California Air Resources Board

Quantification Methodology for the California Department of Fish and Wildlife Wetlands Restoration for Greenhouse Gas Reduction Program

Greenhouse Gas Reduction Fund
Fiscal Year 2017-18

Note:
The California Air Resources Board (CARB) is accepting public comments on the Draft Wetlands Restoration for Greenhouse Gas Reduction Quantification Methodology and Draft Wetlands Restoration for Greenhouse Gas Reduction Calculator Tool for Fiscal Year (FY) 2017-18 until May 16, 2018 via GGRFProgram@arb.ca.gov. The Draft Wetlands Restoration for Greenhouse Gas Reduction Quantification Methodology and the Draft Wetlands Restoration for Greenhouse Gas Reduction Calculator Tool are subject to change pending stakeholder comments and final Wetlands Restoration for Greenhouse Gas Reduction Program Proposal Solicitation Notice for FY 2017-18. The final Wetlands Restoration for Greenhouse Gas Reduction Quantification Methodology and Wetlands Restoration for Greenhouse Gas Reduction Calculator Tool will be available on the CARB quantification website at www.arb.ca.gov/cci-quantification.

DRAFT
May 2, 2018

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Section A. Introduction

The goal of California Climate Investments (CCI) is to reduce greenhouse gas (GHG) emissions and further the purposes of the Global Warming Solutions Act of 2006, known as Assembly Bill (AB) 32. The California Air Resources Board (CARB) is responsible for providing the quantification methodology to estimate the net GHG benefit and co-benefits from projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF). CARB develops these methodologies based on the project types eligible for funding by each administering agency as reflected in the program Expenditure Records available at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/expenditurerecords.htm. CARB staff periodically review each quantification methodology to evaluate its effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified.

For the California Department of Fish and Wildlife's (CDFW) Wetlands Restoration for Greenhouse Gas Reduction Program, CARB staff developed this Quantification Methodology and Wetlands Restoration for Greenhouse Gas Reduction Program Calculator Tool to provide methods for estimating the net GHG benefit and co-benefits of each proposed project (Section B), provide instructions for documenting and supporting the estimate (Section C), and outline the process for tracking and reporting GHG and other benefits once a project is funded (Section D).

This methodology uses calculations to estimate carbon sequestration in restored wetlands, changes in soil organic matter decomposition due to land use change, avoided nitrous oxide emissions due to land use change, and methane production in rewetted soil. Projects will report the total project GHG benefits estimated using this methodology as well as the total project GHG benefits per dollar of GGRF funds requested.

In an effort to enhance the analysis, provide greater transparency, and assist in project-level reporting, CARB also included an additional output worksheet in the Wetlands Restoration for Greenhouse Gas Reduction Program Calculator Tool that summarizes key variables that can be used to estimate additional co-benefits from Wetlands Restoration for Greenhouse Gas Reduction Program projects. The Calculator Tool estimates the land area restored in acres, which can be used to quantify the Soil Health and Conservation and Climate Adaptation co-benefits. As available, methodologies to assess social, economic, and public health co-benefits achieved by CCI projects are posted at: www.arb.ca.gov/cci-cobenefits.

Wetlands Restoration for Greenhouse Gas Reduction Program Project Types

The Wetlands Restoration for Greenhouse Gas Reduction Program achieves a net GHG benefit by decreasing rates of soil organic matter loss, increasing wetland carbon

sequestration, and avoiding GHG emissions created by agricultural and other land uses. CDFW developed three project types that meet the objectives of the Wetlands Restoration for Greenhouse Gas Reduction Program and for which there are methods to quantify a net GHG benefit.[i] Each project requesting GGRF funding must include at least one of the following project components for FY 2017-18:

- Sacramento-San Joaquin Delta Wetlands Restoration
- Coastal Tidal Wetlands Restoration; and
- Mountain Meadows Restoration.

Section B of this Quantification Methodology details the methods to use based on the project component(s) proposed.

Methodology Development

CARB and CDFW developed this Quantification Methodology consistent with the guiding implementation principles of CCI, including ensuring transparency and accountability.[ii] CARB and CDFW developed this Quantification Methodology through a public process to be used to estimate the outcomes of proposed projects, inform project selection, and track results of funded projects. The implementing principles ensure that the methodology would:

- Apply at the project-level;
- Provide uniform methods to be applied statewide, and be accessible by all applicants;
- Use existing and proven tools and methods;
- Use project-level data, where available and appropriate; and
- Result in net GHG benefit estimates that are conservative and supported by empirical literature.

CARB assessed peer-reviewed literature and tools and consulted with experts, as needed, to determine methods appropriate for the Wetland Restoration for Greenhouse Gas Reduction Program project types. CARB also consulted with CDFW to determine project-level inputs available. The methods were developed to provide estimates that are as accurate as possible with data readily available at the project level.

Tools

This Quantification Methodology and the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool rely on CARB-developed emission factors. CARB has established a single repository for emission factors used in quantification methodologies, referred to as the CCI Quantification Methodology Emission Factor Database (Database).[iii] The Database Documentation explains how emission factors used in CARB quantification methodologies are developed and updated.

Applicants must use this Quantification Methodology, in conjunction with the accompanying Wetland Restoration for Greenhouse Gas Reduction Calculator Tool, to estimate the net GHG benefit and co-benefits of the proposed project. The Wetland Restoration for Greenhouse Gas Reduction Calculator Tool can be downloaded from: www.arb.ca.gov/cci-quantification.

Updates

CARB staff periodically review each quantification methodology to evaluate its effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified. CARB updated the Wetland Restoration for Greenhouse Gas Reduction Quantification Methodology from the previous version[iv] to enhance the analysis and provide additional clarity. The changes include:

- More prescriptive methods for quantifying GHG emissions benefits created by wetland restoration projects, using guidance from the Intergovernmental Panel on Climate Change (IPCC), United States Department of Agriculture (USDA), the American Carbon Registry (ACR), and peer-reviewed published literature.
- The creation of a Calculator Tool that assists in estimating GHG benefits created by wetland restoration projects.
- Addition of key variables and co-benefits related to project activities.

Program Assistance

CDFW and CARB staff will review the quantification portions of the Wetlands Restoration for Greenhouse Gas Reduction Program project applications to ensure that the methods described in this document were properly applied to estimate the net GHG benefit and co-benefits for the proposed project. Applicants should use the following resources for additional questions and comments:

- Questions on this document should be sent to GGRFProgram@arb.ca.gov.
- For more information on CARB's efforts to support implementation of GGRF investments, see: www.arb.ca.gov/caclimateinvestments.
- Questions pertaining to the Wetland Restoration for Greenhouse Gas Reduction Program should be sent to WatershedGrants@wildlife.ca.gov.

