Central Coast Watershed Studies

CCoWS

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Agricultural Management Practices and Treatment Wetlands in the Gabilan Watershed:

Project Assessment and Evaluation Plan

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Preface

Funding for this project has been provided in full or in part through Agreement number 03-193-553-0 with the State Water Resources Control Board (SWRCB) pursuant to the Costa-Machado Water Act of 2000 (Proposition 13) and any amendments thereto for the implementation of California's Nonpoint Source Pollution Control Program. The contents of this document do not necessarily reflect the views and policies of the SWRCB, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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This project is done in partnership with Moss Landing Marine Laboratories, the Resource Conservation District of Monterey County, Community Alliance with Family Farmers, Coastal Conservation and Research, and Return of the Natives.

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1 Project Summary

1.1 Project Description

Several local groups have come together for this project to addresses water quality concerns in the Gabilan Watershed – also known as the Reclamation Ditch Watershed (Fig. 1.1). These are Moss Landing Marine Laboratories (MLML), the Resource Conservation District of Monterey County (RCDMC), Central Coast Watershed Studies (CCoWS), Return of the Natives (RON), Community Alliance with Family Farmers (CAFF), and Coastal Conservation and Research (CC&R). The primary goal is to reduce non-point source pollution – particularly suspended sediment, nutrients, and pesticides – and thereby improve near-shore coastal waters of Moss Landing Harbor and the Monterey Bay.

