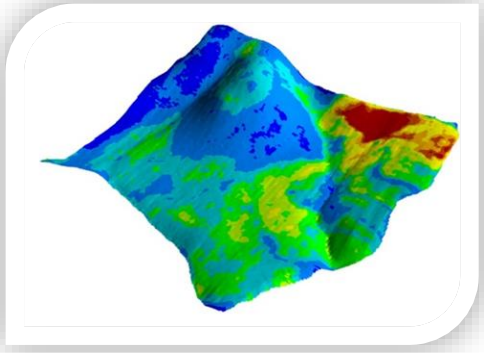
LandStream

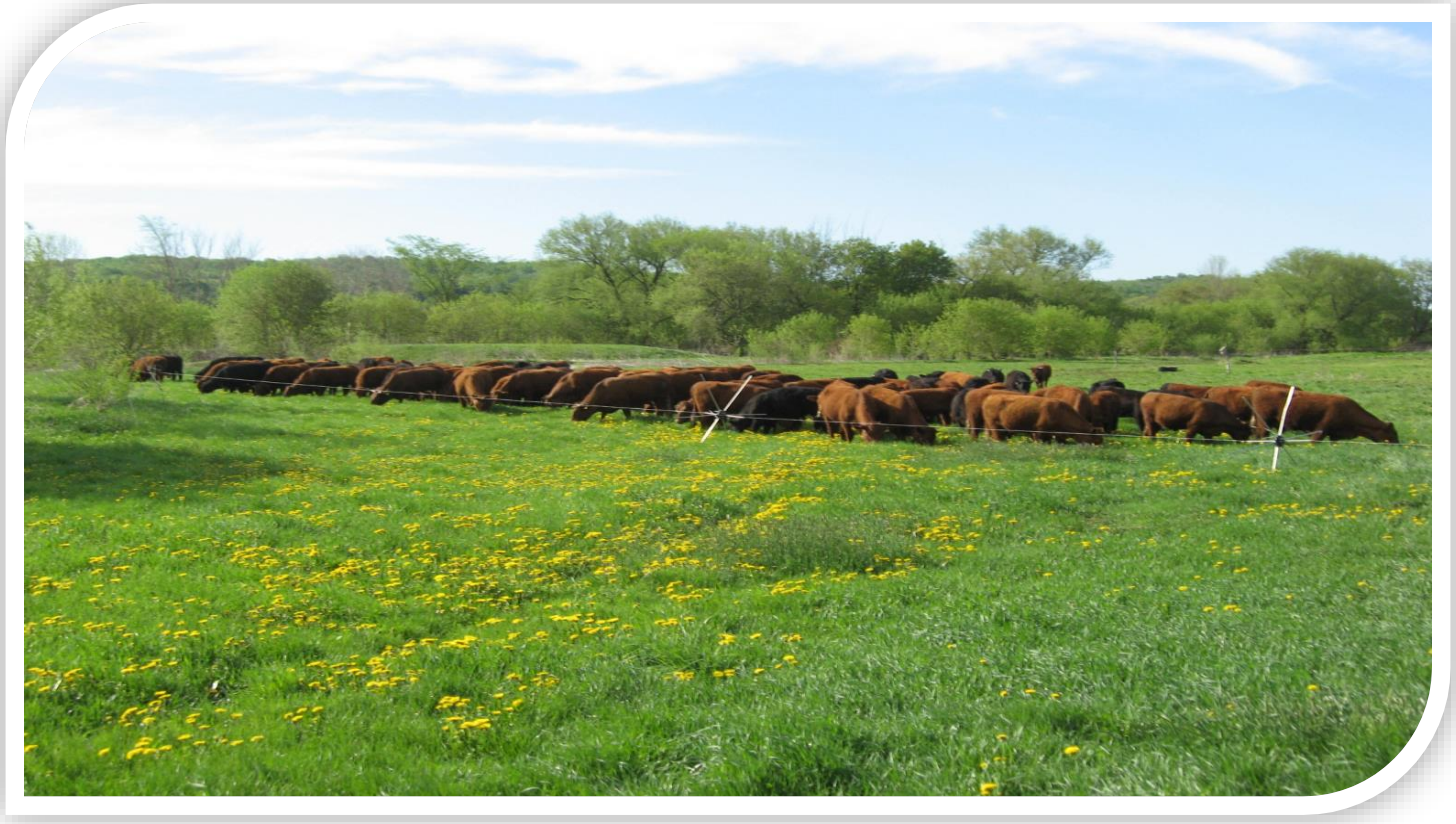
Grow Strong Land

Growing Deep-Topsoil, Clean-Water Watersheds: The Monitoring BMP to Grow Vermont's Base-Infrastructure



Abe Collins
LandStream
(802) 782-1883 abenewsoil@gmail.com

Healthy, covered, aggregated topsoil: the root source of clean water and flooding regulation.

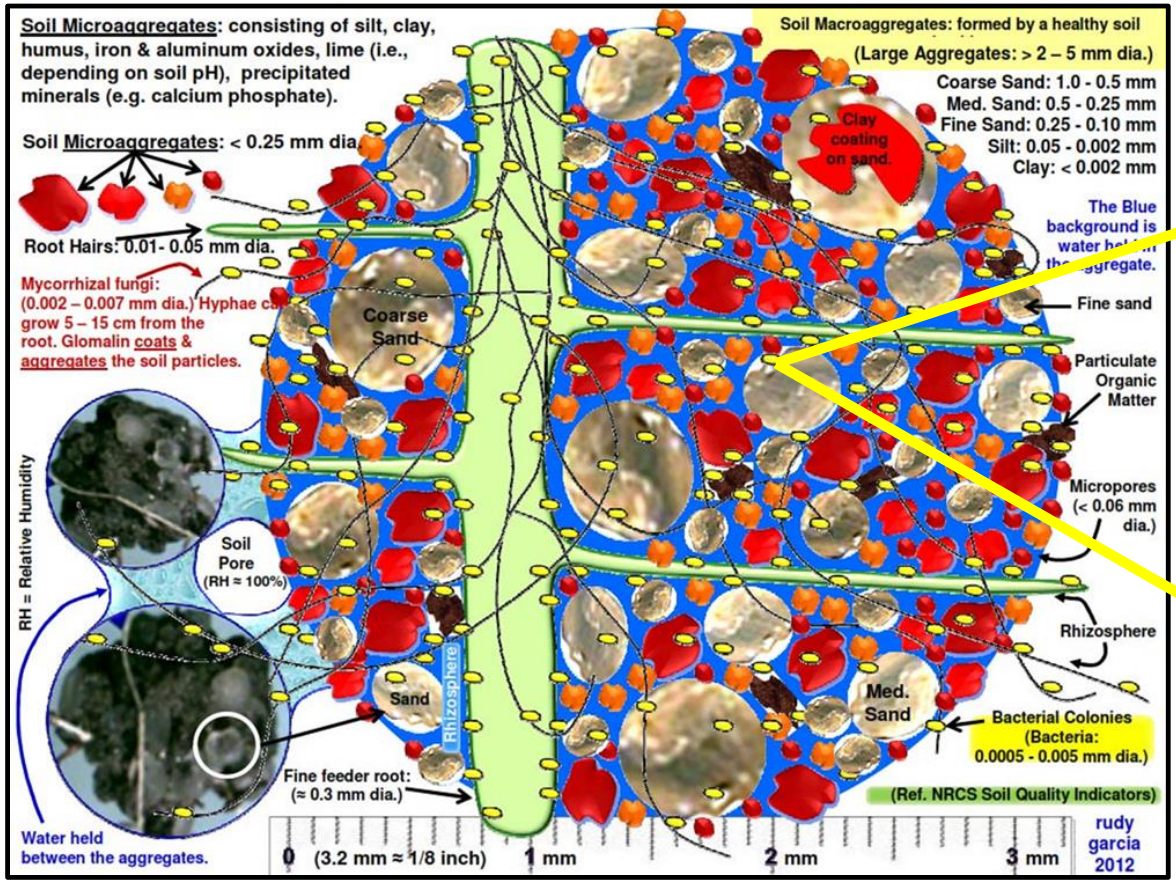


Grow Topsoil to Grow Clean Water

- "Every era has been shaped by its response to the great water challenge of its time....those societies that find the most innovative responses to the crisis are most likely to come out as winners."

-- *Steven Solomon, Water - The Epic Struggle for Wealth, Power and Civilization*

The soil aggregate is the fundamental unit of infrastructure.



The Living Landscape Sponge

Infiltrate, Hold, Purify, Slowly Release

16
17
18
19
20

Who can grow new topsoil and clean water?

Farmers.

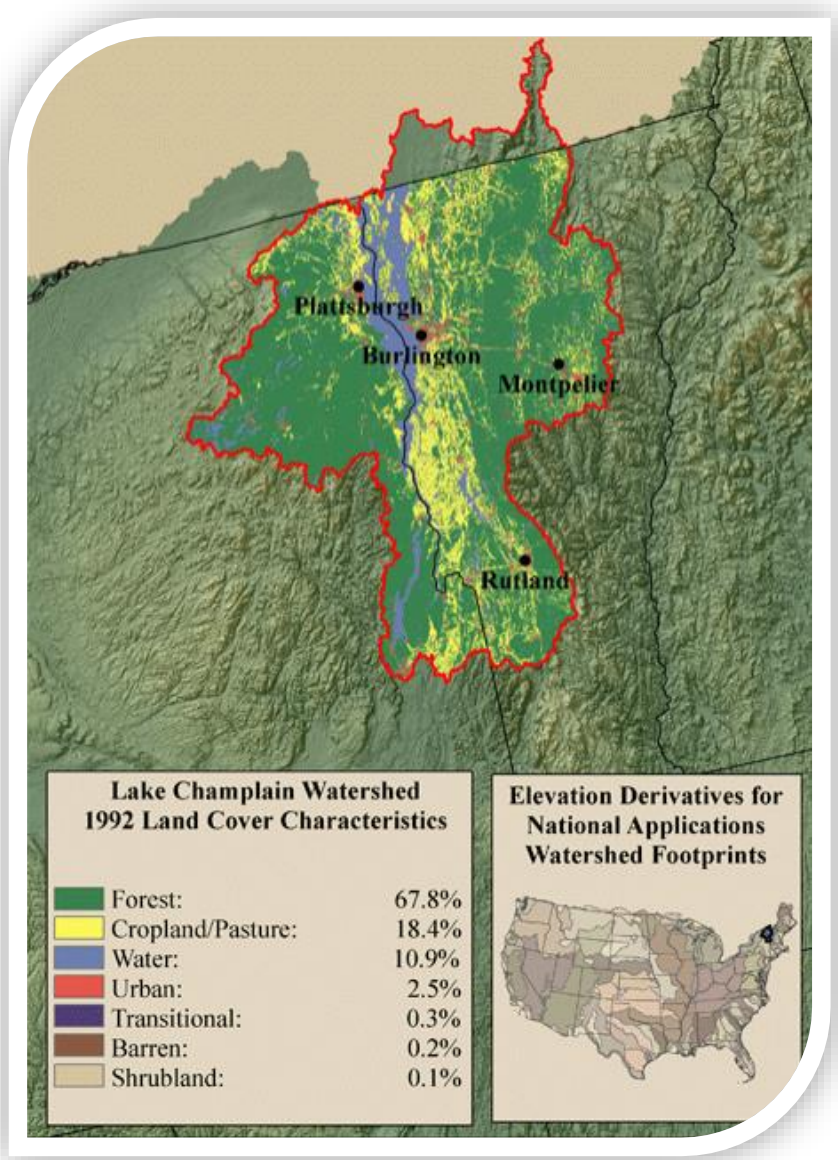
What do we need to grow new topsoil and clean water?

