

**Newfoundland and Labrador**

# **Human Footprint**

**A Snapshot of Human Influence on the Landscape**



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# Introduction

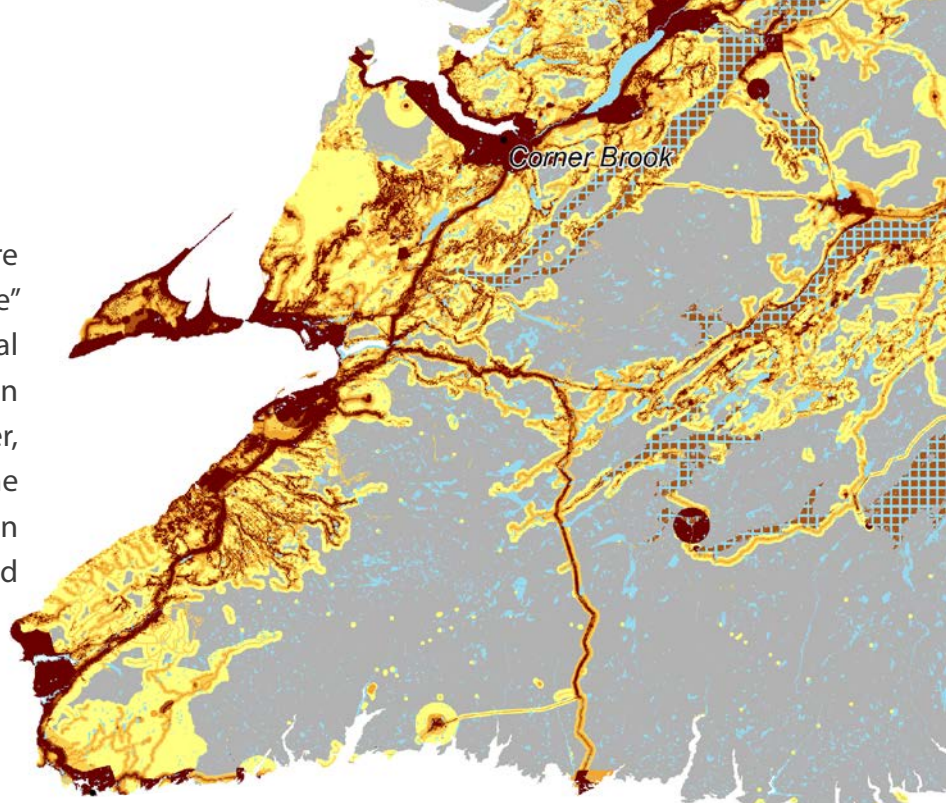
The Human Footprint for Newfoundland and Labrador is a point-in-time snapshot that estimates the level of human influence on the natural landscape (Newfoundland - 2007; Labrador - 2011). The project arose from government conservation planning efforts to locate relatively natural areas in Newfoundland. In Labrador, the Human Footprint has been developed by the Nature Conservancy of Canada (NCC) and the Labrador Blueprint Core Team as part of a collaborative effort to support conservation planning in Labrador.

The Newfoundland and Labrador Human Footprint Project was based on earlier “Footprint” projects from around the world, such as one to identify the last “wild” spaces left on Earth (Sanderson et al. 2002) and another developed for conservation planning in the Northern Appalachian-Acadian region (Woolmer et al. 2008).

This report presents the Human Footprint for Newfoundland and Labrador. We also provide an overview of the data used and a description of how human influence was estimated in determining the overall Human Footprint on the provincial landscape.



The Human Footprint maps presented here are best considered from a “big picture” perspective rather than for detailed local planning, because some of the information is only available at a coarse scale. However, the maps offer an interesting picture of the province to anyone reflecting on human patterns of activity across Newfoundland and Labrador.



# Data and Analysis

To estimate a complete picture of human influence across the land, human activities were mapped for the whole province. The categories chosen were based on the Northern Appalachian-Acadian footprint project (Woolmer et al. 2008), and were modified to include those human activities that most obviously affect the natural landscape in Newfoundland and Labrador.

The NL Human Footprint maps depict five categories of human uses or influences:

1. Human habitation;
2. Access roads and trails;
3. Power generation and distribution;
4. Resource development activities; and
5. Military, aviation, and communications (Labrador only).

Across the landscape and for each of the five categories, human influence was estimated using scores that ranged from zero (little to no influence) to 10 (maximum influence). The degree of human influence for a particular activity or development was considered relative to all the other activities or developments in the analysis. We used the scoring system developed by Woolmer et al (2008), but adjusted it for Newfoundland and Labrador according to local conditions with input from academic, government, and local experts.

For many of the features considered for each category, there was a zone of decreasing human influence from the source of the disturbance. To illustrate these zones of influence, buffers of various widths were drawn extending

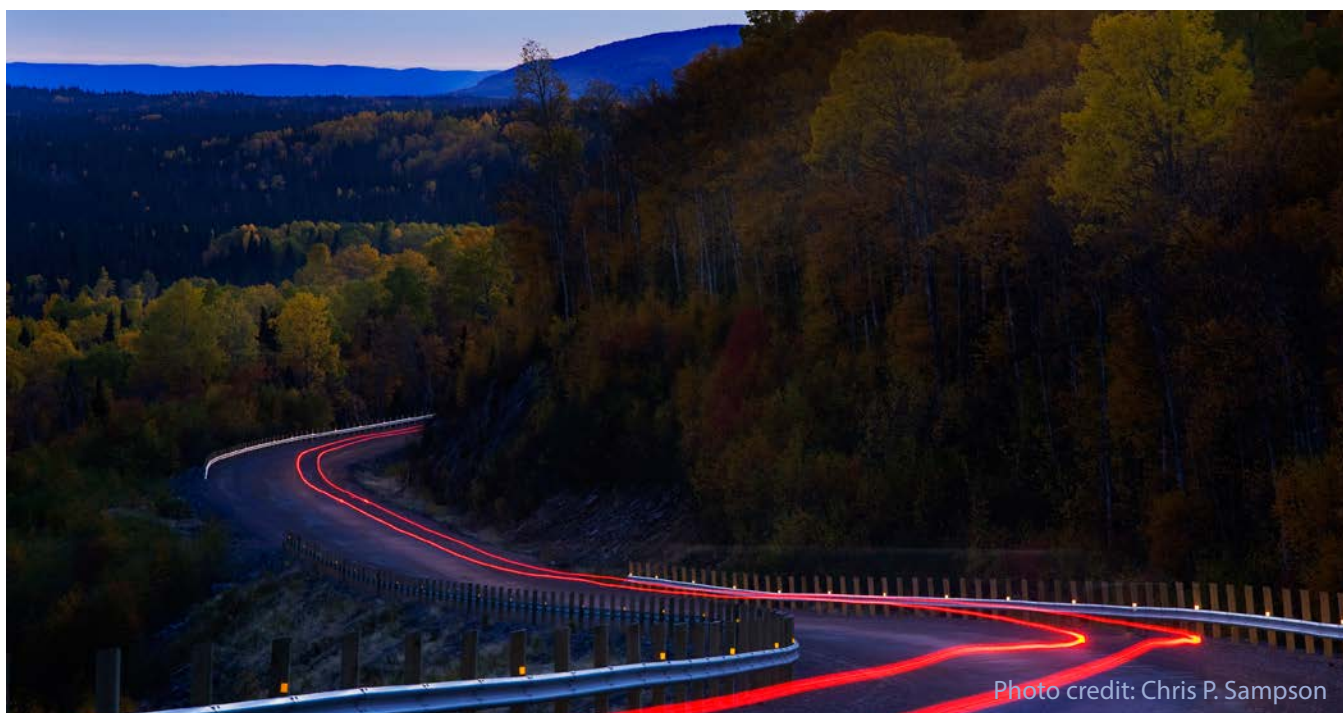
outward from the source and these buffers were then assigned scores. For example, roads were assigned a score of maximum influence (10) at the road bed, because the land has been completely and permanently transformed from a forest or bog to a paved surface. Areas immediately adjacent to the road were assigned a lower influence score (8 for 100-500 m from the road bed), because of associated impacts such as noise, changes to water run-off, and pollution. A little farther from the road, there are decreased impacts from noise and pollution and increased human access for fishing, hunting and firewood cutting. These are human influences on the landscape which are facilitated by the road (score 4 for 500-1000 m from road).

Where two features from different categories overlapped (e.g., where a road crossed a zone of influence associated with a mine), scores for each feature were added, and capped at a maximum

score of 10. After a score of 10 was reached, the area was considered to be highly-influenced by human activities and therefore likely to have reduced natural or conservation value.

Further technical documentation describes the data and analyses in detail (Keough unpub. 2008; NCC unpub. 2011, NCC unpub. 2012). These reports are available from the Government of Newfoundland and Labrador upon request.

A general overview of the data and approaches to scoring are briefly described below.



# Human Habitation

In general, cities and towns are associated with loss of habitat, use of resources, pollution and related influences from human activities on the surrounding environment (e.g. Medley et al, 1995).

Statistics Canada 2006 census information on population density, housing density and areas defined as urban on the Island (i.e., having a population of 10,000 or more) were the primary data used in this analysis. For Newfoundland, cottages accessible by road were also included

in housing density. In Labrador, we used the the NL Statistics Agency's (2011) definition of urban (areas having a population of 5,000 or more) which better reflected the centres of human habitation in that part of the province.

Urban areas received a score of 10. Rural areas with fewer than 9.5 inhabitants/km<sup>2</sup> or with fewer than 6 dwellings/km<sup>2</sup> were assigned scores less than 10.