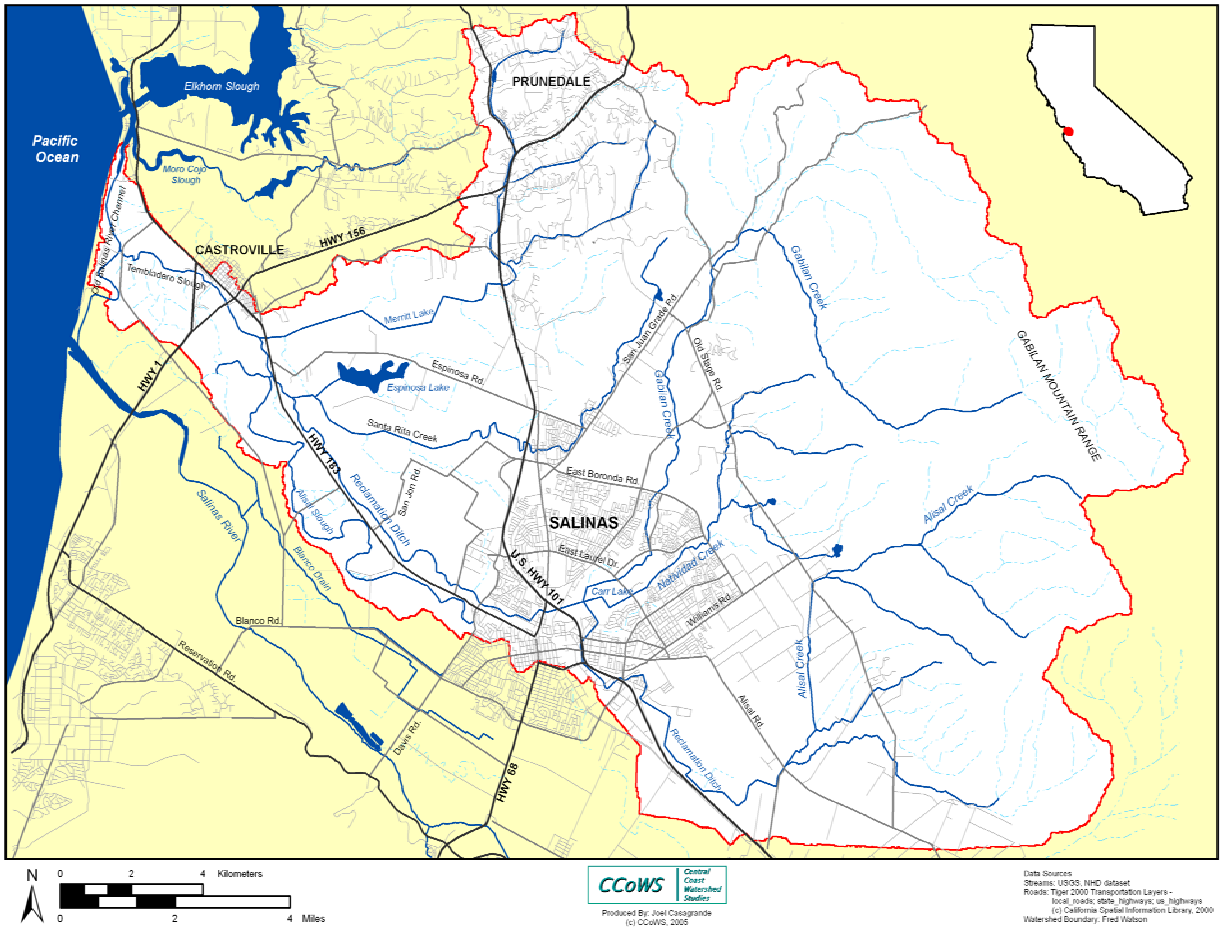

Figure 1.1. Gabilan Watershed boundary. Map created by Joel Casagrande, 2005.

During the project agricultural management practices have been installed in cooperation with growers throughout the Gabilan Watershed to improve the quality of runoff water. A treatment wetland has been constructed at the confluence of the Old Salinas River Channel and the Tembladero Slough. Monitoring is being conducted to determine the effects of the agricultural management practices and the wetland on water quality. Education and outreach has included workshops and individual contact with landowners, growers and other stakeholders. Schoolchildren will be involved by growing native plants for agricultural sites and the wetland at RON greenhouses.

1.2 Problem Statement

The Gabilan Watershed is defined as the watershed of the Potrero Road Tide Gates, excluding the watershed of the Salinas River. It includes Gabilan Creek, Natividad Creek, Alisal Creek, Alisal Slough, Santa Rita Creek, Merritt Lake, Espinosa Slough, Tembladero Slough, Salinas Reclamation Channel, and the lower part of the Old Salinas River Channel. Sixteen total maximum daily load (TMDL) action plans are in development or scheduled for these waterbodies. At the receiving end of the Gabilan Watershed is Moss Landing Harbor, a State-listed Toxic Hot Spot that is scheduled for three TMDL action plans.

There are six 303(d) listed waterbodies within the Gabilan Watershed (Casagrande & Watson, in prep.).

1) Gabilan Creek:
   303d list – fecal coliform
2) Salinas Reclamation Canal (Reclamation Ditch):
   303d list – fecal coliform*, low dissolved oxygen*, nitrate*, pesticides, priority organics
3) Alisal Creek:
   303d list – fecal coliform*, nitrate*
4) Espinosa Slough:
   303d list – nutrients, pesticides, and priority organics
5) Tembladero Slough:
   303d list – fecal coliform*, nutrients, pesticides
   State-listed Toxic Hot Spot** – pesticides, PCB's, metals – Ni, Cr
6) Old Salinas River Channel:
   303d list – fecal coliform*, low dissolved oxygen*, nutrients, pesticides
   State-listed Toxic Hot Spot ** – pesticides, PCB's, metals – Ni, Cr

In addition, there are three listed waterbodies downstream of the Gabilan Watershed.

1) Moss Landing Harbor:

303d list – pathogens, pesticides, sedimentation/siltation
State-listed Toxic Hot Spot** – pesticides, PCB's, metals – Ni, Cr

2) Elkhorn Slough:
303d list – pathogens, pesticides, sedimentation/siltation
3) Monterey Bay South (Coastline):
303d list – metals, pesticides

*added since 1998. http://www.swrcb.ca.gov/tmdl/docs/2002reg3303dlist.pdf
**SWRCB Toxic Hot Spots Clean Up Plan.
http://swrcb2.swrcb.ca.gov/bptcp/docs/dftfedcp.doc

Nonpoint sources of pollution in the watershed include agricultural and urban areas of Salinas, Prunedale and Castroville. This project will reduce agricultural inputs in these areas. The following sections describe how project goals will be met for habitat restoration, management practices, education and outreach, and research and monitoring

