Trends and transitions between farm types and spatial layout of farm fields

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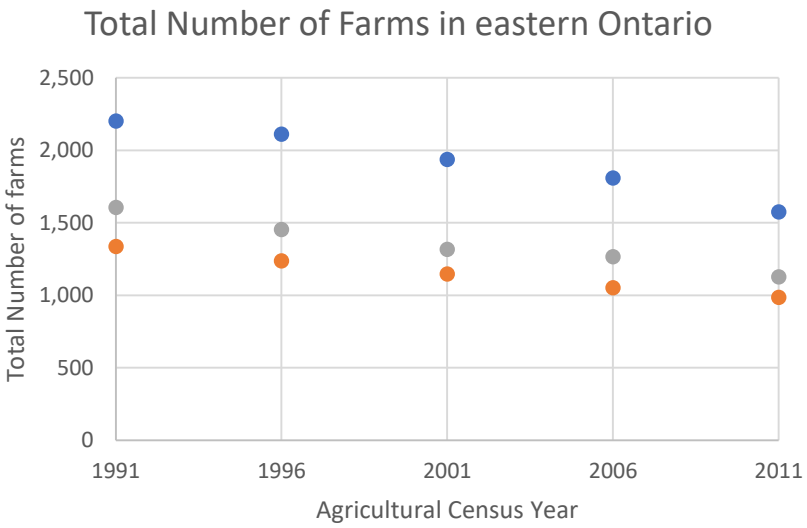
What are we interested in modelling?

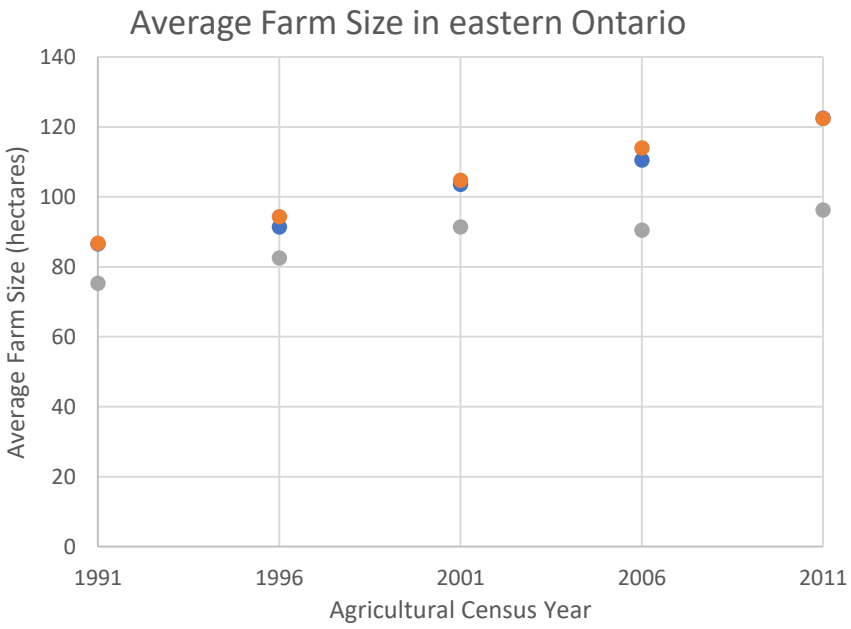
- Future possible trends in:
  - The number of different types of farming operations
  - The size of farming operations
  - Field size

Why is this worth modelling?

Present Trends in Agriculture:

- Every 5 years the number of farms in eastern Ontario decreases by an average of 364
- Average farm size is increasing at a rate of between 5 to 9 ha every 5 years throughout the region
- As a result, we have fewer larger farms





Farm Type and Size Trends

Farm Types

- Dairy
  - Dairy and Grain ↑
  - Dairy and Hay
  - Dairy

- Beef
  - Beef
    - Cow Calf
    - Feeder
  - Beef and Grain
    - Cow calf and field crop ↑
    - Feeder and Field Crop

- Field Crop
  - Field Crop ↑
  - Field Crop and Dairy ↑
  - Field Crop and Beef
    - Field Crop Cow Calf ↑
    - Field Crop Feeder
  - Field Crop and Other livestock ↑
  - Field Crop Hogs ↑
  - Field Crop and Poultry

- Poultry and Egg
  - Poultry and Egg and Field Crops
  - Poultry and Egg
- Other Livestock
  - Other Livestock and Field Crops ↑
  - Other Livestock
- Hogs
  - Swine and Field Crops
  - Swine
- Fruit and vegetable
- Other Crops

Indicates a decrease in the number of these farm types

Indicates an increase in the number of these farm types

↑ Indicates an increase in the average size of these farm types

What drives farm size trends?

- Economic drivers
  - Uneven accessibility to agricultural support programs
  - Larger farms with greater capital investments are more easily able to acquire and farm more lands
- Market drivers
  - Volatility of market prices for agricultural products
  - Changes in the structure of farm ownership
  - Advances in technology (i.e. mechanical or biological)

Field sizes are growing

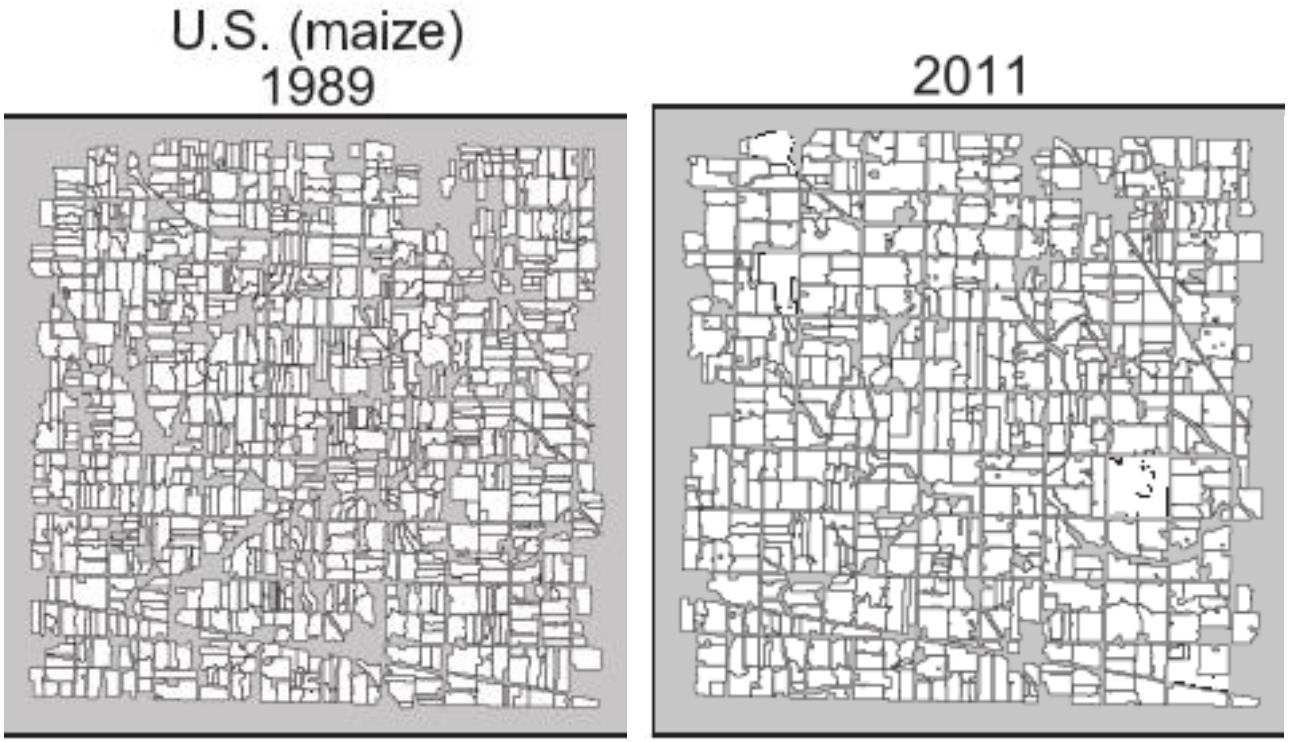


Figure 1. Maps displaying 15km by 15km agricultural landscape showing only corn fields and their size differences between 1989-2011, as extracted from Landsat imagery (White & Roy, 2015).

