



Resource Concerns & Soil Health Indicators

Objectives

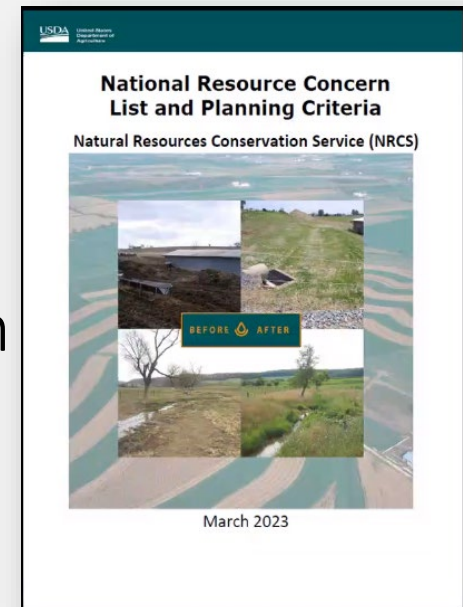
- Define and identify the soil health resource concerns and planning criteria that drive soil function
- Review the use of the Cropland In-Field Soil Health Assessment Tool and others.
- Locate and discuss the value and limitations to the soils data and interpretations that are currently available: WSS
- Utilize planning criteria from CART to document Resource Concerns



NRCS Resource Concerns

Resource Concern: An **existing or 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. (FOTG Section III)

- Compaction
- Organic matter depletion
- Soil organism habitat loss or degradation
- Aggregate instability



Compaction

- Description: Management induced soil compaction at any level throughout the soil profile resulting in reduced rooting depth/structure, plant growth, biological activity, infiltration, etc.
- Objective: No platy structure or restrictive layer, thickened or J-roots, or layers exceeding 300 psi at field capacity in the surface 0-8 inches.



Soil Organism Habitat Loss or Degradation

- Description: Quantity, quality, diversity or connectivity of food, cover, space, shelter and/or water is inadequate to meet requirements of beneficial soil organisms
- Objective: Improve habitat for soil organisms, determined by monitoring several related indicators



Aggregate Instability

- Description: Management-induced degradation of water stable soil aggregates resulting in destabilized soil carbon; surface crusting; reduced water infiltration, water holding capacity, and aeration; depressed resilience to extreme weather; increased ponding and flooding; increased soil erosion and plant stress; and reduced habitat and soil biological activity.
- Objective: Improved aggregate stability where water stable aggregates are present at critical levels and no evidence of poor aggregate stability, such as surface crusting, lack of soil structure.



Cropland Assessment

- Field visit
- Interview producer/Management
- Web Soil Survey and Conservation Assessment and Ranking Tool (CART)



Organic Matter Depletion

- Description: Management induced depletion of any or all soil organic matter pools resulting in limited soil function and processes that support: plant productivity, biological productivity; water/nutrient cycling.
- Objective: Total organic matter or carbon is being monitored and increasing according to approved total organic matter or carbon soil test



In-Field Assessment

Tools of the trade

- Shovel
- Knives
- Water
- Sink strainers
- Infiltration rings
- Notetaking
- Camera
- Color book
- Phone: Land PKS or Survey 123



Cropland In-Field Soil Health Assessment Worksheet

Soil Health Resource Concerns <input type="checkbox"/> CPT: Compaction <input type="checkbox"/> SOM: Soil Organic Matter Depletion <input type="checkbox"/> AGG: Aggregate Instability <input type="checkbox"/> HAB: Soil Organism Habitat Loss or Degradation	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)
Location <input type="text"/>	Soil Cover ☁️ SOM, AGG, HAB • Surface cover from plants, residue or mulch; cover greater than 75% (estimated)	<input type="checkbox"/> Y <input type="checkbox"/> N
Field/CMU <input type="text"/>	Residue Breakdown ☁️ ⚙️ 🌱 SOM, HAB • Natural decomposition of crop residues or organic mulch is as expected with crop and conditions	<input type="checkbox"/> Y <input type="checkbox"/> N
Tract # <input type="text"/>	Surface Crusts 🚜 🌱 🌿 AGG, HAB • Crusting on no more than 5% (estimated) of the field/CMU	<input type="checkbox"/> Y <input type="checkbox"/> N
Client/Customer <input type="text"/>	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	<input type="checkbox"/> Y <input type="checkbox"/> N
Plan <input type="text"/>	Penetration Resistance 💧 🚜 🌱 🌿 CPT • Penetrometer rating <150 psi within top 8-inch depth and <300 psi in the 8 to 18-inch depth; • OR, slight or no resistance with wire flag inserted to 12 inches	<input type="checkbox"/> Y <input type="checkbox"/> N
Date <input type="text"/>	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	<input type="checkbox"/> Y <input type="checkbox"/> N
Soil Map Units <input type="text"/>	Soil Structure ☁️ CPT, SOM, AGG, HAB • Granular surface soil structure and no platy or massive structure in top foot of soil	<input type="checkbox"/> Y <input type="checkbox"/> N
Soil Moisture <input type="text"/>	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	<input type="checkbox"/> Y <input type="checkbox"/> N
Surface Horizon Texture <input type="text"/>	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	<input type="checkbox"/> Y <input type="checkbox"/> N
	Biological Diversity 💧 🚜 SOM, AGG, HAB • Evidence of more than 3 different types of organisms observed or biological hotspots present	<input type="checkbox"/> Y <input type="checkbox"/> 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	<input type="checkbox"/> Y <input type="checkbox"/> N
	<input type="button" value="Clear Worksheet"/> <input type="button" value="Clear Worksheet Except Client/Customer, Plan and Date"/>	

