CLIMATE ACTION RESERVE

Nutrient Management Project Protocol

Reducing Nitrous Oxide Emissions through Improved Nutrient Management in Crop Production

WORKGROUP DRAFT
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Table of Contents

List of Tables

List of Figures

List of Equations

Abbreviations and Acronyms

CO_2	Carbon dioxide
CH_4	Methane
CRT	Climate Reserve Tonne
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
GHG	Greenhouse gas
MT	Metric ton (or tonne)
N	Nitrogen
N_2O	Nitrous oxide
NPS	Nonpoint source
Reserve	Climate Action Reserve
SSR	Source, sink, and reservoir

1 Introduction

The Climate Action Reserve (Reserve) Nutrient Management Project Protocol provides guidance to account for, report, and verify greenhouse gas (GHG) emission reductions associated with improvements in nitrogen use efficiency in crop production.

The Climate Action Reserve is a national offsets program working to ensure integrity, transparency, and financial value in the U.S. carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of GHG emission reduction projects in North America; issuing carbon offset credits known as Climate Reserve Tonnes (CRT) generated from such projects; and tracking the transaction of credits over time in a transparent, publicly-accessible system. Adherence to the Reserve's high standards ensures that emission reductions associated with projects are real, permanent and additional, thereby instilling confidence in the environmental benefit, credibility and efficiency of the U.S. carbon market.

Project developers and aggregators that initiate Nutrient Management projects use this document to quantify and register GHG reductions with the Reserve. The protocol provides eligibility rules, methods to calculate reductions, performance-monitoring instructions, and procedures for reporting project information to the Reserve. Additionally, all project reports receive independent verification by ISO-accredited and Reserve-approved verification bodies. Guidance for verification bodies to verify reductions is provided in the Reserve Verification Program Manual and Section 8 of this protocol.

This protocol is designed to ensure the complete, consistent, transparent, accurate, and conservative quantification and verification of GHG emission reductions associated with a Nutrient Management project.[1]

[1] See the WRI/WBCSD GHG Protocol for Project Accounting (Part I, Chapter 4) for a description of GHG reduction project accounting principles.

2 The GHG Reduction Project

2.1 Background

Nitrous oxide (N_2O), a potent agricultural greenhouse gas (GHG), is a by-product of the nitrification-denitrification cycle, performed by soil microorganisms. Nitrous oxide emissions from agricultural land are generally related to the application of inorganic and organic nitrogen (N) fertilizer, or legume-derived N. Any factor or action that affects the availability of mineral N in the soil may impact N_2O emissions, due to the fact that a necessary condition for N_2O emissions is excess mineral Nitrogen (N) in the soil.

Nitrogen is an essential nutrient for plants, and agricultural producers have long supplied additional N soil amendments to their crops. During much of history, N was supplied to crops primarily in organic form such as through manure application and N-fixing legumes. However, during the latter part of the 19th century, inorganic N (typically synthetic fertilizer) replaced organic N as the main source of this nutrient, and today, inorganic N has become essential to world food production.

Because excess mineral N drives N_2O emissions, any agricultural management practice that reduces the presence of excess mineral N in the soil is a good candidate N_2O emission reduction strategy. Specifically, N_2O emissions can be reduced with the implementation of nutrient management practices that focus on improving the N use efficiency by matching nutrient supply as exactly as possible with plant nutrient uptake to avoid the presence of excess N in the soil (i.e., less N applied for the same crop productivity). Applying the proper rate of N at the right time during the year are major management decisions agricultural producers have to make. Using too little N may result in lower yields, poorer crop quality, and, hence, reduced profits. When too much N is applied, yields and quality are generally not compromised, but profit may be reduced and negative environmental effects will occur related to N leaching and nitrous oxide (N_2O) emissions.

The objective of a NM project under this protocol is to reduce N_2O emissions by adopting practices that further improve nitrogen use efficiency beyond what is projected to happen in the future absent a carbon market. Fertilizer use trends for corn in the US show a relatively stable amount of inorganic N fertilizer application on a per acre basis since the mid-1990's with a corresponding trend of increasing yield (Figure 1). Assuming these trends are representative of other major US crops, these data suggest a baseline increase in nitrogen use efficiency for most crops would be expected absent the existence of a carbon market. Global crop production modeling concludes that fertilizer application rates will most likely remain stable in the US during the period 2010-2025, even if N fertilizer prices and demand for agricultural commodities increase[2] (Rosas 2011), which further supports the assumed trend of increasing N use efficiency under business as usual—i.e., the same amount of N will be used to produce greater yields over the next 15 years.

This protocol provides a methodology for quantifying N_2O emission reductions that occur as a result of further improvements in nitrogen use efficiency beyond business as usual. Because fertilizer application rates are projected to remain constant while yields would likely increase in

[2] Rosas F. 2011. World Fertilizer Model-The World NPK Model, Working Paper 11-WP 520, April. Center for Agricultural and Rural Development, Iowa State University

the future, the protocol assumes reductions in nitrogen application rates compared to recent historic practices (i.e., the past five years) represent improvements in nitrogen use efficiency compared to business as usual.

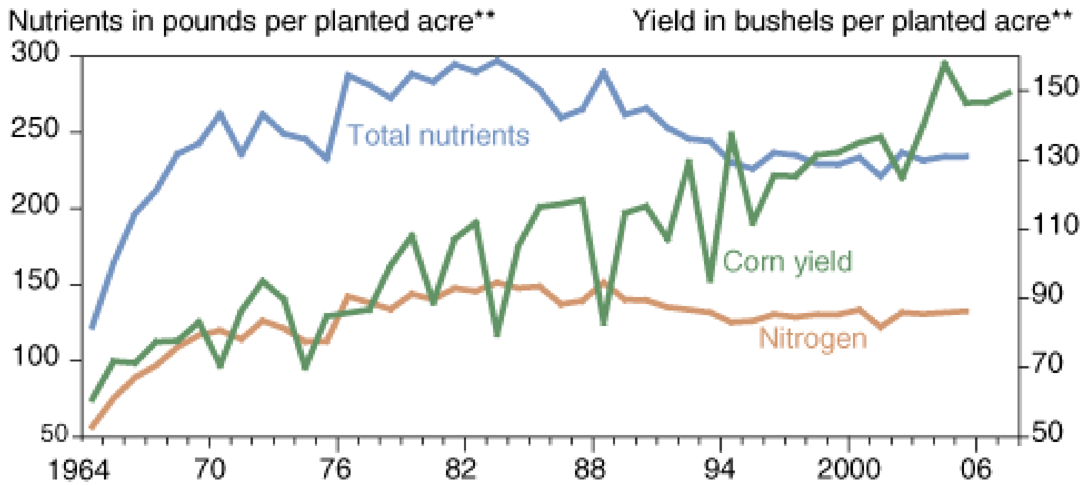

Figure 1. Historical nitrogen application rates and corn yields between 1964 and 2008 (Source: USDA ERS and NASS). Copied from http://www.ers.usda.gov/AmberWaves/December09/Features/USCornYields.htm

N_2O emissions are positively correlated with low pH, higher temperatures, high water-filled pore space, soil compaction, and available C substrate.[3] These relationships drive the strong regional and crop variability in expected N_2O emissions and N_2O emission reduction potential across the US, as well as the feasibility and efficacy of various nutrient management practices for reducing N_2O emissions while maintaining or improving yield. Therefore, the methodology in this protocol has regional and crop specific eligibility criteria as noted below and employs a GHG quantification approach that can account for the variability by explicitly considering site specific conditions.

2.2 Project Definition

For the purpose of this protocol, a GHG reduction project ("project") is defined as the adoption and maintenance of approved practices[4] that improve nitrogen use efficiency of crops, including a reduction in the amount of inorganic nitrogen fertilizer applied annually to crops. Specific project practices must be adopted and maintained on individual fields with at least five fields combined to define a project. Boundaries for individual fields must be defined according to the requirements in Section 2.2.1.

At least [x] approved nutrient management practice changes must be implemented on each individual field in the project, one of which must be a reduction in the amount of inorganic nitrogen fertilizer applied annually to crops. The project does not need to be comprised of contiguous fields, and can encompass fields located on one operation, or distributed amongst

[3] Chantigny et al. 2010; Farahbakhshazad et al. 2008; Venterea and Rolston 2000
[4] Note that a project is defined by the adoption of practices, however GHG reductions are quantified based on actual project performance in terms of reduced N_2O emissions.

different farms and/or producers. Project areas that encompass fields on multiple farming operations are considered a project aggregate.

