Municipality of the District of Yarmouth

Municipal Climate Change Action Plan

Thriving Amidst Uncertainty

This report serves as the Municipal Climate Change Action Plan in fulfillment of the 2010-2014 Canada-Nova Scotia Municipal Funding Agreement. It functions as an amendment to the Integrated Community Sustainability Plan of the Municipality of the District of Yarmouth.

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Executive Summary

Climate-wise municipal planning aims to reduce exposure and corporate susceptibility to natural hazards and extreme weather events. Climate-wise planning also builds community resilience by enhancing the ability of the municipal organization and its citizens to live attentively to its ever-changing landscape. This report serves as the Municipality of the District of Yarmouth's Municipal Climate Change Action Plan in fulfillment of the 2010-2014 Canada-Nova Scotia Municipal Funding Agreement.

The federal government and Nova Scotia entered into a Municipal Funding Agreement that set out the terms and conditions of the Gas Tax Fund. As a requirement for this funding, municipalities prepared and submitted Integrated Community Sustainability Plans in 2010. This Municipal Climate Change Action Plan is an amendment to the Municipality of the District of Yarmouth's Integrated Community Sustainability Plan and its approval is, again, a requirement for continued funding. This requirement stems in part from the fact that when Integrated Community Sustainability Plans were submitted in 2010, the majority of municipalities identified climate change as a challenge to maintaining infrastructure and overall financial health.

As the result of a request for tender, ABL Environmental Consultants Limited was hired to assist in completing a municipal climate change action plan for the municipality. Development of the Plan involved a series of six workshops facilitated by ABL in which the municipality's Climate Change Committee was guided through a process that fulfilled requirements set forth by the Province. The Committee reviewed locally relevant climate trends and projections. It then used a Hazard Risk Vulnerability Assessment approach to evaluate how, in the context of changing climate conditions, natural hazards could cause adverse effects on municipal infrastructure, resources and personnel. Once the risks were identified, personnel identified action items that if implemented would lessen risks to natural hazards and extreme weather events, and strengthen the municipality's adaptive capacity within realistic resource limitations and time constraints.

Results of the hazard assessment indicate eight natural hazards that have potential to negatively impact the municipality. Generally speaking, coastal flooding from storm surge, particularly during tropical storms or hurricanes,

presents the greatest risk. During such extreme weather events, coastal flooding and intense rainfall can happen simultaneously, which exacerbates flood impacts. Wildland fire and winter storms/blizzards present moderate risk. Inland flooding, drought, extreme heat events and coastal erosion were recognized as presenting low levels of risk to the municipality, its infrastructure and people.

Impacts from climate-influenced natural hazards were assessed from both short-term and long-range perspectives. They were also considered from an emergency management perspective and in the context of land use planning. The Committee's research and discussions culminated in the identification of actions that could either prevent or lessen the severity of impacts.

The municipal climate change action plan identifies a total of 33 action items for consideration. While the committee identified all these actions as important steps to building community resiliency, the action ideas were put through a prioritization process that considered both risk reduction value and the municipality's capacity for implementation. The prioritization process recognizes three levels of urgency. Four actions were ranked as high priorities (i.e., highly urgent) in both value and capacity to implement. Eleven were identified as medium priority actions. Sixteen were listed as lower priority actions indicating that while it may be straightforward for municipal staff to achieve the action's intent, the action itself does not reduce the threat.

A tremendous benefit of municipality's climate change action planning effort was that it brought multiple aspects (Departments and Council) of the municipality together in a collaborative learning and decision-making process. As hazards and associated impacts were identified and discussed, staff and Councilors learned a great deal from each other: not just from their respective knowledge base, but also about the work demands of their individual roles and how climate or weather stress will factor into their projects and activities. Central to this collaborative engagement and knowledge exchange was the participation of Committee members familiar with MoDY's emergency preparedness work.

1. Introduction

The federal government has committed to transfer funds equivalent to a portion of the federal excise tax on gasoline to municipalities. This transfer has now become permanent. The federal government and Nova Scotia entered into a Municipal Funding Agreement that set out the terms and conditions of the program. As a requirement for funding, Nova Scotia municipalities were asked to submit Integrated Community Sustainability Plans (ICSP) in 2010. In 2013, municipalities were asked to amend their ICSPs through the submission of a Municipal Climate Change Action Plan (MCCAP), again, a requirement for funding.

The Municipality of the District of Yarmouth (MoDY) received approximately $450,000 in gas tax revenue in 2012-2013. Gas tax revenue can be spent on “environmentally sustainable municipal infrastructure projects: community energy systems, public transit infrastructure, water infrastructure, wastewater infrastructure, solid waste infrastructure, local roads and bridges, capacity building, and active transportation infrastructure.”

In 2012, Service Nova Scotia and Municipal Relations released a Guidebook outlining a suggested framework for the development of the MCCAPs. The Guidebook presents a 6-step framework with questions nested in each step. The intent of the MCCAP process undertaken by municipalities in 2013 is the identification of priority areas for adaptive action. In other words, municipalities are determining what the most important items to address are in order to make sure people, property, special places and essential services aren’t compromised by natural hazards exacerbated or introduced by climate change.

The process of developing the MCCAP created an opportunity to respond to changing natural hazards in an informed way. It has provided perspective on climate change impacts MoDY ought to be protecting from or ready to respond to, and initiated discussions about policy and procedures that could help protect people, properties, special places, and essential municipal services susceptible to changing climate conditions. The MCCAP also updates and summarizes MoDY’s greenhouse gas emissions and presents ideas for emissions reductions.

2. Climate Change Adaptation Committee

In February of 2013, MoDY issued a Request for Proposals for the purpose of engaging a consultant to assist in the development of the municipality's MCCAP. The contract was awarded to the municipality's consulting engineers, ABL Environmental Consultants Limited (ABL) who teamed up with Elemental Sustainability Consulting and HMC/EMC Inc. MoDY simultaneously assembled a Climate Change Committee (Table 1) for the purpose of contributing to and advising on the development of the MCCAP for eventual adoption by Council. The Committee's Terms of Reference can be found in Appendix A.

Table 1 MoDY Climate Change Committee Members

MoDY Climate Change Committee Members	
Gerard LeBlanc	Councilor
John Cunningham	Councilor
Brad Fulton	Senior Planner, Yarmouth-Argyle District Planning Commission
Roger Devine	Director of Development and Inspections
Derek Sutherland	Director of Public Works
Alix d'Entremont	GIS Technician
Harold Richardson	REMO Coordinator
Francine Comeau	Recording Secretary

Between April and September of 2013, the Committee progressed through six collaborative working sessions. The focus of the Committee's working sessions included, but were not limited to:

- an EMO-led analysis of eight natural hazards for the identification of impacts and a means by which to assign rankings for impact severity, and frequency
- an introduction to climate trends and projections relevant to MoDY,
- detailed discussions about water level scenarios leading to the selection of an elevation to delineate an area of increasing risk from storm surge impacts,
- discussing economic opportunities and vulnerabilities in the context of regional climate trends,
- framing the MCCAP as a means of improving organizational adaptive capacity and municipal resilience,
- the selection of MCCAP action items, and
- the prioritization of MCCAP action ideas using a process that considers level of risk, adaptive capacity to implement an idea, urgency to act, and threat reduction capability.

All Climate Change Committee Meetings were open to the public and the minutes from all work sessions are public record. While public participation and comment was always welcome, it was not specifically sought after for a few reasons. First, the municipality had just finished a Municipal Planning Strategy (MPS) review process. This review consisted of regular public monthly meetings, with discussion and debate of all components of the MPS policies and Land Use By-Law (LUB) provisions. The meetings were well attended by area residents, and the ongoing public participation contributed greatly to the overall planning exercise. In addition to the regular research and review work, a number of planning amendment issues were addressed by the committee, dealing with agricultural, industrial and environmental issues. These planning issues were unrelated to the formal review process, yet MoDY invested considerable time and resources on them.

Second, the Committee needed to build its own knowledge capacity about climate change trends and projections and potential affects: adverse or positive. Therefore, the Committee focused its time on learning and then putting what was learned into local context. To assist with this, the Committee reached out to subject experts to better understand climate trends, projections, hazards and impacts. Examples of subject experts who were consulted during MCCAP development included:

- Professional Geoscientists, Geologists, Hydrogeologists and a Forester within the Nova Scotia Department of Natural Resources: Philip Finck, Garth DeMont, Gavin Kennedy and Kevin Keys.
- Réal Daigle, Climatologist, Director R.J. Daigle Enviro®, co-author of the ACAS report, *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level.*
- Dr. Blair Greenan, Head, Oceanography and Climate Section, Ocean and Ecosystem Sciences Division, Fisheries and Oceans Canada at the Bedford Institute of Oceanography.
- Dr. Li Zhai, Research Scientist specializing in sea level rise, Bedford Institute of Oceanography
- Tim Webster, Research Scientist at the Applied Geomatics Research Group, Centre of Geographic Sciences, Nova Scotia Community College.
- Dr. Bob Robichaud of Environmental Canada's Meteorological Services Centre, Atlantic Storm Prediction Centre.
- Jo Ann Fewer, Executive Director, Nova Scotia Commission on Building our New Economy.
- Dr. Greenburg, Department of Fisheries and Oceans Research Scientist, Bedford Institute of Oceanography

Third, the Committee's MCCAP development process focused on increasing the knowledge capacity of municipal staff and Council, and doing so in a way that improved organizational adaptive capacity. Having a shared understanding among Committee members about how existing municipal operations and services are susceptible to climate change, and how these susceptibilities would affect the roles and responsibilities of the municipal staff, better positions MoDY to design more meaningful public education and engagement on resulting initiatives.

3. MoDY's Approach to MCCAP Development

3.1 Use of a Hazard Risk Vulnerability Assessment Tool

Trend:
The 'direction' of change

Event:
A thing that happens

Hazard:
Any source of potential damage, harm or adverse effects

Impact:
A change to the environment, positive or negative

Development of MoDY's MCCAP started with a Nova Scotia Emergency Management Office tool called the Hazard Risk Vulnerability Assessment (HRVA). The HRVA is premised on a collaborative evaluation and decision-making process. Because climate change planning deals not just with gradual shifts in climate conditions but also climate-influenced extreme weather events (e.g., tropical storms, extended drought) and rapid onset natural disasters (e.g., wildfires), including an emergency management perspective in the assessment of natural hazards and impacts is critical. In fact, it is a duty of the Regional Emergency Management Office (REMO) to analyze hazards to inform planning for disaster preparedness, mitigation, response and recovery. Therefore, municipal climate change planning is well served to draw from and complement this existing body of experience and knowledge.

For this reason, MoDY used the HRVA for ranking risk vulnerability. A 1-5 scale was used to denote an Overall Impact Score that ranks severity of consequences (Table 2). The HRVA also uses a 1-5 scale for ranking probability (Table 3). MoDY modified the HRVA probability scale so that the scale's timeframes reflected timeframes found in climate research. As well, the HRVA takes public risk tolerance into consideration. The degree to which the public is or is not tolerant of a specific impact may influence the manner or speed with which the municipality addresses the issue.

It should be noted that the HRVA uses narratives describing each Overall Impact Score. These narratives are written from an emergency management professional's perspective. Emergency management professional are concerned with people's lives and safety first and foremost. That concern is immediate in nature, meaning that the emergency management (EMO) perspective is inclined to focus on the most probable event in the near term. Comparatively, municipalities as a whole take a wider view of 'threat'. In addition to public safety, a municipality concerns itself with anything that poses a **potential interruption of services** (e.g., ability to distribute an adequate supply of potable water). Likewise, events or conditions that may result in **damage to infrastructure** are threats to a municipality's bottom line. As well, anything that has the potential to cause local **job loss** is also a threat, and changes in climate conditions will likely have significant economic ramifications. To a lesser degree, events to which a municipality cannot adequately respond (in the eyes of the public) are considered threatening because of the potential for **diminished trust** in or credibility of elected officials and municipal staff.

Because municipal interests have more breadth than the focus of emergency management, the HRVA narratives for Overall Impact Scores needed to be slightly modified before being employed as a guide for risk ranking. The Committee used the modified narratives to evaluate each impact by choosing the narrative that most accurately reflected the potential impact if it were *not* mitigated. For example, if the impact of concern were an interruption in the distribution of drinking water, the Overall Impact Score chosen would be the score/narrative that best described how the community would be affected (or infrastructure damaged) if the hazard causing the impact were not mitigated.

Bunker Island Lighthouse (Bug Light). Photo by Alix d'Entremont, August 2013.

Table 2 HRVA Probability Scoring Used for MCCAP

Probability Score: Considering historical occurrences and projections, the likelihood of occurrence in years.	
1	Highly probable: once every 5 years or less
2	Likely to occur once every 10 years or less
3	Might occur once every 25 years or less
4	Not expected; could occur once every 50 years
5	Rare chance of occurrence; once every 100 or more years

Table 3 HRVA Impact Severity Scoring Used for MCCAP

Overall Impact Score: Considering each of the impacts identified and the guidelines below, select an overall impact score.	
1	Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement (over 72 hours); long term effects to environment; destruction of critical infrastructure; loss of socially valued infrastructure; external resources required for immediate response; community unable to function without outside (provincial/federal) support: Municipal Emergency Operations Centre (EOC) activated for 24 hours or longer
2	Significant; 51-100 people affected; no immediate fatalities; multiple serious injuries; long-term hospitalization required; displacement (24-72 hours); significant impact to environment- medium term effects; critical infrastructure, socially valued & property damage repairable within emergency budgets; external resources required to support/supplement community services/responders; some community services unavailable for less than 72 hours; Municipal EOC activated for less than 24 hours
3	Moderate; 11-50 people affected; no fatalities, minor injuries; short-term hospitalization and treatment required; displacement (6-24 hours); no long term environmental, infrastructure or property damage; localized damage rectified by routine arrangements and mutual aid agreement resources; minor localized disruption to community services (non-critical) for less than 6 hours, EOC activated less than 8 hours
4	Minor; less than 10 people affected; no fatalities, minor injuries requiring first aid/ out-patient treatment only; displacement (less than 6 hours); no sustained damage to infrastructure or property; normal community functioning with some inconvenience; no external resources required; Municipal emergency officials notified but no EOC activation
5	Insignificant; less than 10 people affected; no fatalities, injuries or impact on health and property beyond first responder “everyday” capacity; no displacement; no damage to properties or environment; no disruption to community services or infrastructure; no resources gaps; No Municipal emergency official notification or activation required

For each impact, the scores for impact severity and probability were multiplied. This provided a number on a scale of 1-25 that served as a measure with which to compare impacts (Table 4). However, a qualitative discussion about the public’s risk tolerance of an impact could serve as persuasion to increase or decrease the final risk ranking. For example, the coastal nature of our culture has created a high degree of tolerance for coastal erosion. And although the rapidity at which the coast is eroding is quite concerning, as are our often maladaptive attempts to control it, the public has not historically looked to the municipality to mitigate this natural hazard. This historically ‘high’ risk tolerance was thus taken into consideration when evaluating how to rank the risks from coastal erosion. That being said, it is undeniable that public expectation for the level of service, including protection from hazards, is rising. What were once culturally acceptable levels of risk are shifting as quickly as the hazards themselves.

Table 4 HRVA Risk Prioritization Ranking

Score	Risk Ranking	
1-5	High	The score used to rank risk is derived from multiplying the overall impact score and the probability score, and then considering if and how the score should shift into another risk category based on public risk tolerance.
6-10	Medium	
12-25	Low	

The Committee completed a HRVA for six of eight natural hazards analyzed for the MCCAP, including:

1. Coastal flooding
2. Winter storm / ice event
3. Tropical storm / hurricane
4. Wildland fire
5. Inland flooding
6. Drought

The two natural hazards that were not analyzed with the HRVA tool are **extreme heat events** and **coastal erosion**. It was felt by members of the Committee that the probability of these natural hazards activating an emergency response was too low to warrant the HRVA process. However, they *are* climate concerns that warrant municipal attention, so are included in the MCCAP analysis.

7. Extreme heat event
8. Coastal erosion

The eight chosen hazards were based on a review of recent and locally relevant climate trends and projections, climate impact research, and local knowledge and experience. The body of knowledge drawn from included the Atlantic Climate Adaptation Solutions (ACAS) program; the Bedford Institute of Oceanography; the Nova Scotia Department of Natural Resources; Nova Scotia Department of Environment, Climate Change Unit; and the National Atmospheric and Oceanic Administration of the United States Department of Commerce.

Prior to assessing potential impacts from each of the natural hazards, the Committee discussed and listed MoDYs essential infrastructure and socially valued assets (i.e., facilities, special places, community services). This list was then used *during* impact assessment for helping to determine potential loss due to weather events (Table 5).

