

LOCAL APPROACHES TO EVALUATING SOIL HEALTH

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Five Approaches - Timeline

- 2013: Side-By-Side Comparison Study in the Gully Creek subwatershed
- 2013-15: Soil Health Report Card Process – joint project with OMAFRA, ABCA, UTRCA and MVCA
- 2016: Watershed Soil Monitoring Pilot Project
- 2017: Soil Monitoring at the Huronview Demonstration Site
- 2018: Reporting on overwinter cover in the Watershed Report Card

Side-By-Side Comparison



- In 2012, the field on the left had 6 WASCoBs installed. The producer used conventional tillage methods to level the ground for planting.
- The field on the right has had a mix of no-till and conservation tillage methods for several years.
- Fields were on the same crop rotation for several years – however, different corn varieties were used.
- Visual during the growing season
- Visual cob difference

Side-By-Side Comparison - Results

- Some soil sampling was completed on both fields in 2013
- The results show the difference between the two management styles

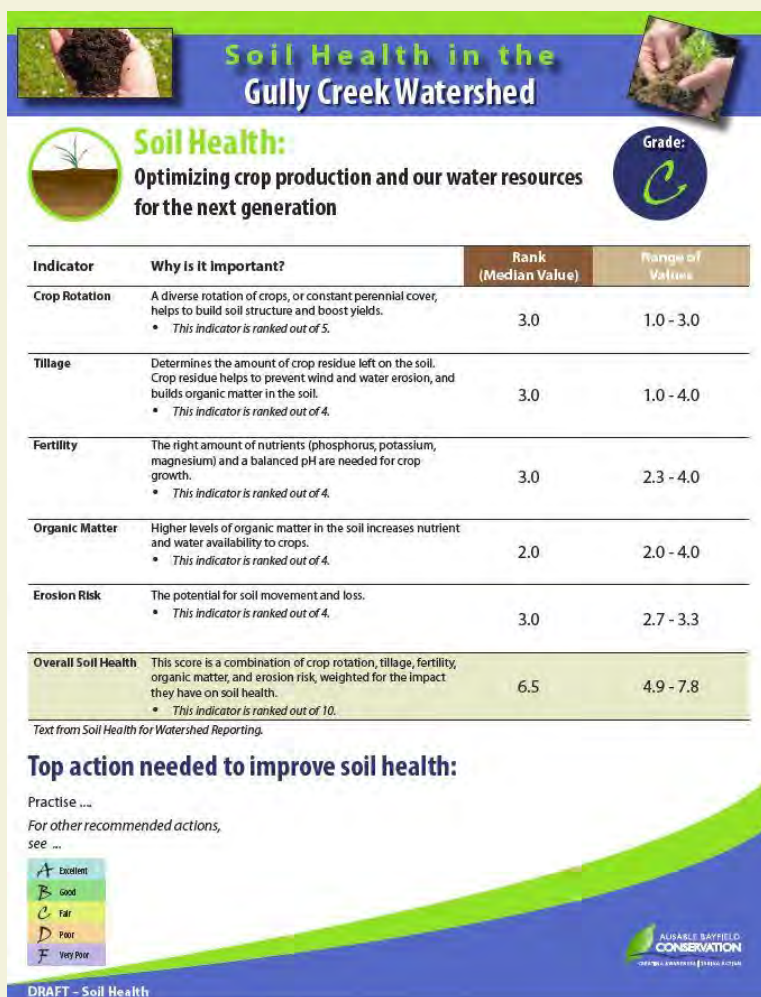
Indicator	Conventional Management	Conservation Management
Yield (bu/ac)	65	201
Organic Matter (%)	2.1	3.3
Porosity (%)	36	43
Aggregate Stability (%)	62	88
Density (g/cm ³)	1.70	1.52

Soil Health Report Cards

- Shared project between OMAFRA, ABCA, UTRCA and MVCA
- Used three specific subwatersheds where detailed data was collected to evaluate soil health on individual fields using a ranking process
- Metrics evaluated included:
 - Crop Rotation
 - Tillage Practices
 - Soil Fertility
 - Soil Organic Matter
 - Erosion Risk

