of increased ranch viability and sustainability following implementation of conservation practices and restoration projects. These can be fun conversations, so let attendees tell their stories.

Materials/Speakers:

- Historical conservation practices evolved into the highly engineered designs used today by the NRCS and RCDs. Discuss common practices mentioned by and familiar to attendees, and how these practices have been improved to increase success and reduce unintended consequences.
- Invited speaker and facilitator of discussion would be someone with knowledge in rangeland and watershed management from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Completed Projects—Worksheet 6" (8 minutes).
- Bring a few extra copies of RWQP Template. Provide extra copies of Completed Projects—Worksheet 6.

Time Allocated:

Allow 40 to 60 minutes (20 minutes for presentations and 20 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Revisit any potential concerns for water quality identified while completing Pasture Assessment—Worksheet 4 and Stream Assessment—Worksheet 5, focusing on those situations where participants have already taken steps to address concerns.
- Present video: "Completed Projects—Worksheet 6."
- Review the format for Completed Projects—Worksheet 6 and begin filling it out with sites and/or pastures that have received conservation improvements such as watering facilities, cross-fencing, seeding, erosion control, culvert upgrades, and so on.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Have participants consider their previously completed projects to ascertain if they need more work or maintenance to meet water quality objectives.

Resources:

Macon, D. 2002. Grazing for change: Range and watershed management success stories in California. Sacramento: California Cattlemen's Association. http://www.carangeland.org/images/Grazing_for_Change.pdf

Lewis, D., M. Lennox, N. Scolari, L. Prunuske, and C. Epifanio. 2011. A half century of stewardship: A programmatic review of conservation by Marin RCD & partner organizations (1959–2009). Prepared for Marin Resource Conservation District by UC Cooperative Extension. http://ucanr.org/sites/Grown_in_Marin/files/138393.pdf

Next Steps/Future Lessons:

- Consider sites and pastures with water quality concerns that could be improved and management options and practices that could be employed to make improvements.

Lesson Plan 11.
Future Water Quality Projects

Goals/Overview:

To understand the process of identifying and prioritizing future water quality improvement projects. Explain steps to brainstorm alternative conservation practices for each site and pasture as well as to track progress toward implementing ranch stewardship efforts.

Learning Objectives:

1. Understand how to complete Future Water Quality Projects—Worksheet 7, including conservation practices options and preliminary cost estimates.
2. Prioritize identified future projects.
3. List next steps to plan and implement identified future projects.

Introduction/Hook:

- The process of listing and organizing future projects offers an adaptive management tool for years to come. It helps in identifying sites and projects that can be completed with existing ranch resources and also leverages technical and financial assistance for more complicated, large-scale projects.

Materials/Speakers:

- Invited speaker and facilitator of discussion would be someone with knowledge in rangeland and watershed management from UCCE, NRCS, RCD, or other relevant organization.
- Invited speaker could be NRCS or RCD staff discussing technical and cost-share assistance options.
- Instructional video: "Future Water Quality Projects—Worksheet 7" (9 minutes).
- Have the entire RWQP Template available in case anyone still needs one, with extra copies of Future Water Quality Projects—Worksheet 7.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 40 to 60 minutes (20 minutes for presentations and 20 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Present video: "Future Water Quality Projects—Worksheet 7."
- Review the format of Future Water Quality Projects—Worksheet 7 and how to list projects along roads, in pastures, or on streams that present potential water quality problems.
- Consider the pollutants that might be transported during storm events and practices that can address these water quality issues.
- List options for fixing water quality that may increase vegetation cover and/or slow runoff. Start with the least expensive and complicated projects that could be implemented in the near term by the ranchers themselves. Then move to sites and practices that may need cost-share or technical assistance from NRCS and/or RCD.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Allow participants to discuss challenging sites where they are struggling to come up with practical actions to improve water quality. In some instances, previous unsuccessful attempts to address these sites offer important lessons to reconsider with information provided during the RWQP education program.

Resources:

Larson, S., K. Smith, D. Lewis, J. Harper, and M. George. 2005. Evaluation of California's rangeland water quality education program. Rangeland Ecology & Management 58(5). https://ucanr.edu/sites/UCCE_LR/files/180937.pdf

Lewis, D. J., K. W. Tate, J. M. Harper, and J. Price. 2001. Survey identifies sediment sources in North Coast rangelands. California Agriculture 55(4):32–37. https://escholarship.org/uc/item/1nh5291b

Miner, J. R., J. Buckhouse, and J. Moore. 1992. Will a water trough reduce the amount of time hay-fed livestock spend in the stream (and therefore improve water quality)? Rangelands 14:1. https://journals.uair.arizona.edu/index.php/rangelands/article/viewFile/11053/10326

Natural Resources Conservation Service. 2020. Conservation Planning. https://www.nrcs.usda.gov/wps/portal/nrcs/main/ca/technical/cp/

Next Steps/Future Lessons:

- Contemplate which sites and pastures are more important to fix—and where fixes will also benefit ranch operations, improve livestock health, or facilitate grazing management and ease animal handling.

Lesson Plan 12.
Setting Project Priorities

Goals/Overview:

Explain how to prioritize future water quality improvement projects.

Learning Objectives:

1. Understand how to balance multiple factors in decision making.
2. Gain ability to estimate potential sediment delivery to waterways from erosion sites.

Introduction/Hook:

- With well-organized priorities and time, progress is planned and made incrementally toward completing water quality improvements. Having a plan with multiple options makes the impossible seem possible.

Materials/Speakers:

- Review Ranch Goals—Worksheet 2, Pasture Assessment—Worksheet 4, and Stream Assessment—Worksheet 5 forms.
- Invited speaker and facilitator of discussion would be someone with knowledge in rangeland and watershed management or conservation planning from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Sediment Delivery Inventory and Monitoring" (28 minutes).
- Have the entire RWQP Template available in case anyone still needs one.
- Provide handouts of publication Sediment Delivery Inventory and Monitoring (#8014).
- Have extra copies of Future Water Quality Projects—Worksheet 7 available so each participant has one.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 45 to 60 minutes (30 minutes for presentation and 15 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Review ranch goals and assessment worksheets to encourage participants to refer to their completed forms to identify and prioritize projects.
- Present video: "Sediment Delivery Inventory and Monitoring."
- Review the multiple measurement tools available to help prioritize eroding areas for potential fixes. Remind participants to balance the potential water quality improvement with the immediate cost, long-term maintenance, and benefits to ranch operations.
- Note the priority for the individual ranch of each potential problem area listed and efforts to implement new practices, including contacting professionals or applying for grant funding.
- Discuss participants' priorities for erosion control and other water quality projects on their ranches, and have them explain some of their choices.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- How did the Goals and Stream/Pasture Assessment forms help to review ranch conditions and set priorities for future projects?
- Did setting priorities help in making the laundry list of potential future projects easier to start implementing? For example, ranchers might work on the most important projects first, or group projects into those that can be done with

ranch resources and those for which a rancher will seek cost-share or technical assistance.

