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RE: Feedback on Soil Enrichment Protocol and related documents

Mr. Osman:

Thank you for the opportunity to participate in the Soil Enrichment Protocol Workgroup. I have reviewed the draft version of the Soil Enrichment Protocol (SEP) and its related documents in detail. Before providing comments and feedback on the SEP, I would like to provide a brief background about my experience and context for the comments. I have participated in carbon markets for nearly 15 years, most of that with the Reserve and its predecessor, the California Climate Action Registry. I have reviewed and commented on many of the protocols developed by the Reserve, starting with the Forest Project Protocol. Through various roles at multiple organizations, I have supported the development of ten of the Reserve's protocols. I have also developed projects and purchased credits created under five protocols. I am not an expert on biogeochemical models nor do I have the wealth of experience the Reserve does in writing and revising protocols and approving projects. However, I do have a broad understanding of the carbon market, in general, and the development of agriculture-based projects, specifically. With this background in mind, I have four overarching comments on the SEP. The overarching comments are followed by detailed comments on the SEP and supporting documents. I appreciate the hard work that has gone into this effort. Many people have spent countless hours on this effort. These comments are intended to make the protocol more robust and adopted by a significant number of agricultural producers and project developers.

First, the SEP has developed specialized quantification equations for many of the carbon pools. Rather than developing using the Reserve developed equations, I strongly encourage the Reserve to review and use the applicable equations developed by the US Department of Agriculture (USDA) in *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*, Technical Bulletin 1939. This guidance was developed by scientists who specialize in quantifying GHG emissions from Cropland and Grazing Land Systems. Chapter 3, Quantifying Greenhouse Gas Sources and Sinks in Cropland and Grazing Land Systems, is particularly applicable to the SEP and was developed by fourteen highly respected scientists from USDA, the University of California at Davis, Michigan State University, and Colorado State University.

Second, the treatment of drought on the sequestration of soil carbon is not adequately addressed in the protocol. Drought can have a significant impact on soil carbon concentrations. A 2017 paper by Canarini, Kaier, and Dijkstra states that "C-rich soils (>2% organic carbon) increase CO<sub>2</sub> release into the atmosphere

after intense droughts.”<sup>1</sup> At a minimum, the impact of drought needs to be included in the calculations of buffer pool contributions in Section 5.3.1.

Third, the requirement for peer reviewed research supporting a practice is not clearly stated in the protocol. The most significant reference to using peer reviewed research is found in the Model Validation & Verification Guidance. Multiple studies have stressed that both theoretical and empirical support for a given practice in a specific geographic location and cropping system is critical for environmental markets.<sup>2</sup> Not only is this important for a given practice on a given crop in a specific geography, it is also important when multiple practices are applied to a crop. The effects of multiple practices on net GHG emissions cannot be evaluated through separate studies – studies must consider the synergistic effects of multiple practices.

Fourth, I encourage the Reserve to develop a biogeochemical model that project developers can use for this project. Previous agricultural offset protocols have been developed which allow for the use of applicable peer-reviewed models. Unfortunately, for those protocols, no projects have been developed because the cost to calibrate and validate a model for a given crop, geography and practice has been prohibitive. To maximize the uptake of this protocol, tools are necessary to allow project developers to efficiently create projects.

In addition to the overarching comments above, below are detailed observations, edits, comments and questions by page number and section. Some of this feedback includes detailed comments covered in my general comments.

#### Detailed Protocol Comments

Page 3: Change “Globally, agriculture, forestry, and other land use sectors contribute to 24% of total GHG emissions (IPCC, 2014).”

To “Globally, agriculture, forestry, and other land use sectors contribute **up** to 24% of total GHG emissions (IPCC, 2014).”

Page 3: “Project activities must also not result in a sustained displacement of any pre-existing productive activity in the project area by more than 10%.” How do you measure this? Is it yield? You need some equation or guidance to determine this impact.

Page 4: Footnote 3 states “Ephemeral field lands are not required to be excluded, so long as they do not remain in the same location permanently.” But it is tied to the phrase “Permanent or improved roads.” I do not understand what you mean.

