Soil Health Scaling-Up Project

Inter-jurisdictional Review

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CREATING AWARENESS | TAKING ACTION

Background

- We have a watershed community interested in soil health
  - How do my field measures compare to my neighbours, to what might be considered “healthy”?
  - How well do field scales relate to regional scales?

- What are other agencies trying?

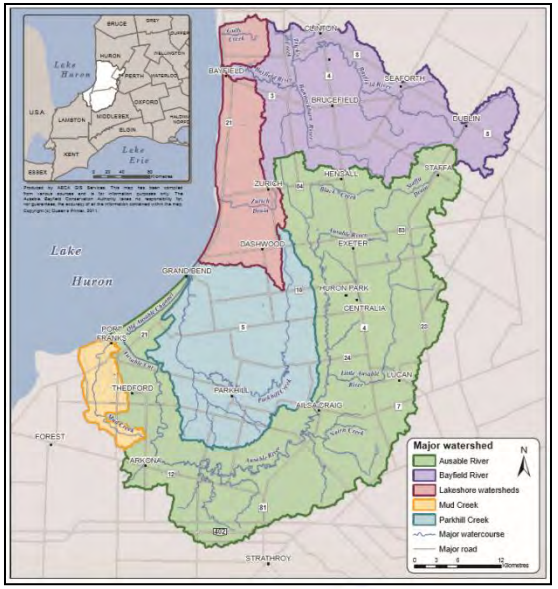
"You are working on an EXCEEDINGLY important but difficult topic that people frequently ask about but rarely tackle"