At present, only practice changes described in Table 2.1 below are considered approved project activities. Note that performance standard criteria may limit the actual number of approved practices that are eligible depending on the crops grown and geographic region of the project.

Table 2.1. Definitions for Approved Project Activities

Approved Practice Changes to Improve Nitrogen Use Efficiency	Description
Reduce nitrogen application rate	Reduction in the annual nitrogen application rate compared to recent historic application rates at the site for the specific crop rotation during the project. Practices listed below may enable the rate reduction.
Optimize the timing of N fertilizer application	Change the timing of N fertilizer application to optimize the application for crop N demand, minimizing the N lost as emissions. Options include specific timing of application relative to planting date and crop emergence. Includes split application technology and management.
Placement of fertilizer	Improve the placement of fertilizer by placing it closer to the active root uptake zone, maximizing the efficiency of N uptake by the plant. Includes injecting near seeds during sowing, injecting in sub-surface drip irrigation (fertigation), and precision agriculture (GPS-aided fertilizer application, optimized for the soils at each specific location)
Include mixed[5] cover crops in a rotation	Plant mixed cover crops to scavenge residual nitrogen and immobilize this nitrogen during the off-season and/or to use leguminous cover crops as a nitrogen source. To minimize increased emissions from using cover crops, the timing between cover crop incorporation and planting should be as minimal as possible.
Changing fertilizer composition	Change in the chemical composition of fertilizer used (anhydrous ammonia to urea) or change to controlled-release nitrogen fertilizer, which have coatings designed to provide a slow but steady release of mineral N.
Use of organic amendments	Complete or partial replacement of inorganic N with organic amendments (such as, manure or compost).
Use of nitrification and urease inhibitors	Use of nitrification and urease inhibitors to slow the biological transformation of nitrate and urea, respectively, leading to greater N use efficiencies
Adding deep rooting plants into crop rotations (e.g. alfalfa or other hay plants)	Add in deep rooting plants (e.g. alfalfa) to crop rotation, which can scavenge residual nitrogen and redistribute nitrogen through the soil profile by root uptake.

[5] "Mixed" refers to the combination of nitrogen fixing and non-nitrogen fixing cover crop species. Mixed cover crop systems have been shown to absorb residual N from the previous season while providing N in the subsequent cropping season (Tonitto et al 2006).

Workgroup Question: This is a comprehensive list for starting the discussion; however, some activities may need to be removed if they do not consistently result in N_2O emission reductions or potentially cause leakage (unintended increases in GHG emissions). Which activities should remain and which should be removed? Are any missing? This may be a question to ask the Science Advisory Committee (SAC) as well. The Performance Standard will provide details on regional eligibility and standards for how the practice must be implemented.

2.2.1 Defining Field Boundaries

For the purposes of this protocol, an individual field must be defined by the following criteria:

1. The field must be under the direct management control of a single grower.
2. Management within the field boundary must be homogeneous. More specifically, a field must have the same crop/crop rotation grown (including cover crops), and homogeneous fertilizer management (rates, timing and placement).
3. The field must be calibrated and modeled independently of all other fields, using soil, management, and climate data inputs specific to the defined boundary

Soil input parameters necessary for DNDC model calibration and emissions modeling must be determined for each field through use of soil sampling, or use of the USDA NRCS SSURGO soil survey data.[6] See Section 6.1 for soil input data collection requirements.

Workgroup Question: We may need to add a minimum size requirement or some other criteria to ensure that otherwise homogeneous fields are not further subdivided into “fields” for the purposes of meeting the requirement of having 5 fields in a project. Are there other verifiable criteria that are relevant/useful/important

2.3 The Project Developer

The project developer is an entity that has an active account on the Reserve, submits a project for listing and registration with the Reserve, and is ultimately responsible for all project reporting and verification. Project developers may represent a project or a project aggregate. Project developers may be agricultural producers (including landowners or land tenants), GHG project developers, aggregators, or other entities.

Project participants are agricultural producers who elect to enroll in a project aggregate. Project participants must be responsible for making management decisions for crop production on their fields enrolled in the project. Project participants are not required to hold an account on the Reserve.

All fields in a project or project aggregate must be under continuous management. Project fields may not change ownership, tenant occupancy, or management control during the project crediting period.

Unless all fields in a project are under the management of a single farming operation, the project must be submitted as a project aggregate by a qualifying aggregator. An aggregator may

[6] See http://soils.usda.gov/survey/geography/ssurgo/.

be a corporation or other legally constituted entity, city, county, state agency, individual or a combination thereof. An aggregator must have an account on the Reserve.

There is no upper limit on the total number of fields or acres enrolled in a project aggregate. However, no single field may comprise more than 33 percent of the total combined acreage in a project aggregate.

Aggregators act as official agents to the Reserve on behalf of project participants and are ultimately responsible for submitting all required forms and complying with the terms of the NMPP. Aggregators manage the flow of ongoing monitoring and verification reports to the Reserve and may engage in other project development activities such as developing monitoring plans, modeling emission reductions, managing data collection and retention etc.. The scope of aggregator services is negotiated between project participant and the aggregator and should be reflected in contracts between the project participant and the aggregator. Such contracts must include mandatory components as defined in Section X (TBD).

In all cases, the project developer must attest to the Reserve that they have exclusive claim to the GHG reductions resulting from the project. Each time a project or project aggregate is verified, the project developer must attest that no other entities are reporting or claiming (e.g. for voluntary reporting or regulatory compliance purposes) the GHG reductions caused by the project.[7] The Reserve will not issue CRTs for GHG reductions that are reported or claimed by entities other than the project developer.

Workgroup Questions: Are these definitions workable—Project, Project Participant, Project Aggregate, Aggregator. Are the roles and responsibilities clear and reasonable?

Is the requirement that project fields not change ownership or management control realistic? Should we explore ways for a field to stay in an aggregate even if ownership/control changes?

[7] This is done by signing the Reserve's Attestation of Title form, available at: http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/

3 Eligibility Rules

Projects must fully satisfy the following eligibility rules in order to register with the Reserve. The criteria only apply to projects that meet the definition of a GHG reduction project (Section 2.2).

Eligibility Rule I:	Location	→	*U.S. and U.S. tribal areas*
Eligibility Rule II:	Project Start Date	→	*No more than six months prior to project submission**
Eligibility Rule III:	Additionality	→	*Meet performance standard*
		→	*Exceed regulatory requirements*
Eligibility Rule IV:	Regulatory Compliance	→	*Compliance with all applicable laws*

* See Section 3.2 for additional information on project start date

3.1 Location

Only projects located in the United States and on U.S. tribal lands are eligible to register reductions with the Reserve under this protocol.

Note to Workgroup: Performance standard data and model calibration availability will functionally constrain the geographic eligibility. We may be able to state that here with some specificity after the methodology is further developed.

3.2 Project Start Date

Each field has a unique start date defined as the first day of the cultivation cycle within which the approved project activities were implemented for the first time. There must be five or more fields that originate a project or project aggregate and those fields must have start dates in the same year. The earliest start date of the originating fields becomes the project or project aggregate start date. Additional fields can join a project or project aggregate and remain part of the project or project aggregate until the end of the project or project aggregate's crediting period (defined below).

A cultivation cycle is defined as the period starting immediately after a harvest and ending at the end of the next calendar year's harvest. A complete cultivation cycle may be slightly greater or less than 365 days depending on planting and harvest dates.

To be eligible, the project or project aggregate must be submitted to the Reserve no more than six months after the project/project aggregate start date, unless the project/project aggregate is submitted during the first 12 months following the date of adoption of this protocol by the Reserve board (the Effective Date).[8] For a period of 12 months from the Effective Date of this protocol (Version 1.0) [estimated to be in February 2012], projects with start dates no more than

[8] Projects are considered submitted when the project developer has fully completed and filed the appropriate Project Submittal Form, available on the Reserve's website.

24 months prior to the Effective Date of this protocol are eligible. Specifically, projects with start dates on or after [estimated February 2010] are eligible to register with the Reserve if submitted by [estimated February 2013]. Projects with start dates prior to [estimated February 2010] are not eligible under this protocol. Projects may always be submitted for listing by the Reserve prior to their start date.

Workgroup Questions:

Temporal flexibility may be very important to the success of the aggregation approach, but it comes with added administrative complexities. Have we struck the right balance with the above approach?

Does the definition of cultivation cycle make sense with regard to when changes in nutrient management are likely to occur? Does it work as a generic definition for all crops and crop rotations? Note, the definition is important for DNDC model runs as well.