In-Field Soil Health Assessment To Identify Resource Concern Presence



In-Field Assessment



Indicator: Soil Cover

Description	Soil cover is the percent of the soil surface that is covered by plant residue, organic mulch and/or live plants.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Aggregate instability Soil organism habitat loss or degradation Soil organic matter depletion 	
In-field measurement	1. Farmer interview, 2. Photo estimation method or state approved method, OR 3. Line intercept: https://www.nrcs.usda.gov/sites/default/files/2022-10/Cropland InField Soil Health Assessment Guide.pdf	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Cover > 75% after planting	Cover \leq 75% after planting

In-Field Assessment



Indicator: Residue Breakdown

Description	The rate at which residue decomposes is an indicator of relative biological activity; biological shredding, fragmenting, cycling or incorporating of previous crop residue.	
Resource Concerns Addressed	<ul style="list-style-type: none"> • Soil organism habitat loss or degradation • Soil organic matter depletion 	
In-field measurement	Look at existing residue cover for signs of breakdown, consider: <ol style="list-style-type: none"> 1. If tillage present, then not applicable. 2. How many seasons/layers of crop residue are present 3. Residue composition and type (C:N) residue crops were grown 4. Residue color and condition of most recent crop residue 	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Residue pieces are small, mixed in surface or minimal crop residue remaining from >1 cropping season	Residue is in large pieces left after planting, can be handled without crumbling and/or significant residue from 2 or more cropping seasons is present

In-Field Assessment



Indicator: Surface Crusts

Description	Crusts form after rain or irrigation on soils with weak aggregate stability.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Aggregate instability Soil organism habitat loss or degradation 	
In-field measurement	Evaluated by visual observation after rainfall/irrigation and drying: <ul style="list-style-type: none"> Note whether crusts are throughout the field or only in patches. Near surface will be dense, show layered sediment deposits Poor crop emergence uneven stand 	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Evidence of surface crust \leq 5% of field	Evidence of surface crust $>$ 5% of field

In-Field Assessment



Indicator: Ponding/Infiltration

Description	Areas of the field that collect and hold runoff water from other parts of the field.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Aggregate instability Surface compaction 	
In-field measurement	Farmer interview or visual observation after rainfall/irrigation: <ul style="list-style-type: none"> Note evidence of crop residue deposits Evidence of ponding from observation or on recent aerial photos Poor crop conditions (yellowing) Soil infiltrates 1-inch of water in 30 minutes or less 	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Evidence of ponding 24 hours or less after a typical rain event; 1-inch water infiltrates < 30 min.	Evidence of ponding more than 24 hours after a rain event; 1-inch of water takes \geq 30 min. to infiltrate

In-Field Assessment

Indicator: Penetration Resistance

Description	Management induced reduction of large pores and degraded structure (i.e., platy) that results in decreased rooting depth, plant growth and soil biological habitat and activity in the upper eight to twelve inches of soil.	
Resource Concerns Addressed	<ul style="list-style-type: none"> • Compaction 	
In-field measurement	Conduct with soil moisture near field capacity: <ul style="list-style-type: none"> • Evaluate multiple representative locations in the field • Record depths of restrictive layer(s) & PSI readings (penetrometer) a wire flag can be used in place of the penetrometer • Evaluate root development and distribution • Look for platy structure: dig a and look for platy non-friable structure 	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Granular structure, appropriate PSI reading, vertical channels or roots.	Evidence of platy structure, unacceptable PSI, root restriction, surface ponding, horizontal or abnormal root architecture.

