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M.E.G.S.

Building Experimental Ecosystem Accounts

London Group, Ottawa

October 2012

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Statistics Canada Statistique Canada

Canada

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2. Why is MEGS: Policy issues
3. MEGS so far: Workgroups results
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The Project

- Measuring Ecosystem Goods and Services (MEGS) is a 2 year Statistics Canada-led interdepartmental initiative aiming to develop prototype ecosystem accounts to support policy needs of:
  1. Environment Canada
  2. Agriculture and Agrifood Canada
  3. Fisheries and Oceans Canada
  4. Natural Resources Canada
  5. Parks Canada

- "Virtual" team of 60 mostly part-time staff in 6 departments

The Project (Cont.)

1. Build a statistical infrastructure
   1. Develop coherent spatial frameworks and geo-referenced data
   2. Adopt common classifications

2. Measure extent and quality of ecosystems
   1. Acquire and integrate data
   2. Measuring indicators

3. Refine approaches to valuation
   1. Produce exploratory case studies

General Policy Issues

1. Many demands from resource departments:

    1. Monetary values of ecosystems and their services to support discussions of protection, conservation, climate change, sustainability, pollution prevention, land use change...

    2. Opportunity to raise argument beyond “environment” versus “economy” to understand the real contribution of ecosystems to human well being, sustainability and “green growth”

Specific Policy Issues

1. Environment Canada
    1. Canadian Environmental Sustainability Indicators (CESI)
    2. Federal Sustainable Development Strategy (FSDS)
    3. Data legacy project for the ESTR series of reports that would facilitate reporting under the United Nations Convention for Biodiversity
2. Department of Fisheries and Oceans
    1. Marine Ecosystem Status and Trends reporting
    2. Regulatory cost-benefit analysis
    3. New policy frameworks based on an ecosystems approach
3. Agriculture and Agrifood Canada
    1. Integrated Assessment Modelling Systems requires Valuation of ecosystem services and biodiversity to conduct policy-relevant analytical studies and evaluations.
4. Natural Resources Canada
    1. Report on Plans and Priorities Enhanced data about ecosystems and biodiversity and related goods and services.

The Workgroups

1. Ecosystem data accessibility
2. Land cover extent and spatial standards
3. Landscape condition & environmental quality
4. Coastal and marine
5. Wetlands
6. Valuation

Land cover extent and spatial standards

1. Coherent spatial standards and classifications

2. Standardized spatial data for use by stakeholders

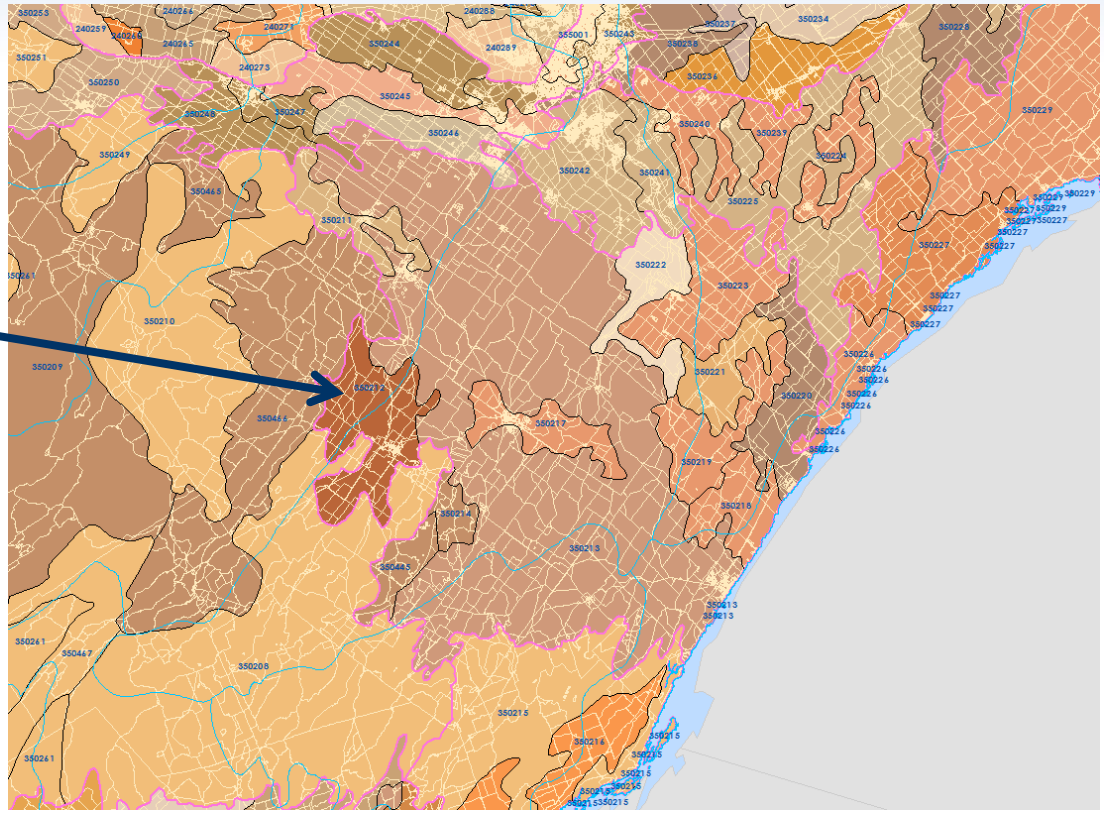
Spatial Attribute Data

- **Main criteria for defining / analysing ecosystems**
  - Landcover / landform / climate / socio-economic variables

- **Soil landscapes units = First level Ecosystem Reporting Unit**
  - Rolls up to ecozone / drainage area hierarchy

<u>Ecosystem Reporting Unit</u>

- 12924 unique ERUs
  - Minimum area 1.4 km2
  - Maximum area 3500 km2
  - Mean area 764 km2



Spatial Attribute Data

Environmental Valuation Reference Inventory

Component table – soil characterstics

SL	100001	100001
CMP	1	2
PERCENT	69	31
KINDMAT	OR	SO
VEGET	F	C
PMDEP	21	M
CFRAG	#	C
ROOTDP	D	C
DRAIN	P	I
DEVEL	Y	W
CALC	#	O
LOCSF	F01	U
SLOPE	A	A
SNF	NF	NF
SOIL_CODE	PPH	BHP
MODIFIER	E1	E4
LEN_KINDMAT	2	2
LEN_VEGET	1	1
LEN_PMDEP	2	1
LEN_CFRAG	1	1
LEN_ROOTDP	1	1
LEN_DRAIN	1	1
LEN_DEVEL	1	1
LEN_CALC	1	1
LEN_LOCSF	3	1
LEN_SLOPE	1	1
MOD_KINDMAT	OR	SO
MOD_VEGET	F	C
MOD_PMDEP	21	M
MOD_CFRAG	#	C
MOD_ROOTDP	D	C
MOD_DRAIN	P	I
MOD_DEVEL	Y	W
MOD_CALC	#	O
MOD_LOCSF	F01	U
MOD_SLOPE	A	A
MOD_SNF	OR F21DPYF01A	SO C MCIW UA
MOD_SOIL_CODE	OR F	SO C
MOD_MODIFIER		
MOD_LEN_KINDMAT		
MOD_LEN_VEGET		
MOD_LEN_PMDEP		
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MOD_MOD_KINDMAT		
MOD_MOD_VEGET		
MOD_MOD_PMDEP		

Ecodistrict Normals 1961 – 1990

Average daily minimum air temperature (° C)	
Average daily maximum air temperature (degrees Celsius)	
Average daily mean air temperature (degrees Celsius)	
Total rainfall (mm)	
Total snowfall (cm)	
Total precipitation (mm)	
Mean hourly vapour pressure (kilopascals)	
Mean hourly wind speed (km/hr)	
Total duration of bright sunshine (hrs)	
Mean daily global solar radiation (megajoules/sq. metre/day)	
Mean hourly dew point temperature (degrees Celsius)	
Precipitation surplus/deficit (mm)	Penman method
	Thornthwaite method
Potential Evapotranspiration and Water Deficit (mm)	Penman PE method
	Thornthwaite PE method
Growing degree-days above 0 degrees Celsius	
Growing degree-days above 5 degrees Celsius	
Growing degree-days above 10 degrees Celsius	
Growing degree-days above 15 degrees Celsius	
Growing season start (calendar or Julian day)	
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Growing season length (days)	
Effective growing degree-days	

Socio – economic 2001 - 2011

Selected population characteristics, Canada, ecozones and ecoregions with population, 2011