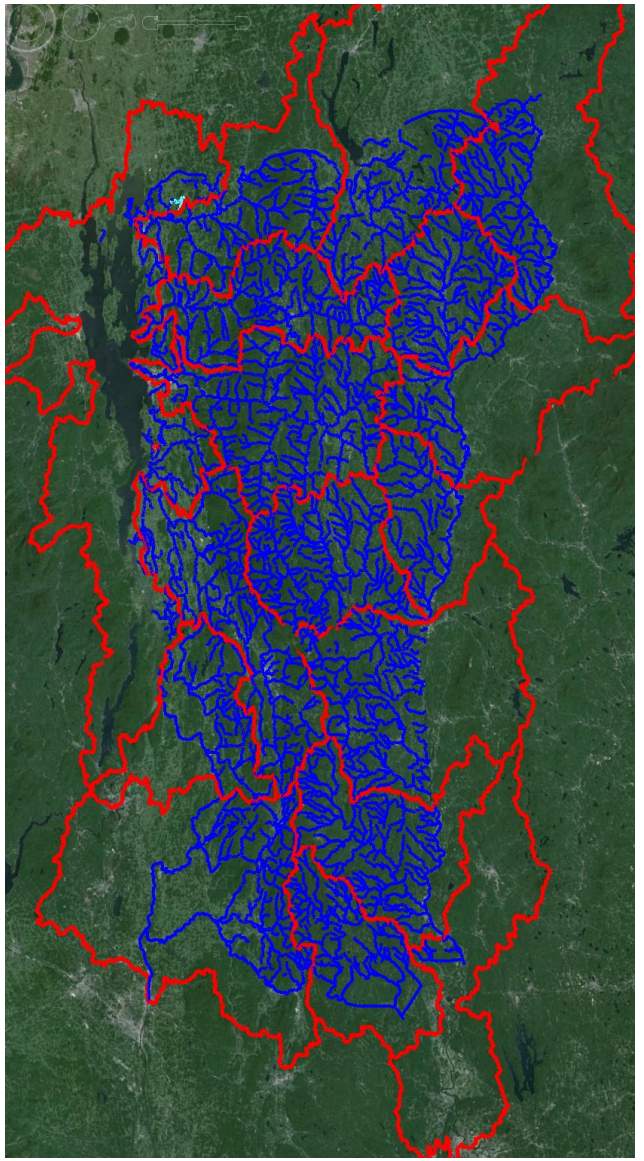
Growing a 16X Reduction in Runoff

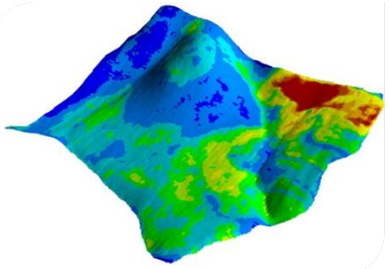
- Gabe Brown's 4,000 acre farm in North Dakota:
  - 265% increase in organic matter in 11 years
  - 16-fold increase in water infiltration: ½"/hour to 8/hour
  - 13.6" of rain in 22 hours: little runoff, zero erosion
  - 0-10% fertilizer use of the county average
  - 0-25% herbicide use of the county average
  - 117 bushel corn yield compared to 70 bushel county average

~ 5.3 million acres total
~ 1 million acres of agriculture

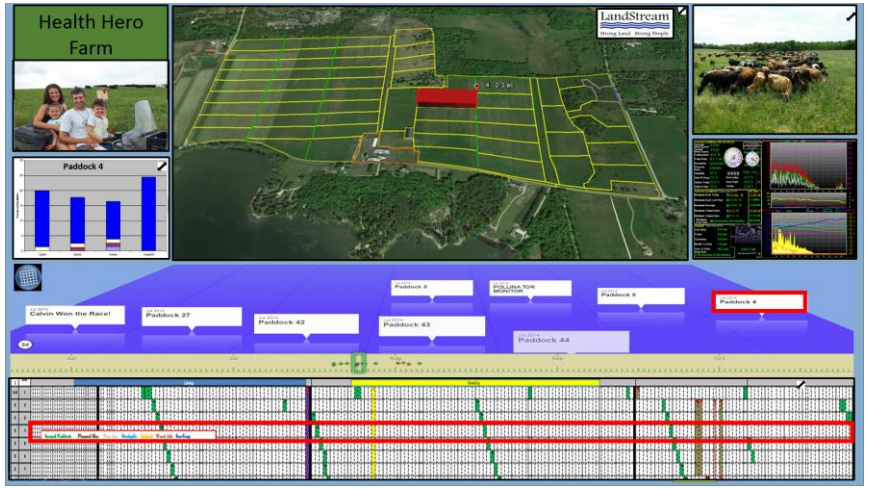
Can we grow deep-topsoil, water-secure watersheds in a decade?

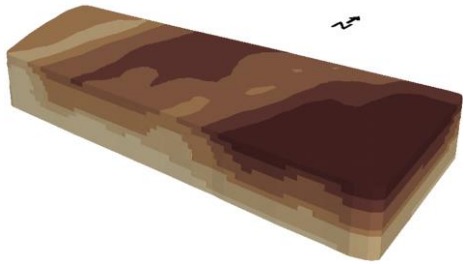


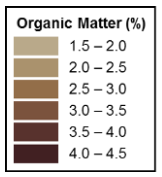


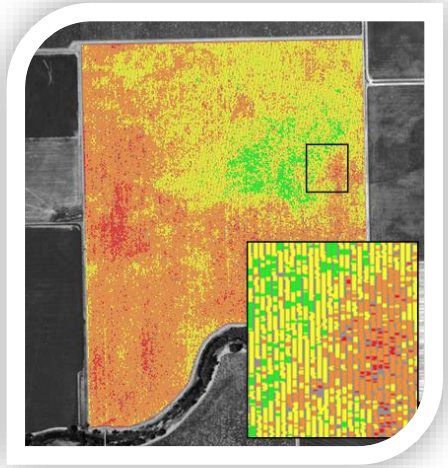


Soil Monitoring and Mapping

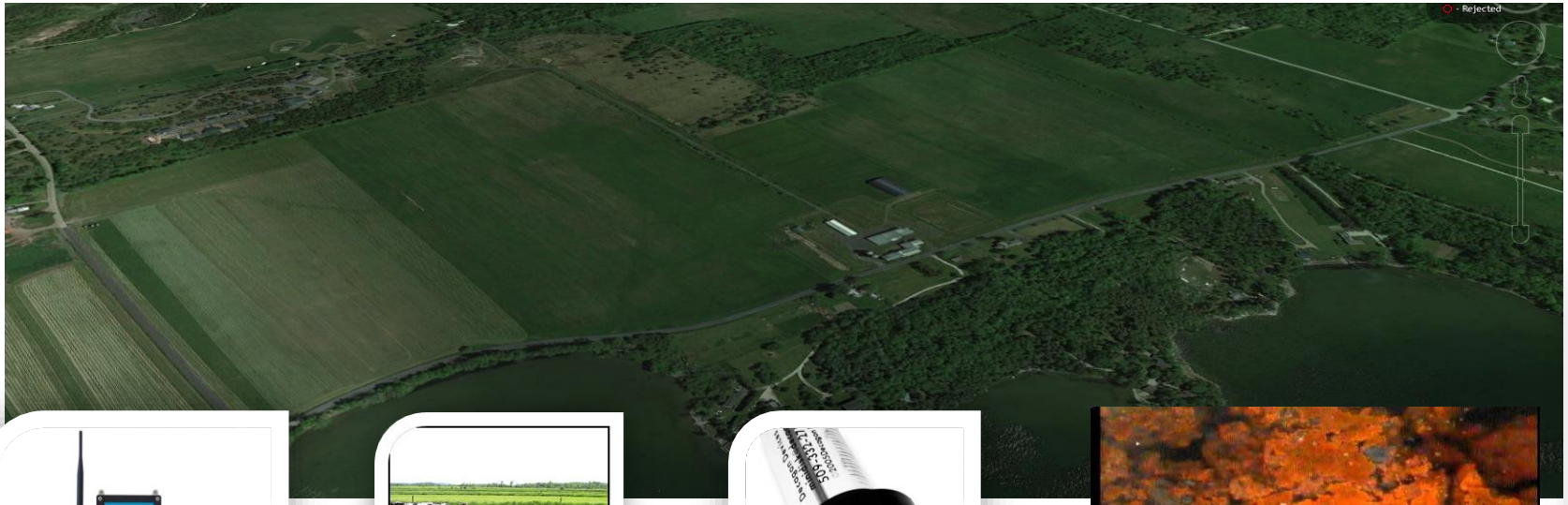


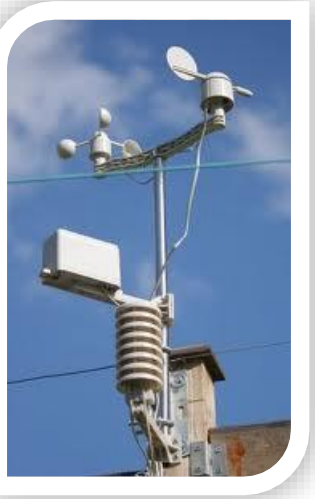






Photosynthesis: Landscape Work Quantification





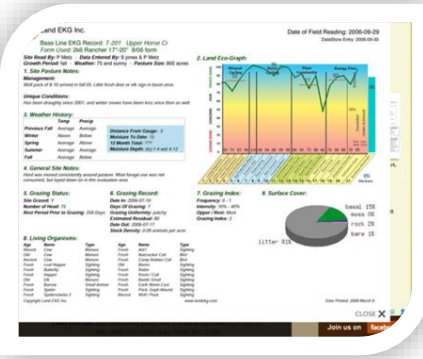
Weather

Water Flow and Quality

Ag Yield

Soil-Water Dynamics

Aggregate Characterization



Soil Surface, Biodiversity, Forage

Watershed Metrics

Reading Monthly-Yearly Photosynthesis and Soil Capacity to Infiltrate, Purify and Slowly Release Water, Plus Weather, Water Flow and Quality