Resources:

Bush, L. 2006. Grazing handbook: A Guide for Resource Managers in Coastal California. Santa Rosa: Sonoma Resource Conservation District. https://carangeland.org/images/GrazingHandbook.pdf

Lewis, D. J., K. W. Tate, and J. M. Harper. 2000. Sediment Delivery Inventory and Monitoring. Oakland: UC Agriculture and Natural Resources Publication 8014. https://anrcatalog.ucanr.edu/pdf/8014.pdf

Next Steps/Future Lessons:

- Ask attendees to measure the volume of sediment that could erode from a few unstable potential erosion sites at individual ranches to compare which site is most important for preventing sediment delivery to waterways.

Lesson Plan 13.
Mapping Ranch Resources

Goals/Overview:

Know how to create a ranch map with online resources and know which agencies (NRCS, RCD) can create and print ranch maps. Understand how ranch maps are used for water quality management and completing an RWQP.

Learning Objectives:

1. Understand and have extra copies of the three types of maps that are common for the RWQP: 1) aerial photography, 2) gradient with USGS topographic contours, and 3) soil type/units (additional map types). Add other map types that are helpful in describing resources pertinent to ranch water quality planning or other aspects of ranch management.
2. Gain ability to add more ranch infrastructure and resources to the ranch maps, using appropriate agency staff or specific software for individuals to do it themselves.

Introduction/Hook:

- Maps are fun for most landowners. Look at them closely for accuracy and precision and see if landowners can find anything unusual that was unexpected on their property.

Materials/Speakers:

- Share ranch maps produced for other regions and how they were used by landowners.
- Historical aerial photos of ranches comparing circa 1970s to present. Google Earth often has comparable imagery from 1990s. Evaluate them for changes in brush encroachment and/or bare soil.
- Invited speaker and facilitator of discussion would be someone with knowledge in natural resource management and mapping from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Mapping Ranch Facilities—Worksheet 8" (15 minutes).
- Bring copies of the RWQP Template, with extra copies of Mapping Ranch Facilities—Worksheet 8.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 30 to 40 minutes (20 minutes for presentation and 20 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Explain how ranch maps can be used to capture changes over time to ranch features and serve as an archive of ranch resources and projects.
- Review historical maps and aerial photos of ranches, focusing on landscape features that have changed over time.
- Present video: "Mapping Ranch Facilities—Worksheet 8."
- If necessary, review software resources presented in the video and the process to create ranch maps.
- Have participants review maps already in hand and identify locations where water quality projects have already been completed and/or where future water quality projects will be done.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Have participants reflect on how ranch features (that is, fencelines, water troughs, and holding fields) can change to support water quality and resource utilization and protection goals.
- Participants should consider adding previously completed conservation practices to maps in addition to springs, fence lines, pipelines, and so on.

Resources:

Fallon, J., and J. Harper. 2002. Farm Maps: Farm Water Quality Planning Series. Oakland: UC Agriculture and Natural Resources Publication 8061. https://anrcatalog.ucanr.edu/Details.aspx?itemNo=8061

Google. 2020. Google Earth. https://www.google.com/earth/versions/

Natural Resources Conservation Service. 2020. Web Soil Survey. https://websoilsurvey.nrcs.usda.gov/app/

UC Agriculture and Natural Resources. 2020. SoilWeb: An Online Soil Survey Browser. https://casoilresource.lawr.ucdavis.edu/gmap/

Next Steps/Future Lessons:

- Have participants consider additional infrastructure or natural resources to include in maps that will help them complete their mapping needs.
- Have participants consider potential problem areas for brush encroachment, available water troughs, and water quality, noting their locations on maps and distance to waterways.

Module 5.
RWQP Template—Monitoring


Photo: Hector Amezcua

Module 5 completes the Ranch Water Quality Plan (RWQP) Template by covering three simple and effective rangeland monitoring practices. In some cases, where regulatory programs are in effect, this type of monitoring may be part of the compliance process. Specific details of a compliance process should be provided by a representative from the Water Board or relevant regulatory entity. In addition to complying with any regulatory requirements, monitoring is useful and needed to evaluate water quality conditions and completed projects and to plan for future projects. Basic components (Lesson Plans 14 to 16) include pasture use records, visual inspections, photo monitoring, and residual dry matter (RDM) monitoring.

Lesson Plan 14.
Pasture Use Records

Goals/Overview:

Explain purposes and techniques to monitor pasture use by livestock and the value of linking pasture and water quality impacts to grazing management practices.

Learning Objectives:

1. Gain ability to use Pasture Use Records—Worksheet 9 in the Template to consistently note the timing and intensity of livestock rotation across the ranch and onto other parcels.
2. Understand that the worksheet may apply to most, but not all, pastures.
3. Understand the purpose of the worksheet is to know exact dates for pasture use, including certain leased pastures, and/or calculate the carrying capacity of individual pastures and ranch.

Introduction/Hook:

- Discuss situations in which pasture use was not recorded and when it would have been useful to have had the information to make management decisions. When evaluating pasture utilization and any impact of grazing, it is critical to know how the pasture was grazed by recording the grazing parameters (timing, type of livestock, density of livestock, and duration of grazing period).

Materials/Speakers:

- Invited speaker and facilitator of discussion would be someone with knowledge in livestock and grazing management from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Pasture Use Records—Worksheet 9" (4 minutes).
- Bring copies of the RWQP Template with extra copies of Pasture Use Records—Worksheet 9.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 20 to 40 minutes (10 to 20 minutes for presentation and 10 minutes for question/answer).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Provide opportunity for participants to ask questions and review previous sections to be sure they understand how they fit together and can change over time according to conditions and priorities.
- Present video: "Pasture Use Records—Worksheet 9."
- Review grazing parameters, issues, and objectives that are frequently encountered by participants.
- Discuss situations and locations, such as conservation easements or leased pastures, where pasture use records would be useful.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Ask participants to consider if some pastures are underutilized, and if pastures could be used at different seasons or grazed more frequently in order for livestock to graze the pasture uniformly.
- If some pastures are overgrazed, think of options for reducing stocking numbers or altering timing of grazing, or consider the use of other pastures to expand forage resources.

Resources:

Allen-Diaz, B., R. D. Jackson, J. W. Bartolome, K. W. Tate, and L. G. Oates. 2004. Long-term grazing study in spring-fed wetlands reveals management tradeoffs. California Agriculture 58(3):144–148. http://calag.ucanr.edu/archive/?type=pdf&article=ca.v058n03p144

George, M., D. Bailey, M. Borman, D. Ganskopp, G. Surber, and N. Harris. 2007. Factors and Practices that Influence Livestock Distribution. Oakland: UC Agriculture and Natural Resources Publication 8217. https://anrcatalog.ucanr.edu/pdf/8217.pdf

Tate, K. W., E. R. Atwill, N. K. McDougald, and M. R. George. 2003. Spatial and temporal patterns of cattle feces deposition on rangeland. Journal of range management 56(5):432–438. https://journals.uair.arizona.edu/index.php/jrm/article/view/9824

Undersander, D., B. Albert, D. Cosgrove, D. Johnson, and P. Peterson. 2014. Pastures for profit: A guide to rotational grazing. Madison, Wisconsin: University of Wisconsin Extension. https://cdn.shopify.com/s/files/1/0145/8808/4272/files/A3529.pdf

Next Steps/Future Lessons:

- Consider drought impacts on forage production and how pasture use was different during dry years (for example, 2013) and wet years (for example, 2005). Did bare soil or compaction increase?
- Where are there opportunities to stockpile vegetation for late summer and early fall forage and avoid grazing during winter months—such as riparian, wetland, sensitive, or brush areas?