3.3 Project Crediting Period

The crediting period for Nutrient Management projects under this protocol is ten years. At the end of a project or project aggregate's first crediting period, project developers may apply for eligibility under a second crediting period. As described further in Section X (Joining and Aggregate), a field may re-enroll in a new project or project aggregate for a period of ten years after the field start date. The Reserve will cease to issue CRTs for GHG reductions if at any point in the future, any one of the practices adopted by a project becomes legally required, as defined by the terms of the Legal Requirement Test (see Section 3.4.2).

Thus, the Reserve will issue CRTs for GHG reductions quantified and verified according to this protocol for a maximum of two ten year crediting periods after the project/project aggregate start date, or until the project activity is required by law. Section 3.4.1 describes requirements for qualifying for a second crediting period.

Workgroup Questions:

Should we consider a shorter crediting period?

3.4 Other Criteria

Projects on histosol soils are not eligible.

Only where the DNDC model meets the calibration requirements specified in this protocol are projects considered eligible.

Increases or decreases in yields compared to pre-project yields are allowable. However, yield reductions may result in leakage effects that must be estimated (see Section X for further guidance).

There must be at least five years of data available on the history of crop production practices for each field enrolled in a project/project aggregate.

The crop production system on a field enrolled in project or project aggregate must be consistent with the past five years of management data for that field.

The same crop production system, in terms of the primary crops produced and rotation schedule (if applicable) must be maintained on a field for the duration of its participation in a project or project aggregate

Workgroup Questions:

We suspect the last three criteria regarding data requirements and limits on changing crop production/rotations may need refining. The purpose of these criteria are to ensure equivalency of goods/services under the project compared to business as usual, which is important for accurate accounting, and for model calibration needs. Comments on the need for and suggestions for how to improve/refine these criteria?

3.5 Additionality

The Reserve strives to register only projects that yield surplus GHG reductions that are additional to what would have occurred in the absence of a carbon offset market.

Projects must satisfy the following tests to be considered additional:

1. The Performance Standard Test
2. The Legal Requirement Test

3.5.1 The Performance Standard Test

Projects pass the Performance Standard Test by meeting a performance threshold, i.e. a standard of performance applicable to all Nutrient Management projects, established by this protocol.

Each field in a project must meet or exceed the following two performance thresholds every cultivation cycle following the start date to register CRTs.

1. Nitrogen Application Rate Threshold: The amount of synthetic fertilizer applied during the cultivation cycle must be equal to or less than the threshold amount for the region and crop grown on that field during the cultivation cycle as specified in Appendix Table X [TBD]. If a soil test or crop N requirement test is conducted in accordance with guidance in Appendix X within 6 months of the start date (either 6 months before or after the start date) that confirms the Nitrogen Application Rate Threshold is insufficient to meet crop nitrogen demand without compromising yield on that field, the recommended annual nitrogen application rate based on the soil test can be set as an alternative performance threshold for that field for the duration of the fields eligible participation period (10 years).

2. Nutrient Management Practice Standard Threshold: At least [x] more practices are adopted from the list of approved region and crop specific practice and maintained per the standards specified for a cultivation cycle. Performance standards are provided in Appendix Table X [TBD].

By meeting both performance thresholds for all fields in a project or project aggregate, the project demonstrates that that nutrient management strategies adopted exceed regional common practice for nutrient management.

After the first cultivation cycle of a project:

- The specific nutrient management practice standards chosen for a field cannot change for the duration of the field's eligible period.
- If either of the performance thresholds cannot be met for any reason on a given field during a cultivation cycle, that field cannot earn CRTs for that period. However, it remains an eligible field and can earn CRTs in subsequent cultivation cycles provided both performance standards are met during those cultivation cycles.
- If either of the performance thresholds is not met for [two] years in a row, for any reason, the field becomes ineligible.

If a project developer wishes to apply for a second crediting period, the project must meet the eligibility requirements of the most current version of this protocol, including any updates to the Performance Standards.

Workgroup Questions:
Should we consider N use efficiency (N/yield) for the first threshold instead of N application rate (N/acre)?

It seems important to require consistency in which practices are adopted on a single field for the duration of the eligibility period (10 years). The ability to switch practices year to year seems to open up risks to gaming and non-additionality. For practices with significant investment costs, this may not be a concern. Any thoughts on this requirement? Will this requirement limit flexibility too much?

3.5.2 The Legal Requirement Test

All projects are subject to a Legal Requirement Test to ensure that the GHG reductions achieved by a project would not otherwise have occurred due to federal, state or local regulations, or other legally binding mandates. A Nutrient Management project passes the Legal Requirement Test when there are no laws, statutes, regulations, court orders, environmental mitigation agreements, permitting conditions, or other legally binding mandates (including conservation management plans and deed restrictions) that require the adoption or continued use of any approved nutrient management practices that are implemented on the project fields.

If it is legally required to implement a conservation or nutrient management plan on a field enrolled in project or project aggregate, any if the approved nutrient management practices in this protocol that are included in the plan will be considered legally required and will not pass the Legal Requirement Test. The producer may be able self-select practices for their conservation or nutrient management plans such that at least some approved nutrient management practices in this protocol do not become part of the plan, thereby allowing additional, voluntary nutrient management practices above and beyond the legal requirements to be implemented as part of the Project activity.

To satisfy the Legal Requirement Test, project developers must submit a signed Attestation of Voluntary Implementation form[9] prior to the commencement of verification activities each time the project is verified (see Section 8). In addition, the project's Monitoring Plan (Section 6) must include procedures that the project developer will follow to ascertain and demonstrate that the project at all times passes the Legal Requirement Test.

As of the Effective Date of this protocol, the Reserve could identify no existing federal regulations that explicitly obligate agricultural producers to adopt the nutrient management practices approved under this protocol. However, the Reserve has identified circumstances in which state and local-level regulations enacted to implement the federal Clean Water Act require some of the nutrient management practices approved as project activities. The Clean Water Act will be discussed in more detail below.

Modeling of the project baseline must reflect all legal constraints in effect at the time of the project's start date, as required in Section [5] of this protocol. If any of the approved project activities of an eligible project later become legally required, emission reductions may be reported to the Reserve up until the date that the management practice is required by law to be adopted.

If a project includes implementation of more than one of the approved nutrient management practices and one or more (but not all) of those practices later becomes legally required, emission reductions from the legally required project activity(ies) may be reported to the Reserve up until the date it is required by law and the project may continue reporting emission reductions from the project activities that continue to be voluntary. Modeling of the project's baseline must be redone to reflect the new legal requirement. The project must also demonstrate that it continues to meet or exceed the performance standard at each verification, adopting additional project activities, as necessary

Workgroup Questions:
This does not allow for actions "above and beyond" the legal requirement to receive credit. There may be cases where regulation requires implementation of practice to a lesser degree than might be implemented as a project activity (e.g., legal requirement is 5% of land in cover crops and approved protocol activity is 10% of land in cover crops). A potential alternative is to allow crediting of emission reductions from actions which exceed the legal requirement.

How important and realistic is it to allow for quantification of actions that are "above and beyond" the legal requirement?

[9] Form available at http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/.

3.5.2.1 Clean Water Act

Though the Reserve could identify no existing federal regulations that explicitly and consistently require implementation of the approved project activities, as noted above, state or local implementation of the federal Clean Water Act may result in direct and indirect requirements for nutrient management.

The Clean Water Act (CWA)[10] is the federal law regulating water quality in the United States, which is implemented on the state-level. The CWA establishes a comprehensive federal system for regulating the discharge of pollutants into navigable waterbodies, while restoring and maintaining the health of the nation's surface waters.[11] The CWA distinguishes between point source (e.g. industrial or sewage treatment plants) and nonpoint source (e.g. urban runoff, agricultural runoff) pollution and makes it unlawful for point sources to discharge any pollutant into navigable waters without a permit. Nonpoint source (NPS) pollution comes from many defuse sources and is caused by runoff from rainfall or snowmelt moving over and through the ground, picking up pollutants and eventually depositing them in waterbodies.

When watersheds are successfully meeting the CWA's water quality standards, nonpoint sources are generally unregulated. However, in polluted watersheds that are not in compliance with CWA water quality standards (e.g. "impaired" waters), nonpoint sources may come under regulation, depending on regulations established on the state-level to improve water quality, which typically must be approved by EPA. Part 303(d) of the CWA requires states to biennially identify waters within their jurisdiction which are "impaired" (e.g. waters currently not meeting water quality standards) or "threatened" (e.g. waters believed likely to become "impaired" by the time the next "303(d) List" is due).[12] Subsequent to listing waters on the 303(d) List, states must establish priority rankings for restoring these waters based on the severity of pollution and develop Total Maximum Daily Loads (TMDLs)[13] for these waters. In practice, once a TMDL is established, the state implements a concrete plan to reach this limit through a combination of regulations and voluntary incentives that reduce NPS pollution. If the NPS pollution is related to runoff from agricultural sources, the TMDL implementation plan may include requiring implementation of agricultural Best Management Practices (BMPs), as part of a legally required conservation management plan, as well as voluntary incentive payments for planting cover crops.