In-Field Assessment



Indicator: Aggregate Stability

Description	Soil aggregate stability is related to soil porosity and how well a soil can resist raindrop impact and erosion.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Aggregate instability Soil organism habitat loss or degradation Soil organic matter depletion Surface compaction 	
In-field measurement	Choose one of the following three methods: <ul style="list-style-type: none"> Slake test (ensure samples are completely dry) Strainer test (soil slump) Jornada soil aggregate stability test (stability kit) or bottle cap method 	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Aggregates remain intact <ul style="list-style-type: none"> ≥80% for slake test “stands up” for slump test, runoff water is translucent Jornada criteria (rating 5-6) 	Aggregate disintegrates <ul style="list-style-type: none"> <80% remaining (slake) Soil “slumps” into a puddle, runoff is not translucent Jornada criteria (rating < 5)



In-Field Assessment



Indicator: Soil Structure

Description	Soil structure is the arrangement of soil particles in various aggregates differing in shape, size, stability, and degree of adhesion to one another.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Aggregate instability Soil organism habitat loss or degradation Soil organic matter depletion Surface compaction 	
In-field measurement	Observe soil structure and compare to the official series description.	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Granular structure in the surface, or structure is as described in the official series description	Platy or massive structure, or structure does not match the description in the official series description

In-Field Assessment



Indicator: Soil Color

Description	Soil color is used as an indicator of loss or accumulation of organic matter.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Soil Organic Matter Depletion 	
In-field measurement	Use soil color chart/book and compare to official series description, or compare surface soil to an undisturbed area nearby.	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	An obvious darker surface layer; similar to official series description value (OSD)	Lighter than OSD; soil mixing observed and/or surface is lighter in color than the horizon below

*Note soil moisture makes soil appear darker and should be noted if comparing different fields

In-Field Assessment



Indicator: Plant Roots and Biopores (continuity)

Description	Roots influence the soil immediately adjacent to them through exudates, growing and leaving soil organic matter as they die.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Aggregate instability Soil organism habitat loss or degradation Soil organic matter depletion Compaction (Plant Roots) 	
In-field measurement	Observe evidence of dark root channels or biopores left by previous plants or earthworms.	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Presence of dark root channels or biopores left by previous plants or earthworms; roots healthy, branched, extended, with rhizosheaths	Roots are stressed and do not follow previous root channels, no pores evident from earthworms

In-Field Assessment



Indicator: Biological Diversity

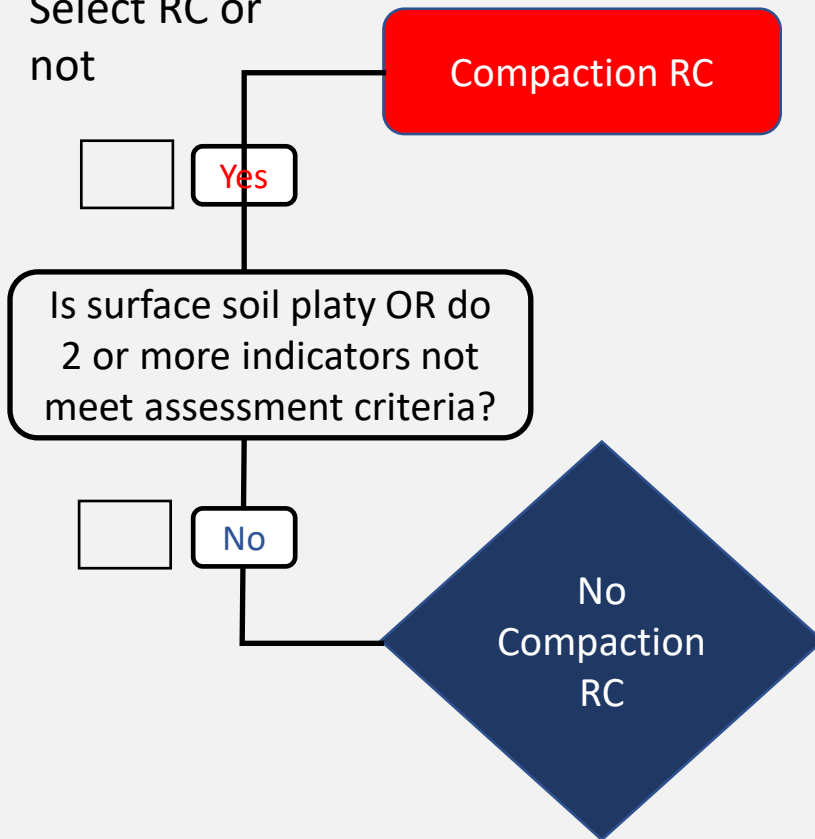
Description	Presence and relative abundance of earthworms, mites, springtails, millipedes, roundworms, beetles, termites, fungal hyphae and other organisms provide evidence of a healthy soil ecosystem.	
Resource Concerns Addressed	<ul style="list-style-type: none"> Aggregate instability Soil organism habitat loss or degradation Soil organic matter depletion 	
In-field measurement	Look for evidence of soil organisms (e.g., earthworm casts, middens, large pores, active nodules, insects, fungal hyphae, etc.).	
Rating Criteria	Meets Criteria	Does Not Meet Criteria
	Clearly evident: more than 3 types of organisms observed	No biological activity visible, lacking earthworms, no saprophytic fungi, low to no evidence of macrofauna

