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Soil Enrichment Protocol v2.0 Update

Technical Task Force Meeting #3

November 7, 2024

Housekeeping

- Please keep yourselves muted unless / until you would like to speak
- Please use the raise your hand function when answering a question
- All other attendees/observers are in listen-only mode
- Observers are free to submit questions in the question box
 - All attendees will be able to see questions submitted to the Q&A section, as well as comment on questions / up-vote questions
- For workgroup members submitting comments and questions via chat: Please change your message settings to send comments to Everyone
- The slides and a recording of the presentation will be posted online
- **Workgroup Member Updates:**
 - Jay Weeks, Grassroots Carbon – replacing Sarah Coffman as GRC rep
 - Kevin Silverman, Kateri – alternate for Kevin Tu today
 - Charlie Brummitt, Indigo Ag – joining call to support discussion of Indigo proposals



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AGENDA

- **Application of SOC re-measurement (SEP Section 5) (30 min)**
 - Current “True-up” language and SOC re-measurement (pg. 29 – 30)
 - Proposed alternatives to current “true-up” language
- **Cumulative Accounting (Brief overview/introduction) (20 min)**
- **Section 6.5 – Soil Sampling and Testing Guidance (1 hr)**
 - Minimum Standards for Sampling Soil Organic Carbon (Table 6.2)
 - Minimum Standards for Laboratory Analysis (Table 6.3)
- **Next Steps (10 mins)**



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APPLICATION OF SOC RE-MEASUREMENT SECTION 5 – PG. 29 - 30

Current “true-up” language

Section 5, pg. 29 states:

- Soil organic carbon levels must be directly measured in relation to the initiation of the project, as well as at least every five years thereafter.
- Using this directly measured SOC input, projects must model their baseline SOC stock change (as well as, optionally, CH₄, and N₂O emissions) during each cultivation cycle of the crediting period
- The SOC component must be "trued-up" at least every 5 years using direct measurements. For projects using models to estimate project scenario SOC stocks, the subsequent direct SOC measurement would be used in the same manner as in the first year of the project, as the input to the model simulation for that year.
 - No equivalent “true-up” for baseline scenario – creates problems with differing modeling errors between project and baseline scenarios
 - Timing issue - Unlike initial soil sample which starts the model run, re-measurement sample may occur at any point during RP of the re-sample year. Would still need to model SOC until end of RP

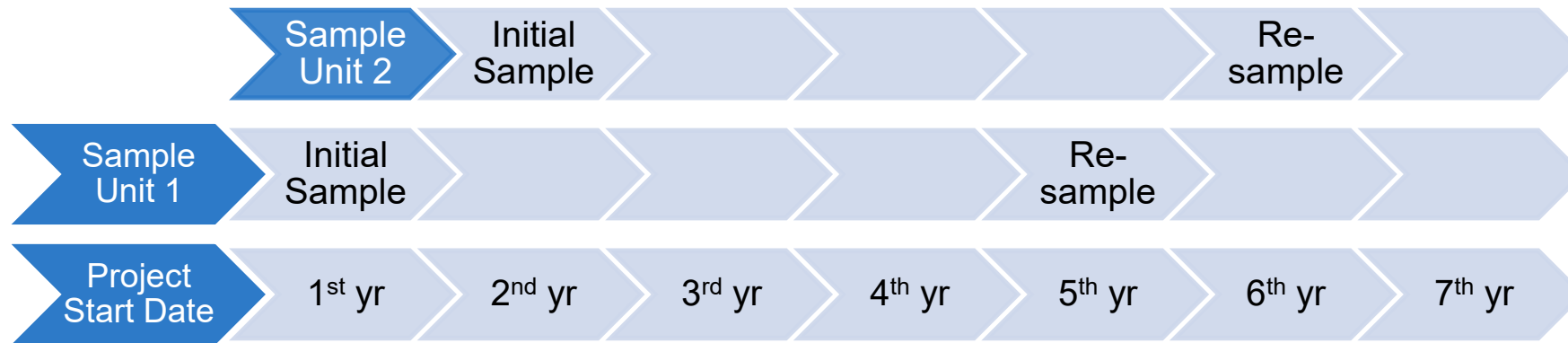
Current “true-up” language

Section 5, pg. 30 states:

- In all other intervening years where direct measurement of SOC is not employed, the SOC component can also optionally be quantified using a modeling approach.
 - Make clear modeling required for SOC, not optional
- In reporting periods where direct measurement is employed, if the direct measurement reveals SOC levels for a given field below the previously modeled project scenario SOC for that field, that field will contribute a negative stock change to the overall project quantification for that reporting period.
 - Confusing language – direct measurement not possible given dynamic baseline needed to calculate change in SOC stocks
- In this way, the measurement method will provide for a reconciliation or ‘true-up’ between the modeled and measured approaches. If the net SOC stock change across the entire project area for a reporting period is found to be negative, this would result in a reversal.
 - Implies SOC stock change is between initial baseline sampling and re-measurement – ignores dynamic baseline which is being used in net SOC stock change

Proposed alternative – Model Forecast Evaluation

- Propose that projects should use re-measurement data to conduct a check on the model's performance by evaluating SOC temporal flux as an indicator of the model's accuracy in overall emission reductions.
- The proposal would require that project developers evaluate their model's forecasts starting in year 7 since its project start date, and every five years thereafter.
 - Sampling units still need to be re-sampled every 5 years, but will not be factored into model evaluation until 7th year?
- Add requirement in the Model Requirements and Guidance document



Model Forecast Evaluation

- Either the residual in stocks ($\text{resid}_{\text{stock},i}$) or the residual in the temporal change in stocks ($\text{resid}_{\Delta,i}$) must be used as defined in Equation 6.1
- $\text{resid}_{\text{stock},i}$ must be used if possible, but $\text{resid}_{\Delta,i}$ may be used if the project developer directly models temporal changes and not the underlying stock or emissions.
- **Equation 6.1**

$$\text{resid}_{\text{stock},i} = P_{\text{stock},i} - O_{\text{stock},i}$$

$$\text{resid}_{\Delta,i} = P_{\Delta,i} - O_{\Delta,i}$$

where

$P_{\text{stock},i}$ = Predicted (modeled) SOC at a single point in time at location i

$O_{\text{stock},i}$ = Observed SOC at a single point in time at location i

$P_{\Delta,i}$ = Predicted (modeled) temporal change in SOC at location i

$O_{\Delta,i}$ = Observed temporal change in SOC at location i

Model Forecast Evaluation

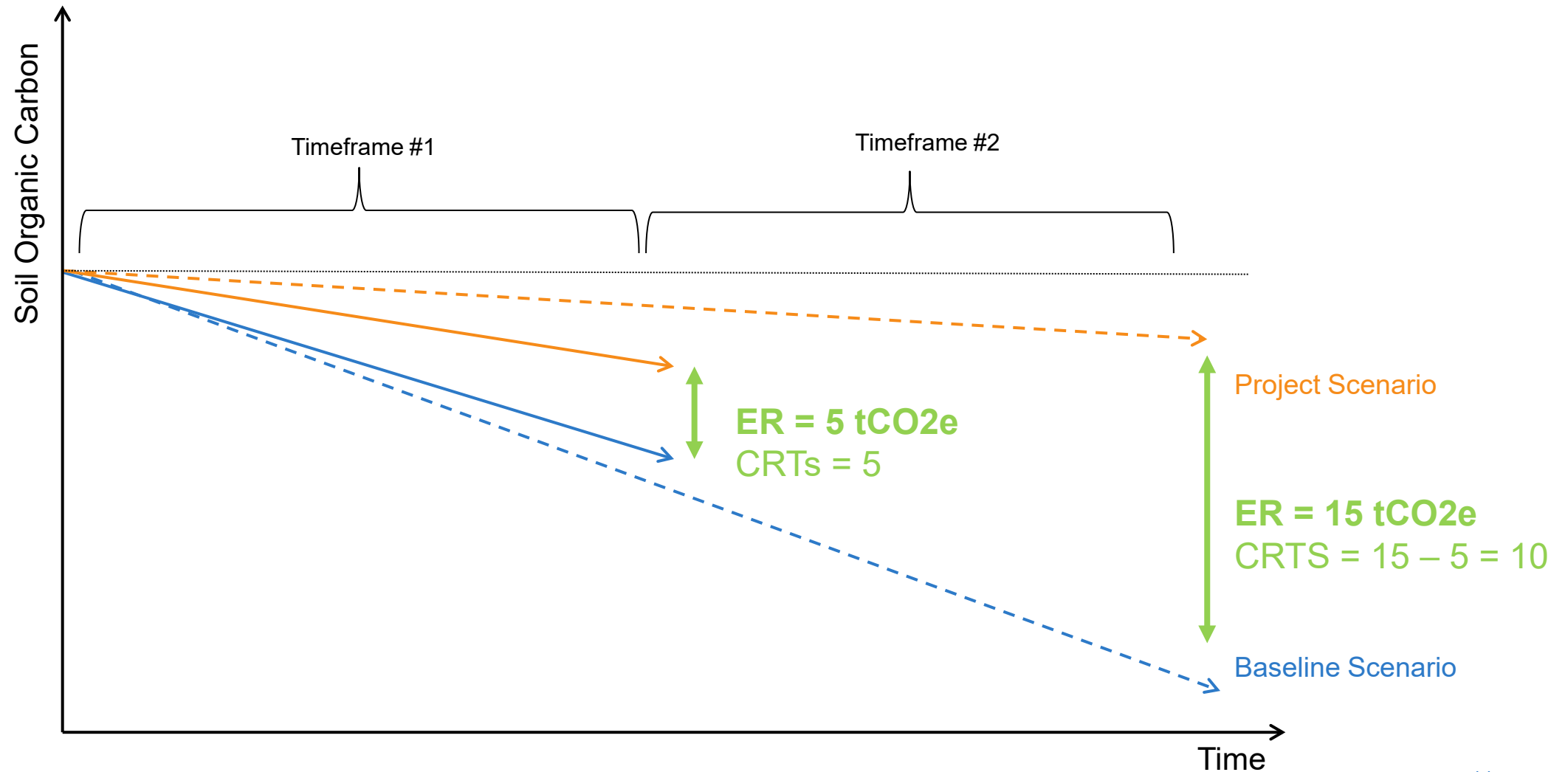
- Reporting of the results of this status check would be a combination of a histogram of the residuals obtained during calibration and when modeling the re-measurements, as well as a scatter plot of predictions versus observations.
- A statistical test should also accompany the assessment to determine whether the estimates of model uncertainty (used in monitoring reports) have been conservative given the distribution of the residuals.
 - Define conservative?
- If the results of this analysis suggest that modeling has been anti-conservative, then remedial actions must be taken to correct the model.
- **Questions/Clarifications:**
 - How will baseline forecasting be evaluated?
 - How to evaluate model predictions for N₂O and CH₄?
 - Require update to model validation after evaluation? Update N₂O and CH₄ with new literature data?