Circumstances exist where the agricultural producer has significant flexibility for meeting their TMDL obligations, where producers self-select which best management practices will become part of their legally required pollution reduction strategy (typically in the form of a Conservation Management Plan (CMP). As noted in Section 3.5.2 above, once a practice is self-selected as part of an NPS pollution obligation, the Reserve considers that practice non-voluntary, as

[10] The Clean Water Act (CWA) was previously known as the Federal Water Pollution Control Act (FWPCA), which was enacted in 1948. The FWPCA was significantly reorganized and amended in 1972, receiving further amendments and becoming known by its current name in 1977.

[11] Federal Water Pollution Control Act of 1948 (commonly, the Clean Water Act). 33 U.S.C. §1251 et seq. (2002).

[12] Once identified as impaired or threatened, these waters are included in the "Impaired or Threatened Waters List," also known as the "303(d) List." As this list is updated frequently, project developers and verifiers should refer to the US EPA website for the most up-to-date list of impaired watersheds: http://iaspub.epa.gov/waters10/attains_nation_cy.control?p_report_type=T

[13] Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant, such as nitrate, that a given waterbody can receive without violating water quality standards.

continued implementation of that practice is required by law, and that practice will not be considered an eligible project activity for that farm.

3.5.3 Ecosystem Services Credit Stacking Test/Methodology

Under development

3.6 Regulatory Compliance

As a final eligibility requirement, project developers must attest that the project is in material compliance with all applicable laws relevant to the project activity (e.g. air, water quality, water discharge, nutrient management, safety, labor, endangered species protection, etc.) prior to verification activities commencing each time a project is verified. Project developers are required to disclose in writing to the verifier any and all instances of material non-compliance of the project with any law. If a verifier finds that a project is in a state of recurrent non-compliance or non-compliance that is the result of negligence or intent, then CRTs will not be issued for GHG reductions that occurred during the period of non-compliance. Non-compliance solely due to administrative or reporting issues, or due to “acts of nature,” will not affect CRT crediting.

4 The GHG Assessment Boundary

The GHG Assessment Boundary delineates the GHG sources, sinks, and reservoirs (SSRs) that must be assessed by project developers in order to determine the net change in emissions caused by a Nutrient Management (NM) project.[14]

The GHG Assessment Boundary encompasses all the GHG sources, sinks, and reservoirs that may be significantly affected by project activities, including sources of nitrous oxide and methane emissions from the soil, biological CO_2 emissions and soil carbon sinks, and fossil fuel combustion GHG emissions. For accounting purposes, the sources, sinks, and reservoirs included in the GHG Assessment Boundary are organized according to whether they are predominantly associated with an NM project's "primary effect" (i.e. the NM project's intended N_2O reduction), or its "secondary effects" (i.e. unintended changes in carbon stocks, CH_4 emissions, or other GHG emissions).[15] Secondary effects may include increases in mobile combustion CO_2 emissions associated with site preparation, as well as increased GHG emissions caused by the shifting of cultivation activities from the project area to other agricultural lands (often referred to as "leakage"). Projects are required to account for all SSRs that are included in the GHG Assessment Boundary regardless of whether the particular SSR is designated as a "primary" or "secondary" effect.

Figure 4.1 below provides a general illustration of the GHG Assessment Boundary, indicating which SSRs are included or excluded from the boundary.

Table 4.1 provides a comprehensive list of the GHG sources, sinks, and reservoirs (SSRs) that may be affected by an NM project, and indicates which SSRs must be included in the GHG Assessment Boundary.

[14] The definition and assessment of sources, sinks, and reservoirs (SSRs) is consistent with ISO 14064-2 guidance.
[15] The terms "Primary Effect" and "Secondary Effect" come from WRI/WBCSD, 2005. *The Greenhouse Gas Protocol for Project Accounting*, World Resources Institute, Washington, DC. Available at http://www.ghgprotocol.org.

[TBD: Diagram of the GHG Assessment Boundary SSRs]

Figure 4.1. General illustration of the GHG Assessment Boundary

Table 4.1. Description of all Sources, Sinks, and Reservoirs

SSR	Source Description	Gas	Included (I) or Excluded (E)	Quantification Method	Justification/Explanation
Primary Effect Sources, Sinks, and Reservoirs					
1. *Soil Dynamics*	Soil dynamics refer to the biogeochemical interactions occurring in the soil that produce emissions of carbon dioxide(biogenic), methane , nitrous oxide, and changes in soil carbon stocks. GHG flux rates are dependent on water management (including during seeding and after harvest), residue management, fertilizer application, and other site-specific variables.	CO_2	I	DNDC	Changes in soil carbon stocks resulting from project activity may be significant. Decreases in carbon stocks must be accounted for.
		CH_4	E	DNDC	Methane production and oxidation is considered insignificant for non-flooded soils.
		N_2O	I	DNDC	The primary effect of an NM project is reduction in nitrous oxide emissions from soil due to reduced N rate and/or increased N-use efficiency through changes in timing, type, and placement,
Secondary Effect Sources, Sinks, and Reservoirs					
2. *Manure Incorporation*	Indirect emissions from storing and handling of manure	CO_2	E	N/A	Excluded. Note that the impact of manure on soil organic carbon is captured under SSR 1.
		CH_4	E	N/A	Excluded, as this emission source is assumed to be very small.
		N_2O	I	N/A	Included. Nitrous oxide emissions from storing and handling manure may be significant.
3. *Cultivation Equipment*	Fossil fuel emissions from equipment used for field preparation, seeding, fertilizer/pesticide/herbicide application, and harvest.	CO_2	I	Emission Factors	Emission may be significant if management (e.g., number of fertilizer applications, planting of cover crops) is altered. Increased emissions due to project activity must be accounted for.
		CH_4	E	N/A	Excluded, as this emission source is assumed to be very small.
		N_2O	E	N/A	Excluded, as this emission source is assumed to be very small.
4. *Leaching and Run-off*	Leaching and run-off of applied nitrogen, followed by denitrification into N_2O	CO_2	E	N/A	Excluded, as this emission source is assumed to be very small.
		CH_4	E	N/A	Excluded, as this emission source is assumed to be very small.
		N_2O	I	DNDC and Emission Factors	Leaching and runoff may cause significant emissions of N_2O.
5. *Volatilization*	Volatilization of applied nitrogen to NH_3 and NOx, followed by deposition onto aquatic and soil surfaces and conversion to N_2O	CO_2	E	N/A	Excluded, as this emission source is assumed to be very small.
		CH_4	E		Excluded, as this emission source is assumed to be very small.

SSR	Source Description	Gas	Included (I) or Excluded (E)	Quantification Method	Justification/Explanation
		N_2O	I	DNDC and Emission Factors	Volatilization of N and subsequent transformation to N_2O may be significant.
6. *GHG Emissions from Shifted Production (Leakage)*	Increases in production outside the project area, sometimes referred to as Indirect Land Use Change, may occur if yields are significantly and negatively affected by a project activity.	CO_2	I	TBD	If yield are found to have statistically decreased due to project activity, the associated GHG emissions from shifted production must be estimated.
7. *GHG Emissions from Fertilizer Production*	Decreases in fertilizer use on fields may affect the amount of fertilizer produced and indirectly cause reduction of GHGs associated with fertilizer production.	CO_2	E		Indirect emission reductions are not included.
		CH_4	E		
		N_2O	E		

Workgroup Questions:

Should the following sources be considered for inclusion in the boundary (will they potentially be affected by the project activities): energy use for irrigation; CO_2 emission from lime application? Any other sources we haven't considered?

5 Quantifying GHG Emission Reductions

GHG emission reductions from a Nutrient Management project are quantified by comparing actual project emissions to baseline emissions from Nutrient Management. Baseline emissions are an estimate of the GHG emissions from sources within the GHG Assessment Boundary (see Section 4) that would have occurred in the absence of the Nutrient Management project. Project emissions are actual GHG emissions that occur at sources within the GHG Assessment Boundary. Project emissions must be subtracted from the baseline emissions to quantify the project's total net GHG emission reductions (Equation 5.1).

Project/project aggregate level emission reductions must be quantified and verified on at least an annual basis. Project developers may choose to quantify and verify GHG emission reductions on a more frequent basis if they desire. The length of time over which GHG emission reductions are quantified and verified is called the "reporting period."

