DEFENCE R&D DÉFENSE

# Applicant-derived Areas of Responsibility for Canadian Forces Recruiting Centers

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by

François Larochelle and Fraser Moffatt
DG Military Personnel Research & Analysis (DGMPRA)

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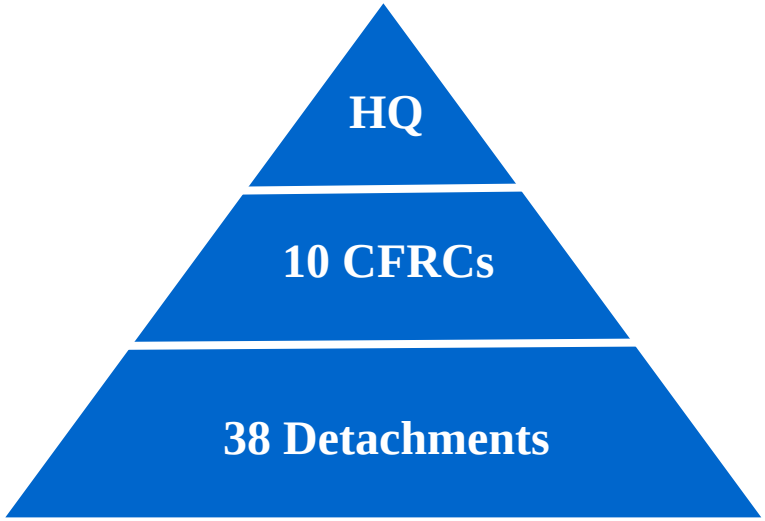
Canada

# Canadian Forces Recruiting Group




- Each Canadian Forces (CF) Recruiting Center has been assigned an Area of Responsibility (AOR).
- No prescriptive area has been defined for the detachments located inside the AOR of a recruiting center.
- The location of CF applicants processed by a detachment can inform the CF on what the detachment's recruiting environment looks like.