2 Habitat Restoration Activities

1. Does your project include habitat restoration activities?

Yes

2. List the specific habitat restoration activity (ies) from your Scope of Work along with its task number(s).

The wetland construction has transformed an area that was primarily non-native weeds into a waterway lined with native plants. The restoration has multiple objectives, but only those aspects that relate to *habitat* are discussed in this section. Other objectives for the same activities are discussed in subsequent sections. Specific activities encompassing habitat restoration objectives will include:

a) Developing further participation of the landowners by presenting preliminary design plans and soliciting input (Task 6.1.1)
b) Obtaining signed landowner agreements (Task 6.1.2)
c) Planning and coordinating the restoration and construction activities (Task 6.1.3)
d) Ensuring that all involved parties are fully informed on the goals of the project and have ample opportunity to provide input into the planning and implementation stages of the project (Task 6.1.4)
e) Providing information to landowners who are not yet involved in the process, so that they better understand the benefits to both the region and to their own operations (Task 6.1.5)
f) Development of restoration design plans to restore wetlands and native vegetation in conjunction with engineering and hydrological recommendations. (Task 6.2.1)
g) Submitting design plans for review to the SWRCB's Project Representative and landowners for approval prior to implementation (Task 6.2.2)
h) Removal of non-native weeds from project site (Task 6.3.1) and propagation of native plants (Task 6.3.2)
i) Excavation and berm construction to emplace a sinuous treatment channel in the eastern half of the site (off-line from the main channel of the Slough) (Task 6.4) (Note that this task has changed from the Scope of Work since a new project site has been chosen)
j) Excavation and berm reinforcement to increase the fraction area of the western half of the site that is shallowly inundated during normal water levels (Task 6.4)

3. What do you hope to accomplish with this activity?

Overall, with respect to habitat restoration objectives, we hope to achieve overall enhancement of wetland ecosystem functioning in the small site that is available. This includes:

a) A functioning treatment wetland
b) Creating a thriving native plant community and reducing non-natives
c) Use of the site by more birds than prior to the project
d) Have a BMI community populate the wetland

4. What indicator or parameter will you use to measure whether or not you have accomplished the items listed in 3 above?

Indicators of the success of our restoration activities listed in (2) above shall be:

a) Completion of written restoration design plans, including documentation of basis for chosen design, site description, and maps and cross-sections of planned installation (submitted to SWRCB under Task 6.2.2)
b) Reduction in weed abundance and an increase in native plants, as inferred from baseline plant survey completed by MLML at the beginning of the project, compared with plant survey to be completed near end of project
c) Photo monitoring (Task 7.3) that shows the general character of wetland enhancement from project commencement to completion
d) Avian monitoring that shows an increase in bird diversity from project commencement to completion (7.4)
e) The existence of an aquatic invertebrate community in the wetland (Task 7.5)

Table 2.1. Summary of goals and targets for habitat restoration activities.

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
1 Create a functioning treatment wetland in the Gabilan Watershed	To create a sinuous channel and a shallow ponding area on a three acre parcel that will facilitate water quality treatment.	- Develop further participation of the landowner - Obtain signed agreement - Plan and coordinate restoration and construction activities - Ensure all parties provide input - Provide information to landowners not involved in the project so they understand benefits - Develop restoration and design plans - Submit plans for review - Wetland construction	Development of a physically stable channel (ie. it holds water, the berms are stable)	Photo monitoring that shows general character of wetland enhancement from project commencement to completion	Sinuous wetland for water quality monitoring with the following attributes: Volume = 785m3 Surface area = 2500m2 Depth = 45cm
2. Plant native wetland plants and reduce non-native plants	To replace areas previously inundated with non-native plant species with native plants	Same as above, plus: - Weed removal effort at the site - No. of plants propagated and planted at the site	- %decrease in non-native plant cover - %increase in native plant cover	- GIS survey (comparison of pre- vs. post-project %plant cover of non-native and native plants) - Photo monitoring	- Increase in native plant cover - Reduction in non-native plant cover
3. Increase bird use at the site	To provide additional habitat for birds presently in the Tembladero Slough and attract other bird species	Same as above, plus: - No. of times bird monitoring is completed	- %use increase by existing species - %use increase by new species	Monthly bird monitoring by MLML	- Increased use by birds - Greater species diversity
4. Have a BMI community populate the wetland	To have BMIs populate the new wetland area from the Tembladero Slough	To determine this, sampling will occur 6 times	BMIs present in the wetland, potentially in greater numbers than in the Slough	BMI sample collection, modified from Harrington and Born (2000)	A BMI community in the wetland, in greater or at ;east equal numbers to that which exists in the Slough

3 Management Practice Implementation Activities

1. Does your project include management practice implementation activities?

Yes

2. List the specific management practice implementation activities from your Scope of Work along with its task number(s).

