Purpose of this Document

Each study conducted by the Washington State Department of Agriculture’s (WSDA) Natural Resources Assessment Section (NRAS) must have approved Standard Operating Procedures (SOP). The SOP documents practices related to site selection, soil sampling, and other aspects of the State of the Soils Assessment.

Publication Information

This SOP was approved to begin work in March of 2022.

This SOP is available on WSDA’s Soil Health webpage (https://agr.wa.gov/departments/land-and-water/natural-resources/soil-health/funding-opportunities) and is also available upon request from the authors.

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COVER PHOTO: Putting soil sample into bag. PHOTO BY WSDA.

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Standard Operating Procedure

Soil Health Monitoring in Washington State

Prepared by: Jadey Ryan, Leslie Michel, and Dani Gelardi
January 2022

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1 General Information

1.1 Foreword

This Standard Operating Procedure (SOP) is the internal policy of the Natural Resources Assessment Section (NRAS) and the Washington State Department of Agriculture (WSDA). Personnel shall make no significant deviations from this policy without prior approval from the Natural Resources Assessment Section Manager.

1.2 Purpose

The purpose of this SOP is to specify the procedures for a typical site visit in which soil sampling is conducted to measure physical, chemical, and biological soil health indicators. Procedures include equipment preparation prior to sampling, best practices for filling out field forms, the selection of sampling locations, sampling protocols, sample handling and storage, and submitting samples to the lab. This SOP serves to ensure data quality by creating audit trails and enabling verification that data are present, complete, and accurate. Additionally, this SOP will be used to maintain consistent sample collection procedures throughout the state for WSDA employees and partners.

1.3 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil samples in the field. On the occasion that field personnel determine any of the procedures described in this section are inappropriate, inadequate, or impractical, and that another procedure must be used in its place, the variant procedure will be documented on the field form, along with a description of the circumstances requiring its use.

1.4 Responsibility

This document must be read and followed by all WSDA personnel and affiliated soil sampling practitioners who will be soil sampling. This SOP is intended to guide the work of practitioners (WSDA staff, contractors, or partners) who have already completed the required education, training, and experience for collecting field data, as described below. Required experience includes a thorough review of this document.

All samplers must complete the WSDA training to ensure samples are collected to project specifications. This training includes attending one in-person training, watching the provided videos, and reviewing this document. SOPs should be printed and kept on-site with sampling equipment. All samplers are subject to an in-person annual audit by WSDA staff to ensure data quality.

1.5 Revisions, routine review, and distribution

1.5.1 Required revisions

This SOP must be revised within 30 days after the discovery of:

- Errors
- Observed problems with accuracy
- Applicable compendia or changes in requirements
1.5.2 **Routine review**

This SOP may be reviewed as many times as needed within a twelve-month period but must be reviewed by the Soil Health Scientist at least once within a single twelve-month period. If no revisions are required, the SOP does not need to be reissued, but a new cover page must be generated. If there were revisions, the revision dates and the signatures of the preparer, reviewer and approval authority must be affixed to the new cover page. The appended cover page must be attached to the original signed copy of this SOP. This SOP must be revised no later than three years after its last effective date.

1.5.3 **Distribution**

The revised SOP will be distributed to users who will be asked to destroy older versions. The section manager will maintain archival copies of the SOP. Copies of the current (active) SOP will be available in the work area.

### 2 Acronyms

NRAS – Natural Resources Assessment Section

WaSHI – Washington Soil Health Initiative

SOP – standard operating procedure

WSDA – Washington State Department of Agriculture

### 3 Acknowledgement of WSDA Support in Publication

If your organization publishes soils data generated and paid for by WSDA under this program, please include the following statement: “Funding was in part provided by the Natural Resources Assessment Section of the Washington State Department of Agriculture.” If WSDA staff make substantial scientific contributions to your manuscripts, consider reaching out for co-authorship credit.

### 4 Project Planning and Site Selection

More details on project planning, selection criteria, and program requirements are found in the WSDA NRAS Quality Assurance Project Plan (Ryan et al. 2021), which is available upon request, and in Appendix 9.1.

#### 4.1 Protocol for contacting producers and land managers

Producers and land managers should be chosen prior to field sampling based on their willingness to share soil sampling data with WSDA, Washington State University, and conservation districts, as well as their willingness to respond to the required management survey. Producers and land managers will receive soil sampling results and an individualized soil health report in return for their participation.

#### 4.2 Data privacy statement

Data will be aggregated and reported in a way which mitigates personal identification of growers. Information will be used to understand broad impacts and characterize trends in soil health and production practices across regions. Results will not be reported in a way that makes individuals
identifiable. Information collected in this survey may be subject to release in accordance with RCW 42.56 (Public Records Act).

4.3 Pre-sampling preparation

4.3.1 Site and sample point selection

Program participants will work with producers and land managers to identify specific fields based on management history, producer willingness, and sites approved by WSDA during the application process. Wherever possible, paired fields should be selected from sites of similar soil texture, slope, climate, and cropping history. Subsamples within a field should be taken from the same soil texture, slope, and management history. Do not select sample points from unusual areas, such as corners, edges, or fence rows.

If you have access to ArcGIS Online and the ArcGIS Collector app, follow the steps outlined in Appendix 10.1. These steps are demoed in the short video titled “Sample Point Selection Using ArcGIS” in WSDA’s Soil Health playlist on YouTube.