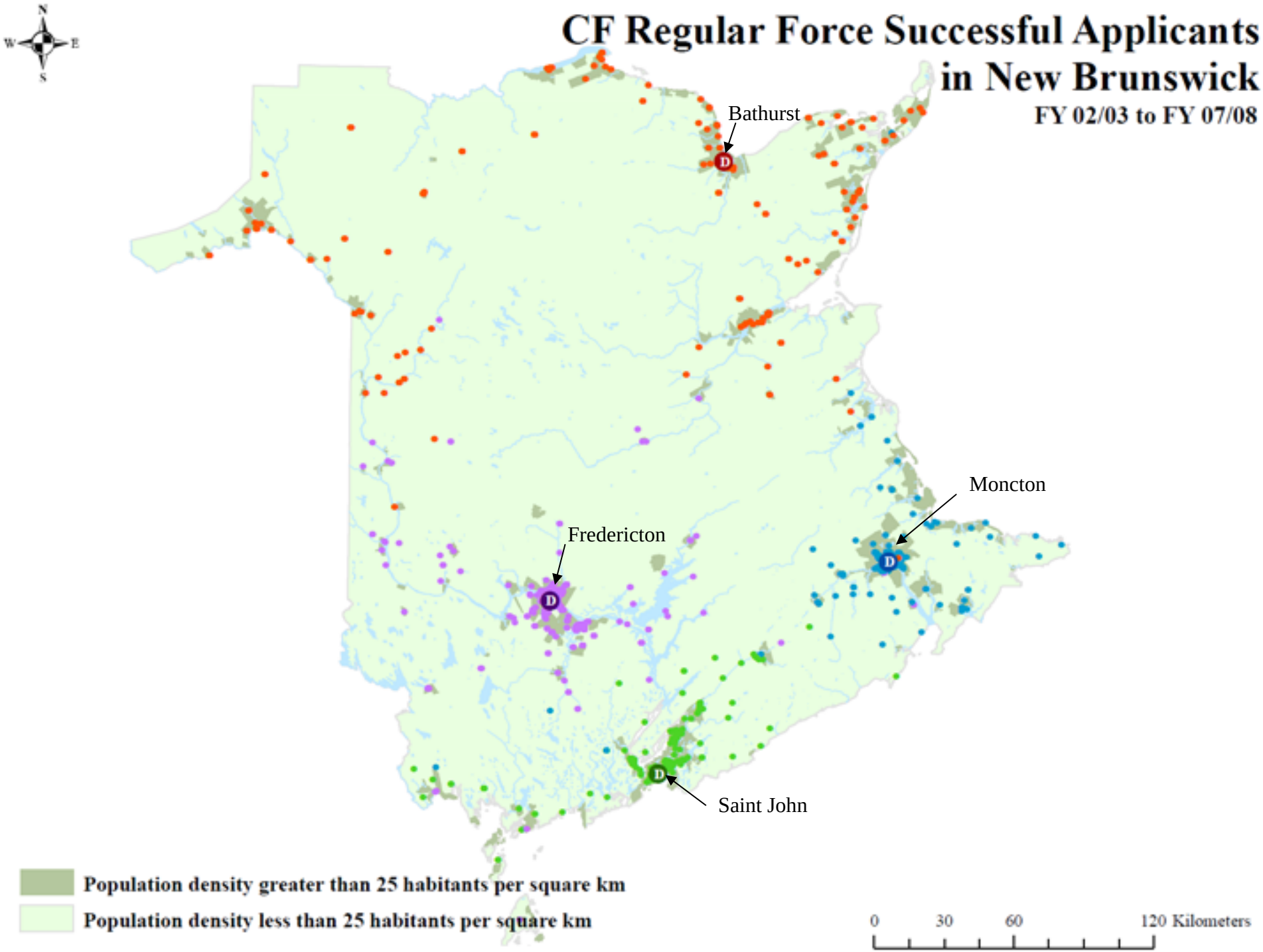
# Problem Statement

- ESRI Business Analyst (BA) provides rudimentary tools for developing applicant-derived Areas of Responsibility (ADAOR) using its Trade Area Wizard tools.

- ADAORs developed using these basic tools have shortcomings and limited means with which to deal with spatial outliers in the data .

- We have experimented with a way to overcome these shortcomings using the Canadian province of New Brunswick as a case study.

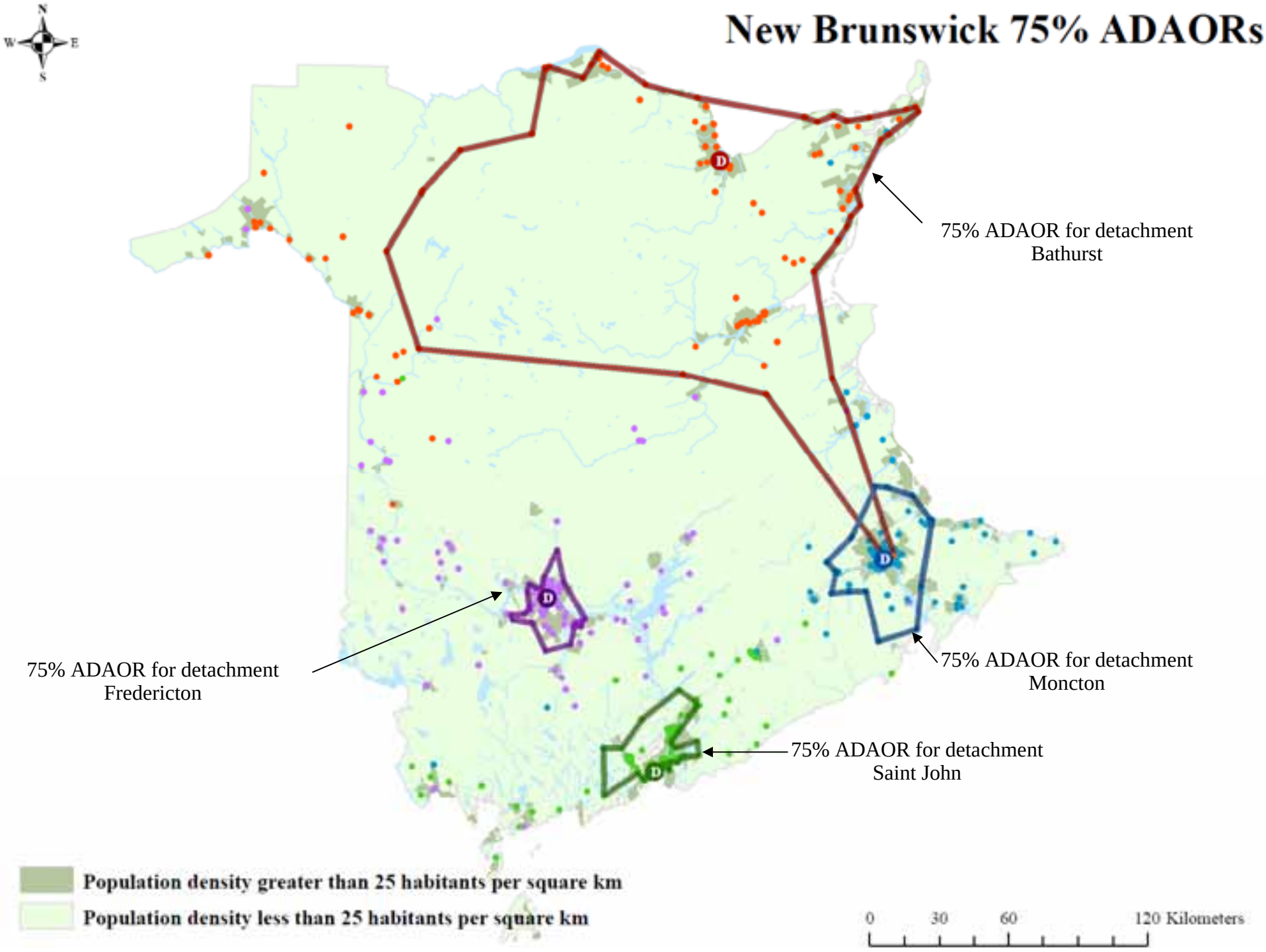
# CF Regular Force Successful Applicants in New Brunswick