Table 5 MoDY's Essectial Infrastructure and Assets

Essential Infrastructure	Sewer system (2 flooding pump stations and Port Maitland plant) Municipal building Lake George Watershed area Road systems (3 municipal and all others private or NSTIR) Industrial Park (not critical) Hospital (shared with Town) Fire Halls and EHS RCMP (2 stations both in Town of Yarmouth)
Socially Valued Community Assets	Cape Forchu Wharfs (throughout district) Schools (Arcadia, Port Maitland, Carleton)

Traditionally, HRVAs would primarily be based on historical data, but within the MCCAP process the Committee had the context to complete the HRVAs with climate trends and projections mind. This added element to the HRVA process not only made HRVAs relevant to MCCAP development, but also *improved* the content of the HRVAs themselves, which would now be available to REMO for their standard risk analysis exercises (i.e., which are to be completed in autumn of 2013), and an updating of the Comprehensive Emergency Management Plan starting in autumn of 2013. The general format of the HRVA work sessions was:

1. Review the links between climate trends and projections and the natural hazards being assessed.
2. Review basic impacts of each threat with consideration for climate change projections.
3. Review critical infrastructure and vulnerabilities for each threat.
4. Complete information gaps for each HRVA required for overall analysis.
5. Assign overall ranking of threat by group consensus.

Results of the HRVA risk ranking process are presented in Table 6. These results merely provide a relative comparison for emergency management professionals to use as a guide for prioritizing efforts in preparedness planning. The facilitated discussions had within the assessment and ranking process provided the fodder needed to complete the MCCAP, including issues that are not necessarily REMO related.

Table 6 HRVA Results of Six Natural Hazards

Hazard	Probability Score	Impact Score	Risk Tolerance	Overall Prioritization Score
Tropical Storm/Hurricane	1	3	High	3-High
Winter Storm/Blizzard	2	3	Medium	6-Medium
Coastal Flooding	4	2	High	8-Medium
Wildland Fire	3	3	High	9-Medium
Inland Flooding	3	4	High	12-Low
Drought	5	4	High	20-Low

Completion of the HRVAs provided a strong foundation from which to build the MCCAP. The task of the Committee was to add to the HRVA analysis consideration of climate change impacts that would not activate REMO. The municipality's interests include not only public safety, but also operations and services (e.g., wastewater systems, recreation, administration), community sustainability (e.g., financial, environmental) and good governance. Impacts to this broader spectrum of considerations was captured in discussions and transferred into hazard impact matrices, along with HRVA content.

3.2 Completion of Hazard Impact Matrices

Once the HRVAs were completed, the information was transferred into hazard impact matrices. At this point, all eight of the identified climate change hazards could be included and summarized consistently.

The hazard impact matrices organize and present the following information:

- hazard-related impacts
- locations of concern when impacts can be spatially defined
- rankings for impact severity (consequence)
- rankings for frequency (probability)
- rankings for level of public risk tolerance, and
- an overall risk rating

Hazard impact matrices are often used to compare and rank the risk posed by different hazards. However, MoDY's hazard impact matrices listed and ranked *impacts* because it is useful to consider what environmental changes (positive or negative) the hazards may induce at the operational level.

Environmental changes *are* impacts to which the municipality has to respond. Climate impacts will likely range from extremely to not at all concerning. There may even be welcomed changes. Evaluating impacts in terms of their potential consequences, probability and degree to which the community would tolerate such change (i.e., disturbance), sets the stage for identification of actions that are specific enough that municipal staff and Council can easily grasp what needs to be done, why and by whom. Thus the actions are more likely achieved.

4. Hazard Impact Analyses

4.1 Coastal Flooding

Storm surge, sea level and tide level are three factors that culminate to create conditions for flooding. Flooding from storm surge may be combined with river flooding, thus increasing the flood severity. It is important to note that coastal flooding is different from river flooding, which is generally caused by severe precipitation. (Storm Surge and Coastal Inundation)

A storm surge is the difference between the observed water level and the predicted astronomical tide. The surge can be created by meteorological conditions including low atmospheric pressure, strong winds or swells that can be caused by tropical cyclones (such as hurricanes), by mid-latitude extratropical storms (such as Nor'easters), or by any severe weather conditions. (Storm Surge and Coastal Inundation)

At this time, there is inconclusive evidence that Nova Scotia will experience an increase in the frequency of weather that drives up water levels. Despite high levels of uncertainty about storm tracks and frequency, there is strong evidence that the intensity of storms is increasing and will continue to do so. This trend is evident through shifts in storm return periods.

Storm return periods are the average time between occurrences of an event exceeding a given level / magnitude. For example, a 100-year return period storm is defined by storm characteristics that have a 1% chance of occurring in any given year, or a 1% annual exceedance probability (Table 7). The advantage of using the language of annual exceedance probabilities instead of return periods is that people may erroneously assume that an event called a 100-year storm will happen once every 100 years.

Table 7 Storm Return Periods Expressed as Annual Exceedance Probabilities

10 year return period = 10% annual exceedance probability
25 year return period = 4% annual exceedance probability
50 year return period = 2% annual exceedance probability
100 year return period = 1% annual exceedance probability

The observed climate trend is that the amount of time between storms of a given magnitude has decreased. Said another way, the annual exceedance probabilities are increasing. For example, the meteorological conditions that used to be associated with a storm with a 1% annual exceedance probability based on statistics from the 20th century may have a 4% annual exceedance probability by the 2040s. This means that in the next 30 years or so, our ‘100-year storms’ will be our ‘25-year storms’.

Even if storms (both hurricanes and nor'easters) do not grow in severity, **coastal flooding will become more frequent as sea level rises**. Thus, a smaller surge would lead to coastal flood levels equivalent to that produced by a major storm today. Sea level rise is usually expressed as the average increase in the global mean sea level. Recent research from the Bedford Institute of Oceanography (BIO) suggests that, “mean sea level rise in most of the Atlantic Basin is projected to be higher than global estimates” (Yin et al. 2012, Xu and Perrie, 2011). This is in large part due to glacial isostatic adjustment (geological process that cause land uplift or subsidence) and changes in dynamic sea level (changes stemming from ocean circulation patterns). Indeed, observations confirm this, showing a doubling of global mean sea level rise in certain Atlantic Canada study sites (Forbes et al. 2009). Given these considerations, the potential relative sea level rise in the southern part of the Atlantic basin on the 50-year time scale is 0.4-0.7m, and could be as high as 0.9 meters in some seasons and at some locations (personal communication, BIO Research Scientist, November 2012). On the 100-year time scale, relative sea level rise in the Atlantic Basin is projected to range from 0.9-1.6m (personal communication, BIO Research Scientist, November 2012).

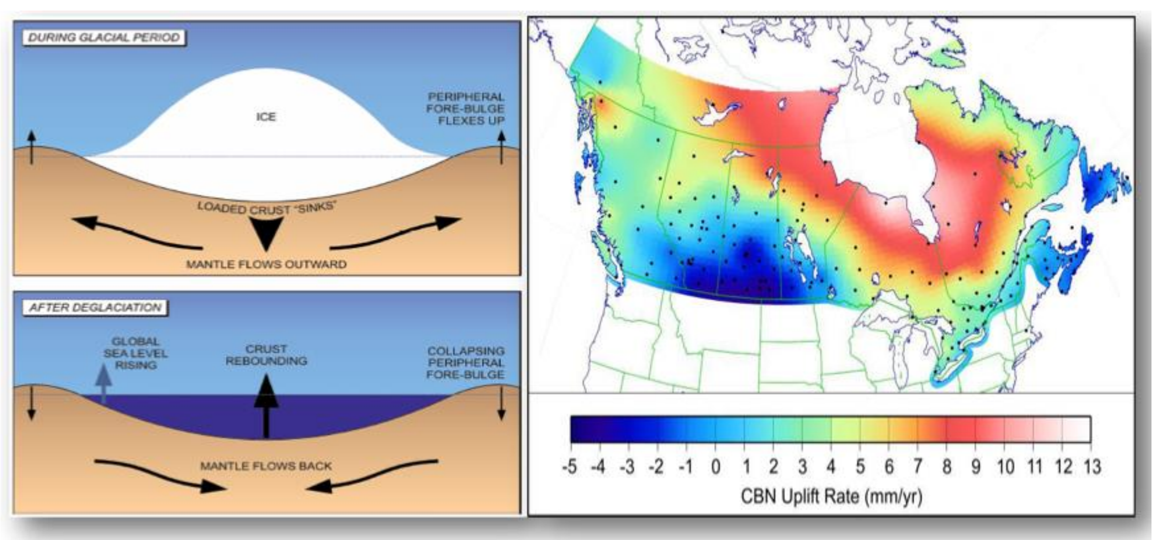

Figure 1 Glacial Isostatic Adjustment

The geological adjustment (change) that is occurring in MoDY is one of subsidence/sinking. This is a result of the post-glacial vertical motion of the earth’s crust. There is a rebound (maximum in the Hudson Bay area) and a corresponding subsidence (sinking) along coastlines in response to a depression of the earth's crust caused by the immense weight of continental ice sheets during the last Ice Age (Figure 1). The Richards and Daigle report (2012) provided localized sea level rise projections that combined sea level rise and glacial isostatic adjustment in the 'Total Sea Level Rise' projection.

Richards and Daigle also reported an Extreme Total Sea Level that combines Total Sea Level Rise, high tide, and storm surge levels generated during benchmark storms for four different annual exceedance probabilities (Table 8). For its coastal flooding analysis, MoDY's Climate Change Committee choose to focus on Extreme Total Sea Level projections for a 1% annual exceedance probability by the end of the century (Table 8).

Table 8 Richards and Daigle (2012) Water Level Scenarios: CHS Site Yarmouth

	2000	2025	2055	2085	2100
Total Sea Level Rise (m)		0.15 ± 0.03	0.43 ± 0.15	0.83 ± 0.36	1.06 ± 0.48
Extreme TSL - 10 Yr Ret Period	5.84 ± 0.10	5.99 ± 0.13	6.27 ± 0.25	6.67 ± 0.46	6.90 ± 0.58
Extreme TSL - 25 Yr Ret Period	5.91 ± 0.10	6.06 ± 0.13	6.34 ± 0.25	6.74 ± 0.46	6.97 ± 0.58
Extreme TSL - 50 Yr Ret Period	5.96 ± 0.10	6.12 ± 0.13	6.40 ± 0.25	6.80 ± 0.46	7.03 ± 0.58
Extreme TSL - 100 Yr Ret Period	6.02 ± 0.10	6.18 ± 0.13	6.46 ± 0.25	6.86 ± 0.46	7.09 ± 0.58

The water level scenarios presented by Williams and Daigle are referenced to Chart Datum: the plane of reference used for nautical charts. In Chart Datum, the lowest normal tide is the 'zero point'. In non-tidal waters, a low water level is adopted as datum. Because the zero point reference for Chart Datum is not the same as the zero point reference for terrain maps, the Climate Change Committee had to convert Chart Datum to Canadian Geodetic Vertical Datum (CDVD28). This conversion required subtracting an offset to account for the difference between these two mapping systems because Chart Datum is lower than CDVD28. The offset for MoDY is 2.31. After accounting for this difference, the elevation used to delineate the area of increasing coastal flood risk in MoDY was 4.78m.

A phenomenon that the Richards and Daigle estimates did *not* incorporate into water level scenarios was the shortening of the resonant period of the Bay of Fundy—Gulf of Maine system due to rising sea levels. As a result, the amplitude of the M2 tide (primary lunar tide of the day) is increasing (Greenburg et al., 2012). The effect that this would have on water levels in MoDY is that the high tide could be between .71 and 1.27m higher by 2100 (Table 9). Therefore, MoDY's Climate Change Committee added the middle estimate —1.01m—to the Extreme Total Sea Level Projection of 4.78m for a new water level scenario of 5.79m for a 1% annual exceedance probability by the end of the century.

The Richards and Daigle report as well as the Atlantic Storm Prediction Centre under Environmental Canada's Meteorological Services Centre based in Dartmouth, Nova Scotia, is quick to remind EMO personnel that water level scenarios do not account for wave action. Wave run up can cause significant damage. Therefore, if winds are shore facing, EMO personnel are advised to add 10% to storm surge estimates. Being an EMO led MCCAP, as well as a municipality that still remembers the Saxby Gale and sees the wisdom of employing the precautionary principle, a factor of 10% was added to the 5.79m water level scenario, resulting in a new factor of 6.36m. For purposes of mapping practicality and capabilities, this Committee rounded up to 6.5m as the new 'line' to delineate coastal land increasingly vulnerable to coastal flooding impacts.

Table 9 Dr. Greenburg et al. (2012)

TABLE 5. The predicted increase in tidal high water in metres at selected locations for the years 2055, 2085 and 2100. The values reflect tectonic influence, ice melt, steric effects and changing M_2 tides. Maximum and minimum values are obtained from tidal runs using our estimated existing sea level trend and the extreme values of the ice and steric inputs.

	2055			2085			2100		
Time	min	mid	max	min	mid	max	min	mid	max
Boston	0.35	0.51	0.69	0.57	0.75	1.05	0.68	0.98	1.23
Portland	0.29	0.46	0.63	0.48	0.66	0.96	0.57	0.87	1.13
Saint John	0.33	0.50	0.68	0.54	0.73	1.04	0.64	0.95	1.21
Cobequid Bay	0.41	0.60	0.79	0.66	0.87	1.20	0.79	1.12	1.40
Yarmouth	0.37	0.54	0.71	0.60	0.78	1.08	0.71	1.01	1.27
Halifax	0.36	0.58	0.69	0.57	0.76	1.04	0.68	0.97	1.22

Table 10 shows "predicted increase in tidal high water in metres at selected locations for the years 2055, 2085 and 2100. The values reflect tectonic influence, ice melt, steric effects and changing M_2 tides. Maximum and minimum values are obtained from tidal runs using estimated existing sea level trend and the extreme values of the ice and steric inputs (Greenburg et al., 2012)"

4.1.2 Coastal Flooding Rationale

Mapping for MoDY and historical data from coastal flooding events, indicates warning of a Total Water Volume (predicted surge plus existing high tide level) of over 1m may trigger infrastructure and public safety concerns. Therefore, the need to account for coastal flooding impacts in municipal and emergency planning is indisputable.

4.1.3 Coastal Flooding Mapping

GIS Technician, Alix d'Entremont, prepared ten coastal flood maps for MoDY. The first is a 1:47,500 scale map of the municipality in its entirety. The other nine maps are 1:15,000 scale maps are 'zoomed in' versions that, collectively, illustrate the entire coastline of the municipality. The nine maps, which can be found in Appendix B are:

1. Pembroke
2. Overton
3. Cape Forchu
4. Sand Beach
5. Arcadia
6. Melbourne 1
7. Melbourne 2
8. Pinkney's Point
9. Sandford

4.1.4 Coastal Flooding Matrix

	Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
			Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
1	Risks to Public Safety & Property	Cape Frochu (surge watchers swept away)		X						X					X	High
2	Isolated Residents	Pinkney's Point; Cape Frochu; Pembroke		X						X				X		High
3	Damage to Infrastructure	Cape Frochu buildings; Arcadia Pumping Station; Port Maitland		X						X			X			High
4	Road/bridge Erosion	Pinkney's Point; Cape Frochu; Pembroke		X						X			X			High
5	Utility Disruption	1000 residents impacted		X						X				X		Moderate
6	Economic impacts (farmland; business disruption)	8000 residents affected; Fishing Industry		X						X				X		High

4.2 Winter Storm

Temperatures are increasing in every season, but the greatest increase in temperature will be experienced in winter. In other words, the greatest amount of *change* from present day to end of the century is expected in the winter season. Winters are also expected to be wetter (Table 10). One of the anticipated results of these shifts in seasonal conditions is an increased number of ice events. The effects of ice on municipal infrastructure, operations or services are anticipated to be modest. Perhaps the biggest risk involves consequences of power interruption. From the EMO and public safety perspective, increased ice events pose serious risk on the roadways and in cases of power failure.

Table 10 Richards and Daigle (2012) Air Temperature and Precipitation Projections: Yarmouth Climate Station

Parameter	1980s	2020s		2050s		2080s	
	Value	Value	SD	Value	SD	Value	SD
Temperature-annual	6.9	8.1	0.4	9.3	0.6	10.6	1.0
Winter	-2.1	-0.8	0.6	0.7	0.8	2.1	1.1
Spring	5.0	6.0	0.4	7.1	0.7	8.3	1.1
Summer	15.7	16.7	0.4	17.9	0.7	19.1	1.0
Autumn	9.3	10.4	0.4	11.5	0.6	12.8	0.9
Value shows the change in degrees in annual average temperature							
Parameter	1980s	2020s		2050s		2080s	
	Value	Value	SD	Value	SD	Value	SD
Precipitation-annual	1275.1	1310.1	31.3	1320.9	36.3	1360.1	47.4
Winter	370.5	388.5	14.7	397.8	19.0	419.5	24.3
Spring	310.9	321.2	13.2	325.8	17.6	338.6	23.2
Summer	255.9	260.2	15.2	259.4	20.1	259.7	33.3
Autumn	337.8	341.9	15.4	341.5	16.2	349.1	25.1
Value shows ?????							

4.2.1 Winter Storm Rationale

Climate prediction trends for the Yarmouth area indicate future warming may decrease the amount of local snowfall while increasing rain-snow mixed events. The trend of warmer wetter winters may lead to fewer heavy snowfalls over time, and/or more ice events.

