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Cropland In-Field Soil Health Assessment Guide

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Contents

Considerations for Using the Assessment

The Cropland In-Field Soil Health Assessment is designed to be used as a diagnostic tool to help conservation planners determine and document if soil health resource concerns exist. This tool was not designed to be a monitoring tool. However, with some adaptation this tool may provide some qualitative means to track changes over time or compare fields under different management. Nor should the in-field assessment be assumed that it is a comprehensive assessment of all biological, physical, and chemical processes that are critical to soil function. Fields where multiple indicators do not meet assessment criteria will likely benefit from the implementation of a management system. This system should utilize as many soil health building practices as practical, to maximize biodiversity, presence of living roots and soil cover, and minimize disturbance. Refer to NRCS Title 450, Technical Note 4, "The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland," found on NRCS eDirectives at https://directives.sc.egov.usda.gov and NRCS National Conservation Practices found on NRCS web site at https://www.nrcs.usda.gov for more information.

In general, it will not be necessary to evaluate all 11 indicators but only those that will enable the planner to adequately assess a field's soil health status and develop management alternatives if soil health resource concerns exist. Numerous variables will contribute to the indicators not being equally useful during any single field visit. Some indicators will be more interpretable and representative of soil health than others depending on site conditions, soil type, landscape position, climate, time of year and production system. Each indicator will have different optimal sampling times or conditions and these conditions should be noted. The timing symbols associated with each indicator are located on the worksheet provides a quick reference for the recommended conditions and time for assessing that indicator.

State technical specialists responsible for soil health resource concerns related to conservation planning should communicate with the Soil Health Division to determine which indicators are likely to provide useful resource concern assessment information for their local conditions. Also, state and area specialists may find it necessary to adjust the assessment criteria of the indicators that are used to ensure they provide meaningful assessment information for local systems and conditions.

Soil chemical properties (nutrients, pH, EC, etc.) are an important component of soil health and can impact soil function but are not part of the in-field assessment. These are best quantified by sending samples to a reputable soil testing laboratory. Additionally, there are physical and biological properties indicative of soil health that can be assessed by laboratory methods as laid out in NRCS Technical Note 450-03, "Recommended Soil Health Indicators and Associated Laboratory Procedures." The soil organic matter (SOM) depletion resource concern can also be identified by tracking trends of lab analyses of SOM through time. Quick in-field assessments of nutrients (pH, EC, etc.) can be done to demonstrate, compare and contrast the impact of management on nutrient cycling or differences within a field and determine whether further soil testing is needed (see NRCS - Soil Health for Educators on the NRCS web site at https://www.nrcs.usda.gov). Finally, soil salinity has not been included in this assessment guide even though it can have negative impacts on soil health. Soil salinity should be evaluated as a resource concern separately and considered in a management plan where appropriate.

Indicator Descriptions

Soil Cover

Importance: A significant factor in promoting soil health is keeping the soil surface covered, particularly during fallow/intercrop periods and prior to canopy closure.

How to assess: Estimate the percent of the soil surface covered with dead plant material (see example in fig. 1), organic mulch or live plants at any time, but ideally right before planting the main cash crop. Evaluate the management and operations to predict cover during critical erosion and fallow/intercrop periods by filling out the management history. Both live crop canopy and crop residues during critical periods must be considered. The crops may be different, but the percent cover will look similar. Take photographs of representative areas.

NRCS conservation practices to address the resource concerns associated with this indicator: *Practice codes 311, 328, 329, 340, 345, 484, 512 and 528* (refer to NRCS National Conservation Practices for details).

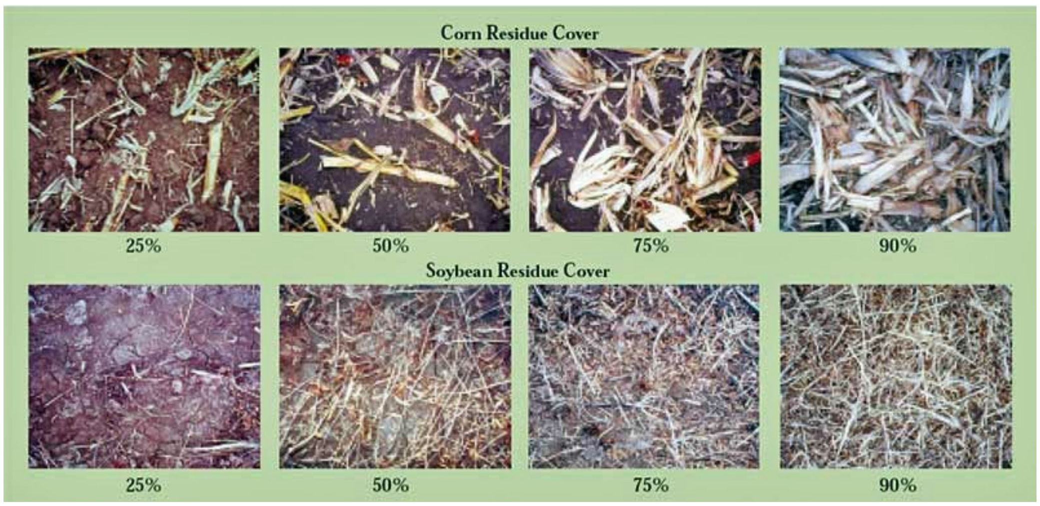


Figure 1: Crop residue at various percentages of cover

Residue Breakdown

Importance: Residue breakdown is the biological shredding, fragmenting, cycling, and/or decomposition of previous crop residue. The rate at which residue decomposes can be an indicator of management-influenced biological activity. Other factors that can influence the rate of residue breakdown include carbon to nitrogen (C:N) ratio of the plant residue, crop type, residue size, residue orientation (standing vs. flat), residue amount, tillage, and environmental conditions (climate, recent weather, etc.) during residue decomposition.