If you do not have access to ArcGIS, then you will need a Google account to follow the steps outlined in Appendix 0. These steps are demoed in the short video titled “Sample Point Selection Using Google” in WSDA’s Soil Health playlist on YouTube.

4.3.2 Management survey

Management surveys specific to each field (one survey per field sampled) will be filled out by the program participant prior to sampling and returned to WSDA by March 31st, 2022. The survey will be submitted online, though the participant may meet in person or over the phone to obtain producer information and then transcribe the results into the online format. Management surveys must be submitted online by March 31st.

Click here to access our online survey:

https://experience.arcgis.com/experience/0c7cfcab5fc4bbcb7a1a2a59f3bfec

4.3.3 Sampling requirements for each site

- Sampling must be conducted between April 1st and June 1st
- Collect two full Soiltest bags of soil (per field sampled) to deliver to lab
- Collect three 2-inch diameter rings of bulk density (per field sampled) and put in labeled gallon size zip top bag
- Collect one 15 mL tube of soil (per field sampled), to be stored in the freezer
- Complete the on-site field form (Appendix 10.7) then scan or photograph.
- At the end of the sampling day, complete the chain of custody as detailed in section 6.7, then scan or photograph the chain of custody.
- Immediately following sampling, attach the images of the field forms and chain of custody, any photos taken in the field that were noted on the field form, and the .kmz files of the sample points to WaSHI@agr.wa.gov. Section 8 provides examples of file naming conventions.

Each of the above requirements are detailed below.
5 Sampling Equipment and Supplies

Prior to sampling, field staff must review the equipment and supply checklist located in Appendix 10.6 to ensure all required equipment and supplies are in the sampling vehicle. Enough field forms should be printed prior to each scheduled sampling event, in addition to backup copies. A copy of the checklist should be kept on a clipboard with the field forms and this SOP.

Sampling equipment and supply amounts will vary depending on the number of teams sampling at each site. Equipment should be checked pre-season to ensure there are adequate tools and supplies for each team. Damaged equipment should be inspected and replaced prior to sampling season. Metal equipment should be checked for any rust, as iron can contaminate soil samples. If rust is present, soak affected areas with white vinegar for 2-3 hours and remove rust with a clean cloth. For severe rust, use a metal scraper then rinse thoroughly with water and dry with clean cloth. To prevent the development of rust, tools should be cleaned after use and stored in a dry environment.

6 Site Visit and Soil Sampling Procedures

6.1 Safety and site arrival

6.1.1 Driving

The most consistently dangerous activity field staff conduct is driving. Traffic laws shall be obeyed, and field staff driving the vehicle shall not text or use their cell phones while operating the vehicle. Vehicles will be parked in a safe manner, such as the road shoulder or a designated parking space and will be parked in a way so that they do not endanger or inhibit traffic, pedestrians, wildlife, livestock, or the field staff themselves.

Upon arrival to the sampling location, field staff should first assess the safety of parking the vehicle, so it does not hinder or endanger any traffic, pedestrians, or endanger the field staff themselves. Placing traffic cones may be necessary to protect field staff and notify traffic and pedestrians. The catalytic converter/exhaust systems located on the underside of vehicles can get hot while driving so avoid parking in dry brush due to the dangers of starting a fire.

6.1.2 Heat-Stress

Due to the intensive nature of soil sampling, field staff should take precautions against heat-related illness. During periods of hot weather, one quart of water per hour, frequent breaks, and vapor barrier clothing is recommended. Sampling during early morning and evening can limit exposure to heat. WSDA recommends terminating soil sampling if temperatures reach 100° F.

6.1.3 Pesticides and Dust

If a pesticide application is occurring near the sample collection location, and/or there is an odor of pesticides in the air, the people collecting the samples should consider leaving the area and returning at a later time to avoid exposing themselves to pesticides. Events such as this should be noted on the field forms. Notes should include the time of witnessed pesticide application or the odor of pesticides in the air.

Work that involves disturbance of soils or plant litter may increase the concentration of fungal spores and bacterial pathogens in the air. Take precautions, such as wearing an N-95 mask, to prevent inhalation of dust from soils and plants litter. Soil sampling equipment can be sharp and/or heavy. Please take precautions to handle these tools with appropriate care.
6.1.4 **Blisters**

Using the slide hammers when pulling soil cores and bulk density samples can be abrasive on your hands. If your hands tend to blister, we highly recommend using gardening gloves to protect your hands. If blisters do begin to develop, immediately apply a blister-specific-bandage and wrap with sports tape to prevent the bandage from falling off.

6.2 **Overview of site visit**

REMINDER: Always navigate with care through a field to minimize disturbance to plants and soil, and to show proper respect to growers and their fields.

1. Prepare field form, labels, and sampling equipment.

2. Confirm with handheld GPS unit, phone, or tablet that GPS coordinates and sample ID match your current location. Move along the perimeter of the field as much as possible to reduce foot traffic within field.

3. Assess sample location for sampling suitability. If there are obvious disturbances, large rocks, ponding, etc. at the sample location, move to the nearest undisturbed location.