Ecoregion	Type	Rural	Total population	Total Ecoregion population	Pop centre population	Rural population	Total population density	Pop centre population as share of total population	Rural population as share of total population	Total private dwellings	Total Ecoregion dwellings	Pop centre dwellings	Rural dwellings	Private dwelling density	Population per private dwelling	Population per pop centre dwelling	Population per rural private dwelling
Canada			**33476688**		**27147274**	**6329414**	**3.3883**	**81.1**	**18.9**	**14569633**		**11522042**	**3047591**	**1.475**	**2.30**	**2.36**	**2.08**
5	Rural	1	520	520	0	520	0.0059	0	100.0	180	180	0	180	0.002	2.89	0.00	2.89
6	Rural	1	934	934	0	934	0.1030	0	100.0	216	216	0	216	0.024	4.32	0.00	4.32
9	Rural	1	5	5	0	5	0.0001	0	100.0	0	0	0	0	0.000	0.00	0.00	0.00
12	Rural	1	214	214	0	214	0.0037	0	100.0	80	80	0	80	0.001	2.68	0.00	2.68
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14	Rural	1	61	61	0	61	0.0055	0	100.0	33	33	0	33	0.003	1.85	0.00	1.85
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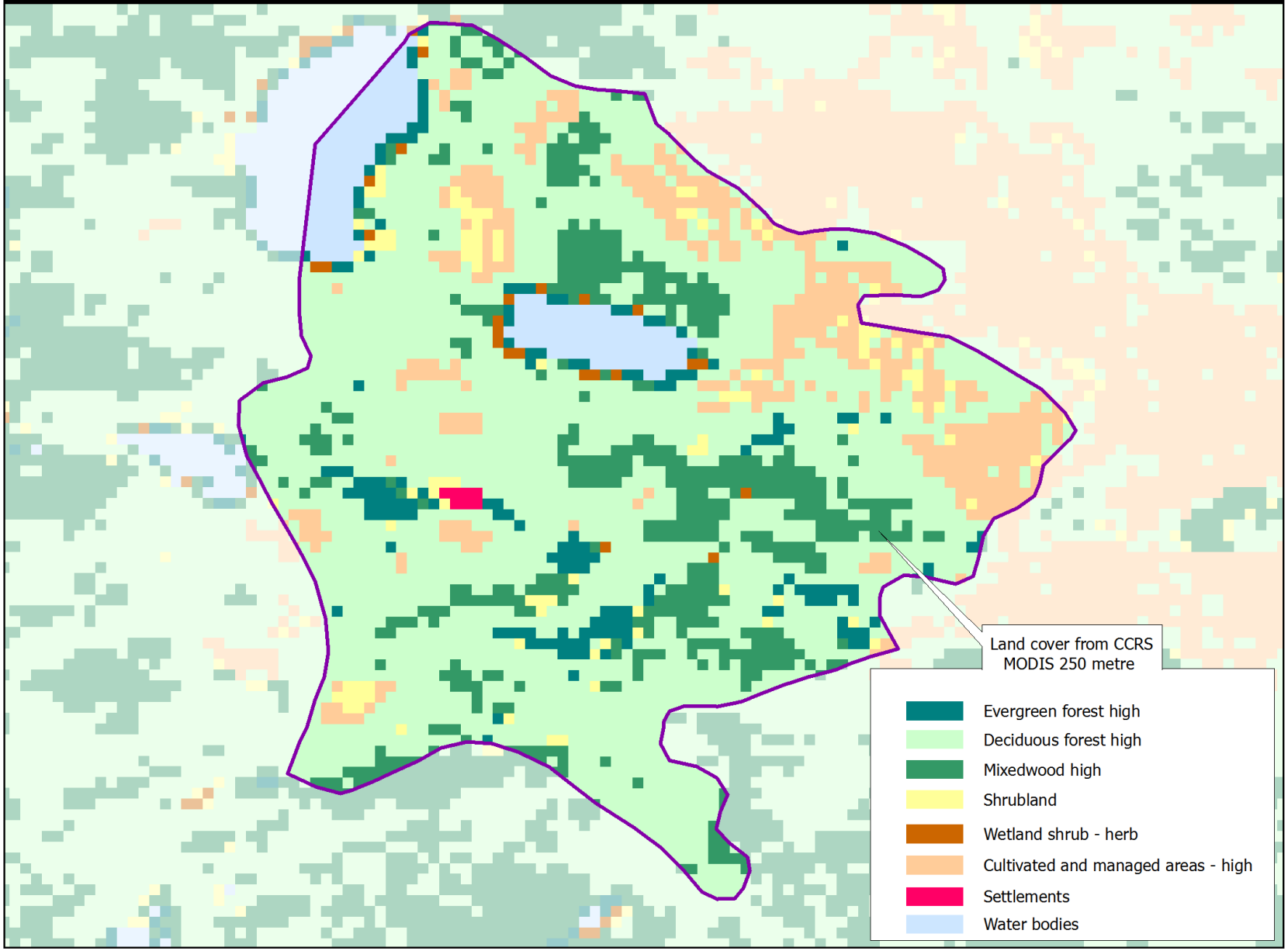
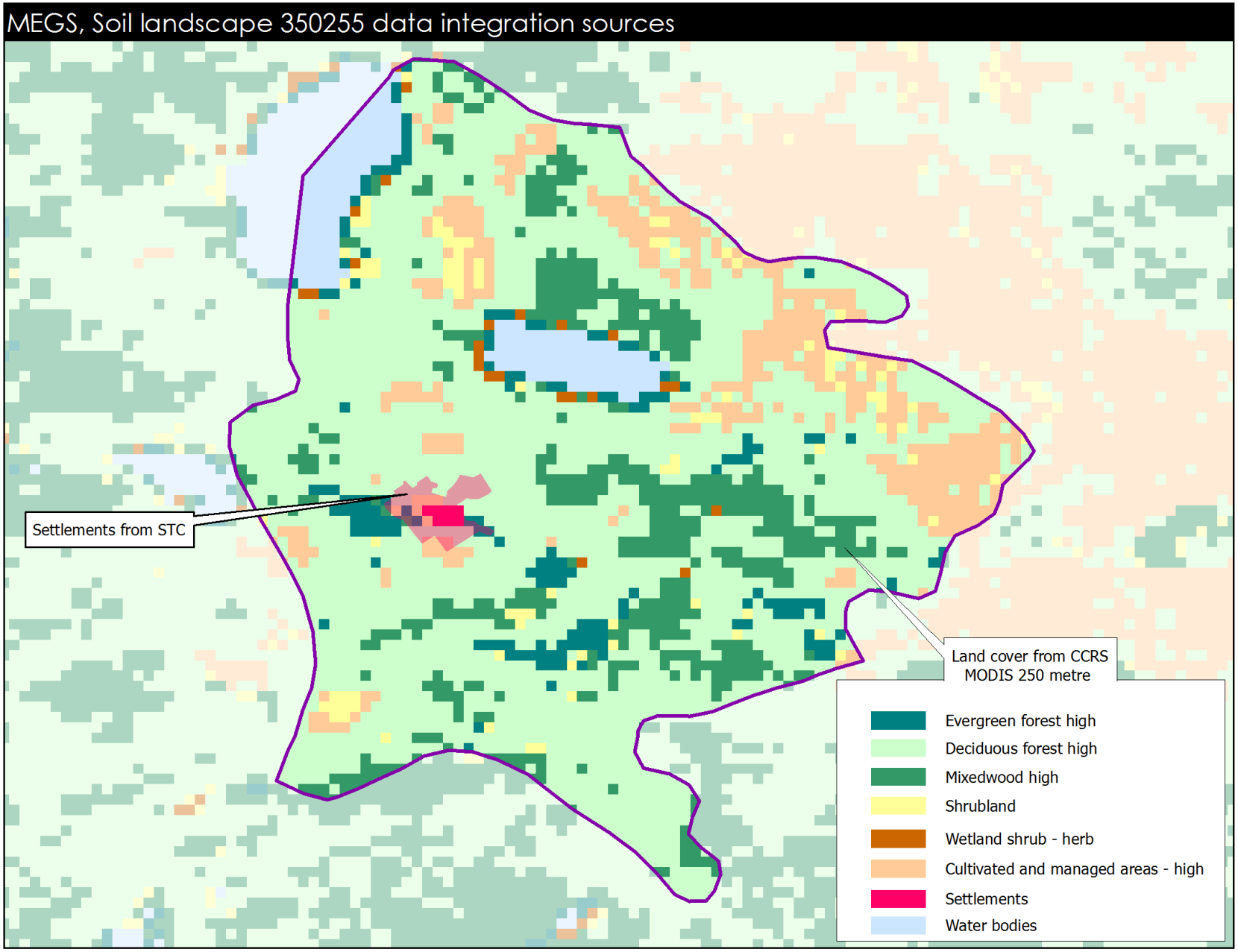
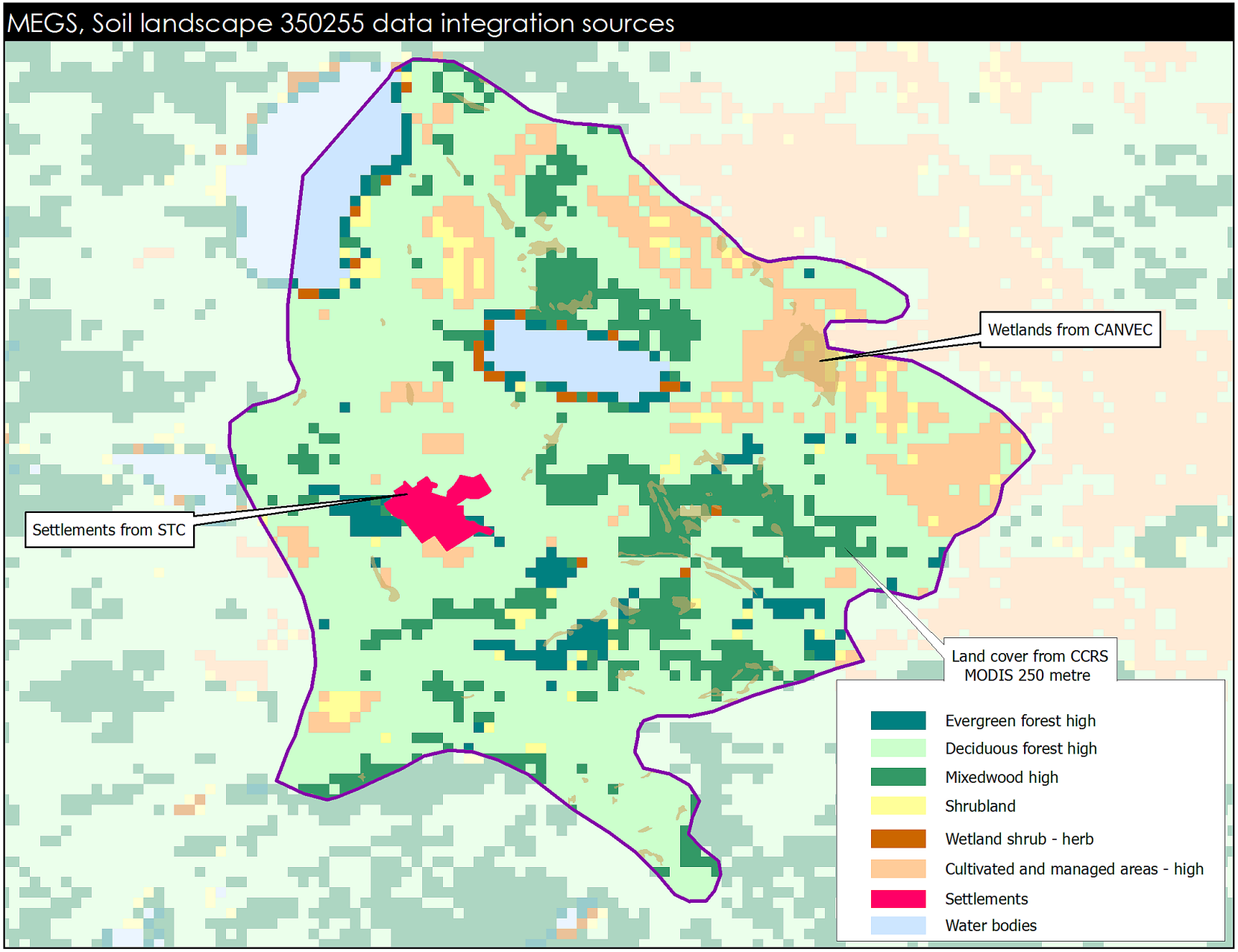
MEGS, Soil landscape 350255 data integration sources