## Roads and Trails

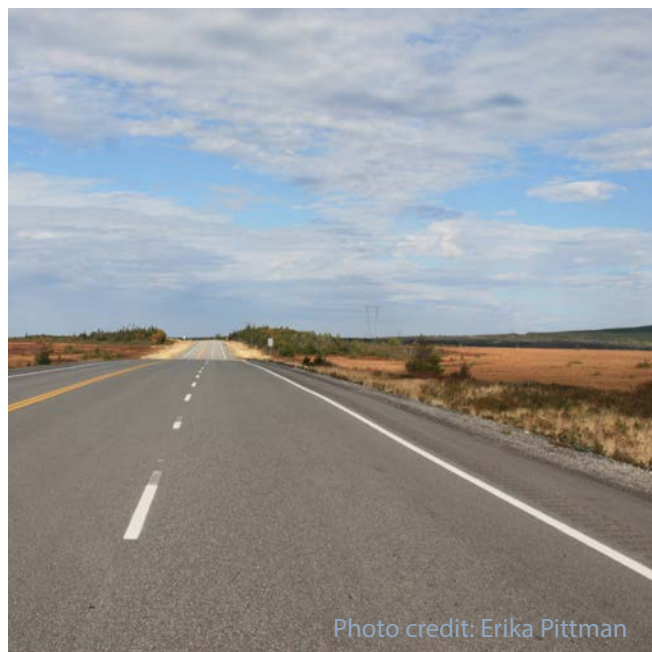
Roads have long-term impacts on the natural environment (e.g. Forman and Alexander, 1998; Spellerberg, 2008). There is habitat loss at and near the road, roads are barriers to movement of wildlife, and traffic can result in wildlife mortalities. Roadside vegetation is usually changed to weedy species and exotic, invasive plant species often become established and spread along roadways. Indirect effects include increased access for public consumption of natural resources (e.g., domestic wood cutting, fishing, and hunting) and increased occurrence of ATV trails, remote cottages and snowmobile traffic in the area.

Road and trail information was compiled from the NL Surveys and Mapping Division. Data on forest access roads (as of 2007 for the Island, and 2011 for Labrador) were included, as well as ATV trails and snowmobile trails registered with the provincial Crown Lands Division. There are a large number of unregistered ATV and snowmobile trails across the province which are not reflected in this analysis because the data are not presently available.

On the Island, the Trans Canada Highway was given a score of 10 with decreasing zones of



influence out to a distance of 3000 m. Other paved roads scored 8 with a zone of influence out to 1000 m. Forest access roads scored 6, since they are generally well constructed and well used for recreation, while trails were given a score of 4. In Labrador, the Trans Labrador Highway was assigned a score of 10 with a maximum zone of influence out to 5000 m (Vistnes and Nellemann, 2008). In the absence of other major roads, roads and trails in Labrador were considered to have a greater zone of influence than on the Island because of the tendency in Labrador to heavily use the few access routes that are present.



## Electrical Generation and Distribution

This category includes data on transmission lines, dams and reservoirs for hydro-electric generation. Transmission lines were given a score of 5 to account for off-road vehicle access and vegetation management activities such as spraying and cutting. Dams and reservoirs greatly influence aquatic vegetation and aquatic and terrestrial animal populations by altering natural water levels and flow regimes.

We used the area of large reservoirs to estimate the footprint of dams. Reservoirs scored relatively high (7) because of the permanent conversion of land to reservoir and because of unnatural water level fluctuations which affect the ecology of the water body. Impacts at the dam locations themselves were also included

and assigned a score of (10) because of the associated infrastructure and access created at those locations (Bajzak and Roberts, 2011).

There are numerous small dams throughout the Island, particularly on the Avalon Peninsula and in Central Newfoundland, that do not create a reservoir large enough to meet the criteria for inclusion in our analyses. The human influence on aquatic systems is therefore underestimated. The appendix includes a map of power generation impacts in Newfoundland that shows the locations of all dams, including small dams that didn't show up in the overall Human Footprint map.

# Resource Development

The resource development category includes data on forest harvesting and associated activities, agriculture, and mineral exploration and extraction, as well as tourism and outdoor recreational development.

## *Forestry*

The primary influence on the landscape from forestry activity is the removal of whole trees and the associated regeneration techniques that follow harvesting. Forest harvesting results in temporary or permanent changes to plant communities in harvested areas and associated changes to wildlife habitat. Since harvested areas generally return to mature forests over time, this disturbance was considered to be a temporary land transformation and therefore scored lower (4) than many other land uses. Note that forest access roads were assessed in the Roads and Trails category.

For Newfoundland, the extent of forest harvesting and silviculture was estimated by mapping stands under 40 years of age and removing those known to have been disturbed by natural events (fire, wind, or insects). Cutover and silviculture data were also available for Labrador and were added to the analysis there. Due to slower tree growth in much of Labrador, the impact of forest harvesting was estimated to have a slightly greater impact than on the Island; cutovers were thus scored a 6 in Labrador





and a 4 in Newfoundland. Plantations were included as a human influence (in Labrador only) with plantations of non-native species ranked as a higher influence.

## *Agriculture*

Agriculture scored a range of 3-6 depending on the type of activity. Agriculture generally results in more significant changes to the landscape than forestry activity, as all previously-existing vegetation is removed and the soil is disturbed, compacted, and altered. Ecosystems are suppressed from returning to their natural state. Fur farms were also considered for Labrador due to the clearing that results from infrastructure construction as well as ecological risks associated with escapees.

## *Mining and Mineral Exploration*

Mines were considered areas of large human impact on the land; each mine scored 10 due to complete habitat removal. There are also many effects associated with mines including waste deposition, air and water pollution, and noise. The maximum zone of human influence around mines was up to 5000 m for mines on the Island and 10,000 m for some of the larger mines in Labrador. Mines are generally larger in Labrador so we considered larger zones of influence for Labrador mines.

Data on mineral exploration were not readily available; many of the associated impacts such as line cutting, trenching and ATV use on wetlands are not well documented. Information on drilling sites was available from the provincial Department of Natural Resources and provided some measure of associated human influences; areas of higher densities of drill sites/m<sup>2</sup> received higher scores.









## *Tourism and Recreational Development*

The most extensive developments in this category are cabins, cottages and camps associated with tourist outfitting businesses across the province. Private cabins which were registered with provincial Crown Lands Division were also considered in the analysis. Tourism and recreational cabins have relatively low influences on the landscape, with tourist outfitting businesses having a slightly higher impact (score: 4 within 100 m of a structure ) than private cabins (score: 2 within 100m of a structure). Developments are limited in area with most outfitting associated impacts, such as clearing and wood harvesting, estimated to be within 500 m of a structure (score: 2).

Ski hills and golf courses were included because they result in a long-term land transformation over a large area.

## **Military, Aviation and Communications**

The Military, Aviation and Communications category was added for Labrador because these activities have a significant influence on the landscape. The Department of National Defense's large Practice Target Area (PTA), and Safety Template Area (STA), which is a safety buffer for the PTA, were included in the assessment. The PTA has been used in the past for precision-guided missile training, and is currently used for military training not involving low level flights (T. Chubb, personal communication, 2012). These areas were assigned a relatively low influence score (2 and 1 for the PTA and STA, respectively) over a fairly large area. Runways, Northern Warning System sites (including former Pine Tree line sites) and military camera targets were small point locations. Northern Warning System sites had a high human influence (8) because of the history of localized pollution at those sites.

Communication sites (towers, dishes, etc.) (score: 2) and fuel storage locations (score: 8) were added as impacts primarily for vegetation clearing in those areas and the high risk of fuel contamination.

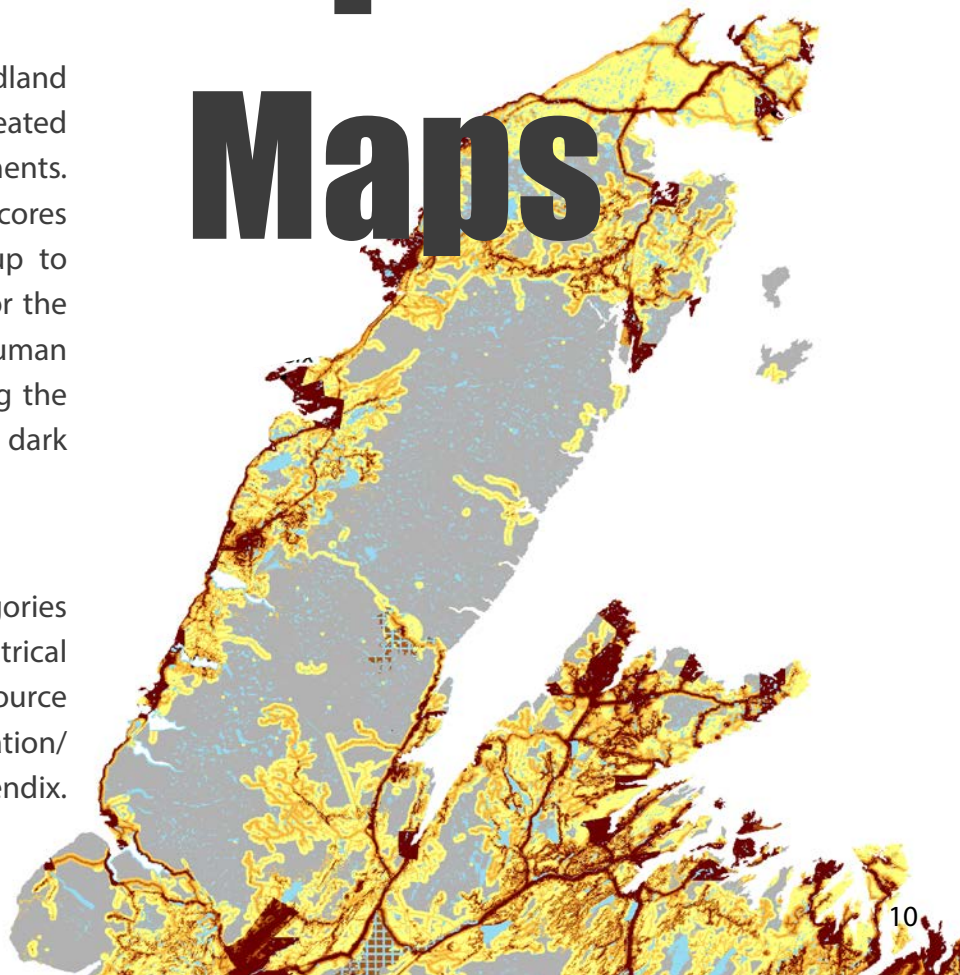




# Human Footprint Maps

Human Footprint Maps for Newfoundland (Figure 1) and Labrador (Figure 2) were created by summing the scores for all the components. For each analysis point (pixel), the scores from each component were summed up to a maximum of 10. The colour scheme for the resulting scores shows the variation in human influence across the land with grey being the lowest level of influence (score zero) to dark brown being the highest (score 10).