CF Regular Force Successful Applicants in New Brunswick
FY 02/03 to FY 07/08
N
W
E
S
Bathurst
Moncton
Fredericton
Saint John
Population density greater than 25 habitants per square km
Population density less than 25 habitants per square km
0
30
60
120 Kilometers

# Applicant Derived Area of Recruiting (ADAOR)

- The ADAOR is a polygon containing the applicants processed by a detachment. It can be used to:
  - Describe historical sources of applicants.
  - Allocate CF personnel and resources to the detachment.
  - Analyse the socio-demographic characteristics of the population within the ADAOR.
  - Analyse the characteristics of the ADAOR such as bus routes, universities, high schools and shopping centers.
  - Study the factors which attract the applicants to a particular detachment.
- Definition: For $x$ in [0,1], a polygon containing $x$% of the applicants processed by a detachment is called a $x$% ADAOR.

# New Brunswick 75% ADAORs



# Generating an ADAOR with BA

- **Tool**: BA Trade Area Wizard/Customer Derived Areas
- **Tool input**: Percentage (*x*%) of applicants contained in the ADAOR.
- **Tool output**: An *x*% ADAOR containing the closest applicants to the detachment. The shape of the ADAOR can be simple or detailed.

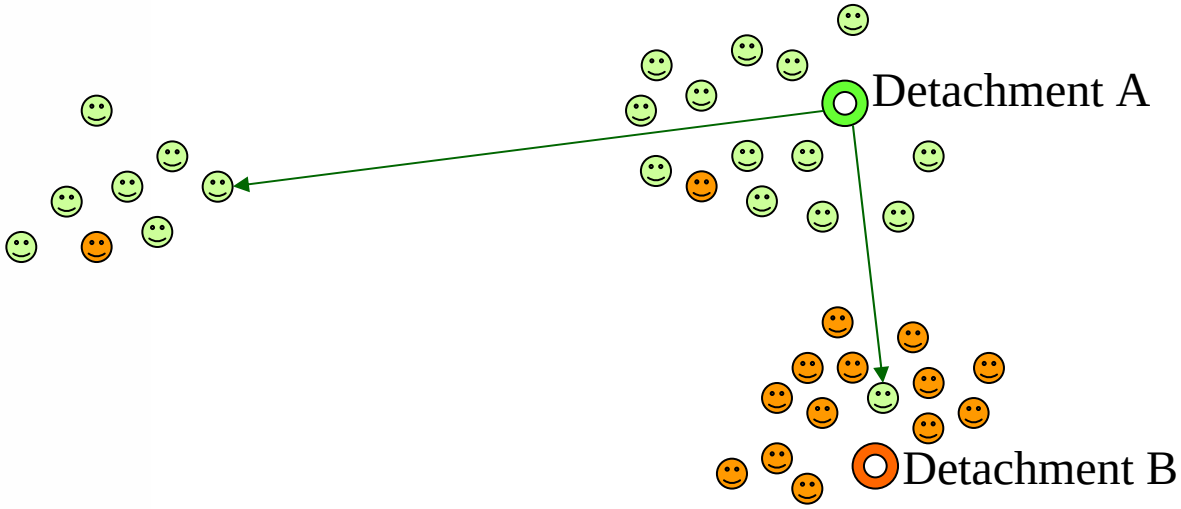
| CF Applicant ID | Distance from Detachment |
|---|---|
| 1 | 0.50 km |
| 2 | 0.52 km |
| … | … |
| 74 | 150.05 km |
| 75 | 150.20 km |
| 76 | 151.51 km |
| … | … |
| 100 | 405.73 km |