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<sup>1</sup> Canarini, A., Kiær, L.P., Dijkstra, F.A. Soil carbon loss regulated by drought intensity and available substrate: A meta-analysis. (2017). *Soil Biology and Biochemistry*. doi: [10.1016/j.soilbio.2017.04.020](https://doi.org/10.1016/j.soilbio.2017.04.020)

<sup>2</sup> Tonitto, C., Woodbury, P., & McLellan, E.L. (2018). Defining a best practice methodology for modeling the environmental performance of agriculture. *Environmental Science and Policy*, 87, 64–73. doi: [10.1016/j.envsci.2018.04.009](https://doi.org/10.1016/j.envsci.2018.04.009)

Venterea, R.T., et. al. (2012). Challenges and opportunities for mitigating nitrous oxide emissions from fertilized cropping systems. *Frontiers in Ecology and the Environment*, 10, 562–570. doi: [10.1890/120062](https://doi.org/10.1890/120062)

Niles, M., et. al. (2019) Policy options to streamline the carbon market for agricultural nitrous oxide emissions, *Climate Policy*, 19:7, 893-907, DOI: [10.1080/14693062.2019.1599802](https://doi.org/10.1080/14693062.2019.1599802)

Page 6, Section 2.2.3.2: I expected this section to talk about a field leaving a project. I suggest it be renamed “Transferring between projects” and the language updated to reflect the activity that is occurring.

Page 6, Section 2.3: Change “In the table above, any of the other defined entities could be the Project Owner. In an aggregated project, one of the Field Managers could be the Project Owner and the aggregator, or those roles may be filled by a third party. In any case, the project developer may be a contracted third-party (i.e., a technical consultant).”

To “In the table above, any of the **other** defined entities could be the Project Owner. In an **Aggregated** project, one of the Field Managers could be the Project Owner and the **Aggregator**, or those roles may be filled by a third party. In any case, the **Project Developer** may be a contracted third-party (i.e., a technical consultant).”

Page 8, Section 2.4: Change “The Soil Enrichment Protocol (this document) is intended to reduce emissions” to “The Soil Enrichment Protocol (this document) is intended to reduce **GHG** emissions”

Page 15, Section 3.5.1: Is a drought considered an unavoidable reversal? See detailed comments at the start of this letter.

Page 17, Section 3.5.3: The process is not clear for option 1. If a PIA must have a term of enforcement of 100 years, why would the Reserve accept a PIA with a shorter enforcement period only to then extend it?

Page 18:

“As described in **[inset section]**, growers are generally reluctant to change their land management practices for a variety of reasons.”

“If they have maintained their adopted practice(s) without payment following opting out of the project, we can consider that they will continue to maintain that practice (or practices), and the SOC can be considered effectively permanent. **Appendix A,**” – Looks like a sentence is missing.

Page 20, Section 3.6: Minor typo “**3.6 3.5Regulatory Compliance**”.

Page 23: “Baseline emissions are an estimate of the difference between the soil organic carbon pool in the current reporting period and baseline scenarios” This sounds to me like it should be the project period. Why is the carbon pool in the current reporting period part of the baseline emissions?

Page 25, Box 5.1: doesn't *i* need to equal *s* in the second equation? If you don't isn't there a problem with the scale of *i* and *s*?

Page 27, Section 5.1: Will *x* in “*x* cultivation years” be determined by the project proponent or the Reserve? I think you should introduce the dynamic baseline approach at the beginning of this section. I also think that calling it a dynamic baseline makes it clearer.

Page 29, Section 5.2: What is the basis for the selection of the 15% margin of error threshold? Is there a scientific paper or concept that can be cited?

Page 30, Equations 5.2a and b: Shouldn't there be an “*s*” as a part of  $\Delta CO_2_{soil_t}$ ? Don't you need to sum over the multiple strata?

Page 31, Box 5.2: I appreciate the example. I would recommend that you include one that is in a future reporting period to demonstrate the impact of  $PER_t$ .

Page 31, Equation 5.3: In this equation, you define  $\Delta CO2_{soil_t}$  as “Carbon dioxide emission reductions from soil organic carbon pool across all strata in cultivation year t,” which is different than the definition in Equation 5.2a and b.

Page 32: “The risk of an unavoidable reversal to a soil enrichment project is extremely low.” Do you have papers you can cite that support that? I don’t think it is accurate. According to Canarini, A., 2017, “C-rich soils (>2% organic carbon) increase CO2 release into the atmosphere after intense droughts” (<https://doi.org/10.1016/j.soilbio.2017.04.020>)

Page 32: Can you give me an example of a public agency or organization that could enter into a soil carbon project? I thought it wasn’t possible for public agencies to prove permanence of their projects. A couple versions ago, the Forest Project Protocol didn’t allow for public agencies. What provisions have you been able to include in the FPP to allow public agencies to develop projects?

Page 33, Equation 5.4: It isn’t clear to me where the 0.1 (Default risk of unavoidable reversals, applicable to all projects) is used in the equation.

Page 33, 5.3.2: “For example, if a single field were enrolled in a stand-alone project and the participating Field Manager discontinued eligible soil enhancement activities, then **those soil enhancement activities on that field, as a stand-alone project,** would be considered to have experienced an avoidable reversal.”