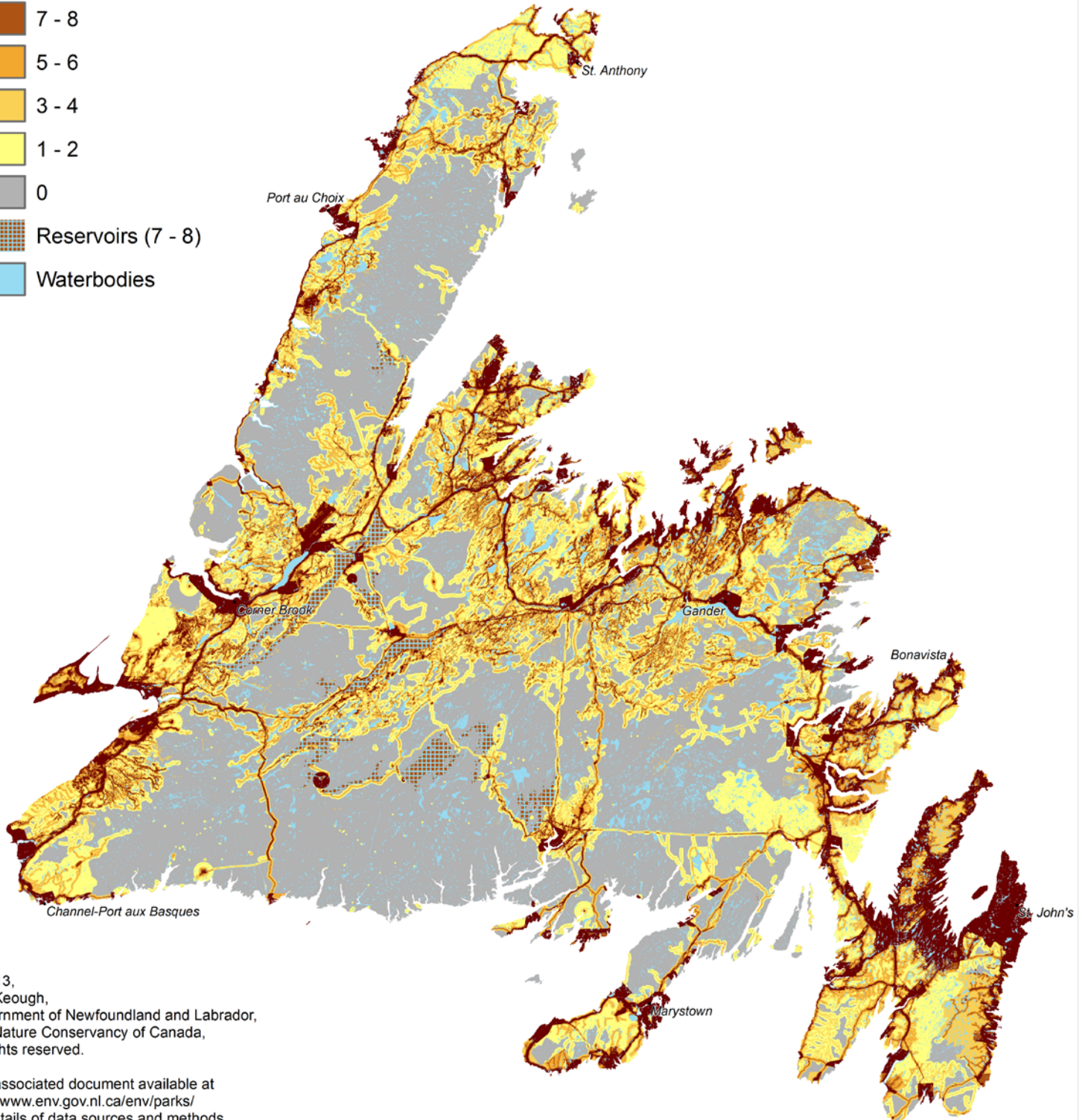
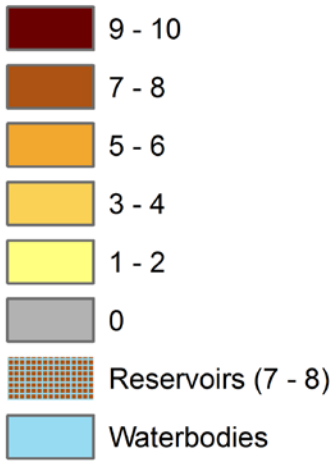
Individual maps for each of the five categories (Human Habitation, Human Access, Electrical Power Generation and Distribution, Resource Development and Military/Aviation/Communications) are included in the appendix.





# Island of Newfoundland Human Footprint (2007 data)

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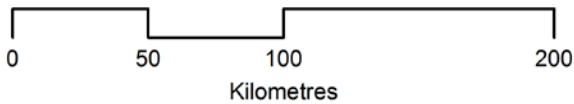
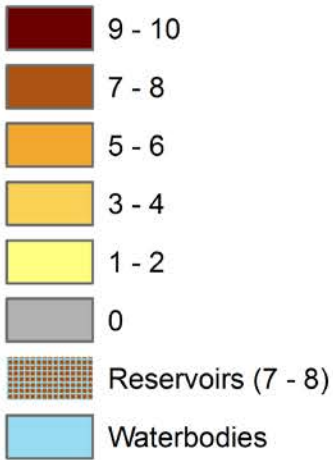


Figure 1. The Human Footprint Map for Newfoundland combines estimates of human influence on the landscape for 4 categories of human activity and development: habitation, access, power generation/distribution, and resource development. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.



# Labrador Human Footprint (2011 data)

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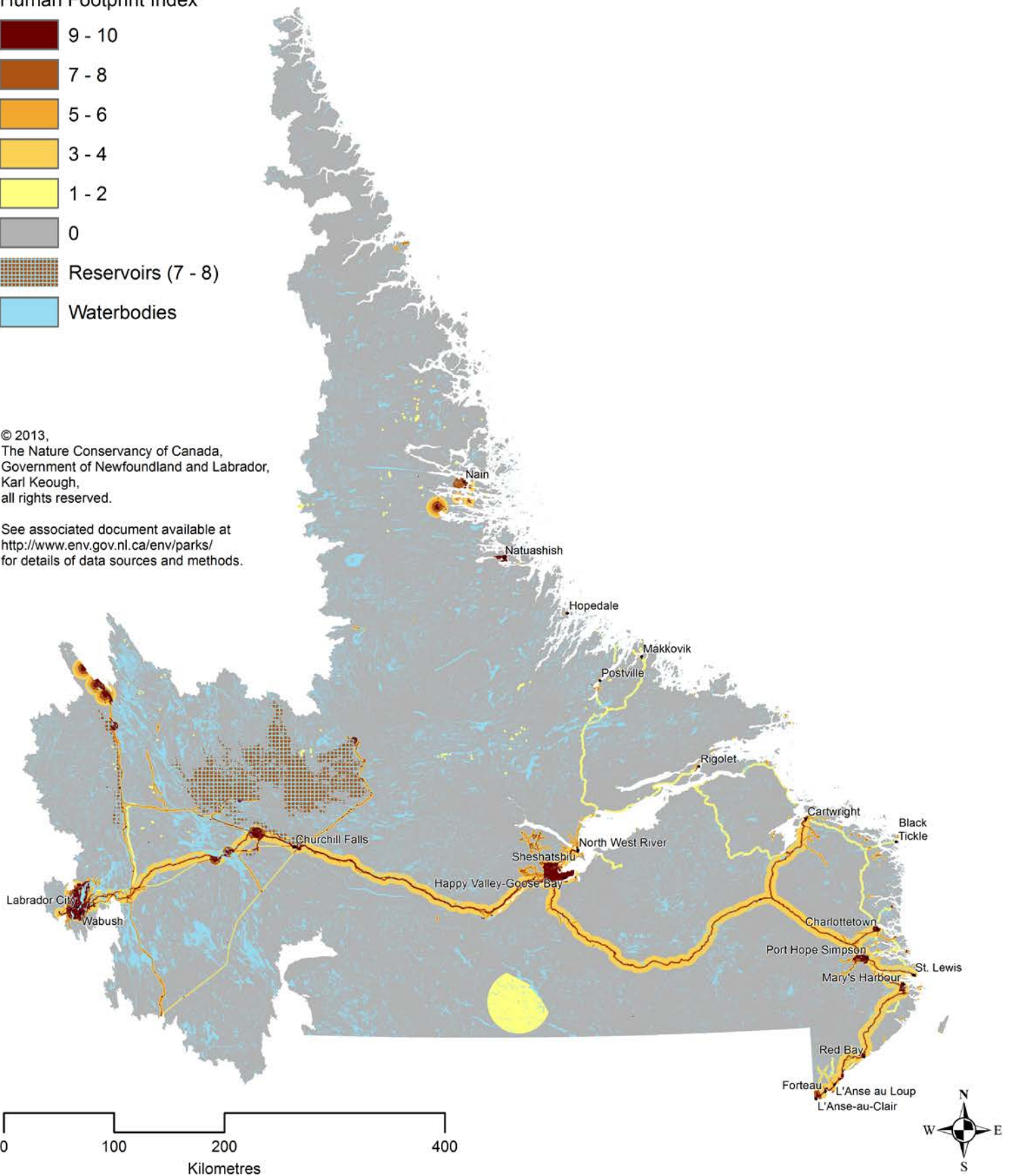


Figure 2. The Human Footprint Map for Labrador combines estimates of human influence on the landscape for 5 categories of human activity or development: habitation, access, power generation/distribution, resource development and military/aviation/communication activities. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.