How to assess: Breakdown is highly dependent on management, recent weather, climate, soil and crop type. Residue breakdown is assessed by looking at existing residue cover for signs of decomposition, shredding, and incorporation by soil organisms. Note the depth of litter and color and condition of the most recent residue. The conversation with the producer will help provide information about management, residue age and plant types. Threshold guidance may need to be adjusted locally. Take photographs of representative areas. This indicator can be assessed at any time but may not be as useful after full-width conventional tillage since very little residue may be present.

NRCS conservation practices to address the resource concerns associated with this indicator: *Practice codes 328, 329, 340, 345, 528, 590 and 595.*

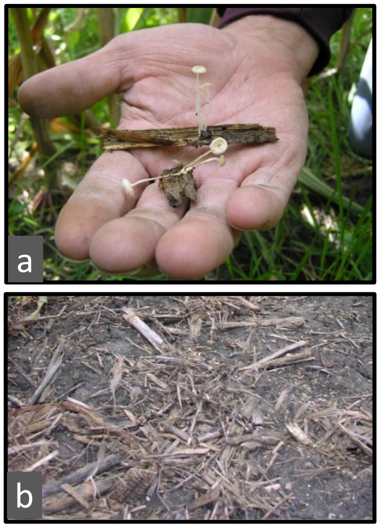


Figure 2: a) Close-up and b) wide view example of natural biological processes decomposing crop residues.

Figure 3: Example of slow residue turnover showing multiple years of crop residues.

Surface Crusting

<u>Importance</u>: Standing water or evidence of surface runoff on the soil resulting from poor infiltration can be an indication of poor aggregate stability, crusting, lack of cover, poor soil structure, and/or compaction. This leads to runoff, erosion and crop damage. Ponding during the growing the season has a negative impact on nutrient cycling, water quality, gas exchange and increases flooding resulting from poor infiltration. Slow infiltration can also result from naturally occurring conditions such as: a fragipan, other slowly permeable layers close to the surface, a clayey surface or subsurface texture.

<u>How to assess</u>: Determine if crusts are present throughout the field or only in patches. Crusts will remain intact when they are picked up. Assess for physical crusts after irrigation or rain and before next tillage. This indicator can be assessed at any time but may not be as useful after full-width conventional tillage. Additional investigation or assessment of saline or sodic conditions may need to be documented.

NRCS conservation practices to address the resource concerns associated with this indicator:
Practice codes 311, 329, 340, 345, 484, 512, 528 and 610.

Figure 4: Top view of surface crusting

Figure 5: Wheat seeds germinated below the soil, but the shoots were unable to break through the hard surface crust

Ponding/Infiltration

Figure 6: Ponding on cropland

<u>Importance</u>: Standing water or evidence of surface runoff on the soil resulting from poor infiltration can be an indication of poor aggregate stability, crusting, lack of cover, poor soil structure, and/or compaction. Slow infiltration can also result from naturally occurring conditions such as a fragipan or other slowly permeable layer close to the surface or a clayey surface or subsurface texture. This leads to runoff, erosion and crop damage. Ponding has a negative impact on nutrient cycling, water quality, potential for flooding and gas exchange.

<u>How to assess</u>:

Observation method: The best time to assess for ponding is within 24 hours of a typical rainfall or irrigation event. Determine if ponding occurs throughout the Conservation Management Unit (CMU)/field or only in patches. Ponding can result from surface crusting, low infiltration, inherent soil properties or landscape position. This information is often best obtained during producer interviews to determine the extent and severity of ponding.

Figure 7: Preparing soil infiltration test

Infiltration method: An optional, more time-consuming method to determine whether ponding will occur is to conduct an infiltration test. This can be done by either a comparison method or a timed test. Select a location that avoids headlands/turning rows, traffic lanes and wheel tracks. In most soils, water should infiltrate in 30 minutes or less. Refer to the Soil Quality Test Kit Guide (SQTKG) for instructions on how to conduct this test.

NRCS conservation practices to address the resource concerns associated with this indicator: *Practice codes 311, 328, 329, 333, 340, 345, 449, 511 and 528.*

Penetration Resistance

Figure 8: Applying slow, steady pressure when pushing penetrometer into soil

<u>Importance</u>: Soil compaction in agricultural systems can result from repeated wheel or hoof traffic, or repeated tillage at the same depth. Compaction inhibits water and gas movement through the soil in addition to interfering with root growth and soil organism habitat, nutrient cycling, plant productivity and health.