I think you are combining a lot of ideas in the above sentence. Rewriting it to make it clearer.

Page 34, Equation 5.6: The Uncertainty equation is 5.1, not 5.3

Page 37, Box 5.3: “Equation 5.10b and Equation 5.11 require the use of parameter  $AGD_i$ ”

Page 38, Equation 5.11: “Model predicting methane emissions from enteric fermentation” What models predict methane emissions from enteric fermentation? I am not aware of any.

Page 41, Equation 5.16: The units for  $M_{SF,s,t}$  and  $M_{OF,s,t}$  is t, which is defined as metric tons in Abbreviations and Acronyms, however, t is commonly used to designate time. You might consider using Mt. I realize this may not be possible depending on the abbreviations in other protocols.

Pages 41 and 42, Equations 5.16 and 5.17: I strongly recommend that you replace these equations with those developed by USDA in *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*, Technical Bulletin 1939. For equation 5.16, USDA Equation 3-8 on page 3-61 should be used. For equation 5.17, USDA Equation 3-13 on page 3-62 should be used. It was developed by fourteen of the most knowledgeable scientists who specialize in quantifying GHG emissions from cropland and grazing land systems.

Page 48, Section 6.3: “Otherwise, for each reporting period...” I recommend deleting “Otherwise,” it creates confusion. I also recommend putting the paragraph on fossil fuels at the end of the section as it can be de minimis while the other parameters are required to be monitored.

Page 48, Section 6.4: “Direct measurement of soil organic carbon levels must be performed via soil sampling to establish values to be used as the basis for baseline modeling and, as applicable, project modeling,” I recommend deleting “as applicable” in the above sentence as it implies that soil sampling may not be applicable. Soil sampling every 5 years should be required.

Page 49, Table 6.1: Under sample depth, change “Minimum of 30cm”, to “Minimum of 30cm, recommended 1m”

Page 51, Section 6.5, footnote 24: “This may mean that peer-reviewed journal articles have employed the relevant model.” All models should be supported by peer-reviewed journal articles. This protocol should be based on science and has been publicly reviewed. This concept should be more prominently featured in the protocol.

Page 54, Table 6.3: Check the values of  $Frac_{GASF}$  and  $Frac_{GASM}$  against the information in *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*, Technical Bulletin 1939, which also uses IPCC emission factors. Equation 3-14 on page 3-68 contains the values for the volatilization of  $NH_3$  and  $NO_x$  from organic and synthetic fertilizers.

Page 60, Section 6.1: “At a minimum, the above project documentation (except for the detailed project map) will be available to the public via the Reserve’s online registry.” What location information will be provided to the public? None? I recommend providing at least the county or counties in which the project is located.

Page 61, Section 7.2: “This will mean that a project may experience overlapping reporting periods, i.e., a reporting period may end in November of a given year, but if a winter crop is grown on a field submitted to the project for crediting in the next cultivation year, the subsequent project reporting period may actually begin that same November, potentially prior to the end of the last reporting period.” How are credits apportioned if two crediting periods overlap? I understand in the next paragraph you state that “Field reporting periods cannot overlap, because they are defined by the field’s cultivation year. The new cultivation year will only start once the previous crop harvest on that field has concluded.” However, it still appears that practices can overlap. For example, how would you delineate vintage years on a field where a winter crop is grown on the same field that implemented nitrogen reduction?

Page 65, Section 8.3.3: “This involves site visits to the project field (or fields if the project includes multiple fields) to ensure the systems on the ground correspond to and are consistent with data provided to the verification body.” Recommend that you add a reference to the requirements under section 8.4. Read in isolation, this section could be interpreted that all project fields need to be visited annually.

Page 65, Section 8.3.3.1: “If the project employs the use of a third-party expert to undertake validation, parameterization, calibration, and/or running a biogeochemical model in a given reporting period, then there will be no need for the verification team to independently verify such activities have been done appropriately” What are the necessary qualifications of the third-party expert? Is there a way to ensure their independence as is done with verifiers? Are there certain criteria they must follow?

Page 66, Section 8.4: I recommend that you start this section with the verification process and describe the requirements related to site visits and desktop reviews. That information is buried in the section and I think it needs to be laid out at the beginning.

Page 66, Section 8.4: “A field shall be prepared for desktop verification during every reporting period.” Does this mean that not every field will undergo desktop verification every reporting period? How is the risk to misreporting and intended errors addressed with this approach? Most other protocols require that all fields undergo a minimum of a desktop verification every year. What is your logic for a different process in this protocol?

