SCMN Soil Survey Office Sample Processing and Shipping Instructions

Summary

This document is part of a set of documents sharing the Natural Resources Conservation Service (NRCS) protocols for the Soil Carbon Monitoring Network (SCMN). Protocols will be updated as needed.

This document will lay out the initial intake and processing procedures performed at soil survey offices and the shipping instructions for forwarding processed samples to the National Caron Assessment Laboratory (CAL) in Lincoln, Nebraska. The CAL will be primarily responsible for the further laboratory analysis of samples initially processed at the soil survey offices. The topics include a brief summary of the sample processing and shipping procedures; safety and personal protective equipment (PPE); materials needed; detailed procedures for data entry, drying and sieving, bulk density measurement, sample shipping preparation and packaging, required documentation, and coordination requirements.

Soil Sample Data Entry

This section outlines the steps performed by the soil survey offices to fill in the datasheet used for reporting bulk density. The purpose of this step is to ensure that the appropriate information is collected and recorded in a consistent manner. To this end, all soil survey offices will be provided with a preformatted Excel sheet to fill in and export to the CAL with samples. This Excel file, called “Soil Survey Office Bulk Density.xls” (and referred to from here on as the Excel file) will be made available to the soil survey offices by the SCMN staff. Soil survey offices will be responsible for the following steps.

1. Receive soil samples and sample list from SCMN field sampling team.
2. Verify that all soil samples are accounted for and organize and lay out samples by site, cluster, and layer.
3. Save a new copy of the Excel file as “Soil Survey Office Bulk Density_site ID.xls.”
4. Enter the applicable information under the “General Info” tab in the Excel file.
5. If using the SCMN data application, import data for all sites and samples into the Excel file.
6. If not using the SCMN data application, manually input the data.
    a. Complete the following fields under the “App Sample Info” tab of the Excel file.
        1) Site ID
        2) Laboratory ID
        3) Regional POC
        4) Technical Contact
        5) Field Lab Name
        6) Shipping POC
    b. Complete the following fields under the “Manual Sample Bag Entry” section of the “Bulk Density Worksheet” tab.
        1) Sample ID
        a) NRI cores use composited samples; one sample ID includes the total volume and weight of each core

b) Center pedon cores from clusters will be one 10 cm section (unless otherwise noted) cut from each genetic horizon
c) Satellite samples from clusters will be composites of the same 10 cm depth increments from the probe samples
2) Vol Method (hydraulic probe, slide hammer, frame, compliant cavity, or none (for composited samples with no volume information))
3) Core Diameter (cm)
4) Core Length (cm) (Note: for NRI cores, where multiple cores are composited into one sample, this is the total length of all cores)
5) Calc Core Volume (automatically calculated - πr2 * h)
a) Best volume is used for further calculations
b) The auto-populated value from app is considered best, but it should be checked for accuracy and corrected as needed

Note: Bulk density is not measured on composited cluster satellite samples. These samples should be air dried, sieved to less than 2 mm, and entered in the Excel file for tracking and shipping. Even though samples are tracked and reported, all volumetric data entry fields are black and should remain blank.

Sample Processing and Bulk Density Procedure

A sample with known volume is collected and delivered for bulk density analysis and processing. Record the moist sample weight. Calculate the bulk density for each depth increment by dividing the oven-dry (105°C) weight of the less than 2-mm sieved soil by the volume of the core minus the volume of the coarse fragment.

Method Source

This method is adapted from the "Soil Survey Manual" (Soil Science Division Staff, 2017).

Safety

- Wear gloves when handling soils.
- Wear an appropriate dust mask while handling and processing samples (i.e., N-95 masks, respirators, etc.).
- Use shop vacuum to remove excess dust as needed.
- Be careful when using oven. Avoid touching hot surfaces and materials.
- Follow standard field and laboratory safety precautions.

Materials

- Paper table cover (brown working paper)
- Sample bags with white writing block
- Permanent markers

Equipment

- Electronic balance, ±0.01g sensitivity

- Weighing pan, aluminum
- Oven, 110 ±5 °C
- Graduated cylinder 1,000 ml
- No. 10 (2 mm) sieve
- Additional empty sample bag for taring balance
- Additional empty sample bags to prepare samples for shipping (two sizes: quart and gallon)

Field Moisture Procedure

1. Weigh an equivalent empty sample bag and record in the "Empty Bag Weight" column of the Excel file.
2. Weigh each sample in its bag and record the weight in the "Field Moist Total Bag Weight" column of the Excel file.
   a. If the sample bag weight exceeds scale capacity, split the sample and weigh each portion separately.
   b. For NRI cores, this is the total weight of the composited sample.
3. Label and weigh pans used for oven drying subsamples; record in "Subsample Pan Label" and "Subsample Pan Weight" columns respectively.
4. Take a 10.0 g subsample from the moist sample to be oven dried. Record this (to 0.01 g) in the "Pan + Subsample Moist Weight" column of the Excel file (the sample pan is NOT tared out).
5. Dry the subsamples in an oven at 105°C or higher for 12 hours.
6. Once the oven drying process has finished and samples are cool enough to handle, record the weight of the dried subsample (to 0.01 g) in the "Pan + Subsample Oven Dry Weight" column of the Excel file to calculate the percent moisture.
   a. Samples should not be allowed to remain at room temperature longer than 10 minutes before being weighed.
   b. Redry samples that remain at room temperature for longer than 10 minutes before weighing.