Agricultural management practices will be installed throughout the watershed. Specific activities (after identification of participating landowners) that will occur include:

a) Obtaining signed landowner agreements (Task 5.1.3)
b) Designing and planning the implementation of a minimum of twenty practices, on at least seven properties throughout the Gabilan Watershed. (Task 5.2.1) Practices will be determined on a site-by-site basis depending on conditions and will include sediment and water retention basins, grassed waterways, filter strips, critical area plantings (establishment of vegetation on steep slopes), and streambank stabilization.
c) Submitting design plans for review to SWRCB's Project Representative and landowners for approval prior to implementation (Task 5.2.2)
d) Implementing a range of BMPs at participating farms (Task 5.4.1) and providing technical support to landowners when needed (Task 5.4.2)

3. What do you hope to accomplish with this activity? (in reference to each item listed in 2 above)

By completing the above activities, we hope to successfully install 20 agricultural management practices throughout the watershed that will reduce pollutants entering waterways.

4. What indicator or parameter will you use to measure whether or not you have accomplished the items listed in 3 above?

We would consider the installation of management practices to be accomplished if twenty practices on seven properties are completed.

Table 3.1. Summary of goals and targets for management practice implementation.

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
1. Install management practices at agricultural sites throughout the Gabilan Watershed	Design, plan, and implement 20 management practices on 7 properties	- No. of landowners outreach was conducted to about management practice implementation - Obtain signed landowner agreement - Submit design plans for approval - Provide technical support to landowners	- No. of participating properties - No. of management practices installed	- %of the 7 properties on which practices were implemented - %of the 20 management practices implemented	100%of planned management practices installed

4 Education and Outreach

1. Does your project include education and/or outreach activities?

Yes

2. List the specific education and/or outreach activities from your Scope of Work along with its task number(s):

The education and outreach components of the project are vital to gain participation for agricultural management practices and wetland installation. Outreach is also key to creating future interest of other landowners in utilizing management practices. The following activities will occur to gain project participation:

a) Conduct outreach and educate growers/landowners on economic and environmental benefits of BMPs (Task 5.1.1) and contacting individual growers to identify participants (Task 5.1.1) (RCD lead, CAFF support)
b) Contact individual growers through direct phone calls, farm visits and referrals and follow up with participants in educational events to identify participants for BMP implementation (Task 5.1.2) (RCD and CAFF co-leads)

The following activities will occur during or post-installation:

a) Depending on landowner willingness, lead community volunteers and K-12 schoolchildren in planting native species at various sites (Task 5.4.3) (RON lead)
b) Demonstrate the value of implementing BMPs to landowners and other stakeholders (Task 5.5.1) (CAFF lead, RCD support)
c) Conduct a minimum of 2 workshops/year, for a minimum of 4 workshops over the project period demonstrating the benefits of vegetated practices and engineered practices (Task 5.5.3) (CAFF lead, RCD support)
d) Conduct on-site tours of the wetland restoration (Task 6.5.3) (MLML lead)

3. What do you hope to accomplish with these activities? (in reference to items listed in 2 above)

Through outreach and education directed at growers and landowners we hope to develop new contacts which may result in the identification of cooperators willing to implement agricultural BMPs with technical assistance from CAFF and the RCD (Task

5.1.1). By contacting individuals through phone calls, farm visits, referrals, and follow-up to educational events, we hope to further develop relationships with growers and landowners such that some of them can be identified as ready to move from the outreach phase to the conservation planning phase of best management practice implementation (Task 5.1.2).

The goal for Task 5.4.3 is to involve schoolchildren in the project for their educational benefit and enrichment. If there is not landowner willingness to have K-12 school children and volunteers on his/her land, then Return of the Natives will present assessment data from two classrooms of K-8 school children participating in growing native grass plants for the farmers in this BMP project. These children will be involved in an intensive standards based education program at their schools.

The demonstration of the value of implementing BMPs to landowners and other stakeholders (Task 5.5.1) will lead to farm practices that help improve water quality, both on project farms and on neighboring and regional farms. Farmers will learn how to manage vegetation conservation plantings and will be able to continue these activities on other parts of their farms. Farmers will share information about these practices with other farmers, thus helping raise the level of knowledge about these activities throughout the watershed.