Ann Lewandowski

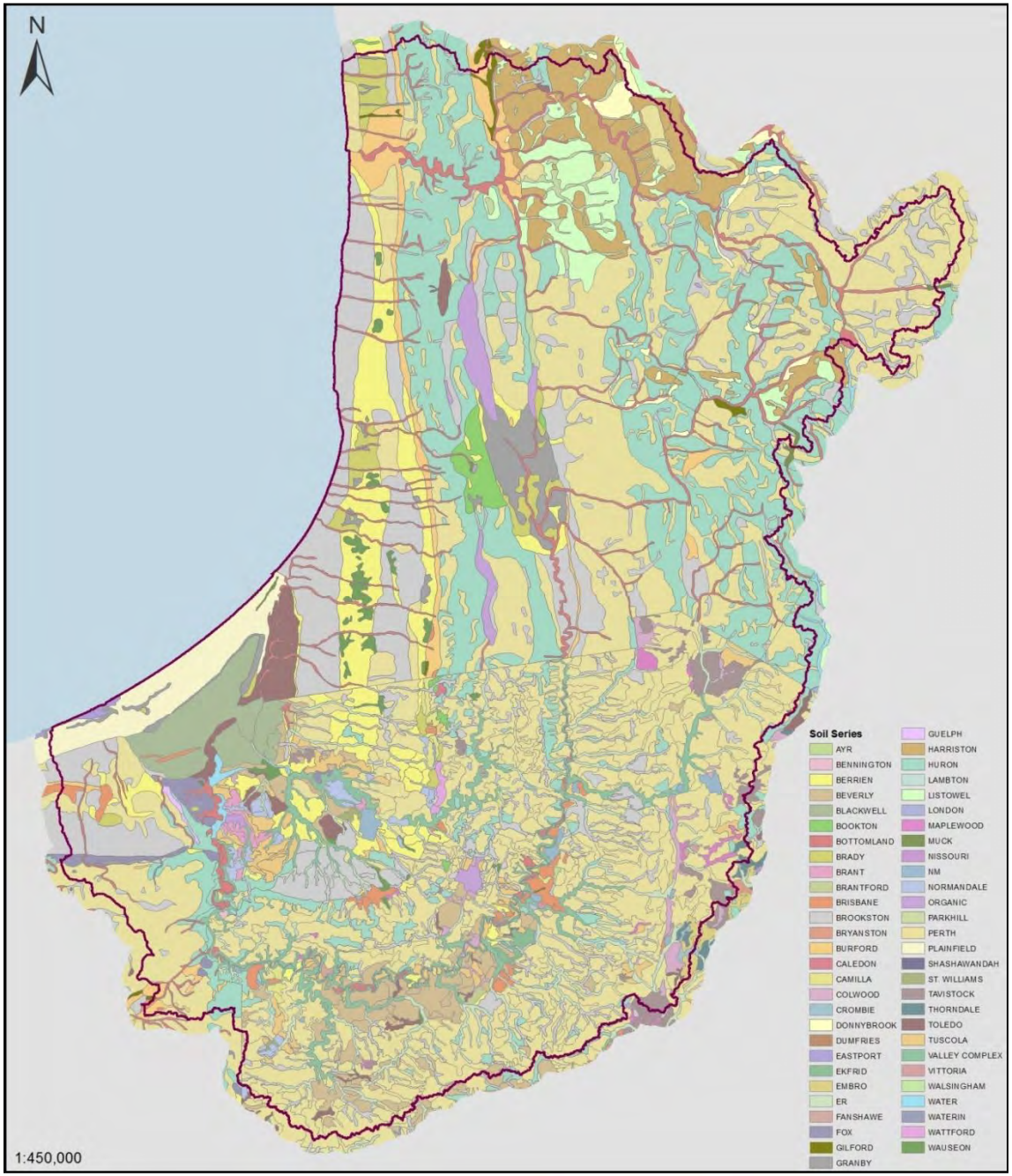
Minnesota Office of Soil Health

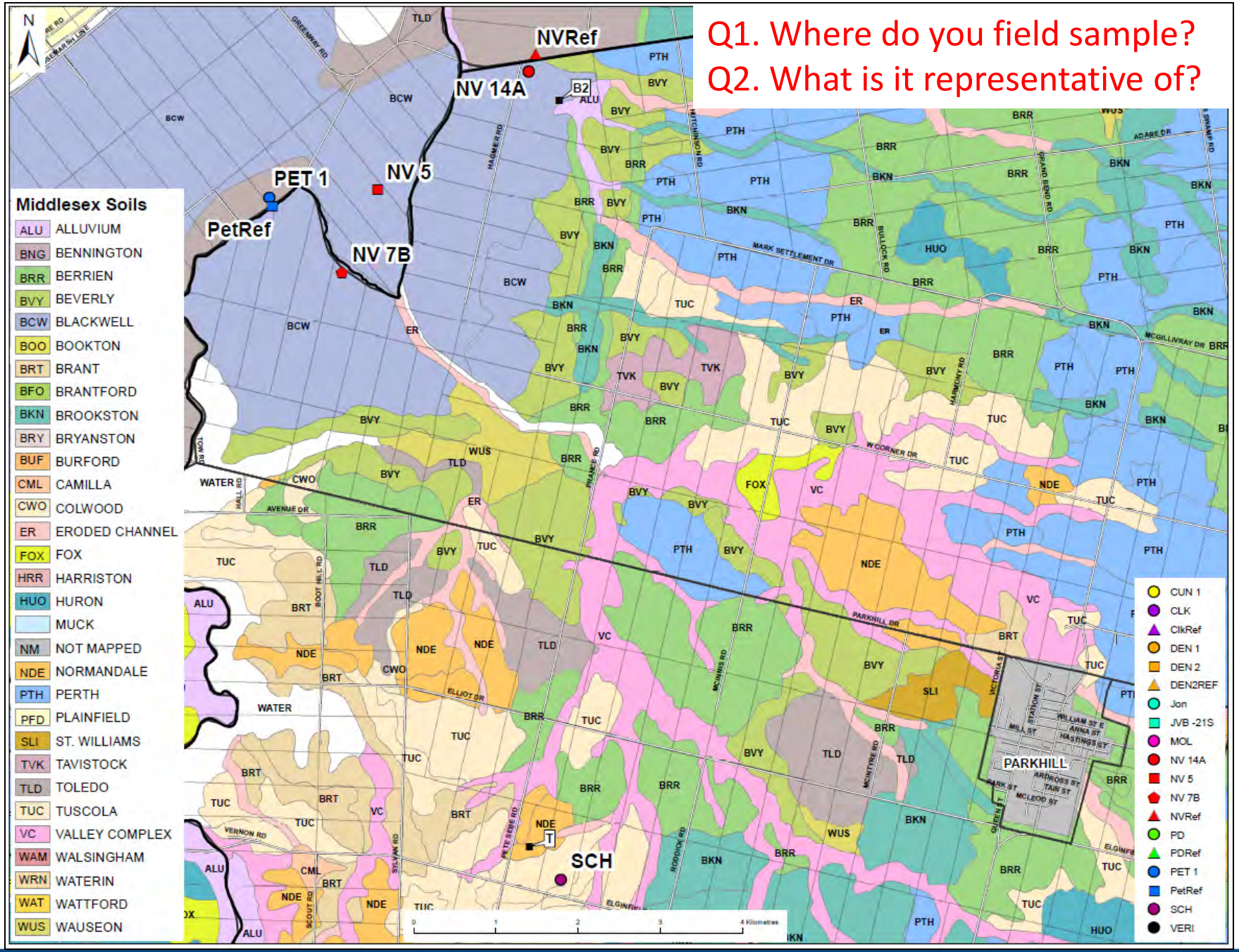
Study Objective

- To investigate methods to transfer *field scale* soil health data to larger scales, such as watershed or county scale



What value do you assign to your untested soils, based on your tested soil values??