Lesson Plan 15.
Monitoring with Visual Inspections and Photographs

Goals/Overview:

Understand why and how to conduct simple, but meaningful, visual inspections and photo-monitoring.

Learning Objectives:

1. Gain appreciation for the ways in which monitoring can fulfill compliance requirements and is a useful management and maintenance tool.
2. Understand the process for completing visual and photographic monitoring.
3. Gain ability, during visual inspections, to reconsider questions from Pasture Assessment—Worksheet 4 and Stream Assessment—Worksheet 5, as well as projects in Completed Projects—Worksheet 6 and Future Water Quality Projects—Worksheet 7, and update worksheets appropriately. For example, locations may be added or removed if conditions worsen or improve.
4. Learn how to conduct photo-monitoring.
5. Learn to use forms in RWQP Template to record observations and actions taken to improve water quality.

Introduction/Hook:

- Ranchers should take credit for maintenance normally done following large storms, such as cleaning plugged culverts, which is a beneficial practice for water quality management and an example of one of the primary purposes of visual inspections.
- Visual inspections are useful to make sure previous investments in ranch operations and conservation practices are not lost from deferred maintenance.
- Pictures say 1,000 words.

Materials/Speakers:

- Invited speaker and facilitator of discussion would be someone with knowledge in rangeland and watershed management and monitoring experience from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Monitoring—Worksheet 10" (26 minutes).
- Bring RWQP Template with extra copies of Monitoring—Worksheet 10.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 50 to 60 minutes (30 minutes for presentation and 20 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Review Pasture Assessment—Worksheet 4, Stream Assessment—Worksheet 5, Completed Projects—Worksheet 6, and Future Water Quality Projects—Worksheet 7 for projects, sites, and areas of the ranch to include in monitoring.
- Present video: "Monitoring—Worksheet 10"
- Review visual inspection methodology and schedule. Use Monitoring—Worksheet 10, suggested in the RWQP Template, to demonstrate how to record observations of RDM estimates, visual inspections, and photo-monitoring conducted throughout a given year.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Locate historical photos of ranch and retake current photo from same location to create a new photo-point for future ranch monitoring.

Resources:

California Rangelands Research and Information Center. 1995. Monitoring with ranch records. Monitoring Series no. 2. https://ucanr.edu/sites/UCCE_LR/files/180577.pdf

McDougald, N., B. Frost, and D. Dudley. 2003. Photo-monitoring for Better Land Use Planning and Assessment. Oakland: UC Agriculture and Natural Resources Publication 8067. Davis, California. https://anrcatalog.ucanr.edu/pdf/8067.pdf

Next Steps/Future Lessons:

- Consider who will be responsible for ranch monitoring and be sure the person understands the protocols.

Lesson Plan 16.
Monitoring Residual Dry Matter (RDM)

Goals/Overview:

Explain the residual dry matter management tool, as well as monitoring protocols, and discuss approaches on specific ranches.

Learning Objectives:

1. Apply the management benefits of RDM to specific ranch locations and conditions.
2. Understand purpose of RDM monitoring and guidelines.
3. Learn about approaches to rapidly monitor ranch with RDM categories and how to record data.
4. Discuss ocular RDM estimate with local rangeland experts.
5. Develop ability to determine RDM objectives for similar and dissimilar pastures.

Introduction/Hook:

- Directly tie healthy productive pastures and livestock animals to water quality through achieving RDM levels as much as possible.
- Compare usefulness and efficiency of visual estimate methods, using photo guides, for monitoring RDM across ranch versus the protocol for clipping and weighing RDM from multiple locations.

Materials/Speakers:

- Collaborate with NRCS staff regarding which landowners are already clipping and weighing and the specific protocols being followed.
- Invited speaker and facilitator of discussion would be someone with knowledge in rangeland management and monitoring experience from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Guidelines for Residual Dry Matter on Coastal and Foothill Rangelands in California" (22 minutes).
- Bring copies of RWQP Template with extra copies of Monitoring—Worksheet 10 for reviewing and note-taking.
- Provide attendees handouts of pertinent resources, including Photo Guides.

Time Allocated:

Allow 40 to 90 minutes (25 minutes for presentation and 20 to 70 minutes for questions/discussion).

Procedures/Activities/Strategies/Questions:

- Open with a brief story or anecdote, welcome newcomers, and ask for outstanding questions or concerns.
- Review the purpose and importance of using RDM monitoring for evaluating pasture conditions. Refer back to Lesson Plan 8 (Pasture Inventory) for information on RDM guidelines.
- Present video: "Guidelines for Residual Dry Matter on Coastal and Foothill Rangelands in California."
- Explain the need to calibrate visual estimate with clipping and weighing methods and discuss future field workshop to do this.
- Explain circumstances in which recorded RDM is below or above recommended guidelines, such as for fuel control, weed management, deferred grazing, or drought.
- Provide photos of pastures containing known RDM and ask attendees to estimate pounds per acre.
- Review and maybe conduct quantitative survey of rangeland composition to monitor trends over time using transects. Have fun discussing the importance of composition and how management alters the quality of forage available or facilitated weed invasions. Follow the interests and stories of participants.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Consider if and why low- and high-RDM locations on your ranch are consistently the same every year, or just certain years, depending on precipitation or management.
- Are low-RDM locations near or connected to waterways during storms?
- Consider if any revisions are needed to Pasture Assessment—Worksheet 4 and Stream Assessment—Worksheet 5 to accurately characterize ranch water quality challenges.

Resources:

Bartolome, J. W., W. E. Frost, N. K. McDougald, and M. Connor. 2006. California Guidelines for Residual Dry Matter (RDM) Management on Coastal and Foothill Annual Rangelands. Oakland: UC Agriculture and Natural Resources Publication 8092. http://anrcatalog.ucanr.edu/pdf/8092.pdf

Bush, L. 2006. Grazing handbook: A Guide for Resource Managers in Coastal California. Santa Rosa: Sonoma Resource Conservation District. https://carangeland.org/images/GrazingHandbook.pdf

Guenther, K., and G. Hayes. 2008. Monitoring annual grassland residual dry matter: A mulch manager's guide for monitoring success. 2nd ed. Brewster, Washington: Wildland Solutions. http://www.wildlandsolutions.com/rdm/

Next Steps/Future Lessons:

- Consider certain pasture locations on ranches that could benefit from more intensive monitoring approaches, such as riparian areas or pasture units with unstable gullies or active headcuts.
- How are low-RDM areas being included in Future Water Quality Projects—Worksheet 7 to improve conditions such as developing or relocating water sources and/or troughs, seeding, weed management, cross-fencing, and so on?