Example with $x = 75\%$

**Applicants included in the 75% ADAOR**

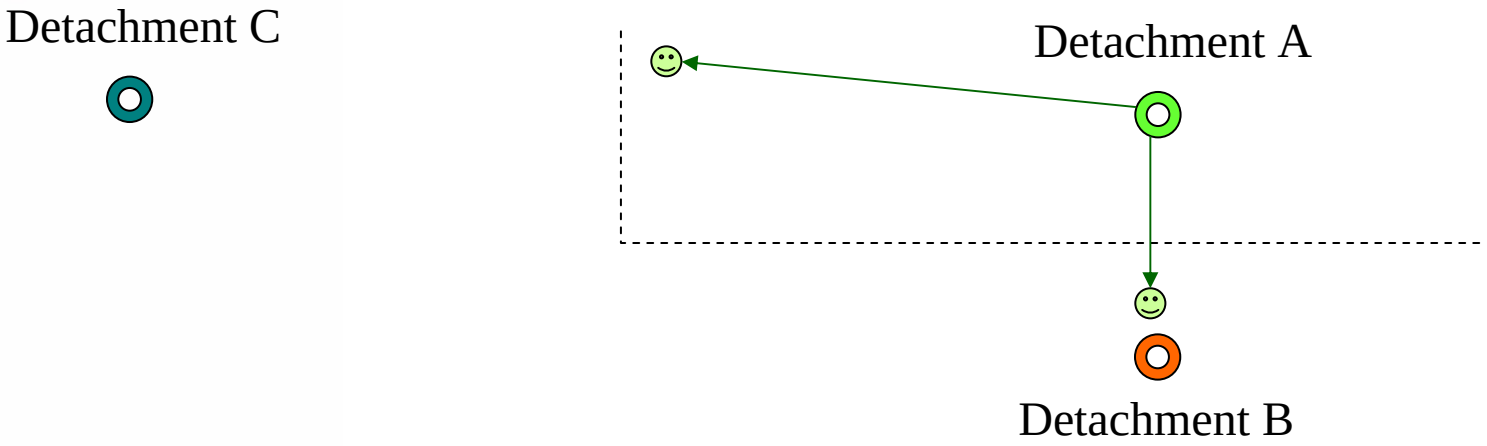
**Applicants excluded in the 75% ADAOR**

# Alternative Metric for Generating an ADAOR




- Ideally, we would like the *x*% ADAOR for detachment A to exclude the applicants that are located in areas in which the probability that an applicant chooses to be processed by detachment B is the largest.
- Research question: Can we find an alternative metric which is used to determine the *x*% applicants included in the ADAOR and which is more robust to “outliers”?

# Alternative Metric for Generating an ADAOR




- According to Reilly's law and to the Huff model, the probability that an applicant chooses to be processed by detachment A increases as:
  - His/her distance to detachment A decreases; AND
  - His/her minimum distance to another detachment increases.

# Alternative Metric for Generating an ADAOR

- Alternative metric for creating an *x*% ADAOR for detachment A:

$$\text{Reilly's metric } (RM) = \frac{\text{Distance to detachment A}}{\text{Minimum distance to another detachment}}$$