Correlate Farmer Dashboards and Stream Quality/Flow Monitoring

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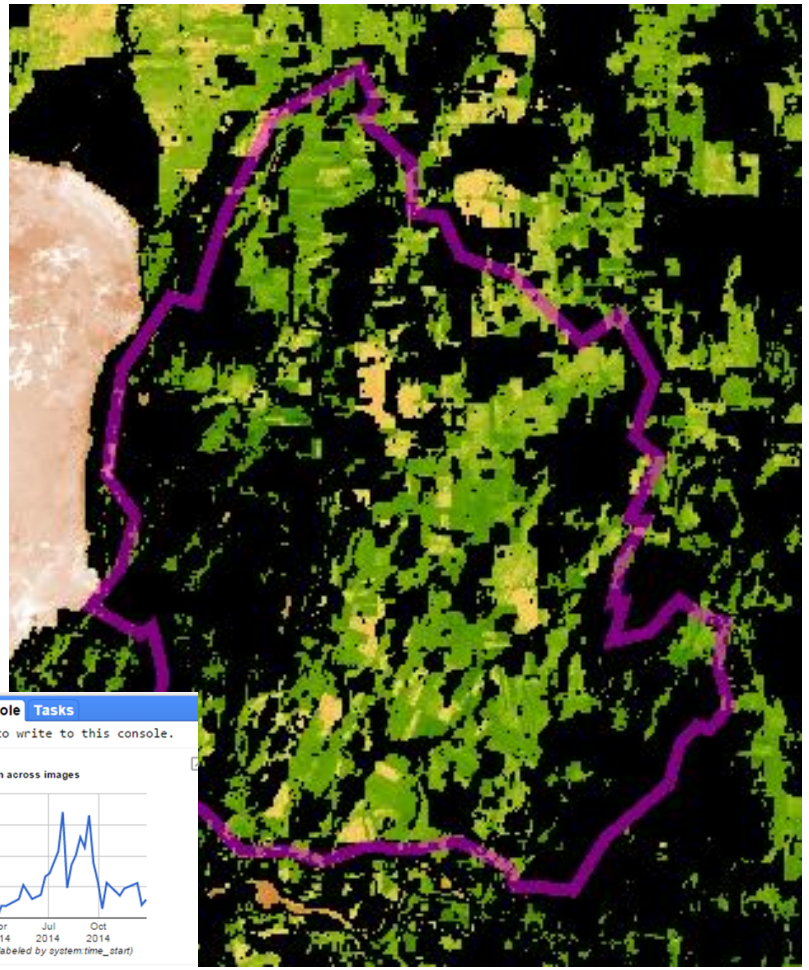
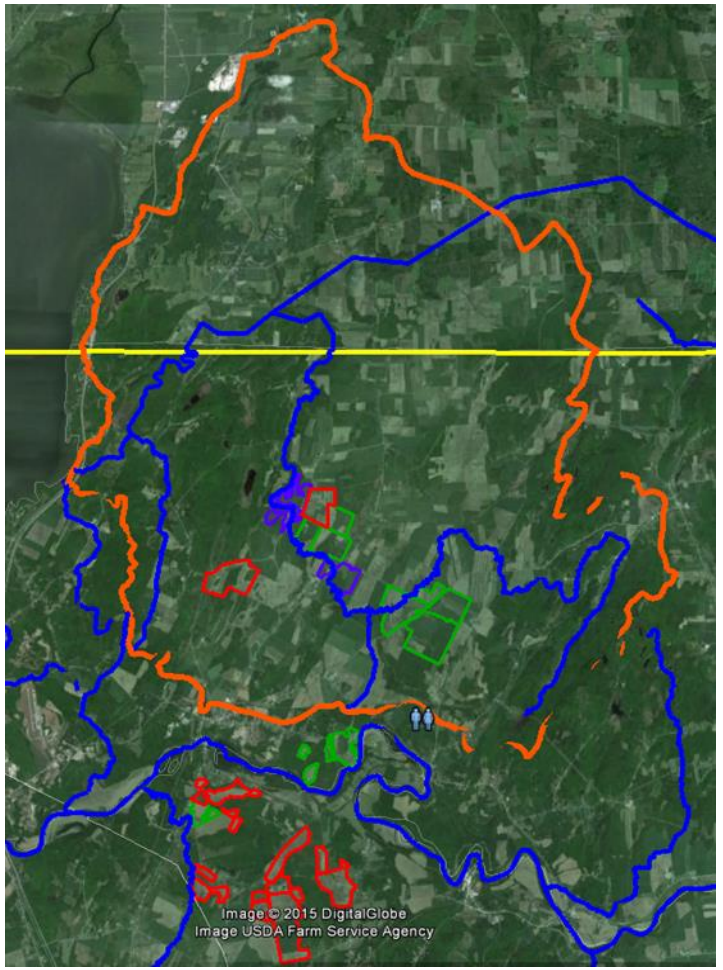
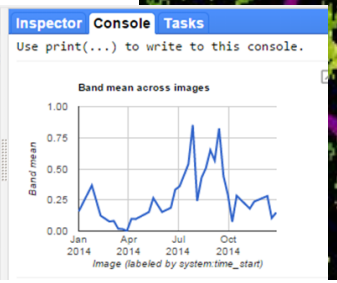
Landsat 8 imagery: Median Normalized Difference Vegetation Index for Calendar Year 2014:

Proxy for average photosynthesis over 2014.







Clean Water as A Crop

- Forbes: The $8 Billion Bargain: How Watershed Payments Save Cities, Support Farms And Combat Climate Change

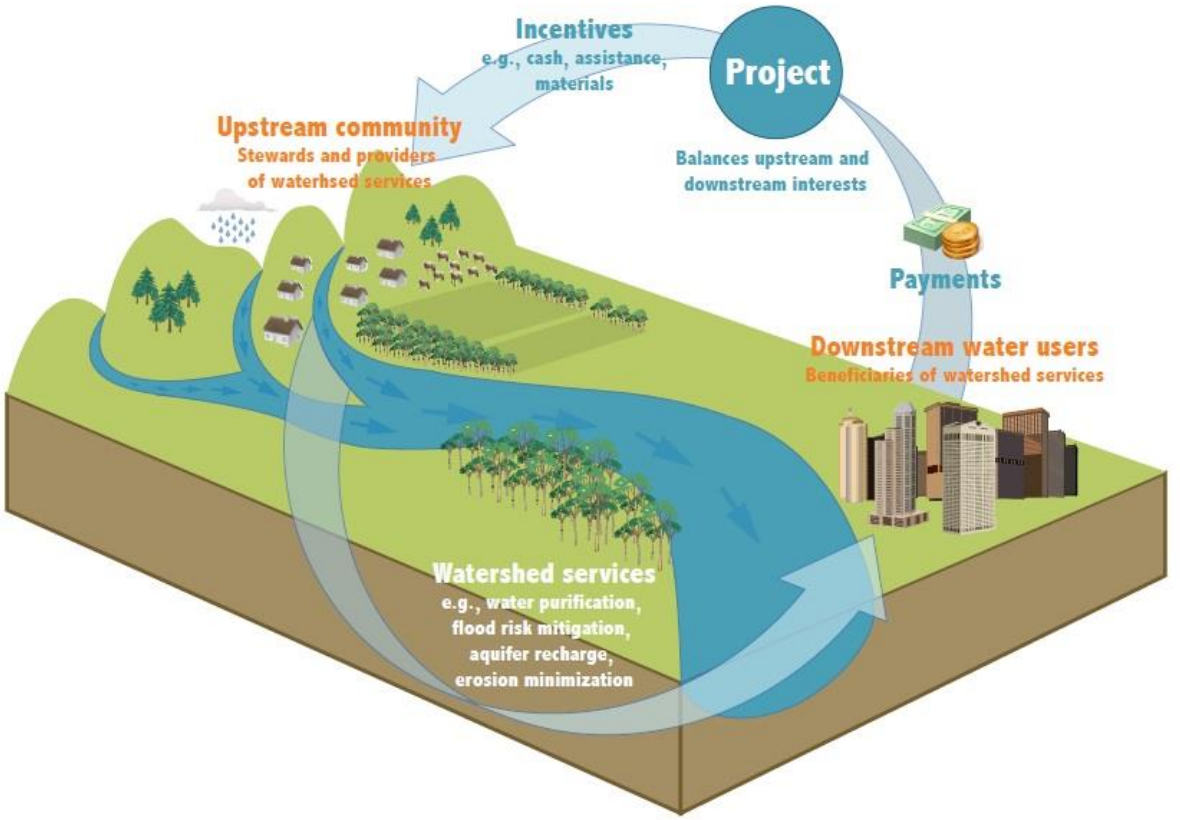
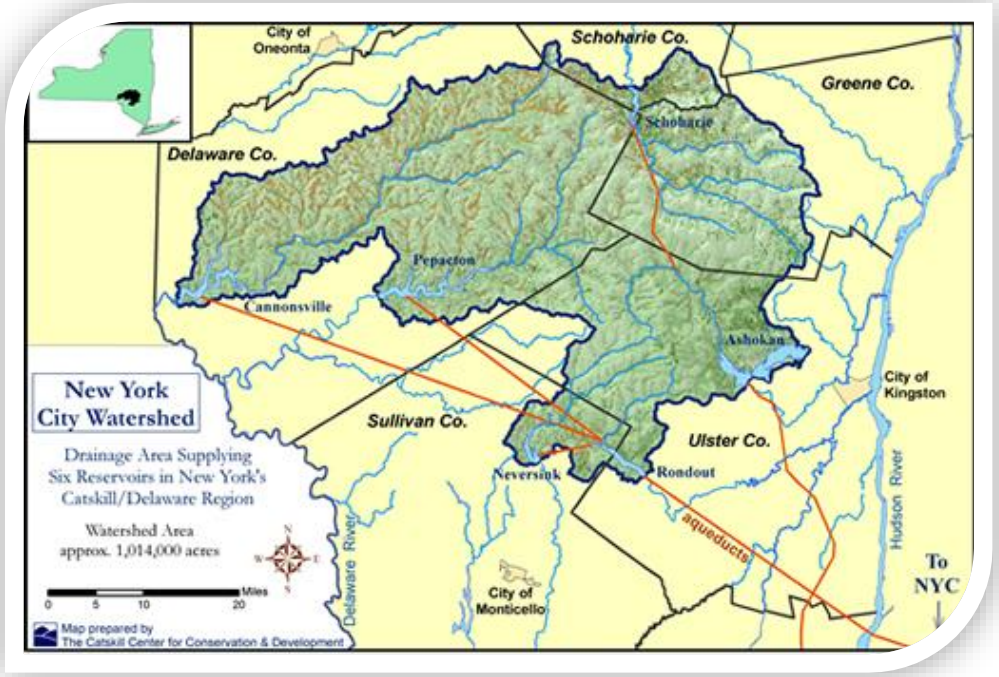


Image: Forbes Magazine

NYC and the Catskill Watershed



"Watershed communities have to be your partner in protecting the system, and there's no amount of mechanical systems or science that's going to protect the water unless people in the watershed are your partner in protecting it." *Marilyn Garber, Commissioner, NYC Department of Environmental Protection*

"We've become a water-exporting region." *Alan Rosa, Director, Catskill Watershed Corporation*

"More than 140 US cities are considering watershed conservation instead of building filtration plants."

Two Perspectives, Two Futures

Topsoil is non-renewable

Conserve what's left. Continually solve the problems that are symptoms of degraded soil.

Reduce P/N loading. Reduce erosion. Clean up after floods.