By holding workshops and field tours (Task 5.5.3), the goal is to spread information and techniques on vegetation conservation plantings. By hearing technical information and seeing the practices in the field, farmers will be better able to apply these practices to their own farms. Workshops and field tours give farmers opportunities to ask questions and to discuss the issues with agricultural resource professionals as well as with other farmers. Networking and giving farmers the setting to interact with others are important features of events.

By conducting site tours of the wetland restoration, we hope to demonstrate the water quality and habitat benefits of wetlands to planners, local agency personnel and landowners within the local agricultural community (Task 6.5.3).

4. What indicator or parameter will you use to measure whether or not you have accomplished the items listed in 3 above? This will include a determination of how the target population will be surveyed for behavioral responses to project activities.

The best indicator that outreach and education activities were sufficient and effective in generating interest in management practices among agricultural operators and

landowners (Task 5.1.1) will be the identification of enough cooperators to implement 20 practices on seven properties.
As in Task 5.1.1, the best indicator of success in contacting individual growers (Task 5.1.2) will be the identification of enough cooperators willing to implement 20 practices on seven properties.
To determine if student involvement in the project (Task 5.4.3) was beneficial to them, there will be a pre-post evaluation procedure based on grade specific CA science education standards.

Task 5.5.1: Successful vegetation conservation plantings have been shown to reduce soil erosion, filter nutrients and improve water quality. With the installation of twenty practices on seven properties, there will be a certain reduction in pollutants entering the aquatic system. The value of these plantings to landowners and other stakeholders will be measured by their willingness to implement similar practices on other parts of their farms and by encouraging neighboring farmers to do the same. Implementation of similar practices on neighboring farms will be another measure of success.

Workshops and field days (Task 5.5.3) can be deemed successful by several means: number of attendees; amount and quality of media coverage; and post-event activities by attendees. Having a workshop that is poorly attended and poorly covered by the media can still be successful if those who are in attendance benefit from the presentations. An evaluation survey to be filled out at the event can provide some measure of its success.

The target group for on-site wetland tours (Task 6.5.3) is local agricultural landowners that are considering implementing similar practices on their own land. An indicator that the tours accomplished their objective is that the landowners choose to implement similar practices. Following the tours each participant will be called to discuss the value of the activity and their potential to adopt the suggested practices.

Table 4.1. Summary of goals and targets for education and outreach.

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
1. To gain participation for agricultural management practices and wetland installation, as well as, raise the level of knowledge about management practices throughout the watershed	To identify cooperators willing to implement agricultural BMPs with technical assistance from CAFF and the RCD (a minimum of 7 landowners that agree to install a new management practice) - spread information and techniques on management of vegetation conservation plantings - provide networking opportunities for farmers to discuss management practices with resource professionals and other farmers	- No. of landowners attending outreach events - amount and quality of media coverage - post event activities by attendees	Identification of enough cooperators to install 20 practices on 7 properties	- Final number of installed practices - Phone calls to individual landowners to discuss the value of the activity and their potential to adopt the suggested practices	20 practices installed on 7 properties
2. Provide education and enrichment to school children about the role of native plants in agricultural land management	Lead schoolchildren in planting native species at various sites (depending on landowner willingness), OR participate in growing native grasses in RON Greenhouses.	- No. of students participating in propagation and/or planting. - No. of landowners willing to have students on his/her land.	Increase in knowledge of students	A pre-post evaluation procedure based on grade specific CA science education standards will be implemented	Increase knowledge of the role of native plants in an agricultural setting
3. Demonstrate water quality and habitat benefits of wetlands to local agricultural landowners	A percentage of landowners will choose to implement a similar practice, and if not, at least they will gain an awareness of the benefits that wetlands provide.	No. of landowners attending wetland tours	No. of landowners choosing to implement a similar practice	Phone calls to individual landowners to discuss the value of the activity and their potential to adopt the suggested practices	An increase in awareness of water quality and habitat benefits of wetlands as well as implementation of suggested practices to some degree.

5 Research and Monitoring

Does your project include water quality or biological monitoring?

Yes, the project includes both water quality monitoring and biological monitoring.

5.1 Watershed level Monitoring

1. Does your project include watershed level monitoring?

Yes, watershed level monitoring will be conducted during storms and non-storm conditions in the Tembladero Slough at Haro Road, in the city of Castroville.