MEGS, Soil landscape 350255 data integration sources
Settlements from STC
Land cover from CCRS
MODIS 250 metre
Evergreen forest high
Deciduous forest high
Mixedwood high
Shrubland
Wetland shrub - herb
Cultivated and managed areas - high
Settlements
Water bodies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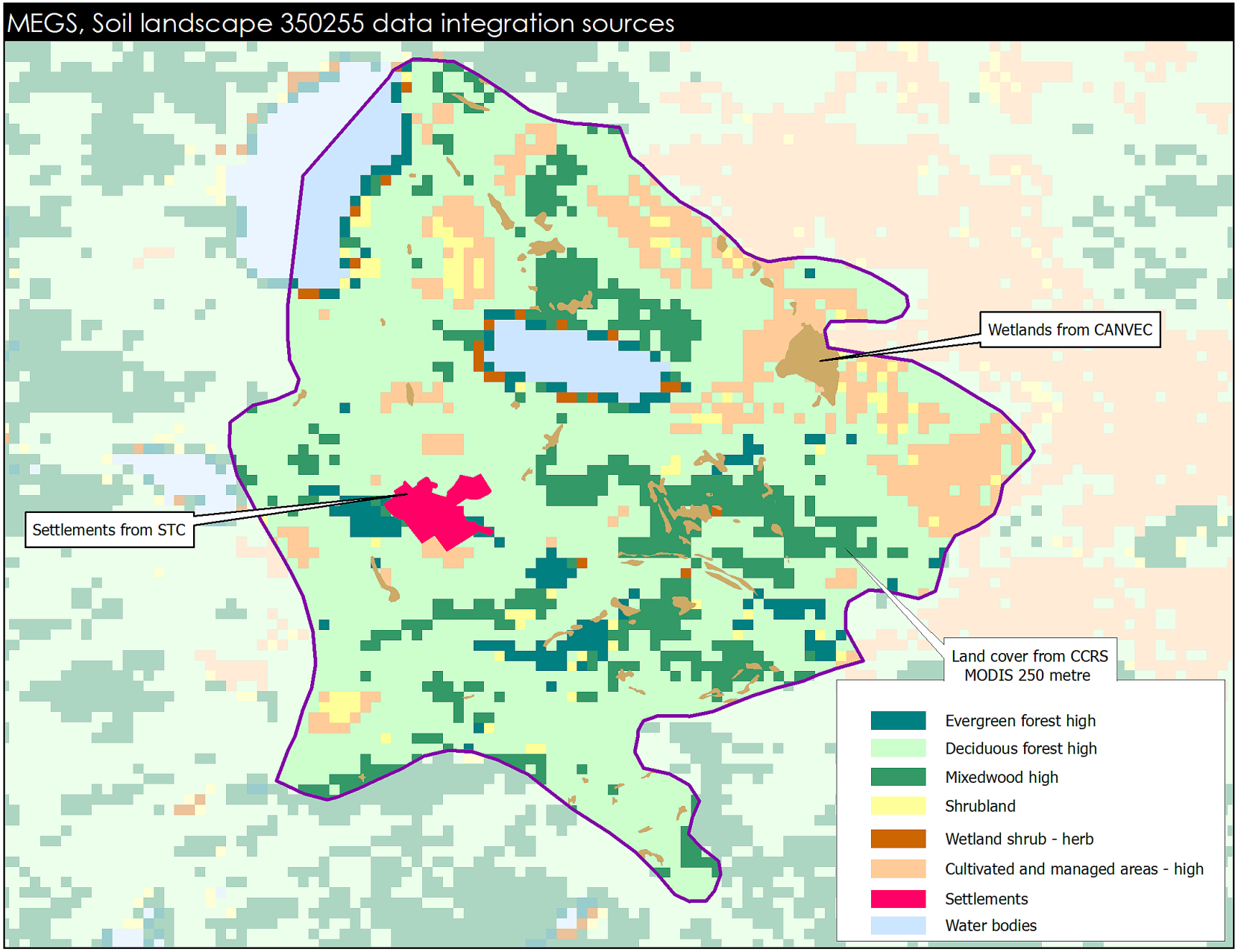
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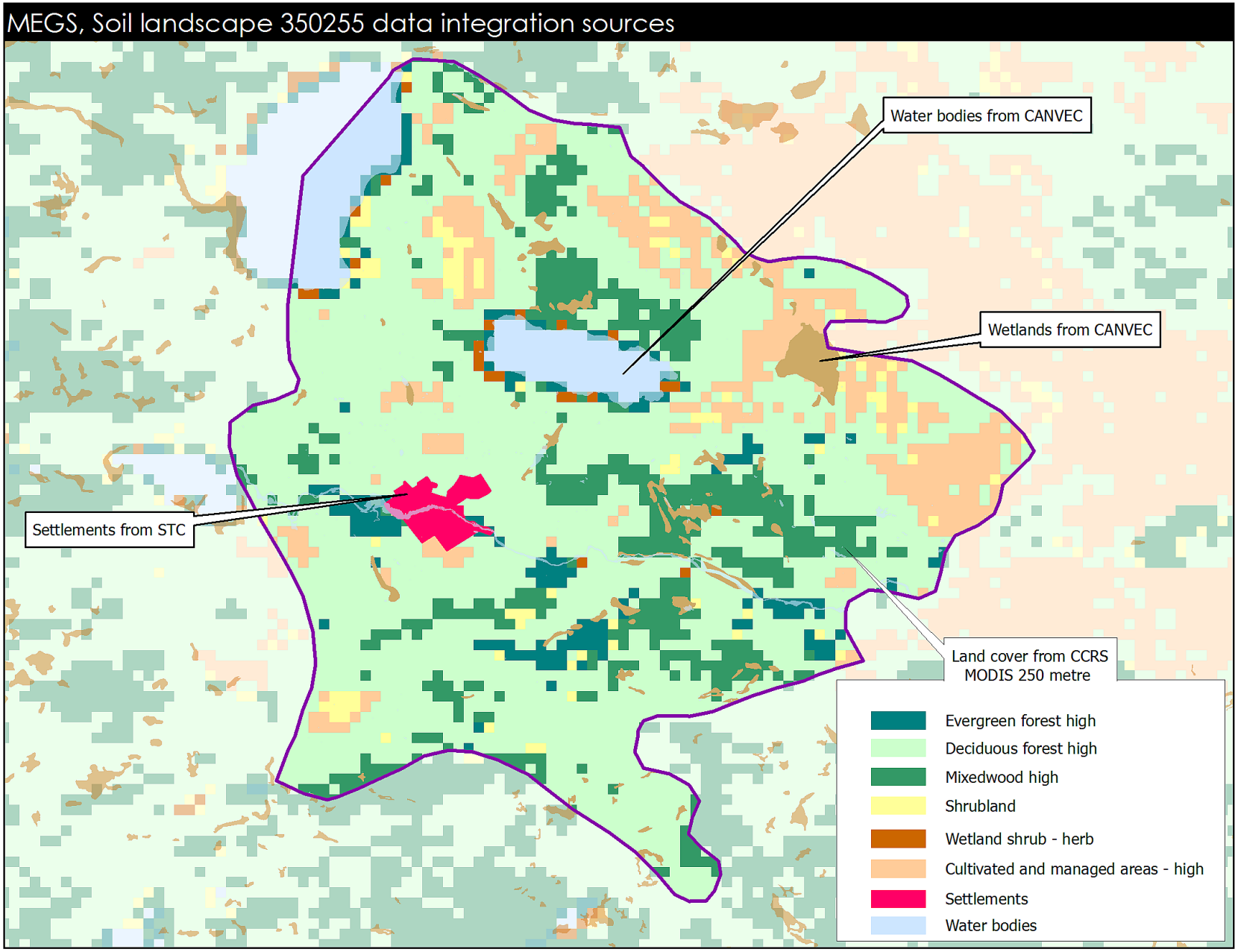
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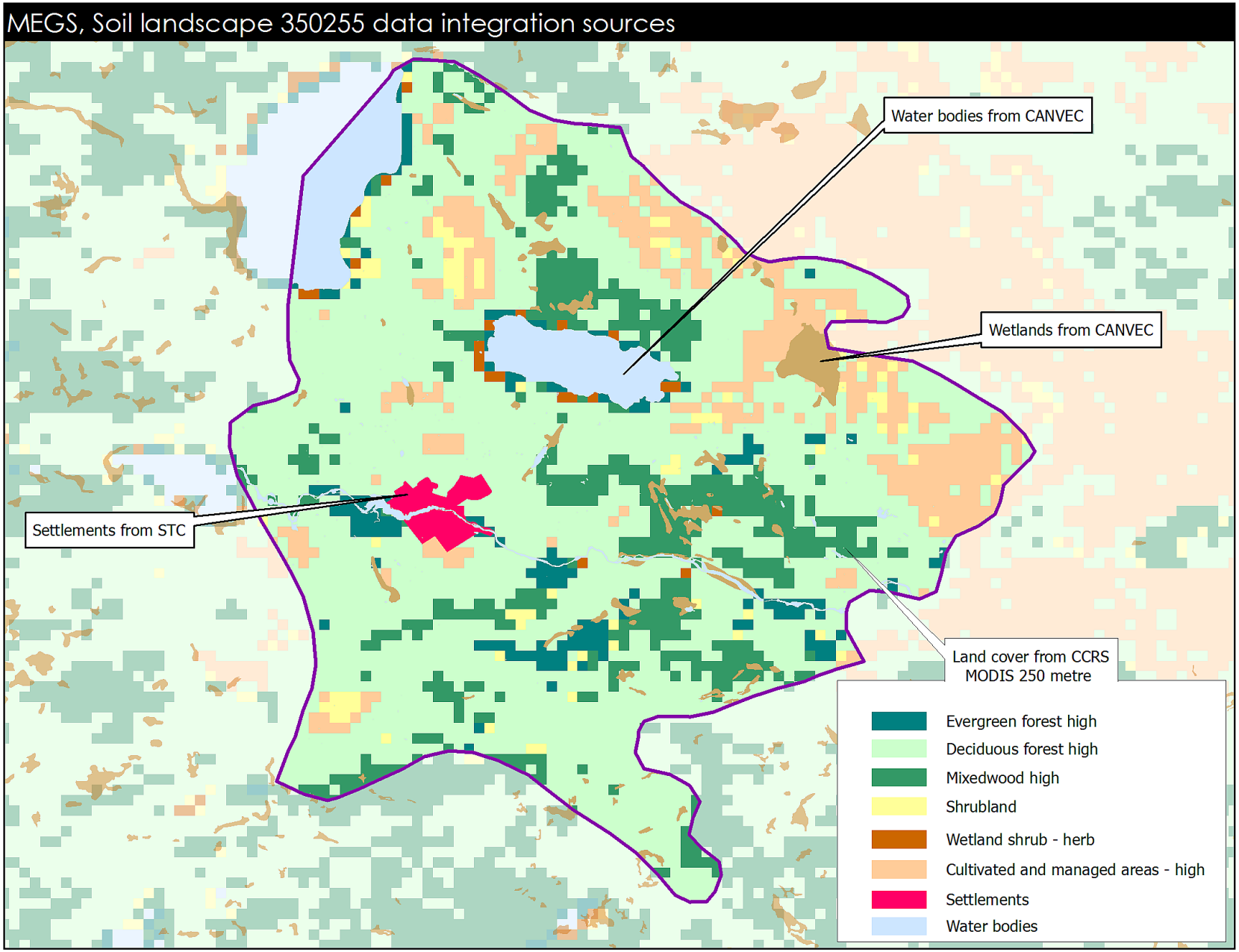
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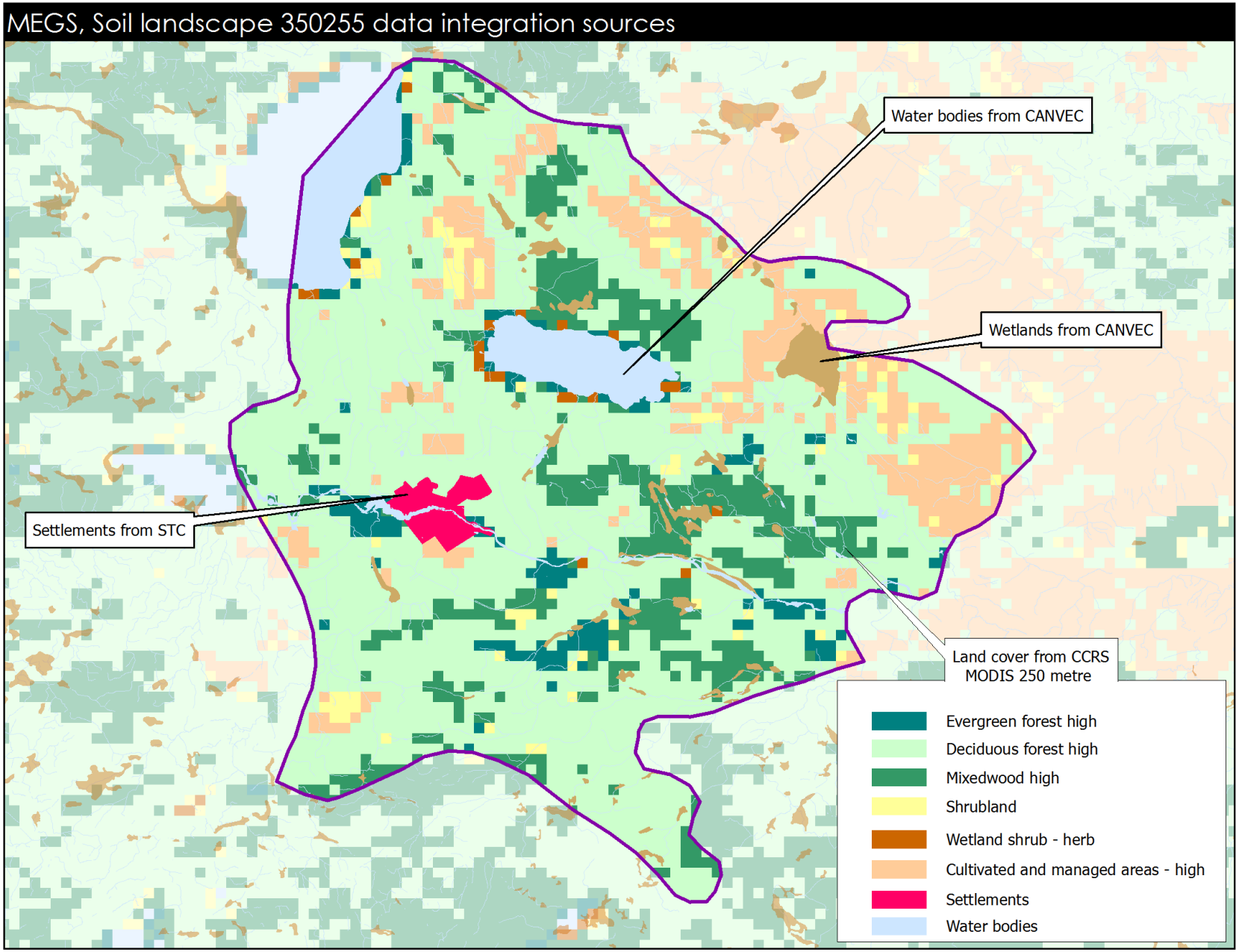
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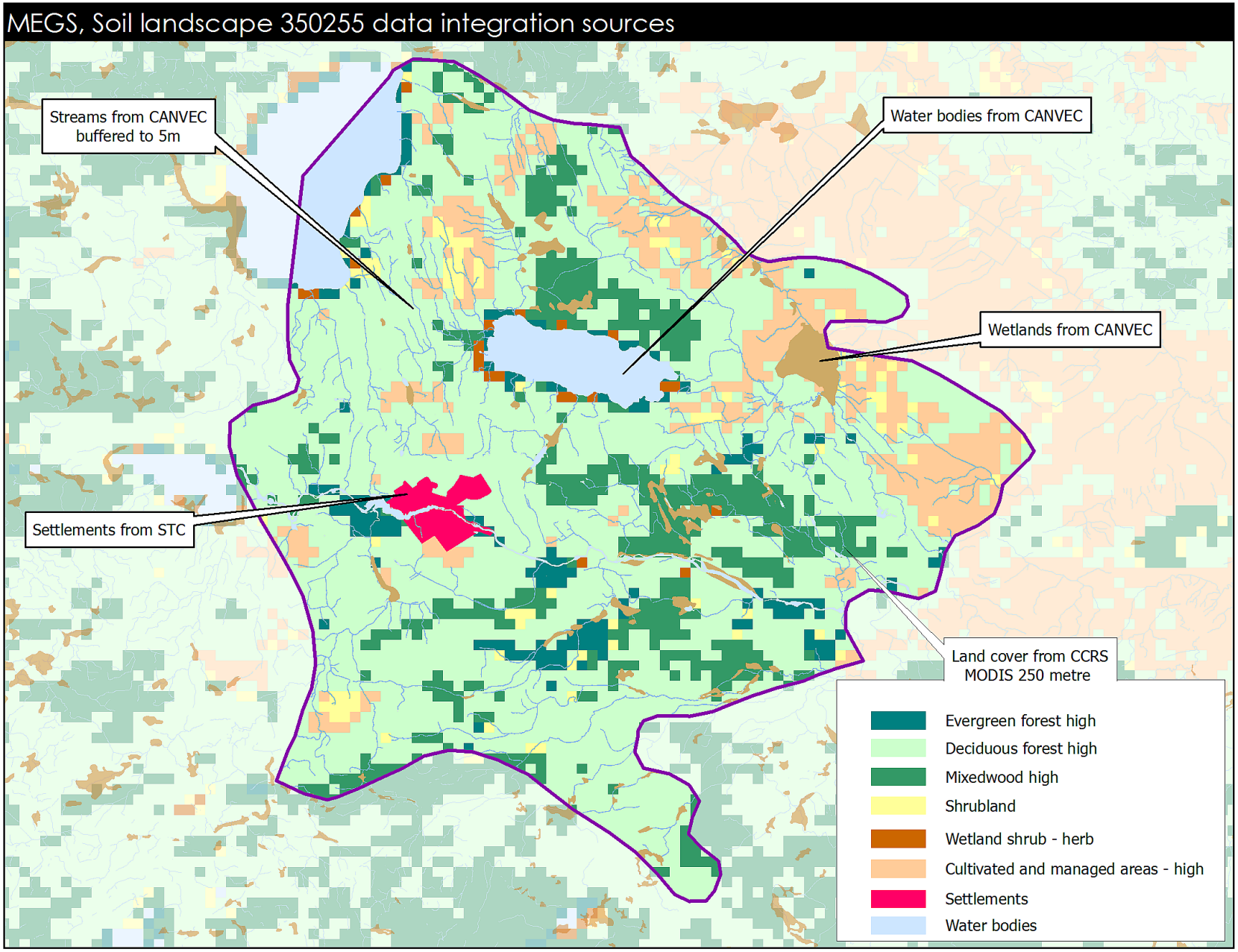
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Streams from CANVEC buffered to 5m