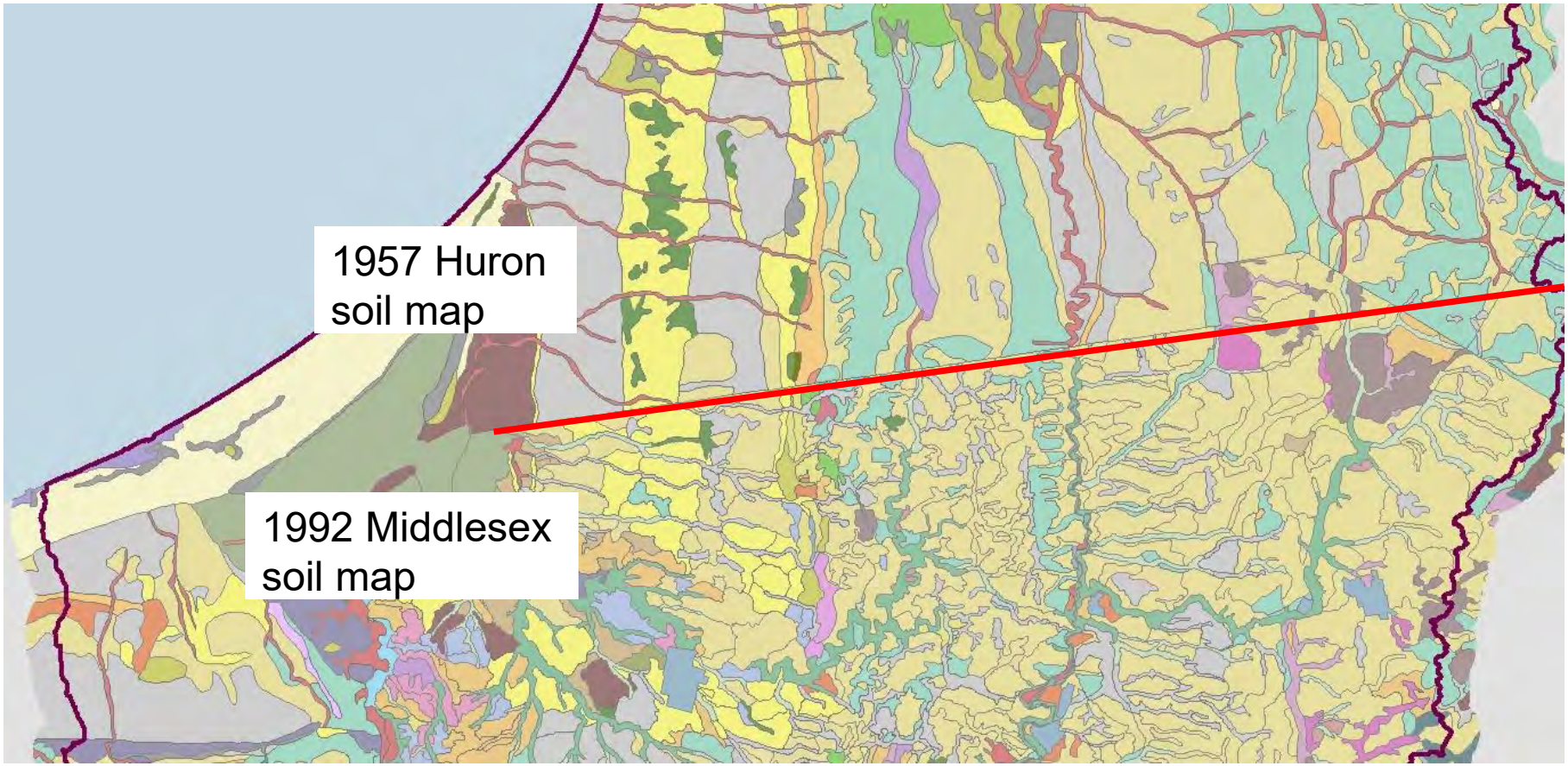

Q1. Where do you field sample?
Q2. What is it representative of?
NVRef
NV 14A
NV 5
NV 7B
PET 1
PetRef
SCH
PARKHILL
Middlesex Soils
ALU ALLUVIUM
BNG BENNINGTON
BRR BERRIEN
BVY BEVERLY
BCW BLACKWELL
BOO BOOKTON
BRT BRANT
BFO BRANTFORD
BKN BROOKSTON
BRY BRYANSTON
BUF BURFORD
CML CAMILLA
CWO COLWOOD
ER ERODED CHANNEL
FOX FOX
HRR HARRISTON
HUO HURON
MUCK
NM NOT MAPPED
NDE NORMANDALE
PTH PERTH
PFD PLAINFIELD
SLI ST. WILLIAMS
TVK TAVISTOCK
TLD TOLEDO
TUC TUSCOLA
VC VALLEY COMPLEX
WAM WALSINGHAM
WRN WATERIN
WAT WATTFORD
WUS WAUSEON
CUN 1
CLK
ClkRef
DEN 1
DEN 2
DEN2REF
Jon
JVB -21S
MOL
NV 14A
NV 5
NV 7B
NVRef
PD
PDRef
PET 1
PetRef
SCH
VERI

Considerations

Soil properties

– **STATIC** (not changing)	vs	**DYNAMIC** (changing)
over time		over time
not space		and space
texture		organic matter

“Scaling up” static properties



Considerations

Soil properties

soil health

– **STATIC** (not changing) vs **DYNAMIC** (changing)

over time not space

texture

over time and space

infiltration rates

organic matter

Key Learnings

- Different users of soil health information
- Static properties
  - such as texture
  - predictive soil mapping and soil surveys
- Dynamic properties
  - properties that change with land use and land management
  - challenging to show at different scales

Contacts

Australia
United States Geological Service (USGS)
Minnesota
Quebec
USDA • Agriculture Research Service (ARS) • Soil Science Division • Soil Health Division
Agriculture Agri Food Canada (AAFC)
Envasso (Europe)
New Zealand
Soil Resources Group
Ausable Bayfield Conservation Authority

Soil Health Program

Agency	Conceptual or Implemented
Australia	implemented
United States Geological Service (USGS)	implemented
Minnesota	conceptual
Quebec	implemented
USDA • Agriculture Research Service (ARS) • Soil Science Division • Soil Health Division	 • conceptual • implemented • conceptual
Agriculture Agri Food Canada (AAFC)	implemented
Envasso (Europe)	conceptual
New Zealand	not contacted
Soil Resources Group (2014 report)	not applicable
Ausable Bayfield Conservation Authority	implemented