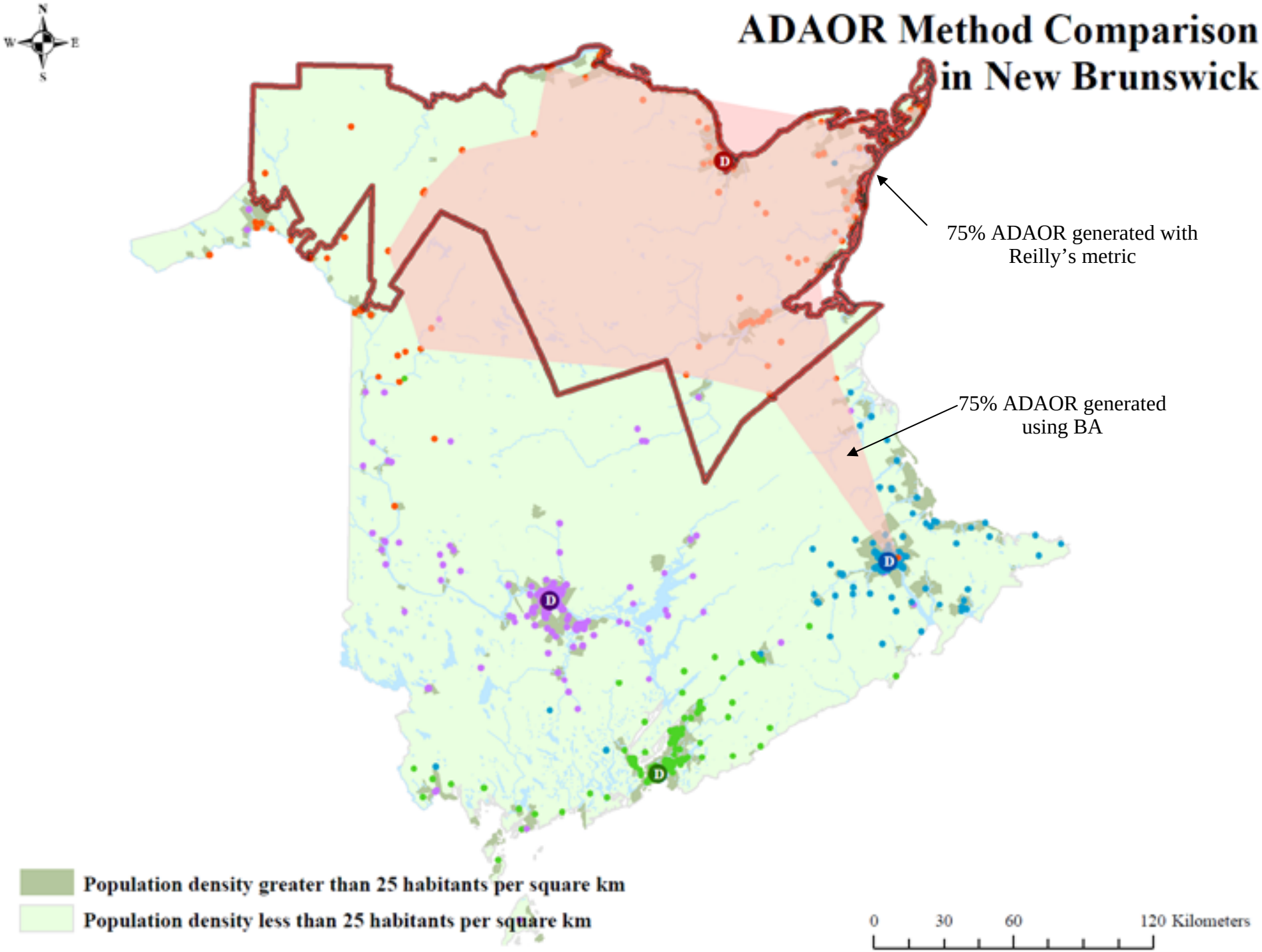
- Example with $x = 75\%$

**Applicants included in the 75% ADAOR**

**Applicants excluded in the 75% ADAOR**

| CF Applicant ID | *RM* |
|---|---|
| 1 | 0.05 |
| … | … |
| 74 | 0.95 |
| 75 | 0.96 |
| 76 | 1.21 |
| … | … |
| 100 | 50.01 |

The 75% ADAOR can be constructed by selecting the geographic units for which the centre has a value of RM not greater than 0.96.


ADAOR Method Comparison in New Brunswick
N
W
E
S
75% ADAOR generated with Reilly's metric
75% ADAOR generated using BA
Population density greater than 25 habitants per square km
Population density less than 25 habitants per square km
0
30
60
120 Kilometers