Compaction Resource Concern Decision Tree

Check No

<input type="checkbox"/>	Ponding/Infiltration
<input type="checkbox"/>	Penetration Resistance
<input type="checkbox"/>	Water-stable Aggregates
<input type="checkbox"/>	Soil Structure
<input type="checkbox"/>	Plant Roots

Select RC or
not

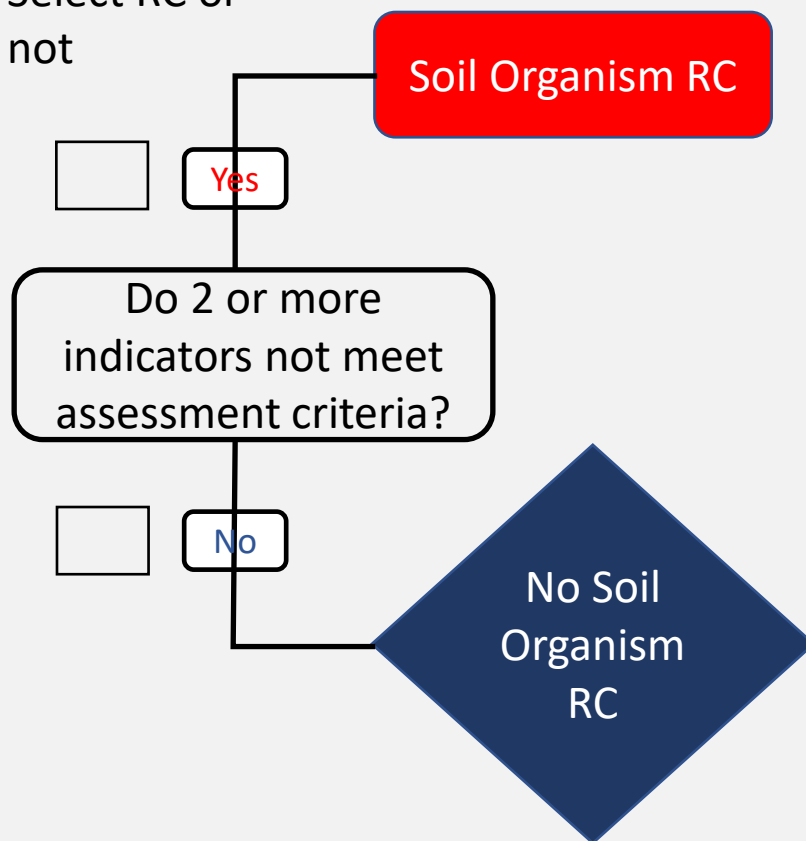


Soil Organism Habitat Loss or Degradation Resource Concern Decision Tree

Check No

<input type="checkbox"/>	Soil Cover
<input type="checkbox"/>	Residue Breakdown
<input type="checkbox"/>	Surface Crusts
<input type="checkbox"/>	Water-stable Aggregates
<input type="checkbox"/>	Soil Structure
<input type="checkbox"/>	Plant Roots
<input type="checkbox"/>	Biological Diversity
<input type="checkbox"/>	Biopores