4. Collect soil at the five you randomly assigned in your geospatial file using ArcGIS or Google. (Figure 1)

5. Collect eight 1-inch cores at each of the five points at each site (every field will result in one soil sample, which is a composite of 40 (5 x 8) unique cores). Cores should be randomly spaced within 10-meters of the point. (Figure 1)

6. Collect one bulk density sample from three of the five sampling points (3 bulk density samples for every soil sample/field). The three bulk density points may be chosen in the field but should be spread out and representative of the five sampling points. Indicate which three points were selected for bulk density samples on the field form.

7. Check the field form for completeness and accuracy.

8. Place labels on all samples then place samples in cooler.

9. Clean and sanitize all sampling equipment.
6.3 Complete field form

To provide consistency in reporting, one member of the field sampling team should take all the notes, photographs, fill out labels, etc.,

Field staff will fill out the field form (Appendix 10.7) with the following information:

- Upon arrival at site:
  - Date
  - Site arrival time
  - County
  - Weather (ex. cloudy, sunny, hot)
  - Organization
  - Sampler Initials
  - Crop
  - Sample ID (assigned by WSDA)
After collecting samples, prior to leaving from site:

- **Notes on irrigation**: For example, “the field is actively being irrigated”, “dryland”, etc.
- **Diseased area**: Indicate any areas that were stunted or showed signs of disease.
- **Photos (optional)**: If there are any abnormal growth patterns, disease, ponding, or other interesting crop or field conditions, you may provide a photograph of the observation. On the field form, record at what sampling point the pictures were taken and describe the observation. Rename these photos with the Sample ID and attach these photos to the email with the field form and .kmz sample point file. Separately, if you are interested in sending us aesthetically pleasing photos for our promotional materials, please do! Send a picture with the name of the photographer and the statement “WSDA has permission to use these images with appropriate photographer credit.”
- **Comments**: Include information about any departures from the SOP, such as when a different sampling technique was required or if a different number of probes were taken. Use this section to record other observations about the field, crop rotation, or other agricultural activities.

Prior to leaving the sampling site, staff must verify the completeness and accuracy of all forms and notes to ensure there are no missing or improbable notes.

### 6.4 Sample IDs and sample labels

#### 6.4.1 Sample IDs

Each sample will be assigned a unique ID by WSDA prior to soil sampling. All program materials must be labeled with the unique sample ID, including Soiltest bags of soil, zip top bag of bulk density rings, field forms, .kmz files of sample points, photographs, and management surveys. It is essential that all program participants ensure the ID on each of these materials correctly corresponds with the others (i.e., the same ID is assigned to both the management survey and the corresponding field and bulk density samples, etc.

Sample IDs will be assigned to fields with the following format:

- Last two digits of year: (ex. 22)
- First three letters of the county: (ex. Whatcom = WHA)
- Three-digit landowner number assigned by WSDA: (ex. 001)
- Two-digit field number assigned by WSDA: (ex. 01)
- If the fields are paired, there will be a letter extension: (ex. 01A and 02A)
- Ex. Sample IDs for two paired fields: 22WHA00101A and 22WHA00102A

#### 6.4.2 Labels

Five labels are required for each site:

- Two labels for the two Soiltest bags (two separate bags containing the composite of 40 subsamples (8 cores x 5 sites)
- One extra label to send to Soiltest
• One label for the falcon tube subsample (with packing tape to secure the label to the tube)
• One label for the zip top bag containing the three bulk density samples (with packing tape to secure the label to the zip top bag)

A label will be placed on each sample bag or tube (Figure 2) with the following information:

• Project: WaSHI
• Sample ID (assigned by WSDA)
• Date: date sample collected
• Site arrival time: ensure this matches the field form and chain of custody
• Sampler’s initials: initials of field technicians pulling soil samples
• Org.: organization – conservation district, industry group, etc.

![Figure 2. Example label.](image)

### 6.5 Collect soil samples

Table 2 summarizes the four distinct soil sampling activities that must be completed at each site, after all paper and online forms have been completed (details in section 3.3). The following sections provide guidance for how each step must be carried out.

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<tr>
<td>2</td>
<td>Collect bulk density samples (section 6.5.3)</td>
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<tr>
<td>3</td>
<td>Sample homogenization (section 6.5.4)</td>
</tr>
<tr>
<td>4</td>
<td>Subsample for cryogenic storage into 15 mL centrifuge tubes (section 6.5.5)</td>
</tr>
</tbody>
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### 6.5.1 Soil sampling best practices

The following best practices should be followed when soil sampling:

• Subsamples within a field should be taken from the same soil texture, slope, and management.

• Do not sample where fertilizer has been applied recently.

• Do not sample unusual areas, such as corners or edges of former fields or fence rows that are now in the field.

• Remove surface crop residues, grass, or organic debris before sampling.
• The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials.

• Keep all samples in a cooler with ice packs and keep the coolers in the shade as much as possible.

6.5.2 Collect soil cores using probes

Please watch the short video titled “Collecting Soil Cores” in WSDA’s Soil Health playlist on YouTube, which demos the steps detailed below:

Probes must be marked to show how deep the probe should be inserted to collect a 12-inch-deep soil core. Probes may be marked with either an etcher (Figure 3) or nail polish; tape and permanent marker are not durable.

![Figure 3. A line is etched at the 12-inch mark, as measured from the bottom of the probe.](image)

Either a hammer or step probe may be used:

• Step-probes are used to quickly collect soil samples. Applying pressure to the step with your heel helps insert the 1-inch diameter stainless steel probe into the soil.