Module 6.
Field Workshops

Field workshops are highly encouraged as part of an RWQP program since they are often preferred over indoor, classroom-type sessions, and inspire participants to talk and exchange ideas. Workshops also provide many opportunities for participants to visit other working ranches, observe different ranch management practices, and learn how landscape features, which are often overlooked, can influence landscape outcomes. The workshops outlined in this module cover three important ranch landscape features that are commonly the focus of water quality issues on California ranches—roads, streams/gullies, and pastures. These workshops are most effective when planned during the spring months, when the weather is likely to permit outdoor workshops while runoff into streams is still occurring.

Carefully select workshop locations on ranches that demonstrate a breadth of issues covered within each lesson plan. Host ranchers should be willing, without hesitation, to host the group and explain their ranching operations and history of practices and natural events that have led to the current conditions. In advance of each workshop, clarify with host ranchers whether or not they are comfortable inviting regulatory agency staff to the workshop. Keep in mind that while participants may have had congenial relationships with regulatory agency staff at prior meetings, a ranch visit might cross a comfort threshold. These workshops are good educational opportunities for Water Board staff to learn the interface of livestock management and water quality practices and constraints. The host should have assurances that Water Board staff are attending only for educational purposes and without regulatory intent.

Workshop partners should meet at host ranch(es) with landowners to plan workshops well in advance in order to assure that RWQP concepts and details presented in class workshops can be covered and to divide up the logistical workload, and to plan the flow of the workshop agenda. Generally, each field workshop begins with introducing the field tour topics, reviewing RWQP Template components that are appropriate for the field tour topics, and answering questions. This is often done at a convenient location at the ranch being visited. Important details to consider are food/beverages, ranch walking tour discussion/activities, and acquiring infrastructure (for example, tables, chairs, a "portapotty," and so on). Keep in mind that some participants may require mobility assistance.

Lesson Plan 17.
Ranch Roads

Goals/Overview:

Explain ranch road hydrology and common management practices so attendees can assess their roads and even trails for erosion potential and understand options to reduce maintenance and improve water quality.

Learning Objectives:

1. Understand chronic versus episodic sediment sources.
2. Gain ability to evaluate stream crossings for culvert upgrades.
3. Understand how roads can interrupt natural hydrology or overland flow.
4. Explain specifications of "debris flow orienters," or single-post trash rack design adapted from urban areas, to keep culverts from plugging during large storm events.
5. Compare and contrast grant-funded approaches to road improvement versus options and techniques that take more time, such as installing rolling dips at the top of eroding sections, which often require annual maintenance and grading.

Introduction/Hook:

- Share example of sediment sources from ranch road failures during large storm events and common causes. Explain how avoiding smaller failures is mutually beneficial for ranch operations and water quality management.

Materials/Speakers:

- Historical aerial photos of watershed, region, and/or ranch comparing circa 1970s to present. Google Earth often has comparable imagery from the 1990s.
- Invited speaker and facilitator of discussion would be someone with knowledge in rangeland and watershed management from UCCE, NRCS, RCD, or other relevant organization.
- Instructional video: "Ranch Road Storm-Proofing" (25 minutes).
- Water Board staff available to review and further explain regulations and history.
- Bring copies of the RWQP Template and extra copies of Pasture Assessment—Worksheet 4, Stream Assessment—Worksheet 5, Completed Projects—Worksheet 6, Future Water Quality Projects—Worksheet 7, and Monitoring—Worksheet 10.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 2 to 4 hours, including lunch (40 minutes for presentations, 30 minutes for question/answer, 10 minutes for reviewing regulations, 20 minutes for traveling within ranch, 30 minutes for lunch, and 1 to 2 hours for discussing sites).

Procedures/Activities/Strategies/Questions:

- Visit the host ranch, preferably with the rancher and invited speakers, several days prior to the field tour to plan site visit, discussion points, and the tour progression/flow.
- Welcome; attendees introduce themselves if there are some newcomers. Introduce and thank the landowner for hosting.
- Discuss observations of landowner for historical erosion patterns such as when certain sections of road or crossings unraveled and eroded during previous years' rainfall events.
- Review ranch maps for how to document future water quality projects planned to improve ranch roads. Review how to use Pasture Assessment—Worksheet 4, Stream Assessment—Worksheet 5, Completed Projects—Worksheet 6, Future Water Quality Projects—Worksheet 7, and Monitoring—Worksheet 10 from the RWQP Template.

- Review Pasture Assessment—Worksheet 4 regarding how to assess sources of erosion from ranch roads, such as estimating continuous road length producing runoff.
- If an indoor venue is available for video presentation, present video: "Ranch Road Storm-Proofing."
- Discuss potential treatments of problem areas during walking tour and workshop's concluding remarks.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Reflect upon the rainfall-runoff process from compacted road surfaces and where runoff goes during large storm events—directly to waterway or alternatively to a buffer.
- Reflect on road sediment sources from your ranch and which are the high-priority sources to fix. Consider where road locations may be potential chronic sources of sediment or other pollution on your ranch. Consider locations where ranch roads need annual maintenance, such as regrading or filling in ruts, and estimate time working on them. Are techniques discussed applicable to your ranch in order to reduce maintenance time or costs and reduce sediment delivery?

Resources:

5C Program. n.d. Addressing road sedimentation, a video presentation. http://www.5counties.org/video1.htm

Kocher, S. D., J. M. Gerstein, and R. H. Harris. 2007. Rural Roads: A Construction and Maintenance Guide for California Landowners. Oakland: UC Agriculture and Natural Resources Publication 8262. https://anrcatalog.ucanr.edu/pdf/8262.pdf

Nunamaker, C., J. LeBlanc, G. Nakamura, and Y. Valachovic. Forest Roads. 2007. Forest stewardship series 17. Oakland: UC Agriculture and Resources Publication 8247. https://anrcatalog.ucanr.edu/pdf/8247.pdf

Pacific Watersheds Associates. 2020. Typical drawings of road upgrades and treatments. http://www.pacificwatershed.com/

Weaver, W., E. Weppner, and D. Hagans. 2015. Handbook for Forest, Ranch, and Rural Roads. Arcata, California: Pacific Watershed Associates. http://www.pacificwatershed.com/sites/default/files/roadsenglishbookapril2015b_0.pdf

Next Steps/Future Lessons:

- Ask participants to consider if and where runoff from ranch roads connects to a waterway or stream. Are the stream channels or banks unstable where this occurs? How and where do ranch roads alter normal overland flow, and are these alterations causing erosion problems?

Lesson Plan 18.
Streams and Gullies

Goals/Overview:

Explain importance of properly managing streams, gullies, and other waterways to maintain ranch water quality while improving grazing management options and minimizing impacts to overall ranch viability.