Air Drying and Sieving Procedure

1. Fold the tops of the remaining sample bags down to allow the rest of the sample to air dry. This should take 3 to 4 days for most soils, but more time may be required for high clay soils. Note: A dehumidifier can be used to assist with the drying process, if available.
2. Once samples are air dried, break up any remaining aggregates with hands, mallets, and rolling pins, if possible. If this is not possible, contact your SCMN regional coordinator for further instructions.
3. Press whole soil through a less than 2-mm (No. 10) sieve with a large rubber stopper or by hand.
4. Retain the fraction larger than 2 mm as coarse fragment and set aside (separate from sieved sample) to dry.
5. Pour the sieved material back into its bag.
6. Tare the scale with an empty pan or plate.
7. Place the dry coarse fragment component on the pan or plate and record the weight of the air-dry coarse fragment in the "Coarse Fragment Weight" column.

8. Partially fill a graduated cylinder with water and record volume in "Initial Volume -water (ml)." Be careful to leave enough space in the cylinder for all the coarse fragments.
9. Place the coarse fragments in a graduated cylinder, being careful not to spill the water in the cylinder.
10. Record the volume of water and coarse fragments together in "Final Volume - Water + Coarse Fragments (ml)."
11. The difference in volume before and after is calculated as "coarse fragment volume" in the appropriate column of the Excel file. Note: ml is the equivalent of cm^3
12. Calculate bulk density using the in-house data sheet.
13. Copy and paste final bulk density values (as values only) into the export datasheet provided by the SCMN. Export values to the database following the instructions provided in the export datasheet.
14. Dispose of any unused samples in the proper manner for each location.

Bulk Density Calculations

SWC = (SFW – SDW) / SDW

Where:

SWC = Soil water content

SFW = Weight of moist soil subsample

SDW = Weight of the oven-dry sample

ODW = (MBW – EBW) / (1 + SWC)

Where:

ODW = Oven-dried weight of the < 2 mm fraction

MBW = Moist bag weight

EBW = Weight of the empty sample bag

SWC = Soil water content (calculated above)

Db = ODW/[WCV – (CFW/CFD)]

Where:

Db = Bulk density of < 2-mm fraction at sampled field water state (g cm-3)

ODW = Oven-dried weight of the < 2 mm fraction (from equation above)

WCV = Whole core volume (collected from the field collection method)

CFW = Weight of coarse fragments

CFD = Density of coarse fragments (coarse fragment weight / coarse fragment volume)

Shipping and Submission

Please follow the instructions below exactly as they are written when shipping soil samples to the Carbon Assessment Laboratory (CAL). These procedures are required by APHIS or NDA. If you have questions about the instructions, contact the current permit holder, Tiffany Carter (tiffany.carter@usda.gov).

With the exception of packaging tape and additional packing material such as newspaper or packing paper, the regional POC will furnish all required packaging supplies. Packing peanuts are not allowed. To request packaging supplies, contact the regional POC or Tiffany Poydras (tiffany.poydras@usda.gov), the CAL IRA shipping coordinator.

The CAL will arrange all soil sample shipments. Please have the following information available when coordinating sample shipments:

- Field laboratory shipping lead
- Total number of samples to be shipped
- Shipping date
- Sample data Excel sheet

You must always have written approval before shipping samples to the CAL. Do not ship soil samples to the CAL without written authorization.

Definitions

- Nonregulated soil sample: A soil sample collected from an area that is not under quarantine by either the Nebraska Department of Agriculture (NDA) or the USDA, Animal and Plant Health Inspection Service (APHIS).
- Regulated soil sample: A soil sample that is collected from an area that is currently under quarantine by the NDA, APHIS, or both. The current APHIS map of "Federal Domestic Soil Quarantines" is shown in figure 1 below.