• If soils resist step probes, a hammer probe may be used. A hammer probe has a weighted handle attached, which helps drive the probe into heavy or dry soils.

The lighter step probe should be used wherever possible. If a step probe does not easily penetrate the soil, switch to the hammer or hammer head cross to facilitate ease of sampling. Probes should be pushed directly into the soil at an approximately 90-degree angle, or exactly perpendicular to the ground. Sampling should take place within the current or most recent crop row, and approximately 4-6 inches from the base of plant. At each of the five designated sampling points, eight 1-inch cores should be taken for a total of 40 composite cores (Figure 1). After each core is taken, carefully pull the probe out of the soil and invert the probe over your bucket to dump the soil contents into the bucket. You may need to use a butter knife or screwdriver to loosen soil from the probe, but care should be taken not to contaminate the sample by touching the soil with bare hands. If sampling in rocky soils, extra probe tips should be on hand in case tips are damaged and need to be replaced.

![Figure 4. A damaged probe tip that needs to be replaced.](image)
6.5.3 Collect bulk density samples

Bulk density cores will be collected at three out of the five sampling points. Record which sampling points the cores were collected from on the field form. Bulk density cores will be collected using a bulk density core sampler and a slide hammer. A video tutorial can be found at the following link:

Please watch the short video titled “Collecting Bulk Density Samples” in WSDA’s Soil Health playlist on YouTube, which demos the steps detailed below:

Insert three 2-inch diameter stainless steel liners into the soil core cup, then screw on the cap. Screw the other end of the cap (with the cup and liner attached) onto the compact slide hammer – use the adjustable wrench to tighten. Use the slide hammer to hammer the bulk density core until the cap is level with the ground. Carefully pull the core out of the ground, unscrew from the hammer, unscrew the cap, invert using your hand to hold the soil in place and carefully remove the cap from all three cups. Use a paring knife to remove the bottom cup from the middle cup. Then place on the cap, top side down onto the soil side of the middle cup, and invert again. Repeat the process to remove the top cup taking care to cut any roots or excess clumps of soil. Soil should be smooth along the rim of the cup. Place cap on ring. If necessary, stretch cap prior to placing on ring. Be sure that both caps are tightly in place to ensure no soil moves during transport.

Place the three bulk density cores into the labeled zip top bags and place in the cooler.

6.5.4 Sample homogenization

Once 40 subsamples have been taken and emptied into each bucket (8 samples at each of the 5 locations across the field), sample homogenization can begin. All soil samples must be thoroughly mixed to ensure that the sample is as representative as possible. Care should be taken not to touch soil samples with bare hands or contaminated gloves during homogenization. A clean pair of new, non-powdered, disposable gloves must be worn while mixing composite samples and filling pre-labelled zip top or Soiltest bags. Gloves should be changed any time during mixing and distribution when their cleanliness is compromised.

Pick out any large organic debris, roots, and rocks. Take care to break up only large clumps (typically the soil in the probe tip), while leaving soil aggregates intact.

6.5.5 Subsample for cryogenic storage

Once samples have been thoroughly mixed, a small subsample from each bucket must be placed into the provided sterile 15 mL centrifuge tube. These subsamples will be kept in cryogenic storage in perpetuity, so that WaSHI has archival materials for later analysis. To preserve the integrity of the samples and their respective microbial communities, it is crucial these samples are kept on ice until they can be transferred to a -80 °C freezer. Samples should never be allowed to reach room temperature. To carry out archival subsampling, field samplers will add approximately 12 mL of soil from their buckets into each tube (soils will expand slightly in the freezer, do not fill soils to the very top). Samplers should always wear gloves and take care not to contaminate falcon tubes with hands, clothes, or soils that do not belong inside. Stick the label onto the falcon tube then place a piece of packing tape over the label to secure it. Labeled falcon tubes should be stored in their plastic rack in an orderly manner. After tubes have been filled with soils, the plastic racks should be kept directly in the cooler until samples can be moved into the freezer. On longer sampling days, it may be necessary to restock the ice in the cooler, or to take a break to place samples in the freezer, depending on what is more efficient. WSDA will retrieve frozen samples as soon as possible.
6.5.6 Labeling all samples

Once archival subsamples have been contained in labeled 15 mL falcon tubes, the remaining homogenized soil can be placed into labeled Soiltest or zip top bags. To ensure there is sufficient quantity of samples for all laboratory analysis, it is essential these bags are filled to their maximum capacity with minimal organic debris and gravel.

![Image of labeled samples]

*Figure 5. Two labeled Soiltest bags, one labeled 15-mL falcon tube, and one labeled zip top bag containing three bulk density rings*

6.5.7 Sample storage

After samples are composited, bagged, and labeled, place them in cooler with ice packs or ice – use 1-2 plastic bags to line to cooler to keep water out of the samples. Keep the coolers in the shade as much as possible. At the end of the sampling day, store all sample bags in a refrigerator for shipping once a week. Store the 15 mL falcon tubes in a freezer for WSDA pickup.

Samples must be kept cold to preserve the condition of the soil and reduce degradation. The subsamples for cryogenic storage in 15 mL falcon tubes should never be allowed to reach room temperature.

