United States Department of Agriculture

Conservation Evaluation and Monitoring Activity

Soil Health Testing
CEMA 216

DEFINITION

Quantitative testing for biological, chemical, and physical characteristics of soil and constraints using approved laboratory methods.

APPLICABLE LAND USES

All Land Uses.

REQUIREMENTS

Qualified Individual Requirements

The Natural Resources Conservation Service (NRCS) strongly encourages Conservation Evaluation and Monitoring Activity (CEMA) participants to know the Qualified Individual (QI) requirements to ensure the person they employ to provide the CEMA is fully qualified to meet the objectives of the activity.

A QI for Soil Health Testing CEMA 216 meets one of the following:

1) Certified Crop Advisor (CCA) or Certified Professional Agronomist (CPAg) through the American Society of Agronomy or a Certified Professional Soil Scientist (CPSS) or Associate Professional Soil Scientist (APSS) through the Soil Science Society of America.

2) Technical Service Providers (TSP) certified for Soil Health Management Plan Conservation Practice Activity (116) or Soil Health Management Design and Implementation Activity (162).

3) An associate degree or higher in an agricultural or soil science field with at least 2 years of experience collecting soil for laboratory analysis.

4) Individuals working under the guidance or management of a QI are allowed to collect soil samples for this CEMA.

General Requirements

1) This CEMA includes the performance of work and documentation of the tasks, results, interpretations, and other activities described herein by a QI.

2) Prior to initiation of the CEMA, the QI must arrange a pre-work conference to ensure all parties understand the participant's objectives, required deliverables, and characteristics of the CEMA tasks.

   a) The parties in the pre-work conference must include the participant, the QI, and the NRCS field office staff. The parties should agree whether they will join in-person or join via phone, web-meeting, etc.

   b) It is recommended that the Technical Service Provider (TSP) (if one is needed to support

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the results of this CEMA) is invited to the pre-work conference for the implementation of a Conservation Planning Activity (CPA) or Design and Implementation Activity (DIA).

3) A QI may use any reference information, resource concerns, conservation practice standards and related documents served in the NRCS Field Office Technical Guide (FOTG) for the state where this CEMA is performed. The FOTG home page hyperlink is: https://efotg.sc.egov.usda.gov/#/

TECHNICAL REQUIREMENTS

This CEMA includes details to collect and analyze soil based on soil health resource concerns and planning objective(s). Soil samples are to be collected in the Soil Health Management Unit (SHMU) and submitted to commercial laboratories for analysis using standardized methods.

All Soil Testing

1) Record the purpose and strategy for testing the soil. Design the soil sampling strategy based on goals, available tools, and other applicable guidance. Analyze the soil type, topography, and management information to determine appropriate sampling locations within a SHMU.

2) Participants must choose among the following combinations for indicator analysis:

a) Basic Soil Health Testing.

b) Minimal Suite of Soil Health Indicators.

c) Single Indicator Testing.

3) Use the following sampling strategies, or combination of strategies, when applicable:

a) Random – Soil in management unit is homogeneous and there are few problem areas. Sampling locations are chosen by assigning random numbers to areas on a grid overlay.

b) Stratified – Soil in management unit is heterogenous and contains different soil types across different landscape positions. Sampling locations are chosen randomly within delineated subareas (or strata) in proportion to the size of the subarea in relation to the management unit.

c) Composite – Soil is subsampled from many locations in a larger management unit and combined into one homogenous sample.

d) Problem – Distinct areas with uneven crop performance are strategically sampled.

4) Ensure all equipment is relatively clean and free from residue prior to collection. Remove vegetation or debris from the soil surface.

5) Collect soil samples during the current crop year and at the same time of year for subsequent samples. Sample when soil moisture and temperature are not extreme and there have not been any recent physical disturbances, additions of soil amendments, or other chemical inputs.

6) Avoid collecting or combining soil samples under the following conditions, unless a sampling strategy is used to specifically address the variability (e.g., stratified sampling):

a) Wheel tracks or drive lanes, field borders, depressions, or other odd areas within the field.

b) Areas with historically lower or higher productivity.

c) Different landscape positions.

d) Fields with different crops or rotations, or the same crops with a different management.