Topsoil is renewable

Grow new topsoil in our watersheds. Support the soil-growers. Monitor to complete the feedback loop. Be creative. Cooperate. Get to work.

The Regenerative Agricultural Canon

~ 40 tools over 115 Years

Dairy One

DAIRY ONE Forage Analysis Laboratory
730 Warren Rd. Ithaca, NY 14850
Telephone: 607-257-1272 Ext. 172 Fax: 607-257-1350

LIVESTOCK WATER ANALYSIS REPORT

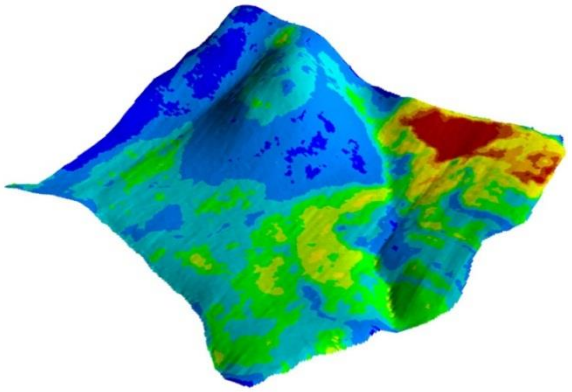
Sample Number: 20106360
Date Sampled:
Date Received: 01/14/2014
Date Mailed: 01/21/2014
Description: STREAM #1

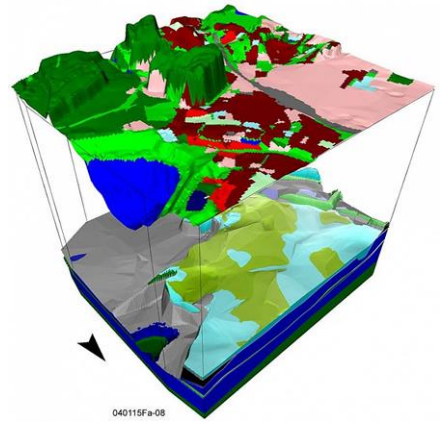
Statement ID: HEALTH HERO FARM

HEALTH HERO FARM
ERIC NOEL
350 WEST SHORE RD
SOUTH HERO, VT 05486

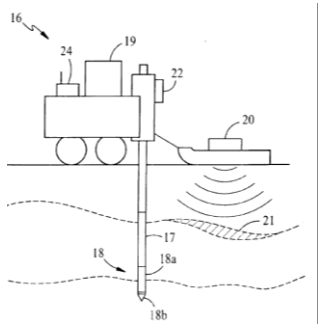
Component	Result	Expected *	Possible problems for mature cattle. **
Nitrates, ppm	14	0 - 44	100
Nitrates - Nitrogen, ppm	3	0 - 10	23
Chlorides, ppm	19	0 - 250	300
Hardness, ppm CaCO3	122	0 - 370	
Total Dissolved Solids (TDS), ppm	328	0 - 500	3,000
Calcium (Ca), ppm	24.6	0 - 100	500
Phosphorus (P), ppm	12.4	0 - 0.3	0.7
Magnesium (Mg), ppm	14.8	0 - 29	125
Potassium (K), ppm	75.8	0 - 20	20
Sodium (Na), ppm	13.3	0 - 100	300
Iron (Fe), ppm	.06	0 - 0.3	0.3 (taste)
Zinc (Zn), ppm	.04	0 - 5	25
Copper (Cu), ppm	.20	0 - 0.6	0.6
Manganese (Mn), ppm	.01	0 - 0.05	0.05 (taste)
Molybdenum (Mo), ppm	< 0.01	0 - 0.07	.07
pH	8.1	6.8 - 7.5	< 5.5 or > 8.5

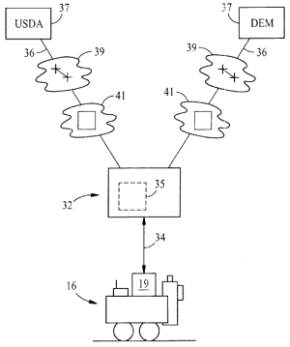
The Limits of AAPs and BMPs





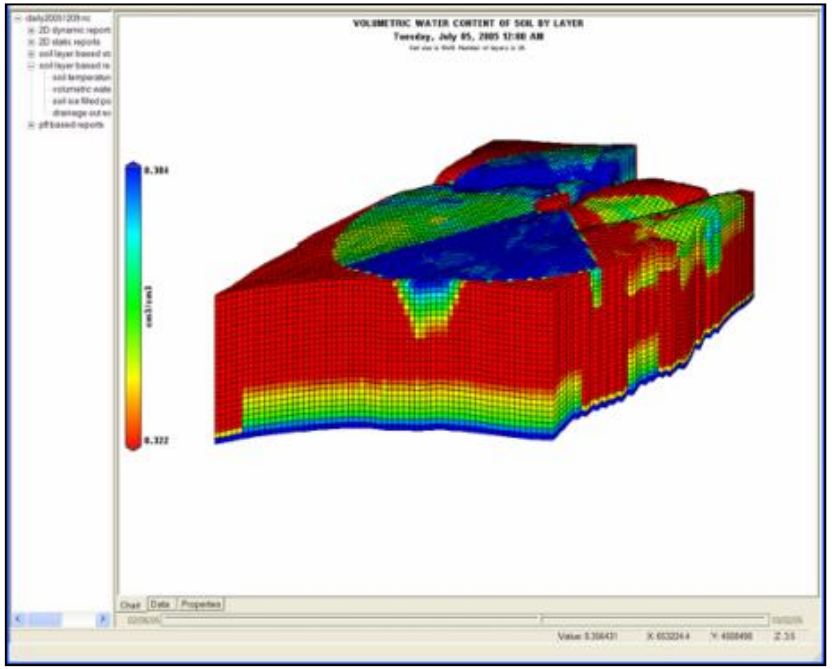
A New BMP:
Real-time Environmental Feedback from Sensed Landscapes

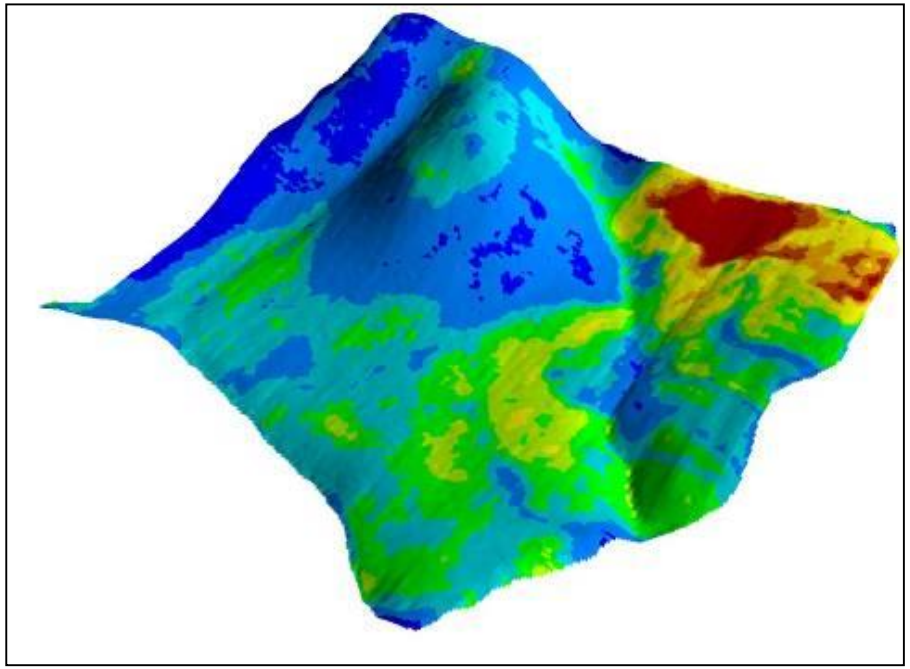


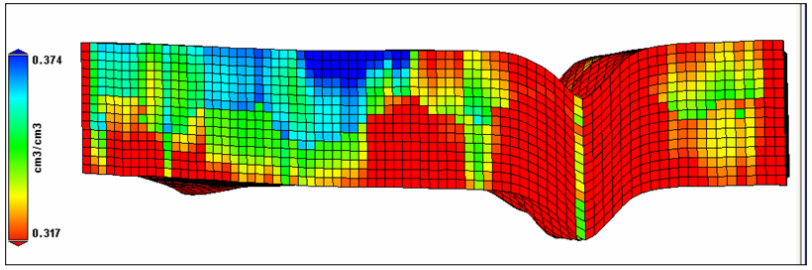


Advanced Soil Monitoring

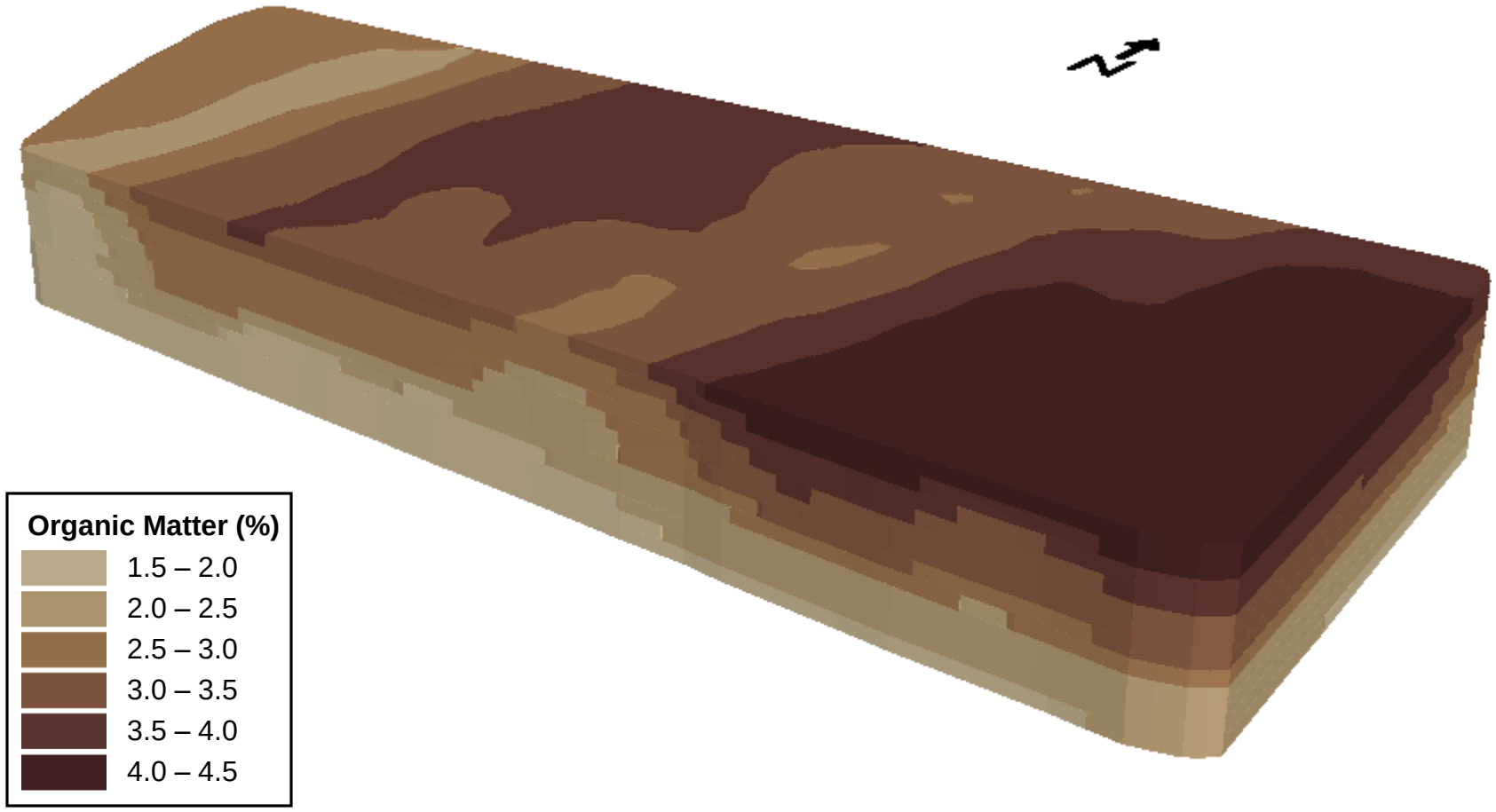
Accurate, Precise Mapping of All Soil Properties to 4’ +