At least once per week, pack the soil samples with ice packs and ship to Soiltest using overnight delivery. Ship samples on Monday – Wednesday to prevent the samples from getting stuck in the mail. See section 6.7.2 for packaging and shipping details.

6.6 Invasive species, insect, and disease evaluations

Washington law prohibits the transportation of a variety of diseases, insects, invasive plants, animals, and many noxious weeds. In order to minimize the introduction or spread of insects, diseases, and invasive species, field staff will follow the Washington State Department of Agriculture advisories and rules, and also the Department of Ecology’s SOP EAP070 Minimize the Spread of
Invasive Species, Version 2.2 (Parsons et al. 2018). After sampling at a site, field staff will inspect and clean all equipment including buckets, probes, boots, and any other field equipment. Field staff will remove any visible soil, vegetation, seeds, and organisms from equipment. Fields will be accessed on foot, and care will be taken to avoid walking through large patches of invasive weeds.

6.6.1 Contamination prevention

Sample buckets, probes, shovels, and other equipment which come into contact with soil during sampling should be wiped clean with a solution containing 70% ethanol or equivalent prior to site entry. Care should be taken not to touch soil samples during sampling. Ejection spoons, screwdrivers, or butter knives can be used to remove soil cores from the probes. A clean pair of new, non-powdered, disposable gloves will be worn while mixing composite samples and filling pre-labelled zip top bags. Care should be taken that a soil sampler does not touch skin or clothing while wearing gloves. Gloves should be changed any time during mixing and distribution when their cleanliness is compromised.

6.7 Complete chain of custody, package, and ship samples

6.7.1 Chain of custody

Prior to shipping or transferring samples to Soiltest Farm Consultants, Inc, a chain of custody (CoC) form will need to be completed (Figure 6) with the following information:

- WSDA contact information for a copy of the report to be sent to WSDA:
  - WaSHI@agr.wa.gov
- Sample dates
- Site arrival times
- Sample IDs
- Number of containers: 3 (there should be two filled Soiltest bags and one zip top bag containing three bulk density rings per field sampled)
- Releasing name
- Date shipped
- Shipping company name

Ensure that a completed CoC that correctly lists all samples is included with each shipment. Scan or take a picture of the completed CoC to send to WSDA in an email with the field forms, any field photos, the .kmz file of sample points, and any other pertinent documents or files.

All shipments must include an ice pack to preserve the condition of the soil and to prevent the change of carbon and nitrogen dynamics.
Figure 6. Example of completed chain of custody form

6.7.2 Pack and ship samples

Pack and ship the samples as follows:

1. Bag each individual sample in a 1-gallon zip top bag. Freezer bags are preferred. Make sure the bag is properly labeled.

2. Double bag your soil sample in a larger zip top bag. You can either place the single sample within another 1-gallon zip top bag or place multiple sample bags in a secondary, larger plastic bag.

3. Place the double-bagged sample(s) in a cardboard box. The size of the box depends on the number of samples.

4. Add packing material (such as crumpled paper or bubble wrap) to minimize sample movement within the box. Add ice packs (also within their own plastic bags). Ice packs and coolers are not returned.
5. Place the CoC form in the box, on top of the packaging material. Protect the form within its own plastic bag.

6. Ship via UPS or FedEx to:
   Soiltest Lab
   2925 Driggs Drive
   Moses Lake, WA 98837

7. Provide the tracking number to WaSHI@agr.wa.gov.

If near enough to Moses Lake, drop the sample(s) off at the office or one of their drop boxes found in the Kittitas Valley.

If using a drop box, be sure to call so they can expeditiously retrieve the samples.

**Drop Box Locations:**

a. McGregor at 200 S Railroad Ave Ellensburg, WA
b. Kern Company at 200 S Main St. Kittitas, WA

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### 7 Data Quality Assurance and Quality Control

Care should be taken prior to sampling to improve quality control and reduce factors that impede successful sampling. One or more plots or sampling locations can be affected by:

1. Logistics – ex. insufficient staff or equipment
2. Environment – ex. inclement weather, ponding, dry soil, heat
3. Management activities – ex. pesticide applications, irrigation events

Instances such as those listed in Table 3 should be documented along with the action taken. Sampling according to schedule is not always possible, but clear notes and communication help to mitigate incomplete datasets.

**Table 3. Potential issues, actions, and outcomes**

<table>
<thead>
<tr>
<th>Delay/Situation</th>
<th>Action</th>
<th>Outcome for Data Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incomplete sampling</td>
<td>Communicate with WSDA.</td>
<td>Dataset may be incomplete, or sampling may need to be redone. The latter may result in a product delivery delay.</td>
</tr>
<tr>
<td>Scheduled sampling will not capture intended biological conditions (ex. not mid-season of crop)</td>
<td>Reschedule, if possible, communicate with WSDA.</td>
<td>Samples will not be collected for this time period; no data generated.</td>
</tr>
<tr>
<td>Standing water within a plot where sampling is to occur.</td>
<td>If possible, move to nearest unsaturated soil to collect</td>
<td>No adverse data outcome.</td>
</tr>
<tr>
<td>Delay/Situation</td>
<td>Action</td>
<td>Outcome for Data Products</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Delay/Situation</td>
<td>Action</td>
<td>Outcome for Data Products</td>
</tr>
<tr>
<td>Pesticide application</td>
<td>Reschedule for soonest available re-entry date</td>
<td>No adverse data outcome.</td>
</tr>
<tr>
<td>Shallow/rocky soil profile in</td>
<td>If possible, move to area where full depth profile is reached. Otherwise, achieve 85% or greater full depth soil profiles. Mark location on map and note reason for adjustments.</td>
<td>Minimal adverse data outcome.</td>
</tr>
<tr>
<td>plot.</td>
<td>Communicate with WSDA, reschedule site for after irrigation or rain event.</td>
<td>Samples will not be collected for this time period; no data generated.</td>
</tr>
</tbody>
</table>