<u>How to assess</u>: Penetration resistance increases as soils dry, therefore, the ideal condition to assess is at field capacity. Management-induced compaction typically occurs at depths of 2–8 inches but may be deeper depending on soil type and management. Resistance to penetration should be checked at 8–10 randomly selected spots in the field. Make sure that soil is the same soil type for the assessment area. Use one of the following methods:

Wire flag method: Hold a wire flag near the flag end inserting it into the soil observing how much resistance it takes to push it into the soil. Compare the resistance to a known noncompacted area, such as in a fence row or other nonimpacted field border. This test is better suited when soil moisture is near field capacity.

Penetrometer method: Use a penetrometer
by applying slow, steady vertical downward pressure so the rod is sinking at the rate of 1-inch per second while observing the pressure gauge reading. Record depth of restrictive layers and resistance pressure. Use the 0.5-inch cone for silty, clayey and loamy soils, and the 0.75-inch cone for sandy soils. This test is also better suited when soil moisture is near field capacity. See Wisconsin University YouTube tutorial in the appendix for additional information.

NRCS conservation practices to address the resource concerns associated with this indicator: *Practice codes 328, 329, 334, 340, 345, 511, 528 and 808.*

Water-Stable Aggregates

Importance: The stability of soil aggregates in the presence of water is important for water infiltration and storage, air exchange, plant root growth, soil organism habitat, protecting soil organic matter, decreased soil erodibility, nutrient cycling, plant productivity and health as well as water quality and flooding. This indicator overlaps and is tied to many other resource concerns.

How to assess: Coarse textured soils may not develop aggregates easily in semiarid and arid climates resulting from a lack of rainfall. These soils may also be limited in their ability to form water-stable aggregates. Some soils are more chemically prone to strong aggregation and may give false-positive results. To assess for water-stable aggregates, use one of the following three methods:

Strainer method: Obtain a sample from the soil surface and crumble any large peds (BB size or slightly larger; don't grind too fine). Place the soil in a sink strainer or small wire colander, level with top. Immerse in a bowl filled with water and allow to become fully saturated (about 1 minute). Turn strainer upside down on a flat surface. Soils with good aggregate stability will maintain their structure with aggregates apparent while soils with poor aggregate stability will slump and have a pudding-like consistency. This method can be used with soils that are not air dry but are at field capacity or less. You may also note the clarity of the water as an indicator. Easiest infield method is:

SQTKG method: See Slake Test, Chapter 9 on how to use the slake box for procedure and scoring. This method can be used with dry to field capacity soil moisture.

Cylinder method: Take a soil ped about the size of a golf ball from the surface just below any residue and air dry it (this could take additional time at the office). You may need to take the soil back to the office to assess this indicator after it has dried. Submerge the dried ped in a strainer basket within a container and note the time. As the water enters the pore spaces in the ped, the water creates internal pressure. After 5 minutes observe the water in the container (see fig. 9 below). Is the water cloudy or clear? Estimate the percentage of the ped that remains intact. Some soils are so highly degraded that soil peds may not break apart or dissolve because high bulk density may not allow water to enter, affecting how aggregates respond to water. You may be able to remove the intact ped and break it apart to determine if the ped is saturated or dry within the center of the ped. If the ped is dry in the center, this indicates that the soil is highly degraded. If this method provides unclear results, the strainer method or the SQTKG method may provide clearer results. ***NRCS conservation practices to address the resource concerns associated with this indicator:*** *Practice codes 311, 328, 329, 333, 334, 340, 345, 511, 528, 590, 595 and 808.*

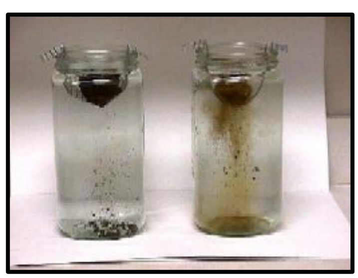


Figure 9: Close up and wide view of cylinder method

Figure 10: Slake box

Figure 11: Sink strainer method showing water-stable aggregates on left and unstable aggregates on right

Soil Structure

Figure 12: Platy structure

Importance: Soil structure affects water infiltration impacting flooding and gas exchange, plant rooting, nutrient cycling, plant condition and health, and soil organism habitat. Poor plant condition as a result of compacted soil may have an impact on animal health.

How to assess: Structure should be observed for granular, massive or platy structure within horizons of the top foot of soil. This indicator can be assessed at any time but may not be as useful after full-width conventional tillage. Soil structure will be damaged after tillage and give a false positive toward granular structure. Comparison to the official soil series description may give you an indicator of the potential of that soil, depending upon location.

- Granular structure typically is associated with soils rich in organic matter and good aggregation. Sandy soils are less likely to exhibit granular structure.
- Massive is a condition where nearly all structure is lost leaving a very dense unconsolidated soil layer with very little pore space.
- Platy structure is characterized by distinct layers that can be separated along the horizontal plane and is typically associated with a compacted layer, or often, E horizons. Local, naturally occurring conditions will also affect structure.

For more information on different types of soil structure see: Field Book for Describing and Sampling Soils Version 3.0 beginning on page 2-52 or Section 11: Assessing Soil Physical Observations and Estimations in the SQTKG.

NRCS conservation practices to address the resource concerns associated with this indicator: *Practice codes 311, 328, 329, 334, 340, 345, 511 and 528.*

Soil Color

Importance: Color can be used as an indicator of loss or accumulation of SOM which influences most aspects of soil function, with higher SOM contents generally improving soil function. Typically, loss of SOM results in a lighter color, with accumulation resulting in darker colors.