Learning Objectives:

1. Understand the hydrology and erosion process of headcuts and identify them before they cross a stability threshold that leads to significant gully formation and soil erosion.
2. Gain ability to estimate volume of sediment with potential erosion as a tool to prioritize sites to correct.
3. Learn about the role of riparian vegetation in filtering storm runoff and controlling erosion.
4. Understand the conditions that warrant riparian fencing and alternative practices that attract livestock away from riparian corridors.
5. Understand multiple options have been proven to improve riparian vegetation by changing grazing management. Riparian grazing, restoration, and enhancement methods used with success on ranches include: 1) controlling the timing and duration of riparian grazing by fencing riparian corridors within existing pastures, 2) fencing riparian areas to exclude livestock, 3) changing the type/age class of livestock, 4) reducing duration of grazing, or 5) reducing grazing intensity and controlling season of use. **Completely removing livestock has not been the best restoration method or the only solution for every site.**
6. Learn about options for revegetating streams with trees, using multiple species. Consider the appropriate species in your area. For example, in coastal California, taller tree species with upright growth, such as a 15-year-old box elder (*Acer negundo*), are able to compete with arroyo willow (small trees), need less maintenance, and use less water. Other tall, canopy-forming tree species include Pacific willow (*Salix lucida*), Fremont cottonwood (*Populus fremontii*), and Oregon ash (*Fraxinus latifolia*).

Introduction/Hook:

- The start of large gullies could be tied to specific weather events. Participants can compare when gullies formed on their ranches (1964, 1982, 1986, 1997, 1998, 2006, and so on) compared to the ranch being visited. Were there specific storm events, perhaps in El Niño years, that caused significant erosion?
- Stockpiled and well-managed riparian vegetation near streams and gullies can be an important forage resource, especially during drought years, during late summer and early fall.

Materials/Speakers:

- Invited speaker and facilitator of discussion would be someone with knowledge in watershed management and soil science from UCCE, NRCS, RCD, or other relevant organization.
- Consider inviting Water Board staff to review regulations and learn about ranch streams.
- Invite NRCS and RCD staff to be available to explain funding sources for projects to remedy stream and gully water quality problems.
- Bring copies of the RWQP Template and extra copies of the Pasture Assessment—Worksheet 4, Stream Assessment—Worksheet 5, Future Water Quality Projects—Worksheet 7, Monitoring—Worksheet 10, and the worksheets from the Sediment Delivery Inventory and Monitoring publication.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 2 to 4 hours, including lunch (40 minutes for presentations, 30 minutes for question/answer, 10 minutes for reviewing regs, 20 minutes for traveling

within ranch, 30 minutes for lunch, and 1 to 2 hours for discussing sites).

Procedures/Activities/Strategies/Questions:

- Visit the host ranch, preferably with the rancher and invited speakers, several days prior to the field tour to plan site visits, discussion points, and the tour progression/flow.
- Choose a host ranch that has a mix of implemented fixes and current problems that can be visited and discussed during the field tour.
- Welcome; attendees introduce themselves if new attendees are present. Introduce and thank the landowner for hosting.
- Ask landowner and/or ranch manager to tell the history of ranch being visited. Be careful to ask appropriate questions that the landowner has considered ahead of time and prioritized adequately.
- Observe and review accessible conservation and restoration project sites along streams and gullies. Share information on why and how project was conducted and how well it has reduced erosion risk.
- At an actual or potential erosion site, work through the sediment assessment forms in the Sediment Delivery Inventory and Monitoring publication so that participants know how to assess sites on their ranch.
- Discuss historical observations of attendees around their ranches following large rainfall events and when gullies began to form.
- Review Pasture Assessment—Worksheet 4, Stream Assessment—Worksheet 5, and Monitoring—Worksheet 10 from RWQP Template during and after guided walk around ranch.
- Explain how NRCS cost-share funds and other grant funds can help landowners "fix" problematic sites.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Discuss potential opportunities to improve riparian vegetation on participants' ranches. Have fun with group predicting outcomes and brainstorming options for how to design projects that balance trade-offs, and acknowledge concerns.
- Locate and compare active and stable headcuts on the ranch. Will the information about estimating potential erosion volumes help you manage and prioritize your streams and gullies for reducing sediment delivery downstream?

Resources:

Lennox, M. S., D. J. Lewis, J. Gustafson, K. W. Tate, and E. R. Atwill. 2007. Water Quality Treatment for Livestock Feeding and Exercise Areas on California Coastal Dairy Farms and Ranches. Oakland: UC Agriculture and Natural Resources Publication 8210. https://anrcatalog.ucanr.edu/pdf/8210.pdf

Lennox, M. S., D. J. Lewis, R. D. Jackson, J. Harper, S. Larson, and K. W. Tate. 2011. Development of vegetation and aquatic habitat in restored riparian sites of California's North Coast rangelands. Restoration Ecology 19(2): 225–233. https://doi.10.1111/j.1526-100X.2009.00558.x

Lewis, D. J., E. R. Atwill, M. S. Lennox, L. Hou, B. Karle, and K. W. Tate. 2005. Linking on-farm dairy management practices to storm-flow fecal coliform loading for California coastal watersheds. Environmental Monitoring and Assessment 107:407–425. https://doi.org/10.1007/s10661-005-3911-7

Lewis, D. J., E. R. Atwill, M. S. Lennox, M. D. G. Pereira, W. A. Miller, P. A. Conrad, and K. W. Tate. 2009. Reducing microbial contamination in storm runoff from high use areas in California coastal dairy pastures. Water Science and Technology 60(7):1731–1743. https://doi.10.2166/wst.2009.561

Lewis, D. J., K. W. Tate and J. M. Harper. 2000. Sediment Delivery Inventory and Monitoring. Oakland: UC Agriculture and Natural Resources Publication 8014. http://anrcatalog.ucanr.edu/pdf/8014.pdf

O'Geen A. T., R. A. Dahlgren, A. Swarowsky, K. W. Tate, D. J. Lewis, and M. J. Singer. 2010. Research connects soil hydrology and stream water chemistry in California oak woodlands. California Agriculture 64(2):78–84. https://doi.org/10.3733/ca.v064n02p78

Wong, K. M. 2007. Islands in a sea of grass. The Bay. April 1. https://baynature.org/article/islands-in-a-sea-of-grass/

Next Steps/Future Lessons:

- Consider historical pasture productivity changes resulting from erosion—gullies, streams and/or sheet/rill types of erosion. How has carrying capacity of ranches changed over preceding decades?

Lesson Plan 19.
Pastures

Goals/Overview:

Explain pasture production fundamentals and water quality improvements using examples in the field. Enable participants to assess their ranches with specific tools and knowledge gained during field workshop to prioritize options for future conservation practices, using the form in the RWQP Template.

