Chapter 11  Soil Stability Test

11.1 Overview
This chapter covers data elements relating to

- Soil Surface Stability

11.2 What’s New

- Update of section 11.4.1 Conditions for Data Collection to reflect updates to land cover/use codes in Chapter 6.

11.3 Critical Points to Remember

- This procedure will require some practice to become proficient.
- Walk on the south side of the transect line to avoid disturbing vegetation and soil particles.
- Acquire surface soil samples at least two inches away from the transect line to avoid disturbing data collection points.
- Canopy cover for soil aggregate stability to exclude annual plants and include only biennial plants, perennial plants, shrubs and trees.
11.4 Preliminary Steps

11.4.1 Conditions for Data Collection

- For the non-Federal range sample, soil aggregate stability data are documented for non-Federal points with land cover/use 2001 Grassland defined as range or 2201 Scrub Shrub defined as range; and optionally for 2000 Grassland not defined as range or 2200 Scrub Shrub not defined as range.
- For the non-Federal pasture sample, soil aggregate stability data are documented for non-Federal points with land cover/use 2001 Grassland defined as range or 2201 Scrub Shrub defined as range; and optionally for 2000 Grassland not defined as range or 2200 Scrub Shrub not defined as range.
- For the BLM range sample, soil aggregate stability data are documented for BLM-managed Federal points with land cover/use 2001 Grassland defined as range or 2201 Scrub Shrub defined as range.

11.4.2 Ancillary Resources

The following resources may be useful in collecting data for this chapter:


11.5 Data Collection Procedure for Soil Stability

11.5.1 Equipment

- Soil stability test kit (provided)
- Deionized water (any noncarbonated bottled water except mineral water (1 quart per test)
- Stopwatch or chronograph watch (CASI also provides timer)
- Small spray bottle (atomizer or equivalent with very fine mist)

11.5.2 Definitions

**Soil aggregate stability.** Soils vary in the degree to which they are vulnerable to externally imposed destructive forces. Aggregate stability is a measure of this vulnerability. For example, soil structure may begin to deteriorate visibly and rapidly as the soil surface is subjected to destructive forces such as repeated traffic, machinery, cultivation, hoof impact, and water and wind erosion. [NRI-03-Range]

**Soil Stability Test.** This test provides information about the integrity of soil aggregates, soil structural development, and erosion resistance. The test measures the stability of the soil when exposed to rapid wetting. Soil aggregate stability is affected by texture (soil particle size) and biotic and mineral constituents that may be present. [NRI-03-Range]
11.5.3 Procedure

1. Start at the zero (0.0) end of the NE-SW transect (transect 1). Select small surface samples from the selected transect marks. The number of samples will vary depending upon whether you selected the NRI or ecological site data collection option.

Note: If the point can be used for ESD documentation, the CASI will provide 18 sub-plots for soil stability at transect marks 15, 30, 45, 60, 75, 90, 105, 120, and 135 on each transect. If the NRI data collection option is selected (see Chapter 8 for more information), only 9 subplots (5 from the NE/SW transect and 4 from the NW/SE transect will be sampled.

- Always sample at least 2 inches from any vegetation measurement line.
- As a rule of thumb, obtain samples one stability box length away from the transect line.
- If a surface root mat, moss, duff or water (on the soil surface) is present, the procedure need not be completed. Select root mat with or without canopy from the CASI choice list and move to the next mark.
- Always walk on the south side of the transect tape and obtain sample from the undisturbed area along the transect line.

2. Record the presence or absence of canopy for the sample in the CASI screen in the corresponding entry cell.

- Canopy is recorded as present if there is at least 50 percent canopy over the sample.
- Canopy cover for soil aggregate stability to exclude annual plants and include only biennial plants, perennial plants, shrubs and trees.

3. Excavate a small trench 1/2 inch deep in front of the area to be sampled (fig. 11-1).

4. Use the spatula to lift a surface fragment (soil ped) from the trench (fig. 11-2). The size should be 1/4 inch (6-8 mm) in diameter and no more than 1/8 inch (2-3 mm) thick. Do not shatter the soil fragment during sampling. It may work best to lift out a larger fragment and carefully break it down to the desired size.

- If the sample mark was disturbed by previous measurements or is covered by rock (>1/4 inch diameter), water, or embedded litter (i.e., removal of litter disturbs soil surface and/or leaves an indentation in the soil’s surface), randomly select another point by moving 1/2
foot down the line. Repeat until you reach an appropriate sampling point. All samples must be at least 5 ft apart.