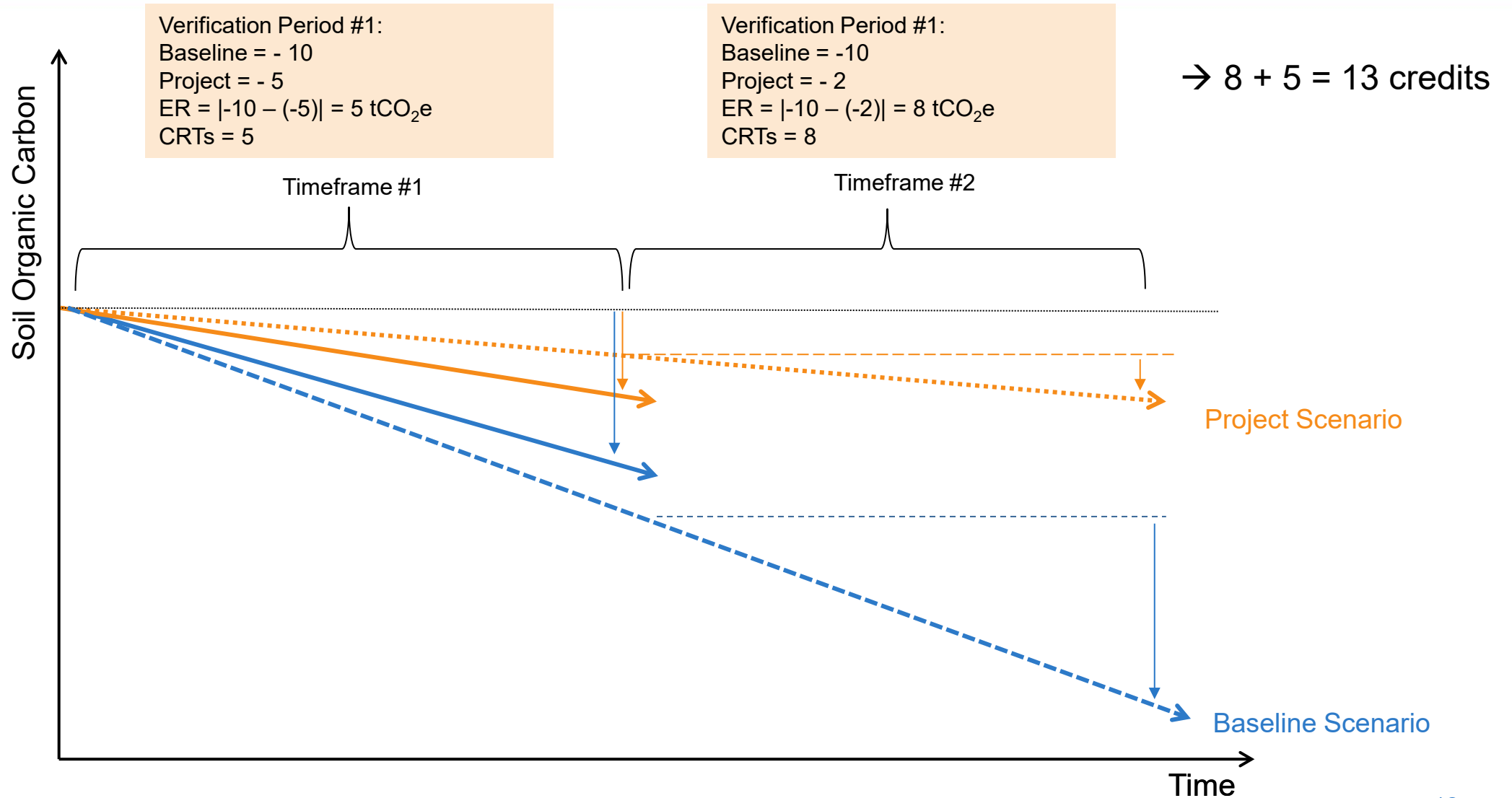
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CUMULATIVE ACCOUNTING