How to assess: Color can be assessed in at least three ways listed below. Be sure to compare the same soil type. Soil color can be indicative of different soil mineralogy as well as organic matter.

Color chart method: Use a color chart and soil survey pedon description for the field. The value is the number that reflects soil darkness. For example, a soil with color 10YR 3/6 is darker than a 10YR 5/6 soil. For the 10YR 5/6 sample, 10YR is the hue, 5 is the value, and 6 represents the chroma (brightness). A lower value number is darker than higher numbers. The assessment can be accomplished with dry or moist samples and should be compared to the official series description. For instructions on describing soil colors, see: Field Book for Describing and Sampling Soils Version 3.0 beginning on page 2-8.

Figure 13: Using a color chart to determine soil color

Smartphone app method: Use a soil app on a smartphone such as the LandPKS mobile app to determine soil color. The soil surface should be flat and dry or if that is not possible then it should be uniformly moist but not glistening. The reference and the soil should be in the same plane. Also, ensure that there are no internal shadows (e.g., dark areas between aggregates or microaggregates).

Figure 14: Determining soil color using a soil app on a smartphone

Field versus fencerow comparison method: In a few locations, compare relative color changes from the field versus a fencerow or other non-cropped, undisturbed perennial vegetation which may be located at the field edge in the same landscape position. Exceptions to this are in semiarid environments where irrigation and fertility in agronomically managed soils can lead to higher SOM levels compared to fencerows.

Figure 15: Healthy soil in a cover crop mixture

Figure 16: Using a sharpshooter to extract a slice of soil

Figure 17: Comparing relative color changes

NRCS conservation practices to address the resource concerns associated with this indicator:
Practice codes 311, 327, 328, 329, 340, 345, 512, 528, 590 and 808.

Plant Roots

Importance: Plant roots exude simple and complex carbohydrates that provide food and habitat to the microbial communities which in turn builds soil structure by forming soil aggregates. Root channels can remain from season to season and function as areas of carbon concentration and biological activity (see biopores indicator), improve infiltration and contribute to the ability of the soil to store water, reduce soil erosion, and create pathways for gas exchange after senescence.

How to assess: Observe growth patterns of actively growing roots within the top 0–8” or deeper depending on the crop. Best done during times of active desirable plant growth and adequate soil moisture.

Things to look for:

- Healthy roots are abundant, deep, not inhibited by restrictive layers, and well-branched
- Roots are not balled up or growing sideways, lateral root growth indicates a hardpan or compacted layer.
- Look for fine root hairs; lack of them indicates oxygen deprivation in the root zone.
- Rhizosheaths: roots that are covered in a soil film. Rhizosheaths are highly species- and environment-dependent (*e.g.,* brassicas and many broadleaf weeds do not tend to form rhizosheaths). May indicate the presence of beneficial soil biology colonization.
- Roots that are entangled and enmeshed with soil aggregates that adhere to the roots.

NRCS conservation practices to address the resource concerns associated with this indicator:
Practice codes 311, 328, 329, 334, 340, 345, 512, 528, 590 and 808.

Figure 18: Healthy rhizosheaths on eight-week-old winter cereal rye seeded early fall with no nitrogen

Figure 19: J-rooting of cover crop roots resulting from a soil restrictive layer

Figure 20: Fine root hairs

Biological Diversity

Importance: Soil organisms broadly influence all aspects of soil function including but not limited to aggregation, water dynamics, nutrient cycling and pest suppression.

How to assess: Observe the presence of soil organisms within the residue or soil. Restrict observation to the area of the soil surface represented by the assessment area, take a shovel full of soil and look for soil organisms within that sample and the residue at the top of that sample. Fungal hyphae will appear as white to light tan threads or masses with a hand lens. Look for active nodules if legumes are growing, meso- and macro-invertebrates such as earthworms or earthworm middens, mites, springtails, millipedes, roundworms, beetles and ants. The best time to assess is during spring or fall or other times of the year when soils are moist at or near field capacity. The biological hotspots: aggregate surfaces, residue, plant roots, porosity/structure and biopores may be used if no soil biology is apparent because of the timing of the year to determine if the potential and habitat for soil biology is possible. Temperature will also affect the presence and activity of organisms. Additional soil macrofauna photos can be found in the Soil Macrofauna Field Manual beginning on page 85.

NRCS conservation practices to address the resource concerns associated with this indicator: *Practice codes 311, 328, 329, 340, 345, 484, 511, 528, 590, 595 and 808.*

Figure 21: a) ectomycorrhizal fungi covering plant roots, b) saprophytic fungi on plant residues, c) nodules on roots formed from rhizobia bacteria, d) mite, e) springtail, f) millipede, g) woodlice/pill bug, h) dung beetle, i) anecic earthworm – deep burrowing, j) endogeic earthworm – topsoil dwelling, k) earthworm cocoons, l) earthworm midden

Biopores

Importance: Plant roots and earthworms leave behind large pores called biopores. These biopores are important for rapid air and water exchange. They provide additional access to water and nutrient resources for improved plant health and productivity. In addition, earthworm channels tend to be enriched in organic matter, microbes, and nutrients which assist nutrient cycling. Old biopores provide excellent pathways for newly established roots and soil biology movement corridors.