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e) Row versus inter-row areas.

f) Eroded versus non-eroded areas.

g) Saturated soil.

7) When using this activity to monitor practice effects over multiple years, it is recommended to remain consistent in the following ways: use the same georeferenced locations, employ the same sampling strategy, collect soil under similar soil conditions, collect soil at the same time of year, utilize the same lab tests and methods, and utilize the same laboratory.

8) Follow all USDA-APHIS regulations for prohibited, regulated, or quarantined soils.

9) Ensure laboratories maintain current certification from one of the following:

a) The Performance Assessment Program (PAP) from The North American Proficiency Testing Program (NAPT) under the auspices of the Soil Science Society of America, or

b) The American National Standards Institute (ANSI) National Accreditation Board (ANAB), or

c) The International Organization for Standardization (ISO/IEC 17043:2010) for ISO 10694:1995, or

d) State-approved certification program that considers laboratory performance and proficiency to assure accuracy of soil test results.

Soil Health Sample Collection

1) Collect soil in the same locations where resource concern assessments for the appropriate land use were already completed. Within the SHMU, collect soil from at least 3 representative locations (main locations). At each of the 3 main locations, collect soil from the main location plus 4 additional subsamples about 20 to 50 feet from the main location (5 subsamples per location). Combine all 15 subsamples to create 1 composite sample. Gently break up any large clods, and remove stones, roots, or debris from the soil. Gently and thoroughly mix the samples.

2) When practical, use a tile spade, sharpshooter, or straight shovel to collect soil. Dig a hole 8 inches deep and remove a 2-inch thick vertical, rectangular slice of soil 6 to 8 inches in depth. Sampling a soil slice in this way preserves the structure and aggregates better than sampling with a probe. If it is impractical to sample a slice of soil, then a soil probe that is 1-inch or more in diameter may be used.

3) Prior to going to the field, contact the soil testing laboratory to obtain recommendations/ protocol (soil temperature, soil moisture content, storage, shipping times, etc.) for the indicator(s) being analyzed. Store soil for soil health testing in a cooler or refrigerator if samples are not immediately sent to the laboratory.

Basic Soil Health Testing

The basic soil health test includes all six of the following indicators by the methods described:

1) Soil organic carbon content measured by dry combustion.

2) Wet macro-aggregate stability.

3) Permanganate-oxidizable carbon.

4) Soil texture.

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5) pH (1:1 Water).

6) pH (0.01M CaCl$_2$).

Minimal Suite of Soil Health Indicators

The recommended suite of soil health indicators by the methods described:

1) Soil organic carbon concentration measured by dry combustion.

2) Carbon mineralization potential measured by 24-hr CO$_2$ burst.

3) Wet macro-aggregate stability.

4) Soil texture which allows for the calculation of available water holding capacity.

Single Indicator Testing

The single indicator test is for any one (1) analysis determined by the in-field soil health assessment.

1) Individually, the indicators listed under Basic Soil Health Testing that were identified during conservation planning.

2) Individually, the indicators listed under The Suite of Soil Health Indicators.

3) Respiration using 1, 2, 3 or 4-day incubation.

4) Bioavailable nitrogen measured by ACE Protein method.

5) Microbial diversity using phospholipid fatty acid (PLFA).

6) Enzyme activity of β-glucosidase, N-acetyl-β-D-glucosaminidase (NAG), arylsulfatase, protease, or acid or alkaline phosphatase.

DEFINITIONS

1) *P*ermanganate-oxidizable C or POXC, is a soil health indicator that measures the fraction of total soil carbon pool that has been shown to be sensitive to management.

2) *Soil health* is the continued capacity for soil to function as a vital living ecosystem to support plants, animals, and humans.

3) *Soil Health Management System* (SHMS) is a collection of NRCS conservation practices that focuses on maintaining or enhancing soil health by addressing soil health management principles: minimize disturbance, maximize soil cover, maximize biodiversity, and maximize the presence of living roots.