8 Records

All management surveys are to be submitted online by March 31st, 2022. Field forms, photos, notes, etc. will be maintained by sampling staff on site. Prior to leaving the sampling site, staff will verify the completeness and accuracy of all forms and notes to ensure there are no missing or improbable measurements/notes.

Immediately following sampling, program participants will rename the following files to include the sample ID and email them to WSDA at WaSHI@agr.wa.gov:

- Chain of custody (ex. file name: 22WHA00101A _CoC.pdf)
- Field forms (ex. file name: 22WHA00101A _FF.pdf)
- Photos that are described in the field form (ex. file name: 22WHA00101A _disease.jpg)
- Geospatial files with sample points (ex. file name: 22WHA00101A.kmz)

These records will be saved in the NRAS Soil Health Initiative shared drive. The data will also be transferred into the electronic database.

9 References


10 Appendices

10.1 Sample point selection: ArcGIS Online and ArcGIS Collector

You must provide your email address to be added to the “WSDA Soil Health – CDs” group on ArcGIS Online to follow these steps. Please watch the short video titled “Sample Point Selection Using ArcGIS” in WSDA’s Soil Health playlist on YouTube, which demos the steps detailed below:

1. Log in to ArcGIS Online, navigate to your Groups, select “WSDA Soil Health – CDs”, and open the Web Map titled “SamplePointSelection” (Figure 7, Figure 8).
   a. Locate the field you will sample from. Use the search feature at the top right to find the field you will sample. You can use an address, coordinates, or type in the nearest city and use the pan/zoom features to find your field.
   b. The SoilSeries data layer (black outlined polygons) shows the different soil series in your field. Make sure these lines are visible by checking the ‘SoilSeries box in the left Content pane. To see the soil series data, you must be zoomed in to at least a scale of 1:24,000.
   c. You can learn about the taxonomy of each soil series by clicking inside the outlined shape. In the example below, there are multiple soil series, though Shalcar series makes up the majority of the field. Take note of this majority soil series because this is the area you must select your five sampling points within.

Figure 7. Web maps within ArcGIS Online: WSDA Soil Health – CDs group.
Figure 8. Step 1 of sample point selection using ArcGIS Online.

- Make sure the Soil Series layer is toggled on.
- Click on the map to see the soil series taxonomy.
- + to zoom in
- - to zoom out
- Search box for address, city, zip code, or county
- Field to be sampled is in the rectangle
- In the next step, select sampling points that fall within the majority soil series (Shalcar)
2. Designate the locations of each of the five sampling points within your majority soil type.
   
   a. Click on the “Edit” button on the top navigation bar, click “SamplePoints” in the left pane, then click on the field to place the point. Notice the points are placed in a W shape and are located only within the Shalcar soil series (Figure 9).
   
   b. Use the drop-down options to select the crop and point number (1-5) and copy and paste the Sample ID assigned by WSDA.
   
   c. Date, bulk density, notes, and attachments will be completed in the field.

Figure 9. Step 2 of sample point selection using ArcGIS Online.
3. To access your map on your phone or tablet, open the ArcGIS Collector app (make sure you are logged into the same account you used for ArcGIS Online on your computer).
   
a. Select the “WSDA Soil Health – CDs” group then select the “SamplePointSelection” map.
   
b. Use the magnifying glass to search for your Sample ID or type in an address. Use the ‘stack of squares’ icon to toggle the layers on/off. Tap the “… “ to access other options (Figure 19).

Figure 10. Step 3 of sample point selection using ArcGIS Collector.
4. While in the field, use the app to navigate to your sampling point and update each sample point with the date, “Yes” or “No” if you pulled bulk density at that sample point, and any notes or observations. If there are any interesting observations, you can tap “Take Photo” to snap a picture. Be sure to describe the photo and observation in the field form and in this notes section within the app. Tap “Submit” when finished. Crop, SampleID, and PointNumber should have been pre-assigned in ArcGIS Online using your computer.

Figure 11. Step 4 of sample point selection using ArcGIS Collector.
5. Before heading into the field where you may not have service, make sure you have the map downloaded for offline capabilities (Figure 12).
   a. The “SamplePoints_OfflineUse” map can be used to download one offline area at a time. The “Level of detail” can be set to various sizes. Tap “Download Area”.
   b. When in service again, navigate back to the offline use map, tap the “…”, and select “Sync”.

Figure 12. Step 5 of sample point selection using ArcGIS Collector.
10.2 **Sample point selection: Google Earth, Google My Maps, Google Maps**

For each field you sample, follow the below steps to generate a .kmz geospatial file with five sample points. If you will be sampling ten fields, you should have ten separate .kmz files, named with the WSDA-assigned sample ID.