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Erosion Risk													
Field ID	Sample ID	USLE Average (2012-13) ¹	USLE Average Rank	Wind Erosion by Soil Type ²	Presence of Windbreak	Potential Wind Erosion ³	Slope % Average ⁴	Slope Class	USLE Slope Rank	Tillage Method Rank ⁵	Potential Tillage Erosion Rank ⁶	Overall Erosion Rank ⁷	
11962531189570610		0.37	4	4	1	3	1.02	B	3	1	2	2.8	
11965581189291610	EAST	0.49	4	4	2	3	2.25	C	2	2	2	3.0	
11965581189291610	WEST	0.48	4	4	2	3	2.80	C	2	2	2	3.0	
11974981189617310	SOUTH	0.20	4	2	3	3	1.62	B	3	3	3	3.2	
11974981189617310	MIDDLE	0.19	4	2	3	3	1.84	B	3	3	3	3.2	
12010341189181310	SE	0.62	4	4	1	3	3.04	C	2	3	3	3.0	
12006261189187210-S	SW	0.80	4	4	1	3	3.24	C	2	3	3	3.0	
12010231189201410	NE	0.69	4	4	1	3	3.64	C	2	3	3	3.0	
12006261189187210-N	NW	0.71	4	4	1	3	2.73	C	2	3	3	3.0	
12017171189234910	1	2.46	4	4	1	3	4.76	C	2	2	2	2.8	
12017171189234910	2	2.73	4	4	1	3	4.74	C	2	2	2	2.8	
12017171189234910	3	2.51	4	4	1	3	4.45	C	2	2	2	2.8	
12017371189194310	1	1.46	4	4	1	3	4.81	C	2	3	3	3.0	
12017371189194310	2	1.60	4	4	1	3	4.72	C	2	3	3	3.0	
12017371189194310	3	1.35	4	4	1	3	4.19	C	2	3	3	3.0	
12017371189194310	4	1.31	4	4	1	3	4.29	C	2	3	3	3.0	
12017001189272810	1	2.42	4	4	1	3	4.90	C	2	2	2	2.8	
12017001189272810	2	2.55	4	4	1	3	5.38	E	1	2	2	2.7	
12017001189272810	3	2.03	4	4	1	3	4.49	C	2	2	2	2.8	
12017001189272810	4	1.76	4	4	1	3	3.74	C	2	2	2	2.8	
12025581189247810	1	1.58	4	4	1	3	2.53	C	2	2	2	2.8	
12025581189247810	2	1.49	4	4	1	3	2.90	C	2	2	2	2.8	
12025581189247810	3	1.83	4	4	1	3	4.04	C	2	2	2	2.8	
12016611189354910	1	2.13	4	4	1	3	4.70	C	2	2	2	2.8	
12016611189354910	2	2.55	4	4	1	3	4.15	C	2	2	2	2.8	

Soil Health Report Cards - Results



- A good overview of many soil variables (missing biology component)
- Good design on a small scale (*i.e.* small subwatershed for field comparison)
- Requires detailed data (such as crop rotations, tillage practices, soil sampling results, USLE computations)
- Not as feasible on a regional scale – too labour intensive

Watershed Soil Monitoring Pilot Project

- Objective was to find a method to start reporting on soils under agricultural production at a larger scale (*i.e.* the entire ABCA watershed, as opposed to a subwatershed)
- Assessed soils across four soil textures:
 - Clay (4 sites, plus 1 benchmark)
 - Clay loam (4 sites, plus 1 benchmark)
 - Loam (2 sites, plus 1 benchmark)
 - Sand (4 sites, plus 1 benchmark)
- Compared to relevant benchmarks (fencerow, or forested area)
 - We need to choose benchmark sites carefully – forested vs. fencerow vs. cemetery

Watershed Soil Monitoring Pilot Project

- Soil Health Metrics used included:
 - Soil Organic Matter
 - Topsoil Depth
 - Wet Aggregate Stability
 - Bulk Density
 - Porosity
 - Resistance to Penetration
 - Infiltration Rate



Watershed Soil Monitoring Pilot Project - Results

- Most of the metrics from farmed soils were lower than benchmark soils
- Some metrics had a broader range of values
- This suggests that some metrics are more responsive to land management practices

	SOM (%)	Infiltration (mm/hr)
Clay Loam 1	3.3	7
Clay Loam 2	3.3	550
Clay Loam 3	3.3	236
Clay Loam 4	3.3	28
Clay Loam Benchmark	3.3	1412

- Another infiltration test at a local producer's farm showed similar results:
 - Lawn – 2 mins to drain
 - Field – 20 mins to drain
 - Headlands – 200 mins to drain

Watershed Soil Monitoring Pilot Project - Results

- Some indicators were measured at two different depths (*i.e.* 0-15 cm and 15-30 cm), and there was found to be very little difference between the results (all within a similar range)
- In future studies, likely only the top 15 cm will be measured.