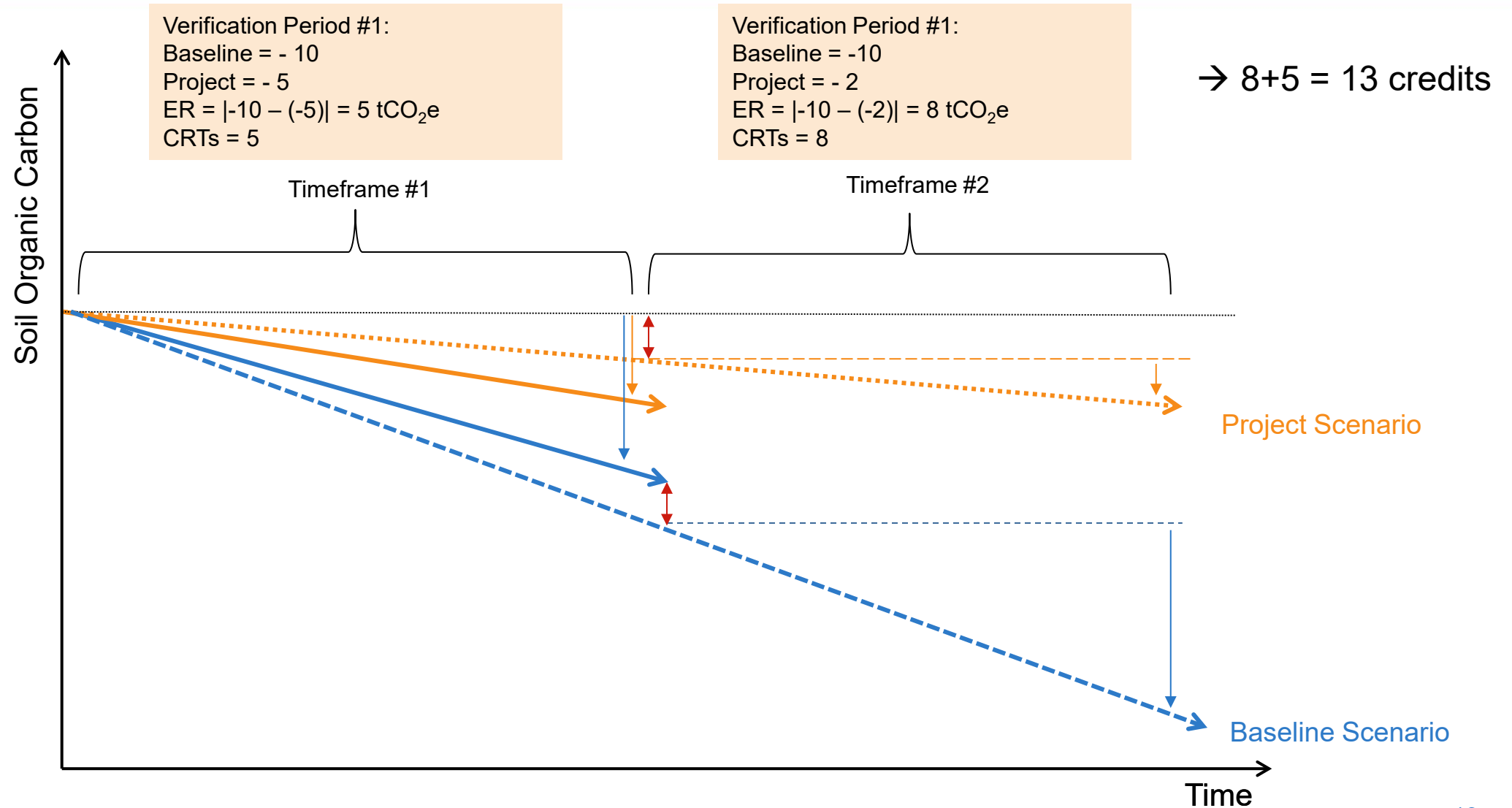
Overview of Cumulative Accounting