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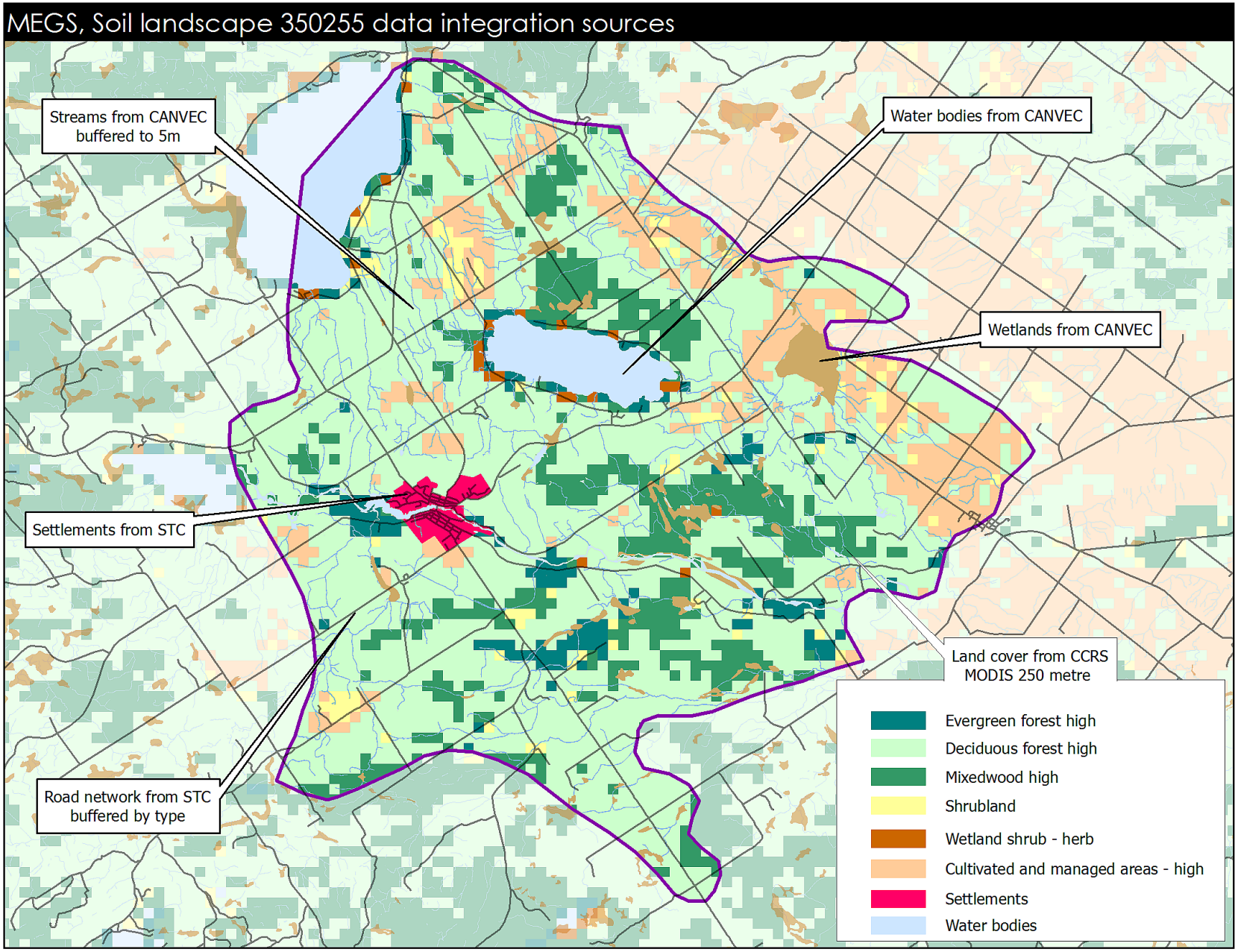
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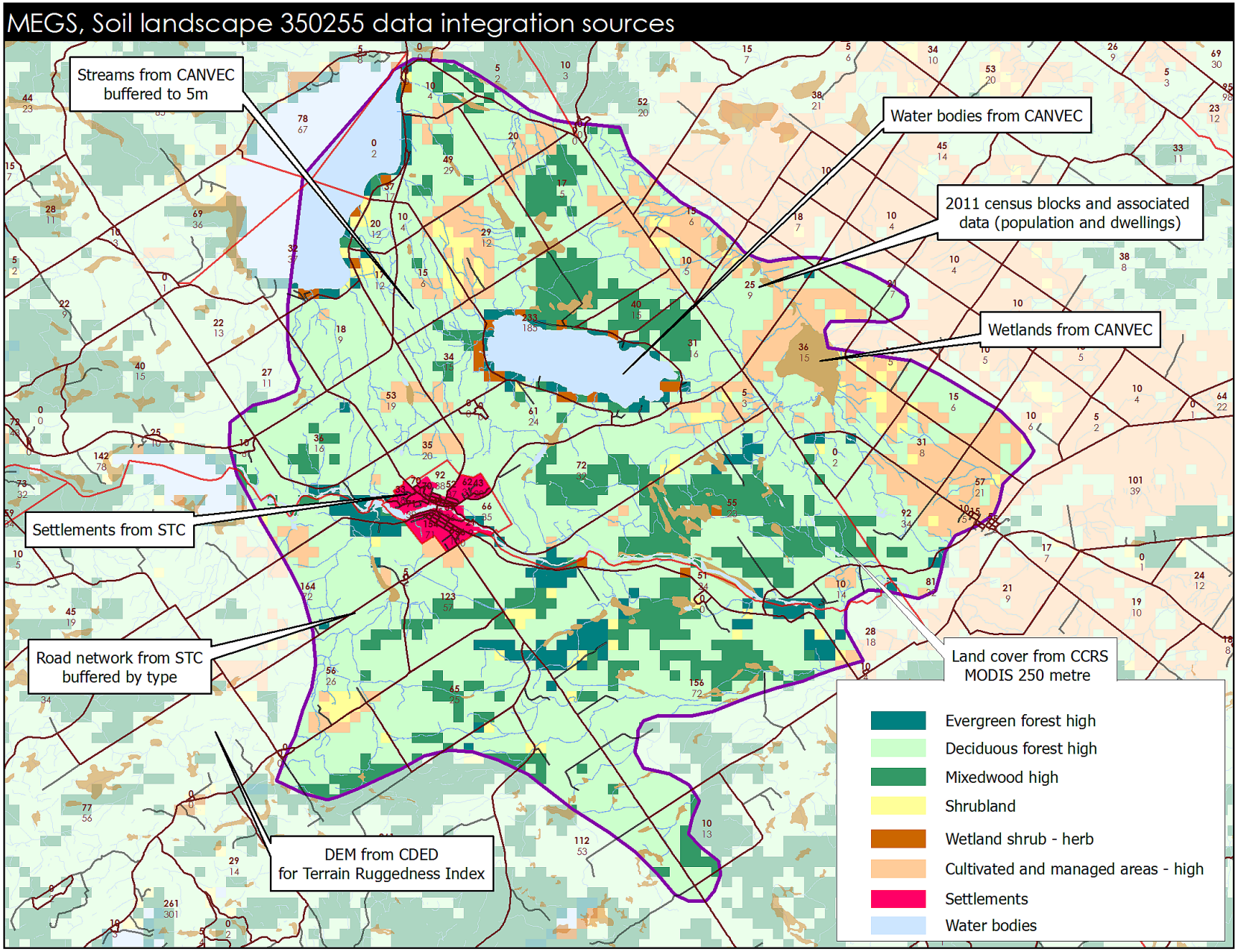
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2011 census blocks and associated data (population and dwellings)
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Settlements from STC
Road network from STC buffered by type
DEM from CDED for Terrain Ruggedness Index
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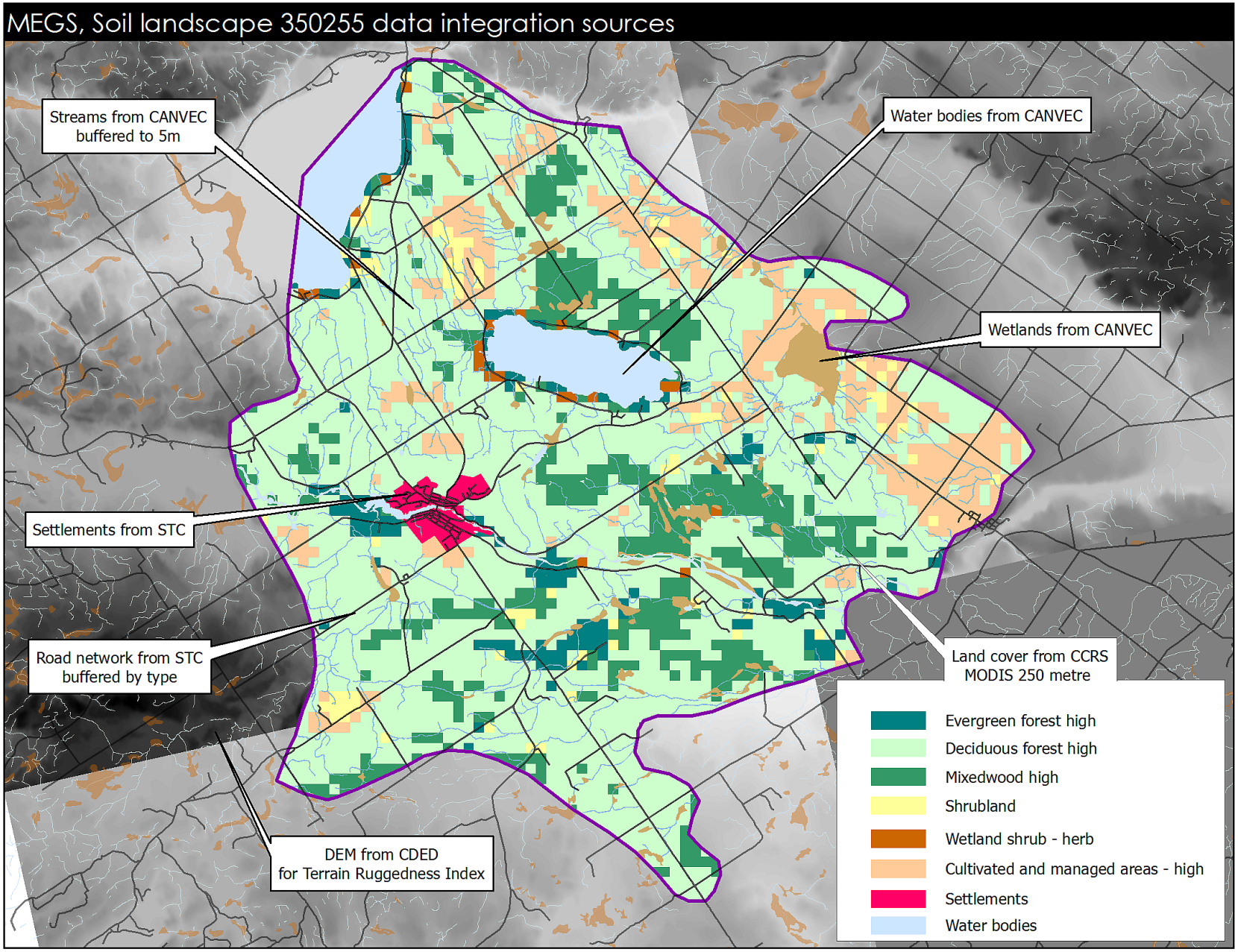
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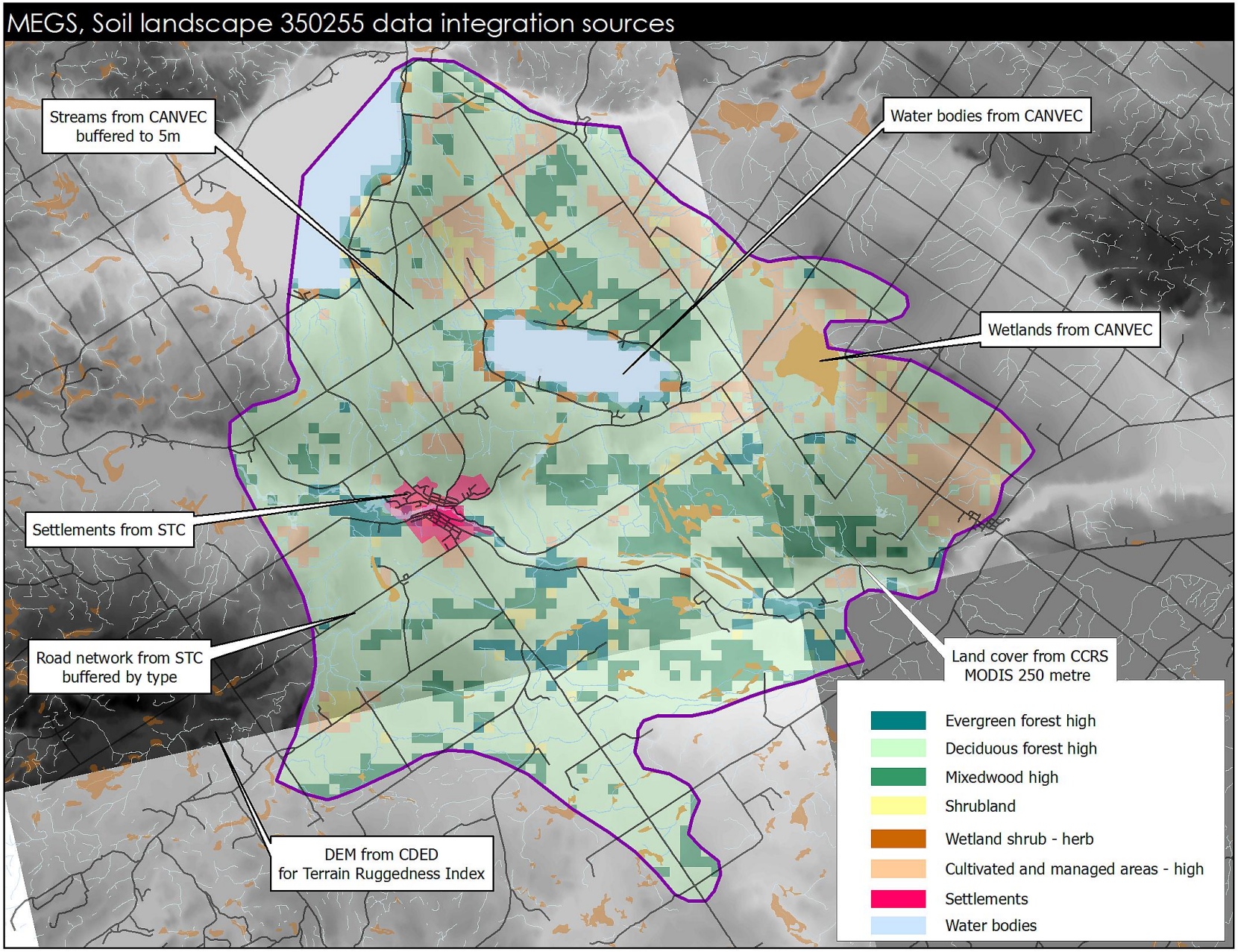
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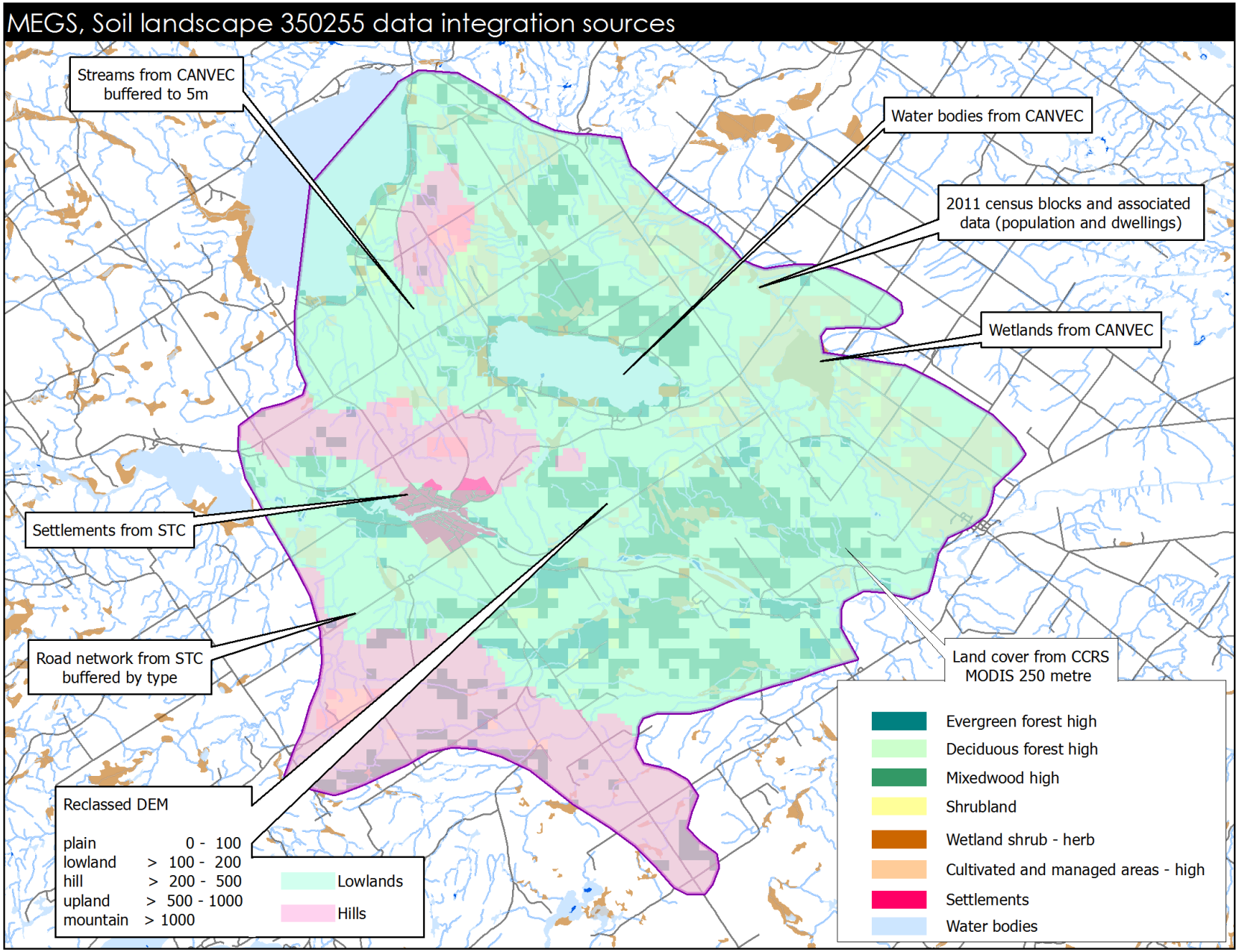
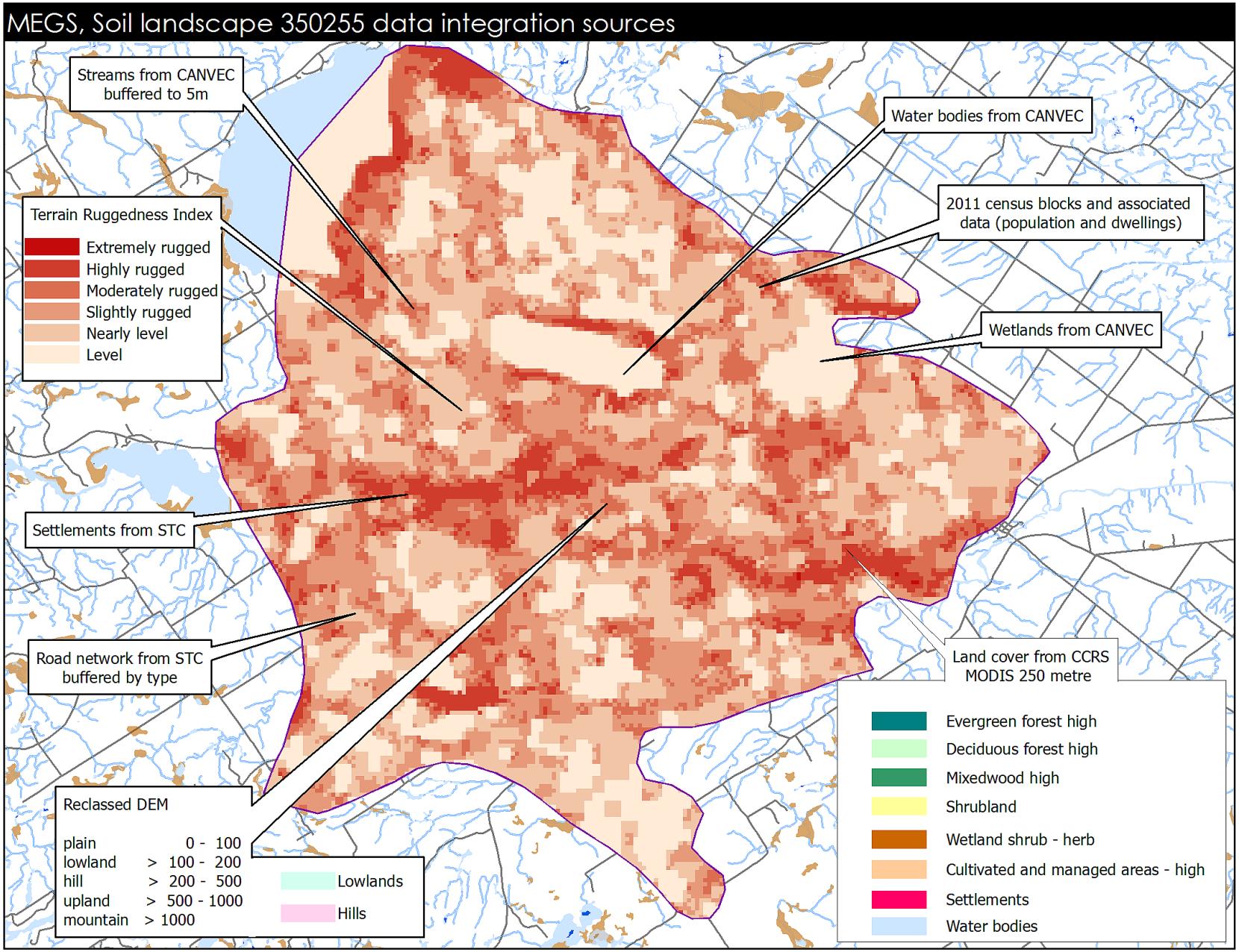
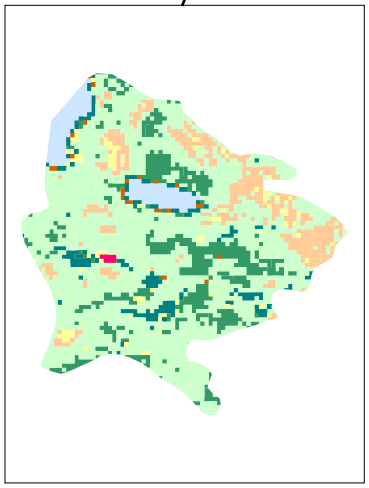
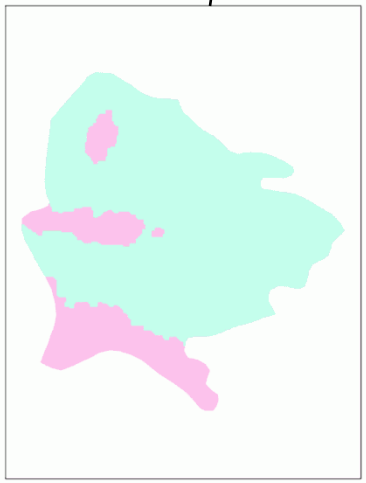