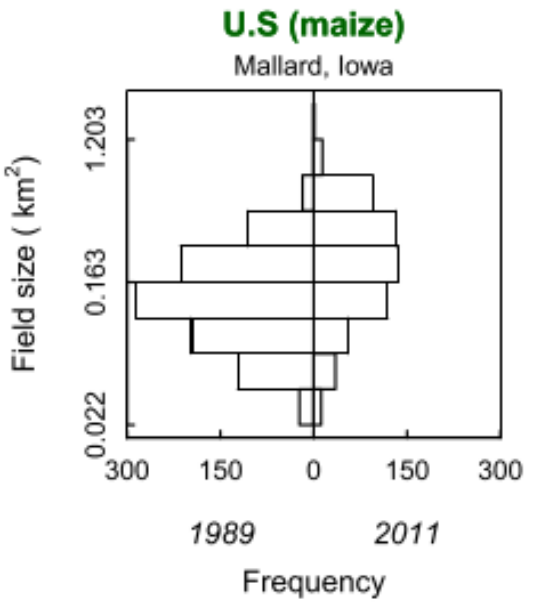


Figure 2. Histogram showing corn field size change from 1989 to 2011 (White & Roy, 2015).

Quantifying field size change in eastern Ontario

2012

2015

Consolidation of fields

2011
Number of fields: 10
Average field size:
1.81 ha

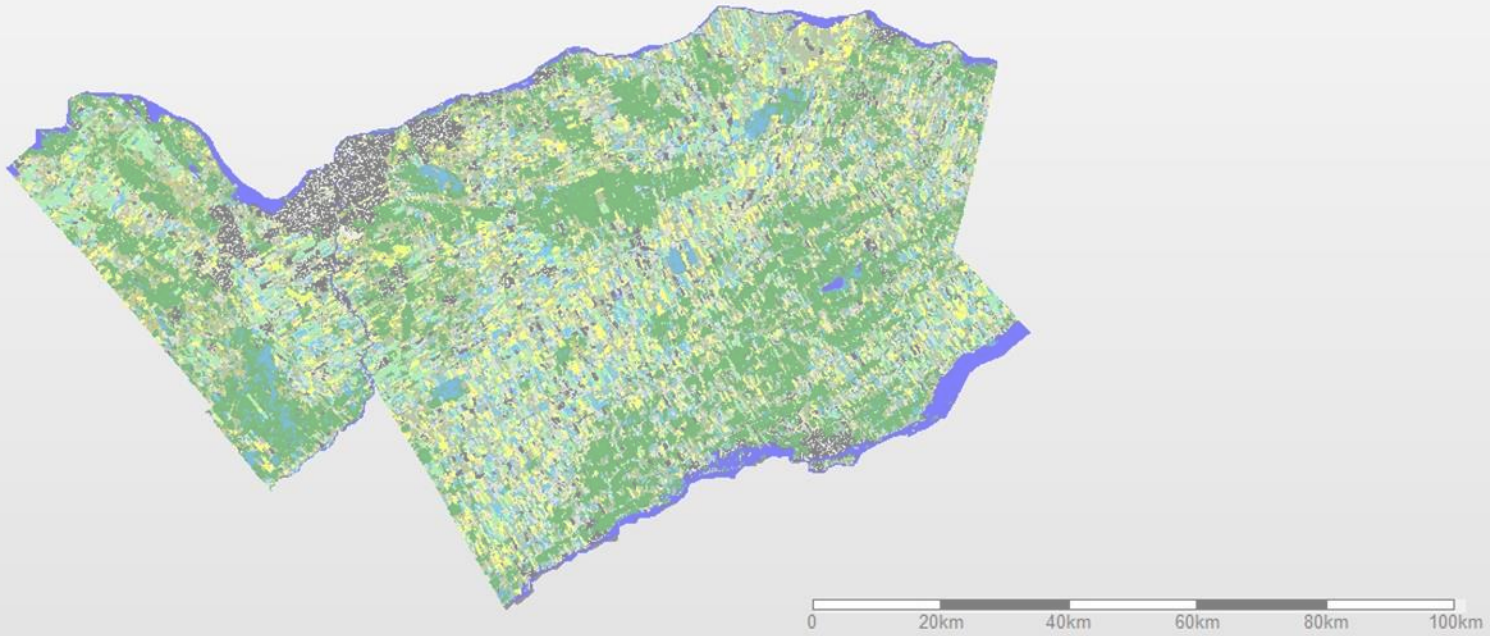
2015
Number of fields: 1
Average field size:
19.56 ha

All satellite images from Google Earth

What drives field size trends?

- Shifts in land management practices
  - Some benefits offered by small fields are made obsolete by more intensive practices
- Conversion of non-crop lands
  - Repurposing “unproductive land”
- Increased efficiency of farm machinery

Farm Model: Expansion, Transition, Retirement, and Field Consolidation



How do you know when and where an event has occurred?

Year	EventCode	EventName	HQ_Idu_Index	Area(ha)	FarmID	FarmType
2011	6	Recovered	16029	578.5253	473	11
2011	6	Recovered	15616	275.4902	516	11
2011	5	Eliminated	109960	564.8455	2854	20
2011	6	Recovered	35318	739.5952	1516	21
2011	6	Recovered	35764	244.8166	1544	21
2011	0	Bought	14	412.4602	3	6
2011	1	Sold	110066	94.36921	761	6
2011	0	Bought	41655	1115.078	7	4
2011	1	Sold	41656	538.6986	1937	4
2011	0	Bought	110329	154.368	16	11
2011	1	Sold	110131	76.9711	841	6
2011	0	Bought	52150	760.2953	21	11
2011	1	Sold	48110	125.7885	2342	11
2011	0	Bought	110356	1423.238	37	10
2011	1	Sold	110163	213.4555	2885	10
2011	0	Bought	34610	981.5925	41	4
2011	1	Sold	28837	469.0963	1116	4
2011	0	Bought	17399	688.5472	42	4
2011	1	Sold	17392	292.3214	614	4
2011	0	Bought	110176	1166.315	43	10
2011	1	Sold	110277	136.8796	1136	10
2011	0	Bought	111002	349.7841	52	11
2011	1	Sold	110762	85.13055	2031	11
2011	0	Bought	110122	572.2407	615	4
2011	1	Sold	110532	124.7836	1580	4
2011	0	Bought	25811	1362.24	967	8
2011	1	Sold	110294	668.8312	1132	8