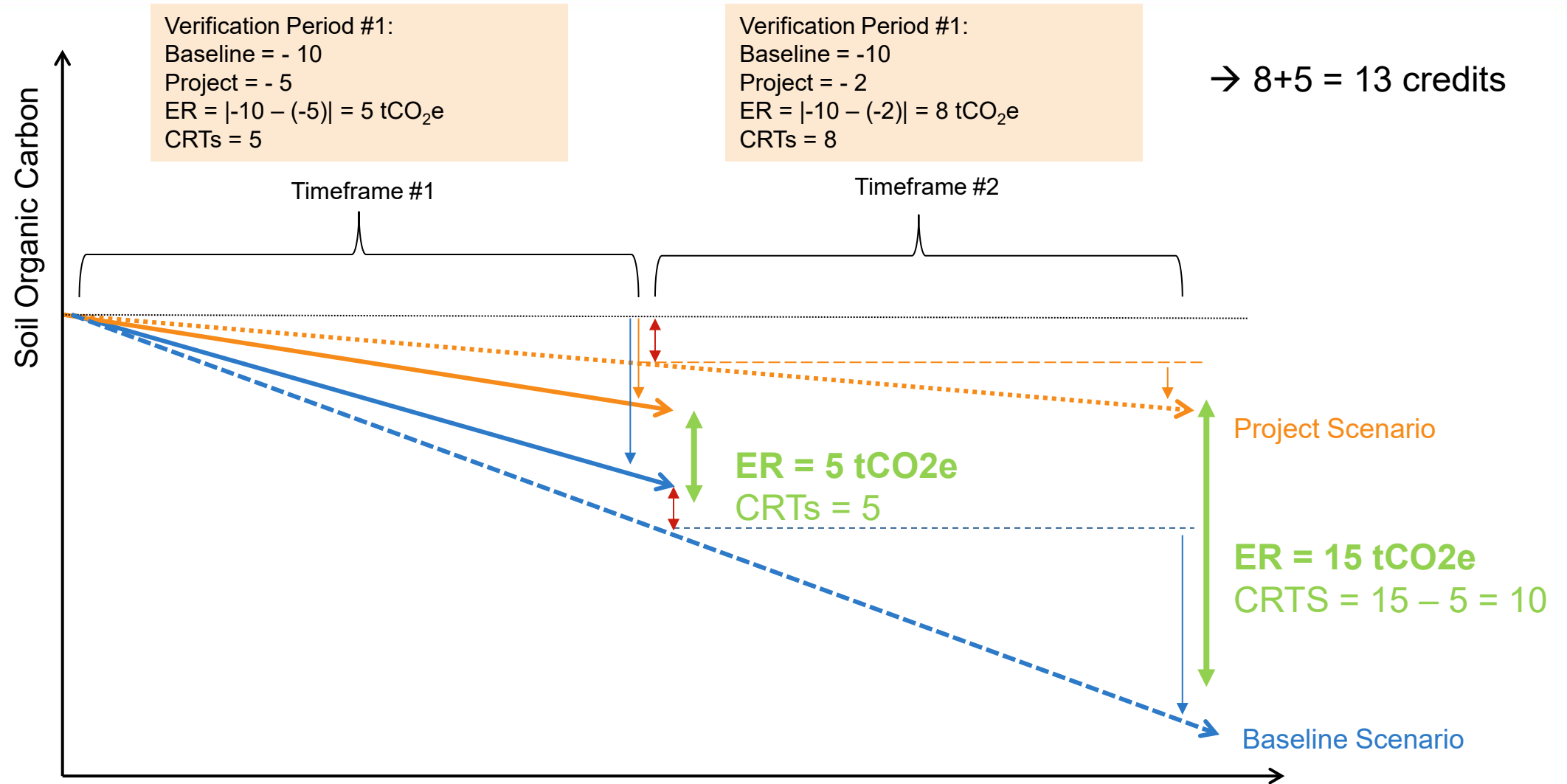
Current Approach: “Non-Cumulative” Accounting