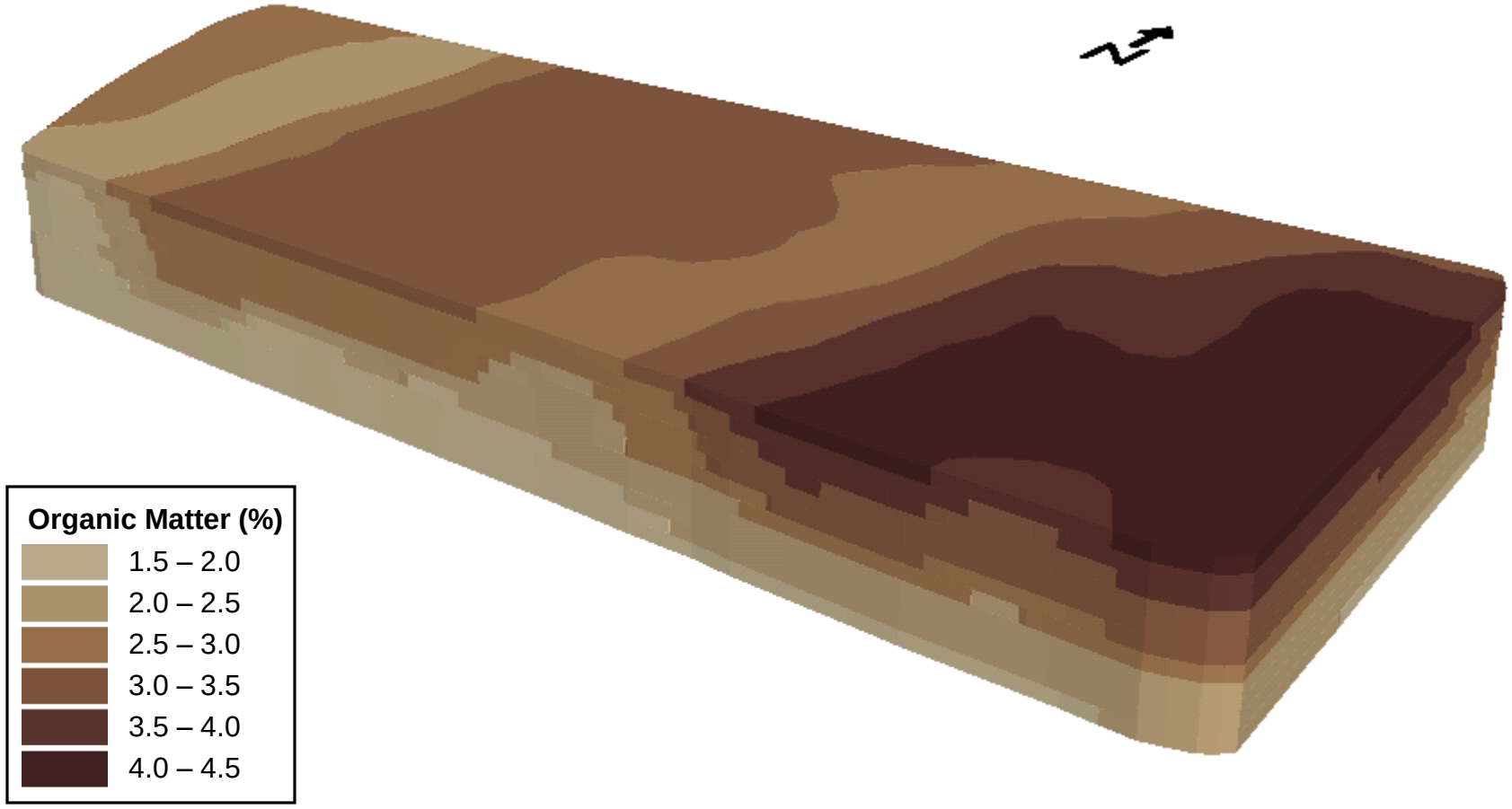


Organic Matter (0 to 10 cm)



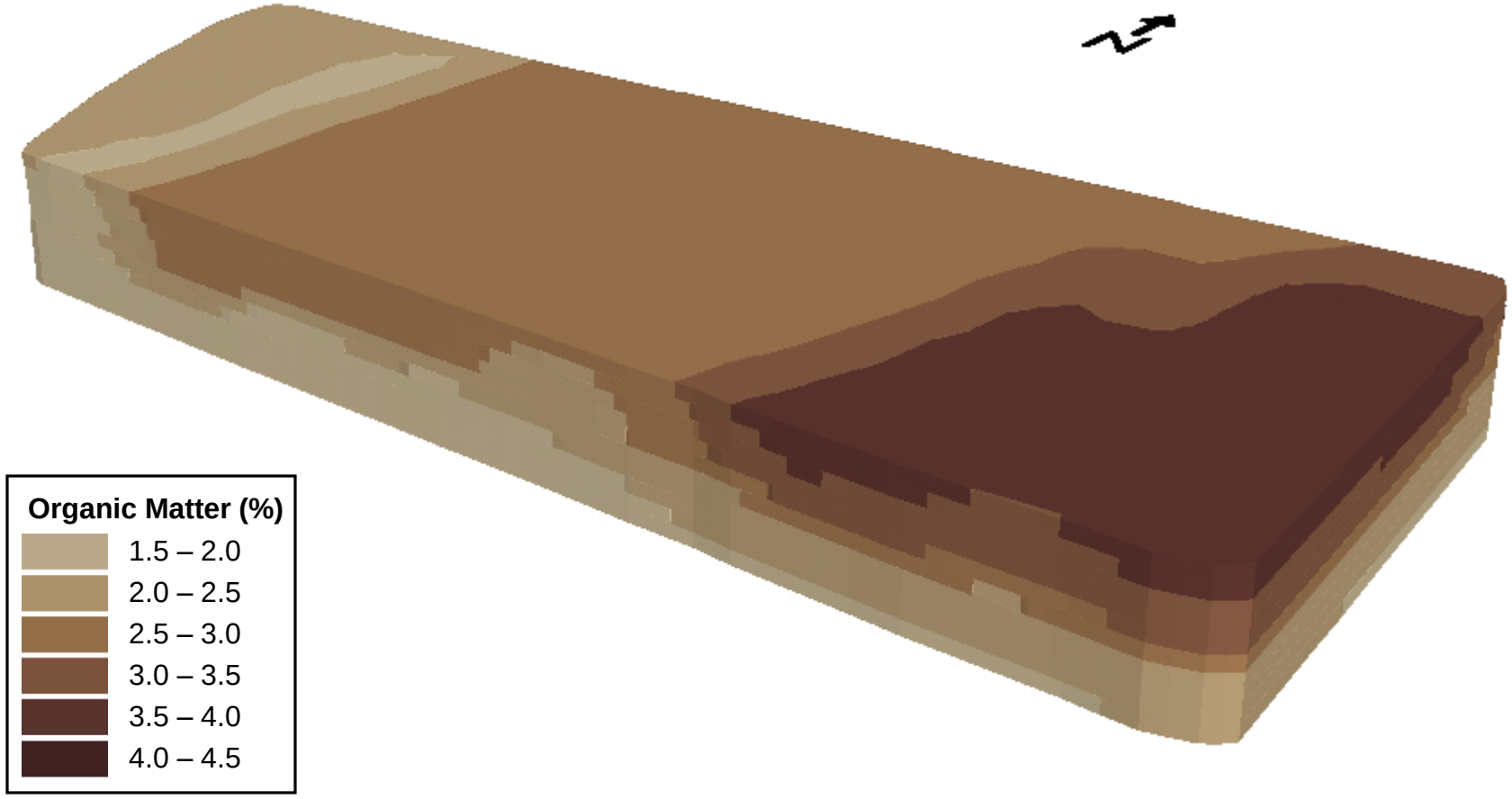
Field 1 (25 Acres)

Organic Matter (10 to 20 cm)