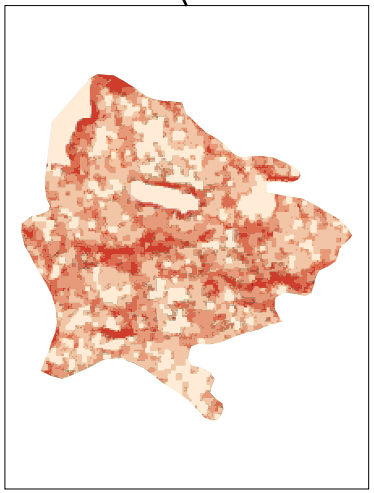

MEGS, Soil landscape 350255 data integration sources
Streams from CANVEC buffered to 5m
Water bodies from CANVEC
2011 census blocks and associated data (population and dwellings)
Terrain Ruggedness Index
Extremely rugged
Highly rugged
Moderately rugged
Slightly rugged
Nearly level
Level
Wetlands from CANVEC
Settlements from STC
Road network from STC buffered by type
Land cover from CCRS MODIS 250 metre
Evergreen forest high
Deciduous forest high
Mixedwood high
Shrubland
Wetland shrub - herb
Cultivated and managed areas - high
Settlements
Water bodies
Reclassed DEM
plain 0 - 100
lowland > 100 - 200
hill > 200 - 500
upland > 500 - 1000
mountain > 1000
Lowlands
Hills

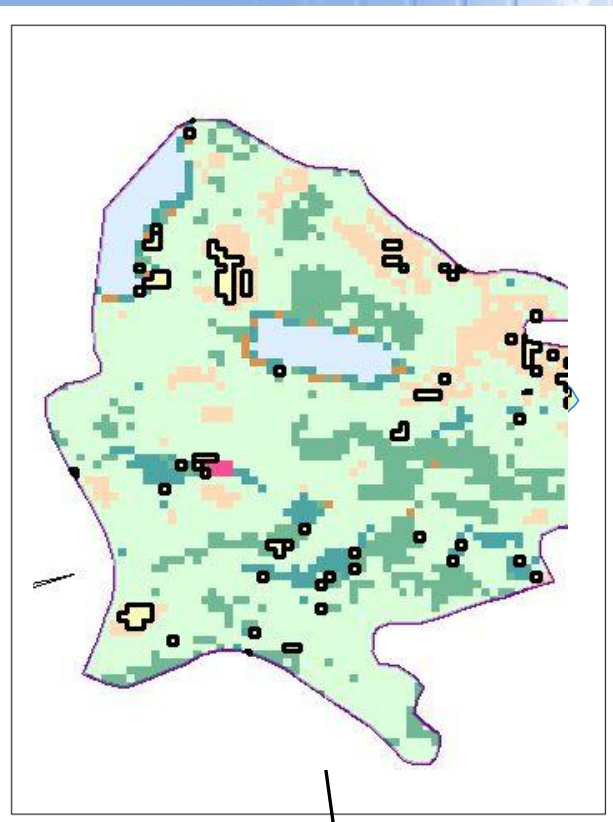
Working towards a Ecosystem Reporting Unit (ERU)

Land cover	Terrain	Ruggedness
Cultivated and managed areas	plain	level
Settlements	lowland	nearly level
Wetland shrub - herb	plain	level
Shrubland	hills	slightly
Mixedwood high	hills	slightly
Deciduous forest high	lowland	moderately
Evergreen forest high	hills	moderately

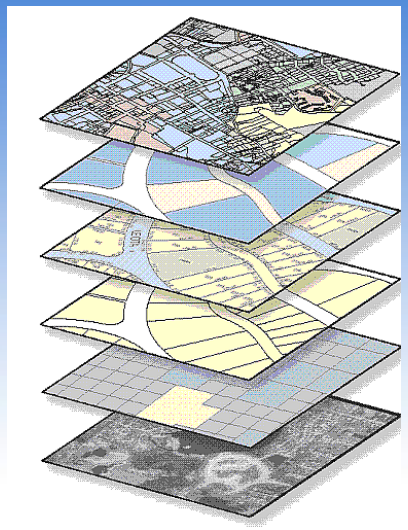








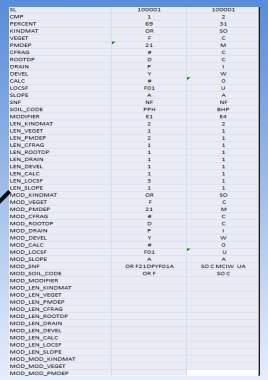
Layers



Environmental Valuation Reference Inventory

EVRI

Attributes



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Selected population characteristics, Canada, ecozones and ecoregions with population, 2011

Ecoregion	Type	Rural	Total population	Total Ecoregion population	Pop centre population	Rural population	Total population density	Pop centre population as share of total population	Rural population as share of total population	Total private dwellings	Total Ecoregion dwellings	Pop centre dwellings	Rural dwellings	Private dwelling density	Population per private dwelling	Population per pop centre dwelling	Population per rural private dwelling
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Terra.gdb
Aqua.gdb

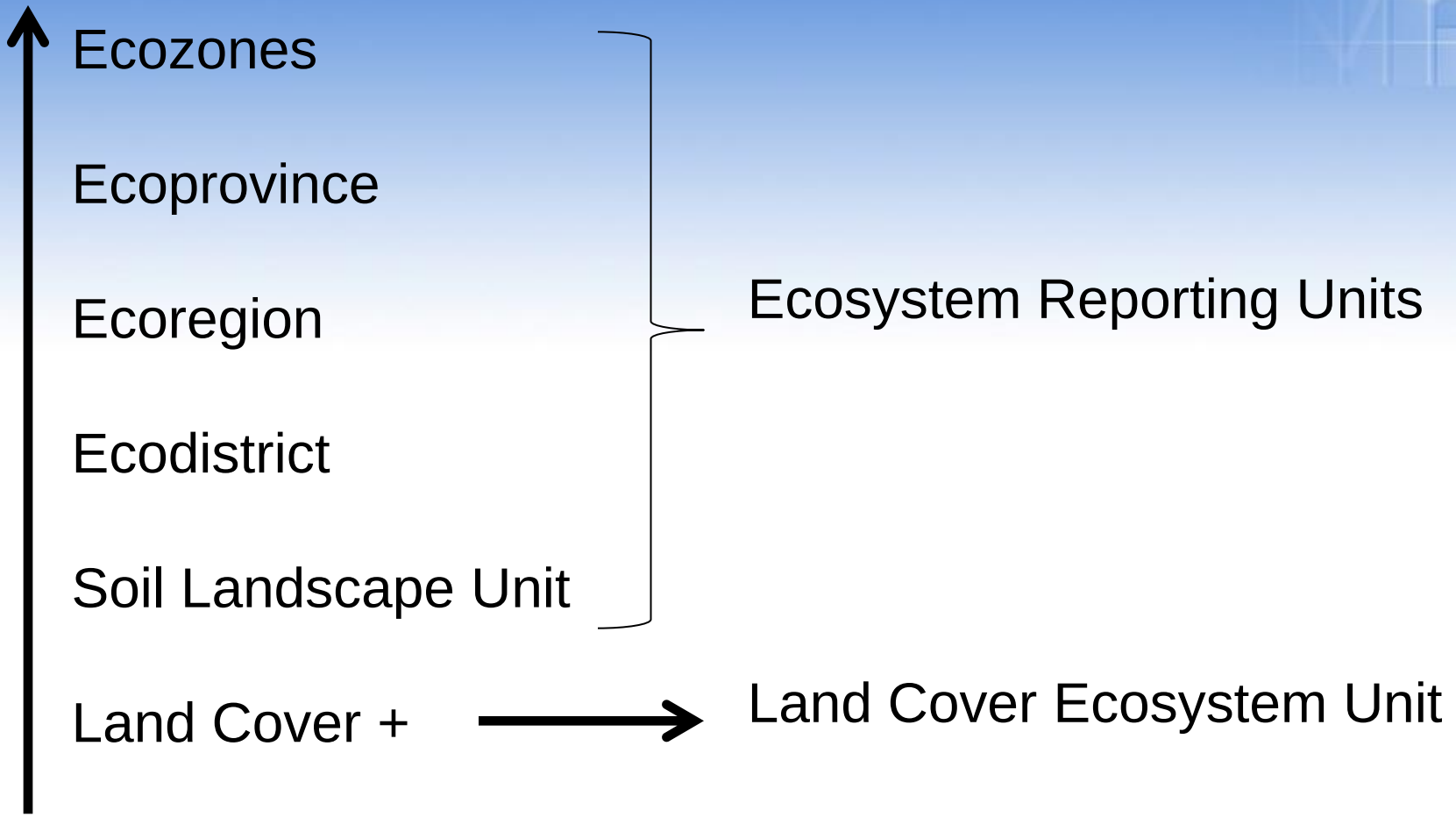
Spatial analysis – define landscape unit by ecozone or drainage area hiearchy