For purposes of assessment, MoDY used Environment Canada's Blizzard definition:

> a severe weather condition characterized by reduced visibility from falling and/or blowing snow and strong winds

that may be accompanied by low temperatures."Blizzard warnings issued by Environment Canada's Meteorological Service (MSC) are considered to be for hazardous weather conditions characterized by high winds, and a widespread reduction in visibility due to falling and/or blowing snow.Blizzard conditions may persist for a period of time on their own, or be part of an intense winter storm in which case a blizzard warning is issued instead of a winter storm or snowfall warning. Blizzard conditions may be accompanied by a severe wind chill making it even more dangerous.

The Municipality of Yarmouth has a long history of winter storms and blizzard conditions that cause power outages for varying lengths of time. Historically, storms that produced heavy wet snow or freezing rain had greater impacts to the area due to more extensive and prolonged (greater than eight hours) power outages. Analysis revealed that although MoDY does not own or maintain utility supplies, the Municipality may experience infrastructure and public safety impacts requiring response for storm events that create power outages extending, or with potential to extend, beyond 48 hours. Similarly, although MoDY only owns 3 km of roads (in Subdivisons), dangerous conditions on existing roadways will have local socioeconomic consequences, ranging from disruptions in the local economy to municipal costs incurred if the EOC is activated.

4.2.2 Winter Storm Matrix

Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
		Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
Public Saftey	Non-specific; may require road clearing for access			X				X				X			Moderate
Prolonged Isolation	Pinkneys Point; Cape Frochu			X				X				X			Moderate
Property Damage	Non-specific				X				X			X			Moderate
Transportation Disruption	Non-specific			X				X				X			Moderate
Supply Shortages	Unknown; Fuel may be problem after 72 hours;		X					X				X			Moderate

4.3 Tropical Storm / Hurricane

When disorganized clusters of showers and thunderstorms become organized so that a definite rotation develops and winds become strong, the weather system is called a tropical depression. If winds continue to increase to 63 kilometers per hour, the system becomes a tropical storm and is given a name. The system becomes more organized and the circulation around the centre of the storm intensifies. As surface pressure drops and wind speed reaches 118 kilometers per hour the storm becomes a hurricane. An eye develops near the center of the storm with spiral rain bands rotating around it. Once a tropical cyclone reaches hurricane strength it is given a rating from 1 to 5 on the Saffir-Simpson Hurricane Intensity Scale. A category 1 storm has the lowest speeds; category 5 has the highest. An Environment Canada Warning of category 1 or above entering Canadian waters with potential to make landfall within Atlantic Canada will trigger Municipal planning/response.

Scientists caution that the Canadian Regional Climate Model, and possibly other global climate models, "underestimate the track density over the northwest Atlantic area (Guo et al. 2012). Current climate data does not indicate more frequent hurricanes. Intensity, however, is increasing. This is in part due to seawater having a higher 'reach' as sea level rises and surge comes ashore. While the impacts of flooding are captured in the coastal flood analysis (section 4.1), impacts from high winds are not. Therefore, the tropical storm/hurricane hazard impact matrix focuses on non-flood related sources of damage or harm.

4.3.1 Tropical Storm / Hurricane Rationale

Historically, the Municipality of Yarmouth has experienced both near misses and impacts from category 1 and 2 Hurricanes. The Municipality monitors Environment Canada warnings. A warning, issued by Environment Canada or the Nova Scotia Emergency Management Organization for a category 1 or above Hurricane entering Canadian water with potential to make landfall within the Atlantic region, will trigger municipal planning and preparedness.

4.3.2 Tropical Storm / Hurricane Hazard Impact Matrix

Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
		Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
Risk to Public Safety	Non-specific				X		X					X			Low
Displacement	Estimated 300 residents (Cape Frochu; Pembroke; Pinkney's Points)			X			X								Moderate
Transportation Disruption	Pinkneys Point			X			X					X			Moderate
Municipal infrastructure Damage: wharfs, pumping stations	6 wharfs; Arcadia pumping station			X			x						X		Moderate
Utility/Power Disruption	Non-specific				X		X					X			Moderate
Property Damage	Private Homes; Recreation Facilities		X				X						X		Moderate
Telecommunicaton Disruption	Non-specific			x			x						x		Moderate
Food & Fuel Shortages	Non-specific														Unknown Impacts
Economic Impacts	Fishing industry		X				X							X	Moderate

4.4 Wildland Fire

Climate trends that increase wildfire risk vulnerability are increased air temperatures (as shown in Table 10) and incidents of drought (Table 11). Simply put, extended periods of warm and dry weather, as well the climate-influenced changes in forest species composition, may result in periods of elevated fire risk. As pointed out in a study about wildfire under climate change by the Dalhousie University School for Resource and Environmental Studies (2013), “Fire prone coniferous species are projected to decline, replaced by pioneer deciduous species. As conifers are a significant factor in fire risk in mixed wood forests, the removal of these species will act as a negative driver of future fire risk. The maladapted species and dead conifer stands will, however, increase woody debris and ladder fuels on the landscape in the short term, acting as a temporary positive driver of risk.” The same study also mentions that changing climate conditions are increasing the severity and duration of insect outbreaks. These outbreaks can exacerbate fire risk by increasing the amount of dead or dying woody debris in a forest system.

4.4.1 Wildland Fire Rationale

Climate Change trends of increased temperatures (warmer shoulder seasons, hotter summers), less snowfall, greater variance in rainfall (drought alternating with intense short period rainfalls) and increased hurricane intensity are all factors that may exacerbate the risk of wildfire.

From April 1 to October 15 each year, the Department of Natural Resources (DNR) positions fire suppression teams on stand-by. Wildland fire events occurring outside this stand-by period may cause greater damage than inside the stand-by period because of weakened response capabilities. Although Wildland suppression is a provincial responsibility, an evacuation of homes will require municipal involvement and resources. Fires that require shutdowns of major transportation routes will also require municipal efforts.

REMO’s Comprehensive Emergency Management Plan stated that, “An ever increasing number of residential areas are being developed where they are surrounded by forest. Hence the potential exists for a forest fire to threaten an area of human habitat. The majority of dwellings are of wood construction and fire constitutes a major hazard, particularly in areas of relatively high density. Forest fires present a very real hazard.”

4.4.2 Wildland Fire Impact Matrix

Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
		Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
Risks to public safety	Non-specific				X				X			X			Low
Displacement of Residents due to Property Damage/threat	Non-specific; Hebron Industrial Park 400+ people		X						X			X			Moderate
Infrastructure damage	Non-specific		X						X			X			High
Utility & Power Disruption	Non-Specific			X					X			X			Moderate
Air Pollution	As per Infrastructure			X					X			X			Moderate
Increase in wind throw to tree stand and elevated fire risk	Non-specific			X					X				X		Moderate

4.5 Inland Flooding

A flood is defined as an overflow or inundation that comes from a river or other body of water and causes or threatens personal harm or damage. This may occur as a result of weather phenomena and events that deliver more precipitation to a drainage basin than can be readily absorbed or stored within the basin over time, or as a flash flood, the result of heavy amounts of rainfall within a short period of time.

Inland flash flooding is far and away the greatest threat to people's safety during heavy rainfall from tropical storms, hurricanes, or short intensity rainfall events. There is also a risk of flash flooding if the Lake Vaughan/Carleton dam, a hydroelectric structure, is compromised.

Two of the climate trends that are of interest when assessing inland flood risk are: changes in precipitation magnitude and frequency, and changes in intensity short period rainfalls. Also of interest is water surplus. Water surplus is the excess remaining after the evaporation needs of the soil have been met and soil storage has been returned to the water holding capacity level. Surplus may be considered runoff.

Table 11 Richards and Daigle (2012) Water Surplus, Deficit, and Short Period Rainfall Projections: Yarmouth Climate Station

	1980s	2020s	2050s	2080s
Water Surplus (mm)	846.9	770.9	739.0	718.6
Water Deficit (mm)	36.3	40.0	47.8	56.0
Intensity Short Period Rainfall (%)	0	5	9	16

A pattern that has emerged from recent research is that the amount of precipitation on an annual basis shows little change. However, it is expected that when rain events happen they will be more intense; more rain will fall in a short period of time. Trends also show a change in seasonal patterns. Annual rainfall is concentrating in the winter season. In other words, MoDY should expect wetter winters and slightly wetter early springs. Summer and autumn mark a precipitation increase that is less than the standard deviation, so changes in these seasons can be considered negligible at this point.

Richards and Daigle (2012) explained that "information on the impact of climate change on intensity short period rainfall rates is inconclusive at this point in time as there is no standard or accepted research methodology to determine how future sub-daily extreme rainfall could change in intensity and frequency at point locations or over a small area in the future climate. In spite of these caveats, enough evidence, based on theory and studies of trends, has been assembled to make recommendations" on how short period rainfalls will increase by a certain magnitude. The change in the intensity of short period rainfall is expressed as a percentage in the Richards and Daigle report. Specifically, the intense rainfall (expressed as millimeters of rain received within 24 hours) that we now expect from an event with a 20-year return period will increase. The amount of water that will fall in a ‘20 year return period’ rainfall (i.e., an event that has a 5% chance of happening any given year) will be:

- 5% more rain fall by the 2020s
- 9% more rain will fall by 2050s
- 16% more rain fall by the 2080s.

4.5.1 Inland Flooding Rationale

An increase in intensity of short period (≤ 24 hours) rainfall could easily endanger public safety and over-extend the capacity of water-handling infrastructure. Intensity-duration-frequency (IDF) curves used by hydrotechnical engineers to model rainfalls events that determine the size and quantity of water handling infrastructure (and bridge heights) are traditionally summarized from historical events. However, the assumption that past rainfall is a good indication of what to expect in the future is no longer valid. It is up to MoDY to specify that infrastructure be planned and designed for future climate conditions.

MoDY has experienced significant rainfall events that have damaged road and bridge infrastructure, required evacuation, and isolated a small number of residents. The most notable event in recent history was in 2010 when the area experienced over 20 cm of heavy rainfall over four days. In the neighbouring municipality of the District of Argyle, the Tusket Bridge on Trunk 3 in Tusket collapsed. Another bridge collapsed in Quinan, where roads were flooded and 50 families (voluntarily) evacuated. Simultaneously, emergency management officials were cautiously monitoring the Nova Scotia Power dams on the Tusket River and Lake Vaughan.

While infrastructure damage remains a concern for future events, roads, bridges, and dam structures are not owned or controlled by the Municipality. As well, there is a dam on Lake Vaughn that, if compromised, would endanger 25 homes. Regardless of lack of direct jurisdiction over infrastructure at play during an emergency event, REMO will prepare and respond to public safety issues every time Environment Canada predicts heavy rainfall.

“Many swamps and a multitude of small streams and brooks keep Yarmouth County relativity flood free under normal conditions.” (Comprehensive Emergency Management Plan) The flooding that *has* occurred has been from extreme rainfall events on a landscape where the water table is relatively near the ground’s surface, creating large areas of poor drainage. Poor drainage, in combination with the fact that ‘normal conditions’ are no longer relevant, means that despite a richness of wetlands, MoDY can still experience freshwater floods.

Indeed, freshwater bodies cover 20% of the municipality. Therefore, the eighth objective under the goal for Environmental Health in the Municipal Planning Strategy is, “To discourage development in environmentally sensitive areas, particularly areas subject to periodic flooding and erosion.”

As described in the Municipal Planning Strategy, “Areas in the Municipality immediately south of the Town of Yarmouth in the Broad Brook watershed are prone to flooding, and the Town of Yarmouth has incorporated policies and provisions in their planning documents prohibiting development in a designated Broad Brook Floodplain (FP) zone. The lower Broad Brook floodplain from the Town boundary to the outfall at Kelleys Cove has been identified as a flood risk area in the Municipality. Council developed policy to designate a Broad Brook Floodplain zone in the Municipal Planning Strategy and included corresponding Land Use By-law provisions to restrict development within the designated zone.”

4.5.2 Inland Flood Mapping

The District’s inland flooding map (Appendix C) was created using Provincial wet areas mapping (WAM), a product of research work carried out by the Forest Watershed Research Centre at the University of New Brunswick.

The Depth to Water Table categories as seen on the map are indications of drainage: the 0-0.10 m class is generally associated with poor drainage, the 0.11-0.50 m class with imperfect drainage. These areas can be used to infer where water will naturally flow and/or accumulate in the landscape. The information is also useful for showing probable connections between wet areas (i.e. by sub-surface flows, unmapped channels, and/or wetlands) (Kevin Keys, personal communication, July 29, 2013). Ideally, these interpretations would become more locally accurate by integrating information on soils.

Where imperfectly and poorly drained WAM units are related to rivers and shorelines—which is what has been mapped for MoDY—then potential flood areas may be inferred with caution. Nonetheless, the inland flooding map does detail where more detailed flood risk mapping is warranted.

GIS Technician, Alix d’Entremont, prepared eleven inland flood maps, each 1:10,000 in scale. These maps are ‘zoomed in’ versions that, collectively, illustrate municipal areas with poor drainage as a factor increasing inland flood risk. The inland flood maps that can be found in Appendix C are:

1. South Ohio
2. Tinkham Road
3. Chegoggin
4. Tusket Falls
5. Arcadia
6. Broad Brook
7. Pinkney’s Point
8. Golden Forest
9. Gardners Mills
10. Lake Vaughan
11. Saunders Road

4.5.3 Inland Flooding Impact Matrix

Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
		Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
Risk to Public Safety	Non-specific				X				X				X		Low
Displacement of Residents due to Property Damage					X				X			X			Low
Isolation	Golden Forest				X				X			X			Low
Property Damage	Minimal, depending on drainage structure					X			X			X			Low
Transportation Disruption	Non-specific could be high provincial (TIR) cost Bridges & roads		X						X			X			Moderate
Community Lifeline Damage	Bridge & road damage could be an issue if combined with Coasal Surge				X				X			X			Moderate
Drinking Water contamination	Homeowners on wells might need to test				X				X			X			Low
Dam Breach	Lake Vaughan; Carleton	X									X		X		Low
Environmental Contamination	Arcadia				X		X					X			Moderate

4.6 Drought

Environment Canada defines drought as a "complex phenomena with no standard definition. Simply stated, drought is a prolonged period of abnormally dry weather that depletes water resources for human and environmental needs." (Threats to Water Availability in Canada)

A climate indicator of drought is water deficit: the amount by which the available moisture fails to meet demands for water. Water deficit is also understood as "water that could evaporate if it were available to do so" (Richards and Daigle, 2012). The severity of this hydrologic imbalance depends upon the degree of moisture deficiency, the duration and the size of the affected area.

Drought can be defined/experienced in four different ways:

- "Meteorological-a measure of departure of precipitation from normal. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.
- Agricultural-refers to a situation where the amount of moisture in the soil no longer meets the needs of a particular crop.
- Hydrological-occurs when surface and subsurface water supplies are below normal.
- Socioeconomic-refers to the situation that occurs when physical water shortages begin to affect people."

4.6.1 Drought Rationale

The Municipality of the District of Yarmouth has no recorded history or experience with drought situations. However, the water deficit, a drought indicator, *is* projected to increase (Table 12).

Table 12 Richards and Daigle (2012) Climate Projections Affecting Drought: Yarmouth Climate Station

	1980s	2020s	2050s	2080s
Water Surplus (mm)	846.9	770.9	739.0	718.6
Water Deficit (mm)	36.3	40.0	47.8	56.0
Days with Rain	129.3	141.0	145.4	149.2
Days with Snow	50.3	50.3	41.8	34.3
Hot Days (Tmax > 30°C)	0.0	0.1	0.2	0.9

MoDY is not responsible for public drinking water. Three hundred and thirty-five homes receive water from the Yarmouth Water Utility that draws from Lake George. The Lake George reservoir is capable of supplying water through 1:100 year drought. For those homes that are serviced, there are not quantity issues, just pressure issues (i.e., too many users on the system and the water has to travel far to MoDY). But this issue is not impacted by climate change.

The majority of residents (98%) have individual well systems. In the past, local Fire Departments drawing on water from Town of Yarmouth, refilled dry wells. The only drought impact trigger that would necessitate a Municipality of Yarmouth response would be a lack of Water for Fire Suppression capacity. For these reasons, the hazard of drought and its potential impacts is considered to be an overall low risk to the municipality.

4.6.2 Drought Hazard Impact Matrix

Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
		Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
Decreased water supply/watershed	300 homes on Town of Yarmouth supply; not municipal concerns					X					X	X			Low
Decreased water supply and/or quality in wells	98% of population on wells; can be filled by Fire Departments					X			X			X			Low
Increased Wildland Fires / constrained ability to supress them	non-specific; Wildland HRVA		X								X	X			Moderate

4.7 Extreme Heat Events

Heat events or “heat waves” occur when weather conditions combine to create higher than normal temperature and/or humidity levels over a period of several days. Hot days are defined as 30 degrees Celsius and above.