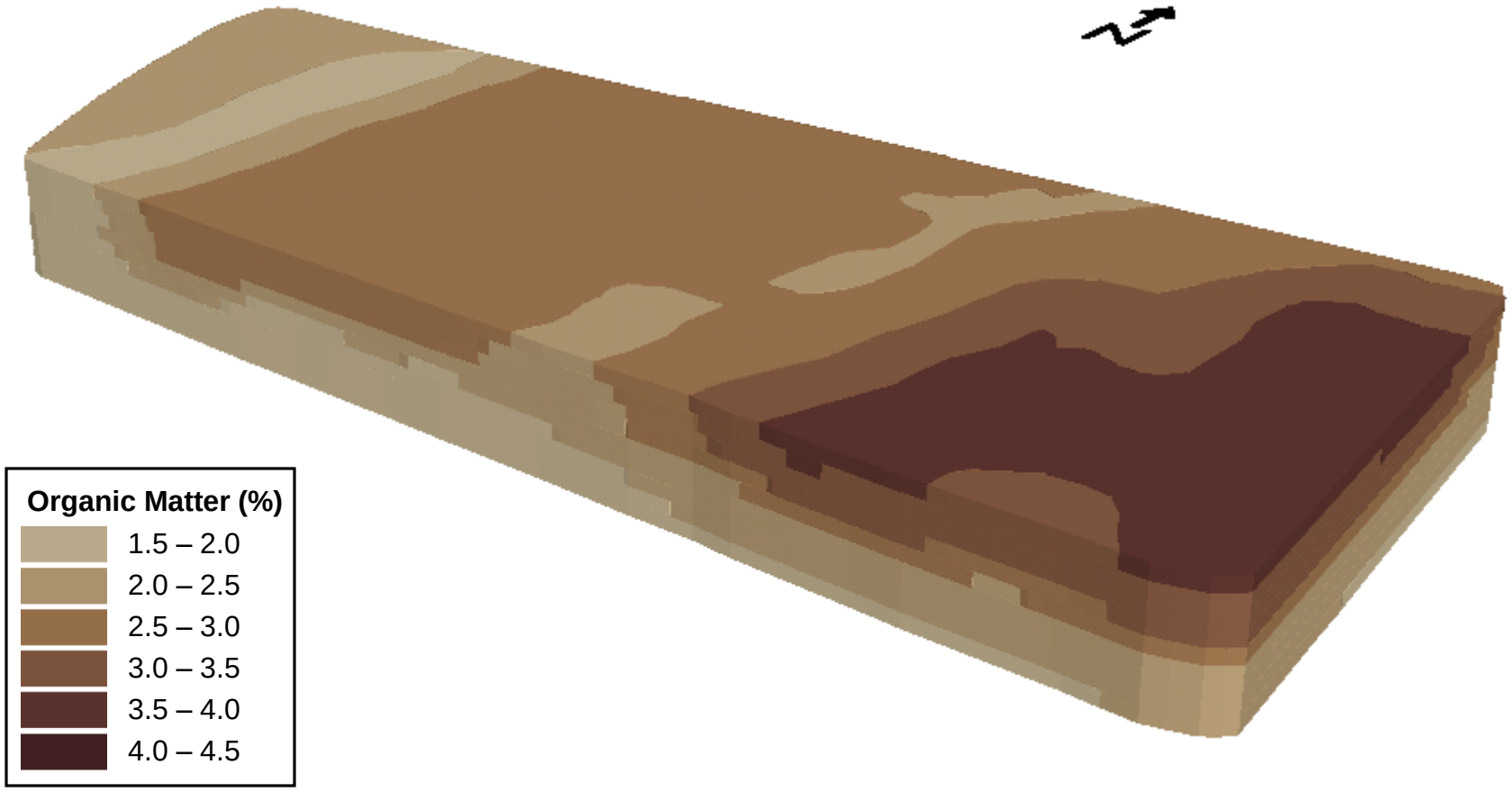
Field 1 (25 Acres)

Organic Matter (20 to 30 cm)



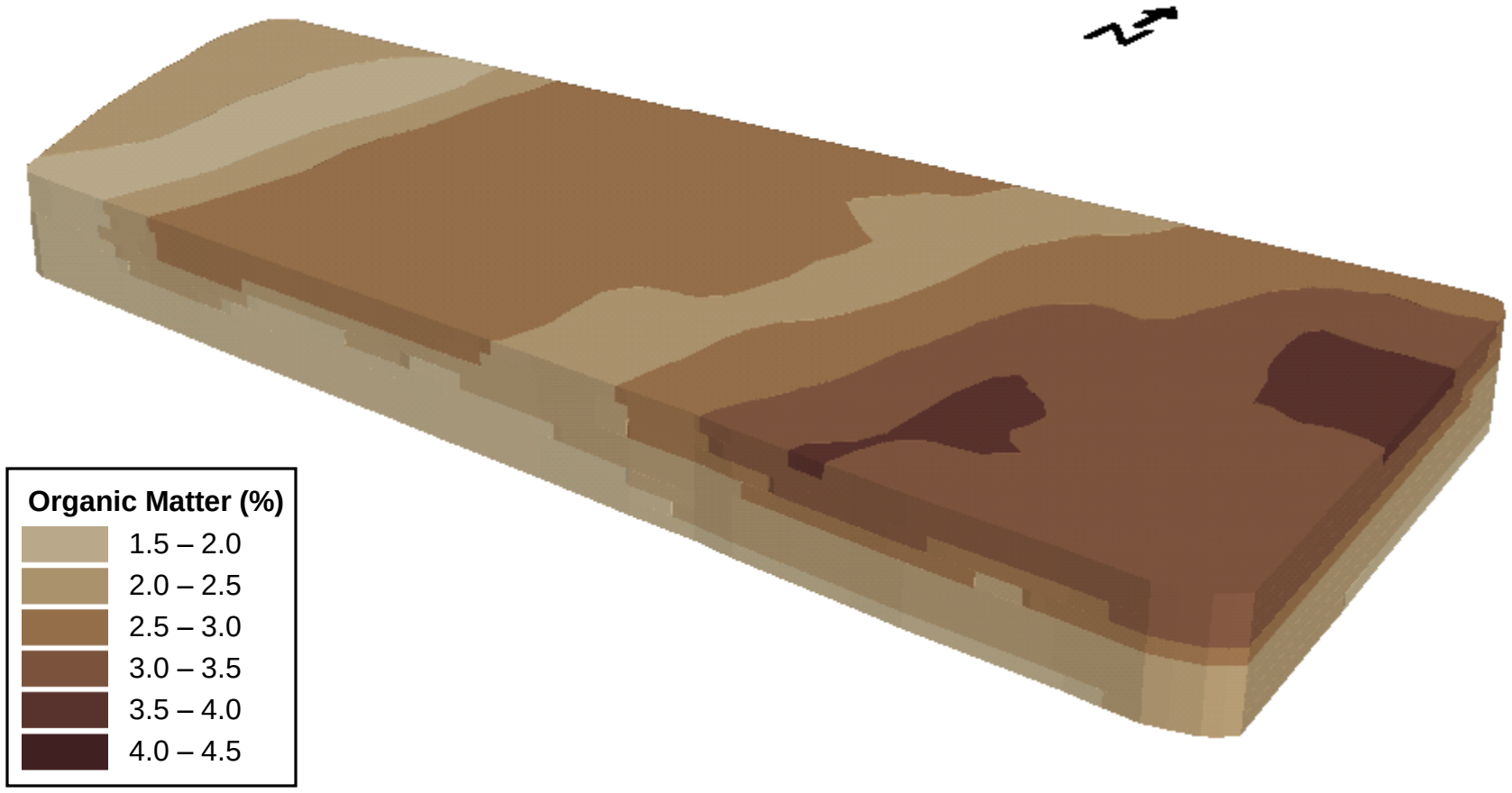
Field 1 (25 Acres)

Organic Matter (30 to 40 cm)



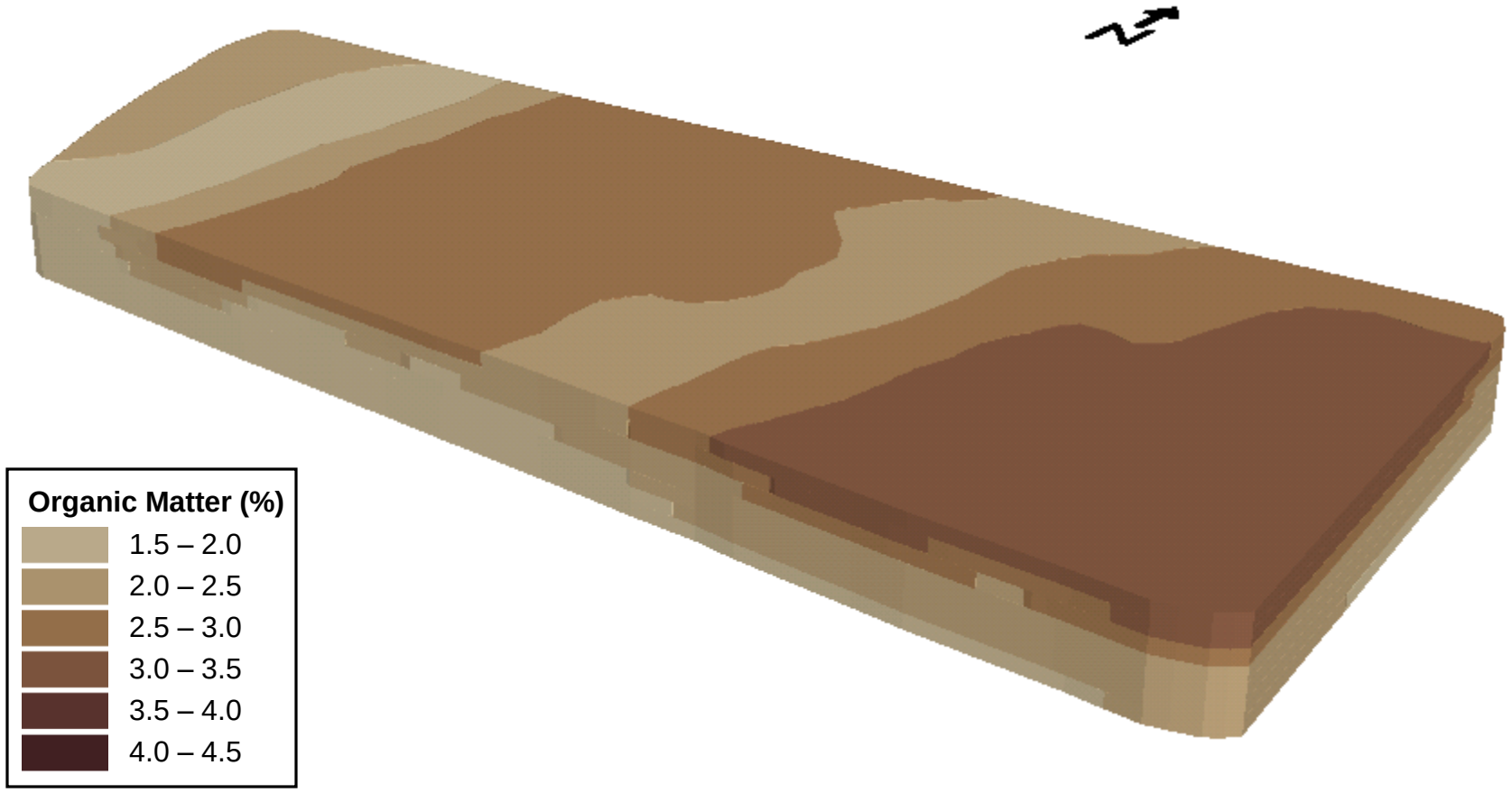
Field 1 (25 Acres)

Organic Matter (40 to 50 cm)



