Soil Restoration: What we have learned.

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Fix Root causes of problems as well as bandaging the wounds.

- Remove the nail in the sole of your boot and buy a new pair of socks.
- Problems associated with runoff are often symptoms of reduced infiltration resulting from poor soil health, thus the solution is to fix the health of the soil

Soil Functions
A Guide to Restoration

- Medium for Plant Growth
- Regulator of Water Supplies
- Modifier of the Atmosphere
- Recycler of Raw Materials
- Habitat for Soil Organisms
- Engineering Medium

  – 14th Ed. The Nature and Properties of Soils

Secret to Reducing Runoff

Put it in the ground as close to where it falls as possible

- Reduce the collection of water to one place
- Spread the infiltration of water over the largest area. Utilize safe outlets in the woods
  - Build
    - Depressional woodlands as
      - Multi-chambered basin like a cranberry bog (200')
      - Multi-basined waterway with drop structure
  - Remove
    - Low flow channels

Basic Conditions

Increase Upland Infiltration to Improve Basin functioning

	Disturbed	Degraded Functions	Natural	Functions Maintained
Upland Little water	Abrupt layers Compacted/ Lifeless	Reduced growth Elevated runoff	Uncompacted/ Alive	Good Filter Meters water
Basin Big water can become water compacted	Abrupt Layers Compacted	Reduced growth Poor filter Lo Infiltration	Uncompacted? /Alive	Poor filter High infiltration

Mimic the Natural Soil

- Disturbed
  - C or A-C horizon
  - Hi/variable SOM on a % wt. basis
    - Hi SOM on a % wt. basis
    - Lo SOM on areal
  - Exposed mineral
  - High Density in surface
  - All pores uniform sized
  - Pores unconnected
  - No organisms
  - Often saturated
- Natural
  - O-A-B-C horizons
  - SOM concentrated at surface and distributed to lower depths
  - Organic blanket
  - High density with depth
  - Mixture pore sizes
  - Pores connected in a net
  - Ants or earthworms
  - Seldom saturated

Construction/Rehab Soil

- These processes are all inter-connected
  - Additions
    - Adding compost, increasing aeration
  - Depletions
    - Leaching, gaseous losses, organic matter removed
  - Transformations
    - Avoiding reducing iron and manganese
  - Translocation

Don’t attempt to Fix what is not broken!

- Soil Assessment First
  - Saves time and Money and avoids doing more harm than good!!
  - Is it so bad that it will not self correct without mechanical treatment?
  - What minimium surface depth would need to be restored to be equal or better than subsurface?
  - What precautions should be in place?

Soil Assessment

- Rod test, if it passes to >20” and the surface of 6” has a distinctly dark surface and visible organisms.
- Bulk Density
- Ksat
- Texture
- pH and % SOM to calculate total areal SOC