Proximity analysis – wetlands / settled areas

Temporal analysis - Land cover change over time

Scenario analysis - Valuation - determine areas with similar ecosystem services

Spatial Statistical Units



N.B. Also rolls roll up to drainage and administrative classifications

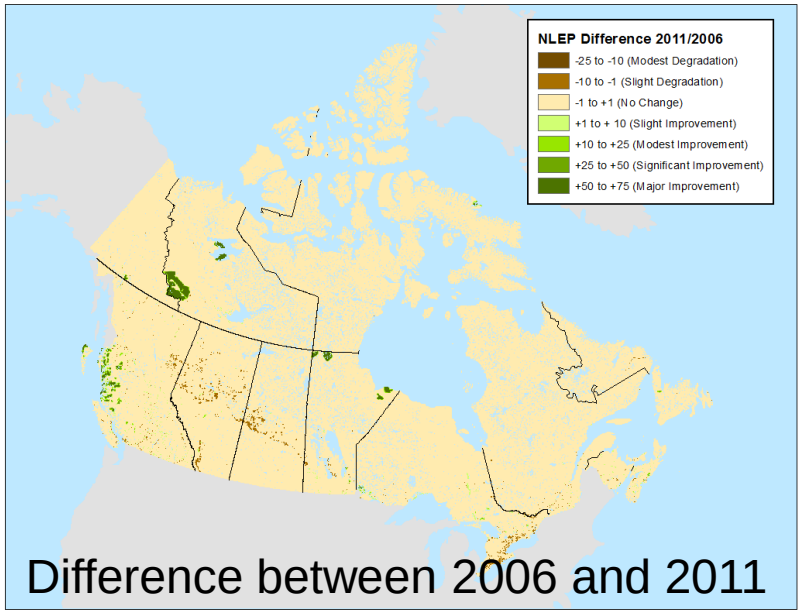
Landscape Condition & Environmental Quality Working Group

1- Coordinate classification and integration of biophysical data

2- Indicators/metrics of ecosystem quality review of recent progress

Landscape ecological potential

- Index based on land-use, protected areas and fragmentation (inspired by the work of Weber and Spyropoulou (EEA) and Soukup and Páramo (ETCLUSI)



Difference between 2006 and 2011

$$NLEP = \sqrt{(\text{favourable to nature index} + \text{protected index}) \times \text{fragmentation index}}$$

Local case study – St Lawrence Islands National Park (SLINP)

- One of the smallest national parks in Canada
  - 19 km^2 (vs Wood Buffalo's 44 807 km^2)
- Fragmented and discontinuous

Local case study – St Lawrence Islands National Park (SLINP)

- Selected main EGS will be measured by biome and integrated into CICES

Partial ecosystem account for St. Lawrence Islands National Park

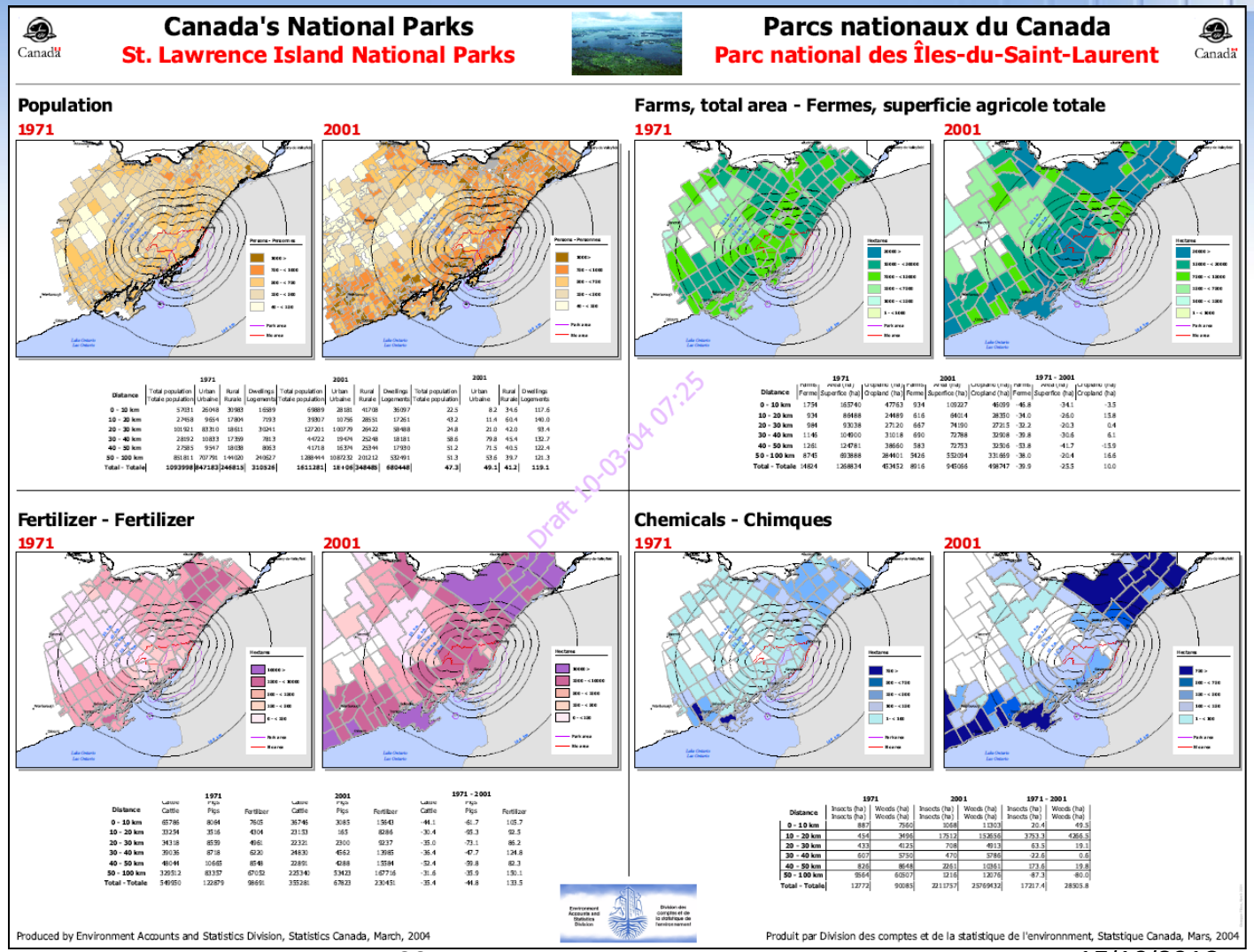
Ecosystem type	Area	Quality	PS: Agriculture	CS: Recreation	CS: Aesthetic/amenity	Total
Wetlands						
Lakes/rivers						
Forests						
Woodland and shrubland						
Grass/rangeland						
Ice/rock/polar						
Cultivated						
Urban (settled)						

PS = Provisioning service
CS = Cultural service

Ecosystem types from MEGS overview, 01DEC2011

Proposed case study: SLINP area

- Vulnerable to external pressures
- Propose to update these pressures maps



Biomass extraction

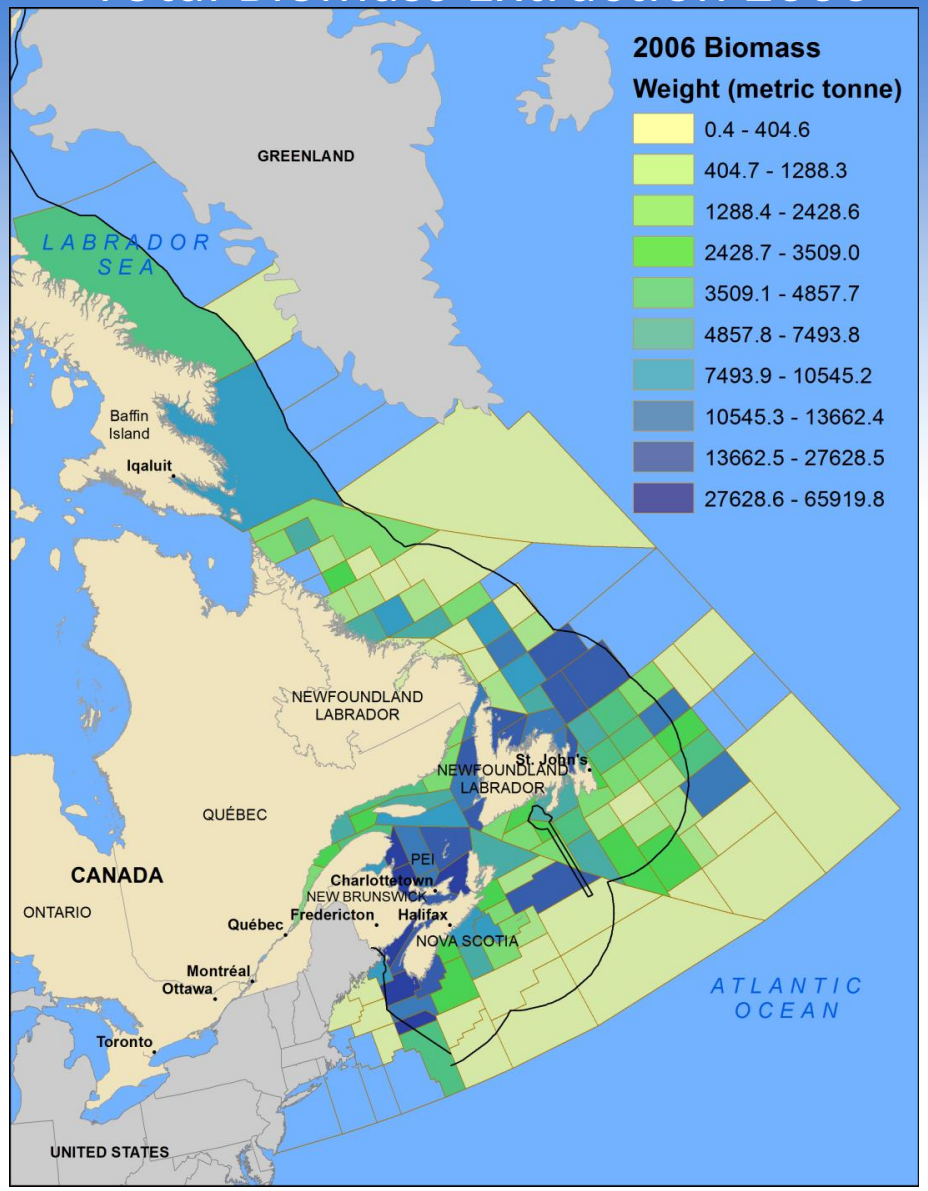
- Map of biomass extracted from Canada, including terrestrial and freshwater landscapes
  - Started background research for data layers in order to piece together a Canadian biomass extraction map
  - Idea is to overlay with similar map for coastal areas and have complete map of Canada

Coastal and Marine

1. Focus on coastal and marine data integration

2. Socio-economic dimensions (coastal population, resources, etc.)

Total Biomass Extraction 2006



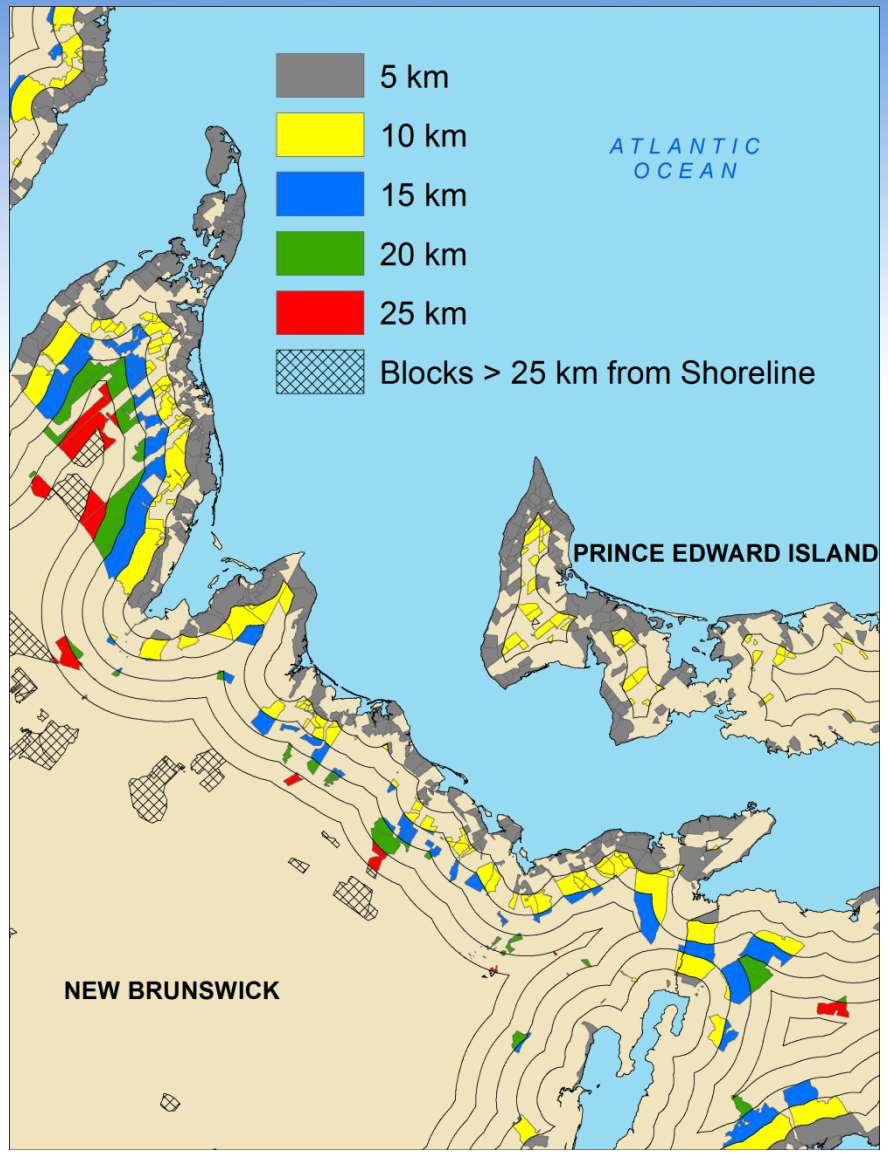
Species Group

	Metric tonnes
Groundfish	108,948.7
Shellfish	464,519.0
Pelagics	261,385.3
Other	46,772.8
Total	881,625.8