Agricultural Field Results for Clay Loam soils

Bulk Density (T/m ³) 0-15 cm	Bulk Density (T/m ³) 15-30 cm	Porosity (%) 0-15 cm	Porosity (%) 15-30 cm
1.52	1.68	43	37
1.49	1.57	44	41
1.55	1.69	41	36
1.56	1.69	41	36

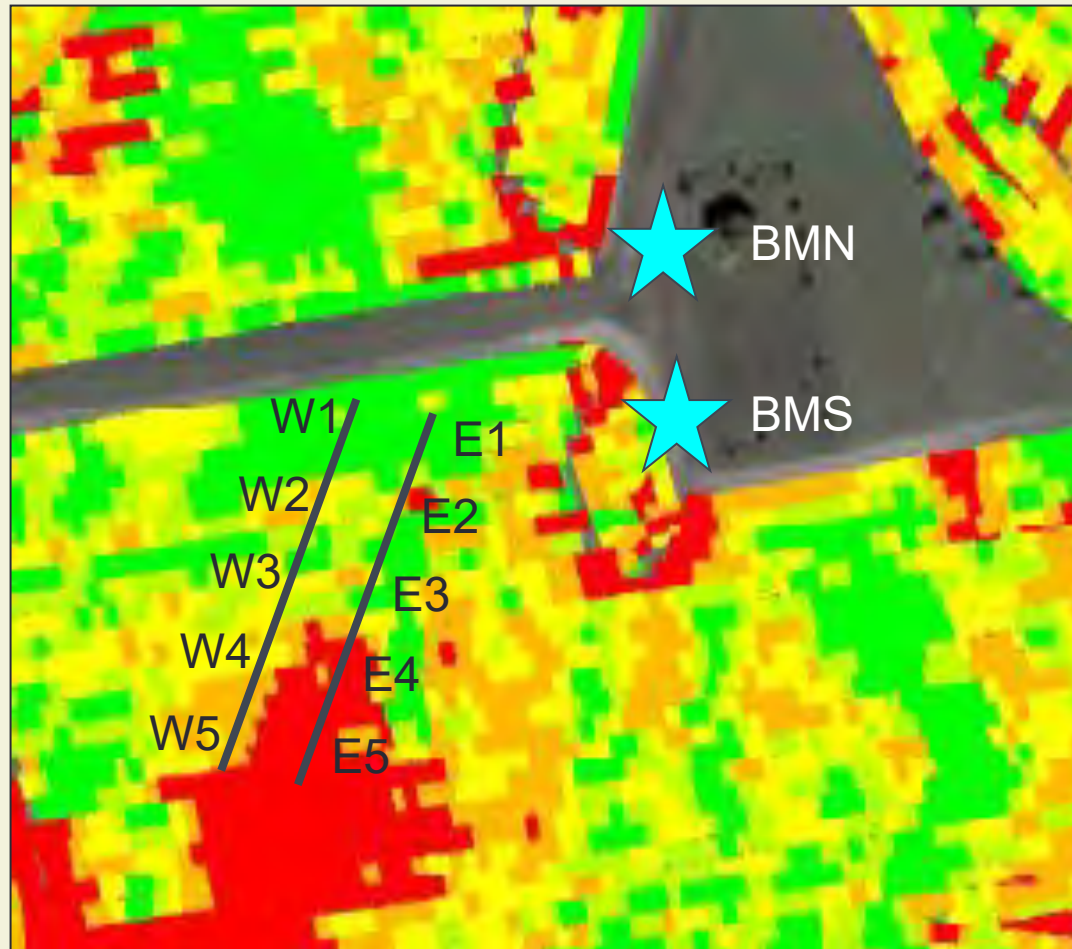
Huronview Demonstration Site

- 2 transects (chosen using yield mapping to find a good representation of yields)
- 5 slope positions per transect
- Slope positions follow elevation and corn yield gradients
- Comparison to 2 sites in cemetery

Metrics used:

- Soil Organic Matter (%)
- Topsoil Depth (cm)
- Wet Aggregate Stability
- Bulk Density 0-15cm
- Porosity 0-15cm
- Resistance to Penetration 0-15cm
- Water Infiltration Rate
- Soil Your Undies
- Respiration Test (Solvita)
- Earthworm populations
- Plant Available WHC