2. What do you hope to accomplish with this activity?

The purpose of monitoring the Tembladero Slough is to determine the loads of suspended sediment, nutrients, and pesticides that are delivered from the Gabilan Watershed in one year.

3. What indicator or parameter will you use to measure whether or not you have accomplished the items listed in number 2 above?

We will consider this task accomplished if enough data is collected to support annual load estimates.

5.2 Management Practice Effectiveness Monitoring

1. Does your project include practice effectiveness monitoring?

Yes, the effectiveness of practices will be primarily determined by water quality monitoring. Agricultural management practices will be monitored throughout the watershed. The wetland restoration in the lower watershed will also be monitored (Task 7.2.1).

2. What do you hope to accomplish with this activity?

Through practice effectiveness monitoring, we will determine the effectiveness of BMPs with respect to water quality improvement. We also will describe some aspects of *how* the wetland is functioning. These goals were presented in the Monitoring Plan, Ch 1, *Project Goals and Research Questions* section, questions 1-5 (pg.1):

Agricultural sites:

> Q1. To what extent is the implemented practice at each agricultural site resulting in a reduction of water quality constituents (sediment, nutrients, pesticides) being exported off-site? This will be answered for storm events and/or irrigation events, as applicable to each specific site.

Wetland site:

> Q2. To what extent does the wetland remove water quality constituents (nutrients, pesticides) from the waters passing through it?
>
> Q3. What are the optimal retention times, inflow-loading rates and depth to achieve maximum removal? How does this vary by season?
>
> Q4. What is the balance of retention of constituents on site, versus neutralization through transformation or degradation, or volatilization?
>
> Q5. Using toxicity tests, is the wetland effluent more/less toxic than the influent?
>
> Q7. What volume of the total pollutant loads from the Gabilan Watershed is the wetland able to mitigate? What is the relationship between wetland area, and fraction of total watershed load treated?

Questions 1, 2 and 3 are the primary questions of the study. Questions 4 and 5 are more difficult. Question 4 will be only qualitatively addressed, but question 5 will be quantitatively addressed. We do not expect to fully answer Q7. The second part of the question is the ultimate, over-arching question of all water quality remediation work. The study will contribute data toward answering this question, but years of further work will be required to fully answer it.

3. What indicator or parameter will you use to measure whether or not you have accomplished the items listed in number 2 above?

We will have accomplished the items listed above by reaching quantitative answers to questions 1, 2, 3, 5 and 7, and a qualitative/investigatory answer to question 4.

5.3 Pollutant Load Reduction

1. Does your project include pollutant load reduction calculations?

Yes. At agricultural sites and at the wetland site this will be the primary way to determine practice effectiveness.

2. What do you hope to accomplish with this activity?

Through pollutant load reduction calculations, we will quantitatively describe the effectiveness of agricultural management practices and the constructed wetland. This will allow us to answer questions 1 and 2 from the Monitoring Plan (See previous section, Management Practice Effectiveness Monitoring).

The following paragraphs describe how overall percent reduction will be calculated and how measured levels of pollutants will be compared to water quality criteria.

Overall percent reduction:

Loads will be analyzed by percent reduction of each constituent being measured. This will be calculated by multiplying the concentration of the constituent of interest by the discharge to obtain an instantaneous load. When applicable, such as for Tembladero Slough monitoring, these data may then be extrapolated to infer a longer time series (ie. seasonal or annual loads), based on discharge measurements over time.

There are not set load reductions that must be met to indicate the success of a practice, since each is unique and locations vary. However, the overall effectiveness of practices is still determined primarily in terms of their effect on load. A greater reduction will be considered a greater success. For practices that are installed multiple times on different properties, the conditions under which the greatest percent reductions occurred will be described.

Sediment load reduction predictions are made by the RCD whenever applicable using the Unified Soil Loss Equation (USLE) Model. These predictions will be compared to monitoring data whenever USLE data exists.

Although it is impossible to predict what load reduction values for the wetland will be, nitrogen and phosphorus reductions reported in previous studies have been obtained (Table 5.1). We hope to achieve reductions similar to these values. However, it is important to note that differences in our monitoring results are expected because of the differing wetland types, location and climate for these studies.