Farm Expansion

Farm Type and Size Trends

Farm Types

- Dairy
  - Dairy and Grain ↑
  - Dairy and Hay
  - Dairy

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  - Beef
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  - Beef and Grain
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- Poultry and Egg
  - Poultry and Egg and Field Crops
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- Other Livestock
  - Other Livestock and Field Crops ↑
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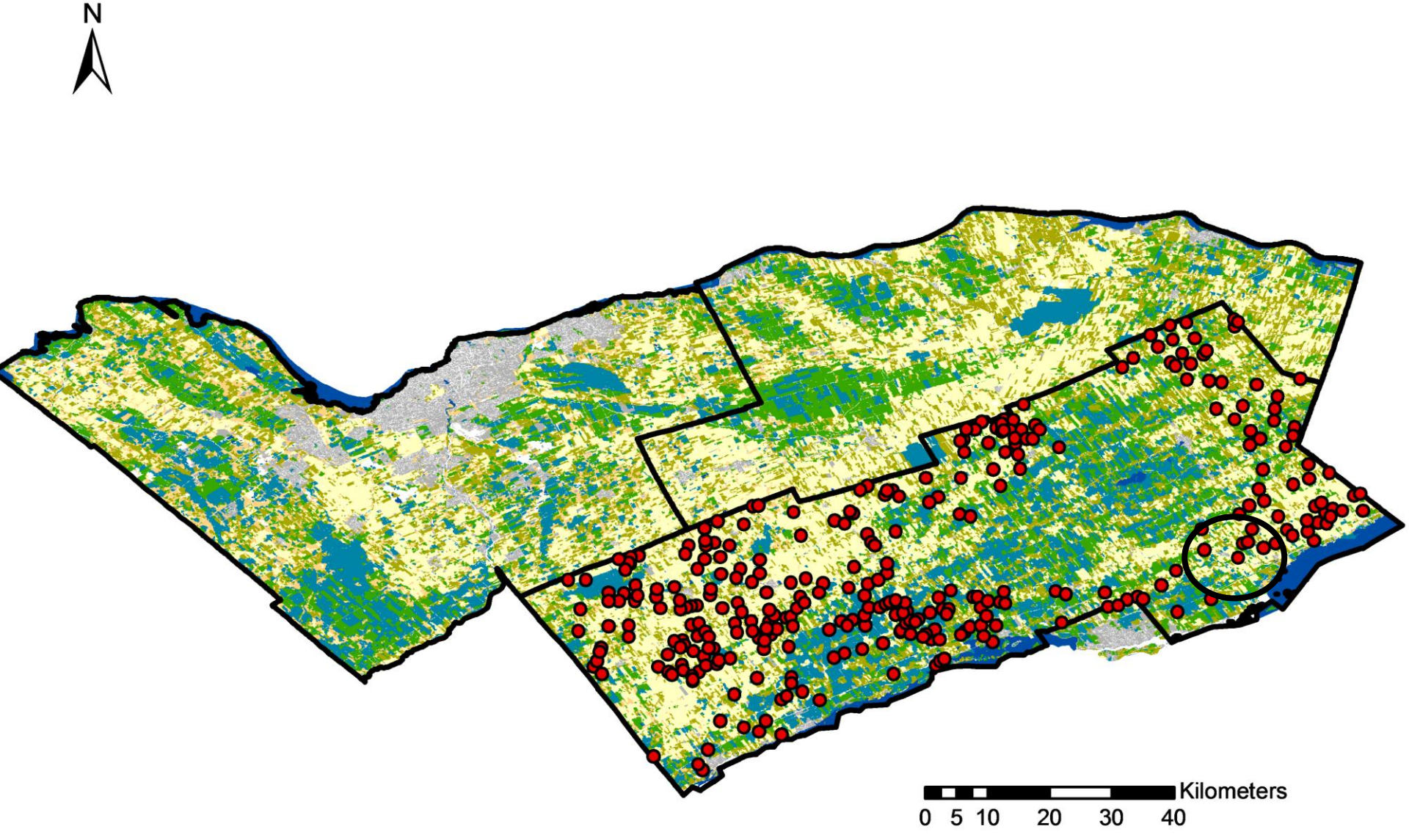
↑ Indicates an increase in the average size of these farm types