An aerial photograph of a dam and power station. A large, silver, cylindrical pipe runs vertically down a rocky, forested slope. At the top of the pipe is a small red building. At the bottom, the pipe connects to a large red power station building with several transmission towers on its roof. The dam is visible in the background, and a river flows through the foreground.

# Summary: Conclusions and Caveats

The NL Human Footprint maps provide a visual summary of human development and activity in Newfoundland and Labrador.

While all developments and land transformations perceived as significant were included in the analyses, it was clear from the final mapping results that many of the developments have very local impacts. At a landscape scale, small dams, blueberry management areas, ski hills and golf courses are almost invisible. Development categories that have a large influence at the landscape level are areas of human habitation and roads (including trails and transmission lines). The impacts of natural resource development are widespread across the Island. Development impacts are not as extensive in Labrador; however, there are large areas of significant impact associated with mining development.



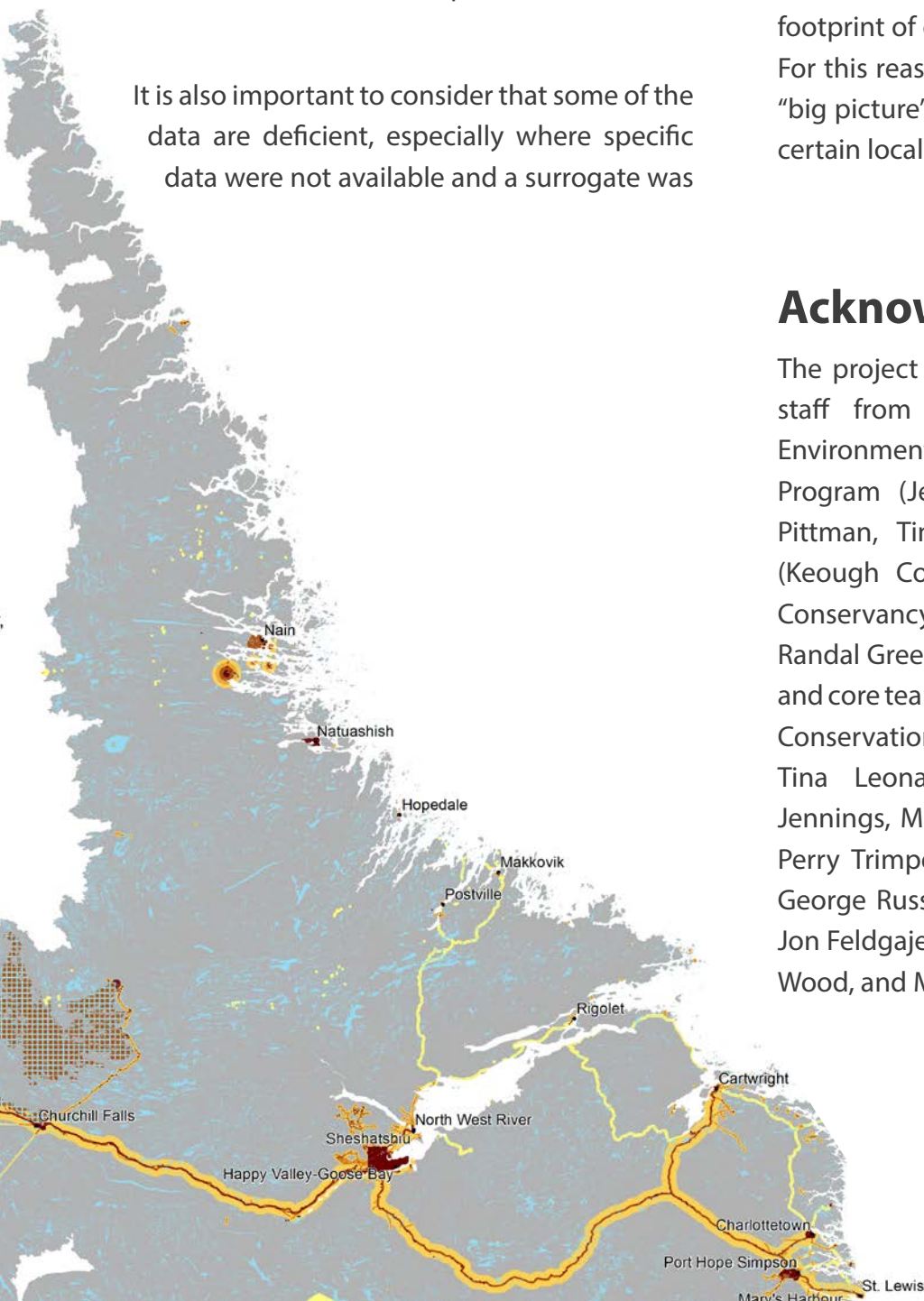
Some parts of Labrador and sections of the Island appear to be as yet relatively unaffected by human developments. This analysis does not consider proposed developments, such as future mines, access roads or transmission corridors. As well, data simply do not exist for some features, such as the many non-registered ATV trails made by recreational users and those associated with mineral exploration.

It is also important to consider that some of the data are deficient, especially where specific data were not available and a surrogate was

used. For example, the assessment areas from the Statistics Canada information were used to represent actual areas with houses. As a result, the human habitation information is mapped according to the assessment areas, which in some cases are quite large. Areas that are clearly not inhabited may show up as an area of high human influence. In Labrador attempts were made to more accurately reflect the actual footprint of communities because of this issue. For this reason, the maps are best viewed as a “big picture” without focusing too narrowly on certain local areas.

## Acknowledgements

The project team for Newfoundland included staff from the provincial Department of Environment and Conservation, Natural Areas Program (Jeri Graham, Crystal Breon, Erika Pittman, Tina Leonard ) and Karl Keough (Keough Consulting). For Labrador, Nature Conservancy of Canada staff (Lindsay Notzl, Randal Greene) worked closely with ENVC staff and core team members from the NCC Labrador Conservation Blueprint project (Jeri Graham, Tina Leonard, Isabelle Schmelzer, Darren Jennings, Marlyce Shangreaux, Wayne Russell, Perry Trimper, Stephen Rowe, Loran Hayden, George Russell, Eldred Allen, Paul McDonarld, Jon Feldgajer, Valerie Courtois, John Riley, Bryn Wood, and Margo Morrison).



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# Appendix

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Figure 2 Labrador Human Footprint - Habitation Component

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Figure 5 Island of Newfoundland Human Footprint - Power Generation/Distribution Component

Figure 6 Labrador Human Footprint - Power Generation/Distribution Component

Figure 7 Island of Newfoundland Human Footprint - Resource Development Component

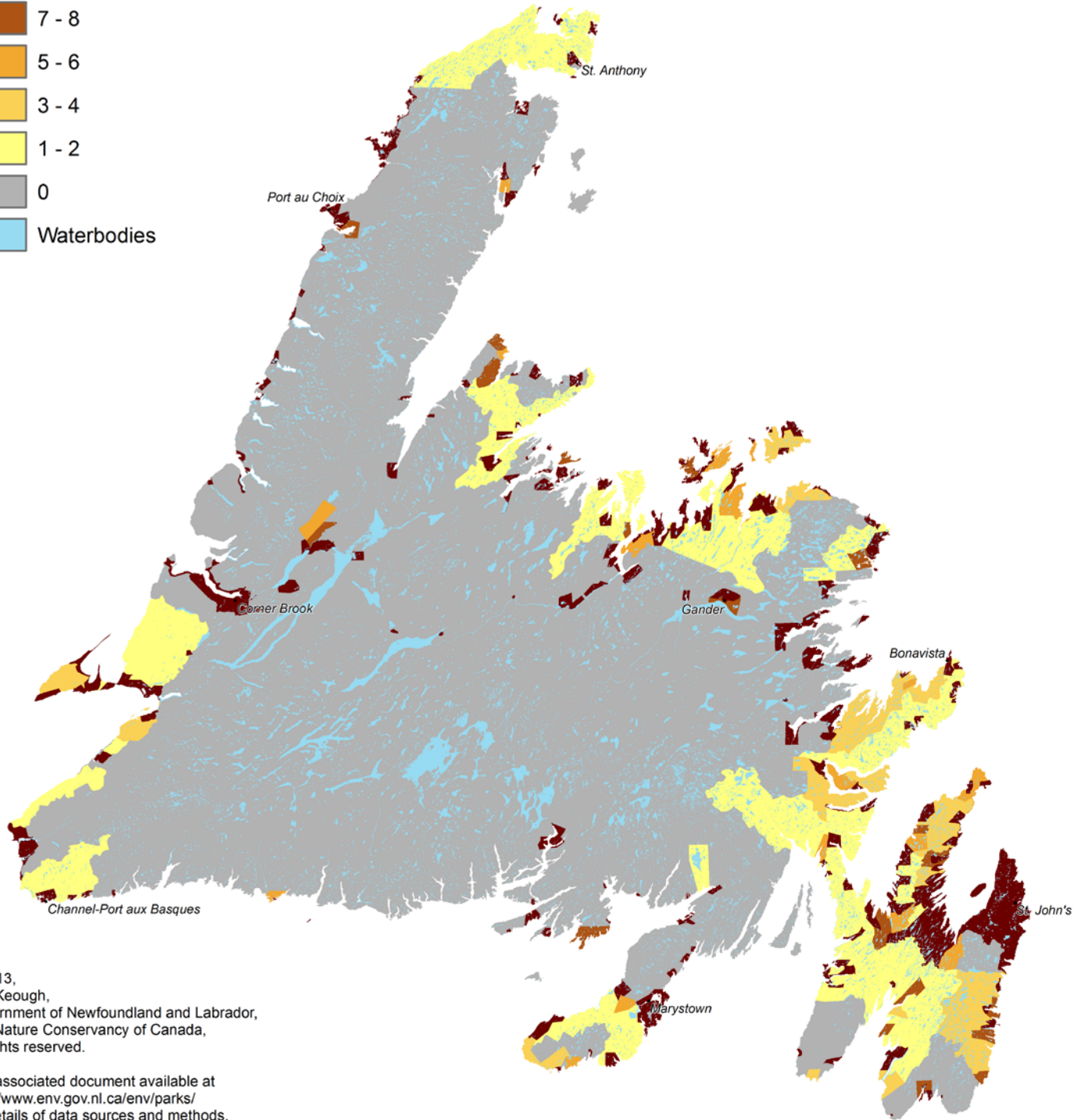
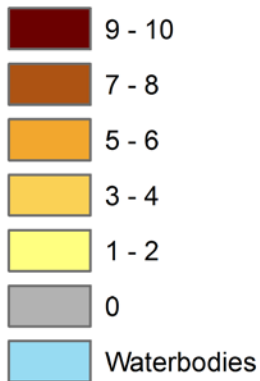
Figure 8 Labrador Human Footprint - Resource Development Component