The Reserve requires all projects to compare the calculated baseline emissions for the reporting period, as calculated in Section 5.1, to the ex-post emissions that over the same period. Equation 5.1 below provides the quantification approach that shall be used for calculating the emission reductions from Nutrient Management project activities.

The primary impact of an NM project is a reduction in nitrous oxide emissions due to i) changing timing, application rates, number of applications, placement, and/or composition of inorganic N, ii) replacing inorganic N by manure or compost, or iii) seeding and incorporation of cover crops and/or incorporating deep-rooting crops in a rotation. While there is directional certainty (i.e. it is highly likely that the above-mentioned project activities will reduce nitrous oxide emissions compared to the baseline scenario), the magnitude of reductions is highly variable and dependent on numerous other parameters related to field-scale management techniques, soil characteristics, and climatic conditions. In order to accurately quantify the baseline and project nitrous oxide emissions, and ensure that changes in related but secondary emissions of nitrous oxide and changes in soil carbon stocks are properly accounted for, this protocol relies on the application of the DNDC model for quantification of the primary and secondary effect SSR-1 defined in Section 4. Detailed requirements for accurate and consistent application of the DNDC model are provided in Section 5.1 below. In addition to SSR-1, NM projects may result with unintended project increases to GHG emission from other secondary SSRs. Section 5.2 provides requirements for calculating those secondary GHG emissions resulting from the project activity.

Total emission reductions from a project or project aggregate equals the combined modeled primary emission reductions from SSR-1 for all fields in the project/project aggregate, minus the increase in emissions from all other SSRs due to the project activities on the fields. Equation 5.1 below provides the emission reduction calculation.

Equation 5.1. Calculating GHG Emission Reductions

$$ER = SDER - SE$$

Where, Units

ER	=	The total emission reductions for the reporting period	$MTCO_2e$
SDER	=	The total modeled GHG emission reductions from soil dynamics (SSR-1) from the project/project aggregate during the reporting period, (as calculated in Section 5.1)	$MTCO_2e$
SE	=	The total Secondary Effect GHG emissions caused by project activities during the reporting period for the project/project aggregate (as calculated in Section 5.2)	$MTCO_2e$

5.1 Modeling Primary Emission Reductions with the DNDC Model

Note to Workgroup: This section is under development. The information presented is meant to give you an understanding of the overall process for using DNDC. More explicit guidance will be developed for the final protocol

For the purposes of this protocol, the modeling of GHG emissions from soil dynamics under baseline and project scenarios must be performed using an approved version of the DNDC model. A separate model run must be performed for each field that is incorporated in the project/project aggregate.

The methodology described in Section 5.1 incentivizes aggregation of multiple agricultural fields by recognizing that structural model uncertainty, which is quantified by comparing modeled gas fluxes to actual measured gas fluxes across multiple modeling runs, decreases with increasing number of independent model runs performed. Therefore, the uncertainty adjustment factors (presented in Section X and derived in Appendix X) that must be applied to the modeled emission reduction results are inversely proportional to the number of fields included in the project or project aggregate.

Section 5.1.1 through Section 5.1.8 provides the quantification approach for determining the total primary modeled emission reductions for each field.

5.1.1 Parameterizing the DNDC Model

To model emission reductions from NM management changes for an individual field, the DNDC model must be properly parameterized with appropriate field-level data related to soil characteristics, climatic drivers, agricultural management, and other related parameters. For each field, a separate model run is performed using an appropriate input parameter file ("*.dnd" file) for both the baseline scenario and the project scenario. The difference between the two emissions estimates (after accounting for both input uncertainty and model structural uncertainty) is the total emission reductions achieved from the project activity at the field. The modeling runs are performed for each cultivation cycle of the reporting period to get net reductions for the field over the reporting period.

Model inputs are classified into two categories: critical inputs and non-critical inputs. The critical inputs are those that relate to the management parameters that are being changed as a result of the project (e.g., changing number of fertilizer applications, incorporation of manure, or including cover crop). The critical inputs to the DNDC model are the only parameters that will vary when modeling baseline and project emissions to determine the GHG reductions related to the field's management change. All other inputs that are used to parameterize the model are referred to hereafter as non-critical inputs, and are by definition identical between the baseline and the project scenario.

Refer to Table X [TBD] in Section X for a list and description of all DNDC input parameters.

5.1.1.1 Determining the Baseline Scenario 'Critical Inputs'

To set a baseline scenario for a field, it is necessary to assign values to each of the critical inputs related to the nutrient management. These critical inputs make up what is referred to as the baseline scenario for each field. Once the baseline critical inputs are set, they must remain unchanged for the entirety of the fields eligibility period (representing the baseline management scenario). The baseline scenario must represent the historical field management practices related to nutrient management based on 5 years of data on field management.

Discrete Project Action	Critical Inputs
Changing number of N applications	For each inorganic N application: date of fertilizer application, fertilizer application rate
Changing timing of N applications	For each inorganic N application: date of fertilizer application
Reduction in N application rate	For each inorganic N application: fertilizer application rate
Changing N fertilizer composition	For each inorganic N application: Inorganic fertilizer type
Use of organic amendments	For each organic N application: date of incorporation, amount applied, quality (C:N ratio)
Including mixed cover crops	Cover crop planting date, incorporation date and harvesting date. Cover crop type.
Use of nitrification and urease inhibitors	Amount of nitrification and urease inhibitors
Adding deep rooting plants to a crop rotation	Crop type

5.1.1.2 Non-Critical Input Parameters

Non-critical inputs are those that, while necessary for an accurate calculation, are not directly related to project activities. All non-critical inputs should be based on actual field-level data (unless otherwise specified), and must be the same when modeling baseline vs. project emissions for a specific cultivation cycle.

Climate Parameters

Seasonal weather can significantly affect nitrous oxide emissions and, hence, the reduction in nitrous oxide emissions due to alternative crop management. Weather during the cultivation cycle will impact decisions made regarding the planting and harvesting dates, and therefore impacts the length of the growing season. The following requirements for determining climate parameter inputs for each cultivation cycle calculation must be met:

- Daily climate data must come from a weather station that is located maximally 20 miles away. If the project area is located in California, it is recommended to use weather data from the nearest CIMIS weather station (http://wwwcimis.water.ca.gov).
- Weather data for the five years preceding the start of the crediting period must be collected. Weather data for the historic period (see Section 5.1.2) must be set by

repeating this five-year weather data set. After the start of the crediting period, actual weather data must be used for all emission calculations.

- Daily values of maximum temperature, minimum temperature, rainfall, and solar radiation must be collected and formatted according to DNDC's climate file mode 1 format (Table below).

Table 5.2. Climate Parameters

Input Parameters	Unit
Jday (Julian day)	Day of year
MaxT (Maximum temperature)	°C
MinT (minimum temperature)	°C
Rainfall	mm day^{-1}
Radiation	MJ m^{-2} day^{-1}

Non-Critical Management Parameters

All non-critical management parameters must be set based on actual data for each cultivation cycle calculation. As with all other non-critical inputs, the values for the following management parameters must be identical in the baseline and project model run for each cultivation cycle during the crediting period. The exact list of non-critical management parameters depends on the (combination of) activities that are planned by project proponents.

[Further guidance will be developed for how to determine the list of non-critical management parameters]

Soil Data

Some soil parameters affect nitrous oxide emissions to a significant extent. Therefore, for each of the fields, values for the following inputs must be obtained either from the USDA NRCS SSURGO data set, or based on soil measurements:

- Clay Content
- Bulk Density
- Soil pH
- Soil Organic Carbon (SOC) at Surface Soil
- Soil Texture

If using soil measurements, data may not be older than 10 years prior to the start date. Official soil laboratory statements must be available during the verification process. See Section [6] for more guidance on determining soil inputs.

5.1.2 Historical Modeling Run and Crop Yield Calibration

Historical Modeling Run

The DNDC model must be run for at least 20 years before the start date so that the model can attain equilibrium in certain critical variables for which empirical data is lacking, such as the sizes and the quality of the different carbon pools, and the inorganic nitrogen contents of soil pore water. This period is referred to as the historical period. The input parameters for the 20-year historical period must be set by repeating all parameters from the five years before the start date four times, unless otherwise noted.

The last five years of the historical period must be used to calibrate the modeled crop yields crop yields (more guidance to be developed here). Table X provides a schematic for the modeling period for each field.