Section B. Quantification Methodology

Overview

This Quantification Methodology accounts for changes in carbon dioxide (CO_2) from organic matter decomposition and carbon sequestration in soil due to land use change and wetland restoration, avoided nitrous oxide (N_2O) production from avoided cultivation of organic soils, and methane production (CH_4) in low-salinity wetlands (methane production is not quantified in wetlands with salinity greater than 18 parts per thousand (ppt)). In general, the net GHG benefit is estimated using the following approaches:

Table 1. General Approach to GHG Quantification by Project Type

SACRAMENTO-SAN JOAQUIN DELTA WETLANDS (Legal Delta Boundary)
Net GHG Benefit = Avoided Organic Matter Decomposition + Avoided N_2O Emissions from Farmland Use Conversion + Change in CO_2 and CH_4 Emissions from Restored Delta Wetland
COASTAL TIDAL WETLANDS
Net GHG Benefit = GHG Emissions Avoided from Farmland Use Conversion – CH_4 Emissions from Rewetted Land + Carbon Sequestered in Restored Wetland + Carbon Sequestered in Restored Adjacent Uplands
MOUNTAIN MEADOW ECOSYSTEMS
Net GHG Benefit = Carbon Sequestered in Restored Mountain Meadow Soil

Methods and equations used in the Wetlands Restoration for Greenhouse Gas Reduction Calculator Tool for estimating the net GHG benefit and co-benefits are provided in Appendix B. Emission factors used in calculations are contained in the Database available at: www.arb.ca.gov/cci-quantification. Documentation on the sources and methods used to develop the emission factors are also provided.

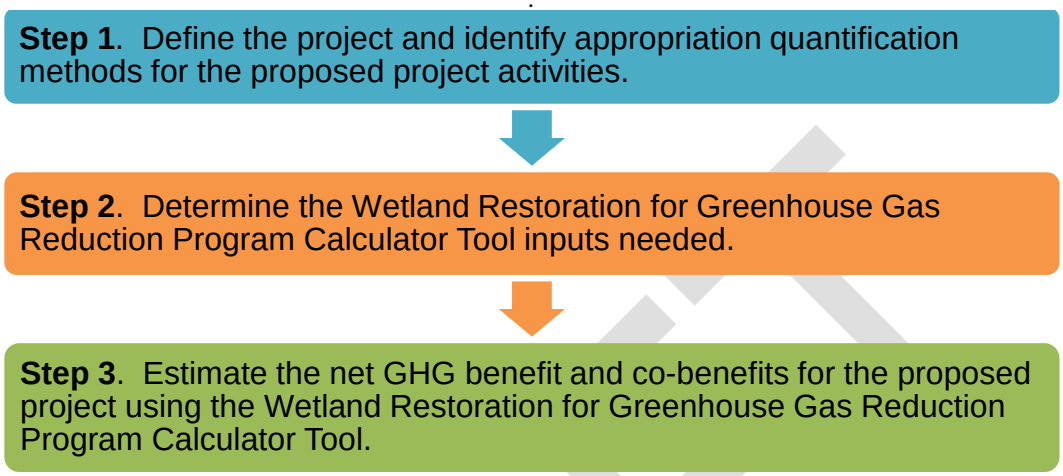
Applicants will follow the steps outlined in Figure 1 to estimate the net GHG benefit and co-benefits from the proposed project. Detailed instructions for each step are provided on subsequent pages. Appendix A contains multiple example projects showing how to estimate the net GHG benefits and co-benefits from different project types using the Calculator Tool.

Step 1: Define the Project

Applicants must define the project by identifying eligible components from Table 2 that apply to the project. Applicants may incorporate more than one project component and

can use multiple methods identified in this Quantification Methodology, as appropriate, to quantify the net GHG benefit.

Figure 1. Steps to Estimating Net GHG Benefits and Co-benefits



- Wetland restoration in the legal Sacramento-San Joaquin Delta, as defined in California Water Code (CWC) section 12220, should be quantified using "Delta" worksheet.
- Coastal Tidal Wetland restorations are located within the coastal zone as defined in the California Coastal Act and the area of jurisdiction of the San Francisco Bay Conservation and Development Commission. Applicants proposing to restore these wetlands should use the "Coastal" worksheet, while restoration projects involving land-use change of farmland to coastal tidal wetland and upland should also include the "Coastal Farm" worksheet.
- Mountain meadow restoration activities in the Sierra Nevada and Cascade ranges should be quantified using the "Mtn. Meadow" worksheet.

The project components identified will determine which subsections of this Quantification Methodology and sections of the accompanying Wetland Restoration for Greenhouse Gas Reduction Calculator Tool must be used in order to estimate the net GHG benefit and co-benefits.

Step 2: Determine the Wetland Restoration Calculator Tool Inputs Needed

Table 3 identifies the required data inputs needed to estimate the net GHG benefit and co-benefits for the proposed project with the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool by project type.

Table 2. Project Components and Appropriate Quantification Methods

Project Component	Method Subsection References	Calculator Tool Worksheet
Land-Use Change from Farmland to Coastal Tidal Wetland/Upland	Step [2] Step [3]	"Coastal Farm" worksheet
Coastal Tidal Wetland Restoration	Step [2] Step [3]	"Coastal" worksheet
Sacramento-San Joaquin Delta Wetland Restoration	Step [2] Step [3]	"Delta" worksheet
Mountain Meadow Restoration	Step [2] Step [3]	"Mtn. Meadow" worksheet

Table 3. Required Wetland Restoration Calculator Tool Inputs for Eligible Project Type(s)

ALL PROJECTS
General Information (for "Read Me" worksheet in Calculator Tool) • Project Name; • Application ID; • Contact Name; • Contact Phone Number; • Contact Email; and • Date Completed. **Total Project GHG Benefit/GGRF $ Requested** (for GHG Summary worksheet) • Total amount of Wetlands Restoration for Greenhouse Gas Reduction GGRF funds requested from this solicitation to implement the project; • Total amount of additional GGRF funds to implement the project (include GGRF funds previously awarded to the project by the Department of Fish and Wildlife's Wetland Restoration for Greenhouse Gas Reduction Program or another CCI program, GGRF funds currently being requested from another CCI program, and GGRF funds the project plans to request in the future from the Department of Fish and Wildlife's Wetlands Restoration for Greenhouse Gas Reduction Program or another CCI program). • Identify CCI program(s) from which the project has been awarded GGRF funds (include award date), is currently requesting GGRF funds, or plans to request GGRF funds. For a list of GGRF funded programs, go to: www.arb.ca.gov/cci-events.
SACRAMENTO-SAN JOAQUIN DELTA WETLAND RESTORATION
Quantification Inputs (for "Delta" worksheet in Calculator Tool) • Acres restored to permanent wetland; • Acres restored to upland; and • Acres of farmland converted.
LAND-USE CHANGE FROM FARMLAND TO COASTAL TIDAL WETLAND/UPLAND
Quantification Inputs (for "Coastal Farm" worksheet in Calculator Tool) • Acres converted from farmland to coastal tidal wetland; • Number of years acres converted from farmland to coastal tidal wetland was tilled in the past ten years; and • Acres converted from farmland to coastal upland. If no tillage history is available, assume 10 years for annual crops, 3 years for perennial crops, and 1 year for woody crops.