How to assess: Take a shovel full of soil and look for intact biopores that will appear as channels, often connected to the soil surface. Biopores forming over multiple years are rich in organic matter and may appear darker than the surrounding soil. This indicator can be assessed at dry to field capacity soil moisture but will be easier to observe in moist to field-capacity soils.

NRCS conservation practices to address the resource concerns associated with this indicator: *Practice codes 311, 327, 328, 329, 340, 512, 528 and 550.*

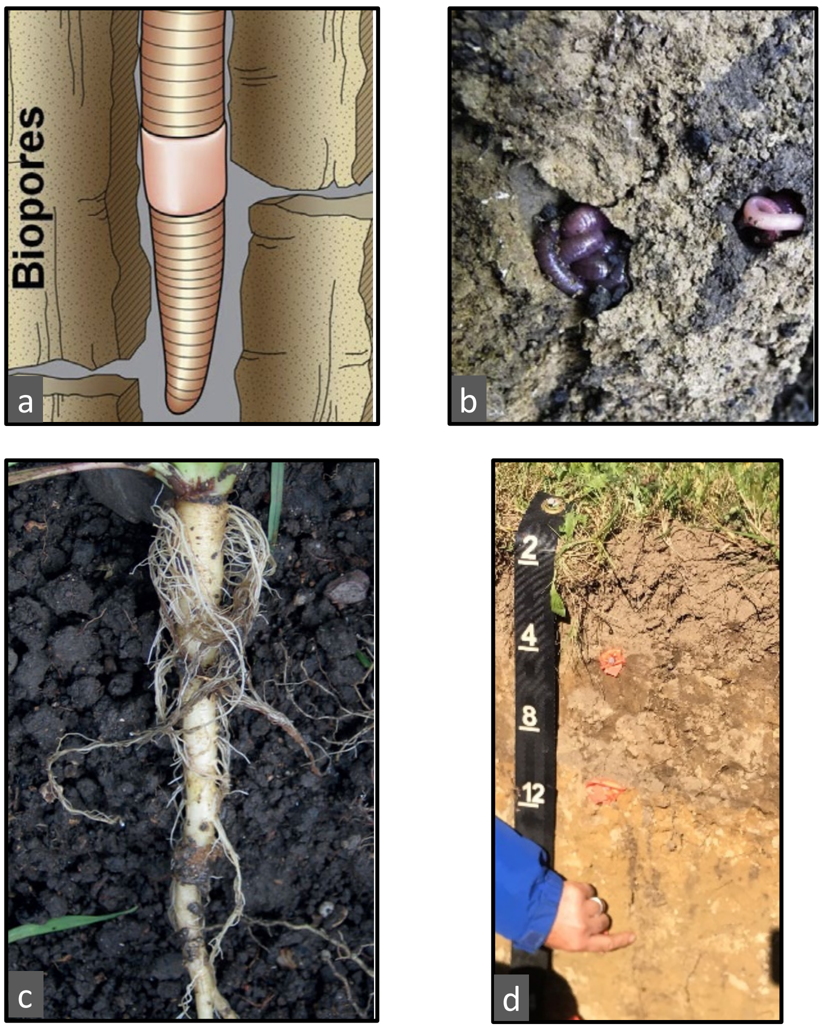


Figure 22: a) earthworm following biopore created by plant roots, b) earthworms creating biopores, c) taproots are characterized by a large, central and dominant root, d) biopore extending into subsoil

Field Tips

(Abbreviated version of instructions to accompany assessment worksheet)

- Please read the full set of instructions before conducting a soil health assessment.
- Some indicators are influenced and/or representative of soil health more than others depending on soil type, landscape position, recent weather, climate, time of year and production system.
- Each indicator will have different optimal sampling times or conditions and these conditions should be noted. The timing symbols associated with each indicator located on the worksheet (next page) provides a quick reference for the recommended conditions and time for assessing that indicator. See above instructions for additional timing suggestions.
- When conducting the assessment, compare the indicators in the assessment area to the same soil type in an adjacent fencerow or non-cropped perennial vegetated area.
- Previous instructions provide guidance for assessing each indicator, and list conservation practices that can be considered for inclusion in a soil health management plan to address the resource concerns associated with each indicator.
- The first four indicators (soil cover, residue breakdown, surface crusts, ponding) represent surface conditions across the assessment area.
- Remaining indicators are indicative of below ground soil health. Observe conditions by digging down to at least 12 inches and evaluating each indicator to determine if it meets the assessment criteria.
- Subsurface indicators are best confirmed by looking at more than one unique location in the CMU/field. If conditions are not consistent within the CMU/field for at least two locations, an additional site should be evaluated.
- Whenever possible, take photos to include in your assessment. These can be added to the customer folder along with assessment area observations and notes.
- Soil moisture can be determined with a handheld soil moisture meter if available, or qualitatively as: *dry, moist, field capacity, or saturated.* Use the Estimating Soil Moisture by Feel and Appearance publication.
- Soil texture can be estimated by using the Guide to Texture by Feel. Soil surveys can provide an estimate but should be verified in the field.