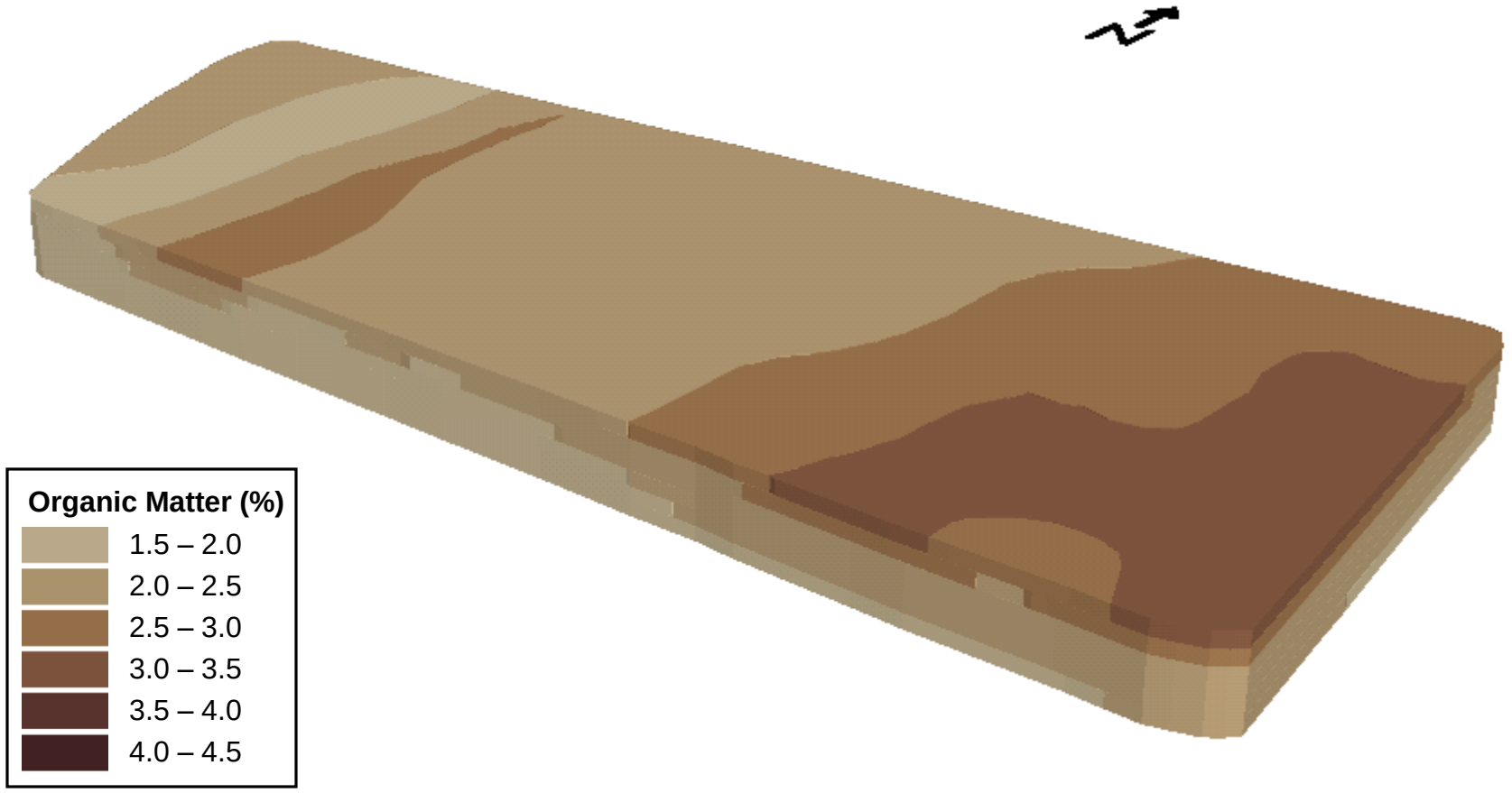
Field 1 (25 Acres)

Organic Matter (50 to 60 cm)



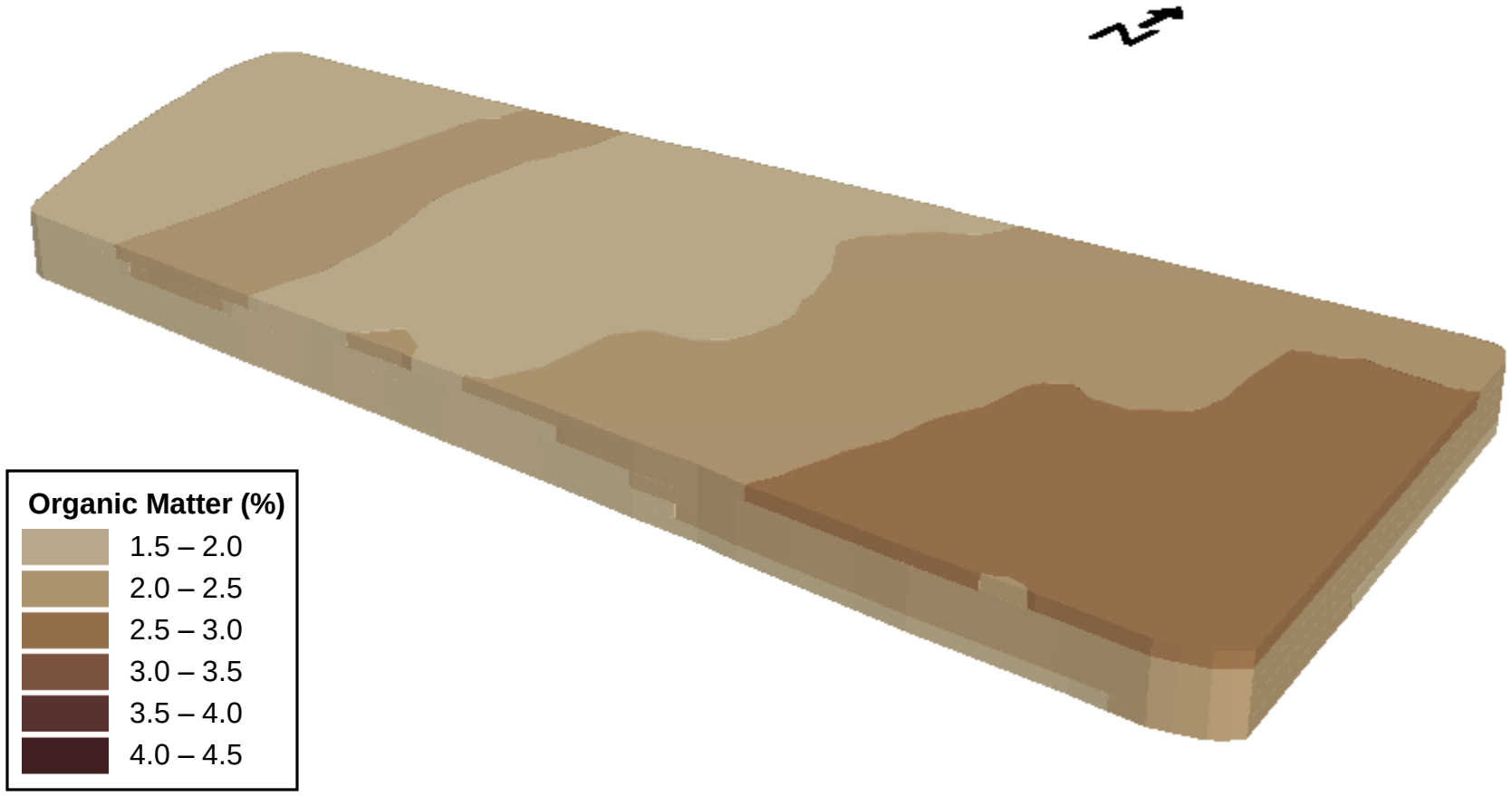
Field 1 (25 Acres)

Organic Matter (60 to 70 cm)



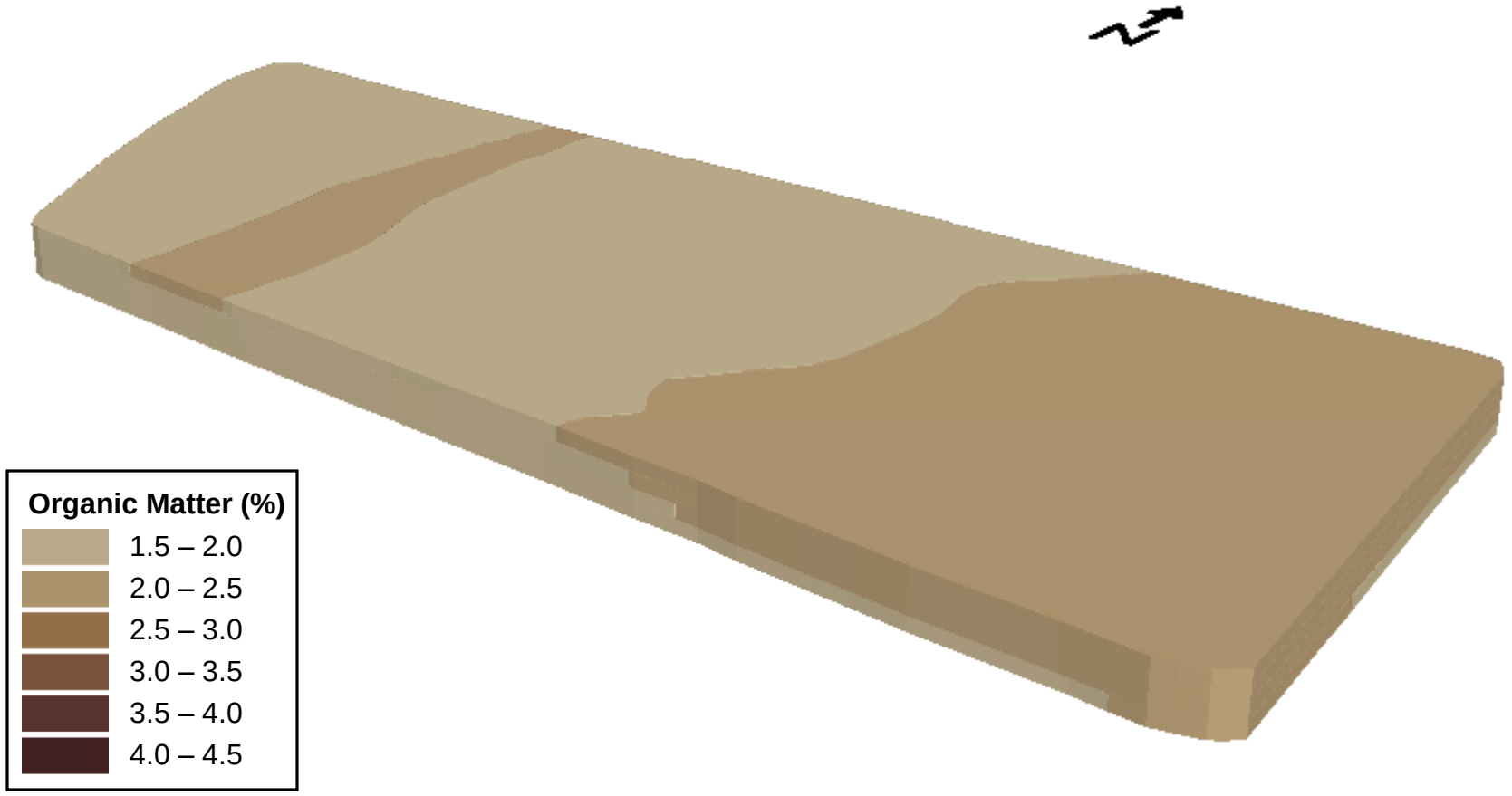
Field 1 (25 Acres)

Organic Matter (70 to 80 cm)