Page 67, Section 8.4.1: “It is possible that a field in a large project or aggregated project never receives a site-visit during its entire crediting period.” Do you think this is wise? Shouldn’t every field be visited at least once during a crediting period? A crediting period is 30 years. Are you saying that over 30 years a field may not be visited at least once?

Page 68, Section 8.4.1: “Examples of proxy data that may satisfy a verifier in this regard include where the project developer has engaged an independent third party with agronomic expertise (such as local NRCS staff and/or local University extension service staff) to instead undertake a site visit, or to complete a signed statement attesting that the things a verifier considered highest risk and for which a site visit would be most useful, have been confirmed by that third-party.” I appreciate this approach and think it is a good solution for ensuring implementation of project activities, addressing risk, and being cost-conscious.

#### **Model Validation & Verification Guidance for SEP Projects**

“Measured datasets must be drawn from peer-reviewed and published experimental datasets with measurements of SOC stock change (and annual/seasonal measures of N<sub>2</sub>O and CH<sub>4</sub> change if applicable) using control plots to test the practice effect.”

I agree with this approach. I recommend that it be included in the protocol.

“Validating a practice effect can only be completed at the scale of an individual sample/field if there are measurements of SOC stock and annual/seasonal N<sub>2</sub>O and CH<sub>4</sub> flux change (if applicable) meeting the above criteria that in total include the same soil textural class or one that is within 30% of the same clay content, as well as the crop type and soil-climate zone relevant to that location.”

You removed the requirement of a minimum number of measurements. I agree that a minimum number of samples is arbitrary, but there should be some quality check on the data. The results of field studies on their impacts on GHG emissions are often inconsistent and sometimes contradictory from one location to another and across years at any given location. The most important questions to address prior to including a practice is whether a consensus has been reached from currently available studies showing a consistent directional trend in GHG fluxes from the given practice implementation in the given environmental conditions of the region in question, and whether that practice leads to a different negative environmental externality (such as an increase in nitrate leaching). The Reserve did this with their Nitrogen Management Project Protocol through a Science Advisory Committee which helped “the Reserve interpret and apply the best available science into the Nitrogen Management Project Protocol.”<sup>3</sup>

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<sup>3</sup> Climate Action Reserve. (2011). Nitrogen Management Project Protocol Development. <http://www.climateactionreserve.org/how/protocols/nitrogen-management/dev/#>

**Q&A**

Q: What happens if you add another 'additional practice' at a later point, would that require more validation?

A: So long as the practice effect is represented for a given practice category (previously referred to as Genre), then any practice within that category can be considered validated. So, depending on the validation status of the category, a new practice may or may not require additional validation.

I am not sure I follow the logic here. Does an additional practice require peer-reviewed literature supporting it?

Q: N<sub>2</sub>O and CH<sub>4</sub> emissions vary significantly throughout the year with significant emissions outside of the growing season. If you accept growing season measurements, will you be able to model annual N<sub>2</sub>O and CH<sub>4</sub> emissions?

A: We have removed the requirement for a certain number of measurements and will accept any temporal scale of measurement in the validation data. A daily-scale model, which many models are, can be tested to hit targets at a variety of temporal scales including growing-season or annual.

The point of my question is that there is not much data about emissions outside of the growing season. There is a higher degree of uncertainty in the model if you don't have emissions data for a quarter to half the year. We know the emissions in the off season can be significant and we should advocate for data to be measured outside the growing season. Similarly, we don't know the emissions of N<sub>2</sub>O from fertilizer when it leaves the field boundary. The protocol uses the IPCC emission factor for this data and that is the best available data we have at this time, but, again, we should advocate for more studies to be conducted to measure these emissions. This lack of data should not prevent the protocol from progressing, but they need to be recognized as challenges in the current science.

**Conclusion**

Significant work has gone into the development of the SEP by many parties. It is impressive. However, there are several important areas that need to be addressed before this protocol should be submitted to the Reserve's Board of Directors. Of particular importance are the four areas raised at the beginning of this letter:

1. The SEP should leverage USDA's resources for their quantification methodology, especially related to N<sub>2</sub>O emissions.
2. The impact of drought on soil carbon sequestration needs to be included in the quantification and buffer pool contributions.
3. The protocol should explicitly require for the use of peer reviewed research for any practice used to generate CRTs.
4. Developing a model that developers can use to create projects will increase the interest and uptake of this protocol.

I thank the Reserve for the opportunity to offer comments and I look forward to continued collaboration with the Reserve and Workgroup in the development and approval of the SEP. I would be happy to discuss any of these comments with the Reserve staff, Board Members, Workgroup members, and stakeholders.

Sincerely,

*Robert T. Parkhurst*