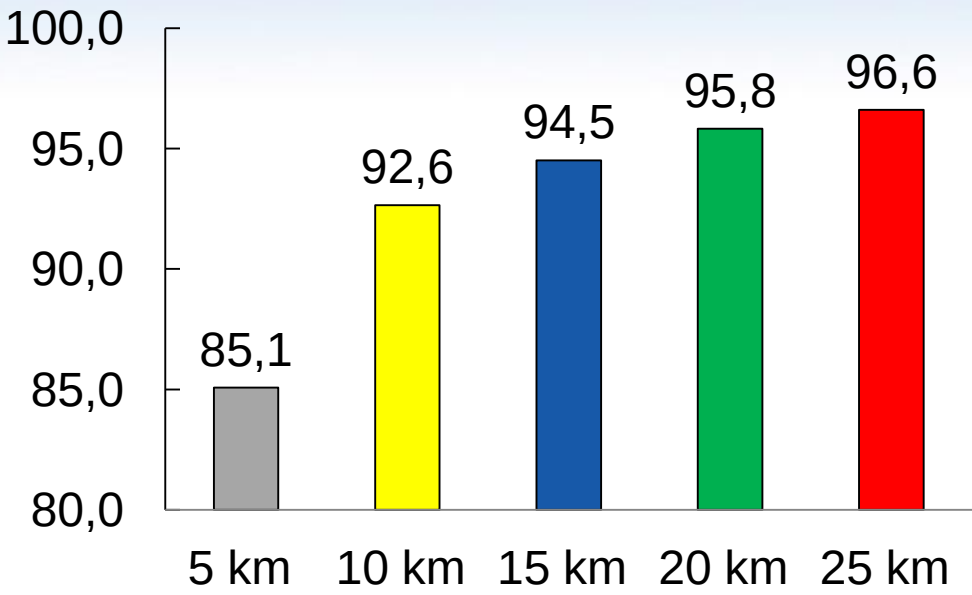
Department of Fisheries and Oceans, Zonal Interchange Format File (ZIFF) Catch and Effort Database.

Blocks with Fishing Employment – Distance from Shoreline 2006

Population Employed in Fishing Industry – Distance from Shoreline 2006

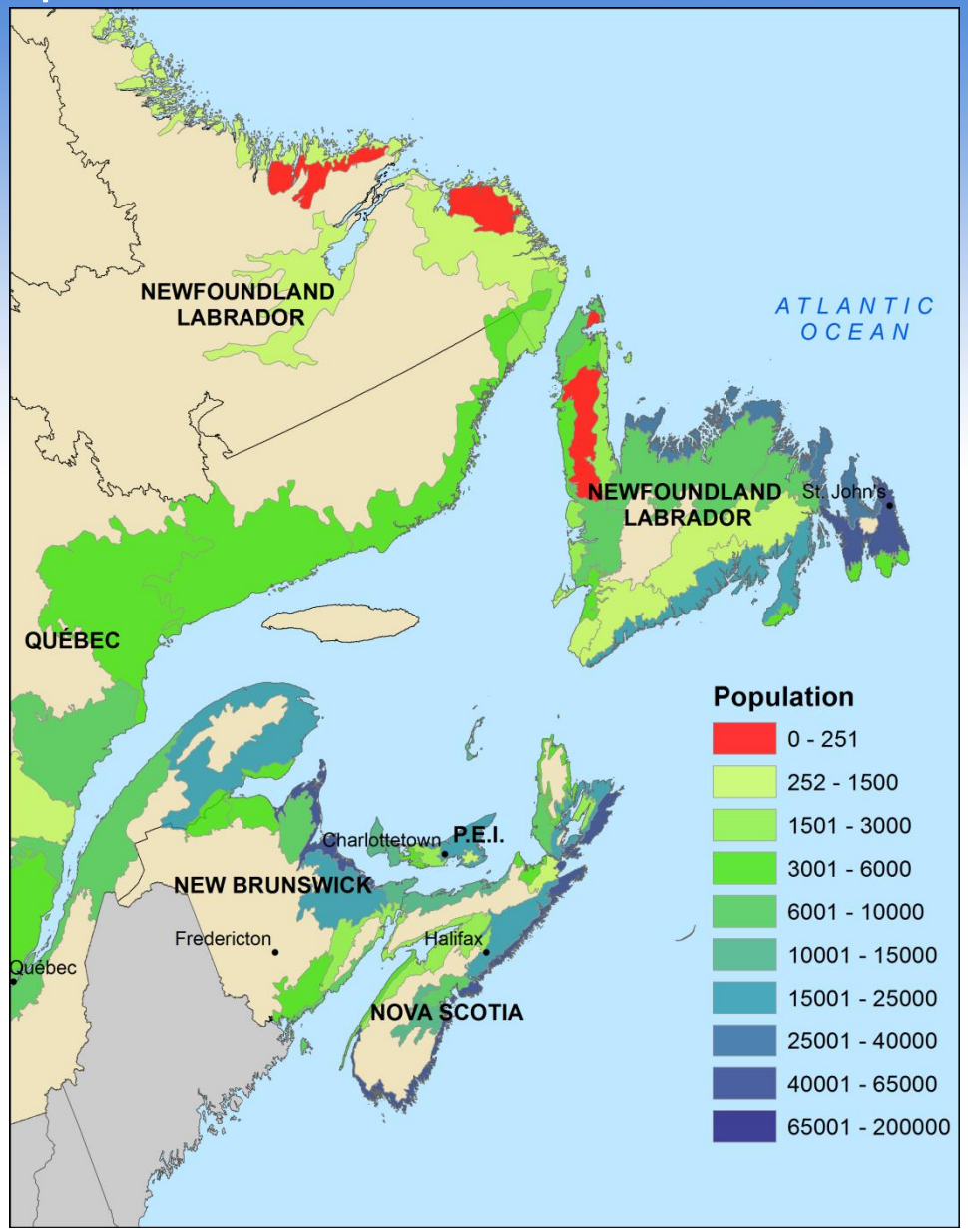


Percent Population Working in Fishing Industry of the Total Population Working in the Fishing Industry With Distance from Shoreline



*Percent was calculated using population working in fishing industries within 100 km of shoreline.

Population per Ecodistrict 2006



Wetlands

1. Integrated study of wetlands extent, quality and values

Wetlands Working Group Overview

- **Indicator and account work**
  - Estimates of nutrient processing, carbon sequestration and flow attenuation services
  - Estimates of population pressures and population benefits, and possible replacement costs
- **Case study(s)**
  - Assiniboine drainage basin examples
  - Completed research on up-scaling, transfer, meta-analysis, regression, land cover, biophysical estimation etc..
- **Contextual approach – non-monetary valuation**
  - Producing spatial data to understand individual wetlands in their socio-economic and bio-physical setting.
  - Analysing the contextual data to determine “value”
  - Deriving characteristic data such as GDP or income of surrounding population, scarcity, total population, bio-physical, upstream and downstream characteristics etc...
  - Following European studies (scaling up) – European Environmental Agency, Fondazione Eni Enrico Mattei and Brander et al.

Draft Wetland Asset Account

Draft and simplified ecosystem classification and account for (Canadian) wetlands with examples**

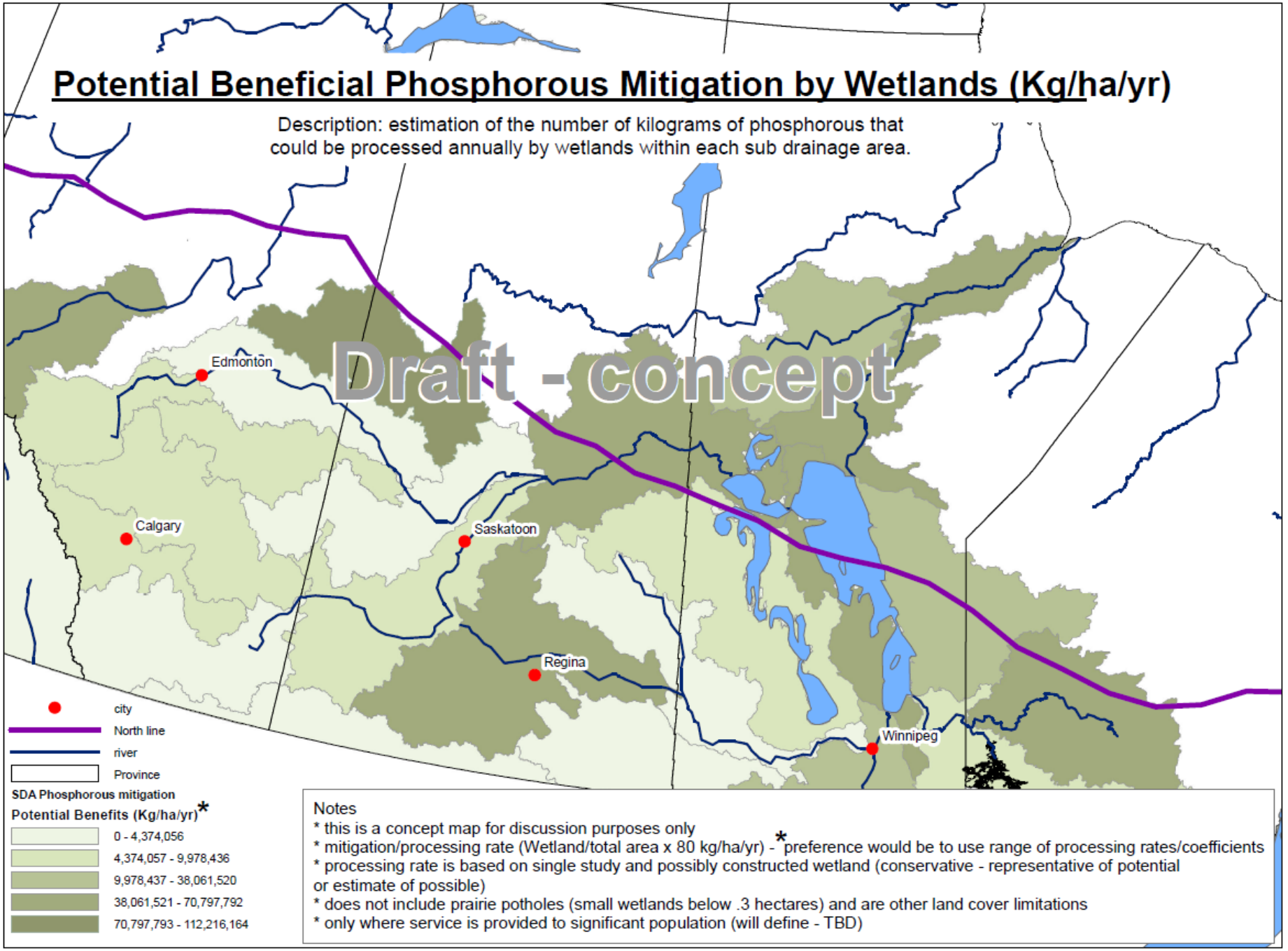
Category	Services: Type	Services: Comments and examples	Class of Wetland (and/or total)	Land Area (km2 or ha)	Quality	Geography (SDA or Ecozone)	Functional value: Variable	Functional value: value and unit	Functional value: Quality	Monetary value: Method	Monetary value: value and unit	Monetary value: Quality
Provisioning												
	Food	production of fish, wild game, fruits, and grains										
	Potable water	a storage and retention of water for domestic, industrial, and agricultural use										
	Biotic materials	genetic material, genes for resistance to plant pathogens, ornamental species, and so on										
	Energy	renewable biofuels - plant or animal based resources										
Regulating												
	Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes (cooling)	Bog, Fen, Marsh, Swamp, Shallow water and/or total			SDA	sequestering carbon	Mg/yr as rate or Mg total	+/- x%			+/- x%
	Regulation of biotic environment	life cycle maintenance, habitat protection, cover, pest and disease control and gene pool protection										
	Water flow regulation	attenuation of runoff, discharge rates and waves - groundwater recharge/discharge - mass flows										
	Water purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants	Bog, Fen, Marsh, Swamp, Shallow water and/or total			SDA	beneficial phosphorous mitigation	P kg/km2/year	+/- x%	replacement (WWT)	$ per yr startified by facility size	+/- x%
	Pollination	habitat for pollinators										
	Soil regulation	soil fertility and structure maintence - sediment, organic matter and nutrient retention, accumulation and cycling										
Cultural												
	Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems										
	Recreational	opportunities for recreational activities										
	Aesthetic	people can find aesthetic value in aspects of wetland ecosystems										
	Educational	opportunities for formal and informal education and training										

* General hybrid of MEA (wetlands) and CICES with some consideration to TEEB and AB study