Huronview Demonstration Site - Results




Huronview Demonstration Site - Results

	SOM - W (%)	SOM - E (%)	RTP - W (psi)	RTP - E (psi)	INFL - W (mm/hr)	INFL - E (mm/hr)
1	3.2	3.2	158	188	44	80
2	2.9	3.0	176	173	16	134
3	2.7	2.9	143	190	0	98
4	2.8	2.8	218	247	44	84
5	3.0	3.1	216	220	14	38
BMN	4.8		108		468	
BMS	4.3		109		1305	

- Differences in yield do not necessarily correspond to differences in soil quality

Watershed Report Cards – Overwinter Cover

Watershed Grades					
Forest Conditions		Grade: B			
Indicator	Description	Result		2017 Grade	
		2012	2017	Bayfield North	Entire ABCA
Forest cover	<ul style="list-style-type: none"> Forest cover is a percentage of a watershed that is forested. An A grade is forest covering more than 35% of a watershed. 	30.0%	30.5%	B	D (14.2%)
Forest interior	<ul style="list-style-type: none"> Forest interior is the percentage of a watershed with forest cover that is at least 100 metres from the forest's edge. Some birds need this area to nest and breed. An A grade is forest interior covering more than 11.5%. 	9.0%	9.0%	B	D (3.3%)
Streamside cover	<ul style="list-style-type: none"> Streamside cover is the percentage of the 30-metre area on both sides of open streams that is forested. An A grade is forest covering more than 57.5% of this streamside area. 	63.4%	63.9%	A	C (32.6%)
 Overwinter Vegetative Cover on Agricultural Lands <ul style="list-style-type: none"> Agriculture comprises 59 per cent of the land use in this watershed. A minimum of 30 per cent of overwinter vegetative cover on agricultural lands might be expected if fields were in a corn-soybean-wheat rotation. Overwinter vegetative cover on agricultural lands ranged from 17 to 24 per cent, in this watershed, in recent aerial photography.* 					
Surface Water Quality		Grade: C			
Indicator	Description	Result		2017 Grade	
		2012	2017	Bayfield North	Entire ABCA
Total phosphorus	<ul style="list-style-type: none"> Total phosphorus is a nutrient. It enhances plant growth. It contributes to excess algae and low oxygen in streams. An A grade is a 75th-percentile* total phosphorus concentration of less than 0.020 mg/L. 	NA	0.042 mg/L	C	D (0.073)
E. coli (Escherichia coli)	<ul style="list-style-type: none"> E. coli are bacteria found in human and animal waste. Their presence indicates water may contain other disease-causing organisms. An A grade is a geometric-mean* E. coli concentration of no more than 30 colony forming units (cfu) per 100 mL. 	177 cfu/100 mL	148 cfu/100 mL	C	C (104)
Benthic invertebrates	<ul style="list-style-type: none"> Benthic invertebrates are small animals, without backbones, that live in stream sediments. Family Biotic Index (FBI) summarizes the numbers and types of these animals in a sediment sample. Values, from 1 (healthy) to 10 (degraded), reflect stream health. An A grade is an average FBI value of no more than 4.25. 	5.26	4.96	B	C (5.59)

* The complete *Ausable Bayfield Watershed Report Card* at abca.ca has information on 2007 grades, definitions (such as 75th percentile and geometric mean), methods, and results.

Bayfield North Watershed

- Soil quality/health largely overlooked in the Watershed Report Cards
- Overwinter vegetative cover – soils that tend to have more cover are less susceptible to erosion, may have increases in SOM
- Reporting on a percentage of agricultural land with some overwinter vegetative cover based on aerial photography

Next Steps

- We have looked at a number of different metrics, and we are beginning to see some metrics are more sensitive to soil health. However, we need more study to:
 - Better define ranges of values (more sites needed) – we worked with producers who were interested – are they the “good” producers? We probably should work with others
 - Document how well the indicators respond to management practices
- Land management data collection
 - We’ve collected some of this data, but we need longer term and more spatially broad information to help interpret soil monitoring results

Thank you...

- Ontario Ministry of Agricultural, Food and Rural Affairs
- Ontario Ministry of Environment and Climate Change
 - Huron Soil and Crop Improvement Association
 - Maitland Valley Conservation Authority
 - Upper Thames River Conservation Authority
- Landowners and Producers in the Ausable Bayfield Conservation Authority area