Learning Objectives:

1. Understand the importance of vegetation distribution, composition, cover, RDM, and infiltration to water quality and pasture productivity.
2. Review attendees' understanding of soil health concepts.
3. Understand the impacts of overgrazing, in addition to underutilizing forage such as brush encroachment, which causes risk of wildfire. Discuss common weeds, such as thistles and medusahead, and how weed populations change with grazing management and rainfall patterns.
4. Review residual dry matter (RDM) monitoring protocols with hands-on activities and mapping approaches that use visual estimates calibrated with clipping and weighing measurements.
5. Practice using forms in the RWQP Template in the field at sites of concern to feel comfortable applying questions in the Pasture Assessments and Future Water Quality Projects forms.
6. Gain ability to use tools discussed back home at attendees' individual ranches.

Introduction/Hook:

- Review clay-pan concept, and introduce "cow-pan" concept of compacted soil from livestock often found in soil profile near trails, feeders, and water troughs.
- Openly discuss grazing management approaches compared to site-specific treatments and how the two interact, such as in the timing and seasonality of grazing versus the number and location of water troughs available.

Materials/Speakers:

- Dig soil pits within pastures to review soil science, compaction, and rooting depth.
- Invited speaker and facilitator of discussion would be someone with knowledge in livestock and grazing management and soils from UCCE, NRCS, RCD, or other relevant organization.
- Consider inviting Water Board staff to review regulations and learn about pastures.
- Bring copies of the RWQP Template and extra copies of the Pasture Assessment—Worksheet 4, Stream Assessment—Worksheet 5, Future Water Quality Projects—Worksheet 7, and Monitoring—Worksheet 10.
- Provide attendees handouts of pertinent resources.

Time Allocated:

Allow 2 to 4 hours, including self-serve lunch (40 minutes for presentations, 30 minutes for question/answer, 10 minutes for reviewing regs, 20 minutes for traveling within ranch, 30 minutes for lunch, and 1 to 2 hours for discussing sites).

Procedures/Activities/Strategies/Questions:

- Visit the host ranch, preferably with the rancher and invited speakers, several days prior to the field tour to plan site visits, discussion points, and the tour progression/flow.
- Welcome newcomers. Introduce and thank the landowner for hosting.
- Review historical maps and aerial photos of ranch being visited. Discuss large changes at ranch over time and contemplate if types of erosion or other pollution sources have changed.
- Review soil health concepts from previous session.

- Fill-out or review Pasture Assessment—Worksheet 4, Stream Assessment—Worksheet 5, Future Water Quality Projects—Worksheet 7, Monitoring—Worksheet 10, or any other form from the RWQP Template, depending on feedback and questions from participants.
- Discuss observations of attendees around their ranches following large rainfall events.
- Review the RWQP Template and open up questions regarding overall process and adaptability of plan for individual ranches.
- Complete the Session Evaluation Form (appendix A).

Conclusion/Self-assessment:

- Consider potential grazing management practices that will improve water quality while also increasing pasture productivity, such as improving distribution to reduce bare soil from trails near streams.

Resources:

Barry, S., R. Larson, G. Nader, M. Doran, K. Guenther, and G. Hayes. 2011. Understanding Livestock Grazing Impacts: Strategies for the California Annual Grassland and Oak Woodland Vegetation Series. Oakland: UC Agriculture and Natural Resources publication 21626. https://anrcatalog.ucanr.edu/pdf/21626.pdf

Brownsey, P., J. Davy, T. Becchetti, M. L. Easley, J. J. James, and E. A. Laca. 2016. Barb Goatgrass and Medusahead: Timing of Grazing and Mowing Treatments. Davis: UC Agriculture and Natural Resources Publication 8567. https://anrcatalog.ucanr.edu/pdf/8567.pdf

DiTomaso, J. M., G. B. Kyser, and M. J. Pitcairn. 2006. Yellow starthistle management guide. California Invasive Plant Council. https://www.cal-ipc.org/docs/ip/management/pdf/YSTMgmtweb.pdf

George, M. R., N. K. McDougald, W. A. Jensen, R. E. Larsen, D. C. Cao, and N. R. Harris. 2008. Effectiveness of nutrient supplement placement for changing beef cow distribution. Journal of Soil and Water Conservation 63(1):11–17. https://doi.org/10.2489/jswc.63.1.11

Hudson, T. D. 2008. Livestock Management and Water Quality. Pullman: Washington State University Extension. http://pubs.cahnrs.wsu.edu/publications/wp-content/uploads/sites/2/publications/eb2021e.pdf

Kroeger, T., F. Casey, P. Alvarez, M. Cheatum, and L. Tavassoli. 2009. An economic analysis of the benefits of habitat conservation on California rangelands. Washington: Defenders of Wildlife. https://defenders.org/sites/default/files/publications/an_economic_analysis_of_the_benefits_of_habitat_conservation_on_california_rangelands.pdf

LeBlanc, J. W. 2001. Getting a Handle on Broom: Scotch, French, Spanish, and Portuguese Brooms in California. Oakland: UC Agriculture and Natural Resources Publication 8049. https://anrcatalog.ucanr.edu/pdf/8049.pdf

McDougald, N. K., W. E. Frost, and R. L. Phillips. 2001. Livestock Management during Drought. Oakland: UC Agriculture and Natural Resources Publication 8034. https://anrcatalog.ucanr.edu/pdf/8034.pdf

Next Steps/Future Lessons:

- Identify where large bare-soil areas frequently connect to tributaries during small storm events. Consider when ditches and drainages within each pasture become hydrologically connected with surface runoff flowing into larger tributaries.
- Consider historical changes in pasture productivity resulting from erosion and management changes.

Summary of Approaches and Options

Every ranch is different, and conservation practices implemented at each ranch should be uniquely designed because there is no single one-size-fits-all prescription or magic "silver bullet" for restoring watershed functions (Briske et al. 2011). Improving land management is as important as implementing site-specific projects, and the two go hand in hand. In reality, the best approach to ensuring environmental benefits from working ranches is an active management philosophy (Macon 2002).

The modules and lesson plans provide a systematic process to successfully educate landowners and managers about complying with nonpoint source water quality regulations for livestock grazing operations. The RWQP Guide is intended to offer flexibility in approaches, with specific options, in order to adapt it to watersheds, resources, and people. The primary purpose is for those being regulated to understand the ranch planning process so they can set priorities and schedules of ranch stewardship efforts to advance ranch viability and maintain compliance with water quality regulations (George et al. 2011).

The nexus of environmental and operational concerns on each ranch guides how and where to prioritize conservation, restoration, and stewardship efforts. Experience and research have shown that restoration projects are more successful when landowners are vested and want it done (Lewis et al. 2011). During the planning phase of projects, consider multiple options that would provide slow versus fast revegetation trajectories; these are often less expensive approaches.

Since no single conservation practice fixes all water quality concerns, many options with numerous combinations of practices offer the greatest long-term benefit to water quality (Prunuske et al. 2007). If ranchers feel hopeless and think there is only one option available to improve stream and ranch water quality, they should be coached to take a step back to see what others have done and reconsider assumptions (Teague et al. 2013). Learning from the successes and failures of other ranchers and reviewing the specific history of ranch management decisions help to keep options available and replace denial with hope about planning future opportunities (Schohr 2012). The ranch visits and field workshops are a critical part of this process of learning options, understanding alternative management practices, and fostering camaraderie among ranchers. They also present many opportunities to tie together many topics covered during the "in-class" sessions.