COASTAL TIDAL WETLAND RESTORATION
Quantification Inputs (for "Coastal" worksheet in Calculator Tool) • Number of months per year water salinity is less than 18 ppt; • If under existing conditions, project area is a seasonal wetland, number of months per year project area is inundated; • If under existing conditions, project area is a seasonal wetland, number of months per year project area is inundated AND water salinity is less than 18 ppt; • Acres project restores to tidal wetland; and • Acres project restores to upland.
MOUNTAIN MEADOW RESTORATION
Quantification Inputs (for "Mtn. Meadow" worksheet in Calculator Tool) • Acres restored to mountain meadow.

Step 3: Estimate Net GHG Benefit and Co-benefits for the Proposed Project Using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool

Applicants must use the Wetland Restoration Greenhouse Gas Reduction Calculator Tool to complete this step. The Calculator Tool can be downloaded from www.arb.ca.gov/cci-quantification.

Users should begin with the **Read Me** tab, which contains instructions and prompts users to enter project information.

The **calculation** tabs identify inputs required by the user, generally requiring project-specific data or assumptions. Input and output fields are color coded:

- Yellow fields indicate a direct user input is required.
- Blue fields indicate a user input or selection is optional.
- Gray fields indicate output or calculation fields that are automatically populated based on user entries and the calculation methods.

If the project site consists of areas with different characteristics, (e.g., different farm plots with different tillage histories, different land uses, or different wetland areas with different seasonality) then the different areas can be entered separately for calculation purposes. Up to five different areas can be evaluated in the Calculator Tool.

Details of calculation methods are provided in Appendix B.

The **GHG Summary** worksheet displays the estimated:

- GHG benefit over the quantification period ($MTCO_2e$);
- Total GHG benefit per total GGRF dollars requested ($MTCO_2e/\$$);
- GHG benefit per Wetlands Restoration for Greenhouse Gas Reduction funds requested ($MTCO_2e/\$$);[1]
- Wetlands Restoration for Greenhouse Gas Reduction funds requested per Wetlands Restoration for Greenhouse Gas Reduction funds GHG benefit ($\$/MTCO_2e$); and
- Portion of the GHG benefit attributable to the GGRF funding from another CCI program, as applicable.

The **Co-benefits Summary** worksheet displays the estimated:

- Land Restored

[1] This is the portion of GHG benefit attributable to funding from the Wetlands Restoration for Greenhouse Gas Reduction Program; GHG emission reductions are prorated according to the level of program funding contributed from the Wetland Restoration for Greenhouse Gas Reduction Program and other CCI programs, as applicable.

Section C. Documentation

In addition to Wetlands Restoration for Greenhouse Gas Reduction Program application requirements, applicants for GGRF funding are required to document results from the use of this Quantification Methodology, including supporting materials to verify the accuracy of project-specific inputs.

Applicants are required to provide electronic documentation that is complete and sufficient to allow the calculations to be reviewed and replicated. Paper copies of supporting materials must be available upon request by agency staff.

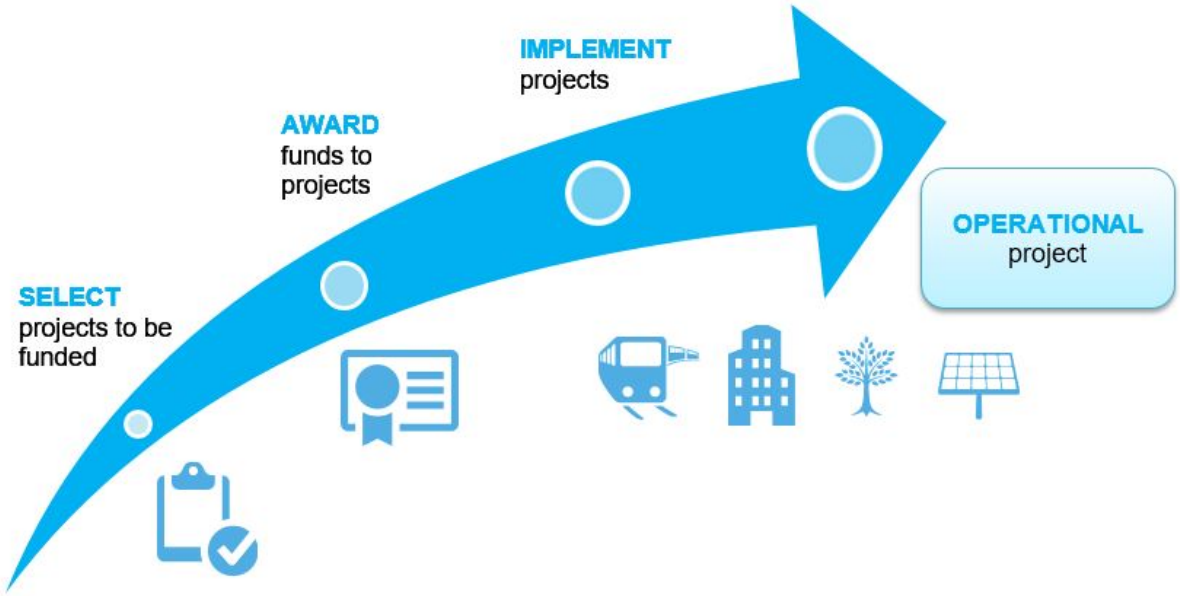
The following checklist is provided as a guide to applicants; additional data and/or information may be necessary as required by CDFW to support project-specific input assumptions.

	Documentation Description	Completed
1.	Contact information for the person who can answer project specific questions from staff reviewers on the quantification calculations	
2.	Project description, including excerpts or specific references to the location in the main Wetlands Restoration for Greenhouse Gas Reduction Program application of the project information necessary to complete the applicable portions of the Quantification Methodology	
3.	Populated Wetland Restoration for Greenhouse Gas Reduction Calculator Tool file (in .xlsx) with worksheets applicable to the project populated (ensure that all non-zero fields in the GHG Summary and Co-benefits tabs are populated)	
4.	Any other information as necessary and appropriate to substantiate Wetland Restoration for Greenhouse Gas Reduction Calculator Tool inputs (e.g., farming records, maps of project site)	

Section D. Reporting after Funding Award

Accountability and transparency are essential elements for all CCI. All administering agencies are required to track project implementation and report on the benefits of those investments. CARB develops tracking and reporting guidance for CCI. The reporting process and requirements are found in Section VI of the draft Funding Guidelines.[2]

CDFW will submit periodic reports to CARB. The specific data that need to be reported depend on the project type and the stage of project implementation at the time of reporting. Initially, administering agencies must report basic project information and expected benefits. As projects are implemented, administering agencies provide additional information on project status, benefits, and results. When projects are completed, administering agencies submit project closeout reports. A subset of projects, selected by CDFW, will report on project outcomes upon reaching a specified milestone and being considered "operational."