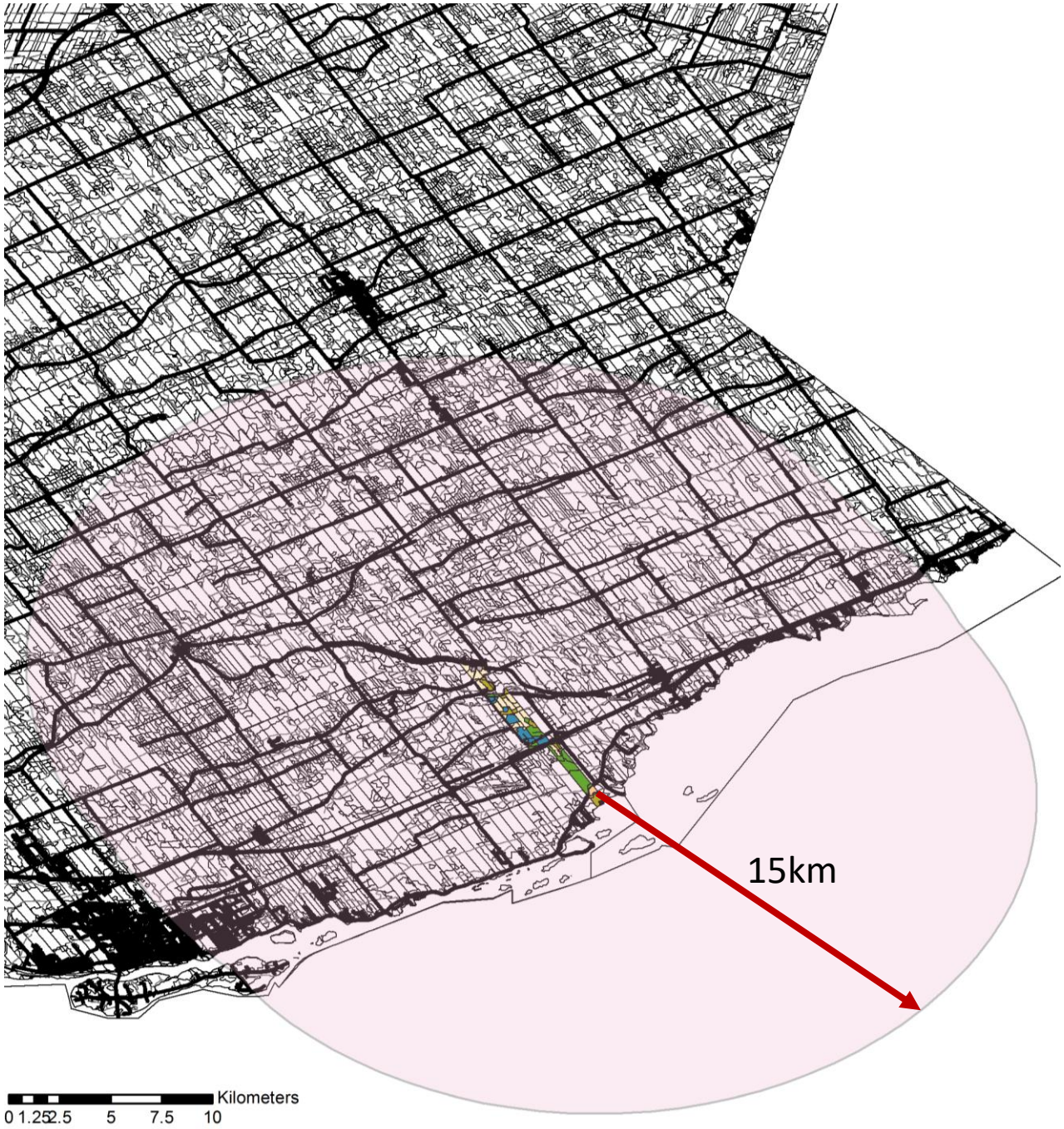
Field Crop Grain Expansion Event



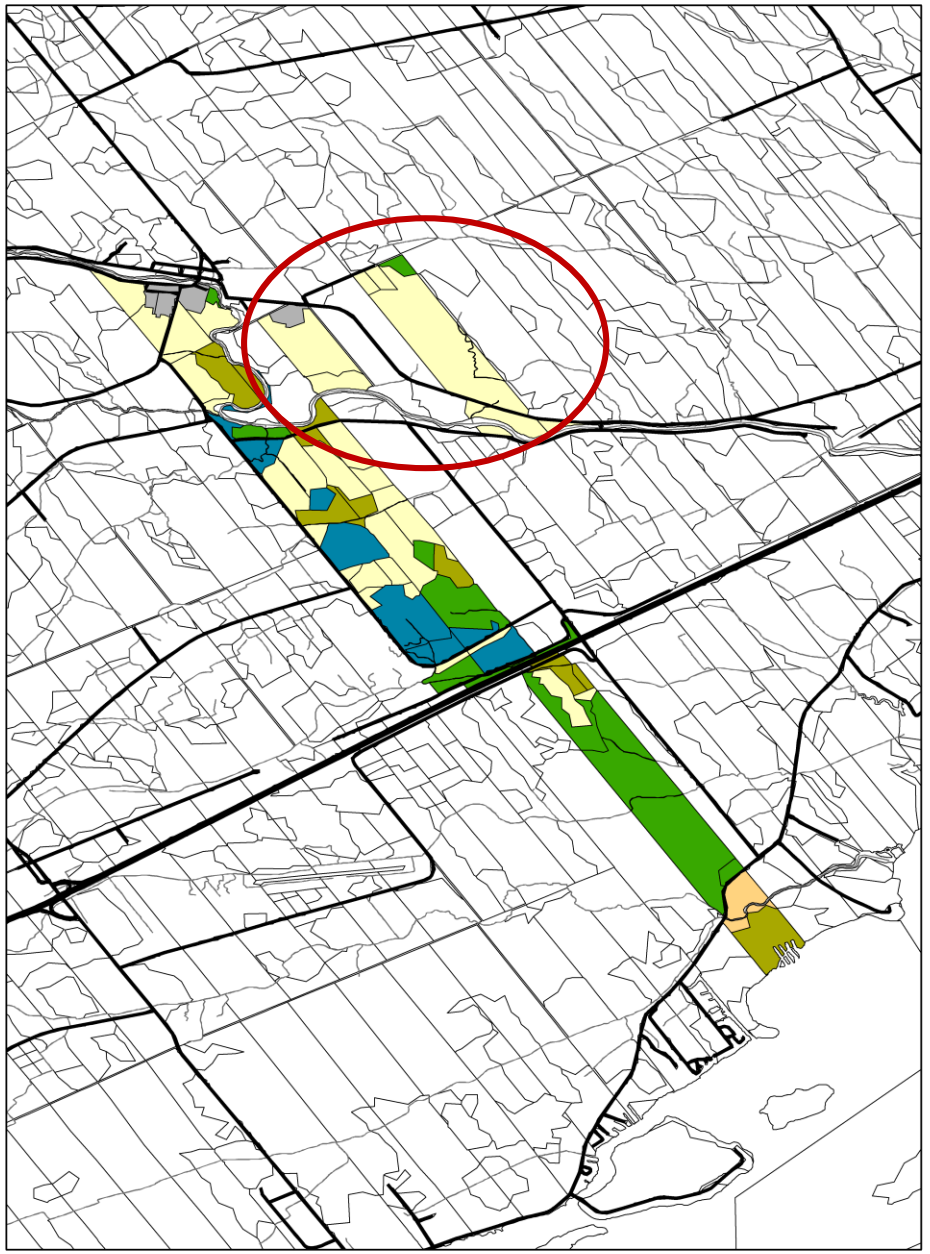
Model Year: 2015

Legend

1	Forest	14
2	Cropland-Annual	23
3	Cropland-Perennial	14
4	Shrub/Grassland	3
5	Developed	4
6	Wetlands	13
7	Water	0


15km
Kilometers
0 1.25 2.5 5 7.5 10

Model Year: 2015

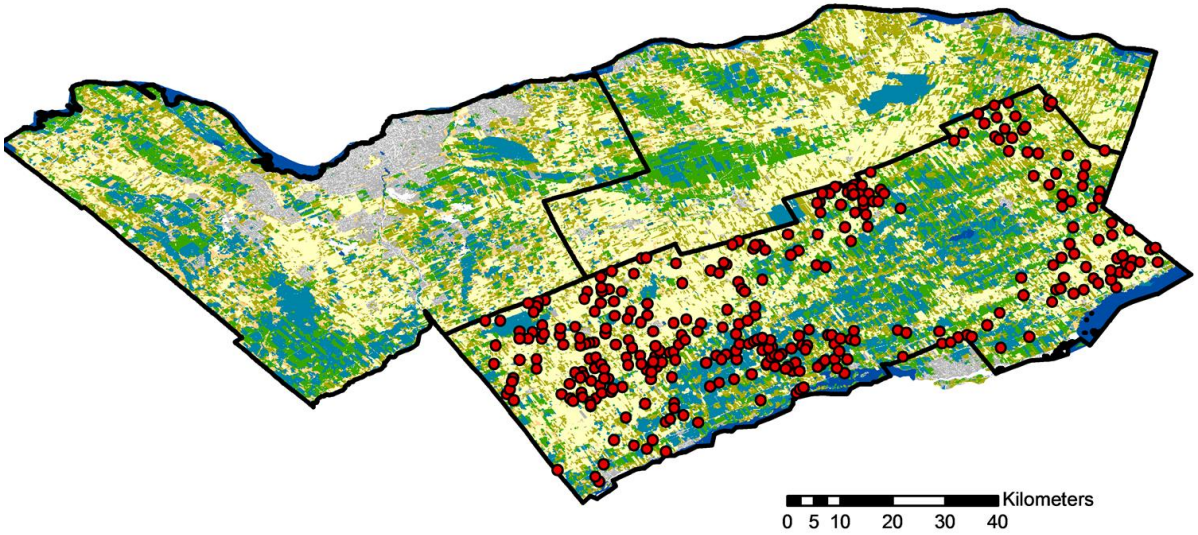


Legend

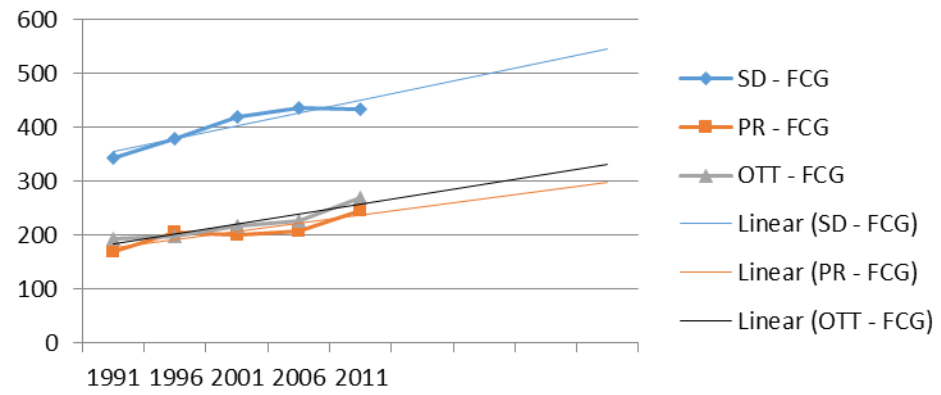
1	Forest	15
2	Cropland-Annual	34
3	Cropland-Perennial	14
4	Shrub/Grassland	3
5	Developed	5
6	Wetlands	13
7	Water	0

0 0.35 0.7 1.4 2.1 2.8 3.5 4.2 Kilometers