Approaches

- Australia
  - Farmer groups driven with field kit. Methods specific to dryland conditions – salinity. Field-> UAV > satellite
- Quebec
  - Carbon measures taken at the field scaled to entire single series. 4 managements, 2 benchmarks
- USGS
  - Satellite -> field. NDVI for cover only. Hyper spectral data for chemistry

Approaches (cont'd)

- AAFC
  - Satellite, ground cover via NDVI.
  - Satellite, SOC status and trends.
- USDA (Soil Science Division)
  - Forest/Field -> ecological sites -> regions
  - Matching unknown sites to known sites
  - Deviation of value within range, due to management

USDA Eco-regions

Summary of Approaches

Agency	Scale	Comments
Australia	Field	Farmer kits
United States Geological Service (USGS)	Regional	Satellite imagery, no soil measures, but management ground-truthed
Quebec	Field	Matching within a series
USDA • Soil Science Division	Field	Matching field to field
Agriculture Agri Food Canada (AAFC)	Regional	Satellite imagery, no soil meaures

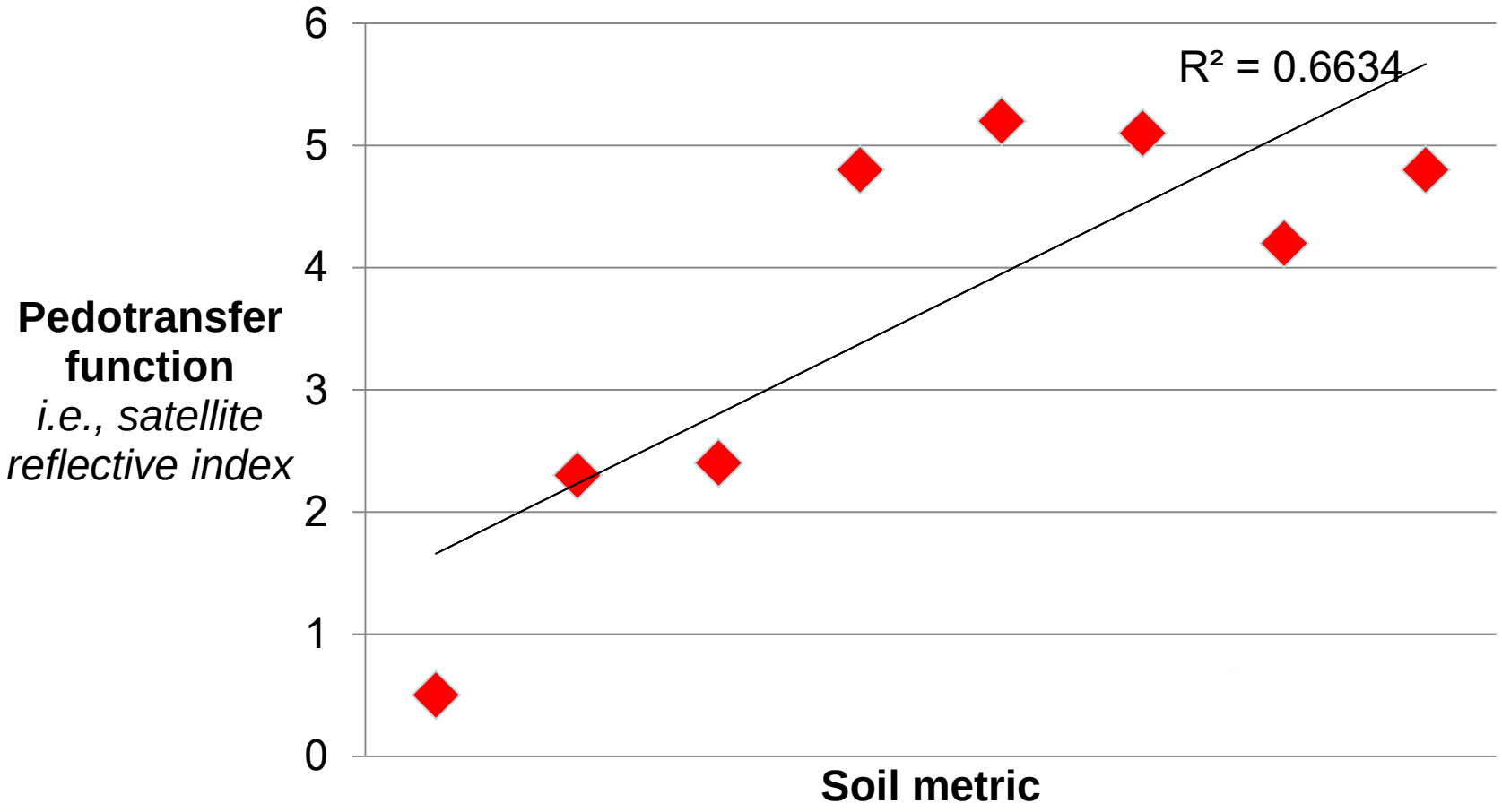
Multi-scale Issues

- From Field to Region
  - Number of samples required (Essex versus Huron):
    - Static properties (some areas have more consistent soils)
    - Different management regimes

- From Region to Field
  - The relationship between the reflectance values and actual soil properties seem to be poor (Huronview explanation)

Scale Considerations

1. Pedotransfer function related to metric
2. Pedotransfer data available at highest scale



Some potential compromises

- ACCURACY vs SPATIAL COVERAGE
  - get one but lose the other
  - which one is more important – depends on the purpose of your study

- Range of metrics
  - many available at field scale we are beginning to find that some may be redundant or have a narrow range
  - there are minimal metrics available at broad spatial scale – cover seems the best

Field to Region Approaches

- Quebec
  - Single series – representative, dominant, variability ?? Pick most similar management
- USDA
  - Many eco-regions i.e., high plains, land mass issues.
  - Deviation within a range, due to management.
- ABCA
  - Limited data available at larger scales

Summary Thoughts

- Know the purpose of your study?
- Assess the PROs and CONs to scaling up
- Some metrics will not “scale” well
- If accuracy is important – closer to field scale
- If spatial coverage is important – regional scale based risk assessments are relevant

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Questions ?

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Watershed divided into 4 soil textures