Crop Model Calibration

Proper parameterization of soil physical conditions (which drive soil moisture dynamics) and crop simulation plays a crucial role in modeling C and N biogeochemistry and N_2O emissions. Through transpiration and N uptake as well as depositing litter into soil, plant growth regulates soil water, C and N regimes, which in turn determine a series of biogeochemical reactions impacting N_2O emissions. Users shall calibrate the DNDC crop model for cropping systems to be included in the project. Figure 1 outlines the steps for crop calibration. In DNDC, crops are defined by the following parameters:

- ***Maximum biomass (kg C/ha)***: The maximum biomass productions for grain, leaves+stems (non-harvest above ground biomass), and roots under optimum growing conditions (namely, maximum biomass assuming no N, water or growing degree day limitations). The unit is kg C/ha (1 kg dry matter contains 0.4 kg C). Maximum yield values will be used for step 2 in figure 1 below.
- ***Biomass fraction***: The grain, leaves+stem, and root fractions of total biomass at maturity.
- ***Biomass C/N ratio***: Ratio of C/N for grain, leaves+stems, and roots at maturity.
- ***Total N demand (kg N/ha)***: Amount of the total N demanded by the crop to reach the maximum production.
- ***Thermal degree days (°C)***: Cumulative air temperature from seeding till maturity of the crop.
- ***Water demand (g water/g dry matter***): Amount of water needed for the crop to produce a unit of dry matter of biomass.
- ***N fixation index***: The default number is 1 for non-legume crops. For legume crops, the N fixation index is equal to the ratio (total N content in the plant)/(plant N taken from soil).

[Further guidance TBD on how to select the right values iteratively]

5.1.3 Accounting for Input Uncertainty using Monte Carlo Simulations

Soil physical and chemical properties have a significant impact on N_2O production, consumption and emissions. Project developers have the choice of estimating soil conditions based on field samples or soil surveys. If field measurements are used, then the target precision level for each soil parameter shall be +/-10% of the mean at a 90% confidence level. The distribution of the field values shall be assumed to be normally distributed.

If NRCS SSURGO soil survey data are used for setting soil parameters, then default uncertainty estimates shall be set based on uncertainty estimates and probability distribution functions (PDF) listed in Table Y. For each stratum, the mean value shall be calculated as the area-weighted sum of the representative values for all compartments with the SSURGO MUKEY.

5.1.4 Modeling Field Level Baseline Emissions

The baseline ($GHG_{BSL\ i,j}$) GHG emissions for each field *i* will be determined by performing a Monte Carlo simulation with 2000 DNDC simulations.
Based on the uncertainty of input soil parameters quantified in section 5.1.3, DNDC will be run through a Monte Carlo analysis for baseline emission calculations. The duration of each Monte

Carlo run should be the same as the duration of the reporting period. The Monte Carlo runs will be accomplished by running DNDC in batch mode with each entry in the batch file list a separate Monte Carlo run (see DNDC user's guide about running in batch mode). Once the Monte Carlo runs are complete, results are recorded in a CSV file. The name of the file is the site name as entered into DNDC. From the CSV file, extract the N_2O emissions and change in SOC content for Monte Carlo run *j* in each field *i*.

5.1.5 Modeling Field Level Project Emissions

The project ($GHG_{P,i,j}$) GHG emissions in each field *i* for each Monte Carlo run *j* will be determined by running DNDC. Based on the uncertainty of input soil parameters quantified in Section 5.1.3, DNDC will be run through a Monte Carlo analysis for both baseline and project emission calculations. The duration of each Monte Carlo run should be the same as the duration of the project. The Monte Carlo runs will be accomplished by running DNDC in batch mode with each entry in the batch file list a separate Monte Carlo run (see DNDC user's guide about running in batch mode).

5.1.6 Structural Uncertainty Adjustments

Inherent in biogeochemical models, like DNDC, are uncertainties due to imperfect science in the models. This uncertainty is often referred as model structural uncertainty. Model structural uncertainty is quantified by comparing model estimates of greenhouse gases with measured emission estimates. The measured data are assumed to have no uncertainty (although it is well known that measurements can have large sources of uncertainties). This section describes the approach for adjusting for model structural uncertainty to insure conservativeness in estimates of project emission reductions.

[TBD]

5.2 Quantifying Secondary Emissions

Note to Workgroup: This section is also largely under development.

Secondary effect GHG emissions are unintentional changes in GHG emissions from the secondary SSRs within the GHG Assessment Boundary. Secondary effect emissions may increase, decrease, or go unchanged as a result of the project activity. If emissions from secondary SSRs increase as a result of the project, these emissions must be subtracted from the total modeled primary emission reductions (as specified in Equation 5.1) for each reporting period on an *ex-post* basis.

5.2.1 Project and Baseline Emissions from Manure Incorporation (SSR 2)

Storing, managing, and applying manure within a farm may increase N_2O emissions. Note that emissions from transportation of manure to the farm are excluded from the accounting. Therefore, only emissions from on-site (on-farm) storage and management are included. Standard emission factors are used to account for such emissions.

[TBD]

5.2.2 Project and Baseline Emissions from On-Site Fossil Fuel Combustion (SSR 3)

All increases in on-site fossil-fuel combustion due to project activities must be included in the carbon accounting. This includes fossil fuel emissions from

- Increasing the number of N fertilizer applications
- Seeding of mixed cover crop
- Incorporation and/or harvesting of mixed cover crop
- Incorporation of manure

Fossil fuel emissions are accounted for by using emission factors expressed as MTCO2 per acre.

[TBD]

5.2.3 Project and Baseline Emissions from Leaching and Run-off (SSR 4)

Quantification of N_2O from leaching and run-off will be done through IPCC Tier 1 default emission factors based on the leaching amount simulated by DNDC.

5.2.4 Project and Baseline Emissions from Volatilization (SSR 5)

Quantification of N_2O from volatilization will be done through IPCC Tier 1 default emission factors based on the leaching amount simulated by DNDC.

[TBD]

5.2.5 Leakage (SSR6)

Note to Workgroup: This is an area in need of further development. We have not begun to explore in detail the risks of leakage and options for quantifying. This will be an area of focus after the in-person meeting. Time permitting, we can begin a discussion at the meeting.

6 Project Monitoring

Text further below is boiler plate for all Reserve protocols and needs to be developed specifically for this protocol. It is included for completeness and to give you a sense of what this section is meant to address.

Immediately below, for your review, are *draft* guidelines for monitoring and verifying project aggregates that represent the kinds of rules we intent to incorporated into this and the following sections of the protocol. This is meant as a starting point for discussion.

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Guidelines for Project Aggregates

The Aggregator is responsible for selecting a single verification body for the entire project aggregate. Verification bodies must pass a conflict-of-interest review against all enrolled fields, project participants, and the Aggregator.

The Aggregator must coordinate a verification schedule that meets these requirements below. The Aggregator must document the verification work and provide a report to the Reserve every 12-month period, from the date of its formation, showing how the verification schedule demonstrates compliance with these guidelines.

Required Site-Visit Verification Schedule for Aggregates

Site-visit verifications must be conducted on a schedule such that at all times a minimum of 50% of the fields in the aggregate (rounding up in the case of an uneven number of fields) have successfully completed a site visit verification within the previous X years, and that 100% of the projects have successfully completed a site visit verification within the previous X years. These verification requirements are mandatory regardless of the mix of entry dates represented by the fields in the aggregate. An initial site visit verification is required for a field to enter into the aggregate and this initial site visit may count toward meet these site verification obligations.

On five year intervals, beginning with first year of the existence of the aggregate, the verifier must select from the total group of fields those that will have scheduled site-visit verifications in order to meet these obligations. The process should utilize random selection to the degree possible and still meet the completion requirements. For example, in the case where there are ten fields that joined the aggregate in the first year. The site-visit verifications may be spread out through each five-year interval or scheduled in a more concentrated manner that economizes on verifier expenses. Project participants must be notified of a site-visit verification prior to the year in which the verification is to take place.

Required Desk Review Verification Schedule for Aggregates

Between site-visit verifications, the aggregator must submit annual monitoring reports for each field in the aggregate. Verifiers must annually audit a sample of the monitoring reports, equivalent to the square root of the total number of fields in the aggregate, or the total number of fields divided by 12, whichever is higher (when rounded to the next highest whole number). As an example, an aggregate with 16 fields must have 4 field monitoring reports verified in a given year. Audited projects must be selected randomly, and must not include fields undergoing site-visit verification for the year. The aggregator will not know which of the annual monitoring reports will require verification in a given year. Since this is a random process, a particular field may have the annual report verified in consecutive years or not until the field is verified with a required site visit.