Biological Activities
Capture the Sun's Energy

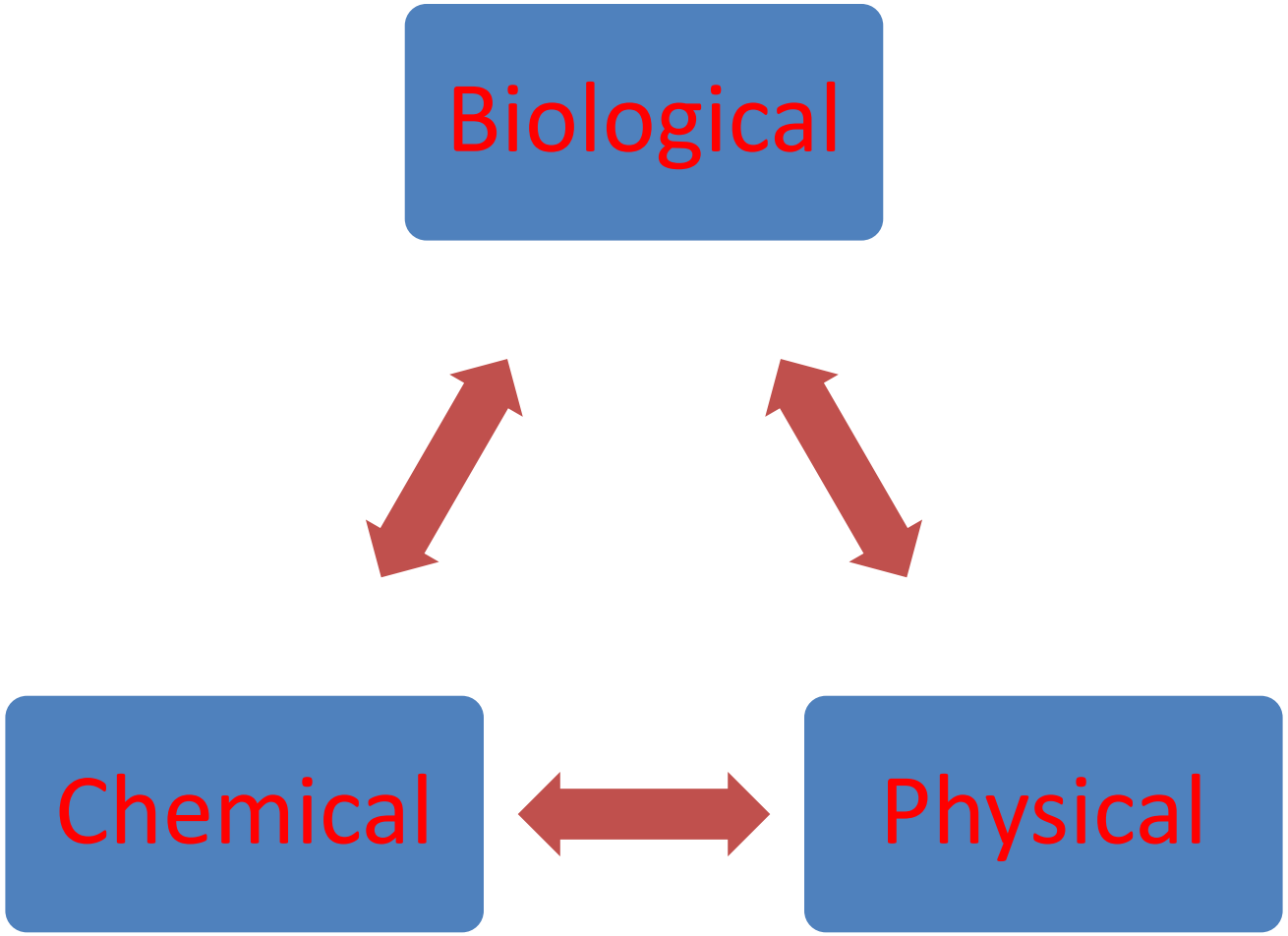
Add Soil Organic Matter

- Plant growth, green manure
- Compost
- Slow steady aeration
- Keep it on the surface
- Forest and Fungus
  - Hi C:N ratio
- Low Albedo - Hi Entropy
  - Cool and moist
- Innoculate

Subtract Soil Organic Matter

- Worms and deer
- N Fertilizer
- Tillage and Incorporation
- Incorporation
- Grass and bacteria
  - Low C:N ratio
- Hi Albedo – Lo Entropy
  - Hot and dry
- Wait for life to return

All three factors interrelated



Chemical Environment

controls direction/efficiency of biological

Desirable for forest landuse

- Lo pH favors Oak/Pine
- Lo pH favors Oak/Hickory
- Lo pH favors forest
- Lo pH stable aggregates biologically in long run

Undesirable for forest landuse

- Hi pH favors Maple
- Hi pH favors grass
- Hi pH stable aggregates electrically

Physical Factor Activities

Leave no trace, walk on it as if you needed snowshoes

Favors Health

- Add fractures to create macropores , however, must stabilize chemically and biologically to maintain

Degrades health

- Too much or little aeration
- Heavy traffic, consider both the Ground pressure (psi)and the total loading(double the weight with the same psi means twice as wide and twice as deep)
- Wait until the soil is dry enough to gain strength (<5% water)

Dos and Don’ts

Do

- Dig and Drop only when the natural structure would be single grained, and have only particle to particle pores at most.

Don’t

- Dig up extra courser soil from below to create a blend of more sandy mix. It will not be enough sand to achieve single grain, and it will not develop aggregate porosity before forming a massive self compacted impermeable layer.

Surface Horizons
Figure 3-13 NSSM

- Mechanically bulked
- Mechanically compact
- Water compacted, repetitive occurrence of free water

- Tillage - loose & friable
- Traffic pan - dense
- Action of large changes in water state without mechanical load except for the weight of the soil. Weak to massive

- Crust <2”
- Fluventic Zone <2”

- Compaction by rain
- Transported materials