4.7.1 Extreme Heat Event Rationale

Health Canada and Nova Scotia Health and Wellness summarized the affects of extreme heat events on the three most vulnerable segments of the population: Older adults, physically active people and children. A webinar prepared for EMO and health professionals pointed out that:

- “many patients and health care workers are unable to assess the risk of heat related illness.
- Limited awareness and knowledge of effective prevention and treatment measures.
- Heat illnesses are probably under recognized and under reported.” (Simpson)

While the health and wellness of MoDY residents is of great concern, there is limited municipal jurisdiction to address health related issues other than collaborate with provincial bodies issuing and responding to heat warnings. This would most likely be done through REMO. REMO can also address extreme heat by planning for accessible cooling shelters in partnership with area service organizations.

The most direct link between municipal operations and services and extreme heat relates to an increase in utility bills. Given the nature of increasing power bills, this *is* a legitimate municipal concern. However, operational changes and building management decisions can help to stabilize electricity bills even in periods of extended extreme heat. These types of decisions and changes do not have to be reactive, but can be anticipatory. In fact, responding to an increased cooling load should be part of an overall energy management strategy aimed to shave electricity and fuel costs while simultaneously reducing greenhouse gas emissions.

4.7.2 Extreme Heat Hazard Impact Matrix

Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
		Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
Power: Municipal Cooling Demand	Non-specific			X				X				X			Low
Water Production: If capacity impacted, potential water restrictions	Water treatment facility				X			X					X		Moderate
Public safety: Older Adults and Young Children	Non-specific			X				X				X			Moderate

4.8 Coastal Erosion

Coastal erosion is the process whereby geological materials comprising the coast are loosened, dissolved, or worn away and simultaneously moved from one place to another. Forces at play include long-term erosion, erosion from storms, and erosion from changing water levels and associated wave action.

4.8.1 Coastal Erosion Rationale

The shoreline of MoDY can be divided into two distinct areas based on the coasts physical response to long term sea level rise and land subsidence.

The area along the west side of Yarmouth Harbour, the area east of Overton, the area north of Chebogue Point and the lower reaches of Chebogue River, and the Little River and Little River Harbour areas are slowly submerging and exhibit little or no erosion. In these areas, extensive salt marsh (Class N2) front the coast. During large storms with or without large storm surges these areas will be submerged. As the areas are sheltered, wave action and thus erosion is limited. Risk to infrastructure is predominantly from coastal flooding. However, this is only the case during extreme, low probability events where infrastructure is located less than 2–3m above the high, high water (tide) mark.

The rest of MoDY has a coastline characterized by non-erodeable bedrock (on multi-generation and/or human life spans) or coast composed of low or absent bedrock outcropping within the intertidal zone or supra-tidal zone. The areas where unconsolidated sediment is found, e.g. till, beach sand or cobble bars, respond to rising sea level and subsidence by eroding at various rates.

Cobble-sand beaches and cobble bars are relatively stable features even along transgressive shorelines where there is an adequate supply of sediment from other eroding landforms, e.g. a drumlin headland. At Pembroke Cove there is an actively eroding drumlin that supplies sediment to a large cobble beach that separates a lake from the ocean. This drumlin, however, will completely erode in the future. This may impact the stability of the cobble beach (defined as Class H1) though other sources of sediment may be sufficient to maintain the stability of the cobble beach. A similar situation exists on Crawleys Island where eroding drumlins (e.g. Garden Head) maintain a spectacular cobble beach (defined as Class H1) between the two drumlin headlands. These drumlins will survive for many decades though this can be influenced by a very large storm event. Ultimately these drumlins will erode at which point the joining cobble beach will disappear. There is no infrastructure at risk in this instance.

Along the west facing shore of the Municipality, north of Yarmouth, segments of actively eroding shoreline are mapped as Class H2. The classification is qualitative. Determination of a specific yearly or average decadal rate of erosion, which may vary from area to area, would require a specifically designed project and establishment of carefully sited long term monitoring stations. However, it is obvious that infrastructure built close to the shore face in these areas is at considerable risk on multi-year to multi-decade time scales. This presents problems from a land use planning and potentially from a permitting perspective.

Areas mapped as Class M1 present issues similar to Class H2, however the areas with higher rates of apparent erosion are interspersed with areas that are more stable. It is not possible to differentiate between these areas at the scale of the present MCCAP mapping.

Areas mapped as Class L1 appear to be stable as evidenced by the presence of steep vegetated slopes without apparent slumping and/or erosion at the base of the slopes. However, this apparent stability may not be accurate. These slopes may in fact respond poorly to a major storm event (e.g. a direct hurricane impact at high tide). In such an instance, the vegetation could be quickly stripped and significant erosion could occur. It is not possible to quantify the probability of this occurring.

4.8.2 Coastal Erosion Mapping

As part of the MCCAP process, Geoscientist, Philip Finck, completed a high level, qualitative assessment of susceptibility to coastal erosion based on existing geological mapping and a visually assessment of the coast. GIS Technician, Alix d'Entremont (Yarmouth-Agyle-Barrington District Planning Commission) converted Mr. Finck’s work into a digital map (Appendix D).

4.8.3 Coastal Erosion Hazard Impact Matrix

Potential Impacts	Susceptible Locations	Severity					Frequency					Level of Risk Tolerance			Overall Risk
		Catastrophic	Significant	Moderate	Minor	Insignificant	Once every 5 yrs or less	Likely once every 10 yrs	Might occur once every 20-30 yrs	Could occur once every 50 yrs	Once every 100 yrs or more	High	Medium	Low	High Moderate Low
Property Damage and displacement	In areas of high erosion susceptibility as mapped					X	Occuring continually					X			Low
Infrastructure Damage / transporation disruption	In areas of high erosion susceptibility as mapped					X	Occuring continually						X		Low
Utility Disruption	In areas of high erosion susceptibility as mapped					X			X				X		Low
Road/bridge Erosion	In areas of high erosion susceptibility as mapped				X		Occuring continually						X		Low

4.9 Information Required to Improve Adaptation Efforts

Inland flooding was assessed during MCCAP development based on Wet Areas Mapping, as described in section 4.5. This technique merely highlights priority areas for further investigation. A great deal of information is needed to better understand MoDY's watershed/surface water systems, particularly to delineate the watersheds beyond the tertiary level. In areas particularly susceptible for inland flooding, the municipality would benefit from having enough information about a site's drainage to justify a requirement for developers to balance not just peak flows (100 year storm events) pre and post development, but also total volume of water pre and post development. The result would be to keep water on the landscape longer in order to mimic natural watershed activity.

There are multiple opportunities for the Province to provide needed information and leadership to mitigate the consequences of natural hazards exacerbated by climate change. Such opportunities include, but are not limited to:

- working with the Insurance Bureau of Canada to develop and disseminate a public service announcement clarifying that home flood insurance does not cover overland flooding, and a homeowner that does not carry home insurance is not eligible for federal disaster financial assistance
- developing a program to better track incidents of seawater intrusion
- working inter-departmentally and with federal departments, such as Department of Fisheries and Oceans, to capitalize on opportunities to gather and/or share LiDAR data at reduced rates

Additional opportunities for provincial leadership were identified in a Bay of Fundy Ecosystem Partnership Report (2013) on its 2012-2013 Climate Change Project. The ideas presented which resonate with the District include:

- develop and distribute directly to municipalities mapping protocol so that municipal mapping done in the context of climate change action planning can be assimilated into a larger provincial database and used seamlessly for subject analysis to inform provincial climate change efforts (i.e., identify data gaps, municipal needs, and areas of priority action to ensure public safety and opportunities for community wealth)
- budgetary support (i.e., staff and operational) for the Nova Scotia Department of Natural Resources for the production of vulnerability and risk assessment products and tools for land use and emergency planning and response
- program support within Service Nova Scotia Municipal Relations and Nova Scotia Environment for the training of newly elected officials on climate change trends and projections, and the role of adaptive capacity and adaptation strategy

5. Facilities and Infrastructure

The three map sets that were produced as part of the MCCAP process that indicate areas of increased risk of geological hazards in the context of climate change are the coastal flooding sets, the inland flooding sets, and the sets showing coastal erosion susceptibility. In all of these maps, attributes of key facilities, essential infrastructure and roadways are included.

The Municipality of Yarmouth is heavily dependent on Town of Yarmouth owned Infrastructure, but has no direct control over its protection. Private infrastructure including homes, wharfs, Fire Departments and business are also of a concern but not a direct responsibility for Municipal government.

Transportation infrastructure is currently susceptible to storm surge flooding, rapid erosion / small land slides from flash flooding, and general erosion in specific, and largely known locations. These situations are only expected to get more concerning over time. Where the municipality has jurisdiction, it is addressing water handling and storage issues that have caused roadway issues historically. It is unknown, however, what Nova Scotia Transportation and Infrastructure Renewal (TIR) is doing about mitigating issues on TIR roadways.

Other climate issues that will affect infrastructure and key facilities (e.g., drought, wildland fire, high winds, ice events, extreme heat) are summarized in Section 4, Hazard Impact Analysis.

5.1 Key facilities and Essential Infrastructure

Key facilities and infrastructure in MoDY include:

- The municipal building in Hebron
- Sewer systems:
  - Port Maitland
  - Arcadia
  - Hebron
- Schools (including those in the Town of Yarmouth):
  - Arcadia Consolidated School (pr to 6); Arcadia
  - Carleton Consolidated School (pr to 6); Carleton
  - Drumlin Heights Consolidated School (pr to 12); Glenwood
  - Maple Grove Education Centre (7 to 8); Hebron
  - Meadowfields Community School (pr to 6); Yarmouth
  - Plymouth School (pr to 8); Plymouth
  - Port Maitland Consolidated Elementary School (pr to 6); Port Maitland
  - South Centennial Elementary School (pr to 6); Yarmouth
  - Yarmouth Adult High School (adults only); Yarmouth
  - Yarmouth Central Elementary School (pr to 6); Yarmouth
  - Yarmouth Consolidated Memorial High School (9 to 12); Yarmouth

- Churches throughout the municipality
- Fishing Industry Assets (including those in the Town of Yarmouth) (any omissions are unintentional):
    - Yarmouth Bar Fisheries; Overton
    - Seakist Lobster Ltd.; Yarmouth
    - Scotia Garden Seafood Inc.; Yarmouth
    - Hervic Enterprises Ltd.; Arcadia
    - Stanley Lobster Company Ltd.; Yarmouth
    - Joel Smith Fisheries Ltd.; Yarmouth
    - Eel Lake Oyster Farm Ltd.; Yarmouth Co.
- Wharves (wharves are in use all year and support numerous fisheries, including the inshore lobster fishery, mid-shore groundfish, scallop and herring fishing, and salmon farming.
- Hebron Recreation Centre
- Port Maitland Sewage Treatment Plant
- Sewage Pump Stations
- Long term care facilities for seniors
- The Yarmouth Regional Hospital; Yarmouth (has a catchment of 70,000)
- Cape Forchu Lighthouse

When assessing how hazard impacts will affect facilities listed above, the following was noted:

- The municipal administration building is not within areas exposed to increased flood risk or erosion. As well, it is fairly removed from the wildland interface, so risk of affects from wildland fire is low. Therefore, the physical structure itself is generally not susceptible to climate impacts.
- Impacts to schools and churches are determined by their exposure to the hazard in question. At present, none of the schools in MoDY are in immediate flood risk.
- The impact from damage to assets of the fishing industry would be economic and quite significant. Storm surge and wave run up poses the greatest physical threat. This threat can be exacerbated by coastal erosion weakening structures in a way that makes them more susceptible to storm damage. Compromised access to coastal infrastructure is also an issue.
- The recreation centre is not in danger of flooding. Generally speaking, the physical structure itself is generally not susceptible to climate impacts. Operations may be affected by power outages caused by ice events or high winds. Conversely, extreme heat events would increase cooling loads.
- Impacts to the Port Maitland Sewage Treatment Plant and sewage pump stations could create backups into homes during intense short period rainfall events. However, the Port Maitland Sewage Treatment

Plant will soon be undergoing some upgrades that may be able to mitigate this concern to some extent.

- Impacts to facilities providing physical and/or mental health care are determined, again, by location and exposure. These facilities are monitored by and in direct contact with REMO when extreme weather is anticipated.
- The Yarmouth Regional Hospital is not within MoDY, but the committee has questioned what kind of water level scenario would need to take place before access to the hospital is compromised. This is a discussion to have with the Town.
- Cape Forchu Lighthouse is built to withstand extreme coastal weather. However, the recently upgraded Leif Erikson Park is naturally exposed to coastal winds and waves and while unlikely, a significant tropical storm or hurricane has the potential to damage Park facilities and trails. As well, *access* to the Lighthouse is vulnerable to coastal flooding.

5.2 Facilities and Infrastructure Vital During Emergencies

The nature of the emergency, of course, dictates which key facilities and infrastructure may be vital. However, it is easy to imagine that certain facilities and infrastructure will be vital in any emergency situation, such as the hospital, the building which houses REMO's Emergency Operations Centre, fire departments and police stations. However, most of these facilities are not located in MoDY. What *is* located in MoDY is:

- The municipal building in Hebron
- Sewer systems:
  - Port Maitland
  - Arcadia
  - Hebron
- Hebron Recreation Centre (alternate EOC site)

MoDY does not have jurisdictional responsibility for most of the facilities and infrastructure that would be vital during an emergency. This is not a concern because REMO, the mutual aid agreements in place, and the common decency and compassion for neighbours that exists in rural Nova Scotia, would activate any and all resources needed during a disaster.

5.3 Canada Nova Scotia Infrastructure Secretariat Preliminary Risk Assessment

The preliminary risk assessment spreadsheet prepared by the Canada-Nova Scotia Infrastructure Secretariat has been completed and can be found in Appendix E.

6. Socioeconomic Impact Analysis

Three general things determine how vulnerable someone is to the impacts of climate change: how exposed one is to the hazard, how sensitive they are, and their capacity to cope with the type of environmental change being experienced (Figure 2). Exposure and sensitivity are, in the study of ecosystems, two of three factors influencing vulnerability. The more exposed something or someone is, or the more sensitive (i.e., prone to being negatively affected by) they are to an impact, the greater the risk vulnerability. The third driver is adaptive capacity. The more adaptive the organism or organization is, the less vulnerable it is to unwanted negative consequences of climate change or extreme weather events. Alternatively, weak adaptive capacity undermines resilience and can magnify disaster outcomes.

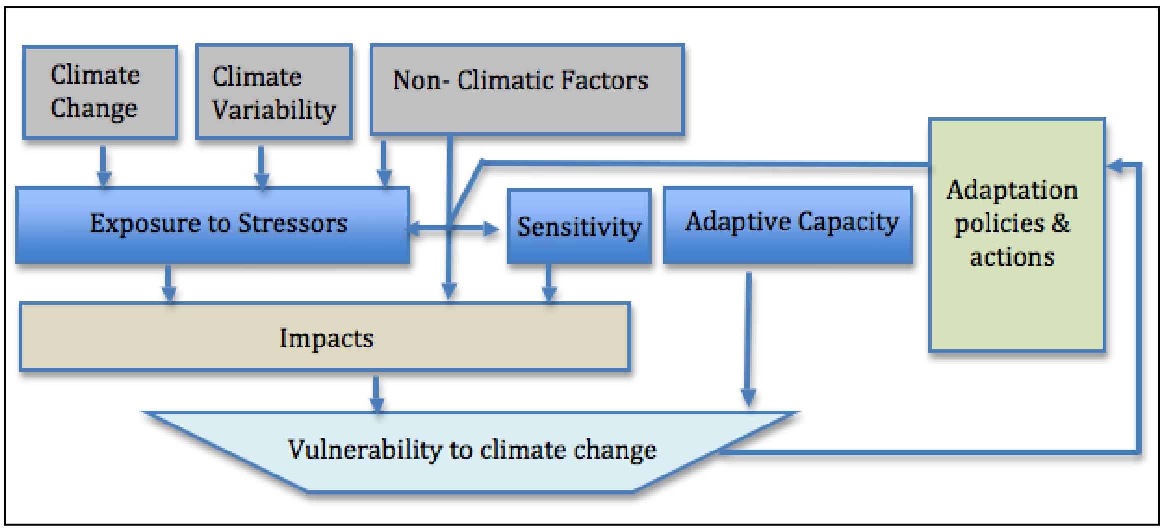

Figure 2 Three Factors of Vulnerabilty. Adapted from Füssel and Klein, 2006

6.1 Vulnerability Due to Exposure

To answer the question of exposure (i.e., vulnerability due to location), MoDY's Climate Change Committee used its coastal flooding map, the inland flooding map, and the identified areas of high susceptibility to coastal erosion. These maps, which were created as part of the MCCAP process, address key natural hazards that are exacerbated by changing climate conditions.

Private property dominated what was found within the areas deemed 'at increased risk' of storm surge flooding, poor drainage that would exacerbate inland flooding, or areas of high susceptibility to erosion. This included assets of the fishing industry, which, if damaged, would cause a great deal of financial hardship in the local economy.