CDFW is required to collect and compile project data from funding recipients, including the net GHG benefit estimated using this Quantification Methodology, co-benefits, and information on benefits to AB 1550[3] Populations. Reported information will be used to demonstrate how the Administration is achieving or exceeding the statutory objectives for CCI. Key variables and co-benefits are highlighted in the Co-benefits Summary

[2] CARB released updated draft Funding Guidelines in April 2018. These draft Funding Guidelines are subject to change based on public input and Board direction. While the draft provides an indication of what is currently required, administering agencies must incorporate all provisions reflected in the draft Funding Guidelines and subsequent Board approved Funding Guidelines.
[3] AB 1550, Gomez, Chapter 369, Statutes of 2016; amending Health and Safety Code Section 39713. Detailed information on AB 1550 requirements is provided in Section V of the draft Funding Guidelines.

worksheet of the Wetlands Restoration for Greenhouse Gas Reduction Calculator Tool. Funding recipients have the obligation to provide, or provide access to, data and information on project outcomes to CDFW. Applicants should familiarize themselves with the requirements within the Wetlands Restoration for Greenhouse Gas Reduction Program Proposal Solicitation Notice (PSN), solicitation materials, and grant agreement, as well as the CARB Funding Guidelines.

Section E. References

The following references were used in the development of this Quantification Methodology and the accompanying Wetland Restoration Greenhouse Gas Reduction Calculator Tool.

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[i] CDFW Wetlands Restoration for Greenhouse Gas Reduction Program https://www.wildlife.ca.gov/Conservation/Watersheds/Greenhouse-Gas-Reduction

[ii] California Air Resources Board. www.arb.ca.gov/cci-fundingguidelines

[iii] California Air Resources Board (2017). California Climate Investments Quantification Methodology Emission Factor Database. Available at: www.arb.ca.gov/cci-quantification.

[iv] Wetlands Restoration for Greenhouse Gas Reduction Program Interim Quantification Methodology for FY 2014-15. https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/cdfwwetlandsqm.pdf

Appendix A. Example Projects

Introduction

The following are hypothetical projects[4] to demonstrate how the FY 2017-18 Wetlands Restoration for Greenhouse Gas Reduction Program Quantification Methodology would be applied. These examples do not provide examples of the supporting documentation that is required of actual project applicants.

A. Delta Wetland Restoration in San Joaquin County

Overview of the proposed project

The proposed project is a Farm-to-Managed Wetlands project proposing the following components:

- Sacramento-San Joaquin Delta Wetland Restoration

The proposed project has the following project features:

- 27 acres of farmland to be converted to permanently flooded, managed wetland
- 3 acres of waterlogged land to be converted to permanently flooded, managed wetland
- $400,000 requested from Wetlands Restoration for Greenhouse Gas Reduction Fund

Methods to apply

Step 1: Define the Project

Refer to Table 2 to match project components with the steps required to quantify the greenhouse gas benefit. More than one component may apply to a single project.

The project components that apply to this project is “Sacramento-San Joaquin Delta Wetland Restoration.” The applicant will need to follow Steps 2 and 3 to complete the quantification. Using Table 2, the applicant determines that the applicant will need to use the “Delta” worksheet of the Calculator Tool.

[4] The hypothetical project has not undergone verification of any Wetland Restoration for Greenhouse Gas Reduction Program requirements; all assumptions about location type and features are for quantification methodology demonstration purposes only.

Step 2: Determine the Wetlands Restoration for Greenhouse Gas Reduction Program Calculator Tool Inputs Needed

The applicant determines all of the required inputs from Table 3 to estimate GHG benefits. There is General Information that all applicants must submit. That information is entered in the "Read Me" worksheet of the Calculator Tool.

Project Name:	**San Joaquin Old River Association**
Application ID:	**SOA-Example**
Contact Name:	**Maggie Knowles**
Contact Phone Number:	**559-555-0199**
Contact Email:	**mknowles@soa.org**
Date Completed:	**6/2/2018**

Total Project GHG Benefit will be estimated by the Calculator Tool. Because the project area has different areas with different characteristics, the areas will be tracked separately.

For the "Sacramento-San Joaquin Delta Wetland Restoration" project component, the quantification inputs required are:

- Acres restored to permanent wetland: 30 acres (27 acres from farmland, 3 acres waterlogged)
- Acres restored to upland: 0 acres
- Acres of farmland converted: 27 acres
- No additional funds requested from other GGRF Programs

Step 3: Estimate Net GHG Benefit and Co-benefits for the Proposed Project Using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool

Project GHG Benefits and Co-benefits are calculated using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool. The applicant enters the inputs into the "Delta" tab.

"Delta" worksheet inputs look like this:

Delta Restoration Worksheet

Area	GHG Calculation Inputs					
	Acres Restored to Permanent Wetland		Acres Restored to Upland		Acres Converted from Farmland	
1	30	acres	0	acres	27	acres
2		acres		acres		acres
3		acres		acres		acres
4		acres		acres		acres
5		acres		acres		acres
SUBTOTAL	30	acres		acres	27	acres

In the "GHG Summary" tab, the applicant enters the funds requested. The Calculator Tool determines the GHG benefits and associated accounting statistics.

Greenhouse Gas Summary

Gas Reduction GGRF funds requested from this solicitation to implement the project:	$400,000
Total amount of additional GGRF funds to implement the project	

Identify California Climate Investment programs from which the project has been awarded GGRF funds, is currently requesting GGRF funds, or plans to request GGRF funds.

California Climate Investment Program	Award Date if Awarded

GHG benefit over the quantification period	9,564	MT-CO_2e
Total GHG benefit per total GGRF dollars requested	0.02391	MT-CO_2e/$
GHG benefit per Wetlands Restoration funds requested	0.02391	MT-CO_2e/$
Wetland Restoration funds requested per Wetland Restoration GHG benefit	42	$/MT-$CO_2e$
Portion of the GHG benefit attributable to the GGRF funding from another CCI program	0	MT-CO_2e

The project is estimated to have a benefit of 9,564 MT-CO_2e.

In the "Co-Ben Summary" worksheet, the Calculator Tool determines the co-benefits associated with the project.

Co-Benefits Summary

KEY VARIABLES	Delta Wetlands	Coastal Wetlands	Uplands	Mountain Meadows	
Land Restored/Treated	30	0	0	0	Acres

The project will restore 30 acres of Delta wetland.

B. Farm to Coastal Tidal Wetland in Ventura County

Overview of the proposed project

The proposed project is a Coastal Tidal Wetlands project proposing the following components:

- Coastal Tidal Wetlands Restoration

The proposed project has the following project features:

- $750,000 requested from the Wetlands Restoration for Greenhouse Gas Reduction Fund
- No additional funds requested from other GGRF Programs

Area 1

- 30 acres of farmland to be converted to permanent coastal tidal wetland
    - Farmland was formerly used to grow annual crops

Area 2

- 10 acres of farmland to be converted to coastal upland
    - 10 acres of farmland used to grow vines
- 5 acres of tidal wetland threatened by sea-level rise to be restored
- 4 acres of degraded upland to be restored

Methods to apply

Step 1: Define the Project

Refer to Table 2 to match project components with the steps required to quantify the greenhouse gas benefit. More than one component may apply to a single project.