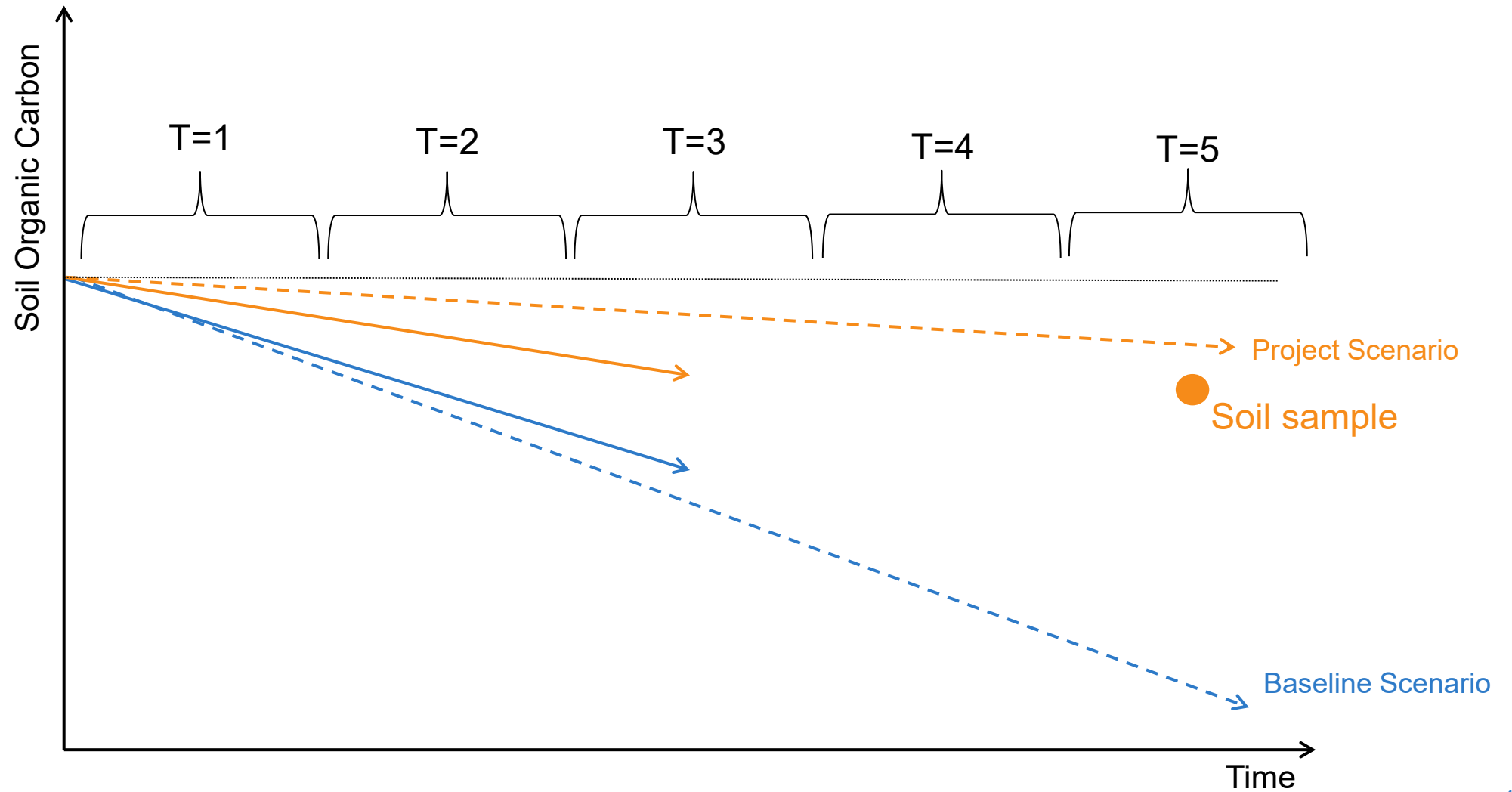
Current Approach: Issues/Concerns



Comparison



Example Scenario



Cumulative Accounting Questions

- Do you believe cumulative accounting would improve the protocol in general?
- Do you have any concerns with this accounting approach vs. current accounting?
- Do you believe it would help utilize improved models over time?
- Do you believe it would help utilize future soil samples? Measure/Re-Measure?
- Other comments or questions?