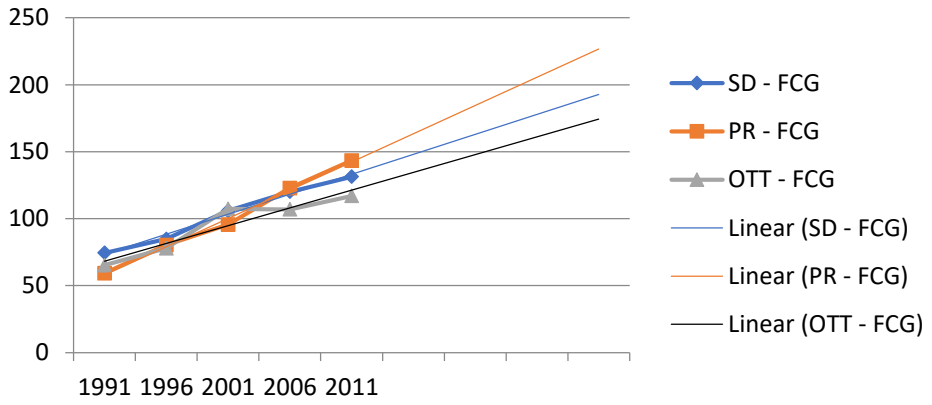
When do expansion events stop, in a given year?



Total Number of Field Crop Grain - Farms reporting



Average Farm Size (ha) - Field Crop Grain



What farm size trajectories look like within the Eastern Ontario.xml.

```
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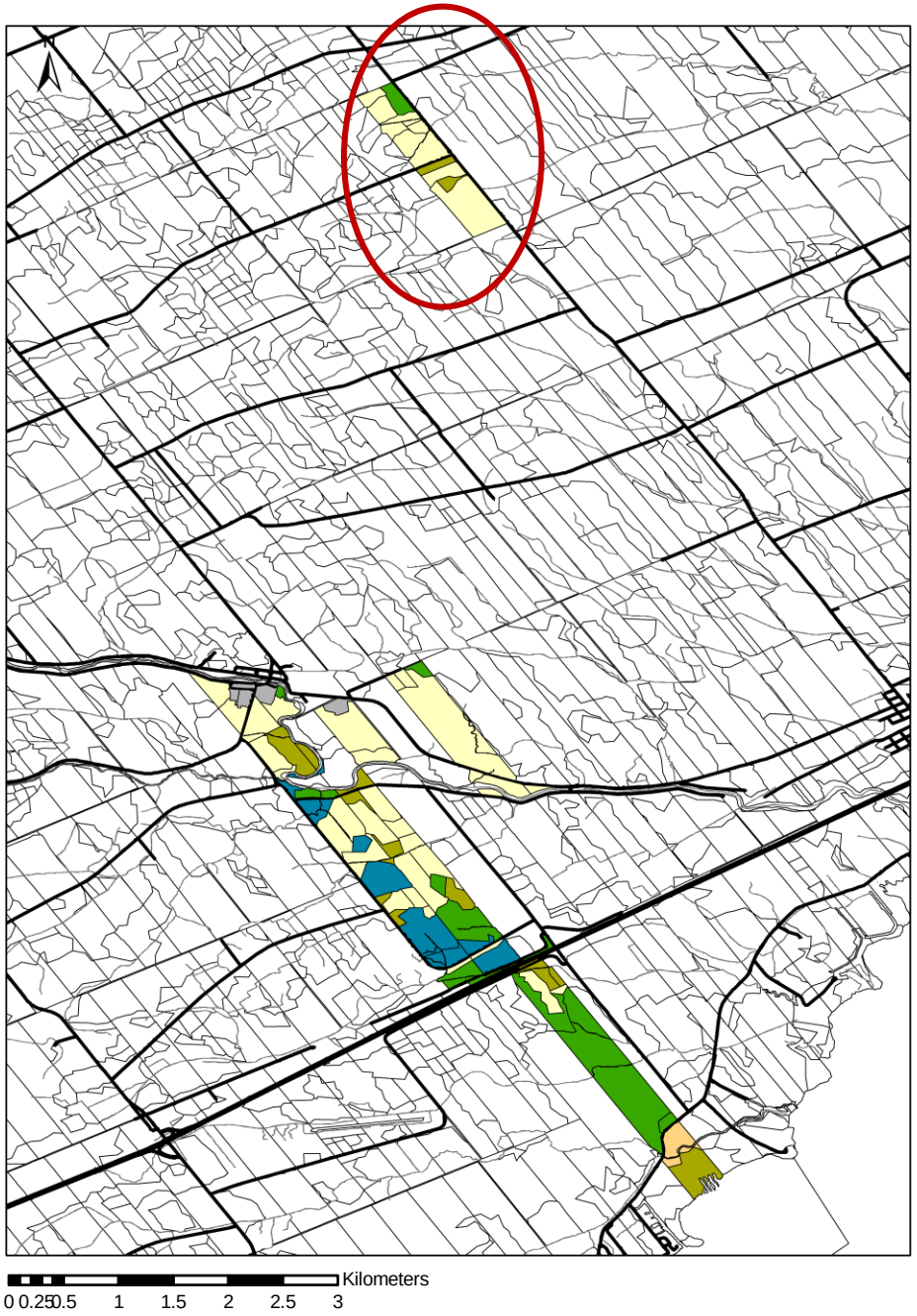
Model Year: 2020



Model Year: 2028

Legend

1	Forest
2	Cropland-Annual
3	Cropland-Perennial
4	Shrub/Grassland
5	Developed
6	Wetlands
7	Water

Farm Transition and Farm Retirement