Remember, the slow approach, using incremental steps, is a completely viable option. Evaluating the effectiveness of stewardship efforts is often a very rewarding process, as lessons learned provide direction, pride, and confidence (McDougald et al. 2003; Lewis et al. 2011). San Benito County rancher Joe Morris explained it well in *Grazing for Change* (Macon 2002):

"It's intellectually challenging and emotionally satisfying to learn about and implement better, more sustainable ways to steward our lands. Cattle producers should understand their work in terms of maintaining and enhancing the communal values inherent in the watersheds they manage, as well as producing valuable food and fiber."

Resources:

Briske, D. D., ed. 2011. Conservation Benefits of Rangeland Practices: Assessment, Recommendations, and Knowledge Gaps. United States Department of Agriculture, Natural Resources Conservation Service. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/?&cid=stelprdb1045811

George, M., S. Larson-Praplan, J. Harper, D. Lewis, and M. Lennox. 2011. California's Rangeland Water Quality Management Plan: An update. Rangelands. February: 20–24. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalespathogens/Calif.Rng.WQMP.2011.pdf

Lewis, D., M. Lennox, N. Scolari, L. Prunuske, and C. Epifanio. 2011. A half century of stewardship: A programmatic review of conservation by Marin RCD & partner organizations (1959–2009). Prepared for Marin Resource Conservation District by UC Cooperative Extension. http://ucanr.org/sites/Grown_in_Marin/files/138393.pdf

Macon, D. 2002. Grazing for change: Range and watershed management success stories in California. Sacramento: California Cattlemen's Association. http://www.carangeland.org/images/Grazing_for_Change.pdf

McDougald, N., B. Frost, and D. Dudley. 2003. Photo-monitoring for Better Land Use Planning and Assessment. Oakland: UC Agriculture and Natural Resources Publication 8067. Davis, California. https://anrcatalog.ucanr.edu/pdf/8067.pdf

Prunuske, L., C. Choo, M. Jensen, and H. Appleton. 2007. Groundwork: A handbook for small-scale erosion control in coastal California. 2nd ed. Marin Resource Conservation District and Marin County Stormwater Pollution Prevention Program. http://www.marinrcd.org/wp/wp-content/uploads/2014/01/Groundwork-A-Handbook-for-Small-Scale-Erosion-Control-in-Coastal-California.pdf

Schohr, T. 2012. Contrary to popular belief: Anti-cow activists in California who have changed perceptions. Western Cowman, April. http://www.carangeland.org/images/12-04_Contrary_to_Popular_Belief.pdf

Teague, R., F. Provenza, U. Kreuter, T. Steffens, and M. Barnes. 2013. Multi-paddock grazing on rangelands: Why the perceptual dichotomy between research and rancher experience? Journal of Environmental Management 128:699–717. https://doi.org/10.1016/j.jenvman.2013.05.064

Glossary

Animal unit (**AU**)**:** considered to be one mature cow approximately 1,000 pounds, either dry or with calf up to 6 months of age, or its equivalent, based on a standardized amount of forage consumed.

Animal-unit month (**AUM**)**:** amount of dry forage required by one animal unit for one month based on a forage allowance of 26 pounds per day. The term *AUM* is commonly used in three ways: 1) stocking rate, as in "X acres per AUM," 2) forage allocations, as in "X AUMs in allotment A," and 3) utilization, as in "X AUMs taken from Unit B."

Assessor's parcel number (**APN**)**:** unique number assigned to each tract of land by the Tax Assessor.

Available forage: portion of the forage production that is accessible for use by a specified kind or class of grazing animal.

Carrying capacity: maximum stocking rate possible which is consistent with maintaining or improving vegetation or related resources. It may vary from year to year on the same area due to fluctuating forage production.

Cover: 1) the combined aerial parts of plants expressed as a percentage of the total area in question; 2) shelter and protection for wildlife.

California Regional Water Quality Control Board (**CRWQCB**)**:** resource agency charged with protecting the quality of California waters.

Discharge: the volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

Erosion: the process in which a material is worn away by a stream of liquid (water) or air, often due to the presence of abrasive particles in the stream.

Exclosure: an area fenced to exclude animals.

Exclusion: range that is closed to grazing by livestock.

Flood, 100-year: a 100-year flood does not refer to a flood that occurs once every 100 years, but to a flood level with a 1 percent chance of being equaled or exceeded in any given year.

Flood plain: a strip of relatively flat and normally dry land alongside a stream, river, or lake that is covered by water during a flood.

Grade stabilization: a structure used to control the vertical and horizontal cutting in natural or artificial channels.

Grazing, heavy: a comparative term which indicates that the stocking rate of a pasture is relatively greater than that of other pastures. Often erroneously used to mean overuse.

Grazing, light: a comparative term which indicates that the stocking rate of one pasture is relatively less than that of other pastures. Often erroneously used to mean proper use.

Grazing management plan: a program of action designed to secure the best practicable use of the forage resources with grazing or browsing animals.

Grazing period: the length of time that animals are allowed to graze on a specific area.

Grazing season: 1) on public lands, an established period for which grazing permits are issued. May be established on private land in a grazing management plan; 2) the time interval when animals are allowed to utilize a certain area.

Grazing system: a specialization of grazing management which defines the periods of grazing and nongrazing. Descriptive common names may be used; however, the first usage of a grazing system name in a publication should be followed by a description, using a standard format. This format should consist of at least the following: the number of pastures (or units), number of herds, length of grazing periods, and length of nongrazing periods for any given unit in the system, followed by an abbreviation of the unit of time used.

Gully: an erosion channel formed by concentrated surface runoff; larger then 1 square foot in cross-sectional area (larger than 1 foot deep by 1 foot wide).

Headwater(**s**)**:** 1) the source and upper reaches of a stream; also, the upper reaches of a reservoir; 2) the water upstream from a structure or point on a stream; 3) the small streams that come together to form a river.

Historical influence: sediment delivery that has a decades-long history.

Hydrological connectivity: degree to which water from a source site or unstable area is conveyed to the network of the natural watercourse of concern.

Impermeable layer: a layer of solid material, such as rock or clay, which does not allow water to pass through.

Infiltration: flow of water from the land surface into the subsurface.

Landslide treatment: treating in place material such as mine spoils, mine waste, or overburden to reduce downslope movement of sediment.

Legacy: something received from an ancestor or predecessor or from the past.

Management induced: sediment delivery traced to land management and use.

Mass wasting: downslope movement of soil mass under force of gravity; often used synonymously with "landslide."

Mercury: a silvery-white, poisonous, metallic element, liquid at room temperature and used in thermometers, barometers, vapor lamps, and batteries and in the preparation of chemical pesticides.

Methylmercury: An organic form of mercury that is highly toxic and is the main culprit in mercury poisoning. Methylmercury is easily absorbed into the living tissue of aquatic organisms and is not easily eliminated, and therefore accumulates in fish that are predators. The degree to which mercury is transformed into methylmercury and transferred up the food chain through bioaccumulation depends on factors such as water chemistry and the complexity of the food web.