The project components that apply to this project is "Land-Use Change from Farmland to Coastal Wetland/Upland" and "Coastal Wetlands Restoration." The applicant will need to follow Steps 2 and 3 to complete the quantification. Using Table 2, the applicants determines that the applicant will need to use the "Coastal Farm" worksheet and the "Coastal" worksheet of the Calculator Tool.

Step 2: Determine the Wetlands Restoration for Greenhouse Gas Reduction Program Calculator Tool Inputs Needed

The applicant determines all of the required inputs from Table 3 to estimate GHG benefits. There is General Information that all applicants must submit. That information is entered in the "Read Me" worksheet of the Calculator Tool.

Project Name:	**Hueneme Wetland Project**
Application ID:	**HWP-Example**
Contact Name:	**J. Q. Mugu**
Contact Phone Number:	**805-555-0192**
Contact Email:	**mugu@ventura.org**
Date Completed:	**6/4/2018**

Total Project GHG Benefit will be estimated by the Calculator Tool. Because the project area has different areas with different characteristics, the areas will be tracked separately.

Area 1

For the "Land-Use Change from Farmland to Coastal Tidal Wetland/Upland" project component, the quantification inputs required are:

- Acres converted from farmland to coastal tidal wetland: 30 acres
- Number of years acres converted from farmland to coastal tidal wetland was tilled in the past ten years: unknown, but annual crops grown. Assume 10 years of conventional tillage.
- Acres converted from farmland to coastal tidal upland: 0 acres

For the "Coastal Tidal Wetland Restoration" project component, the quantification inputs required are:

- Number of months per year water salinity is less than 18 ppt: wetland is coastal, water salinity is always greater than 18 ppt: 0 months
- If project area is a seasonal wetland, number of months per year project area is inundated: area is not a seasonal wetland; 0 months
- If project area is a seasonal wetland, number of months per year project area is inundated AND water salinity is less than 18 ppt: 0 months
- Acres project restores to permanent tidal wetland: 30 acres
- Acres project restores to upland: 0 acres

Area 2

For the "Land-Use Change from Farmland to Coastal Tidal Wetland/Upland" project component, the quantification inputs required are:

- Acres converted from farmland to coastal tidal wetland: 0 acres
- Number of years acres converted from farmland to coastal tidal wetland was tilled in the past ten years: All acres in this area to be converted to upland, not wetland: 0 years
- Acres converted from farmland to coastal upland: 10 acres

For the "Coastal Tidal Wetland Restoration" project component, the quantification inputs required are:

- If project area is a seasonal wetland, number of months per year project area is inundated: area is not a seasonal wetland; 0 months
- Number of months per year water salinity is less than 18 ppt: wetland is coastal, water salinity is always greater than 18 ppt: 0 months
- If project area is a seasonal wetland, number of months per year project area is inundated AND water salinity is less than 18 ppt: 0 months
- Acres project restores to permanent tidal wetland: 5 acres
- Acres project restores to upland: 14 acres (10 acres of farmland restored to upland, 4 acres of degraded upland restored)

Step 3: Estimate Net GHG Benefit and Co-benefits for the Proposed Project Using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool

Project GHG Benefits and Co-benefits are calculated using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool. The applicant enters the inputs into the "Coastal Farm" worksheet and "Coastal" worksheet.

"Coastal Farm" worksheet inputs look like this:

Land-Use Change from Coastal Farmland Worksheet

If no farmland is converted to coastal tidal wetland or coastal upland as part of the project, leave this tab blank.

Area	Project Component Inputs					
	Farmland Area Converted to Permanent Coastal Tidal Wetland		Number of years Area Converted to Coastal Tidal Wetland area was tilled in past ten years		Farmland Area Converted to Coastal Upland	
1	30	acres	10	years	0	acres
2	0	acres	0	years	10	acres
3		acres		years		acres
4		acres		years		acres
5		acres		years		acres
SUBTOTAL	30	acres			10	acres

"Coastal" worksheet inputs look like this:

Coastal Tidal Wetland and Upland Restoration Worksheet

Area	GHG Calculation Inputs									
	Months per year water salinity is less than 18 ppt		If Area is Initially Seasonal Wetland, Months per Year site is Inundated		If Area is Initially Seasonal Wetland, Months per year site is Inundated and water salinity less than 18 ppt		Area Restored to Permanent Coastal Tidal Wetland		Area Restored to Coastal Upland	
1	0	months	0	months	0	months	30	acres	0	acres
2	0	months	0	months	0	months	5	acres	14	acres
3		months		months		months		acres		acres
4		months		months		months		acres		acres
5		months		months		months		acres		acres
SUBTOTAL							35	acres	14	acres

In the "GHG Summary" tab, the applicant enters the funds requested. The Calculator Tool determines the GHG benefits and associated accounting statistics.

Greenhouse Gas Summary

Gas Reduction GGRF funds requested from this solicitation to implement the project:	$750,000
Total amount of additional GGRF funds to implement the project	

Identify California Climate Investment programs from which the project has been awarded GGRF funds, is currently requesting GGRF funds, or plans to request GGRF funds.

California Climate Investment Program	Award Date if Awarded

GHG benefit over the quantification period	32,239	MT-CO_2e
Total GHG benefit per total GGRF dollars requested	0.04299	MT-CO_2e/$
GHG benefit per Wetlands Restoration funds requested	0.04299	MT-CO_2e/$
Wetland Restoration funds requested per Wetland Restoration GHG benefit	23	$/MT-$CO_2e$
Portion of the GHG benefit attributable to the GGRF funding from another CCI program	0	MT-CO_2e

The project is estimated to have a benefit of 32,239 MT-CO_2e.

In the "Co-Ben Summary" tab, the Calculator Tool determines the co-benefits associated with the project.

Co-Benefits Summary

KEY VARIABLES	Delta Wetlands	Coastal Wetlands	Uplands	Mountain Meadows	
Land Restored/Treated	0	35	14	0	Acres

The project will restore 35 acres of coastal wetland and 14 acres of upland.

C. Seasonal Wetland to Permanent Coastal Tidal Wetland in Suisun Marsh

Overview of the proposed project

The proposed project is a Coastal Wetlands project proposing the following components:

- Coastal Tidal Wetland Restoration

The proposed project has the following project features:

- 17 acres of seasonal wetland to be converted to permanent tidal wetland
- Area dries out in summertime: project area is inundated 5 months out of the year.
- During the wet season (3 months), water salinity is less than 5 ppt. During other months of the year, water salinity is typically between 20 and 25 ppt.
- Water salinity is less than 5 ppt for 3 months during the 5 months of area inundation. Water salinity is between 20 and 25 ppt for the other 2 months.
- 5 acres of degraded upland to be restored with native grasses and shrubs.
- $200,000 requested from the Wetlands Restoration for Greenhouse Gas Reduction Fund
- No additional funds requested from other GGRF Programs.

Methods to apply

Step 1: Define the Project

Refer to Table 2 to match project components with the steps required to quantify the greenhouse gas benefit. More than one component may apply to a single project.