```
<!-- farm count trajectories - #/year change -->
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   <fct region="1" ft_code="CCF"  annual_delta="-7.40"  />
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   <fct region="3" ft_code="OTL"  annual_delta="-1.56"  />
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   <fct region="3" ft_code="OLF"  annual_delta="-0.24"  />
   <fct region="2" ft_code="OLF"  annual_delta="-0.10"  />
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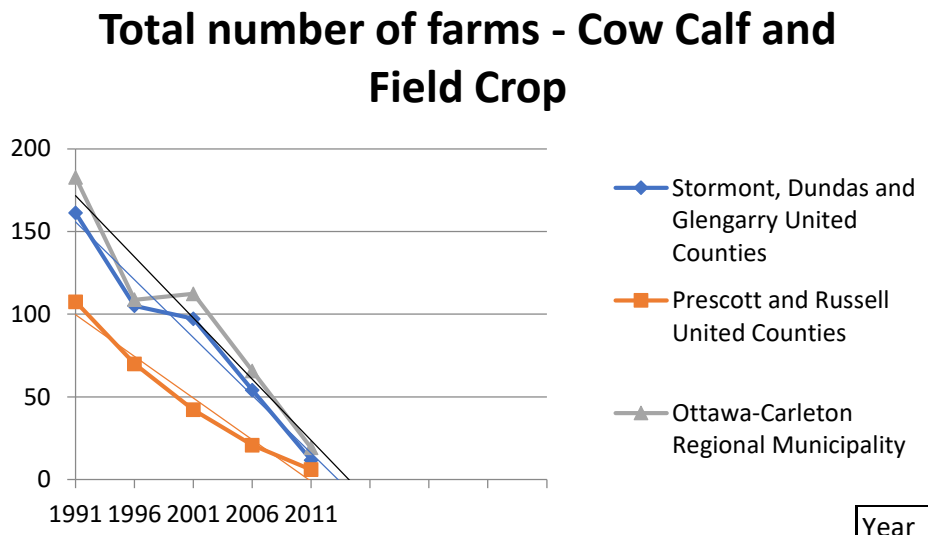
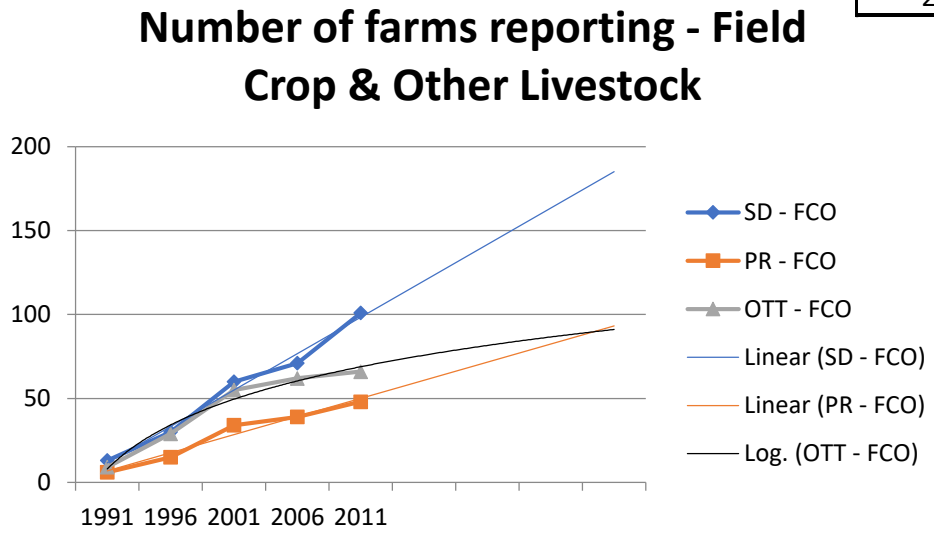
Farm Retirement and Transition Example

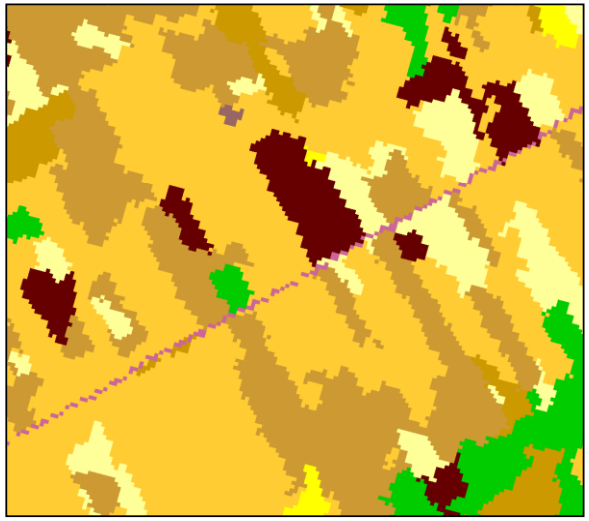


Year	EventCode	EventName	HQ_Idu_Index	Area(ha)	FarmID	FarmType
2011	5	Eliminated	44686	401.1191	1688	1
2013	6	Recovered	44686	401.1191	1688	11

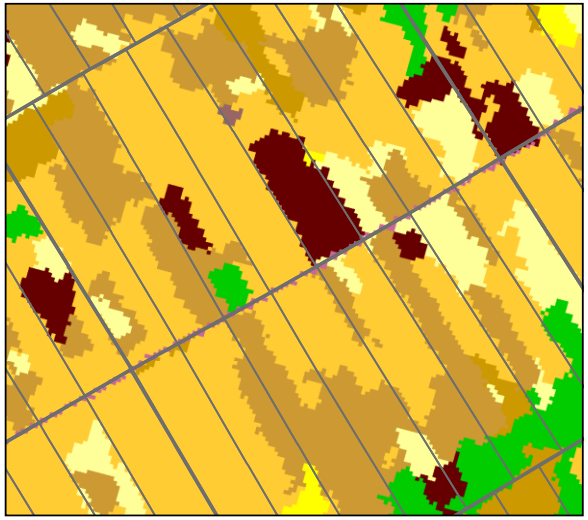


Altering the configuration of fields through consolidation

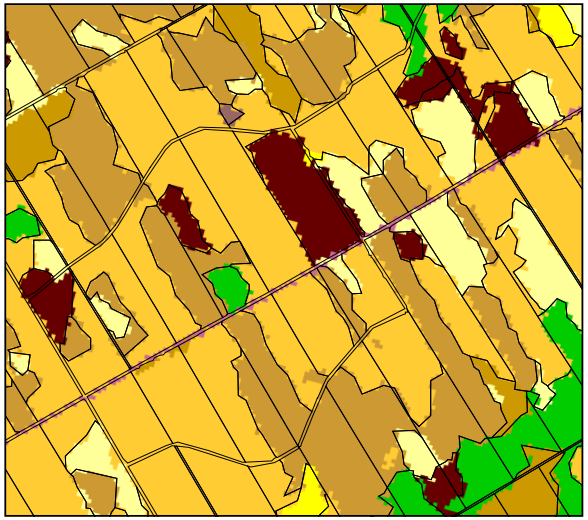
The geometry of an IDU – why it matters for interpreting field size