Useful Assessment Materials

- Shovel
- Wire flag
- 6-inch diameter ring, 5-1/4 inches in length
- Small sledgehammer or dead blow mallet
- Plastic wrap
- Block of wood
- 500-mL plastic bottle or graduated cylinder
- Stopwatch or timer
- Soil color book
- Jornada/soil quality slake box
- Penetrometer
- Clear plastic cups or similar
- Wire sink strainers
- ½-inch × ½-inch wire mesh
- Water
- Small hand lens or phone clip on lens
- Texture-by-feel guide and Estimating Moisture by Feel
- Camera or phone
- Web Soil Survey or Soil Web App

Management History - Interview

The following questions are offered as examples to guide a conversation with the client and help the planner more thoroughly understand current conditions, the client's management and how these may contribute to existing soil health resource concerns. Answers to these and other similar questions will be helpful in assessing some of the indicators.

1. What is the crop rotation?

2. Describe your tillage system?

3. How long have you been in this management system and are you considering any changes?

4. For how many months per year is the soil surface at least 75 percent (estimated) covered with plants, residue or mulch?

5. Is cropland grazed? List animal type, number and weight.

6. Are cover crops a consistent part of the cropping system? If yes, for how many years has the field been continually cover cropped?

7. How are the cover crops terminated?

Management History – Interview Cont’d

8. What integrated pest management strategies are used (e.g., crop scouting, selective spraying, treated seeds)?

9. What nutrient management strategies are used (e.g., banding, split application, use of the 4Rs, manure/biochar/compost)?

10. Is the field irrigated? If yes, what type of irrigation system and how many acre-inches are applied for each crop in the rotation described above?

11. Does water pond or run off during or immediately after typical rainfall or irrigation events? Where in the field?

12. Are there problems with crop emergence or early crop growth? Where in the field?

13. Is water management a concern (i.e., field too wet or too dry at planting)?

Other observations not captured in the assessment including plant condition and recent weather and landscape characteristics that may affect assessment results:

Cropland In-Field Soil Health Assessment Worksheet

Soil Health Resource Concerns
CPT: Compaction SOM: Soil Organic Matter Depletion AGG: Aggregate Instability HAB: Soil Organism Habitat Loss or Degradation
Location
Field/CMU
Tract #
Client/Customer
Plan
Date
Soil Map Units
Soil Moisture
Surface Horizon Texture

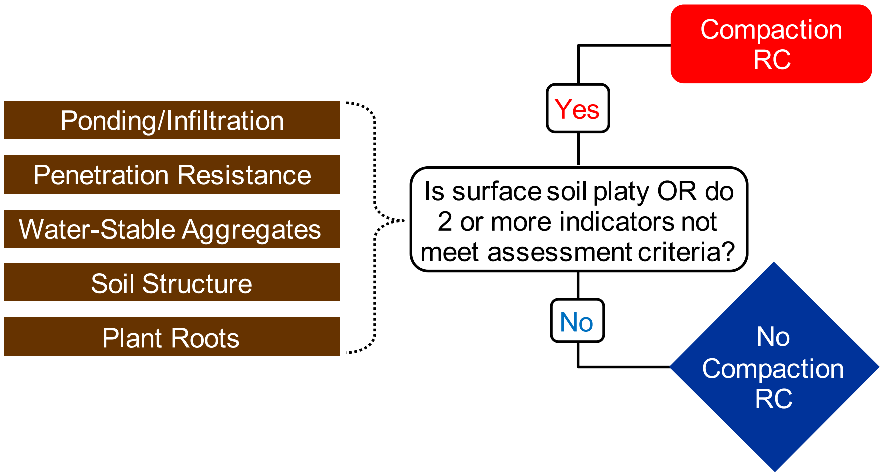
Indicator Timing and Use Anytime | After Rain or Irrigation | With Adequate Moisture | Before a Tillage Event Primarily No-Till Systems | Before Growing Season | During Growing Season | Interview	Meets Assessment Criteria (Yes/No)
Soil Cover | **SOM, AGG, HAB** • Surface cover from plants, residue or mulch; cover greater than 75% (estimated)	☐ Y ☐ N
Residue Breakdown | **SOM, HAB** • Natural decomposition of crop residues or organic mulch is as expected with crop and conditions	☐ Y ☐ N
Surface Crusts | **AGG, HAB** • Crusting on no more than 5% (estimated) of the field/CMU	☐ Y ☐ N
Ponding/Infiltration | **CPT, AGG** • No ponding on non-hydric soils within 24 hours following typical rainfall or surface irrigation event; • OR, no infiltration difference between assessment area and fencerow sample in the same soil type; • OR, soil infiltrates 1-inch of water in 30 minutes or less	☐ Y ☐ N
Penetration Resistance | **CPT** • Penetrometer rating <150 psi within top 6-inch depth and <300 psi in the 6 to 18-inch depth; • OR, slight or no resistance with wire flag inserted to 12-inches	☐ Y ☐ N
Water-Stable Aggregates | **CPT, SOM, AGG, HAB** • Strainer: soil structure remains intact with aggregates apparent; • OR, Soil Quality Test Kit (SQTK)/Jornada slake box meets stability class 5 to 6; • OR, Cylinder: At least 80% (estimated) remains intact after 5 minutes with little cloudy water	☐ Y ☐ N
Soil Structure | **CPT, SOM, AGG, HAB** • Granular surface soil structure and no platy or massive structure in top foot of soil	☐ Y ☐ N
Soil Color | **SOM** • No color difference between assessment area and fencerow sample in same soil type: • OR, value is on the darker range using color chart and official series description	☐ Y ☐ N
Plant Roots | **CPT, SOM, AGG, HAB** • Roots covered in a soil film (rhizosheaths) or are part of soil aggregates; • OR, living roots if present are healthy, fully branched, extended and unrestricted	☐ Y ☐ N
Biological Diversity | **SOM, AGG, HAB** • Evidence of more than 3 different types of organisms observed or biological hotspots present	☐ Y ☐ N
Biopores | **SOM, AGG, HAB** • Presence of multiple intact root or earthworm channels that extend vertically through the soil with some connecting to the surface	☐ Y ☐ N