The project component that applies to this project is Coastal Tidal Wetland Restoration. The applicant will need to follow Steps 2 and 3 to complete the quantification. Using Table 2, the applicant determines that the applicant will need to use the "Coastal" worksheet of the Calculator Tool.

Step 2: Determine the Wetlands Restoration for Greenhouse Gas Reduction Program Calculator Tool Inputs Needed

The applicant determines all of the required inputs from Table 3 to estimate GHG benefits. There is General Information that all applicants must submit. That information is entered in the "Read Me" worksheet of the Calculator Tool.

Project Name:	**Suisun Solano Project**
Application ID:	**SSP-Example**
Contact Name:	**Matthew Diablo**
Contact Phone Number:	**707-555-0193**
Contact Email:	**matthew.diablo@water.ca.gov**
Date Completed:	**6/5/2018**

Total Project GHG Benefit will be estimated by the Calculator Tool.

For the Wetland/Upland Restoration, the quantification inputs required are:

- Number of months per year water salinity is less than 18 ppt: 3 months
- If project area is a seasonal wetland, number of months per year project area is inundated: 5 months
- Acres restored to permanent wetland: 17 acres
- If project area is a seasonal wetland, number of months per year project area is inundated AND water salinity is less than 18 ppt: 3 months
- Acres restored to upland: 5 acres

Step 3: Estimate Net GHG Benefit and Co-benefits for the Proposed Project Using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool

Project GHG Benefits and Co-benefits are calculated using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool. The applicant enters the inputs into the "Coastal" worksheet.

Coastal Tidal Wetland and Upland Restoration Worksheet

Area	GHG Calculation Inputs									
	Months per year water salinity is less than 18 ppt		If Area is Initially Seasonal Wetland, Months per Year site is Inundated		If Area is Initially Seasonal Wetland, Months per year site is Inundated and water salinity less than 18 ppt		Area Restored to Permanent Coastal Tidal Wetland		Area Restored to Coastal Upland	
1	3	months	5	months	3	months	17	acres	5	acres
2		months		months		months		acres		acres
3		months		months		months		acres		acres
4		months		months		months		acres		acres
5		months		months		months		acres		acres
SUBTOTAL							17	acres	5	acres

In the "GHG Summary" tab, the applicant enters the funds requested. The Calculator Tool determines the GHG benefits and associated accounting statistics.

Greenhouse Gas Summary

Gas Reduction GGRF funds requested from this solicitation to implement the project:	$200,000
Total amount of additional GGRF funds to implement the project	

Identify California Climate Investment programs from which the project has been awarded GGRF funds, is currently requesting GGRF funds, or plans to request GGRF funds.

California Climate Investment Program	Award Date if Awarded

GHG benefit over the quantification period	857	MT-CO_2e
Total GHG benefit per total GGRF dollars requested	0.00429	MT-CO_2e/$
GHG benefit per Wetlands Restoration funds requested	0.00429	MT-CO_2e/$
Wetland Restoration funds requested per Wetland Restoration GHG benefit	233	$/MT-$CO_2e$
Portion of the GHG benefit attributable to the GGRF funding from another CCI program	0	MT-CO_2e

The project is estimated to have a benefit of 857 MT-CO_2e.

In the “Co-Ben Summary” tab, the Calculator Tool determines the co-benefits associated with the project.

Co-Benefits Summary

KEY VARIABLES	Delta Wetlands	Coastal Wetlands	Uplands	Mountain Meadows	
Land Restored/Treated	0	17	5	0	Acres

The project will restore 17 acres of coastal tidal wetlands and 5 acres of uplands.

D. Mountain Meadow in Tuolumne County

Overview of the proposed project

The proposed project is a Mountain Meadow Ecosystems project proposing the following components:

- Restoration of a degraded Mountain Meadow

The proposed project has following project features:

- 36 acres of degraded Mountain Meadow to be restored
- $600,000 requested from the Wetlands Restoration for Greenhouse Gas Reduction Program.
- No additional funds requested from other GGRF Programs.

Methods to apply

Step 1: Define the Project

Refer to Table 2 to match project components with the steps required to quantify the greenhouse gas benefit. More than one component may apply to a single project.

The project component that applies to this project is Mountain Meadow Restoration. The applicant will need to follow Steps 2 and 3 to complete the quantification. Using Table 2, the applicant determines that the applicant will need to use the "Mtn. Meadow" worksheet of the Calculator Tool.

Step 2: Determine the Wetlands Restoration for Greenhouse Gas Reduction Program Calculator Tool Inputs Needed

The applicant determines all of the required inputs from Table 3 to estimate GHG benefits. There is General Information that all applicants must submit. That information is entered in the "Read Me" worksheet of the Calculator Tool.

Project Name:	**Mountain Meadows Admirers**
Application ID:	**MMA-Example**
Contact Name:	**L. v. Trapp**
Contact Phone Number:	**209-555-0191**
Contact Email:	**LVTrapp@mma.org**
Date Completed:	**6/4/2018**

Total Project GHG Benefit will be estimated by the Calculator Tool.

For the Mountain Meadow Restoration, the quantification inputs required are:

- Acres restored to mountain meadow: 36 acres

Step 3: Estimate Net GHG Benefit and Co-benefits for the Proposed Project Using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool

Project GHG Benefits and Co-benefits are calculated using the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool. The applicant enters the inputs into the "Mtn. Meadow" worksheet.

Mountain Meadow Restoration Worksheet

Area	GHG Calculation Inputs Acres Restored to Mountain Meadow	
1	36	acres
2		acres
3		acres
4		acres
5		acres
SUBTOTAL	36	acres

In the "GHG Summary" tab, the applicant enters the funds requested. The Calculator Tool determines the GHG benefits and associated accounting statistics.

Greenhouse Gas Summary

Gas Reduction GGRF funds requested from this solicitation to implement the project:	$600,000
Total amount of additional GGRF funds to implement the project	

Identify California Climate Investment programs from which the project has been awarded GGRF funds, is currently requesting GGRF funds, or plans to request GGRF funds.

California Climate Investment Program	Award Date if Awarded

GHG benefit over the quantification period	2,548	MT-CO_2e
Total GHG benefit per total GGRF dollars requested	0.00425	MT-CO_2e/$
GHG benefit per Wetlands Restoration funds requested	0.00425	MT-CO_2e/$
Wetland Restoration funds requested per Wetland Restoration GHG benefit	235	$/MT-$CO_2e$
Portion of the GHG benefit attributable to the GGRF funding from another CCI program	0	MT-CO_2e

The project is estimated to have a benefit of 2,548 MT-CO_2e.

In the “Co-Ben Summary” tab, the Calculator Tool determines the co-benefits associated with the project.

Co-Benefits Summary

KEY VARIABLES	Delta Wetlands	Coastal Wetlands	Uplands	Mountain Meadows	
Land Restored/Treated	0	0	0	36	Acres

The project will restore 36 acres of Mountain Meadow.