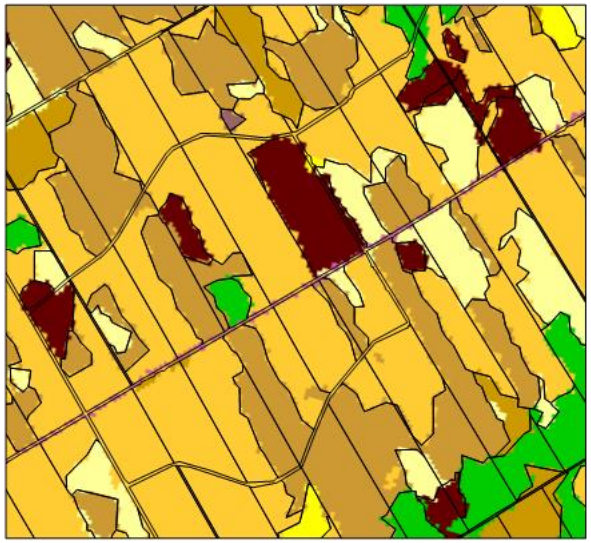
AAFC Crop Inventory



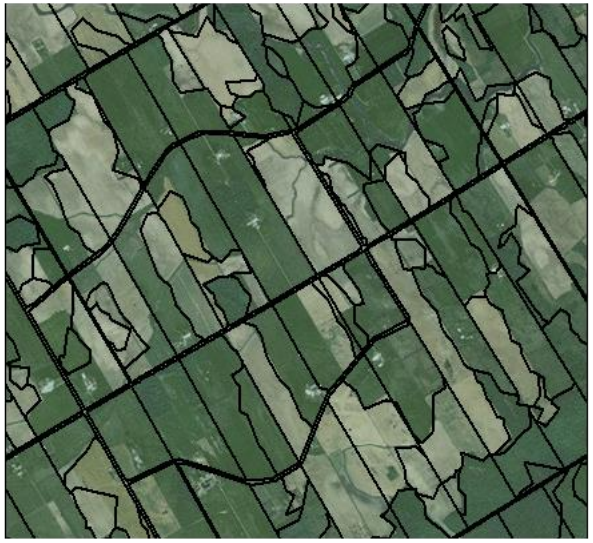
Cadastre



IDU’s



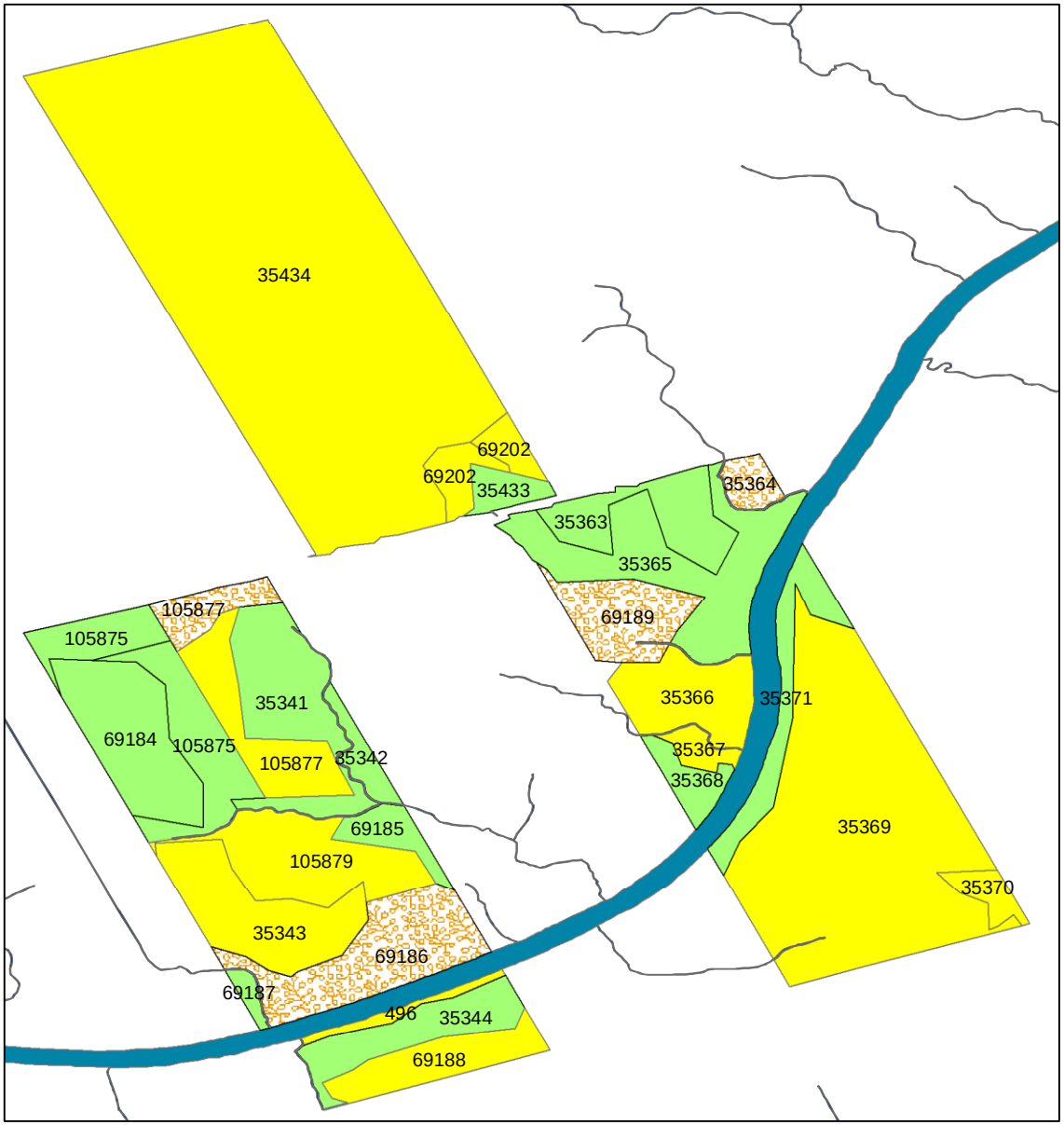
IDU’s



IDU’s over top of World Imagery, 1m resolution satellite and aerial imagery

IDU’s with updated Configuration

Example Field Consolidation

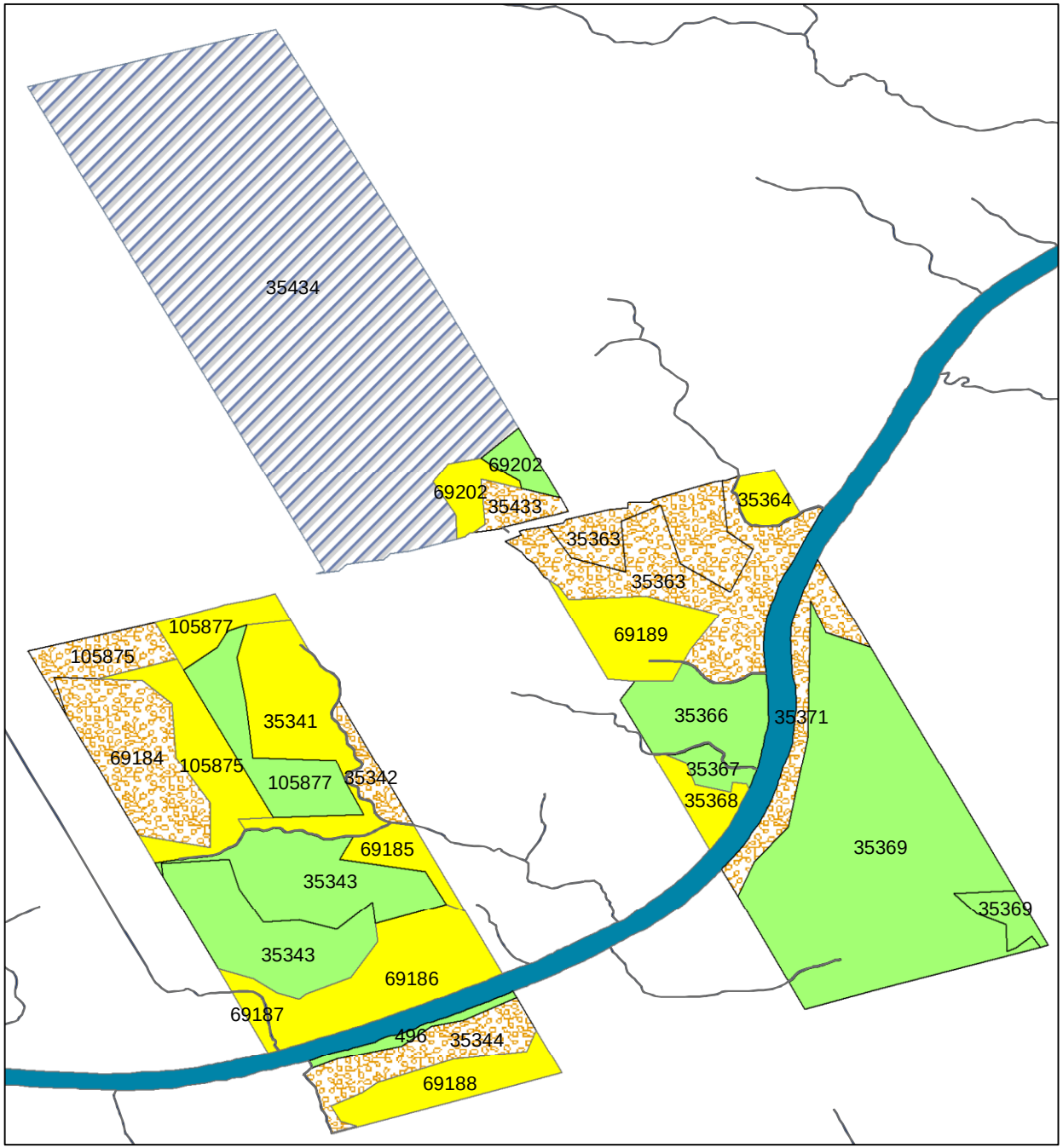


Year: 2012
Farm ID: 44
Farm Type: Field Crop Grain

Legend

LULC_B