Please watch the short video titled “Sample Point Selection Using Google” in WSDA’s [Soil Health playlist](https://www.youtube.com/playlist?list=PL-SoilHealth) on YouTube, which demos the steps detailed below:

   a. Click on “SoilWeb Earth.” This will download a .kmz file. Open the downloaded file, which will automatically open in Google Earth.
   b. Locate the field you will sample from (Figure 13).
   c. Use the search feature at the top left to find the field you will sample. You can use an address, coordinates, or type in the nearest city and use the pan/zoom features to find your field.
   d. The SoilWeb data layer (yellow lines with a number inside) shows the different soil series in your field. Make sure these yellow lines are visible by checking the ‘SoilWeb' box underneath the ‘Places’ tab to the left of the page.
   e. You can learn about what each soil series is by clicking inside the outlined shape. In the example below, there are multiple soil series, though Shalcar series (143) makes up the majority of the field.
   f. In the next step, please draw your polygon only where the majority soil series is because this is the area where your five sampling points will be taken.
Figure 13. Step 1 of sample point selection using Google Earth.
2. Designate the locations of each of the five sampling points within your majority soil type.

   a. Click on the “Add Polygon” button on the top navigation bar. Name the polygon “Sample Area” and move to the “Measurements” tab to change the area units to “Acres”. Left click and drag your mouse to draw a polygon within the majority soil sample that measures approximately 40 acres or less. Click “OK.” Notice the polygon is only drawn around the majority part of the field with the Shalcar soil series (143) (Figure 14).

   ![Figure 14. Step 2a of sample point selection using Google Earth.](image)
b. Under the “Places” header, hover your cursor over “My Places” and right-click to select “Add”, then “Folder”. Rename the folder with the sample ID assigned to your field (ex. SMI1of10WHA) and click “OK” (Figure 15).

![Google Earth Pro interface showing sample point selection](image)

Figure 15. Step 2b of sample point selection using Google Earth.
c. Add five sampling points in a W shape to your named folder. Click on the “Add Placemark” button at the top navigation bar. Move each pin to your preferred area to create a W shape and rename it a number 1 through 5. Click “OK” after each point. Make sure each of these five points are inside your named folder (Figure 16). If they are not, you can drag and drop them into the folder. These five points are where you will sample from within your field.

Figure 16. Step 2c of sample point selection using Google Earth.
3. Save and export sampling points to a .kmz file. This file will be your guide to finding the points in the field.
   a. Hover your cursor over your named folder and right click to “Save place as.” Save the .kmz file to a secure location on your computer.
4. Import .kmz file to Google My Maps. For this next step, you will need a Google account.
   a. Go to: https://mymaps.google.com/ and login with your Google account.
   b. Click “+ CREATE A NEW MAP”.
   c. Click “Import” to open the dialog box where you can either drag or navigate to your .kmz file. Then click “Select” to import the file (Figure 17).

![Figure 17. Step 4c of sample point selection using Google My Maps.](image-url)
d. Click on “Untitled map” to open the dialog box where you can rename your map to your assigned Sample ID. Then click “Save” (Figure 18).

Figure 18. Step 4d of sample point selection using Google My Maps.
5. To access your map on your phone or tablet, open the Google Maps app (make sure you are logged into the same account you used for Google My Maps on your computer.)
   a. Tap “Saved”, then “Maps”, then the Sample ID map you want to navigate to. Your selected sampling points will now appear. Select any of the sampling points to get directions (Figure 19).

![Google Maps app interface](image)

**Figure 19. Step 5 of sample point selection using Google Maps.**

6. Before heading into the field, make sure you have the map downloaded for offline capabilities. See this Google Support article for instructions to download areas for offline use: [https://support.google.com/maps/answer/6291838?hl=en&co=GENIE.Platform%](https://support.google.com/maps/answer/6291838?hl=en&co=GENIE.Platform%).
   a. While in the field, use the navigation app and your points to locate the appropriate sampling locations.

7. Submit your .kmz files to WSDA.
   a. Along with the scanned copy of your field forms, photos, and chain of custody, email your .kmz files with your sampling points in an email to [WaSHI@agr.wa.gov](mailto:WaSHI@agr.wa.gov). Make sure all file names specify their matching Sample ID.
10.3 **Partnerships in Soil Health Program Materials**

The request for applications informational document, application form, application webinar/Q&A session recording, and other materials are available on the WSDA Soil Health Funding Opportunities webpage: [https://agr.wa.gov/departments/land-and-water/natural-resources/soil-health/funding-opportunities](https://agr.wa.gov/departments/land-and-water/natural-resources/soil-health/funding-opportunities).