Successful verification of the sample of fields results in the crediting of all emission reductions from all fields participating in the aggregate. If verification for a participating field is unsuccessful, the verifier must verify additional participating fields until the total number of successful verifications reaches the required number (as described above). If the required number of successful verifications has not been achieved within 12 months after the date the verification body submits a negative Verification Opinion and Report to the Reserve for one or more fields in the aggregate, crediting for the project aggregate will be suspended until the required number of successful verifications has been achieved.

The Reserve will not issue CRTs for a field in an aggregate that has an unsuccessful verification.

Aggregators may assist project participants in preparing documents for verification and facilitate the verification process. The scope of these services is determined by the specific contract between the Project participant and the Aggregator. The ultimate responsibility for monitoring reports and verification compliance is assigned to the Aggregator.

****

<Start boiler plate text for Monitoring Chapter>

The Reserve requires a Monitoring Plan to be established for all monitoring and reporting activities associated with the project. The Monitoring Plan will serve as the basis for verifiers to confirm that the monitoring and reporting requirements in this section and Section 7 have been and will continue to be met, and that consistent, rigorous monitoring and record-keeping is ongoing at the project site. The Monitoring Plan must cover all aspects of monitoring and reporting contained in this protocol and must specify how data for all relevant parameters in Table 6.1 (below) will be collected and recorded.

At a minimum, the Monitoring Plan shall stipulate the frequency of data acquisition; a record keeping plan (see Section 7.2 for minimum record keeping requirements); the frequency of instrument cleaning, inspection, field check and calibration activities; and the role of individuals performing each specific monitoring activity. The Monitoring Plan should include QA/QC provisions to ensure that data acquisition and meter calibration are carried out consistently and with precision.

Finally, the Monitoring Plan must include procedures that the project developer will follow to ascertain and demonstrate that the project at all times passes the Legal Requirement Test (Section 3.4.2).

Project developers are responsible for monitoring the performance of the project and ensuring that the operation of all project-related equipment is consistent with the manufacturer's recommendations.

6.1 Monitoring Parameters

Prescribed monitoring parameters necessary to calculate baseline and project emissions are provided in Table 6.1.

Table 6.1. Project Monitoring Parameters

Parameter	Description	Data unit	calculated (c) measured (m) reference(r) operating records (o)	Measurement frequency	Comment
General Project Parameters					
Regulations	Project developer attestation of compliance with regulatory requirements relating to the project	Environmental regulations	N/A	Each verification cycle	Information used to: 1) To demonstrate ability to meet the Legal Requirement Test – where regulation would require the installation of a biogas control system. 2) To demonstrate compliance with associated environmental rules, e.g. criteria pollutant and effluent discharge limits.
Baseline Calculation Parameters					
Project Calculation Parameters					

7 Reporting Parameters

Text below is boiler plate for all Reserve protocols and needs to be developed specifically for this protocol. It is included for completeness and to give you a sense of what this section is meant to address.

This section provides requirements and guidance on reporting rules and procedures. A priority of the Reserve is to facilitate consistent and transparent information disclosure among project developers. Project developers must submit verified emission reduction reports to the Reserve annually at a minimum.

7.1 Project Submittal Documentation

Project developers must provide the following documentation to the Reserve in order to register an project:

Project Submittal form
Signed Attestation of Title form
Signed Attestation of Voluntary Implementation form
Signed Attestation of Regulatory Compliance form
Verification Report
Verification Opinion

Project developers must provide the following documentation each reporting period in order for the Reserve to issue CRTs for quantified GHG reductions:

- Verification Report
- Verification Opinion
- Signed Attestation of Title form
- Signed Attestation of Voluntary Implementation form
- Signed Attestation of Regulatory Compliance form

At a minimum, the above project documentation will be available to the public via the Reserve's online registry. Further disclosure and other documentation may be made available on a voluntary basis through the Reserve. Project submittal forms can be found at http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/.

7.2 Record Keeping

For purposes of independent verification and historical documentation, project developers are required to keep all information outlined in this protocol for a period of 10 years after the information is generated or 7 years after the last verification. This information will not be publicly available, but may be requested by the verifier or the Reserve.

System information the project developer should retain includes:

All data inputs for the calculation of GHG reductions, including all required sampled data
Copies of all air, water, and land use permits relevant to project activities; Notices of Violations (NOVs) relevant to project activities; and any administrative or legal consent orders relevant to project activities dating back at least 3 years prior to the project start date, and for each subsequent year of project operation

- Project developer attestation of compliance with regulatory requirements relating to the project
- Results of CO_2e annual reduction calculations
- Initial and annual verification records and results
- All maintenance records relevant to the monitoring equipment

7.3 Reporting Period and Verification Cycle

Project developers must report GHG reductions resulting from project activities during each reporting period. A reporting period cannot exceed 12 months, and no more than 12 months of emission reductions can be verified at once, except during a project's first verification, which may include historical emission reductions from prior years.

8 Verification Guidance

Text below is boiler plate for all Reserve protocols and needs to be developed specifically for this protocol. It is included for completeness and to give you a sense of what this section is meant to address.

This section provides verification bodies with guidance on verifying GHG emission reductions associated with the project activity. This verification guidance supplements the Reserve's Verification Program Manual and describes verification activities specifically related to projects.

Verification bodies trained to verify projects must be familiar with the following documents:

- Climate Action Reserve Program Manual
- Climate Action Reserve Verification Program Manual
- Climate Action Reserve Project Protocol

The Reserve's Program Manual, Verification Program Manual, and project protocols are designed to be compatible with each other and are available on the Reserve's website at http://www.climateactionreserve.org.

Only ISO-accredited verification bodies trained by the Reserve for this project type are eligible to verify project reports. Verification bodies approved under other project protocol types are not permitted to verify projects. Information about verification body accreditation and Reserve project verification training can be found on the Reserve website at http://www.climateactionreserve.org/how/verification/.

8.1 Standard of Verification

The Reserve's standard of verification for projects is the Project Protocol (this document), and the Reserve Program Manual and Verification Program Manual. To verify a project report, verification bodies apply the guidance in the Verification Program Manual and this section of the protocol to the standards described in Sections 2 through 7 of this protocol. Sections 2 through 7 provide eligibility rules, methods to calculate emission reductions, performance monitoring instructions and requirements, and procedures for reporting project information to the Reserve.

8.2 Monitoring Plan

The Monitoring Plan serves as the basis for verification bodies to confirm that the monitoring and reporting requirements in Section 6 and Section 7 have been met, and that consistent, rigorous monitoring and record-keeping is ongoing at the project site. Verification bodies shall confirm that the Monitoring Plan covers all aspects of monitoring and reporting contained in this protocol and specifies how data for all relevant parameters in Table 6.1 are collected and recorded.

8.3 Verifying Project Eligibility

Verification bodies must affirm a project's eligibility according to the rules described in this protocol. The table below outlines the eligibility criteria for projects. This table does not present all criteria for determining eligibility comprehensively; verification bodies must also look to Section 3 and the verification items list in Table 8.2.

Table 8.1. Summary of Eligibility Criteria for an Organic Waste Digestion Project

Eligibility Rule	Eligibility Criteria	Frequency of Rule Application
Start Date	For 12 months following the Effective Date of this protocol, a pre-existing project with a start date on or after may be submitted for listing; after this 12 month period, projects must be submitted for listing within 6 months of the project start date	Once during first verification
Location	United States and U.S. tribal areas	Once during first verification
Performance Standard		Every verification
Legal Requirement Test	Signed Attestation of Voluntary Implementation form and monitoring procedures for ascertaining and demonstrating that the project passes the Legal Requirement Test	Every verification
Regulatory Compliance Test	Signed Attestation of Regulatory Compliance form and disclosure of all non-compliance events to verifier; project must be in material compliance with all applicable laws	Every verification
Exclusions	▪ Grid electricity and fossil fuel displacement	Every verification

8.4 Core Verification Activities

The Project Protocol provides explicit requirements and guidance for quantifying the GHG reductions associated with the . The Verification Program Manual describes the core verification activities that shall be performed by verification bodies for all project verifications. They are summarized below in the context of a project, but verification bodies must also follow the general guidance in the Verification Program Manual.

Verification is a risk assessment and data sampling effort designed to ensure that the risk of reporting error is assessed and addressed through appropriate sampling, testing, and review. The three core verification activities are:

1. Identifying emission sources, sinks, and reservoirs (SSRs)
2. Reviewing GHG management systems and estimation methodologies
3. Verifying emission reduction estimates

Identifying emission sources, sinks, and reservoirs

The verification body reviews for completeness the sources, sinks, and reservoirs identified for a project, such as, *inter alia*, .