6.2 Vulnerability Due to Sensitivity

Sensitivity can confound (or ameliorate) the social and economic effects of climate exposure. Social sensitivity can be understood as the extent to which a person's ability to secure the necessities of life is affected by an impact. A broad view of social sensitivity could take into account someone's financial means, physical and mental health, level of education or level of emergency preparedness. Of course, **children** are particularly vulnerable during extreme weather events or natural disasters. **Older adults** are also considered at higher risk if health (i.e., physical or mental) issues are involved. As is the case with children, collaborative leadership between municipalities, health organizations at all levels of government, and emergency professionals can mitigate risk vulnerability of children and older adults. However, the social vulnerability of people of *any age* is inherently tied to the strength and resilience of social systems that support a family's access to health care, education for all ages, and policy and program assistance with energy and food security.

As an organizational system, economic, political, cultural and institutional factors are going to influence the degree to which MoDY is buffered from or pays attention to climatic changes. MoDY is going to be particularly sensitive to climate change in a few ways. First, because its local economy is highly dependent on a climate-vulnerable natural resource—fishing. As well, there is sensitivity around governance: such as, the cohesiveness of Council and municipal operations, diminishing civic engagement and trust in local and provincial leadership, and decreasing access to tax revenue in tandem with increasing responsibilities as transferred by the Province. Lastly, the demographics of the municipality are such that MoDY—like most places in the Maritimes—has a high age dependency ratio. This means that there is a relatively small 'productive population' of a community supporting a significant number of older citizens and dependent children. On the other hand, there are many reasons MoDY is *not* very sensitive to climate change. Case in point, it owns relatively minimal infrastructure, and thus is does not have a great deal of investment at risk.

"There is substantive agreement internationally that certain socioeconomic circumstances and patterns lend to more adaptive community attributes. These circumstances and patterns include 'harder' dimensions such as economic and employment diversity and growth (as captured in economic scenarios), and 'softer' dimensions such as trust, communication, community health and collaboration. Researchers have found that climate assessments that look only at climate scenarios (i.e., climate trends and projections) and do not consider relevant socioeconomic conditions, or assume that they will remain static, are less complete and useful as a basis for effective adaptation planning." (Stantec)

MoDY's Climate Change Committee pondered if anything within the community's socioeconomic circumstance or patterns implied that sensitivity to an impact might be worse or less than initially presumed. To guide this exploration, the Committee drew from a draft document called, “A Guide for Incorporating Socioeconomic Information into Municipal Climate Adaptation Strategy Development.” (Elemental Sustainability Consulting Ltd.) The research document presents ten theme areas, each with its own set of indicators. The theme areas are:

1. Health
2. Education
3. Demographics
4. Sense of Community
5. Governance
6. Safety & Preparedness
7. Infrastructure
8. Local Economy
9. Macro Economy
10. Technology

The Committee used the ten themes as a platform for an honest discussion about where MoDY lies on a continuum of adaptive capacity. As a point of reference, a continuum was provided that consisted of four story lines: four community characterizations that wove together plausible circumstances within each of the ten socioeconomic theme areas. The community characterizations were not meant to project how MoDY would fare in the future, but rather to establish reference points to reach a general understanding of what different degrees of vulnerability, adaptive capacity, and resilience might look like in relationship to a range of possibilities (Stantec). The four community characterizations were: a thriving, adaptive community; a stable and moderately adapted community; a declining and insufficiently adapted community; and a community in crisis. During a facilitated exercise, Committee members evaluated which of the characterizations best reflected their perception of MoDY’s current reality for each of the ten theme areas. This group exercise served to reveal hidden assumptions as well as topics where more information was needed (e.g., the public works people could see when there was limited understanding of infrastructure capacity). It also prompted the sharing of ideas and information that resulted in a more cohesive and adaptive Committee.

The socioeconomic exercise and conversations had by the Committee served two functions. First, the information was used to evaluate the accuracy of impact severity rankings. In other words, the Committee reviewed the rankings previously assigned to impacts in the hazard impact matrices to ensure the rankings appropriately reflected the community’s vulnerability due to socioeconomic sensitivities.

Secondly, the socioeconomic conversations were used to gain insight into the municipality’s organizational adaptive capacity: the municipality’s dynamic ability to respond and adapt in the face of change. Instead of considering deficiencies in infrastructure, wealth, or other characteristics that could theoretically place a community at a disadvantage during a crisis, adaptive capacity considers processes and response. (Adger et al 2003, 2004, 2005, 2007; Posey, 2009;

Brown & Westaway, 2011). Aspects such as municipal flexibility, professional redundancy, experience, and networks of support were all discussed as key factors of adaptive capacity. This insight was then used when prioritizing adaptation actions.

6.3. Evaluating MoDY's Level of Preparedness

MoDY and the Town of Yarmouth are partners within a Regional Emergency Management Organization (REMO) that operates by authority of the Emergency Management Act and the Bylaws of the Town and the Municipality of Yarmouth. REMO's Comprehensive Emergency Management Plan (EMP) objectives include, to "identify, assess and prioritize local and regional vulnerabilities to emergencies or disasters and the resources available to prevent or mitigate, respond to, and recover from them."

The Committee believes MoDY has a strong level of emergency preparedness given the size and rural nature of the municipality. It was acknowledged that the communication protocols are in place to quickly call in partners in Mutual Aid, the Nova Scotia Emergency Management Office, or other provincial departments as needed. Indeed, this is exactly what should happen because it is unreasonable to expect that rural areas can afford the personnel, purchase of gear, or gear upkeep to be ready to respond to the wide array of potential emergencies that naturally exists.

Hazards that the EMP mentions specifically are: home fires, roadway accidents, high winds, heavy snowfall, airline crashes, explosion or release of oil or propane storage tanks, shipping accidents, and forest fires. A link can be made between climate change and these hazards, with the exceptions of home fires (if not associated with wildland fire) and airline crashes.

The EMP also states, "the County of Yarmouth is likely to experience the effects of natural hazards or incidents associated with high winds and winter storms." (Comprehensive Emergency Management Plan) This confirms the status of tropical storms/hurricanes and winter storms being two of the natural hazards of concern in the MCCAP hazard analysis.

The EMP does not distinguish particular populations as *socially* vulnerable during emergency events. Determination of vulnerability is primarily approached as a factor of exposure to an event. This is, in large part, a reflection of the complexity of determining who is 'susceptible' to what. However, the EMP has a specific response-oriented objective to address social sensitivity by providing for the "utilization and coordination of municipal, provincial, and federal programs to assist disaster victims, and to prioritize the response to the needs of the elderly, disabled, low income, and other groups which may be inordinately affected." (Comprehensive Emergency Management Plan) While that is an important objective in terms of resilience, *during* an event REMO will rely heavily on the local knowledge of community response agencies (e.g., volunteer fire departments) and the Red Cross to protect those who are particularly sensitive/susceptible to risk due to age (i.e., children), mobility issues, drug dependencies, limited access to information and so on.

Community Services/Red Cross is considered a vital component emergency response and recovery. Other non-municipal individuals, organizations, agencies or groups that may be able to help in the event of a weather-related emergency include but are not limited to (Comprehensive Emergency Management Plan):

- Rural RCMP
- Emergency Health Services
- Yarmouth Regional Hospital; there is a liaison and an alternate
- The Amateur Radio Club
- Ground Search and Rescue
- Tri Count Regional School Board
- Yarmouth Airport
- Acadia First Nations
- Department of Environment
- Department of Transportation and Infrastructure Renewal
- Department of Natural Resources
- Owner / operator of the forthcoming ferry
- Fire departments: Carleton, Kemptville, Lake Vaughn, Lakes and District, Port Maitland, Valley and District (MoDY would also be assisted by the Town of Yarmouth Fire Department)
- GIS technician from the Yarmouth-Barrington-Argyle District Planning Commission

One of the reasons that the HRVA tool was used for MCCAP development is that it has been recently demonstrated the two exercises, when done in tandem, can improve the content of each. The HRVA template is based on the definition of a trigger(s): the circumstance or point at which emergency personnel are brought to attention/activated. A key element of the trigger's definition is a climatologically accurate (to the extent possible using latest scientific research) description of the weather event. A benefit of the MCCAP process was the introduction of downscaled climate projections and a new ability to consider how weather events are shifting in probabilities, and/or magnitudes. The introduction of this information provides an opportunity for emergency management planning to learn from the future: to allocate resources and conduct planning with new storm return periods and other climate-related threats in mind.

7 Economic Opportunity Versus Loss

The Municipality of the District of Yarmouth is primarily reliant on a resource-based economy, employing nearly 15% of working constituents in this sector.

Although many are employed in agriculture, forestry, and hunting, its fishery was noted as its top economic asset in the District's Integrated Community Sustainability Plan. Other top sectors include retail trade (14.4%), health care/social assistance (12%), manufacturing (12%) and accommodation/food services & education services tied at 6% (Community Counts). Relying heavily on natural resources for wealth generation makes changing trends in climate and extreme weather events a particularly significant issue to sustainable development in the municipality and surrounding region. Various opportunities and challenges may arise within fishing, agriculture, and forestry as a result of changing climate conditions.

7.1 Fishing

MoDY has a long economic history with the sea. Relatively recent issues with mismanagement of fisheries and unsustainable fishing practices have begun to change the face of this centuries-old tradition. An increased demand on harbour infrastructure due to extended fishing seasons and larger-sized boats for extended range compound the potential impacts of changing climate trends. It is expected that climate change "will affect marine ecosystems through a suite of physical changes in the properties of water masses, such as sea level, temperature, acidification, salinity, oxygen, upwelling, stratification and the subsequent decrease in nutrient input from deeper waters, storm intensity and frequency, changes in coastal run-off" (Chabot et al. pg 3). As well, more severe weather patterns threaten to strain infrastructure that is already dealing with continual maintenance and upgrades to meet current needs, as well as build more capacity. (Chabot, Guénette, and Stortini, 2013)

7.2 Agriculture

Agriculture represents a significant climate opportunity for MoDY. According to 2012 weather data, southwest Nova Scotia offers significant potential for high value agricultural crop production. Yarmouth is "especially attractive for this variable, retaining long frost-free periods regardless of distance inland" (Colville and Wayne, 2012)). Data collected in 2012 "strongly supports the notion that the southwest Nova Scotia region has comparable, and in many cases superior, climatic suitability for high value crops such as peaches, highbush blueberries and grapes, than the agricultural standard represented by the Annapolis Valley." (Colville and Wayne, 2012)

One important strategy MoDY could take to support the agricultural sector would be to protect agricultural land that is not in projected flood zones. In fact, the Agricultural Goal of the Municipal Planning Strategy is, "To protect productive agricultural land and soils so that residents have secure access to locally grown food." This is supported by an objective "To encourage the use of land with agricultural capability for agricultural purposes." However, "Development pressure in Yarmouth District is not at a level that warrants an expensive mapping program and protective zoning for agricultural lands. Council will continue to monitor the situation and is willing to make changes as necessary." (Municipal Planning Strategy, 2013)

As well, the Planning Advisory Committee could support agriculture and horticultural initiatives: asking 'how could this work' and proceeding in a way that heeds lessons learned from past environmental issues, but does not limit future opportunities because of them. As well, the municipality could support economic development efforts that connect constituents with organizations involved in climate change research as it affects local agriculture. Perennia, the bio-food and agri-resource company that conducted the Southwest Temperature and Solar Radiation Study (2012), is an example of such an organization.

7.3 Forestry

Forestry trends in Nova Scotia show that "each year, the lumber, pulp, and paper industries employ fewer people at lower wages" and that those mills still in operation find it "increasingly difficult to source sizable high grade saw logs" (One Nova Scotia; Shaping Our New Economy Together, 2013). Warmer temperatures may increase forest yields, yet fire, drought, and other extreme weather often lead to high tree mortality rates and an increased susceptibility to pests. Therefore, the climate opportunities in MoDY related to forestry, may be at the woodlot scale.

New markets for Forestry Stewardship Council (FSC) certified wood, particularly for commercial and residential building projects pursuing LEED (Leadership in Energy and Environmental Design) or other green building certifications continue to grow. FSC-certified woodlots ensure that a steady supply of lumber is sustained for the future and that forest biodiversity is maintained. While municipalities have limited influence on woodlots, it can choose to support and or recognize progressive and successful woodlot owners.

MoDY's newly revised municipal planning strategy and land use by-law introduce the use of Development Agreements and Site Plans. Within these development tools, the municipality can exercise some influence over the percentage of the site disturbed (versus left in its vegetated state), degree of tree coverage altered, and even landscaping options (e.g., support of species that are native and consistent with projected growing degree days).

7.4 Tourism

The return to service of the ferry to the United States in May, 2014, and associated terminal upgrades will help to realize an existing climate opportunity around tourism. Though tainted by recession and a general slowing of macro economies of North America and Europe, Nova Scotia is well-positioned to capitalize on its water-rich landscape and mild temperatures; it will not suffer extreme droughts and extreme heat to the extent that other regions of North America will. While assessing natural hazards is a must, especially in the context of shifting storm return periods and changes in intense short period rainfalls, the fact is that Nova Scotia in general and MoDY in particular will remain a safe and hospitable environment. MoDY would be well-served to promote its rural character, available land, affordable living and 'openness to business' in the context of being a beautiful coastal environment that is managed in a way that is climate wise and weather prepared.

8. Environmental Assets

MoDY is within the UNESCO designated South West Nova Biosphere Reserve, which encompasses Queens, Shelburne, Yarmouth, Annapolis and Digby Counties. The South West Nova Biosphere Reserve Association seeks "to balance the conservation of nature and cultural heritage with sustainable resource development to support prosperous local economies and healthy communities." (Southwest Nova Bioshpere Reserve Association) "The most amphibians and reptiles east of Ontario can be found in the Biosphere Reserve. The biosphere reserve is a hotspot for biodiversity and is home to 75% of Nova Scotia's species at risk. It encompasses many terrestrial and aquatic ecosystems including the Acadian Forest, rolling plains, drumlins and coastal cliffs. The core of the biosphere reserve is the largest protected wilderness area in the Maritimes. The surrounding counties are touched by the Atlantic Ocean and the Bay of Fundy, which adds to the distinct natural landscape." (Southwest Nova Bioshpere Reserve Association) Many of these significant and sensitive wildlife habitats are illustrated in the Significant Species and Habitat Map (Appendix F).

The rich natural landscape is enhance by a thick tapestry of freshwater bodies and surrounding seascape. Water defines MoDY's sense of place and resonates within its people and culture. Freshwater covers approximately twenty percent of the Municipality. Eight rivers drain this water. The Tusket and its tributaries, the Carleton River, and Annis River are the largest of the eight. Along with these inland waterways, the municipality also contains significant coastal wetlands, beaches, and waterfowl management areas. (Municipal Planning Strategy, 2013) These environmental assets are protected by municipal policy and activities to the extent enabled by the Municipal Government Act.

In the newly revised Municipal Planning Strategy, environmental policies have been expanded to enhance protection of surface and groundwater resources in a manner that simultaneously mitigates flooding by protecting natural drainage and storage capacity. The MPS preserves the natural floodplain of lower Broad Brook, has a Climate Change Adaptation policy "to consider climate change impacts in relation to water resources on a watershed and watershed basis, where appropriate," and supports provincial regulations in the Lake George Watershed. There are also policies and provisions for the requirement of riparian buffers along watercourses and wetlands.

8.1.1 Historical Environmental Issues

MoDY's history includes the extremely rare historical event, the Saxby Gale of 1869. Williams and Daigle used data from Saxby Gale to estimate a Plausible Upper Bound water level scenario. The Plausible Upper Bound is how high the water would be if you add relative sea level rise to the flood levels recorded by meteorologists during the Saxby Gale, and if it occurs during the highest astronomical tide possible. Certainly, the Saxby Gale is an exemplary event.

More typically, the notable environmental problems of the past include inland flooding, storm surge flooding and coastal erosion. Fortunately, MoDY's landscape of wetlands allows the area to absorb floodwaters, and environmental damage has been negligible. At most, heavy rains have carried excess nutrients and sediments into watercourses altering turbidity and oxygen levels affecting aquatic plants and animals.

While a small group of residents have reported property loss from coastal erosion, this erosion is not seen as an environmental 'problem', but instead a result of coastal processes to which we must adapt.

8.2.1 Hazardous Materials

The EMP describes concern over the spread of population and dwellings along Highways 1 and 3, with additional concentration in communities scattered throughout the County. “This presents emergency planners with communication problems associated with the control of operations and the utilization of available resources. The volume of road traffic is ever increasing and the transportation of dangerous commodities constitutes a major hazard.” The release of dangerous commodities is the only issue that came up during MCCAP development for which there was uncertainty about response readiness. The link between chemical spills and climate change is one of extreme weather events: events that cause conditions (e.g., flash floods, high winds) that damage the transport or stores of any of the twenty-four materials found in Schedule A of the Nova Scotia Environmental Emergency Regulations. There is local knowledge of which commercial and industrial enterprises house hazardous materials, but there is not an existing inventory or map illustrating this knowledge. MoDY can encourage First Responders to consider the problem and ensure there is an up-to-date procedure that identifies who First Responders call during an incident. First Responders will need to consider how long it will take trained hazardous material teams to arrive at the site of the problem, and what they could do to protect their own safety and safety of others before a team arrived. They will call REMO if the situation requires support. For example, the municipality would have to do large-scale evacuations while waiting for teams because of long (4 hour plus) arrival times.