Figure 9 Military/Aviation/Communication Component



# Island of Newfoundland Human Footprint - Habitation Component (2007 data)

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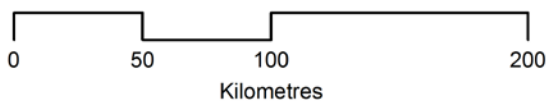
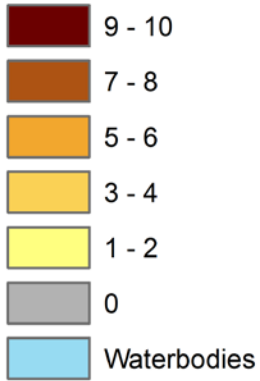


Figure 1. The Human Habitation component of the Human Footprint Map for Newfoundland is a visual estimate of human influence on the landscape based on population, dwelling density and urban areas as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.

# Labrador Human Footprint - Habitation Component (2011 data)

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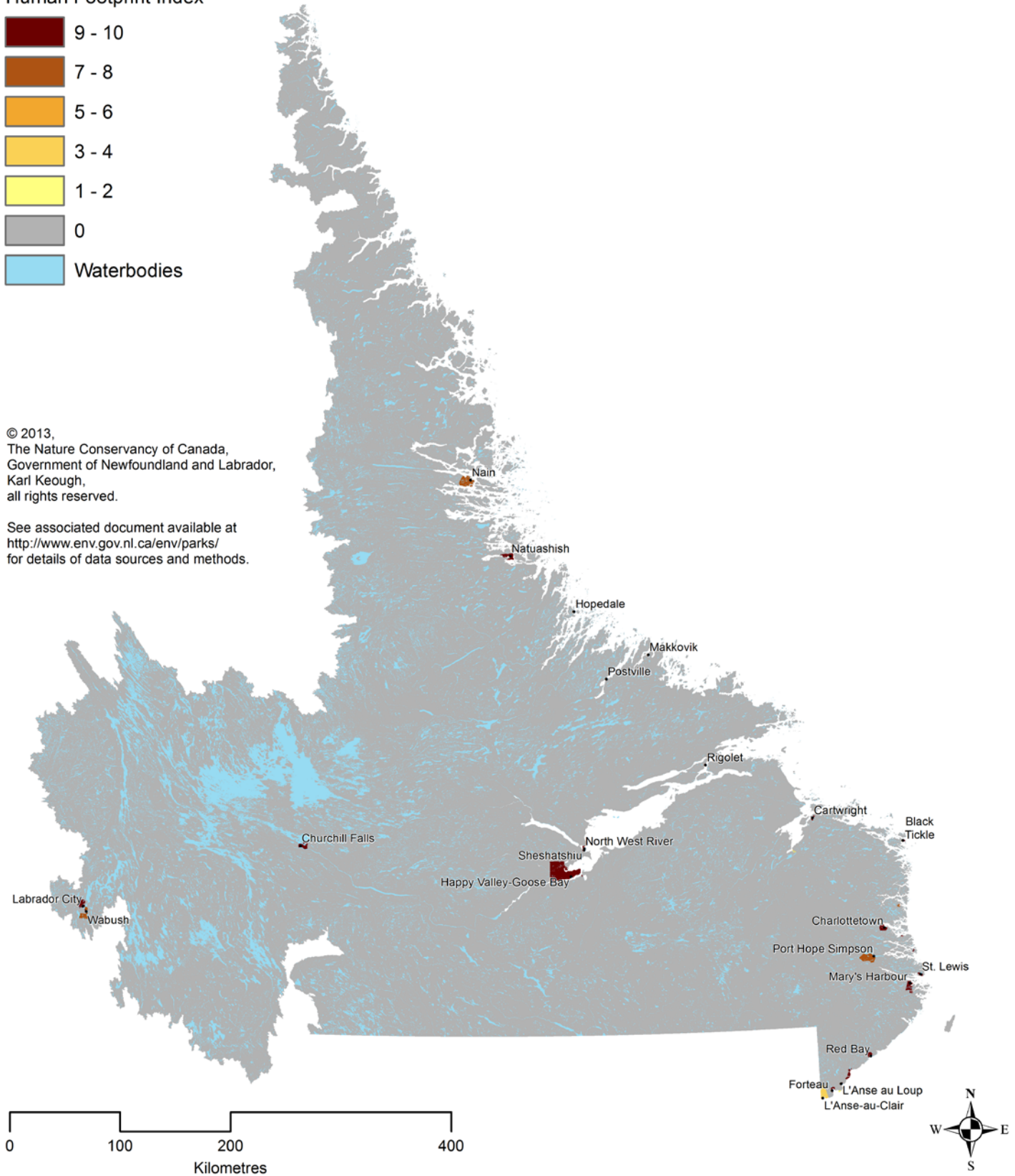
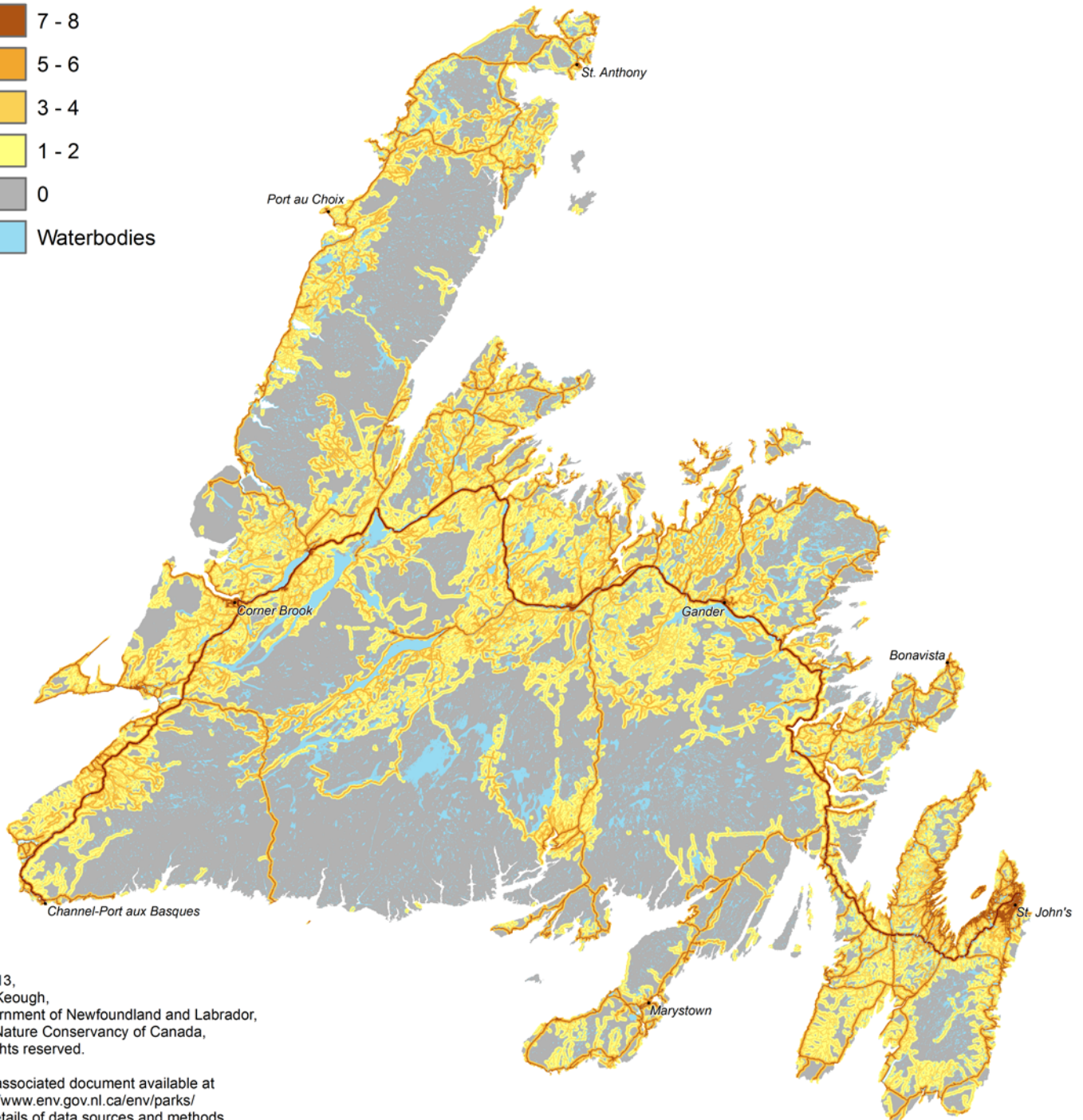
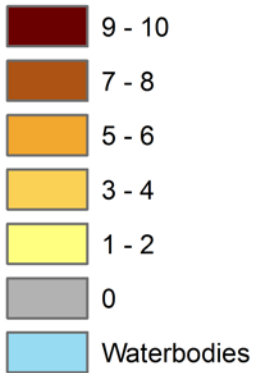


Figure 2. The Human Habitation component of the Human Footprint Map for Labrador is a visual estimate of human influence on the landscape based on population, dwelling density and urban areas as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.