# Alternative Metric for Generating an ADAOR: Theory vs Reality

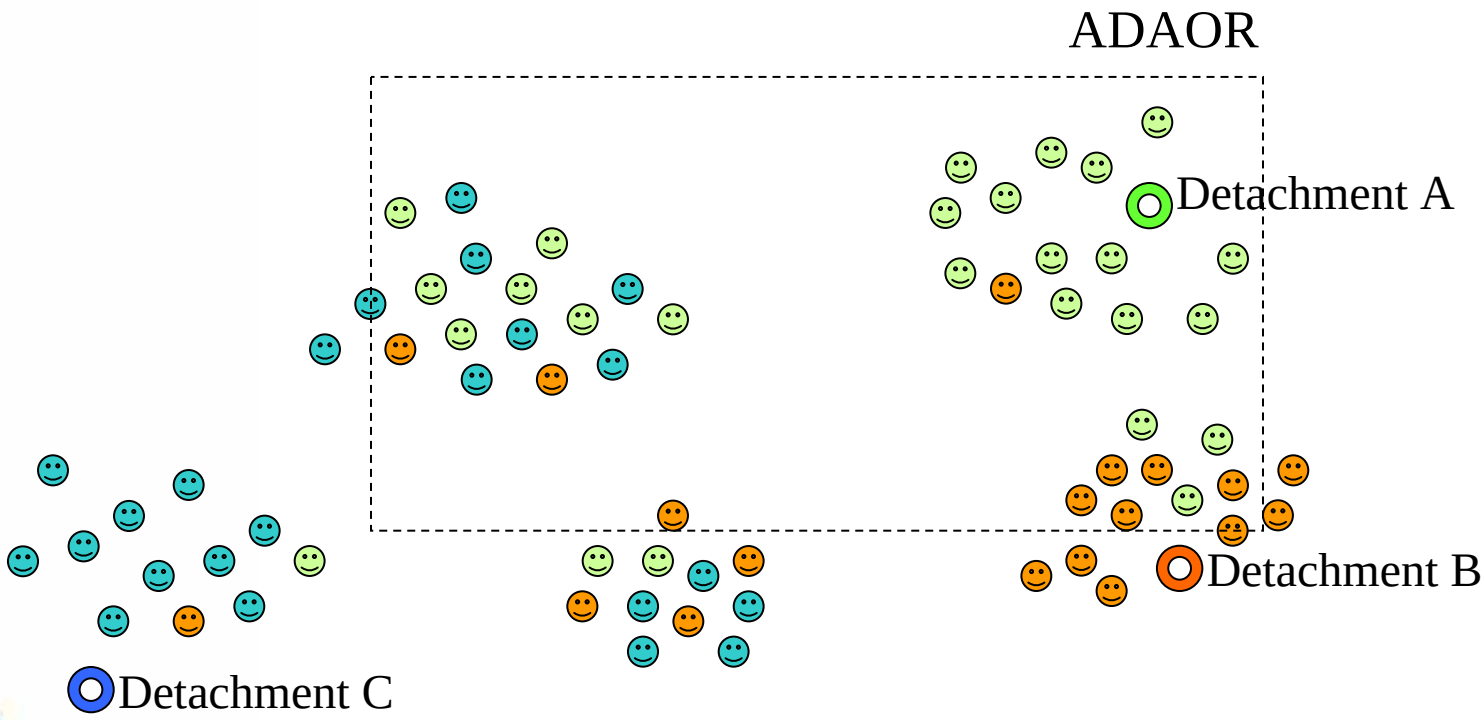
- We have compared the *x*% ADAOR generated using BA and the Reilly's metric for eight detachments and various values of *x*.
- Analysis results:
  - The ADAOR generated with the Reilly's metric was more robust to "outliers" for the majority of detachments
  - The BA ADAOR was more robust for two detachments.
- Conclusion from the analysis: The best metric for generating an *x*% ADAOR will vary depending on *x* and the detachment.
- Future work:
  - Develop a systematic methodology for assessing when the *x*% ADAOR of a detachment should be generated using BA or using the Reilly's metric.
  - Use Network Analyst to calculate drive time distance.