Natural: sediment delivery resulting from natural influences only.

Nonpoint source (NPS) pollution: pollution discharged over a wide land area, not from one specific location. These are forms of diffuse pollution caused by sediment, nutrients, and organic and toxic substances originating from land-use activities, which are carried to lakes and streams by surface runoff. Nonpoint source pollution is contamination that occurs when rainwater, snowmelt, or irrigation washes off plowed fields, city streets, or suburban backyards. As this runoff moves across the land surface, it picks up soil particles and pollutants, such as nutrients and pesticides.

Nutrients: Nutrients are chemical elements and compounds found in the environment that plants and animals need to grow and survive. For water-quality investigations, the various forms of nitrogen and phosphorus are the nutrients of interest. The forms include nitrate, nitrite, ammonia, organic nitrogen (in the form of plant material or other organic compounds), and phosphates (orthophosphate and others). Nitrate is the most common form of nitrogen and phosphates are the most common forms of phosphorus found in natural waters. High concentrations of nutrients in water bodies can potentially cause eutrophication and hypoxia.

Overgrazing: continued heavy grazing which exceeds the recovery capacity of the community and creates a deteriorated range.

Overstocking: placing a number of animals on a given area that will result in overuse if continued to the end of the planned grazing period.

Overuse: utilizing an excessive amount of the current year's growth which, if continued, will result in range deterioration.

Pathogen: a disease-producing agent; usually applied to a living organism; generally, any viruses, bacteria, or fungi that cause disease.

Peak flow: the maximum instantaneous discharge of a stream or river at a given location.

Photo point: an established point used to conduct photographic monitoring.

Range condition: 1) a generic term relating to present status of a unit of range in terms of specific values or potentials. Specific values or potentials must be stated. 2) Some agencies define range condition as follows: The present state of vegetation of a range site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble those of the climax plant community for the site.

Residual dry matter (RDM): the old plant material left standing or on the ground at the beginning of a new growing season. It indicates the combined effects of the previous season's forage production and its consumption by grazing

animals of all types. RDM remaining in the fall will influence subsequent species composition, forage production, and sheet/rill erosion. Management objectives of RDM targets and minimum standards are influenced by slope, woody vegetation, utilization, and annual precipitation. As a result, monitoring results are not intended for regulatory purposes and need interpretation to properly inform rangeland managers and improve grazing practices.

Rest: leaving an area ungrazed, thereby foregoing grazing of one forage crop. Normally, rest implies absence of grazing for a full growing season or during a critical portion of plant development (for example, seed production).

Rest-rotation: a grazing management scheme in which rest periods for individual pastures, paddocks, or grazing units, generally for the full growing season, are incorporated into a grazing rotation.

Revegetate: to plant or replant (barren or denuded land) with vegetation.

Rill: an erosion channel formed by concentrated surface runoff; less than 1 square foot in cross-sectional area (less than 1 foot deep by 1 foot wide).

Riparian zone: the banks and adjacent areas of water bodies, watercourses, seeps, and springs whose waters provide soil moisture sufficiently in excess of that otherwise available locally so as to provide a more moist habitat than that of contiguous flood plains and uplands.

Road cut failure: sediment delivery influenced by the failure of the slope left after a hillside is cut to make a road.

Road drainage design: sediment delivery influenced by the concentration and channeling of runoff from a road.

Road fill failure: sediment delivery influenced by the failure of materials built up to form a road.

Road improvement: measures to reduce road-associated erosion, including culvert improvement, road grading, and road surfacing.

Rotational grazing: a grazing scheme in which animals are moved from one grazing unit (paddock) in the same group of grazing units to another, without regard to specific graze rest periods or levels of plant defoliation.

Sacrifice area: a portion of the range, irrespective of site, that is unavoidably overgrazed to obtain efficient overall use of the management area.

Sediment: material transported and deposited by water or air.

Sheet erosion: the loss of thin layers of soil across a large surface area.

Short-duration grazing: grazing management whereby relatively short periods (days) of grazing and associated nongrazing are applied to range or pasture units. Periods of grazing and nongrazing are based upon plant growth characteristics. Short-duration grazing has nothing to do with intensity of grazing use.

Stocking density: the relationship between number of animals and area of land at any instant of time. It may be expressed as animal units per acre, animal units per section, or animal units per hectare.

Stocking plan: the number and kind of livestock assigned to one or more given management areas or units for a specified period.

Stocking rate: the number of specific kinds and classes of animals grazing or utilizing a unit of land for a specified time period. May be expressed as animal unit months or animal unit days per acre, hectare, or section, or the reciprocal (area of land/animal unit month or day). When dual use is practiced (for example, cattle and sheep), stocking rate is often expressed as animal unit months/unit of land, or the reciprocal.

Stream: a general term for a body of flowing water; natural watercourse containing water at least part of the year.

Streambank protection: stabilization and protection of streambanks, lakes, estuaries, or excavated channels against erosion.

Surface treatment: efforts, such as mulching, used to control erosion on exposed, disturbed, or bare soils.

Total maximum daily load (TMDL): the assessment of problems, sources, and control actions to restore and protect water quality in individual bodies of water.

Trampling: treading underfoot; the damage to plants or soil brought about by movements or congestion of animals.

Tributary: a smaller river or stream that flows into a larger river or stream. Usually, a number of smaller tributaries merge to form a river.

Turbidity: the amount of solid particles that are suspended in water and that cause light rays shining through the water to scatter. Thus, turbidity makes the water cloudy or even opaque in extreme cases. Turbidity is measured in nephelometric turbidity units (NTU).

Undergrazing: the act of continued underuse.

Unstable area: site with potentially deliverable sediment.

Water quality: a term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Watershed: the land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations on a map, often a ridge.

Appendix A: Session Plan Evaluation Form*

Please tell us how much you agree or disagree with each statement by circling a number for each.

As a result of today's lesson . . .	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have a better understanding of current trends in water quality.	1	2	3	4	5
I am more able to plan my time in ways that fit with my ranch needs, values, and priorities.	1	2	3	4	5
I have stronger skills to communicate effectively with agencies and regulators.	1	2	3	4	5
I am confident that I can utilize effective land management strategies to improve water quality.	1	2	3	4	5
I feel more comfortable balancing production and water quality issues on my ranch.	1	2	3	4	5
I plan to create a healthier watershed at my ranch using the skills I have learned today.	1	2	3	4	5
I would recommend this workshop to a friend.	1	2	3	4	5
Please describe any actions you plan to take to improve ranch water quality or watershed health.					
What did you like best about today's workshop?					
What changes or improvements would you recommend?					

* Adapted from D. C. Diehl, S. Smith, B. Crisp, and K. S. Headlee. 2013. Creating Work and Family Balance: Workshop Evaluation. University of Florida Institute of Food and Agricultural Sciences. https://ufdc.ufl.edu/IR00004964/00001

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