Appendix B. Equations Supporting the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool

Methods used in the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool for estimating the net GHG benefit by activity type are provided in this appendix. The net GHG benefit and co-benefits estimates from the project are quantified within the Wetland Restoration for Greenhouse Gas Reduction Calculator Tool using the approaches described below. The Database Documentation explains how emission factors used in CARB quantification methodologies are developed and updated.

A. GHG Benefit from Sacramento-San Joaquin Delta Wetland Restoration

The GHG benefit from Sacramento-San Joaquin Delta Wetland Restoration is estimated using Equation 1.

Equation 1: GHG Benefit from Sacramento-San Joaquin Delta Wetland Restoration

$$GHG_{RDW} = \left(0.05 \times 40{,}468{,}564 \div 1{,}000{,}000 \times \frac{44}{12} - 2.60 \times 0.4047\right) \times A_{RDW} \times 50 + 0.008 \times 0.4047 \times \frac{44}{14} \times A_F \times 50$$

Where,			Units
GHG_{RDW}	=	GHG benefit of restored Delta wetland	$\text{MT CO}_2\text{e}$
0.05	=	Delta carbon flux due to subsidence	$\frac{\text{g C}}{\text{cm}^2\ \text{Year}}$
$40{,}468{,}564$	=	Conversion from square centimeters to acres	$\frac{\text{cm}^2}{\text{Acre}}$
$1{,}000{,}000$	=	Conversion from grams to metric tons	$\frac{\text{g}}{\text{MT}}$
$\frac{44}{12}$	=	Molecular weight ratio of carbon dioxide to carbon	$\frac{\text{MT CO}_2\text{e}}{\text{MT C}}$
2.60	=	Restored Delta wetland CO_2 and CH_4 emission rate	$\frac{\text{MT CO}_2\text{e}}{\text{Hectare} - \text{Year}}$
0.4047	=	Conversion from hectares to acres	$\frac{\text{Hectares}}{\text{Acres}}$
A_{RDW}	=	Area of restored delta wetland	Acres
50	=	Number of years of project life	Years
0.008	=	Nitrous oxide emission rate for cropped wetland soils	$\frac{\text{MT N}_2\text{O} - \text{N}}{\text{Hectare Year}}$
0.4047	=	Conversion from hectares to acres	$\frac{\text{Hectares}}{\text{Acres}}$
$\frac{44}{14}$	=	Molecular weight ratio of nitrous oxide to nitrogen	$\frac{\text{MT N}_2\text{O}}{\text{MT N}}$
A_F	=	Area of farmland converted to managed wetland	Acres

B. GHG Benefit from Land-Use Change from Farmland to Coastal Tidal Wetlands and Uplands

The GHG benefit from land-use change from farmland on organic soils is estimated using Equation 2, which relies on three other equations. Equation 3 is used to determine the value for the difference in carbon loss rates (ΔCLR) from land-use change from farmland that will be restored to coastal wetland for Equation 2. Equation 4 is used to determine the value for carbon sequestration ($Cseq_{F\text{-}U}$) from land-use change from farmland that will be restored to coastal upland for Equation 2. Equation 5 is used to determine the avoided N_2O emissions (ΔN_2O) in Equation 2 from avoided nitrogen application.

Equation 2: GHG Benefit from Land-Use Change from Farmland to Coastal Tidal Wetlands and Uplands

$$GHG_{LUC} = (\Delta CLR + \Delta N_2O \times 298) \times 50 + Cseq_{F-U}$$

Where,			Units
GHG_{LUC}	=	GHG benefit of land-use change from farmland	$\text{MT CO}_2\text{e}$
ΔCLR	=	Change in Carbon loss rate of farmland to be restored to coastal tidal wetland (from Equation 3)	$\frac{\text{MT CO}_2\text{e}}{\text{Year}}$
ΔN_2O	=	Change in nitrous oxide emissions from drained organic soil (Equation 5)	$\frac{\text{MT N}_2\text{O}}{\text{Year}}$
298	=	Nitrous oxide global warming potential	$\frac{\text{MT CO}_2\text{e}}{\text{MT N}_2\text{O}}$
50	=	Number of years of project life	Years
$Cseq_{F-U}$	=	Carbon sequestration from conversion of farmland to be restored to coastal upland (Equation 4)	$\text{MT CO}_2\text{e}$

Equation 3: Carbon Loss Rate Change from Conversion of Farmland to be Restored to Coastal Wetland

$$\Delta CLR = \frac{Freq_{Till}}{10} \times \frac{44}{12} \times 0.4047 \times (14.0 - 3.5) \times A_{F-CTW}$$

Where,			Units
ΔCLR	=	Change in carbon loss rate from project implementation	$\frac{\text{MT CO}_2\text{e}}{\text{Acre Year}}$
$\frac{44}{12}$	=	Molecular weight ratio of carbon dioxide to carbon	$\frac{\text{MT CO}_2}{\text{MT C}}$
$Freq_{Till}$	=	Number of years in the past ten years where a conventional tilling event occurred. If tillage history is unknown, assume: • 10 for annual crops • 3 for perennial crops • 1 for orchard and vine crops	Years
10	=	Length of tillage history	Years
0.4047	=	Conversion from hectares to acres	$\frac{\text{Hectares}}{\text{Acres}}$
14.0	=	Carbon loss rate for cropland in drained organic soils and warm temperate climates	$\frac{\text{MT C}}{\text{Hectare Year}}$
3.5	=	Carbon loss rate for grassland in drained organic soils and warm temperate climates	$\frac{\text{MT C}}{\text{Hectare Year}}$
A_{F-CTW}	=	Area of farmland converted to be restored to coastal tidal wetland	Acres

Equation 4: Carbon Sequestration Change from Conversion of Farmland to be Restored to Coastal Upland

$$Cseq_{F-CU} = \left(CS_{ref} \times F_{LU,G} \times F_{GM,SD} \times A_{F-CU} - CS_{ref} \times F_{LU,C} \times F_{CM,FT} \times A_{F-CU}\right) \times 0.4047 \times \frac{44}{12}$$

Where,			Units
$Cseq_{F-CU}$	=	Total carbon sequestration from conversion of farmland to be restored to coastal upland	$\text{MT CO}_2\text{e}$
CS_{ref}	=	Reference carbon stock for warm temperate dry wetland Soils (48)	$\frac{\text{MT C}}{\text{Hectare}}$
$F_{LU,G}$	=	Land use factor, grassland for warm temperate dry climate (1.37)	
$F_{GM,SD}$	=	Grassland management factor, severely degraded (0.7)	
A_{F-CU}	=	Area converted from farmland to coastal upland	Acres
$F_{LU,C}$	=	Land use Factor, cultivated (1)	
$F_{CM,FT}$	=	Cropland management factor, full till (1)	
0.4047	=	Conversion from hectares to acres	$\frac{\text{Hectares}}{\text{Acres}}$
$\frac{44}{12}$	=	Molecular weight ratio of carbon dioxide to carbon	$\frac{\text{MT CO}_2\text{e}}{\text{MT C}}$