Version 1.3

Cropland In-Field Soil Health Assessment Resource Indicator Decision Trees

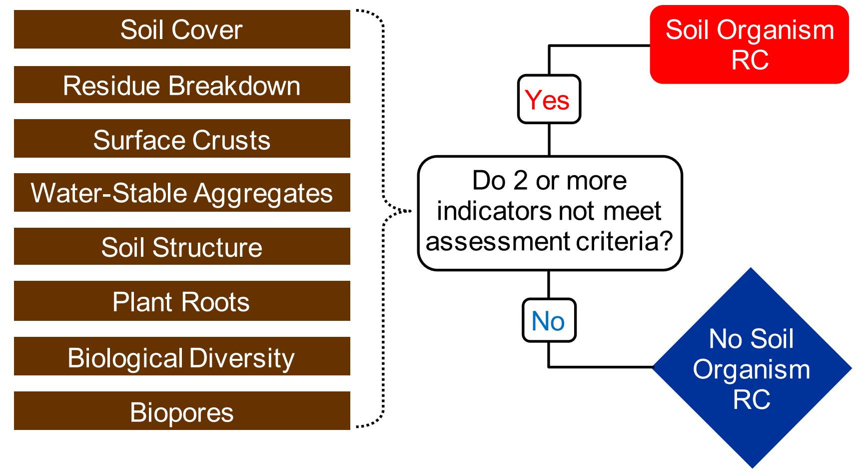
Compaction

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



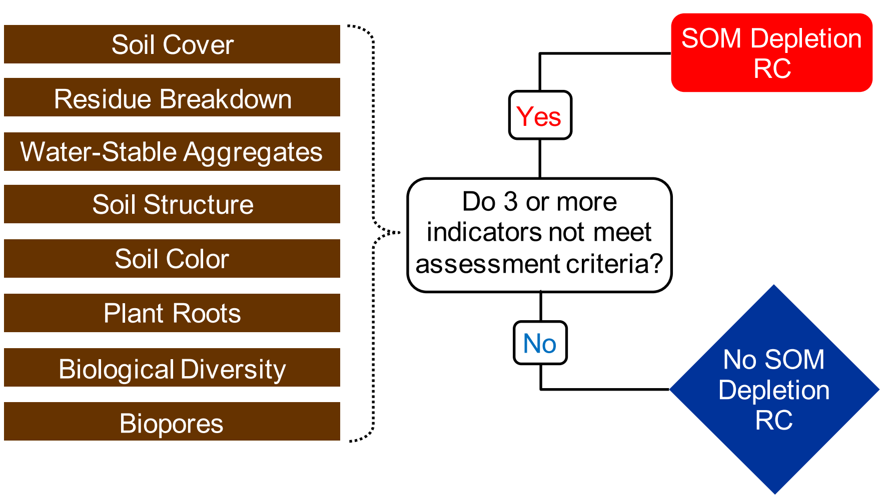
Soil Organism Habitat Loss or Degradation

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



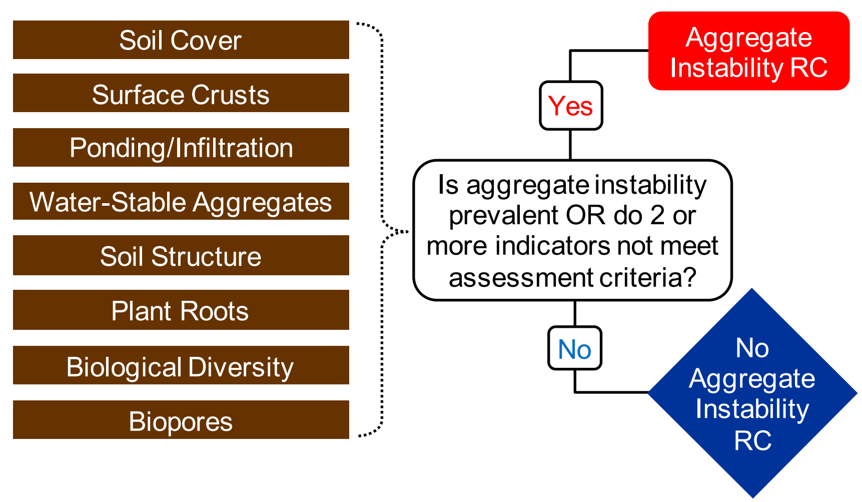
Soil Organic Matter Depletion

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



Aggregate Instability

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



Glossary of Terms

Aggregate.—A group of primary soil particles that cohere to each other more strongly than to other surrounding particles resulting from biological, physical, and chemical processes.