Select RC or not

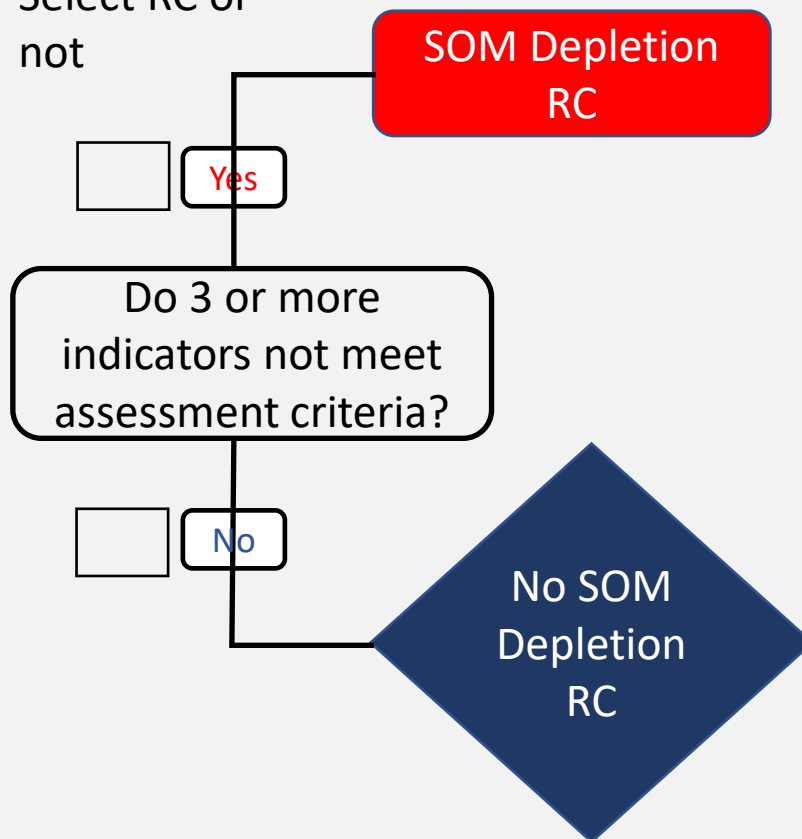


Soil Organic Matter Depletion Resource Concern Decision Tree

Check No

<input type="checkbox"/>	Soil Cover
<input type="checkbox"/>	Residue Breakdown
<input type="checkbox"/>	Water-stable Aggregates
<input type="checkbox"/>	Soil Structure
<input type="checkbox"/>	Soil Color
<input type="checkbox"/>	Plant Roots
<input type="checkbox"/>	Biological Diversity
<input type="checkbox"/>	Biopores

Select RC or
not

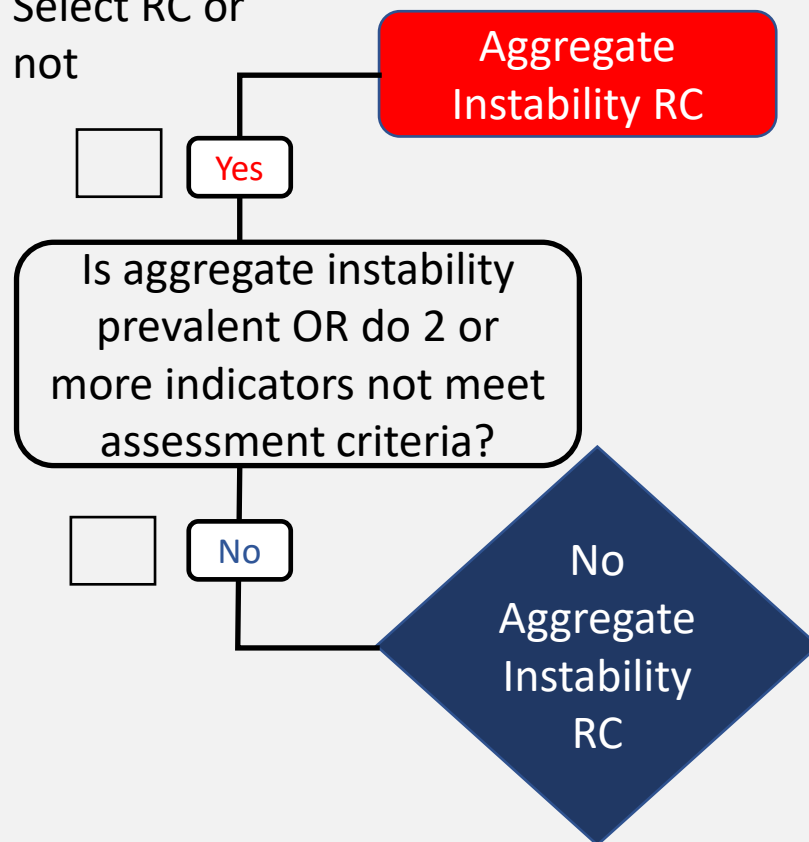


Aggregate Stability Resource Concern Decision Tree

Check No

<input type="checkbox"/>	Soil Cover
<input type="checkbox"/>	Surface Crusts
<input type="checkbox"/>	Ponding/Infiltration
<input type="checkbox"/>	Water-stable Aggregates
<input type="checkbox"/>	Soil Structure
<input type="checkbox"/>	Plant Roots
<input type="checkbox"/>	Biological Diversity
<input type="checkbox"/>	Biopores

Select RC or not



Rifsha an Fifsha pifsha

WSS/CART



https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Web Soil Survey - Home | Web Soil Survey

USDA United States Department of Agriculture
Natural Resources Conservation Service