While REMO does what it can to be ready for the release of dangerous or hazardous materials, land use planning and development control can be used to help mitigate incidents in the first place. The MPS now includes a site planning process in the Land Use By-law to enable a greater level of development control over home occupations such as small gas engine repair, firewood operations and recycled building material operations. These uses have been recognized as having the potential for creating negative effects on adjacent uses, and while release of contaminants may not have been the driving factor for the inclusion of site planning in the Land Use By-law, having that tool in place provides an opportunity for its application to encourage safe storage conditions.

9. Priorities for Adaptation

9.1 Hazard and Impact Priorities

The natural hazard analysis done for MCCAP development revealed that the natural hazards most warranting municipal attention and adaptive action in the near-term (prior to 2055) are coastal flooding (which includes flooding from tropical storms / hurricanes), wildland fire and winter storms (Table 14). As described in section four, Analysis of Hazards and Impacts, these hazards endanger public health and safety and present risk of damage to property and infrastructure. These hazards also have the potential to disrupt local and regional economies by imposing financial hardship at the residential and municipal level.

Although coastal flooding, wildland fire and winter storms/ice events are recognized as priorities because of their associated severity of impacts and probability of occurrence, the Committee believes that *all* hazards identified in the MCCAP process warrant future action in order to avoid the cumulative financial and social affects that these hazards could create.

Table 13 Level of priority for hazards and impacts

Municipality of District of Yarmouth		
HIGH RISK		
Hazard	Impact	Notes
Wildland Fire	Infrastructure / property damage	
Coastal Flooding	Risks to public safety and property	
	Isolated residents	Pinkney's Point; Cape Frochu; Pembroke
	Damage to infrastructure	Cape Forchu buildings; Arcadia Pumping Station; Port Maitland
	Road / bridge erosion	Pinkney's Point; Cape Frochu; Pembroke
	Economic impacts (farmland; business disruption)	8000 residents affected; Fishing Industry
MODERATE RISK		
Hazard	Impact	Notes
Wildland Fire	Displacement of residents due to property damage/threat	Non-specific; Hebron Industrial Park 400+ people
	Utility & power disruption	
	Air pollution	
Tropical Storm	Displacement	Estimated 300 residents (Cape Frochu; Pembroke; Pinkney's

		Points)
	Transportation disruption	Pinkneys Point in particular
	Municipal infrastructure damage: wharfs, pumping stations	6 wharfs; Arcadia pumping station
	Utility/power disruption	
	Property damage	Private Homes; Recreation Facilities
	Telecommunication disruption	
	Economic impacts	Fishing industry
Winter Storm	Public safety	
	Prolonged isolation	Pinkneys Point; Cape Frochu
	Property damage	
	Transportation disruption	
	Supply shortages	Unknown; Fuel may be problem after 72 hours
Inland Flooding	Transportation disruption	
	Community lifeline damage	
	Environmental contamination	Arcadia sewage sys
Coastal Flooding	Risks to public safety	
	Isolated residents	Pinkney's Point; Cape Frochu; Pembroke
	Road/bridge erosion	Pinkney's Point; Cape Frochu; Pembroke
	Utility disruption	1000 residents impacted
LOW RISK		
Hazard	Impact	Notes
Drought	Decreased water supply/watershed	
	Decreased water supply wells	
Wildland Fire	Risks to public safety	
Tropical Storm	Risk to public safety	

Inland Flooding	Risk to public safety	
	Displacement of residents due to property damage	
	Isolation	Golden Forest in particular
	Property damage	Minimal, depending on drainage structure
	Water contamination	Homeowners on wells might need to test
	Dam breach	Lake Vaughan; Carleton
Extreme Heat Event	Health and safety compromised	Older adults and children
	Power: municipal cooling demand	
	Water production: If capacity impacted, potential water restrictions	
	Cyanobacteria blooms	
Coastal Erosion	Displacement of residents due to property damage	
	Infrastructure damage / transportation disruption	
UNKNOWN RISK		
Hazard	Impact	Notes
Tropical Storm	Food & fuel shortages	
Winter Storm	Food & fuel shortages	

9.2 Adaptive Actions Underway

MoDY has undertaken specific actions that will help the municipality adapt to changing climate conditions.

First, a formal MPS and LUB review process began in 2010. There are a handful of updates that enable MoDY to mitigate damage and harm from natural hazards and extreme weather events. As explained by Senior Planner, Brad Fulton,

> Environmental policies have been expanded from the original document policies protecting coastal salt marshes and dykelands to also include policies for protection of fresh water resources and preservation of the natural floodplain of lower Broad Brook. Long-term environmental issues are addressed

in a new section on Climate Change Adaptation. The coastal nature of Yarmouth Municipality, and the abundance of fresh water and high water table areas susceptible to flooding, warranted the adoption of policies designed to address future issues that could result from the increase in frequency and severity of weather events. (Municipal Planning Strategy, 2013)

Important updates to note include the recognition of development agreements as a means of ensuring “adequacy of storm drainage and effects of altemation to drainage patterns, including the potential for creation of a flooding problem.” (Municipal Planning Strategy, 2013) This important land use planning mechanism allows MoDY to address/mitigate inland flooding. The MPS similarly positions development agreements as a means of addressing coastal erosion by including ‘geological conditions’ as an aspect determining suitability for development. Also, the “lower Broad Brook floodplain has been identified as an area where the effects of development could detrimentally affect the ability of the natural floodplain to mitigate the effects of flooding during extreme rainfall events.” (Municipal Planning Strategy, 2013) For this reason, infilling and construction are now restricted activities.

Second, as part the MCCAP process, MoDY coordinated with Professional Geoscientist, Philip Finck, to do a ‘phase one’ assessment of coastal erosion. Having taken this initiative, MoDY is now in a position to implement adaptation actions that aim to mitigate risk from coastal erosion.

Third, as discussed in section 7.2, MoDY participated in a project that assessed weather conditions and their influence on agriculture potential. The results of this study help to position MoDY to capitalize on climate opportunities by supporting the expansion of horticultural and agricultural practices in a manner that does not introduce adverse environmental effects.

Fourth, REMO recently developed a City Watch program. CityWatch is a computerized messaging system to inform citizens and businesses of imminent hazards and issues such as emergency alerts, evacuations, major fires, weather events, and road closures. As described on the municpality’s website, “the Notification will be sent out using a recorded voice message to Landlines and Cell phones and a written message to Email. The system is designed to make multiple attempts to connect with lines that are not answered or ring busy. If the call is picked up by an answering machine, the system can be set up to leave or not leave the message based on the nature of the call.” (CityWatch, 2013)

Fifth, the sewage treatment plant at Port Maitland experiences infrequent overflow to the ocean. A generator is being purchased such that power outages would not trigger an overflow. Given high winds often accompany weather events in MoDY, this effort could mitigate environmental impacts at Port Maitland during tropical storms/hurricanes, winter storms, and heavy rainfall events.

Lastly, the REMO coordinator and the GIS Technician from the Yarmouth-Argyle District Planning Commission worked together during the MCCAP process to accurately name and map all the bridges in the jurisdiction of MoDY and its REMO partners (Appendix G).

9.3 Bridging Impacts and Implementation

To a certain degree, the socioeconomic context of a municipality informs its ability to financially invest in adaptation actions and afford related future maintenance or operational costs. For example, while many adaptations can be low (or no) cost initiatives, hard engineering solutions (e.g., amouring a segment of shoreline, investing in a breakwater) require upfront capital and will inevitably require maintenance or repair. When considering adaptation options, it is important to think about not only the present socioeconomic circumstance of a municipality, but also local/regional socioeconomic trends. Can the municipality afford this adaptation action (e.g., engineering solution) over the long term given local and regional socioeconomic trends? Of course, high capital adaptation actions need to be evaluated against what the social and financial costs would be if not taking that action, and whether or not there are lower cost solutions over the long-term (i.e., do not require significant input of fossil fuels or raw materials) that accrue the same protective benefit.

MoDY's socioeconomic patterns and characteristics were considered by the Committee when selecting options for adaptation actions to include in the MCCAP. During that process, ideas came forth that were important in terms of strengthening organizational capacity and community resilience. These ideas, if not hazard-specific, are grouped into the action categories of **Constrained Emergency Preparedness and Response** and **Organizational Adaptive Capacity**.

To prepare for efficient MCCAP implementation, MoDY evaluated each action in terms of the municipality's long-term capability to absorb the action into existing operations and services, *or* afford its introduction and the maintenance/upkeep. Impact risk rankings were weighed against the municipality's capacity to implement related action ideas. This resulted in an urgency rating for each action idea. Essentially, the less able the organization is to address/implement the risk, the higher the urgency rating. This reflects the municipality's need to attend to an impact that has been judged to carry substantial consequence, but doing so falls outside the normal scope of familiar weekly activity, accessible capital or an existing skill set.

The urgency rating was then weighed against the actions capability to actually reduce the threat. In other words, is the action going to directly mitigate risk vulnerability? Does it reduce exposure to a hazard or lessen sensitivity?

The result of weighing the urgency of an action against the actions threat reduction capability resulted in a high, medium or low priority ranking. It is important to remember that this prioritization process essentially represents a marriage between the significance of the impact (i.e., severity of potential consequences and probability) and the nature of the effort municipal staff would have to invest to achieve the action's intent. For example, if the effort falls outside the normal scope of familiar activity, accessible capital or existing skill sets, but the achieving the action would substantially lessen municipality's risk vulnerability (or position the municipality to capitalize on positive changes in climate), then the action is a **high priority**. Comparatively, if it would be rather straightforward for municipal staff to achieve the actions intent but the action itself did not reduce the threat, the actions priority ranking is going to be low.

In many cases, there are action ideas that provide an appropriate *response* to an impact once the threat/hazard is experienced. These are completely legitimate actions to include in the MCCAP because they are important to the municipality's ability to respond to or recover from an event. In essence, their institution contributes to the municipality's resilience. However, these actions show up as low priorities in the ranking system because they do not prevent damage or harm from happening. Therefore, it is important to remember that **low priority does not mean low importance**. It is safe to say that all action items listed in the MCCAP are important, for each action item presented survived critical discussions about its appropriateness to the municipality's community characterizations and circumstance.

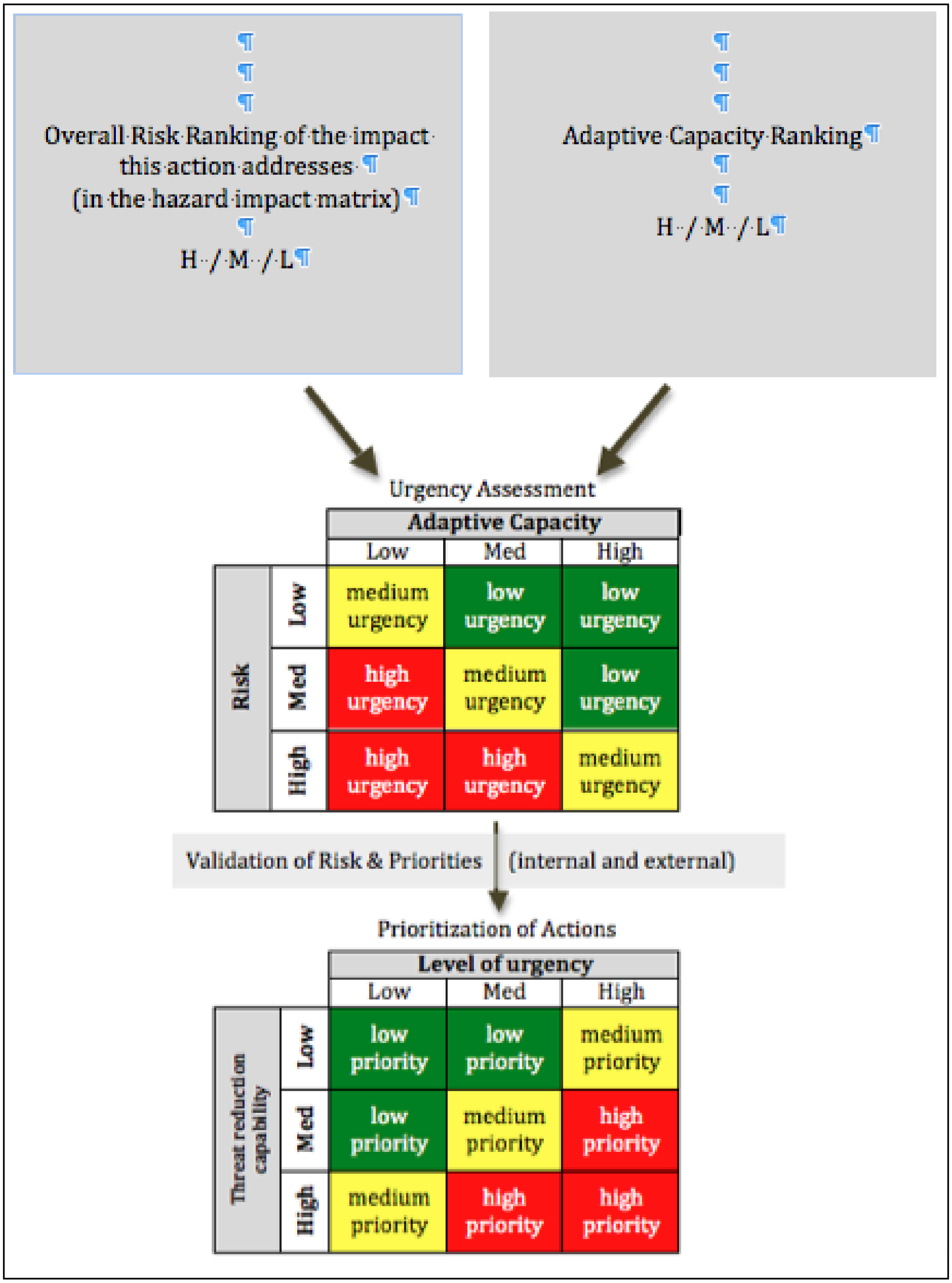

Figure 3 Action Prioritization Process: Modified from the Adaptation Work of Saanich British Columbia and Kings County, Washington.

9.4 Adaptive Actions Under Consideration

Tables 14-16 present the range of potential actions under consideration for each of the natural hazards analyzed in the MCCAP process. As explained in section 9.3, Bridging Impacts to Implementation, MoDY ranked impacts *and* actions. This was done in order to position the municipality for successful mitigation of unwanted climate change impacts, as well as a strengthening of organizational adaptive capacity and community resilience. The next three sections of this report group high priority actions, and moderate and low priority actions respectively.

As stated in the MCCAP Guidebook, there are three key areas of municipal influence where adaptation can begin (2012):

a) Licensing and Regulation – Municipalities can use their powers to set the local regulatory environment in conjunction with their ability to enforce regulations, to implement and enforce adaptive policies.
b) Facilitation, Advocacy, Leadership and Public Education – Municipalities can use their close contact and relationship with community organizations, businesses, residents and other stakeholders at the local level, to develop a shared understanding of the issues and to develop collaborative responses to climate change.
c) Service Delivery, Community Development and Civic Engagement – Many of the services provided by municipalities for businesses and residents can be reviewed in light of adaptive climate change initiatives.

For each action idea listed in Tables 14-16, there is indication of whether or not the action intends to provide information or a deeper analysis of a hazard, or province influence in the key areas listed above. The adaptation actions are also summarized by hazard in Appendix H.