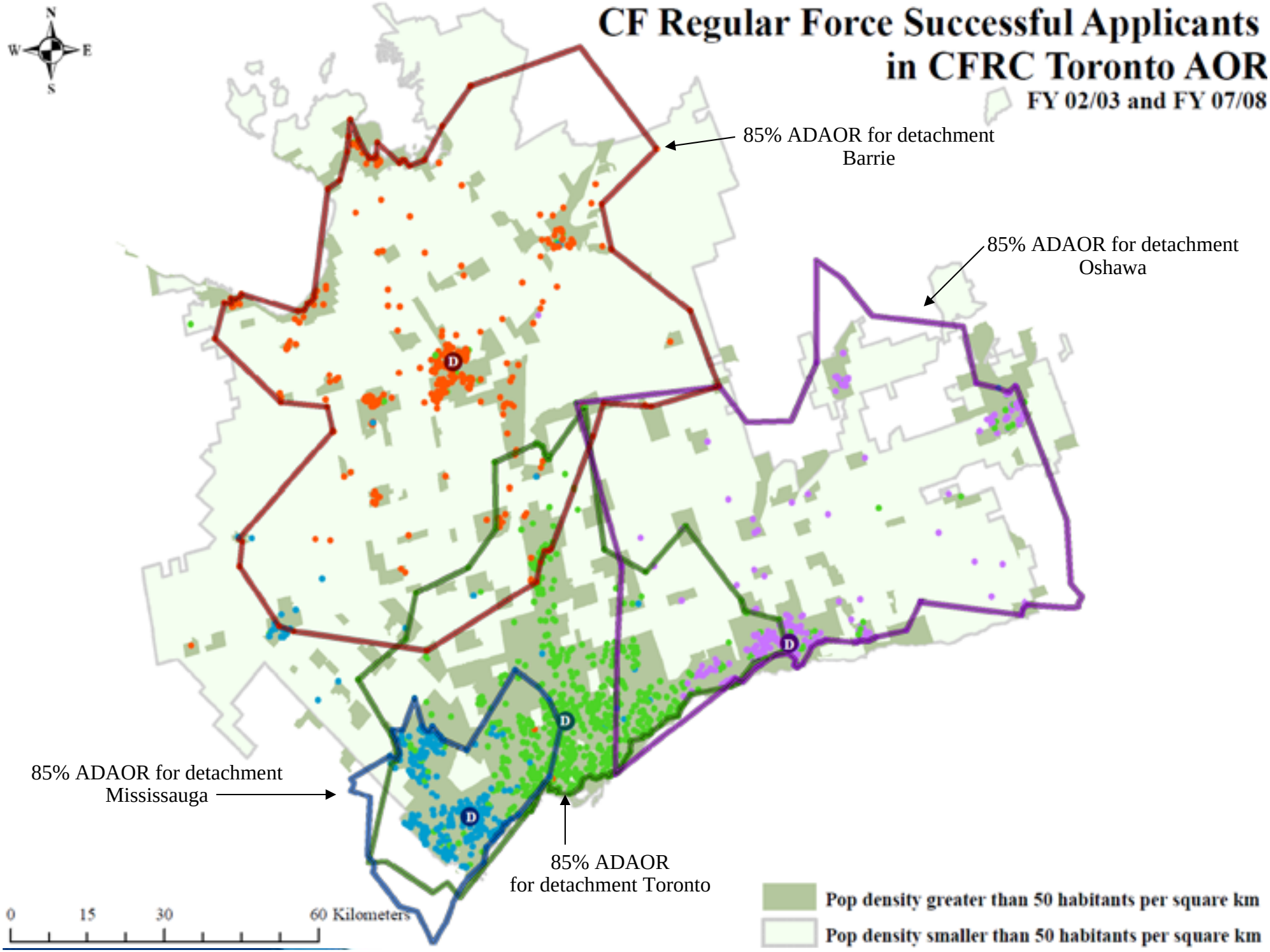
# Suggestions for Improvements

- BA provides a quick way to generate a descriptive trade area based on the location of the customers/clients to a particular location (e.g., store, recruiting center, etc).
- Suggestions for improving the descriptive trade area module in BA:
  - Offer BA users an alternative metric such as the Reilly's metric for determining which customers will be included in the trade area;
  - Incorporate this metric into standard levels of geography for the basis of trade area delineation
  - With the existing methods currently available, allow the capability to specify additional parameters which refine the shape of the trade area (e.g., Reilly's metric, distance distribution parameters, etc).

# At the end of the Day …

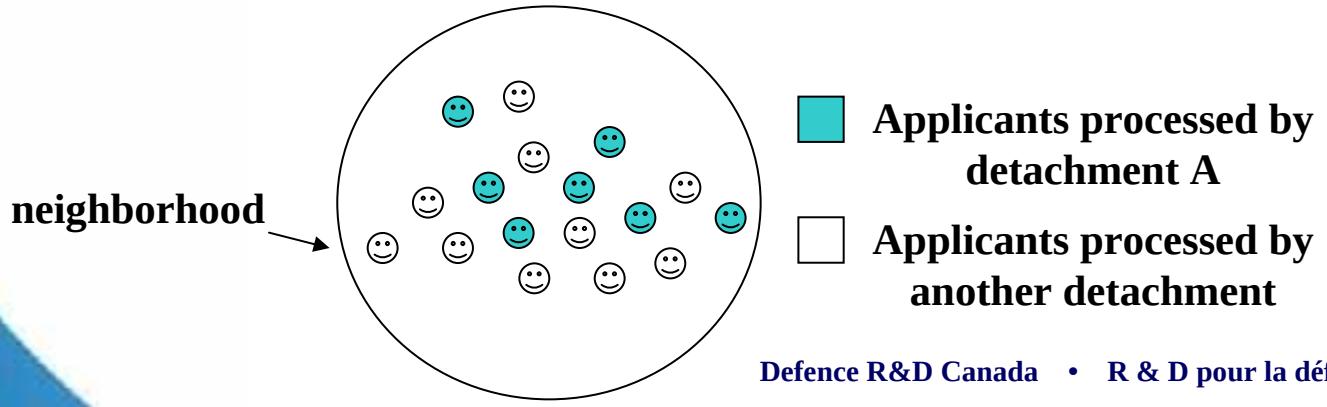
- Whether you are generating an x% ADAOR using BA or the Reilly's metric, you should investigate how attraction to your ADAOR varies from one location to another within your ADAOR.