4) *Soil Health Management Unit* (SHMU) is one or more planning land units with similar soil type, land use, and management that can vary in size or acreage depending on soil texture, topography, and cropping system. SHMU is like a conservation management unit but designed to assess soil health status and potential limitations on soil health indicators.

5) *Soil Organic Carbon* is a soil health indicator that indicates the carbon storage and soil organic matter cycling and is analyzed by high-temperature and dry combustion of soil.

6) *Wet aggregate stability* is a method of testing how well soil aggregates resist breaking apart under water pressure, which indicates the size and quantity of water-stable aggregates.

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DELIVERABLES

The QI must provide documentation showing that all tasks indicated in the **General Requirements** and **Technical Requirements** sections are complete, <u>and</u> the following sections:

Cover Page

Cover page reporting the technical services provided by the QI. Cover page(s) must include the following:

1) CEMA name and number.

2) Participant information: Name, farm bill program name, contract number (QI obtains contract number from participant), land identification (e.g., state, county, farm, and tract number).

3) QI name, address, phone number, and email.

4) A statement by the QI explaining how they currently meet the Qualified Individual Requirements for this CEMA. Attaching or enclosing a copy of documentation on how the QI requirements are met is encouraged. Examples include:

   - Certification Name and Number,
   - License Name and Number,
   - Agricultural Retailer Business Name, or
   - Other brief written statement indicating how the requirements of a QI for this CEMA are met.

5) A statement by the QI that services provided meet NRCS requirements, such as:

   I certify the work completed and delivered for this CEMA:

   - *Complies with all applicable Federal, State, Tribal, and local laws and regulations.*
   - *Meets the general requirements, technical requirements, and deliverables for this CEMA.*
   - *Is consistent with and meets the conservation objectives for which the program contract was entered into by the participant.*
   - *Addresses the participant's conservation objectives for this CEMA.*

   QI Signature: _____ Date: _____

6) A Participant's acceptance statement, such as:

   I accept the completed CEMA deliverables as thorough and satisfying my objectives.

   Participant Signature: _____ Date: _____

7) A space for an NRCS reviewer to certify the agency's acceptance of the completed CEMA such as:

   NRCS administrative review completion by:

   Signature: _____ Title: _____ Date: _____

Notes and Correspondence

1) Document each site visit, its participants, the activity completed in the field, and results of each

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site visit.

2) Copies of correspondence between the QI and the participant relating to decision-making and completion of this CEMA.

3) Copies of observations, data, or test results prepared during completion of this CEMA.

Maps

1) Maps to include, but not limited to:

   a) General location map to locate the sampling area, such as geographic coordinates, public land survey coordinates, roads to access the site, etc.

   b) Soil Sampling map showing the SHMUs polygon data and GPS point data (WGS84 latitude, longitude) for sampling locations.

   c) Other maps as needed, with appropriate interpretations.

2) All maps developed for the CEMA will include:

   a) Map title.

   b) Client's name (individual or business).

   c) Assisted By [QI name].

   d) Date prepared.

   e) Map scale.

   f) North arrow.

   g) Appropriate map unit symbols and a map symbol legend on the map or as an attachment.

Testing Results

At a minimum, prepare a report (including the following) is required:

1) Report describing the sampling strategy used for the test type.

2) Sample identification code(s).

3) Laboratory test results.

4) Schedule of additional testing or monitoring at recommended frequency, as determined by the conservation plan.

Deliver Completed Work

1) The QI must prepare and provide the participant two sets of all the items listed in the **General Requirements**, the **Technical Requirements,** and the **Deliverables** sections of this document.

2) One set is for the participant to keep.

3) The other set is for the local NRCS Office.

4) The QI may transmit a set of the completed work to the local NRCS Office, if their participant has authorized it.

It is recommended to provide the NRCS field office an opportunity to review the CEMA deliverables, prior to asking for their acceptance.

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Post Testing Analysis

After laboratory results are supplied, participants will submit raw data and sampling location(s) coordinates to SoilHealthTest@usda.gov.

Raw data will be used to improve and strengthen the Soil Health Assessment Protocol and Evaluation process, procedures, and results.

Appropriate waivers to release participant information may be used to grant permission for the QI, or NRCS field office to submit the test results.

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