Special circumstances:

- **Lichen on soil**: sample and test the lichen (it is often a stability class 6).
- **Moss on soil**: Code as a root mat in the CASI, move to the next soil stability mrk.
- **Duff on soil**: Code as a root mat in the CASI. Duff is the layer just below litter. It consists of decomposing leaves and other organic material. There should be NO recognizable plant parts. The duff layer is usually dark decomposed organic matter. The bottom of the duff layer is the point where mineral soil (A horizon) begins.
- **Plant base**: remove a sample from inside the plant base or as close as possible to the edge of the plant base.
- **Water**: As part of a wetland site, code as a root mat in the CASI.

**Note:** If the sample is too weakly structured (falls through sieve), mist it lightly with water using an atomizer or equivalent, and then take the sample. If this procedure fails to produce an adequate sample, rate the sample a 1 (see step 9 - ratings).

5. Gently place the sample in a dry sieve (fig. 11-3) and place in the dry box beginning in the top left corner.

6. Repeat this procedure for each of the selected mrks on both transects (1 and 2) placing samples top to bottom and left to right. This results in 9 samples placed in the dry box as shown in figure 11-4 (18 if used for ecological site documentation).

- The samples must be dry before proceeding with the test. If not dry, allow the samples to air dry with the lid off the collection box.
- Do not leave the lid closed on the samples for more than 1 minute on hot/sunny days. Excessive heat can significantly increase humidity in the sample box, which will affect the stability test.

7. Fill the water box with deionized or distilled water (fig. 11-5).

- Fill each compartment to the top.
- The water should be approximately the same temperature as the soil (no melted snow).
- If the sample is hydrophobic (floats on the water surface) push it under the water until it no longer floats on top.

8. Test the samples following the sequence listed below:

- Lower the first sieve into the upper left cell (other box, same cell as it came from)
- It should take 1 second from the time the screen touches the water until it rests on the bottom.
Soil Stability Test

- Start the stopwatch or CASI timer when the first sample touches the water.
- Follow the sequence of immersions, adding one sample every 15 seconds, top to bottom, left to right (see fig. 11-4).
- Observe the samples for 5 minutes (300 seconds).
- Stability rating codes 0-3 are reserved for samples that show loss of structural integrity prior to 300 seconds (see rating description).
- After exactly 5 minutes, raise the basket completely out of the water and then lower it nearly to the bottom (do not allow it to bump the bottom). Repeat this immersion five times. Carefully note the condition of the soil samples and use the table below to rate them. **Do this even if you already rated the sample 1, 2, or 3. (You are allowed to change your rating based on the sieving.)** It should take about 1 second for the basket to clear the surface of the water and 1 second to lower it to the bottom (total 10 seconds to sieve).

9. Record the soil stability rating information in the CASI entry screen.

- The test kit is set up with three rows of six columns (you only need to use 3 columns if point is not for ecological site documentation). Care should be taken to enter the ratings in the right order.
- Rate the sample based on the amount of soil remaining and call out stability class to the individual recording data in the CASI. Do not include sand and gravel particles that cannot pass through the sieve.

**CASI screen choices:**

1 = 50% of structural integrity lost, (melts) within 5 seconds of immersion in water OR soil too unstable to sample (falls through the sieve) **AND** less than 10% remains after 5 dipping cycles

2 = 50% of structural integrity lost, (melts) 5-30 seconds after immersion **AND** less than 10% remains after 5 dipping cycles

3 = 50% of structural integrity lost, (melts) 30-300 seconds after immersion **OR** < 10% remains on the sieve after 5 dipping cycles.

4 = 10-25% of original soil material remains on the sieve after 5 dipping cycles

5 = 25-75% of original soil material remains on the sieve after 5 dipping cycles

6 = 75-100% of original soil material remains on the sieve after 5 dipping cycles
11.6 Supporting Materials

The following example photos illustrating stability class ratings show the key steps of testing soil samples for four stability ratings. Some of the fragments shown in these samples may appear large. They are for illustration only. Be sure to follow the fragment size guidelines (1/4 inch diameter and no more than 1/8 inch thick).

**Sequence for stability class = 1**

Original sample  After 5 seconds  After 5 minutes  After 5 dips

**Sequence for stability class = 4**

Original sample  After 5 seconds  After 5 minutes  After 5 dips

**Sequence for stability class = 5**

Original sample  After 5 seconds  After 5 minutes  After 5 dips

**Sequence for stability class = 6**

Original sample  After 5 seconds  After 5 minutes  After 5 dips