** the primary intent of this account is to assist working group in the selection of services to measure

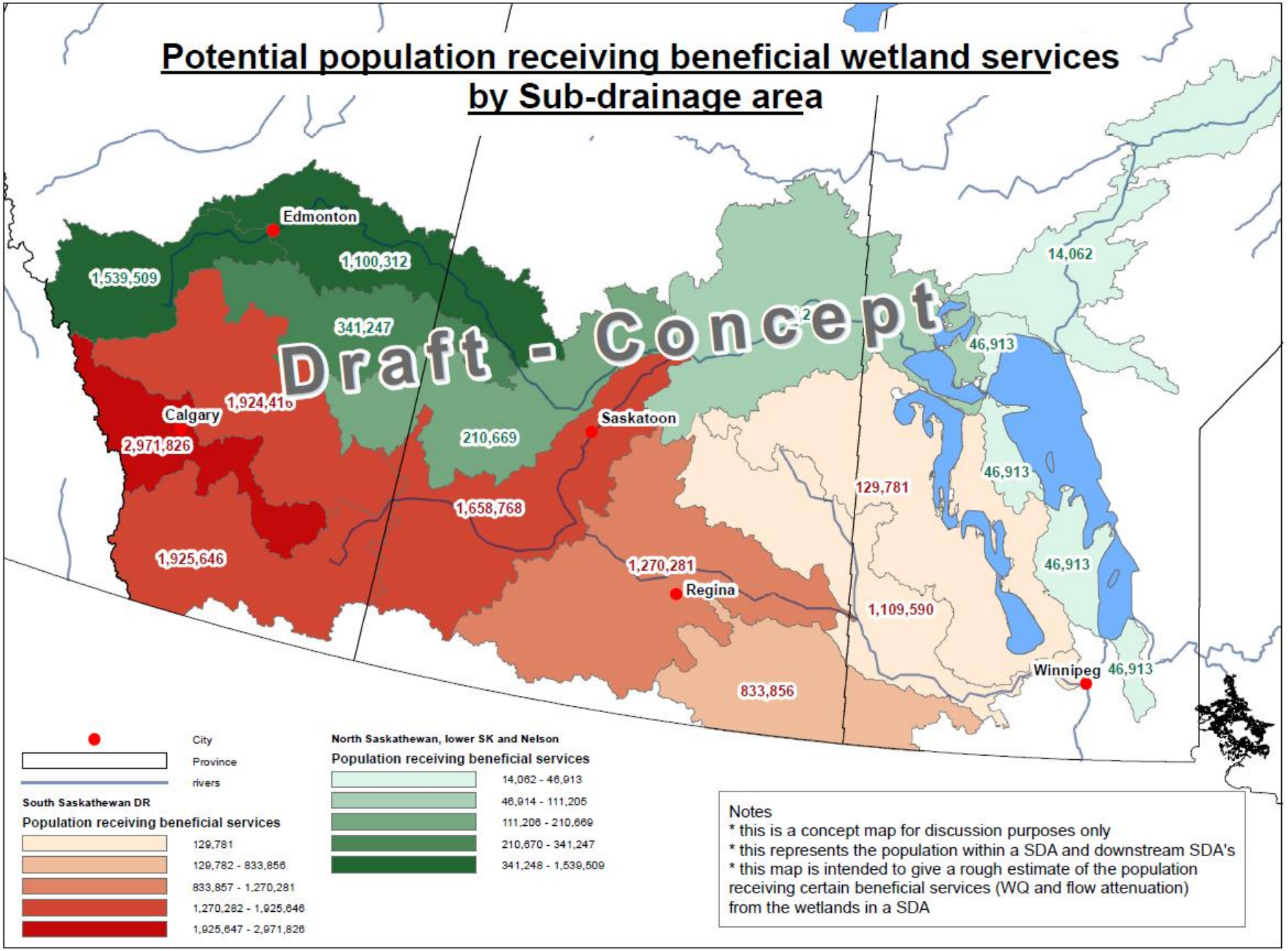
Potential Beneficial Phosphorous Mitigation by Wetlands (Kg/ha/yr)

Description: estimation of the number of kilograms of phosphorous that could be processed annually by wetlands within each sub drainage area.

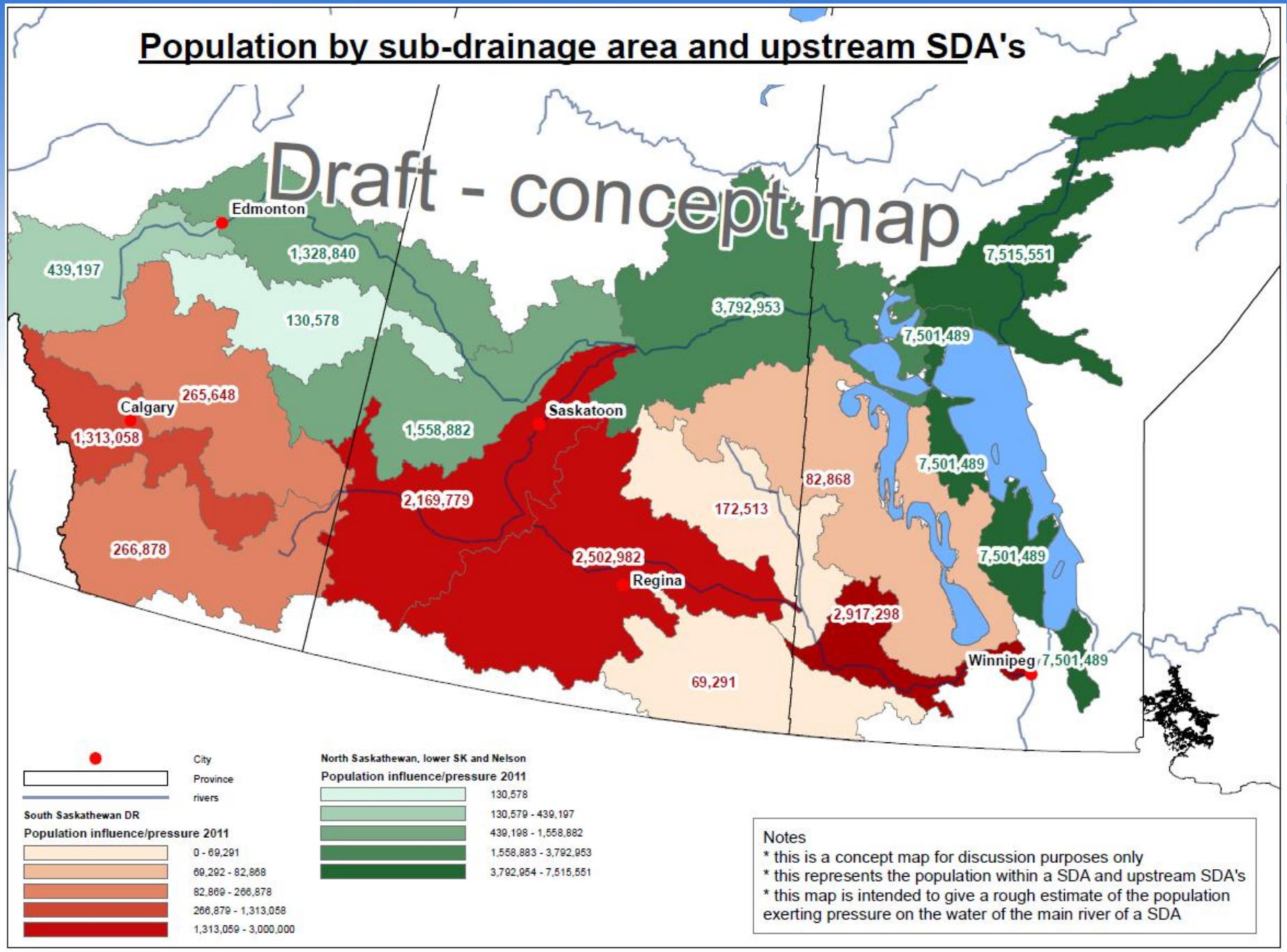


Notes
* this is a concept map for discussion purposes only
* mitigation/processing rate (Wetland/total area x 80 kg/ha/yr) - * preference would be to use range of processing rates/coefficients
* processing rate is based on single study and possibly constructed wetland (conservative - representative of potential or estimate of possible)
* does not include prairie potholes (small wetlands below .3 hectares) and are other land cover limitations
* only where service is provided to significant population (will define - TBD)

Potential population receiving beneficial wetland services by Sub-drainage area



Population by sub-drainage area and upstream SDA's



Notes
* this is a concept map for discussion purposes only
* this represents the population within a SDA and upstream SDA's
* this map is intended to give a rough estimate of the population exerting pressure on the water of the main river of a SDA

1. Valuation

1. Appropriate valuation methods

2. Links to SNA (System of National Accounts) and SEEA (UN System of Environmental-Economic Accounts)

Valuation group research questions

- Marginal vs. Total/Ag Values
- Double Counting
- Protocol for Benefits Transfer
- Scaling Up

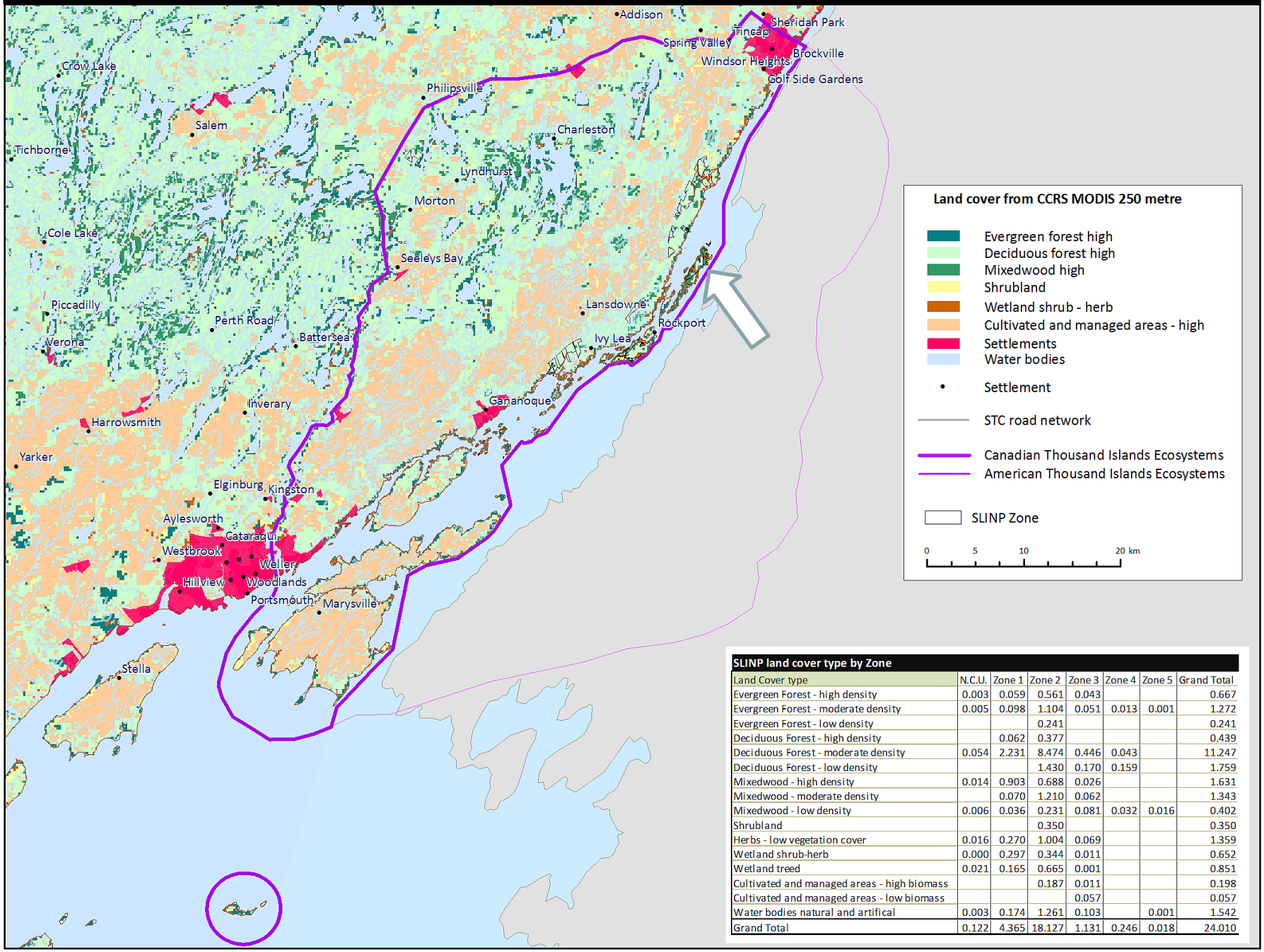
Provide guidelines to MEGS Partners

- on selection and use of valuation approaches
  - link ecosystem service types (e.g. aesthetic services) to documentation on methodologies and best practices for valuation of those services
- incorporates some of the answers to the Valuation Working Group's research questions,
  - e.g. when to use marginal vs. average values for valuation.
  - How to integrate socio-economic information within a spatial context to help modify and transfer benefits (or demand functions)

Developing a benefits transfer process flow for MEGS

- spatial infrastructure
- geo-referenced valuation study data from policy (donor) sites
- and, guidelines to facilitate benefits transfer in a spatially explicit way

St. Lawrence Islands National Park Extent



SLINP land cover type by Zone

Land Cover type	N.C.U.	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Grand Total
Evergreen Forest - high density	0.003	0.059	0.561	0.043			0.667
Evergreen Forest - moderate density	0.005	0.098	1.104	0.051	0.013	0.001	1.272
Evergreen Forest - low density			0.241				0.241
Deciduous Forest - high density		0.062	0.377				0.439
Deciduous Forest - moderate density	0.054	2.231	8.474	0.446	0.043		11.247
Deciduous Forest - low density			1.430	0.170	0.159		1.759
Mixedwood - high density	0.014	0.903	0.688	0.026			1.631
Mixedwood - moderate density		0.070	1.210	0.062			1.343
Mixedwood - low density	0.006	0.036	0.231	0.081	0.032	0.016	0.402
Shrubland			0.350				0.350
Herbs - low vegetation cover	0.016	0.270	1.004	0.069			1.359
Wetland shrub-herb	0.000	0.297	0.344	0.011			0.652
Wetland treed	0.021	0.165	0.665	0.001			0.851
Cultivated and managed areas - high biomass			0.187	0.011			0.198
Cultivated and managed areas - low biomass				0.057			0.057
Water bodies natural and artifical	0.003	0.174	1.261	0.103		0.001	1.542
Grand Total	0.122	4.365	18.127	1.131	0.246	0.018	24.010

Developing a benefits transfer process flow for MEGS

- St. Lawrence Islands National Park case study area (and possibly other case study areas) will provide a test case
- Will confront the value transfer estimates for the SLNP case study area to compare with OMNR estimates received
- Learning as we go

Main problems?

- Lack of original valuation studies; consistency of valuation methods; auxiliary/meta data from studies
- Scaling up methods still young
- Meta analysis to create transfer functions is difficult
- Time and resources a constraint

Conclusion

1. MEGS is exploring various aspects of Ecosystem Accounting
   - Will provide feedback to SEEA II process

2. MEGS' results will be synthesized in *Human Activity and the Environment 2013*

3. There are plans to continue R&D on MEGS issues

4. The challenge will be to keep the community of practice moving forward with the same momentum.

Merci.

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