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Area of Interest (AOI) | Soil Map | **Soil Data Explorer** | Download Soils Data | Shopping Cart (Free)

View Soil Information By Use: All Uses

Intro to Soils | **Suitabilities and Limitations for Use** | Soil Properties and Qualities | Ecological Site Assessment

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Agricultural Organic Soil
Farm and Garden Contamination
Fragile Soil Index
Organic Matter Depletion

View Options

Map ☒
Table ☒
Description of Rating ☒
Rating Options ☒
☐ Detailed Description

Advanced Options

View Description | View Rating

Soil Map

Legend

Scale (not to scale)

Description — Organic Matter Depletion

Soil Organic Matter Depletion

Soil health is primarily influenced by human soil survey data at this time. These interpret soil properties that influence our ability to b

A fertile and healthy soil is the basis for hez organic matter is the very foundation for he Understanding the role of organic matter in for developing ecologically sound agricultur: is identifying areas at greater risk of organi to accumulate in soil, the processes that sy to be greater than the processes that destr occur at continental and local scales. Contir annual temperature, which ultimately gover including both the synthesizing and destroy continental-scale factor is the amount of wa and soil microbes. The amount of available or snowmelt that an area receives ir ation does not take into account th

inental-scale factors are modified b accumulation and destruction of or by seasonal saturation, which gene precedent organic matter content is u. nerability to loss of organic matter. her oxidation rates but may still ac tions, such as ground cover, length and management practices. Clay-s compounds and so tend to favor ori nd surface also influences the orgai accumulate in concave areas while i ne degree of limitation caused by e sum of the ratings is the overall rat

gs are both verbal and numerical. ty of the individual soil properties t gs are shown in decimal fractions i ns between the point at which a soi rganic carbon depletion (1.00) and least likely to allow organic matter

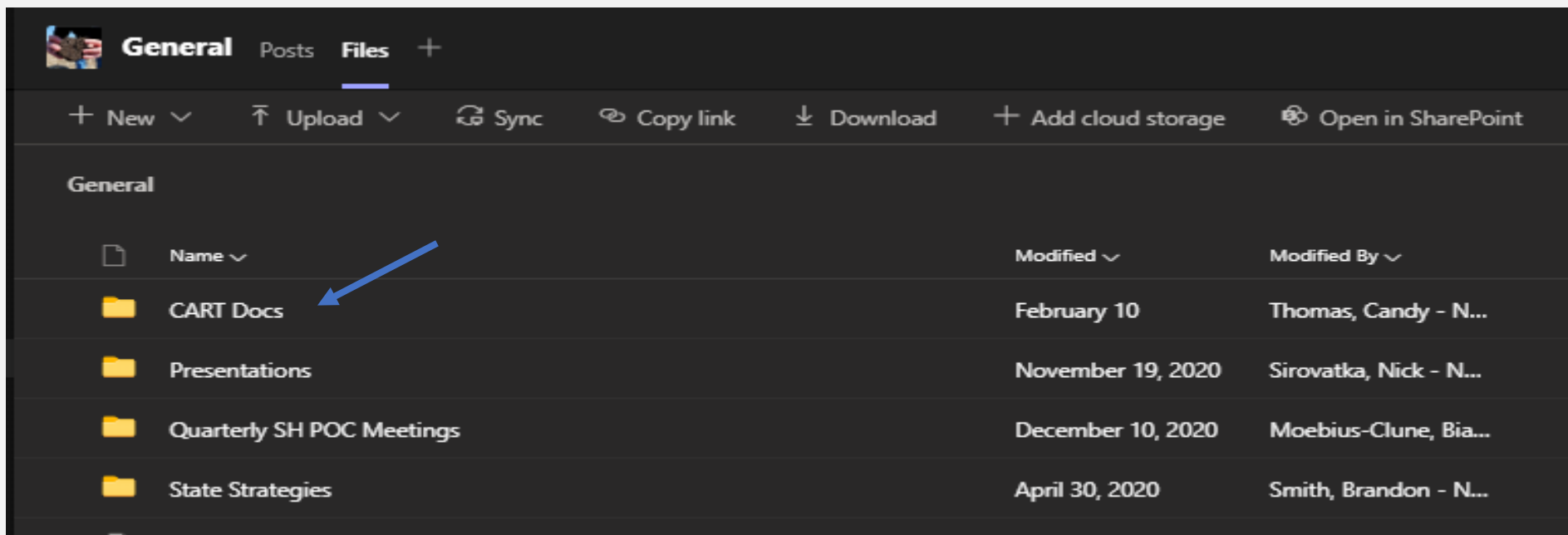
ass terms indicate the extent to wh matter. "Organic matter depletion f tures that are very conducive to th management will be needed to prev ls are farmed. "Organic matter dep lection moderate", and "Organic r of the level of management neede matter depletion low" indicates soi nic matter accumulation. These soil still maintaining favorable organic matter le