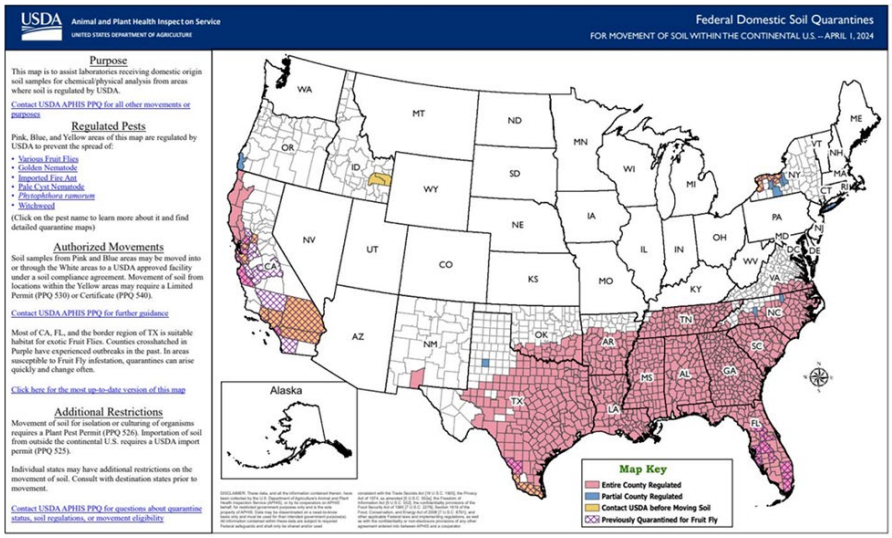

Figure 1.—Map of regulated counties.

National Soil Survey Center (NSSC) Shipping Policy

You must follow the NSSC's policy for labeling, packaging, and shipping soil samples to the Carbon Assessment Laboratory (CAL) at the NSSC.

APHIS Shipping Protocols When Shipping to CAL

1. ALL soil sample shipments MUST be arranged and coordinated with the CAL through the regional point of contact (POC). Samples should never be shipped without written authorization from the CAL.
2. Do not package or ship soil samples from areas regulated by APHIS prior to contacting the CAL. Additional authorization is needed to ship samples to the CAL from regulated areas. These areas include, but are not limited to, samples from:
   a. A foreign country
   b. Contiguous United States (CONUS) counties identified by APHIS as requiring prior authorization for soil movement
   c. U.S. territories or non-contiguous states (e.g., Puerto Rico, Guam, Hawaii)
3. The most current list of county quarantines and areas requiring prior authorization from APHIS can be found on the APHIS website. Please note that the list is updated frequently.
4. Contact Tiffany Carter (tiffany.carter@usda.gov) or her designee via email prior to packaging samples for shipment. Once a shipping request is received, the CAL will request project description information and will send sample packaging instructions.
5. Provide project information and sample list to CAL.
6. Package samples as described in the CAL sample packaging instructions.
7. Prior to shipment, confirm that carrier and shipment arrangements have been made with the CAL. You must receive written authorization (via email) from the CAL APHIS permit holder prior to shipping. The current permit holder is Tiffany Carter (tiffany.carter@usda.gov). Tiffany Poydras (tiffany.poydras@usda.gov) is the CAL IRA shipping coordinator.

Required Sample Submission Documentation for Shipments to CAL

1. All soil sample shipments to the CAL must include hard copies of the sample data Excel sheet. Prior to shipment, these files must also be emailed to Tiffany Carter (tiffany.carter@usda.gov) and Tiffany Poydras (tiffany.carter@usda.gov) at the CAL.
2. You must sign a confirmation email indicating that you have read and understand the shipping procedures PRIOR TO shipping your samples. This signed document must be provided via email, and a hard copy must be sent to the CAL with the shipment.
3. A hard copy of the CAL's soil permits must also be included as a hard copy with the shipment.

Labeling, Packaging, and Shipping Instructions

1. The primary container for each sample must be the plastic sample bag furnished by the regional POC. All sample bags must be labelled externally with a permanent marker and should include a written sample tag inside the sample bag.
2. Fill out the sample tag.
3. Place 250 to 500 g of soil and the written sample tag inside the sample bag.

4. Ensure that each sample bag is completely sealed.
5. Place all samples from a single site into a secondary bag. Label the secondary bag with all information up to the site code (i.e. 24S-SE01-LA033-002). The secondary bag should only contain samples from the same site with the same site code.
6. The secondary bag should contain no more than 40 samples. Do not overfill the secondary bag; the CAL will provide additional shipping material as needed.
7. Seal the secondary plastic bag by double folding and stapling. Fold the top one inch of the sample bag toward the label on the bag. Fold the top ½ inch of the 1st fold again toward the label on the bag. Using a heavy-duty stapler (not a desk stapler), staple the bag across the two folds.
8. Place a single, secondary plastic bag into the box liner (the largest plastic bag) and seal it by double folding and stapling, as described above. Note: Multiple secondary bags that are not filled can be placed into a single bag liner and box together as long as the combined number of samples does not exceed 40 samples total.
9. Place hard copies of the sample data Excel sheet, signed packing instructions, and laboratory permit documentation inside the box liner with the secondary sample bag, and seal it by double folding and stapling, as described above.
10. Place a single box liner into the cardboard box furnished by the CAL. Only one box liner should fit inside the box.
11. Add packing material, such as newspaper or crumpled paper, to completely fill voids and minimize shifting. Packing peanuts are not allowed.
12. Be sure to use only high-quality packing tape and securely close the box.
13. Once the shipment is packaged, please contact the regional POC. They will work with you and CAL to document the weight of each box for shipment, prepare shipping labels, and confirm carrier pick up. Do not ship sample boxes to the CAL until you have received written confirmation.