## Island of Newfoundland Human Footprint - Access Component (2007 data)

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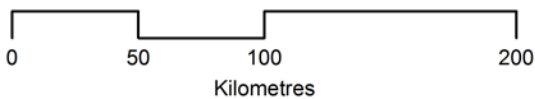
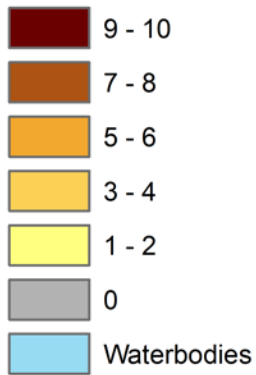


Figure 3. The Access Roads and Trails component of the Human Footprint Map for Newfoundland is a visual estimate of human influence on the landscape based on highways, roads, resources roads, and trails (ATV and snowmobile) as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.

# Labrador Human Footprint - Access Component (2011 data)

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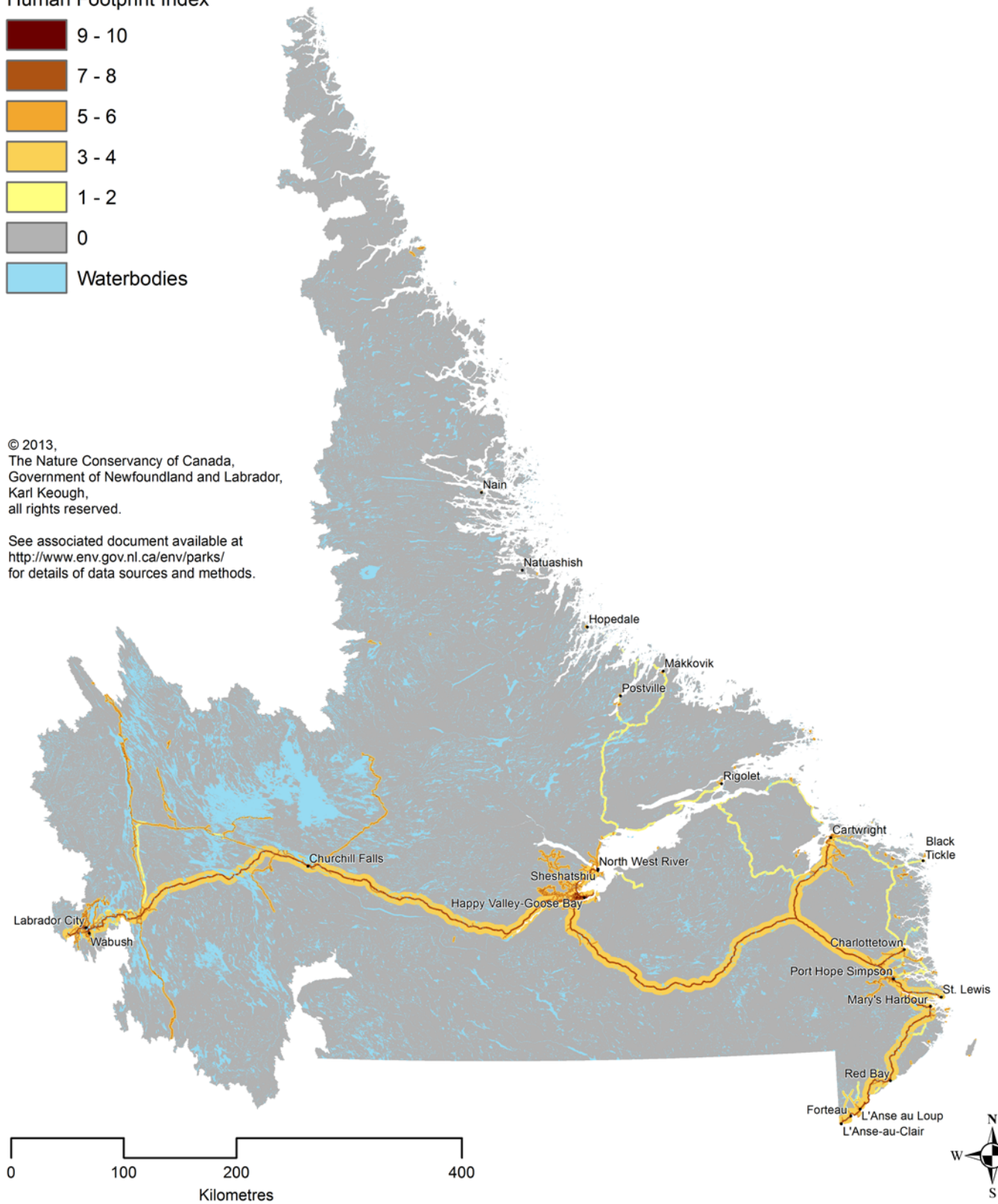
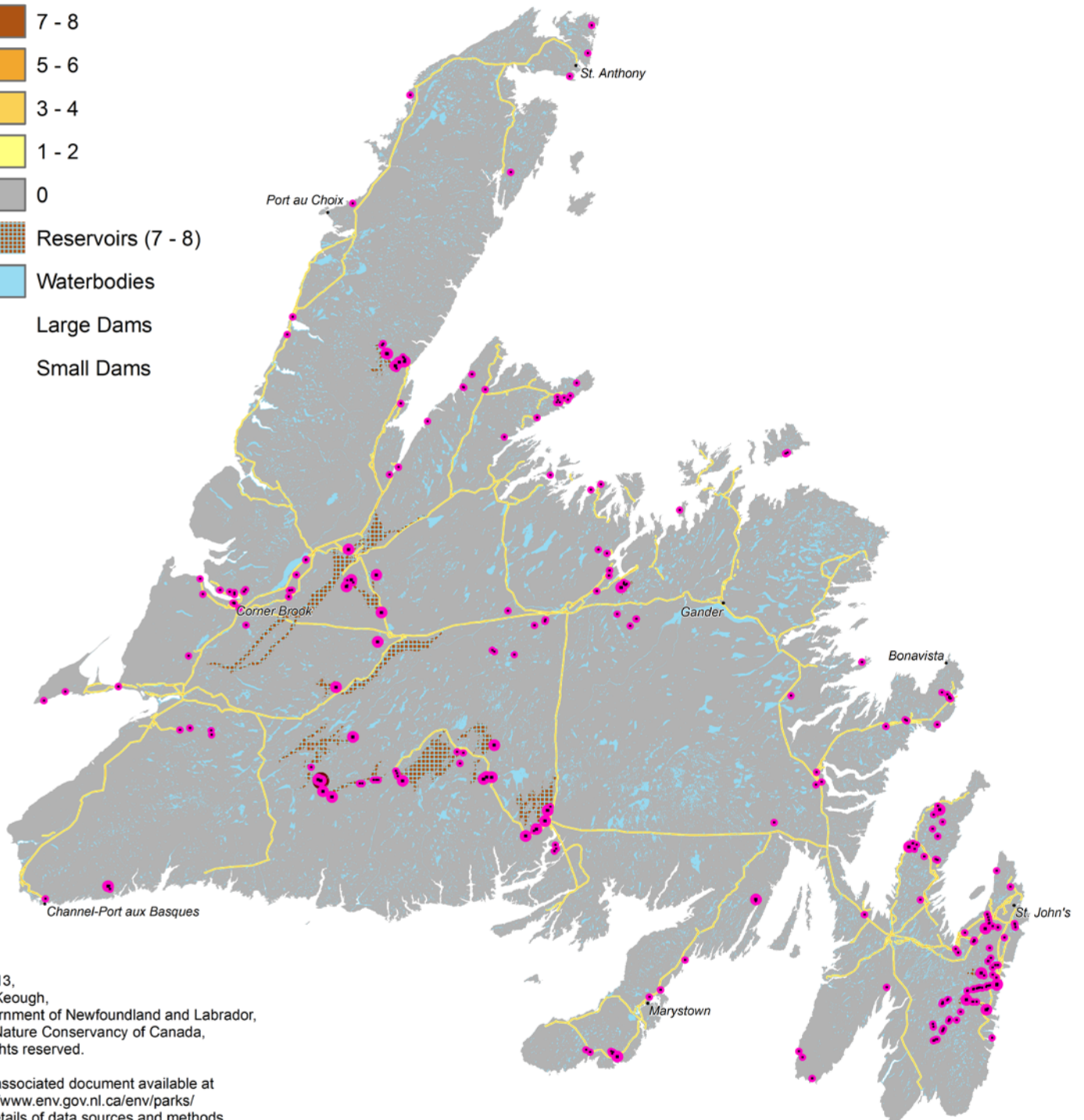
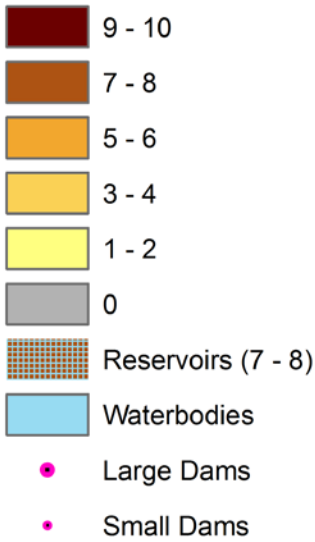


Figure 4. The Access Roads and Trails component of the Human Footprint Map for Labrador is a visual estimate of human influence on the landscape based on highways, roads, resources roads, and trails (ATV and snowmobile) as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.