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SECTION 6.5 – SOIL SAMPLING AND TESTING GUIDANCE

Soil Sampling and Testing Guidance – Current Language

- Soil sampling required for measurement of SOC to establish values used for baseline and project modeling, and for ongoing updates to sampled SOC levels every 5 years.
- SOC measurement includes calculation of SOC based on bulk density and determination of SOC stocks based on either %C by mass, or use of the equivalent soil mass method.
- Project owners must provide documentation describing the soil sampling and laboratory analysis methods employed to estimate soil carbon stocks
- Protocol does not require specific soil sampling and laboratory analysis methods to be used but does require a set of minimum standards to be met.
 - Table 6.2: Standards for sampling SOC (Sample units, stratification, sample location, sample depth, sample handling)
 - Table 6.3: Standards for Laboratory Analysis of Soil Samples
- Statistical uncertainty associated with sampling must be quantified – incorporated into overall uncertainty deduction

General Soil Sampling and Testing Guidance

- Feedback that overall, this guidance and requirements are too vague
- Suggestion for providing guidance for sampling design similar to Model Cal/Val document
 - Proposed minimum disclosures in monitoring report regarding the number of fields included in project, # sampled, sample density, SOC distribution, etc.
- Currently, project owners must describe their sampling approach in the Monitoring Plan
 - For all directly sampled parameters, the project will clearly delineate spatially the sample population and specify sampling intensities, selection of sample units and locations of sample points within sample units
 - Soil sampling approach reviewed by verifiers
- Add additional guidelines for updating the monitoring report?

Table 6.2 - Stratification Guidelines

- The points for soil sampling must be selected randomly according to a sample design, following the guidance in this section and Appendix D (Quantifying Uncertainty).
- Each stratum must contain at least 3 sample points
- All projects must employ either pre- or post-stratification of primary sample units (and any sample stages above the stage based on sample points).
- The governing rules for stratification of primary sample units and stratification methodology must be described.
- The process for updating strata must be described.
- Stratum areas must be provided at verification

Stratification Guidelines cont.

- Stratification may be based on the following:
 - Adopted practice change(s)
 - Bulk density
 - Soil texture
 - Soil series
 - Precipitation (e.g., mean annual)
 - Temperature (e.g., mean annual)
 - Land Resource Region
 - Aridity index
 - Soil wetness index
 - Indicator variable for whether the land was flooded
 - Slope
 - Aspect
- **Should this list of variables be required, or only a suggestion?**
- **Concerns with keeping this list optional?**
 - **PD still must justify stratification approach during verification**

Missing samples guidance

- Stratum areas must be provided at verification with maps and tabular outputs.
- Sample units in the stage directly above sample point stage must be selected for sampling on a randomized basis during initial sampling, with the randomized list of all sample units retained for verification. **If a selected unit is unable to be sampled (e.g., either due to weather constraints or because post-planting sampling could negatively impact the crop), the Project Owner must justify why the unit was not sampled. They may also choose to randomly select another unit to sample in lieu of the unsampled unit to maintain their desired sample size.**
 - Proposal to add missing soil sample guidelines for when sampling plan is not followed
 - Risk of bias in estimates if missing soil samples are disproportionately from areas with lower rates of emission reductions
 - Require tabulating reasons for missing soil samples
 - Verifier assesses if missing samples cause concern for bias
 - Failures in modeling should also be reported

Table 6.2 - Sample location

- “Remeasurement of previously sampled points during subsequent reporting periods is allowed, though **remeasured sample points may comprise no more than 50% of the total number of sample plots**. Furthermore, either the selection of sample points to be remeasured or the selection of sample units in the stage directly above the sample point stage and containing the potential sample points for remeasurement must occur on a randomized basis.”
 - Rationale was originally to prevent gaming or increasing SOC in a small number of areas
 - Does not follow best practices for soil sampling point selection or data usage
 - Re-sampling same locations would improve data quality
 - Propose removing this limitation while also setting a minimum number of locations that must be resampled
 - While initial samples taken on new fields is chosen by PD, statistical design incorporated into uncertainty deduction
 - **Re-measured samples would not have this guardrail – how to set minimum number of locations during re-sampling?**

Table 6.2 - Sample location

- Spatial dependence of sample and sample timing
 - Flagged as an area that is missing in sampling guidance
 - What needs to be accounted for in sampling guidance vs. model cal/val requirements?