Equation 5: Avoided Nitrous Oxide Emissions from Cultivated and Drained Organic Soils

$$\Delta N_2O = 0.008 \times A_F \times 0.4047 \times \frac{44}{14}$$

Where,			Units
ΔN_2O	=	Change in Nitrous Oxide emissions from project implementation	$\frac{\text{MT N}_2\text{O}}{\text{Year}}$
0.008	=	Nitrous oxide emission rate for cropped wetland soils	$\frac{\text{MT N}_2\text{O} - \text{N}}{\text{Hectare Year}}$
A_F	=	Area of farmland converted to coastal tidal wetland and upland	Acres
0.4047	=	Conversion from hectares to acres	$\frac{\text{Hectares}}{\text{Acres}}$
$\frac{44}{14}$	=	Molecular weight ratio of nitrous oxide to nitrogen	$\frac{\text{MT N}_2\text{O}}{\text{MT N}}$

C. GHG Benefit from Coastal Tidal Wetland and Upland Restoration

The GHG benefit from Wetland/Upland Restoration is estimated using Equation 6, which relies on three other equations. Equations 7 and 8 are used to determine the carbon sequestration (*Cseq$_{CTW}$*, *Cseq$_{CU}$*) from restoration of wetlands and uplands in Equation 6. Equation 9 is used to determine the change in methane emissions (*⊿CH$_4$*) from restoration of wetlands in Equation 4.

Equation 6: GHG Benefit from Coastal Tidal Wetland and Upland Restoration

$$GHG_{Coastal} = Cseq_{CTW} + Cseq_{CU} - \Delta CH_4 \times 25$$

Where,			Units
$GHG_{Coastal}$	=	GHG benefit of coastal tidal wetland and upland restoration	$\text{MT CO}_2\text{e}$
$Cseq_{CTW}$	=	Total carbon sequestration from coastal tidal wetlands restoration (Equation 7)	$\text{MT CO}_2\text{e}$
$Cseq_{CU}$	=	Total carbon sequestration from restoration of coastal upland (Equation 8)	$\text{MT CO}_2\text{e}$
ΔCH_4	=	Total change in methane emissions from coastal tidal wetlands restoration (Equation 9)	MT CH_4
25	=	Methane global warming potential	$\frac{\text{MT CO}_2\text{e}}{\text{MT CH}_4}$

Equation 7: Carbon Sequestration from Coastal Tidal Wetlands Restoration

$$Cseq_{CTW} = 79 \times A_{CTW} \times \left(1 - \frac{Freq_{wet}}{12}\right) \times 4{,}046.86 \div 1{,}000{,}000 \times \frac{44}{12} \times 50$$

Where,			Units
$Cseq_{CTW}$	=	Total carbon sequestration from coastal tidal wetlands restoration	$\text{MT CO}_2\text{e}$
79	=	Annual carbon sequestration coefficient for wetland restoration	$\frac{\text{g C}}{\text{m}^2 - \text{Year}}$
A_{CTW}	=	Coastal wetland area restored	Acres
$Freq_{wet}$	=	Number of months project area existed as a seasonal wetland before conversion or restoration to permanent wetland	Months
12	=	Months per Year	Months
4046.86	=	Conversion from square meters to acres	$\frac{\text{m}^2}{\text{Acres}}$
1,000,000	=	Conversion from grams to metric tons	$\frac{\text{g}}{\text{MT}}$
$\frac{44}{12}$	=	Molecular weight ratio of carbon dioxide to carbon	$\frac{\text{MT CO}_2\text{e}}{\text{MT C}}$
50	=	Number of years of project life	Years

Equation 8: Carbon Sequestration from Coastal Upland Restoration

$$Cseq_{CU} = \left(CS_{ref} \times F_{LU,G} \times F_{GM,I} \times F_{GI,HI} \times A_{CU} - CS_{ref} \times F_{LU,G} \times F_{GM,SD} \times A_{CU}\right) \times 0.4047 \times \frac{44}{12}$$

Where,			Units
$Cseq_{Up}$	=	Total carbon sequestration from upland restoration	$\text{MT CO}_2\text{e}$
CS_{ref}	=	Reference carbon stock for warm temperate dry wetland soils (48)	$\frac{\text{MT C}}{\text{Hectare}}$
$F_{LU,G}$	=	Land use factor, grasslands for warm temperate dry climate (1.37)	
$F_{GM,I}$	=	Grassland management factor, improved (1.14)	
A_{CU}	=	Area restored to coastal upland	Acres
$F_{GM,SD}$	=	Grassland management factor, severely degraded (0.7)	
0.4047	=	Conversion from hectares to acres	$\frac{\text{Hectares}}{\text{Acres}}$
$\frac{44}{12}$	=	Molecular weight ratio of carbon dioxide to carbon	$\frac{\text{MT CO}_2\text{e}}{\text{MT C}}$

Equation 9: Change in Methane Emissions from Coastal Tidal Wetland Restoration

$$\Delta CH_4 = 193.7 \times A_{CTW} \times \left(\frac{Freq_{Fresh} - Freq_{FreshWet}}{12}\right) \times 0.4047 \div 1{,}000 \times 50$$

Where,			Units
ΔCH_4	=	Change in methane emissions	MT CH_4
193.7	=	Methane emission factor for wetlands with salinity less than 18 ppt.	$\frac{\text{kg CH}_4}{\text{Hectare} - \text{Year}}$
A_{CTW}	=	Area restored to coastal tidal wetland	Acres
$Freq_{Fresh}$	=	Number of months restored permanent wetland has salinity less than 18 ppt.	Months
$Freq_{FreshWet}$	=	Number of months the project area existed as a seasonal wetland with salinity less than 18 ppt before conversion or restoration to permanent tidal wetland.	Months
12	=	Months per year	Months
0.4047	=	Conversion from hectares to acres	$\frac{\text{Hectares}}{\text{Acres}}$
1,000	=	Conversion from kg to metric tons	$\frac{\text{kg}}{\text{MT}}$
50	=	Number of years of project life	Years

D. GHG Benefit from Mountain Meadow Restoration

The GHG benefit from Mountain Meadow Restoration is estimated as the increase in soil carbon sequestration using Equation 10.

Equation 10: GHG Benefit from Mountain Meadow Restoration

$$Cseq_{MM} = 95.40 \times A_{MM} \times 4{,}046.86 \div 1{,}000{,}000 \times \frac{44}{12} \times 50$$

Where,			Units
$Cseq_{MM}$	=	Total carbon sequestration from mountain meadow restoration	$\text{MT CO}_2\text{e}$
95.40	=	Annual carbon sequestered in restored mountain meadows, 50 Year timescale	$\frac{\text{g C}}{\text{m}^2 \text{ Year}}$
A_{MM}	=	Area of land restored to mountain meadows	Acres
4046.86	=	Conversion from square meters to acres	$\frac{\text{m}^2}{\text{Acres}}$
$1{,}000{,}000$	=	Conversion from grams to metric tons	$\frac{\text{g}}{\text{MT}}$
$\frac{44}{12}$	=	Molecular Weight Ratio of carbon dioxide to carbon	$\frac{\text{MT CO}_2\text{e}}{\text{MT C}}$
50	=	Number of years of project life	Years