# Island of Newfoundland Human Footprint - Power Generation/Distribution Component (2007 data)

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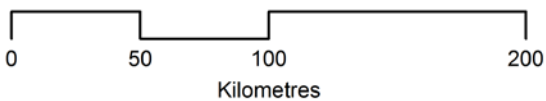
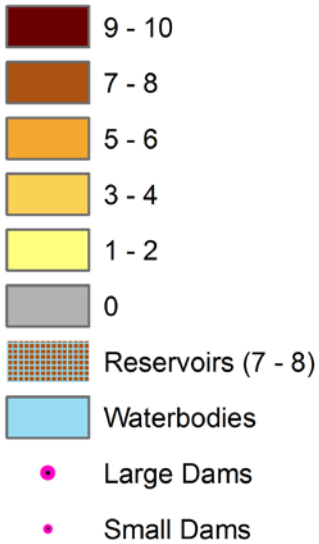


Figure 5. The Electrical Generation and Distribution component of the Human Footprint Map for Newfoundland is a visual estimate of human influence on the landscape based on large reservoirs, dam sites and transmission/distribution lines as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available. Since the small dam locations did not show up at the provincial scale, for this map the actual dam locations have been mapped (purple dots) to show the extent of influence that dams have on aquatic systems. Reservoirs (score: 7) are shown in a stipple composed of the HF score and waterbody colour.



# Labrador Human Footprint - Power Generation/Distribution Component (2011 data)

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for details of data sources and methods.

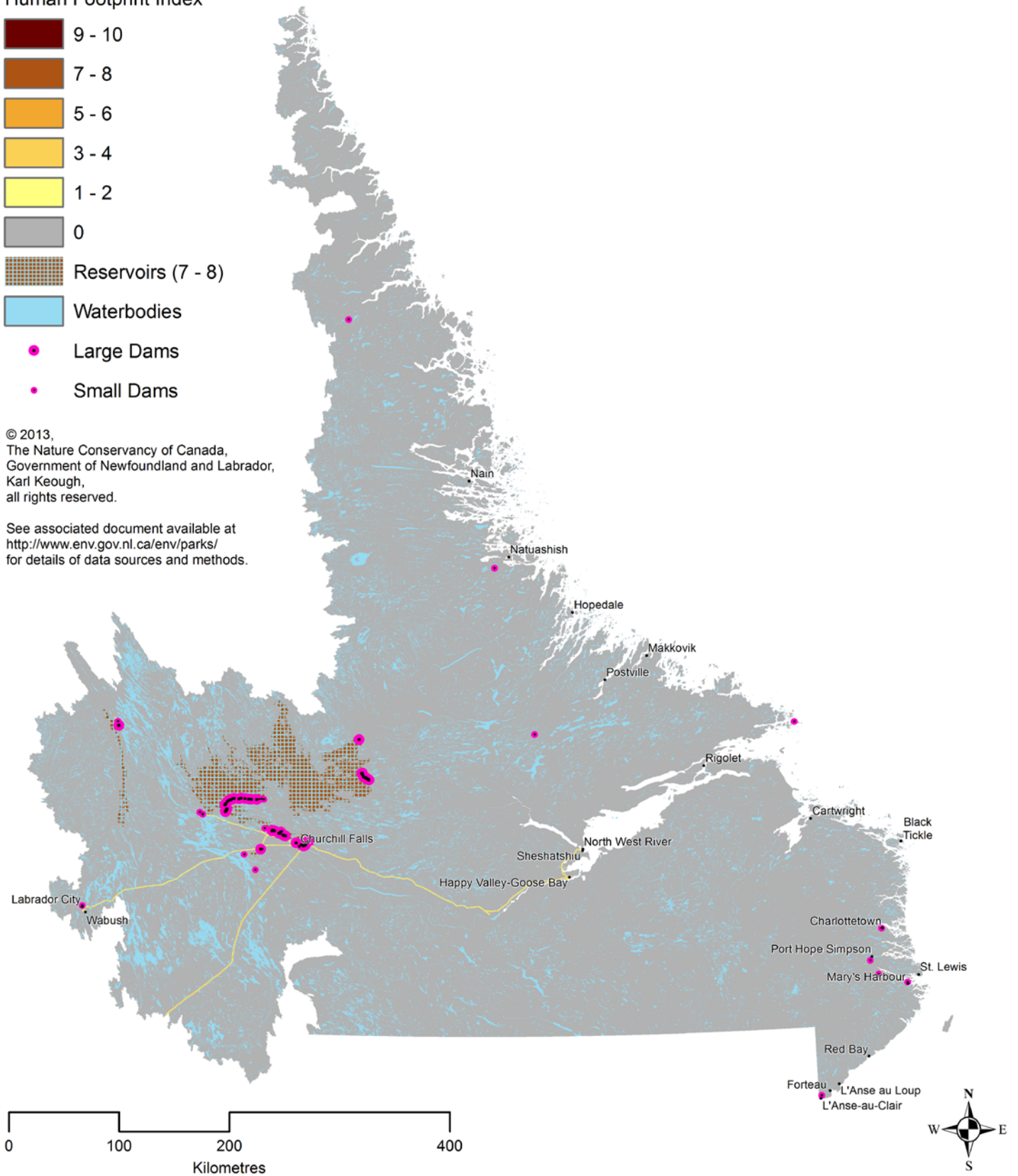


Figure 6. The Electrical Generation and Distribution component of the Human Footprint Map for Labrador is a visual estimate of human influence on the landscape based on large reservoirs, dam sites and transmission/distribution lines as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available. Since the small dam locations did not show up at the provincial scale, for this map the actual dam locations have been mapped (purple dots) to show the extent of influence that dams have on aquatic systems. Reservoirs (score: 7) are shown in a stipple composed of the HF score and waterbody colour.

# Island of Newfoundland Human Footprint - Resource Development Component (2007 data)

## Human Footprint Index

9 - 10

7 - 8

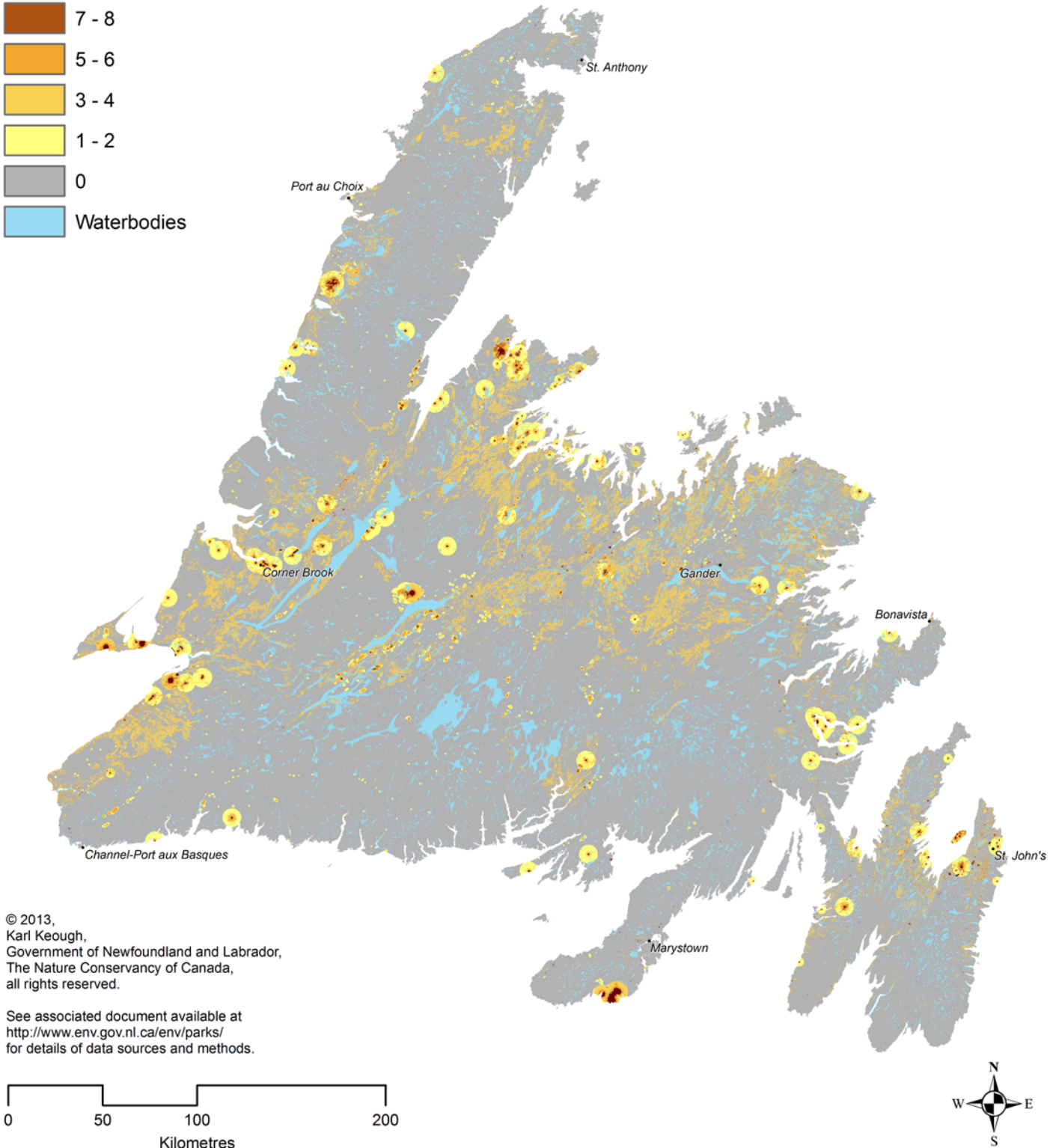
5 - 6

3 - 4

1 - 2

0

Waterbodies



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See associated document available at  
<http://www.env.gov.nl.ca/env/parks/>  
for details of data sources and methods.