Table 6.2 – Sample Depth

- SOC measurement includes calculation of SOC based on bulk density and SOC stocks based on either %C by mass, **or use of the equivalent soil mass method.**
 - Given bulk density expected to change across project crediting period, how/when should ESM be required? How does this affect modeling?
 - Require bulk density be re-taken as well during 5 yr re-measurement?
 - How is modeling accounting for change in BD?
- Deep tillage exceptions
 - “Fields which continuously (i.e., more than once for the same crop) tilled to depths deeper than 20 cm in their historical baseline period, and then go on to employ no-till in their project scenario, will not be eligible to be credited for SOC gains.”
 - BUT “Fields historically employing deep tillage practices (i.e., tillage to depths deeper than 20 cm) may become eligible to be credited for SOC gains if/when they subsequently adopt any tillage practice other than no-till in subsequent reporting periods.”
 - Remove this exception to ensure 30 cm sampling is deeper than depth of practice change

Table 6.2 - Sample Depth cont.

- Feedback received on increasing sampling depth beyond 30 cm
 - Concern that one 30 cm sample may not be sufficient to capture soil C change dynamics throughout soil profile
 - Suggestions for expanding to include a second sample to 60 cm
 - 1 m samples also suggested – while currently encouraged in the protocol, not required
- Question of whether grazing projects or generally those with perennial crop types be required to sample to deeper depths
- Model limitations?
 - Unclear if models are currently validated to model SOC change at deeper depths?

Table 6.3 – Minimum Standards for Lab Analysis of Soil Samples

- Any lab used for testing must be part of North American Proficiency Testing Program (NAPTP)
- General Soil Sample Preparation
 - Soils must be dried within 48 hrs of arrival at lab or kept in refrigeration
 - Soil aggregates must be broken apart by manual or mechanical means (so long as such methods break soil clumps but do not pulverize rocks) and soils sieved to <2 mm. All soil carbon analysis should be performed on the fine (< 2 mm) fraction only.
 - **Is this sufficient? Recent paper (Even et al. 2024) shows high variability in data from cross-laboratory comparison**
 - **Need more specificity in sample preparation to standardize across samples?**
 - If bulk density methods are being used to convert soil carbon concentration to soil carbon stocks, coarse (> 2 mm fraction) content corrections to bulk density must be made.
 - **Concerns with difficulty of sampling for coarse fragments (CF) if large volume of samples is not taken**
 - **Need better guidance on reporting/measuring CF?**

Table 6.3 – Analysis Technique

- Soil carbon analysis must be performed using dry combustion techniques
- The Reserve will continue to work with stakeholders to develop guidance for practically controlling for accuracy, precision, and handling of outliers to enable the use of other testing methods, such as spectroscopy
 - Lab based MIR spectroscopy
 - Proximally-based in-situ NIR spectroscopy
 - Allowable applications for remotely sensed SOC predictions (“digital soil mapping”)?
 - Currently not allowed in any protocol
 - Other considerations for where this approach can be applied beyond replacing soil sampling?
 - Add technology specific requirements or general guidance for any emerging technology?
 - Include requirements for increased sample area if not using dry combustion?

Potential Guidelines for emerging technologies

- Used in peer-reviewed articles
- Project must provide evidence of sufficient accuracy through adequate calibration with data from lab methods (dry combustion)
- Site characteristics of calibration must match project site conditions – range of SOC stocks, soil types, land use
- Specifics of technology must be accessible to VB

Table 6.3 – Analysis Technique

- For dry combustion – inorganic carbonates must be accounted for
 - Either applying an acid pre-treatment prior to dry combustion or quantification of carbonates using a pressure calcimeter or IR spectroscopy
 - Concern that these two methods may yield different results – how to handle discrepancies? Ensure same method used across project?



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NEXT STEPS

Future Topics for Discussion

- **Starting redline of Model Validation/Calibration Guidance Document and Protocol for distribution to the working group**

Next Steps

- Email us with any feedback on topics discussed today
- Reach out any time to discuss protocol topics or process
- All meeting materials related to the SEP update will be posted here:
<https://www.climateactionreserve.org/how/protocols/ncs/soil-enrichment/dev/>
- ***Next Workgroup Meeting TBD***

Key contacts

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THANK YOU!