Table 5.1. Summary of reported removal rates for nitrogen and phosphorus in the literature.

Study	Loc/temp info	Constituent	Inflow	Wetland type	Reported Removal Rates	Converted to g $m^{-2}day^{-1}$
Baker, 1998	N/A	Nitrate	N/A	General report on topic	→ 40-50 kg $ha^{-1}day^{-1}$	4-5 g $m^{-2}day^{-1}$
Fink & Mitsch, 2004	Central Ohio	Nitrate + Nitrite P	50g $m^{-2}yr^{-1}$ 7.1g $m^{-2}yr^{-1}$	1.2 ha emergent marsh	→ 39 g $m^{-2}yr^{-1}$ (N) → 6.2 g $m^{-2}yr^{-1}$ (P)	0.107 g $m^{-2}day^{-1}$ (N) 0.017 g $m^{-2}day^{-1}$ (P)
Mitsch et al., 1995 (as cited in Fink & Mitsch, 2004); (Mitsch, 1992; & Richardson et al., 1997 also suggest)	NE Illinois	P	--	Created wetland basins	→ 1-5 g $m^{-2}yr^{-1}$ (suggested long-term retention rate)	0.0027 - 0.01369 g $m^{-2}day^{-1}$

Comparison to water quality criteria:

Measured water quality values will be compared to several water quality criteria (Tables 5.2, 5.3, and 5.4).[1] These values provide important reference points in our understanding of the quality of the water pre and post-practice. However, the success of a practice is not determined by whether or not post-practice flow is below these values.

[1] The background information of the use of these criteria is described in the Quality Assurance Project Plan.

Table 5.2. Summary of water quality criteria for SSC, turbidity, pH and nutrients.

Analyte	Water Quality Criteria
Suspended sediment (mg/l)	10, 100, 1000
Turbidity (NTU)	2, 20, 200
pH	7.0 – 8.3
NO_3^-–N (mg/l)	1.2
NH_3–N (Un-ionized) (mg/l)	0.025
PO_4^{3-}–P (mg/l)	0.12

Table 5.3. Water quality criteria for selected pyrethroid pesticides.

	Rainbow trout 48-Hr LC_{50}	Fathead Minnow 96-Hr LC_{50}	Daphnia Magna LC_{50}
Permethrin	5.4 µg/L *	--	.075 ppb**
Esfenvalerate	--	0.69 µg/L*	0.24 ppb**
*Montgomery, 1997 **DPR, 2004			

Table 5.4. Water quality criteria for selected organophosphate pesticides.

	Rainbow trout 96-Hr LC_{50}	C. dubia 96-Hr LC_{50}	CMC	CCC
Chlorpyrifos	3 µg/L *	53 ppt **	0.02 µg/L ***	0.014 µg/L ***
Diazinon	16 mg/L *	320 ppt **	0.08 µg/L ***	0.05 µg/L ***
* Montgomery, 1997 ** Baily et al, 1997, ppt = parts per trillion *** Siepmann and Finlayson, 2000				

3. What indicator or parameter will you use to measure whether or not you have accomplished the items listed in 2 above?

Answers to questions 1 and 2 from the Monitoring Plan will indicate success.

5.4 Biological Monitoring

1. Does your project include biological monitoring?

Yes

Biological monitoring will include conducting monthly surveys of birds occurring at the wetlands/riparian restoration site (Task 7.4.2) and sampling benthic invertebrates at the wetlands/riparian restoration site (Task 7.5).

2. What do you hope to accomplish with this activity?

The purpose of bird monitoring at the wetland site is to determine if species diversity, community composition, relative abundance of species, or habitat use changes after the wetland is built.

The purpose of benthic macroinvertebrate sampling is to determine if community composition and abundance vary between the wetland and the adjacent Tembladero Slough. This is question 6 in the Monitoring Plan, in the *Project Goals and Research Questions* section.

3. What indicator or parameter will you use to measure whether or not you have accomplished the items listed in 2 above?

Bird monitoring will have accomplished its purpose if it illustrates how bird usage at the site did or did not change after wetland construction.

Benthic macroinvertebrate sampling will have been successful if analysis of the data illustrates whether there are differences between the Tembladero Slough and the wetland.

Table 5.5. Summary of goals and targets for research and monitoring.