Reviewing GHG management systems and estimation methodologies

The verification body reviews and assesses the appropriateness of the methodologies and management systems that the project operator uses to gather data and calculate baseline and project emissions.

Verifying emission reduction estimates

The verification body further investigates areas that have the greatest potential for material misstatements and then confirms whether or not material misstatements have occurred. This involves site visits to the project to ensure the systems on the ground correspond to and are consistent with data provided to the verification body. In addition, the verification body recalculates a representative sample of the performance or emissions data for comparison with data reported by the project developer in order to double-check the calculations of GHG emission reductions.

8.5 Project Type Verification Items

The following tables provide lists of items that a verification body needs to address while verifying a project. The tables include references to the section in the protocol where requirements are further specified. The table also identifies items for which a verification body is expected to apply professional judgment during the verification process. Verification bodies are expected to use their professional judgment to confirm that protocol requirements have been met in instances where the protocol does not provide (sufficiently) prescriptive guidance. For more information on the Reserve's verification process and professional judgment, please see the Verification Program Manual.

Note: These tables shall not be viewed as a comprehensive list or plan for verification activities, but rather guidance on areas specific to projects that must be addressed during verification.

8.5.1 Project Eligibility and CRT Issuance

Table 8.2 lists the criteria for reasonable assurance with respect to eligibility and CRT issuance for projects. These requirements determine if a project is eligible to register with the Reserve and/or have CRTs issued for the reporting period. If any one requirement is not met, either the project may be determined ineligible or the GHG reductions from the reporting period (or sub-set of the reporting period) may be ineligible for issuance of CRTs, as specified in Sections 2, 3, and 6.

Table 8.2. Eligibility Verification Items

Protocol Section	Eligibility Qualification Item	Apply Professional Judgment?
2.2	Verify that the project meets the definition of an project	No
2.3	Verify ownership of the reductions by reviewing Attestation of Title	No
3.2	Verify project start date	No
3.2	Verify that the project has documented and implemented a Monitoring Plan	No
3.2	Verify accuracy of project start date based on operational records	Yes
3.3	Verify that project is within its 10 year crediting period	No
3.4.1	Verify that the project meets the performance standard test	No
3.4.2	Confirm execution of the Attestation of Voluntary Implementation form to demonstrate eligibility under the Legal Requirement Test	No
3.4.2	Verify that the project Monitoring Plan contains a mechanism for ascertaining and demonstrating that the project passes the Legal Requirement Test at all times	No
3.5	Verify that the project activities comply with applicable laws by reviewing any instances of non-compliance provided by the project developer and performing a risk-based assessment to confirm the statements made by the project developer in the Attestation of Regulatory Compliance form	Yes

Protocol Section	Eligibility Qualification Item	Apply Professional Judgment?
6	Verify that monitoring meets the requirements of the protocol. If it does not, verify that variance has been approved for monitoring variations	No

8.5.2 Quantification

Table 8.3 lists the items that verification bodies shall include in their risk assessment and re-calculation of the project's GHG emission reductions. These quantification items inform any determination as to whether there are material and/or immaterial misstatements in the project's GHG emission reduction calculations. If there are material misstatements, the calculations must be revised before CRTs are issued.

Table 8.3. Quantification Verification Items

Protocol Section	Quantification Item	Apply Professional Judgment?
4	Verify that all SSRs in the GHG Assessment Boundary are accounted for	No
5.1	Verify that the baseline emissions from different eligible waste stream are properly aggregated	No
5.2	Verify that the project emissions calculations were calculated according to the protocol with the appropriate data	No
	Verify that the project developer correctly monitored, quantified and aggregated electricity use	Yes
	Verify that the project developer correctly monitored, quantified and aggregated fossil fuel use	Yes
	Verify that the project developer applied the correct emission factors for fossil fuel combustion and grid-delivered electricity	No
	Verify that the project developer correctly applied nitrous oxide emission factors	No
	If default emission factors are not used, verify that project-specific emission factors are based on official source tested emissions data or are from an accredited source test service provider	No

8.5.3 Risk Assessment

Verification bodies will review the following items in Table 8.4 to guide and prioritize their assessment of data used in determining eligibility and quantifying GHG emission reductions.

Table 8.4. Risk Assessment Verification Items

Protocol Section	Item that Informs Risk Assessment	Apply Professional Judgment?
6	Verify that the project Monitoring Plan is sufficiently rigorous to support the requirements of the protocol and proper operation of the project	Yes
6	Verify that appropriate monitoring equipment is in place to meet the requirements of the protocol	No
6	Verify that the individual or team responsible for managing and reporting project activities are qualified to perform this function	Yes
6	Verify that appropriate training was provided to personnel assigned to	Yes

Protocol Section	Item that Informs Risk Assessment	Apply Professional Judgment?
	greenhouse gas reporting duties	
6	Verify that all contractors are qualified for managing and reporting greenhouse gas emissions if relied upon by the project developer. Verify that there is internal oversight to assure the quality of the contractor's work	Yes
7.2	Verify that all required records have been retained by the project developer	No

8.5.4 Completing Verification

The Verification Program Manual provides detailed information and instructions for verification bodies to finalize the verification process. It describes completing a Verification Report, preparing a Verification Opinion, submitting the necessary documents to the Reserve, and notifying the Reserve of the project's verified status.

9 Glossary of Terms

Accredited verifier	A verification firm approved by the Climate Action Reserve to provide verification services for project developers.
Additionality	Project activities that are above and beyond business-as-usual operation, exceed the baseline characterization, and are not mandated by regulation.
Aggregator	*Need to add*
Anthropogenic emissions	GHG emissions resultant from human activity that are considered to be an unnatural component of the Carbon Cycle (i.e. fossil fuel destruction, de-forestation, etc.).
Biogenic CO_2 emissions	CO_2 emissions resulting from the destruction and/or aerobic decomposition of organic matter. Biogenic emissions are considered to be a natural part of the Carbon Cycle, as opposed to anthropogenic emissions.
Carbon dioxide (CO_2)	The most common of the six primary greenhouse gases, consisting of a single carbon atom and two oxygen atoms.
CO_2 equivalent (CO_2e)	The quantity of a given GHG multiplied by its total global warming potential. This is the standard unit for comparing the degree of warming which can be caused by different GHGs.
Direct emissions	Greenhouse gas emissions from sources that are owned or controlled by the reporting entity.
Effective Date	The date of adoption of this protocol by the Reserve board: .
Emission factor (EF)	A unique value for determining an amount of a greenhouse gas emitted for a given quantity of activity data (e.g. metric tons of carbon dioxide emitted per barrel of fossil fuel burned).
Field	*Need to add*
Fossil fuel	A fuel, such as coal, oil, and natural gas, produced by the decomposition of ancient (fossilized) plants and animals.
Greenhouse gas (GHG)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), or perfluorocarbons (PFCs).
GHG reservoir	A physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store or accumulate a GHG that has been removed from the atmosphere by a GHG sink or a GHG captured from a GHG source.
GHG sink	A physical unit or process that removes GHG from the atmosphere.

GHG source	A physical unit or process that releases GHG into the atmosphere.
Global Warming Potential (GWP)	The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one unit of a given GHG compared to one unit of CO_2.
Indirect emissions	Reductions in GHG emissions that occur at a location other than where the reduction activity is implemented, and/or at sources not owned or controlled by project participants.
Metric ton or "tonne" (MT)	A common international measurement for the quantity of GHG emissions, equivalent to about 2204.6 pounds or 1.1 short tons.
Methane (CH_4)	A potent GHG with a GWP of 21, consisting of a single carbon atom and four hydrogen atoms.
MMBtu	One million British thermal units.
Mobile combustion	Emissions from the transportation of materials, products, waste, and employees resulting from the combustion of fuels in company owned or controlled mobile combustion sources (e.g. cars, trucks, tractors, dozers, etc.).
Project baseline	A "business as usual" GHG emission assessment against which GHG emission reductions from a specific GHG reduction activity are measured.
Project aggregate	*Need to add*
Project developer	An entity that undertakes a GHG project, as identified in this protocol, Section 2.2.
Project participant	*Need to add*
Stationary combustion source	A stationary source of emissions from the production of electricity, heat, or steam, resulting from combustion of fuels in boilers, furnaces, turbines, kilns, and other facility equipment.
Verification	The process used to ensure that a given participant's greenhouse gas emissions or emission reductions have met the minimum quality standard and complied with the Reserve's procedures and protocols for calculating and reporting GHG emissions and emission reductions.
Verification body	A Reserve-approved firm that is able to render a verification opinion and provide verification services for operators subject to reporting under this protocol.

10 References

Appendix A Development of the Performance Standard