- **A sand**
- **B loam**
- **C clay loam**
- **D clay**

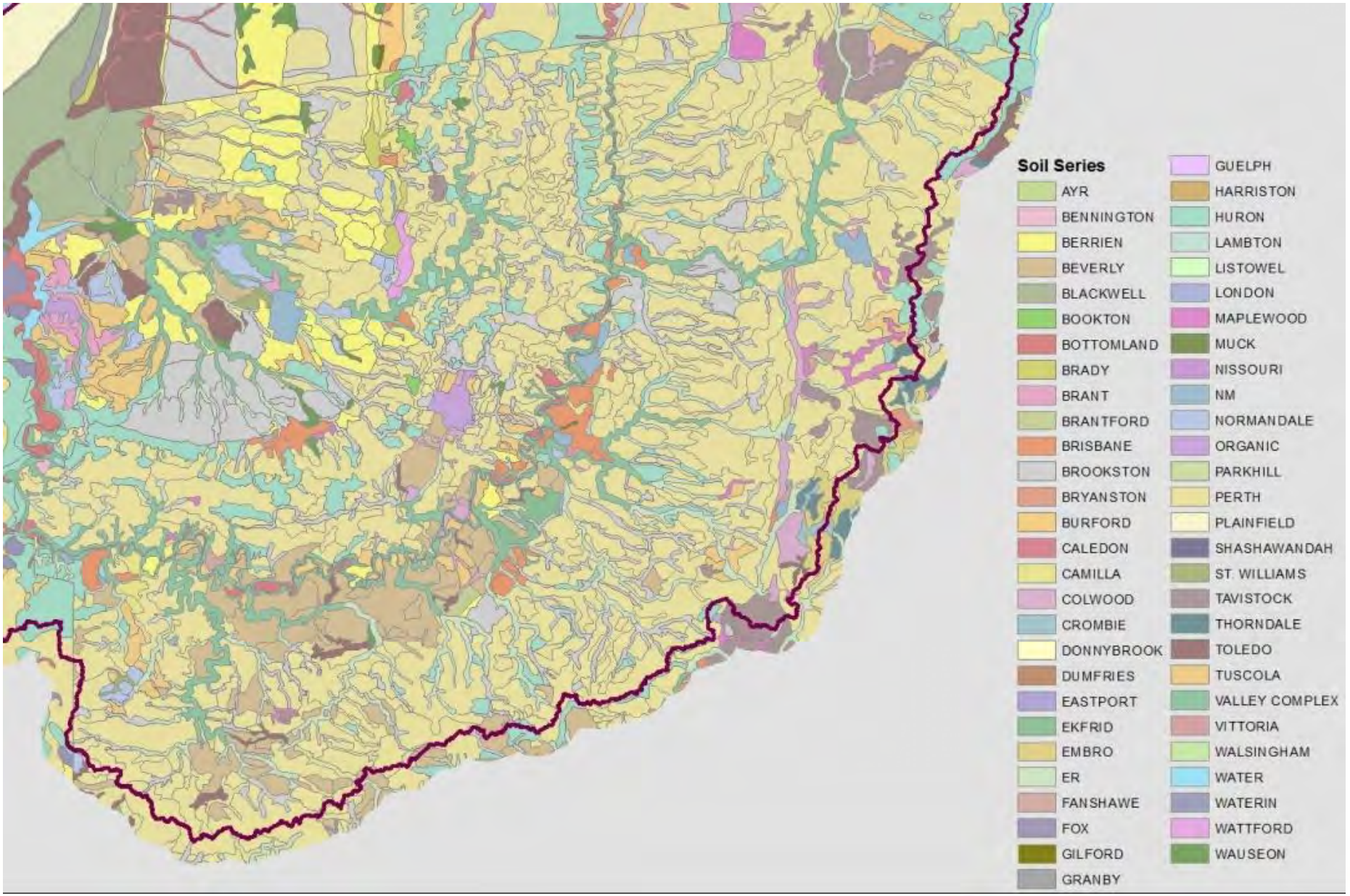
Key Requirements

- Field to Region
  - Matching
    - QC – carbon at field scale **matched** to that one series.
    - USDA measured vegetation and soil suites (aggregate stability, infiltration rates etc.) at the field scale and **matched** to the eco-zone
- Region to Field
  - Relationship
    - reflectance – relate to vegetative cover and poorly to organic matter
    - landscape shape for the predictive mapping of stable soil properties (soil profile development)

• United States Geological Service (USGS)	Down	Ground truth	dynamic
• Minnesota	Not yet		
• Quebec	Up	Yes	Dynamic

• USDA
  • Agriculture Research Service (ARS)
  • Soil Science Division
  • Soil Health Division
	Not yet
	Matching same
	Not yet		

• Agriculture Agri Food Canada (AAFC)	Down	Ground truth	static
• Envasso (Europe)	Not yet		
• New Zealand			
• Soil Resources Group report (2014)	Review		


Soil Series
AYR
BENNINGTON
BERRIEN
BEVERLY
BLACKWELL
BOOKTON
BOTTOMLAND
BRADY
BRANT
BRANTFORD
BRISBANE
BROOKSTON
BRYANSTON
BURFORD
CALEDON
CAMILLA
COLWOOD
CROMBIE
DONNYBROOK
DUMFRIES
EASTPORT
EKFRID
EMBRO
ER
FANSHAWE
FOX
GILFORD
GRANBY
GUELPH
HARRISTON
HURON
LAMBTON
LISTOWEL
LONDON
MAPLEWOOD
MUCK
NISSOURI
NM
NORMANDALE
ORGANIC
PARKHILL
PERTH
PLAINFIELD
SHASHAWANDAH
ST. WILLIAMS
TAVISTOCK
THORNDALE
TOLEDO
TUSCOLA
VALLEY COMPLEX
VITTORIA
WALSINGHAM
WATER
WATERIN
WATTFORD
WAUSEON