10.4 **WSDA Soil Health Playlist on YouTube**

The recording of the webinar/Q&A session and all soil sampling training videos are located in the Soil Health playlist on WSDA’s YouTube channel: [https://www.youtube.com/playlist?list=PL0pB20prk7Ni1daEYiEEXSWy8CfwO34FC](https://www.youtube.com/playlist?list=PL0pB20prk7Ni1daEYiEEXSWy8CfwO34FC)

10.5 **Management Survey**

[https://experience.arcgis.com/experience/0c7cffcab5fc4bbcb7a1a2a59f3bfece/](https://experience.arcgis.com/experience/0c7cffcab5fc4bbcb7a1a2a59f3bfece/)

NRAS Soil Health Monitoring SOP
10.6 Equipment and Supply Checklist

**Recording and Reference Supplies**
- Clipboard
- WSDA SOP
- Soiltest chain of custody
- Pre-printed labels (5 per site)
- WSDA field forms
- Pens/permanent markers
- Packing tape

**Sampling Supplies**
- 4-gallon plastic buckets with lids for compositing soil for the 0-to-12-inch samples
- Plastic buckets to carry bulk density supplies and samples
- Gallon size zip top bags
- Soiltest bags
- 15 mL falcon tubes
- Gloves, non-powdered, disposable

**Field Tools**
- Sharpshooter or drain spade
- Garden trowel
- Paring knife
- Universal slip wrench
- Screwdriver
- Adjustable wrench
- Ejection spoons or butter knives

**Sampling Equipment**
- Step probe (sample 12-inch deep by 7/8-inch wide)
- Soil probe (sample 12-inch deep by 7/8-inch wide)
- (2) slide hammers
- 2-foot extension piece
- 1-inch plated heavy duty replaceable tip
- 2-inch diameter by 6-inch length soil core sampler
- 2-inch diameter bulk density metal liners (5 per site)
- 2-inch diameter bulk density core end caps (6 per site)
- Cooler with ice or freezer blocks
- Heavy duty garbage bags to line coolers

**Field Decontamination Equipment**
- (2) spray bottles with 70% ethanol (or equivalent)
- Alcohol based disinfectant cleaning wipes
- (6-10) cloth rags

**Field Gear/Safety Equipment**
- Gloves for hand protection
- Cell Phone/Car Charger
- N-95 masks

**Before Sampling**
- Communicate with landowners/producers
- Organize field forms and pre-printed labels
- Clean equipment
- Load supplies, equipment, coolers, ice/ice blocks, etc.

**After Sampling**
- Check field forms are complete and correct.
- Ensure all sample bags are properly labelled and sealed.
- Check chain of custody is complete and correct, then place in a zip top bag and inside each cooler.
- Scan and send copies of the field forms, pictures, .kmz geospatial files, chain of custodies, etc. to WSDA.

**Ship to or Drop Off at:**
- Ship or drop off samples at least once per week. Include chain of custody and ice packs.
  - Soiltest Lab
    2925 Driggs Drive
    Moses Lake, WA 98837
- If using one of the below drop boxes, call the office (509-765-1622) to ensure they can expeditiously retrieve the samples.
  - McGregor:
    200 S Railroad Ave,
    Ellensburg, WA 98926
  - Kern Company
    200 S Main St.
    Kittitas, WA 98934

**WSDA Contacts**
- General email: WaSHI@agr.wa.gov
- Dani Gelardi: 360-791-3903
  DGelardi@agr.wa.gov
- Leslie Michel: 509-731-9895
  LMichel@agr.wa.gov
### 10.7 Field Form

**Soil Health Assessment – Field Form**

<table>
<thead>
<tr>
<th>Date</th>
<th>Site Arrival Time</th>
<th>County</th>
<th>Weather</th>
<th>Organization</th>
<th>Sampler Initials</th>
<th>Crop</th>
<th>Sample ID</th>
</tr>
</thead>
</table>

**Data Collection**

<table>
<thead>
<tr>
<th>Point 1</th>
<th>Point 2</th>
<th>Point 3</th>
<th>Point 4</th>
<th>Point 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulk density:</strong> Mark which points were sampled for BD.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Irrigation:</strong> (Ex. Is it actively being irrigated?)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil moisture:</strong> Estimate if saturated, at field-capacity, or dry.</td>
<td></td>
<td></td>
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<tr>
<td><strong>Disease/stunted growth:</strong> Describe any signs of disease.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Photo:</strong> Mark if a photo was taken and describe the observation.</td>
<td></td>
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</tr>
</tbody>
</table>

**Additional Observations and Comments**
### Chain of Custody & Soil Test Request Form

<table>
<thead>
<tr>
<th>Client</th>
<th>Company: Washington Department of Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact:</td>
<td>Contact: Dani Gelardi</td>
</tr>
<tr>
<td>Address:</td>
<td>Address: 1111 Washington St SE</td>
</tr>
<tr>
<td>City, State, Zip:</td>
<td>City, State, Zip: Olympia, WA 98504</td>
</tr>
<tr>
<td>Phone:</td>
<td>Phone: 360-791-3903</td>
</tr>
<tr>
<td>Email:</td>
<td>Email: <a href="mailto:DGelardi@agr.wa.gov">DGelardi@agr.wa.gov</a> and <a href="mailto:WaSHi@agr.wa.gov">WaSHi@agr.wa.gov</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project: WaSHi</th>
<th>Test Group: WSDA S-1</th>
<th>Lab Use Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample ID</td>
<td>Date Sampled</td>
<td>Site Arrival Time</td>
</tr>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Releasing</th>
<th>Receiving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name and Date Shipped:</td>
<td>Soiltest Name:</td>
</tr>
<tr>
<td>Shipping Company Name:</td>
<td>Date Received:</td>
</tr>
</tbody>
</table>

We will make every effort to provide an accurate analysis of this sample. For reasonable cause, we will repeat the tests but because of factors beyond our control in sampling procedures and the inherent variability of soil, our liability is limited to the price of the tests. Recommendations are to be used as general guides and should be modified for specific field conditions and situations.