The map unit components listed for each m by Map Unit table in Web Soil Survey or the are determined by the aggregation method shown for each map unit. The components

Limitations to Soil Health Interpretations: They represent a soil's vulnerability based on inherent properties, but management is the primary driver of whether the resource concern is present. **Need site-specific information on cropping systems to properly assess soil health/indicators/interpretations (e.g., crop rotations, cover crops, irrigation system, irrigation water quality, soil stratification, soil texture, fertility, tillage, grazing, etc.)**

CART

Guidance Available



The screenshot shows a Microsoft Teams chat window with the 'Files' tab selected. The 'Files' tab is highlighted with a blue underline. Below the tab, there is a toolbar with options: '+ New', 'Upload', 'Sync', 'Copy link', 'Download', 'Add cloud storage', and 'Open in SharePoint'. Below the toolbar, there is a table of files and folders. A blue arrow points to the 'CART Docs' folder.

Name	Modified	Modified By
CART Docs	February 10	Thomas, Candy - N...
Presentations	November 19, 2020	Sirovatka, Nick - N...
Quarterly SH POC Meetings	December 10, 2020	Moebius-Clune, Bia...
State Strategies	April 30, 2020	Smith, Brandon - N...

Document for Supplemental Guidance for Soil Health Resource Concerns in CART is available in Teams- NRCS Soil Health Team- Files - CART Docs. It references the CART Manual- CART Version 3.0 And 2021 CART HELP Guide , the memo sent on 1/28/21, and the Most recent version of the IFSHA ver. 1.4 Jan. 2021, Survey 123 instructions

[CART Resource Concern Assessment Document Version 3](#)

[2021 Supplemental Guidance for Soil Health Assessment in CART](#)

CART Help Doc.

INPUT:

Use the dropdown arrows to select answers from the IFSHA Worksheet

Indicators	Yes or NO
Soil cover	Yes
Residue Breakdown	Yes
Surface Crusts	Yes
Pond/Infiltration	Yes
Penetration Resistance	No
Water Stable Agg	Yes
Soil Structure	Yes
Soil Color	No
Plant Roots	Yes
Bio Diversity	No
Biopores	No

Producer:

Evaluator:

Tract/Fld.:

Application #:

Clear Answers

The Green boxes will indicate if a Resource Concern is present. The Blue boxes will show which answer to select in CART.

RESULTS:

Soil OM depletion

Soil cover	No
Residue Breakdown	No
Water Stable Agg	No
Soil Structure	Yes
Soil Color	No
Plant Roots	Yes
Bio Diversity	Yes
Biopores	Yes

Numbers of No's	4
Number of YES's	4

Is this a Resource Concern? **yes**

CART Assessment Levels

None	-
Low	-
Med	MED
High	-

Compaction

Pond/Infiltration	N/A
Penetration Resistance	N/A
Water Stable Agg	No
Soil Structure	Yes
Plant Roots	Yes

Numbers of No's	1
Number of YES's	2

Is this a Resource Concern? **No**

CART Assessment Levels

Compaction is Significant	-
Compaction is NOT Significant	YES

Aggregate Instability

Soil cover	No
Surface Crusts	N/A
Pond/Infiltration	N/A
Water Stable Agg	No
Soil Structure	Yes
Plant Roots	Yes
Bio Diversity	Yes
Biopores	Yes

Numbers of No's	2
Number of YES's	4

Is this a Resource Concern? **yes**

CART Assessment Levels

None	-
Low	Low
Med	-
High	-

Soil Org. Habitat

Soil cover	No
Residue Breakdown	No
Surface Crusts	N/A
Water Stable Agg	No
Soil Structure	Yes
Plant Roots	Yes
Bio Diversity	Yes
Biopores	Yes

Numbers of No's	3
Number of YES's	4

Is this a Resource Concern? **yes**

CART Assessment Levels

None	-
Low	-
Med	MED
High	-

as both Low and Med. It is the planners discretion which is the most appropriate as it is not defined in CART criteria. Although special emphasis is put on Water Stable Aggregates.