- Alfalfa
- Corn
- Other Cereals
- Soybeans
- Swamp
- Fallow
- Broadleaf



Year: 2013
Farm ID: 44
Farm Type: Field Crop Grain

Legend

LULC_B

- Alfalfa
- Corn
- Other Cereals
- Soybeans
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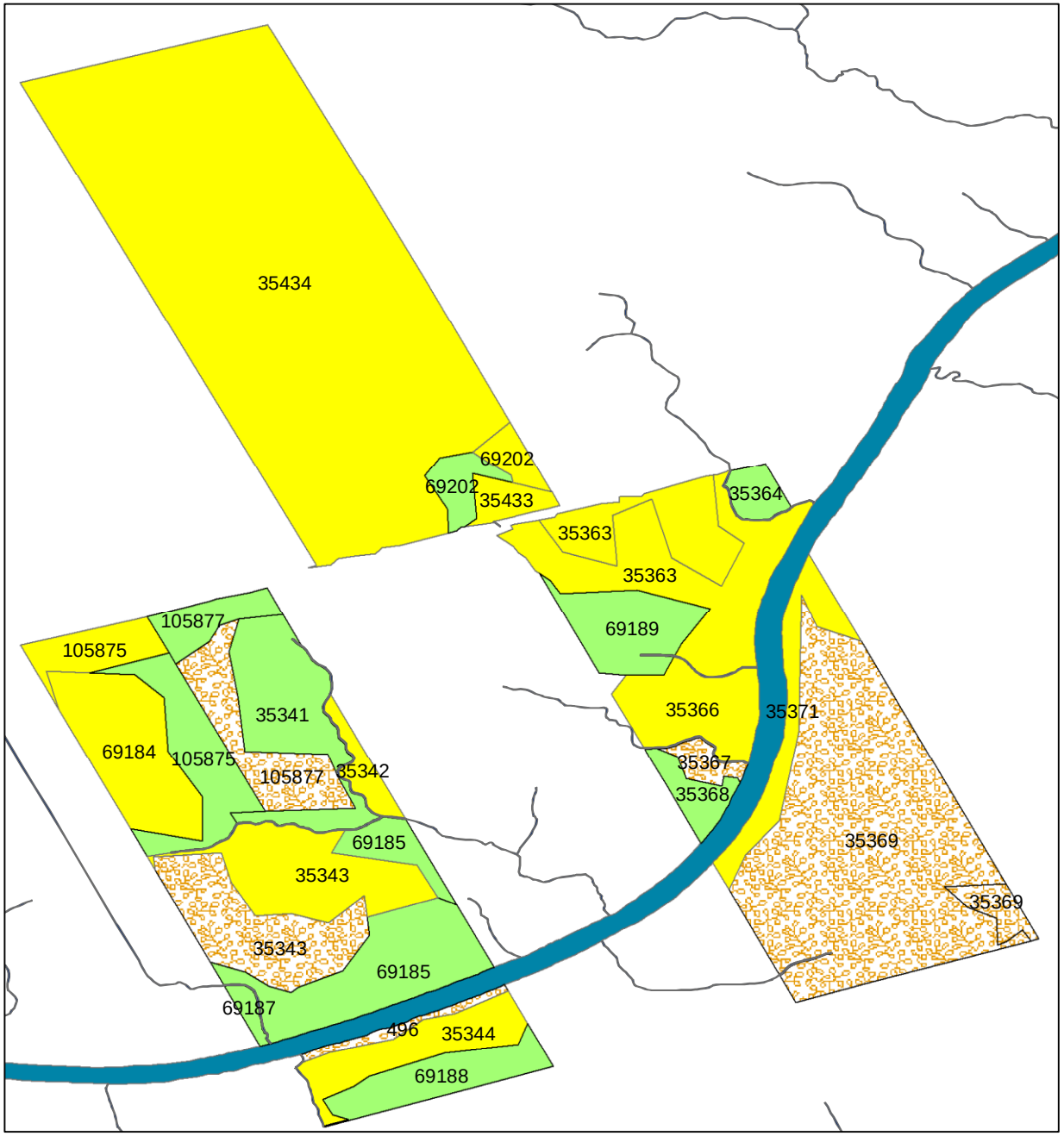

Year: 2014
Farm ID: 44
Farm Type: Field Crop Grain

Legend

LULC_B

- Alfalfa
- Corn
- Other Cereals
- Soybeans
- Fallow
- Swamp
- Broadleaf