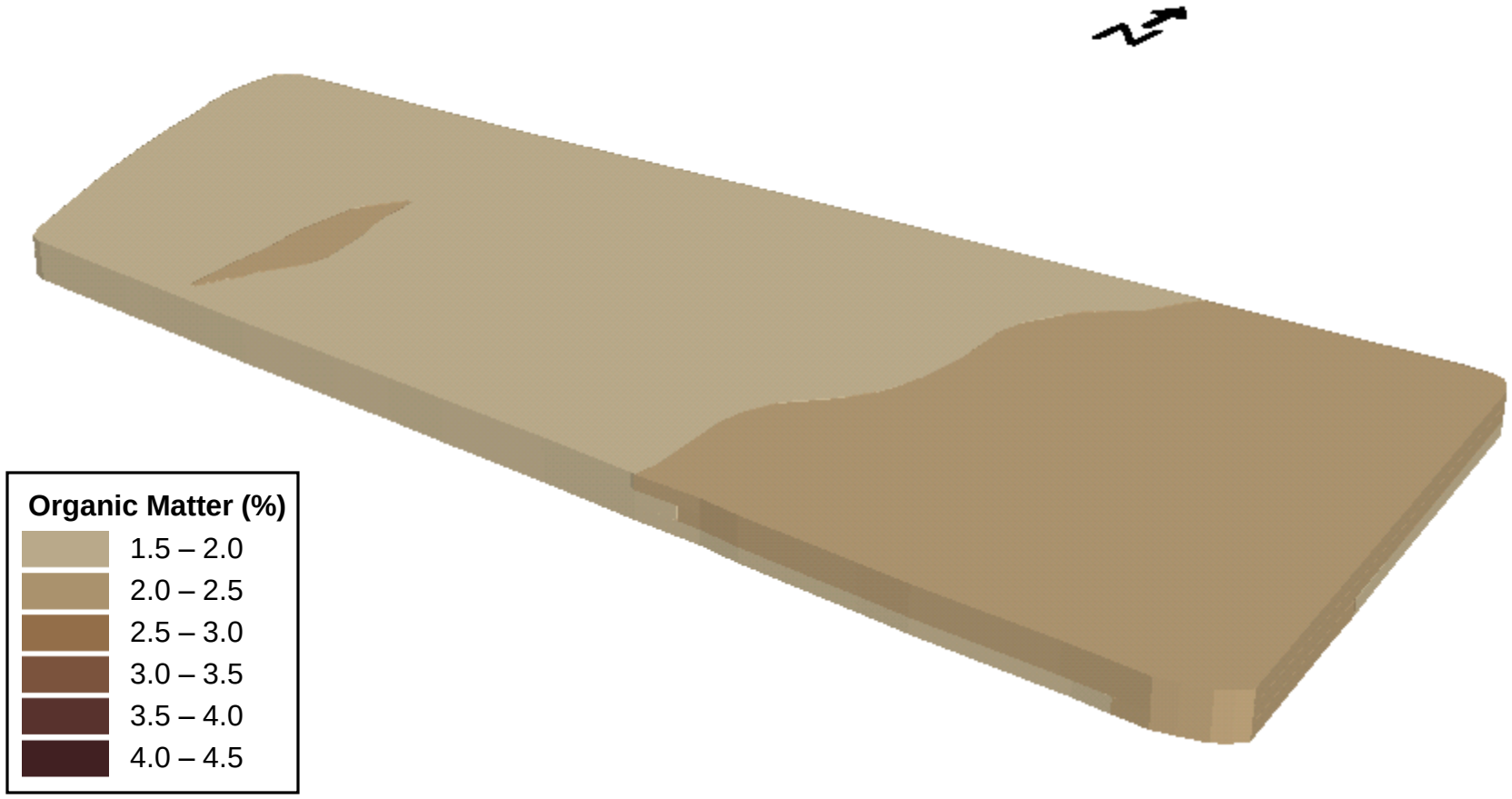
Field 1 (25 Acres)

Organic Matter (80 to 90 cm)



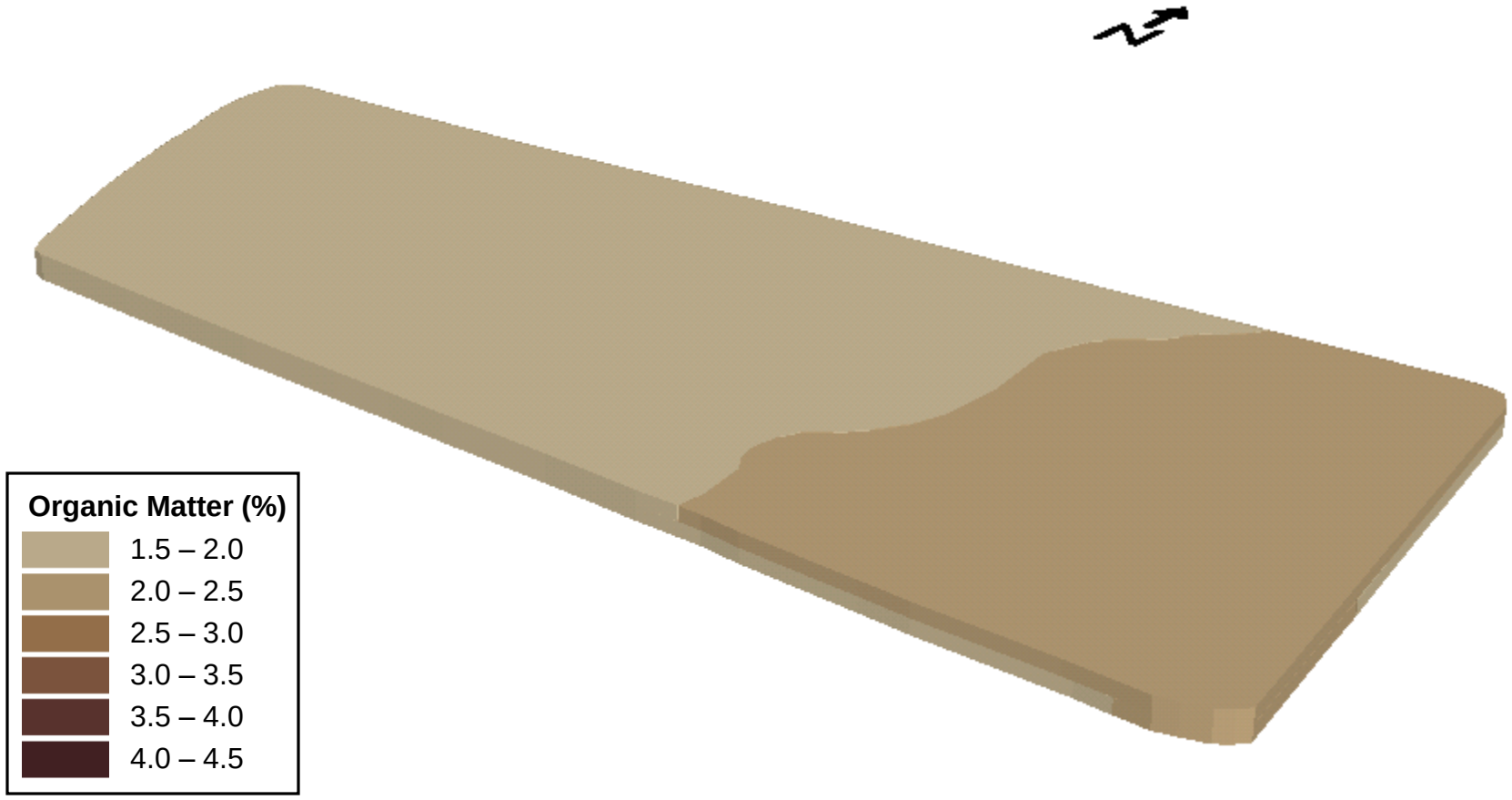
Field 1 (25 Acres)

Organic Matter (90 to 100 cm)



Field 1 (25 Acres)

Organic Matter (100 to 110 cm)



Field 1 (25 Acres)

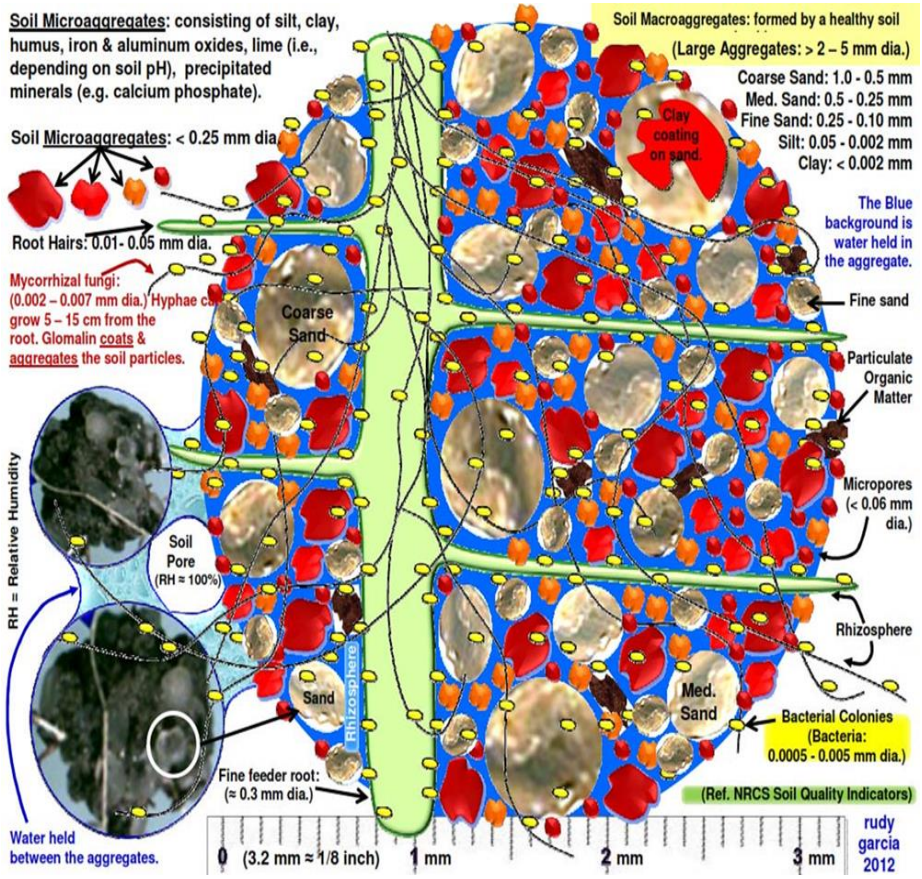
Growing Clean Water: 4 VT Feedback Farms Pilot

- Goal: Develop pilot examples of affordable, distributed farm monitoring as a Best Management Practice for achieving watershed health.
- A pilot to support and further enable four VT leadership farms in:
  - creating improved soil conditions that yield watershed environmental security,
  - improving the economics of production
  - demonstrating the economics of growing clean water as a crop at farm/watershed scales
  - developing tools that provide performance metrics and cooperation between farmers and watershed managers

Hypothesis:

- Farmers with real-time landscape feedback can adaptively manage for:
  - “Harder-working land” - Increased average annual photosynthesis and soil aggregation
  - Improved water quality leaving the farm
  - Increased infiltration →reduced flooding
  - More economically efficient production

Growing Clean Watersheds: Needs



- Land management that keeps soil covered, grows soil aggregates and infiltrates precipitation
- Monitoring soil and water as a BMP/RAP
- Real-time environmental feedback to land managers AND communities
- Supportive non-farmers
- Supporting policy and economics