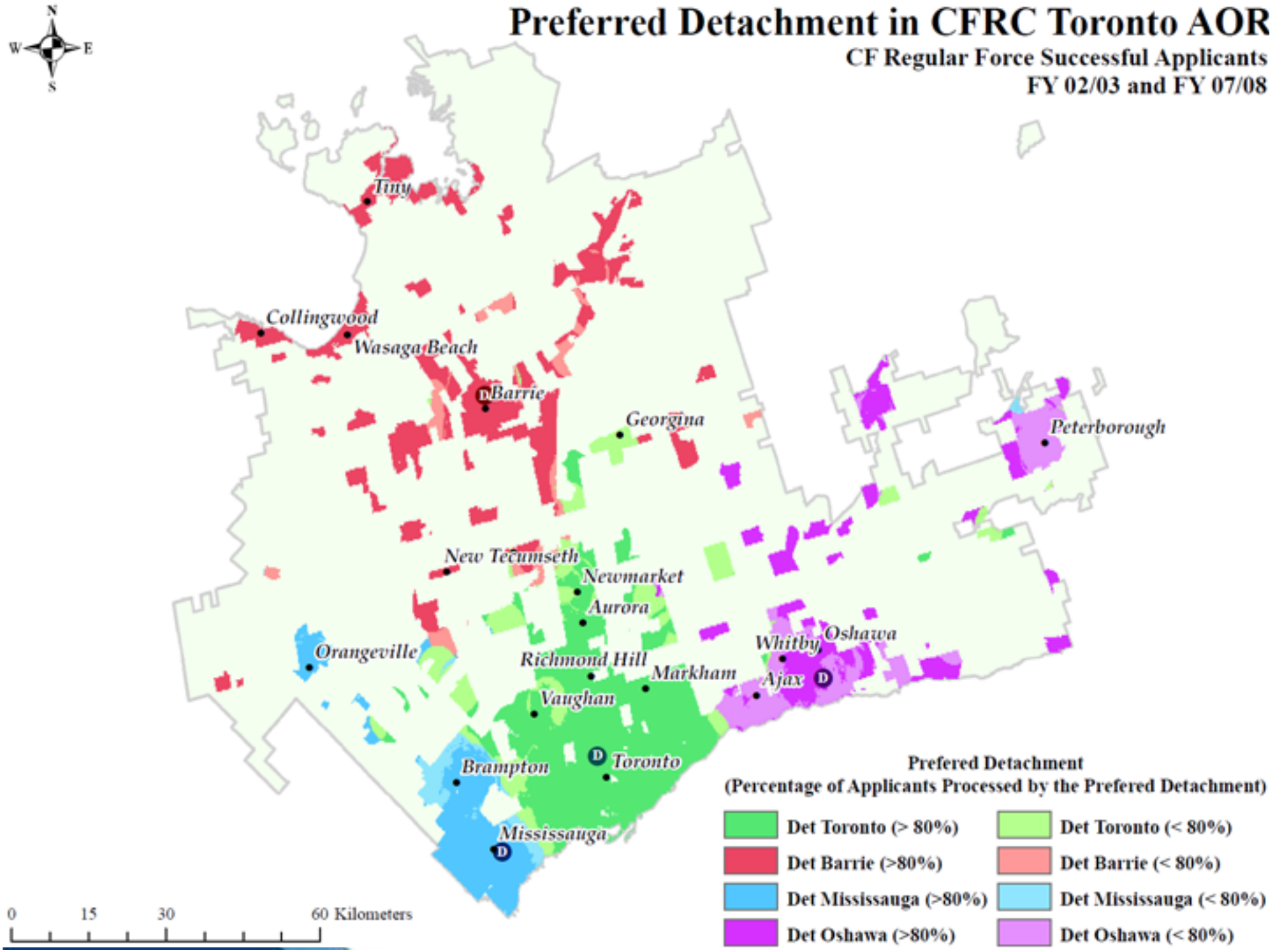



CF Regular Force Successful Applicants
in CFRC Toronto AOR
FY 02/03 and FY 07/08
85% ADAOR for detachment
Barrie
85% ADAOR for detachment
Oshawa
85% ADAOR for detachment
Mississauga
85% ADAOR
for detachment Toronto
N
W
E
S
0
15
30
60 Kilometers
Pop density greater than 50 habitants per square km
Pop density smaller than 50 habitants per square km

# Analysing the Attraction of a Detachment within an ADAOR

- In the table containing the applicant data, create a new binary field which is equal to 1 if an applicant was processed by detachment A and 0 otherwise.
- Use the Point Statistics module for neighborhood analysis in the Spatial Analyst Toolbox to calculate the Mean value of the new binary field within neighborhoods of specified size.
- The output raster provides estimates of the probability that the applicants from the different neighborhoods choose to be processed by detachment A.




Preferred Detachment in CFRC Toronto AOR
CF Regular Force Successful Applicants
FY 02/03 and FY 07/08
N
W
E
S
Tiny
Collingwood
Wasaga Beach
Barrie
Georgina
Peterborough
New Tecumseth
Newmarket
Aurora
Orangeville
Richmond Hill
Markham
Whitby
Oshawa
Ajax
Vaughan
Brampton
Toronto
Mississauga
0
15
30
60 Kilometers
Prefered Detachment
(Percentage of Applicants Processed by the Prefered Detachment)
Det Toronto (> 80%)
Det Toronto (< 80%)
Det Barrie (>80%)
Det Barrie (< 80%)
Det Mississauga (>80%)
Det Mississauga (< 80%)
Det Oshawa (>80%)
Det Oshawa (< 80%)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