Project Goals	Desired outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
1. Watershed level monitoring to determine annual pollutant loads exiting the watershed	Determine the loads of suspended sediment, nutrients and pesticides delivered from the Gabilan Watershed for 1yr	- Water quality monitoring in the Tembladero Slough at the Haro Road bridge during 3 winter storms and 3 ambient periods(total of 6 events) - Analysis of suspended sediment, nutrient, and pesticide samples - Analysis of water quality data	The data collected can support annual load estimates	- Flow measurements: bridge crane with current meter - Suspended sediment filtering: vacuum filtration comparable to ASTM D 3977 - Nutrients: Hach Nitrate 10020HR, Ammonia 10023LR, Orthophosphate 8048 - Pesticides: CDFG Rancho Cordova (GCMS)	Quantitative annual load estimates for sediment, nutrients and pesticides
2. Management practice effectiveness monitoring (at both agricultural sites and the wetland) - To determine the effectiveness of BMPs with respect to water quality improvement - To determine the effect of the wetland during rain and non-rain events	To answer research questions presented in the Monitoring Plan: *Ag Sites* Q1. To determine to what extent BMPs reduce suspended sediment, nutrients, and pesticides *Wetland* Q2. To determine to what extent the wetland is reducing nutrients and pesticides Q3. To determine the optimal retention times, inflow loading rates, and depth to achieve maximum removal Q4. To investigate the balance of retention of constituents on site, vs neutralization through transformation or degradation, or volatilization? Q5. To determine if the wetland effluent is more/less toxic than the influent? Q7. To determine the %of Gabilan annual pollutant loads that the wetland removes	- Water quality monitoring at agricultural sites during rain and irrigation events (monitor 20 practices on 7 properties) - Water quality monitoring at the wetland (monitoring includes 8 events)	- Analysis of suspended sediment, nutrient, pesticide and toxicity samples - Analysis of water quality data	- Suspended sediment filtering: vacuum filtration comparable to ASTM D 3977 - Nutrients: Hach Nitrate 10020HR, Ammonia 10023LR, Orthophosphate 8048 - Pesticides: CDFG Rancho Cordova (GCMS) - Toxicity tests: Granite Canyon Marine Laboratory	Quantitative answers to questions 1, 2, 3, 5 and 7. Qualitative/investigatory answer to question 4.
3. Pollutant load reduction	To answer research questions presented in the Monitoring Plan: - To determine what volume of the total pollutant loads from the Gabilan Watershed the wetland is able to mitigate. - To determine the relationship between wetland area, and fraction of total watershed load treated.	- Water quality monitoring at agricultural sites during rain and irrigation events (monitor 20 practices on 7 properties) - Water quality monitoring at the wetland (monitoring includes 8 events)	- Analysis of suspended sediment, nutrient, and pesticide samples - Analysis of water quality data - Comparison of wetland data to annual loads leaving the watershed	- Suspended sediment filtering: vacuum filtration comparable to ASTM D 3977 - Nutrients: Hach Nitrate 10020HR, Ammonia 10023LR, Orthophosphate 8048 - Pesticides: CDFG Rancho Cordova (GCMS)	To address the questions listed under Desired Outcomes as completely as possible - to contribute data towards answering these questions and support future work
4. Biological monitoring	To answer research questions presented in the Monitoring Plan: *Bird Monitoring* - To determine if species diversity, community composition, relative abundance of species, or habitat use changes after wetland construction *Benthic Macroinvertebrates* - To determine if community composition and abundance vary between the wetland and the adjacent Tembladero Slough	- Monthly surveys of birds at the wetland - Benthic invertebrate sampling in the wetland and Tembladero Slough	- Analysis of bird monitoring data - Analysis of benthic invertebrate samples	- Monitoring three fixed plots for bird usage and flyovers - Adapted from Harrington and Born (2000)	To answer the questions listed under Desired Outcomes

6 Summary of Desired Outcomes

The over-arching project goal is the improvement of water quality in the Gabilan Watershed. To reduce pollution in the watershed, agricultural management practices and a constructed wetland will be built and monitored. This project is large, has many components, and involves the efforts of many agencies and personnel working together. The following list summarizes the primary desired project outcomes:

- Construct agricultural management practices and a treatment wetland
- Monitor these practices to measure how they affect water quality
- Communicate these results to growers and other stakeholders in the watershed, and use the data to improve the function of future practices

7 Literature Cited

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