Aggregate stability.—A measure of the proportion or percentage of the aggregates in a soil that remain intact and do not easily slake, crumble, or disintegrate.

Assessment Area.—A representative location where an assessment is conducted within a field or Conservation Management Unit (CMU).

Biopore.—Soil pores, usually of relatively large diameter, created by plant roots, earthworms, or other soil organisms.

Clod.—A compact, coherent mass of soil varying in size, usually produced by plowing, digging, etc., especially when these operations are performed on soils that are either too wet or too dry and usually formed by compression, or breaking off from a larger unit, as opposed to a building-up action as in aggregation.

Conservation Management Unit (CMU).—A field or group of fields of the same land use having similar treatment needs and planned management. A CMU has definite boundaries such as fence, drainage, vegetation, topography, soil lines or land use and is used by the planner to simplify planning activities and facilitate development of management systems.

Crust (soil), physical.—A surface layer of soils, ranging in thickness from a few millimeters to 3 cm., that physical-chemical processes, in conjunction with the lack of biological aggregation processes, have caused to be much more compact, hard, and brittle when dry than the material immediately beneath it. *Not to be confused with a biological (microbiotic) soil crust.

Crust (soil), biological.—An assemblage of cyanobacteria, algae, lichens, liverworts, and mosses that commonly forms an irregular living crust on soil surface, especially on otherwise barren, arid-region soils.

Eluviation.—The removal of soil material in suspension (or in solution) from a layer or layers of a soil.

Horizon, E.—Zone of leaching or depletion usually characterized by lighter color and platy structure.

Horizon, soil.—A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistency, kinds and number of organisms present, degree of acidity or alkalinity, etc.

Hyphae.—Filaments of fungal cells. Many hyphae constitute a mycelium.

Ped.—A unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes (in contrast with a clod, which is formed artificially).

Pedon.—A three-dimensional body of soil with lateral dimensions large enough to permit the study of horizon shapes and relations.

Resource concern.—An expected degradation of the soil, water, air, plant, or animal resource base to the extent that the sustainability or intended use of the resource is impaired.

Rhizosheath.—Structures composed of mucilage and soil particles that form a cylinder around the root.

Soil color, chroma.—Brightness.

Soil color, hue.—Color or shade.

Soil color, value.—The lightness or darkness of tones or colors.

Soil Health.—The continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.

Structure, soil.—The combination or arrangement of primary soil particles into secondary units or peds. The secondary units are characterized by size, shape, and grade (degree of distinctness).

Structure, granular.—Imperfect spheres, usually sand-size.

Structure, blocky.—Imperfect cubes with angular or rounded edges.

Structure, platy.—A flattened or compressed appearance.

Structure, massive.—Condition where nearly all structure is lost leaving a very dense unconsolidated soil layer with very little pore space.

Structure, single grained.—Soil that has no structure and is at individual soil particle size. Common in sands.

Appendix

Aggregate Stability:
https://www.youtube.com/watch?v=7OYq6-_GW5Q
https://www.youtube.com/watch?v=z8xj5EiNNRo

Biological Activity, Fungi, etc.:
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1015&context=agronomyfacpub

Diagnosing Compaction Using a Penetrometer:
https://extension.psu.edu/diagnosing-soil-compaction-using-a-penetrometer-soil-compaction-tester

Estimating Soil Moisture by Feel and Appearance:
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_051845.pdf

Field Book for Describing and Sampling Soils Version 3.0:
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052523.pdf

Guide to Texture by Feel:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054311

LandPKS mobile app for Determining Soil Color:
https://landpotential.org/

NRCS Conservation Practices:
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/cp/ncps/?cid=nrcs143_026849

Residue Cover:
http://ianrpubs.unl.edu/live/g1931/build/g1931.pdf
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_029000.pdf

Science and Technology Training Library (houses the soil health webinar series):
http://www.conservationwebinars.net/

Soil Crusts:
http://soilquality.org/indicators/soil_crusts.html
http://www.fao.org/docrep/t1696e/t1696e06.htm

Soil Health Management Systems Principles – Factsheet: Principles for High Functioning Soils:
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1388460&ext=pdf.

Soil Health Technical Note 450-03: Recommended Soil Health Indicators and Associated Laboratory Procedures (For quantitative assessment of soil health):
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/soils/health/?cid=nrcseprd1315420

Soil Health Management Systems Technical Note 450-04: The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland:
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/soils/health/?cid=nrcseprd1315420

Soil Health for Educators:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/health/assessment/?cid=nrcs142p2_053870

Soil Quality Test Kit Guide:
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050956.pdf

Soil Web App:
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjsz5nmsYrtAhWnhK0KHdmDC5EQFjAAegQIAhAC&url=https%3A%2F%2Fcasoilresource.lawr.ucdavis.edu%2Fsoilweb-apps%2F&usg=AOvVaw2GUbTgmwoOEqX6nHghzRQq

University of Wisconsin Penetrometer Instruction:
https://www.youtube.com/watch?v=Zq_785JqRq8

Web Soil Survey:
https://websoilsurvey.nrcs.usda.gov/