0 50 100 200  
Kilometres

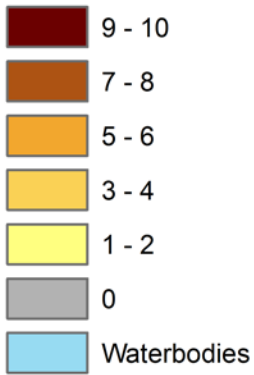


Figure 7. The Resource Development component of the Human Footprint Map for Newfoundland is a visual estimate of human influence on the landscape based on forest harvest areas, agricultural areas, mines, mineral exploration areas and tourism/recreation developments such as outfitter locations, ski hills and golf courses as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.



# Labrador Human Footprint - Resource Development Component (2011 data)

Human Footprint Index



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for details of data sources and methods.

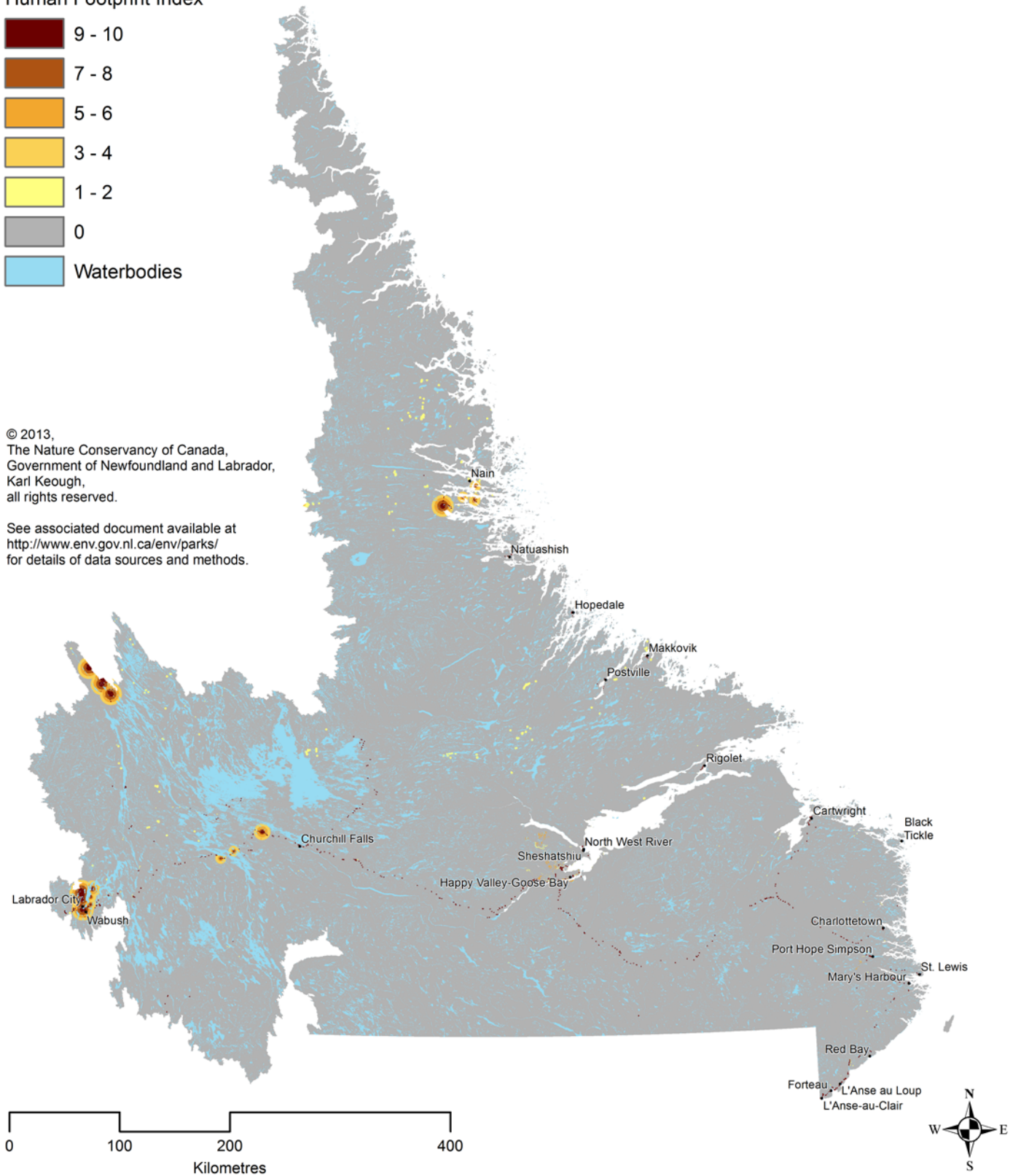
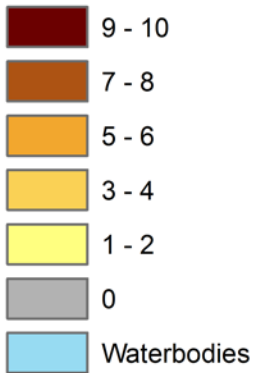


Figure 8. The Resource Development component of the Human Footprint Map for Labrador is a visual estimate of human influence on the landscape based on forest harvest areas, agricultural areas, mines, mineral exploration areas and tourism/recreation developments such as outfitter locations, ski hills and golf courses as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.



# Labrador Human Footprint - Military/Aviation/Communications Component (2011 data)

Human Footprint Index



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for details of data sources and methods.

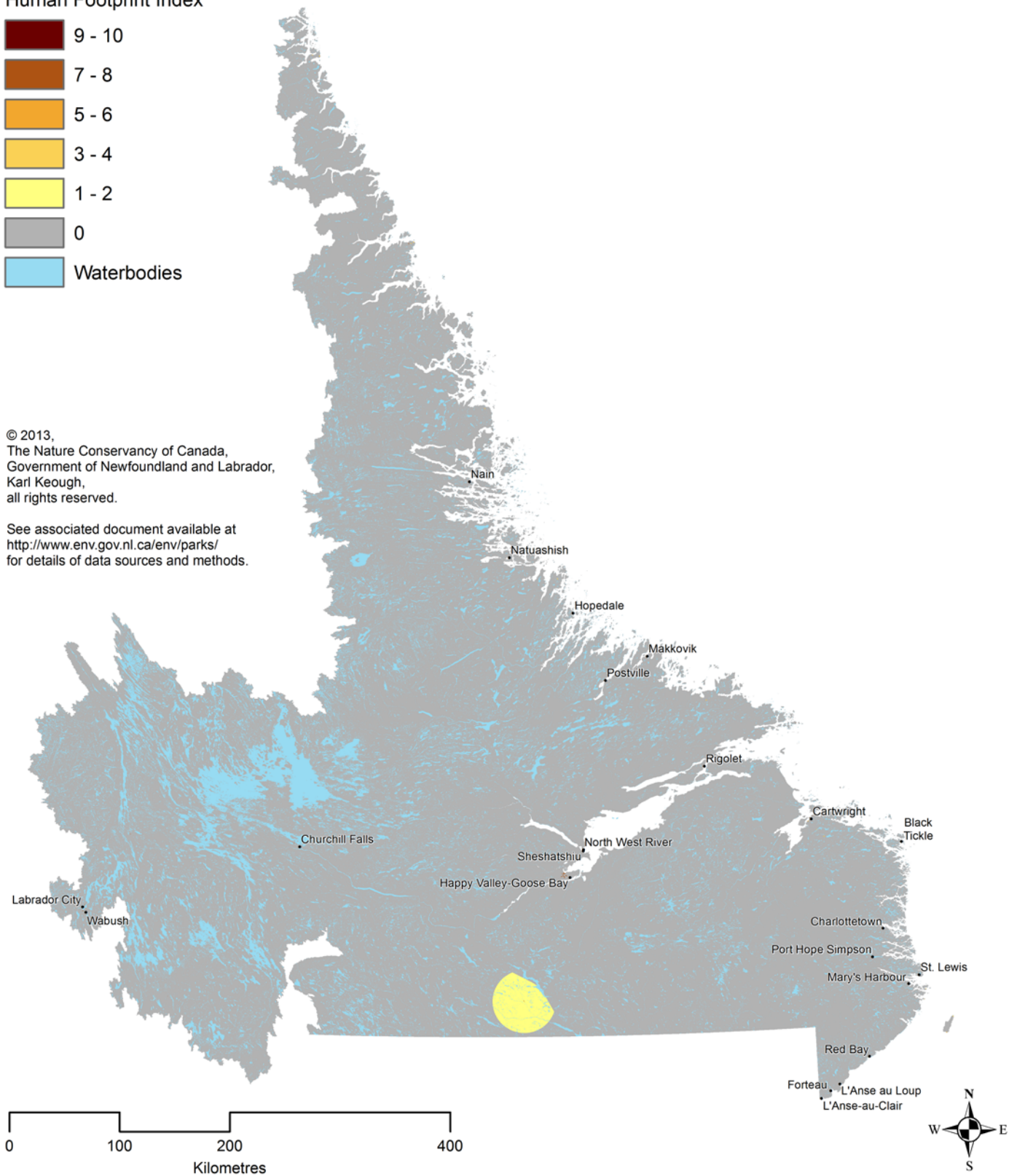


Figure 9. The Military, Aviation and Communications component of the Human Footprint Map for Labrador is a visual estimate of human influence on the landscape based on the Practice Target and Safety Template Areas, as well as other military sites, runways, communication sites and fuel storage locations as described in the report. Impacts range from low (1-2) to high (9-10) for estimated human influence; areas in grey reflect no human influences for the variables measured and the data available.







Newfoundland  
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