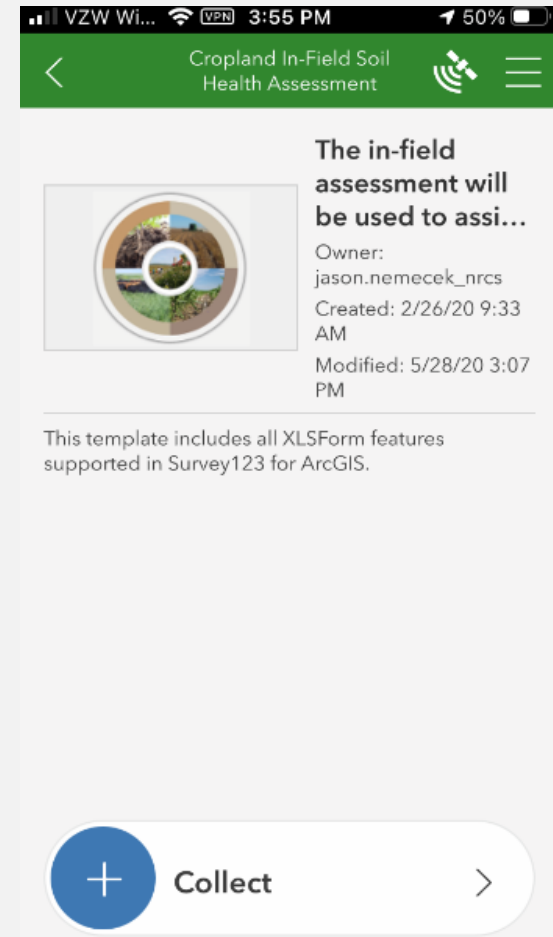
Cart
Help
Doc.

CART DEMO

Bring in Cart Expert to demonstrate how to select the appropriate RC given a completed IFSHA

Survey 123

- Georeferenced IFSHA
- Resource concerns documented
- CART category determined: none, low, medium, High
- Note taking and photo capability





This information is provided as a public service and constitutes no endorsement by the United States Department of Agriculture or the Natural Resources Conservation Service of any service, supply, or equipment listed.

While an effort has been made to provide a complete and accurate listing of services, supplies, and equipment, omissions or other errors may occur and, therefore, other available sources of information should be consulted.

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Meeh, NRCS

EXTRA SLIDES

IN CASE OF INCLEMENT WEATHER SLIDES BELOW CAN BE USED
IF YOU CAN'T GO TO THE FIELD.

A photograph of a field showing the remains of a corn crop. The ground is covered with dark brown soil, numerous dry, broken corn stalks, and scattered corn leaves. Patches of green grass are visible, particularly on the right side of the frame. The scene is captured from a slightly elevated angle, showing the texture of the soil and the debris of the previous crop.

A field of seed corn stubble just before
planting soybean

Residue Breakdown

- Natural shredding and decomposition of residues
- Don't want a corn stalk to see its 3rd birthday
- Biological activity
- C:N Ratios
- Nutrient cycling



Indicator: Surface Crusts



Indicator: Penetration Resistance

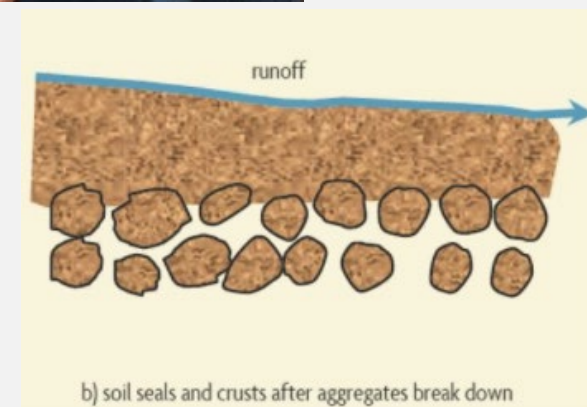
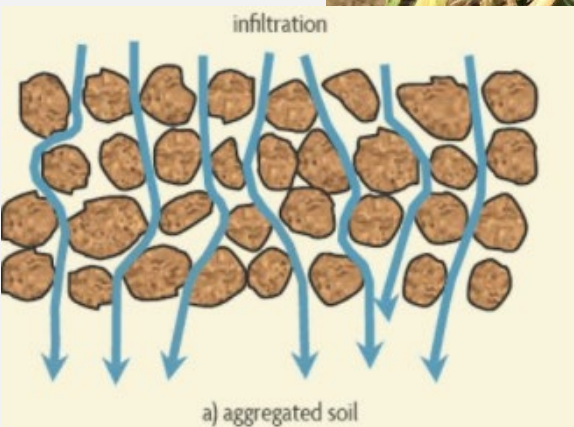


UW- Extension

https://www.youtube.com/watch?v=Zq_785JqRq8



Manage for Water Stable Aggregates



Slake test



Slump Test



Soil Structure



Indicators: Roots and Biopores



Rye Root, Soybean root and earthworm sharing the same biopore

Biological Diversity