9.4.1 High Priority Adaptation Actions

Table 14 High Priority Adaptation Actions

Action Item	Hazard	Impact Addressed	Lead Dept./Agency	Area of influence
Investigate and/or confirm the maintenance regime of the tide gate protecting the Port Maitland Sewage Treatment facility, and assess if the maintenance is sufficient given water level projections for a 100 year return period storm in the 2055 climate normal (i.e., the 30 year period beginning in 2020).	Coastal flooding	Utility Disruption	Public Works	Deeper analysis
Develop planning and design standards and that take into consideration climate change projections.	Organizational Adaptive Capacity	Inability to cope with disasters and challenges without collapsing into a different state	Planning	Licensing and Regulation
Council incorporates planning and design standards into bylaw.	Organizational Adaptive Capacity	Inability to cope with disasters and challenges without collapsing into a different state	Planning/Council	Licensing and Regulation
Develop a project that assesses the historic rate of coastal erosion in the H2 and M1 areas, and establishes a long-term system for measuring future rates of erosion in MoDY. This system, once in place, could be periodically updated at a very low cost (e.g., a yearly basis and if necessary after major storm events) by community volunteers and local landowners.	Coastal erosion	Property and infrastructure damage	Planning & Public Works	Planning

9.4.2 Medium Priority Adaptation Actions

Table 15 Medium Priority Adaptation Actions

Action Item	Hazard	Impact Addressed	Lead Dept./Agency	Area of influence
Establish a municipal policy that requires an inland flood risk assessment prior to the development of, or investment in, municipal infrastructure in areas considered vulnerable to inland flooding, or areas along waterways where inland flood risk is unknown.	Inland flooding	Property Damage	Planning	Licensing and Regulation
Establish a REMO protocol that uses 7m CGVD28 to the water line as the area indicating high risk vulnerability during a tropical storm / hurricane with an annual exceedance probability of 1% or less (i.e., 100 year return period storm). (Note that land use planning uses the 6.5m line to delineate flood risk, but this does not include wave action, so actual risk to safety is acknowledged by REMO as extending beyond 6.5m).	Coastal flooding	Risk to public safety, Displacement of residents due to property damage	REMO	Service Delivery, Community Development and Civic Engagement
Establish a municipal policy that flood risk be taken into consideration for any municipal infrastructure given Plausible Upper Bound water level scenarios (e.g., utilities located above the worst case flood elevation line).	Coastal flooding	Erosion, Property damage	Planning	Licensing and Regulation
Establish a municipal policy that new municipal infrastructure in the coastal zone below 7.5m CGVD28 be assessed for food risk.	Coastal flooding	Property damage (municipal)	Planning; Public Works	Licensing and Regulation
Address the safety of municipally coordinated outdoor recreation events during hot and very hot days as defined as days that are 30°C and 35°C	Extreme heat	Risk to public safety	Recreation	Service Delivery, Community Development and

respectively.				Civic Engagement
Develop a process / mechanism by which a REMO representative has input on planning departments recommendations to Council	Constrained REMO	Reduced capabilities to mitigate, respond to and recover from a natural hazard	Planning/REMO	Service Delivery, Community Development and Civic Engagement
Pursue a means of securing access to fuel (e.g., storing fuel, reserving supply) for emergency use when large storm systems are predicted (i.e., storm impacts could extend beyond 72 hours).	Constrained REMO	Reduced capabilities to mitigate, respond to and recover from a natural hazard	REMO/Public Works	Service Delivery, Community Development and Civic Engagement
Develop a process for progress reporting and annual review on priority adaptation actions stemming in the 2013 MCCAP.	Organizational adaptive capacity	Inability to cope with disasters and challenges without collapsing into a different state	Planning/Remo	Facilitation, Advocacy, Leadership and Public Education
Orientation session between municipal department staff and elected officials on the way climate change trends and projections affect both municipal infrastructure and staff roles and responsibilities.	Organizational adaptive capacity	Inability to cope with disasters and challenges without collapsing into a different state	Planning/ REMO / Council	Facilitation, Advocacy, Leadership and Public Education
Revisit natural hazard analysis in the context of changing climate conditions by end of 2020, drawing from updated municipal efforts in watershed planning, potential new mapping capacities (e.g., additional LiDAR data) and updated findings regarding sea level rise, shifts in return period storms, Bay of Fundy tidal levels, projections for precipitation, provincial information/mapping resources for groundwater quantity and quality, etc.	Organizational Adaptive Capacity	Inability to cope with disasters and challenges without collapsing into a different state	Planning	Service Delivery, Community Development and Civic Engagement

9.4.3 Low Priority Adaptation Actions

Table 16 Low Priority Adaptation Actions

Action Item	Hazard	Impact Addressed	Lead Dept./Agency	Area of influence
Initiate a regional effort to discuss with DNR contingency planning for wildland fires that occur prior to April 1st. Or during decreased water supply (drought) events.	Wildland fire	Risks to public safety	REMO	Service Delivery, Community Development and Civic Engagement
Secure/build a place to store road sand/salt.	Winter storm	Risks to public safety	Public Works	Service Delivery, Community Development and Civic Engagement
Assess preparedness for Emergency Response to Inland Flooding.	Inland flooding	Risks to public safety,	REMO	Service Delivery, Community Development and Civic Engagement
Support redundancy with mapping capabilities for Emergency Preparedness Planning and use in the Emergency Operations Centre (EOC) in collaboration with the Planning Department.	Inland flooding	Risks to public safety	Planning/REMO	Service Delivery, Community Development and Civic Engagement
Support provincial messaging on Climate change trends that affect response, preparedness and mitigation to the general public audience.	Inland flooding	Risks to public safety, displacement of residents due to property damage, property damage	REMO	Facilitation, Advocacy, Leadership and Public Education
Assess preparedness for Emergency Response for coastal flooding.	Coastal flooding	Risk to public safety	REMO	Service Delivery, Community Development and Civic Engagement
Develop and determine how to efficiently make available a one-two page brief describing what is understood regarding the risk of overland flooding and susceptibility to erosion to citizens if requested.	Coastal flooding	Risks to public safety, displacement of residents due to property damage,	Planning	Facilitation, Advocacy, Leadership and Public Education

		property damage		
Establish a joint municipal and REMO protocol to conduct post-storm analysis using a template provided during the MCCAP process, and have REMO keep one copy for their records (i.e., useful for future emergency preparedness planning and municipal mapping exercises) and send one copy to the Atlantic Storm Prediction Centre care of Bob Robichaud.	Coastal flooding	Risks to public safety	REMO	Facilitation, Advocacy, Leadership and Public Education
Hire a coastal geomorphologist or geoscientist to review a coastal erosion informational sheet in collaboration with municipal staff.	Coastal erosion	Displacement and/or economic impact on residents due to property damage, infrastructure damage / transportation disruption, loss of natural, public coastal spaces	Planning	Deeper analysis
Post the climate change (i.e. coastal risks) informational sheet on the municipal website.	Coastal erosion	Infrastructure Damage and Displacement	Planning	Facilitation, Advocacy, Leadership and Public Education
Consider adding to municipal planning strategy the intent to require coastal erosion site assessments for developments.	Coastal erosion	Property damage and Displacement	Planning	Licensing and Regulation
Consider hosting a seminar on armouring the coast, targeted to those employed in this work, and property owners who have, or are considering armouring as a coastal protection option.	Coastal erosion	Displacement and/or economic impact on residents due to property damage	Planning	Facilitation, Advocacy, Leadership and Public Education
Assess preparedness for Emergency Response to extreme heat event	Extreme heat	Risk to public safety	REMO	Service Delivery, Community Development and Civic Engagement

Encourage / support the completion of Risk Reduction Reports as stated on page 18 of the Comprehensive Emergency Management Plan, and include a risk reduction analysis for all hazards included in the MCCAP, except coastal erosion.		Reduced capabilities to mitigate, respond to and recover from a natural hazard	REMO	Service Delivery, Community Development and Civic Engagement
Make available (e.g., in municipal buildings) or distribute (e.g., with municipal mailing) emergency preparedness fact sheets: http://www.gov.ns.ca/nse/resources/publications.asp#EMO	Constrained REMO	Reduced capabilities to mitigate, respond to and recover from a natural hazard	REMO	Facilitation, Advocacy, Leadership and Public Education
Liase with airport authorities to ensure they have contingency plans for weather related events and a clear protocol establishing when to contact REMO if there is the possibility that local business, residents, services or infrastructure may be affected.	Constrained REMO	Reduced capabilities to mitigate, respond to and recover from a natural hazard	REMO	Deeper analysis
Inventory which fire halls / community halls have back up generators, and the size of the generators.	Constrained REMO	Reduced capabilities to mitigate, respond to and recover from a natural hazard	REMO	Service Delivery, Community Development and Civic Engagement
Contact TIR to get copy of incident report / database indicating location of road repairs in District of Yarmouth. Use this information as geographically referenced historical information for EMO planning (e.g., evacuation routes).	Constrained REMO	Reduced capabilities to mitigate, respond to and recover from a natural hazard	REMO	Deeper analysis
Meet with Town of Yarmouth and other key neighbouring municipalities to compare MCCAP action items and identify areas for collaboration.	Organizational Adaptive Capacity	Inability to cope with disasters and challenges without collapsing into a different state	Planning	Deeper analysis

8. Mitigating Greenhouse Gas Emissions

8.1 Municipal Efforts to Reduce Energy Demand

On-going and future efforts by the Municipality to reduce energy demand:

- Street lights – the Municipality has committed to converting all municipal streetlights to LED lighting
- Participation in Active Transportation Plan to encourage non-motorized travel/transportation, thereby reducing greenhouse gas emissions
- Mariner's Centre (arena)– the Municipality of Yarmouth is part owner of the centre - all lighting is being converted to LED; heat recovery project – utilizing excess hot water that is currently going to waste to heat the facility.
- Mapping plan to indicate all areas where wind energy development is permitted in the Municipality, to assist in encouraging this development.
- Variable frequency drives are being installed at sewage treatment plants to reduce energy emissions.

8.2 UNSM Corporate Energy and Emissions Spreadsheet

MoDY completed the UNSM Corporate Energy and Emissions Spreadsheet. The inventory summary is illustrated below.

Total CO_2e/Sector

Sector	Total CO_2e (metric tonnes)
Residential	0
Community Transportation	45,746
Commercial	6,002
Industrial	0
Waste	1,336

Total CO_2e/Energy Source

Source	Total CO_2e (metric tonnes)
Electricity	25,273,664
Natural Gas	0
Heating Oil	3,604
Propane	545
Heavy Fuel Oil	1,732
Diesel	13,793

Criteria Air Contaminants

CAC	Total CO_2e (metric tonnes)
Total CO_2e (t)	53,084
Total CO (t)	16
Total SO_2 (t)	262
Total NOX (t)	74
Total VOC (t)	1
Total TPM (t)	1
Total PM10 (t)	1
Total PM2.5 (t)	0

8.3 Energy and Emissions Inventory Table

Based on the UNSM Corporate Energy and Emissions Spreadsheet, the Energy and Emissions Summary Inventory Table was completed.

Table 17 Summary Energy and Emissions Inventory Table for the County

Emission Category		Energy Type	Energy Consumption	Cost ($)	Units	Emission Factor (tCO_2/units)	Emissions (tCo_2e)
2009-2010	Buildings	Electricity Fuel Oil			kWh L	0.868 kg CO_2 / KWh (2006 coefficient) 2.68kg CO_2/L	
	Water & Wastewater	Electricity			kWh	0.868 kg CO_2 / KWh (2006 coefficient)	
2008-2009	Streetlights	Electricity			kWh	0.868 kg CO_2 / KWh (2006 coefficient)	
	Vehicles	Reg. gasoline			L L	2.34 kg CO_2 / L 2.63 kg CO_2 / L	
	Solid Waste	Emissions from the Regional Balefill Facility is captured in the Buildings category. The emissions associated with corporate waste of paper, yard trimmings and food scraps is unknown, as it is not recorded separately from community solid waste.					

8.4 Emission Reduction Efforts to Date

Efforts to date by the Municipality to reduce energy demand:

- Council has encouraged wind energy development in the municipality both through private industry and working with neighbouring municipalities
- Municipal Recreation Department – lighting in all buildings has been converted to LED; motion sensor light switches have been installed in all buildings; switched to organic products (instead of chemical herbicides)
- Municipal Building – new building (5 years) was designed for passive solar energy; building uses geo-thermal heating; motion sensor switches and low-flush toilets have been installed throughout the building
- Other buildings owned by the Municipality at the Business Park and leased commercially– all lighting has been converted to LED.

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Appendix A: Terms of Reference for the Climate Change Committee

Terms of Reference

Committee to prepare amendment to Municipality of Yarmouth Feb. 24, 2010 Integrated Community Sustainability Plan (ICSP) to include a Municipal Climate Change Action Plan (MCCAP) to satisfy the requirement of the 2010-2014 Gas Tax Agreement

Mandate:

Schedule 9 of the Municipality of MoDY of Yarmouth Municipal Funding Agreement with the Province of Nova Scotia requires the Council to amend its ICSP to prepare and submit to Service Nova Scotia and Municipal Relations (SNSMR) no later than Dec.31, 2013 a Municipal Climate Change Action Plan which shall include the following:

a) A description of actions, measures, practices and initiatives undertaken by the Municipality in order to reduce community and corporate greenhouse gas emissions.
b) A description of actions, measures, practices and initiatives undertaken by the Municipality in order to adapt and respond to impacts resulting from climate change.
c) A resolution of Municipal Council amending an ICSP and a record of public participation.

Objective:

To be responsible for undertaking preparation of the MCCAP and be accountable to SNSMR in accordance with the requirements of the MCCAP Guidebook. Members are bound by the Terms of Reference and are ultimately accountable to the Council of the Municipality of Yarmouth and SNSMR in regards to any elements of the plan.

Goals:

To prepare a Municipal Climate Change Action Plan, in accordance with the MCCAP Guidebook, by:

a) Identifying significant climate change issues and hazards affecting the Municipality of Yarmouth
b) Identifying areas of the Municipality of Yarmouth that are subject to climate change issues
c) Identifying and describing how existing (and proposed) Municipally-owned and operated facilities and infrastructure are vulnerable to climate change
d) Identifying whom within the Municipality might be most adversely affected by climate change issues
e) Indentifying potential economic implications of climate change

f) Identifying potential environmental issues, which could result from climate change impacts
g) Identifying priorities for adaptive action

Scope:

The Adaptation Committee shall consider the following when preparing the plan:
a) The effects of climate change on resource industries such as the fishery, forestry and agriculture
b) The effects of climate change on the residents of the Municipality of Yarmouth
c) The effects of climate change on the businesses operating in the Municipality of Yarmouth

Process:

The MCCAP Committee will prepare the MCCAP in accordance with the MCCAP Guidebook and will provide updates to the Municipal Council quarterly, or when requested by Council until the Plan is complete and has been accepted by SNSMR. The Committee with meet regularly each month or more frequently as needed. The committee will include resource individuals from the community as necessary to provide information necessary for the Committee to fulfill its mandate.

Membership:

The membership of the MCCAP Committee shall be as follows:

a) The core MCCAP committee shall consist of eight members.
b) Two members shall be Municipal Councillors, one of whom shall be a member of the Planning Advisory Committee.
c) The Planner
d) The Development Officer
e) The Director of Public Works
f) The EMO Coordinator
g) GIS Technician
h) Two citizen members

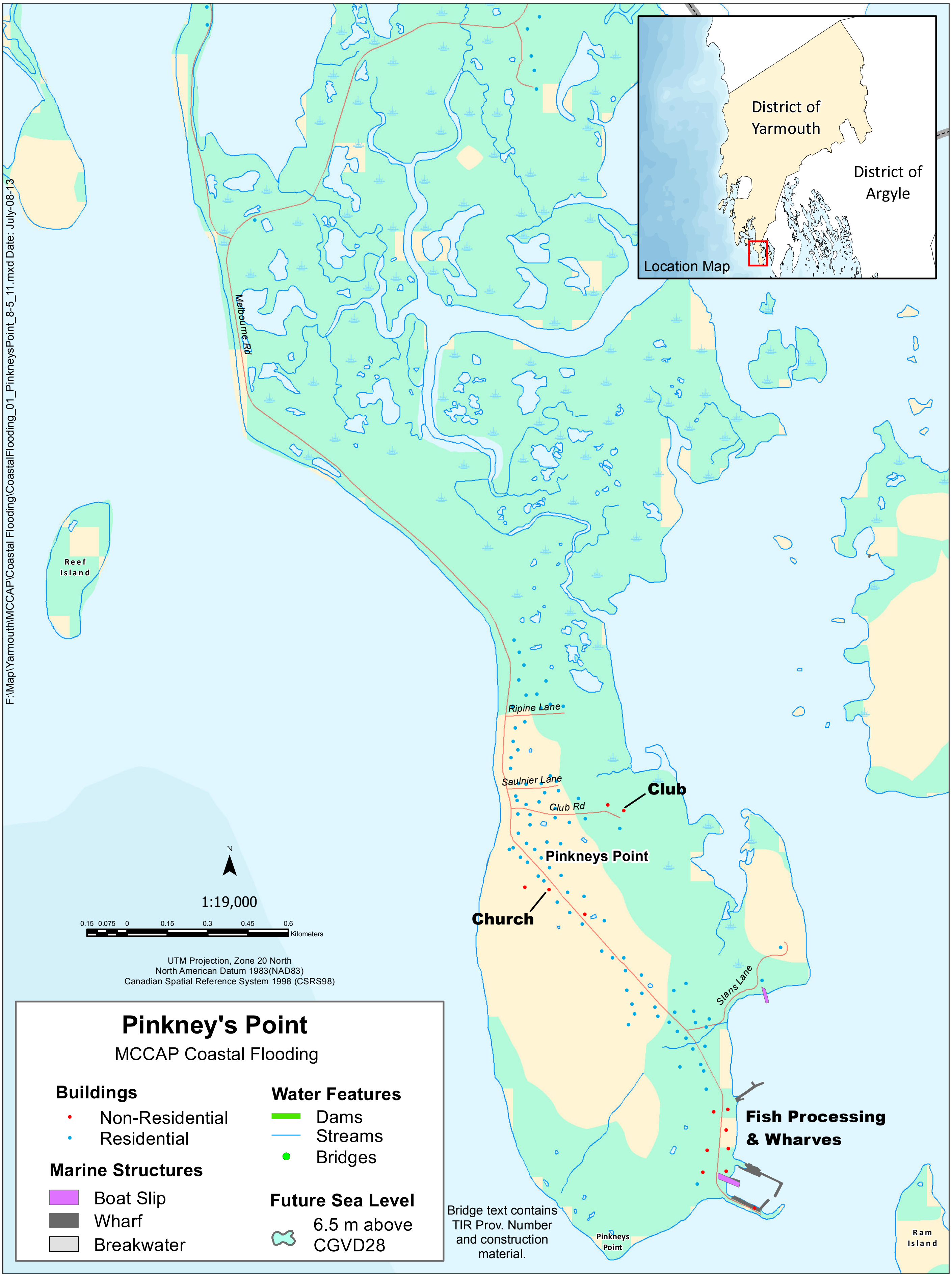
Quorum:

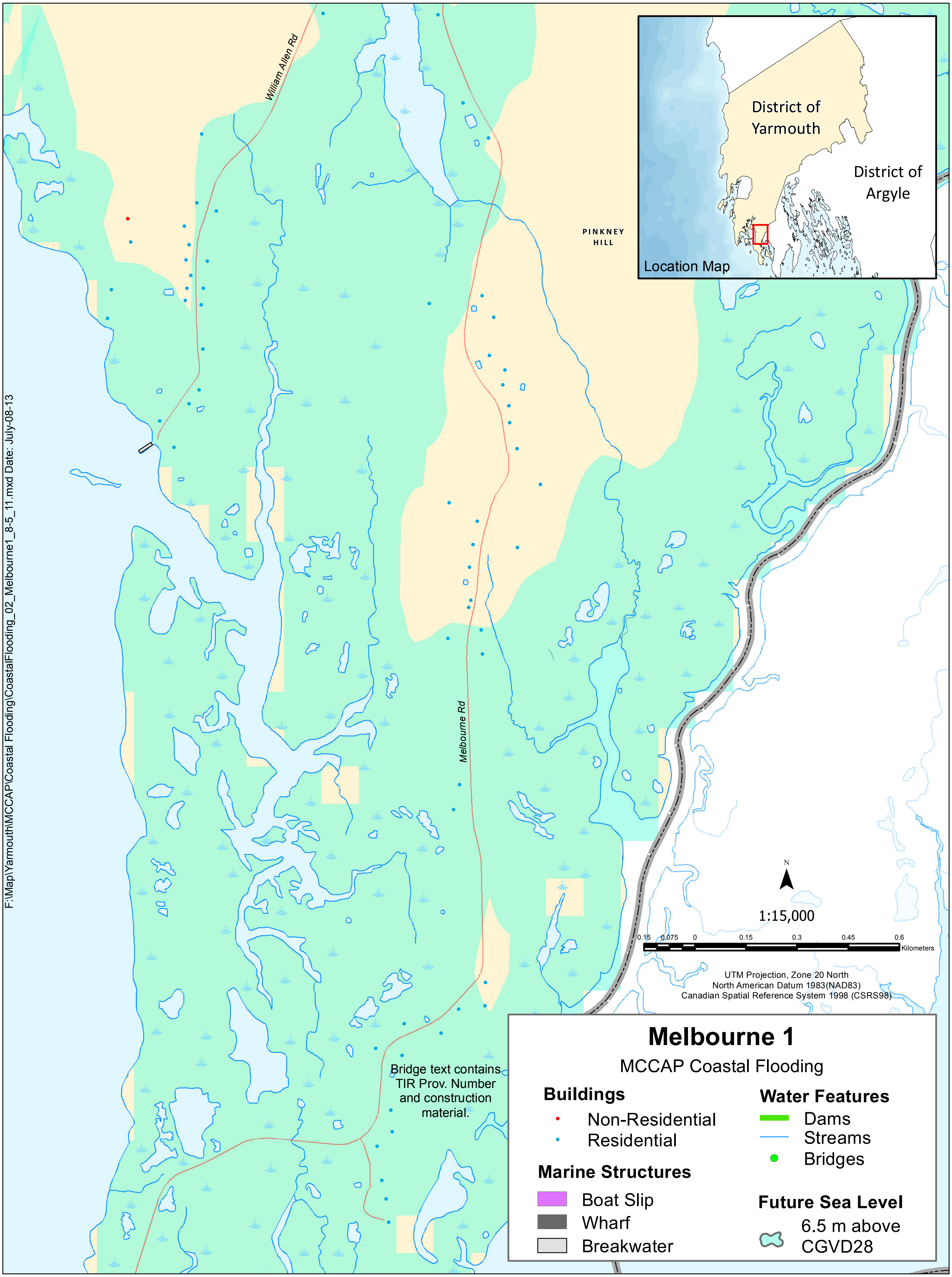
A quorum shall consist of no less than four core members.

Meetings:
a) The MCCAP Committee shall meet monthly or more frequently as required.
b) Agenda items will be compiled by the Chairman and the Planner.

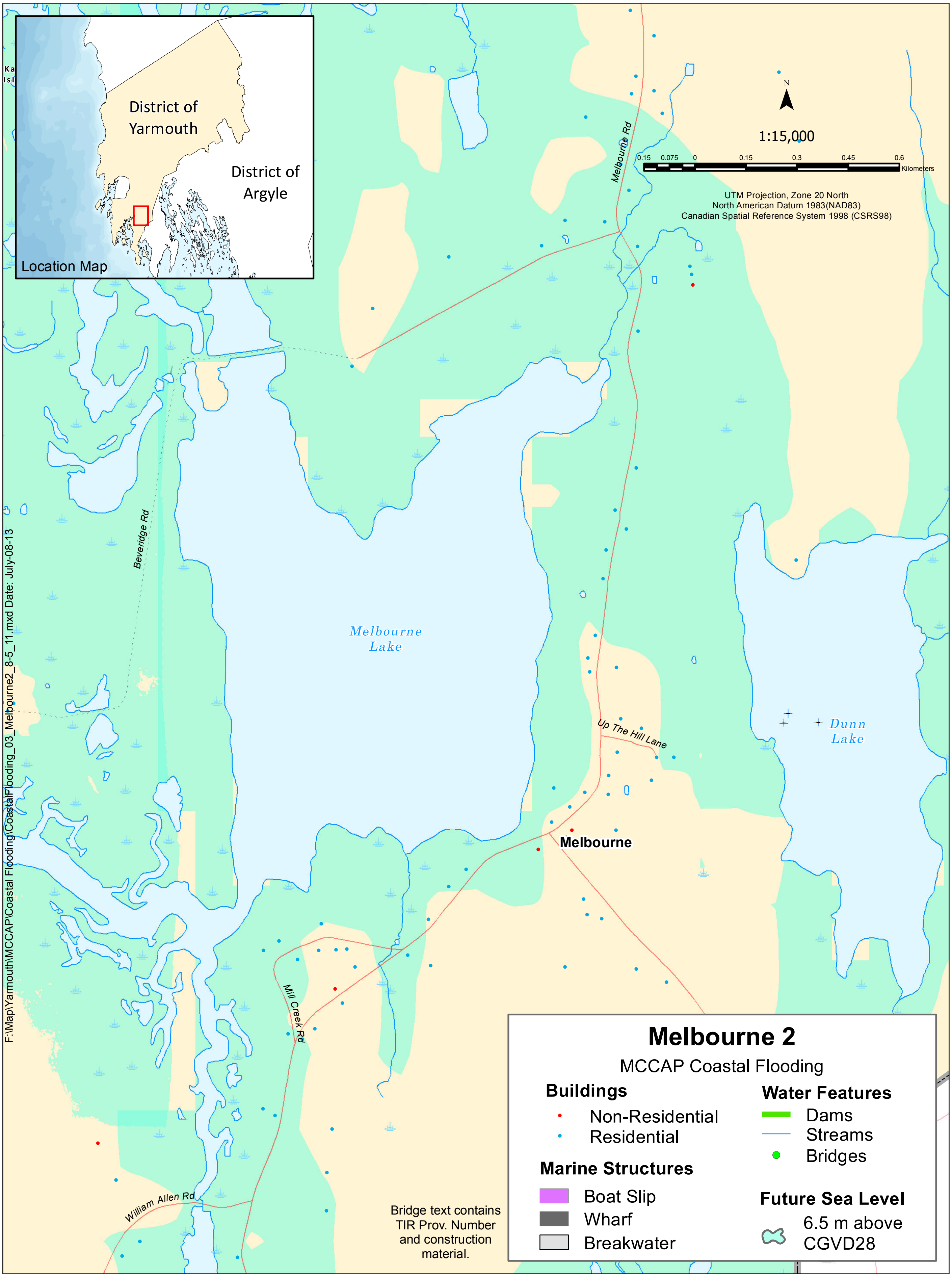
c) Decisions of the MCCAP Committee shall be decided by a majority vote of those members present at the meeting.
d) Meetings shall be open to the public.
e) Minutes shall be kept of the meetings proceedings, and approved minutes of the Committee shall be made available to the public for viewing.

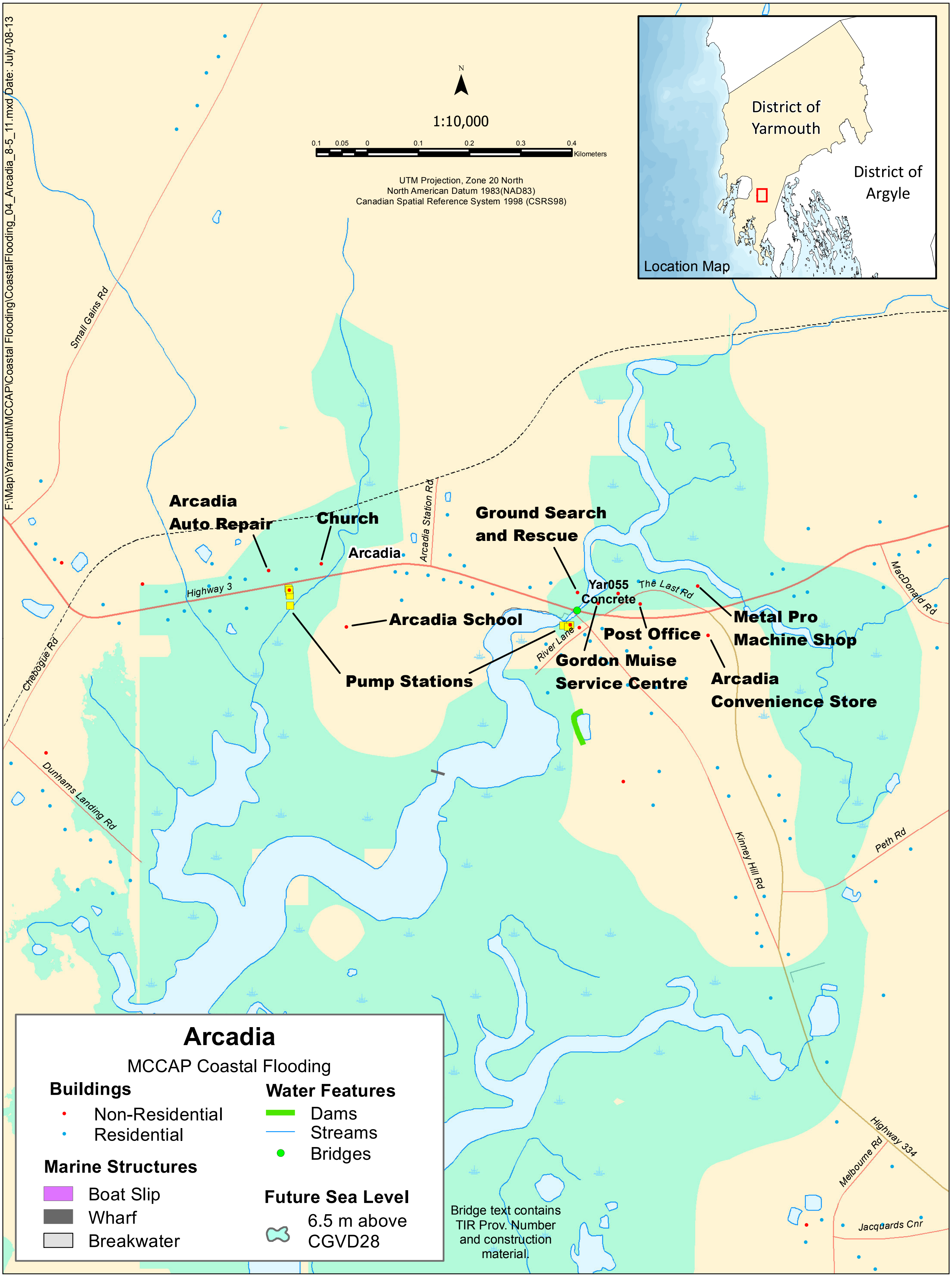
Appendix B: Coastal Flood Maps

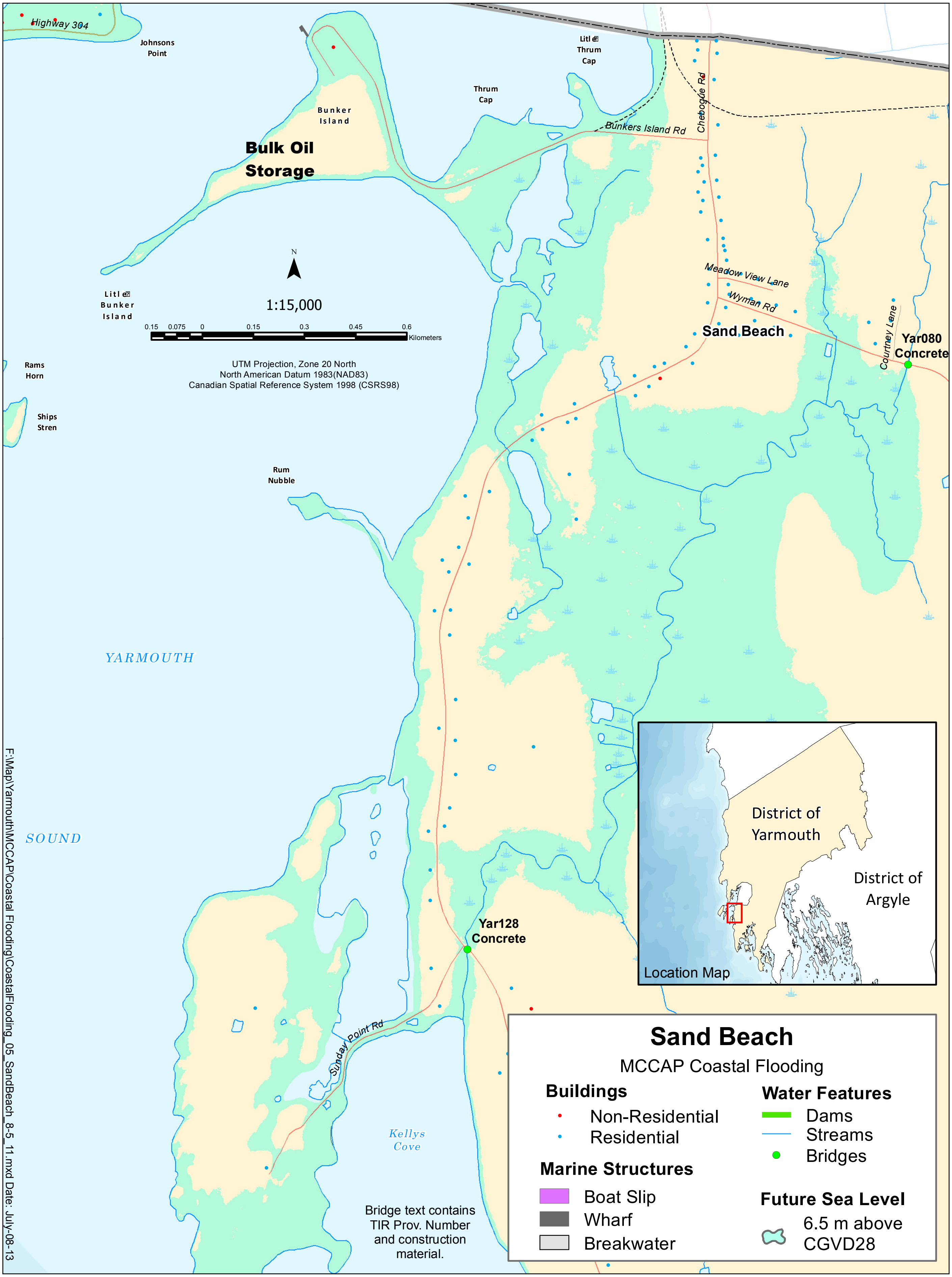

Pinkney's Point
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Marine Structures
Boat Slip
Wharf
Breakwater
Water Features
Dams
Streams
Bridges
Future Sea Level
6.5 m above CGVD28
Bridge text contains TIR Prov. Number and construction material.
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
1:19,000
0.15 0.075 0 0.15 0.3 0.45 0.6
Kilometers
N
District of Yarmouth
District of Argyle
Location Map
Melbourne Rd
Ripine Lane
Saulnier Lane
Club Rd
Club
Pinkneys Point
Church
Stans Lane
Fish Processing & Wharves
Reef Island
Pinkneys Point
Ram Island
F:\Map\Yarmouth\MCCAP\Coastal Flooding\CoastalFlooding_01_PinkneysPoint_8-5_11.mxd Date: July-08-13

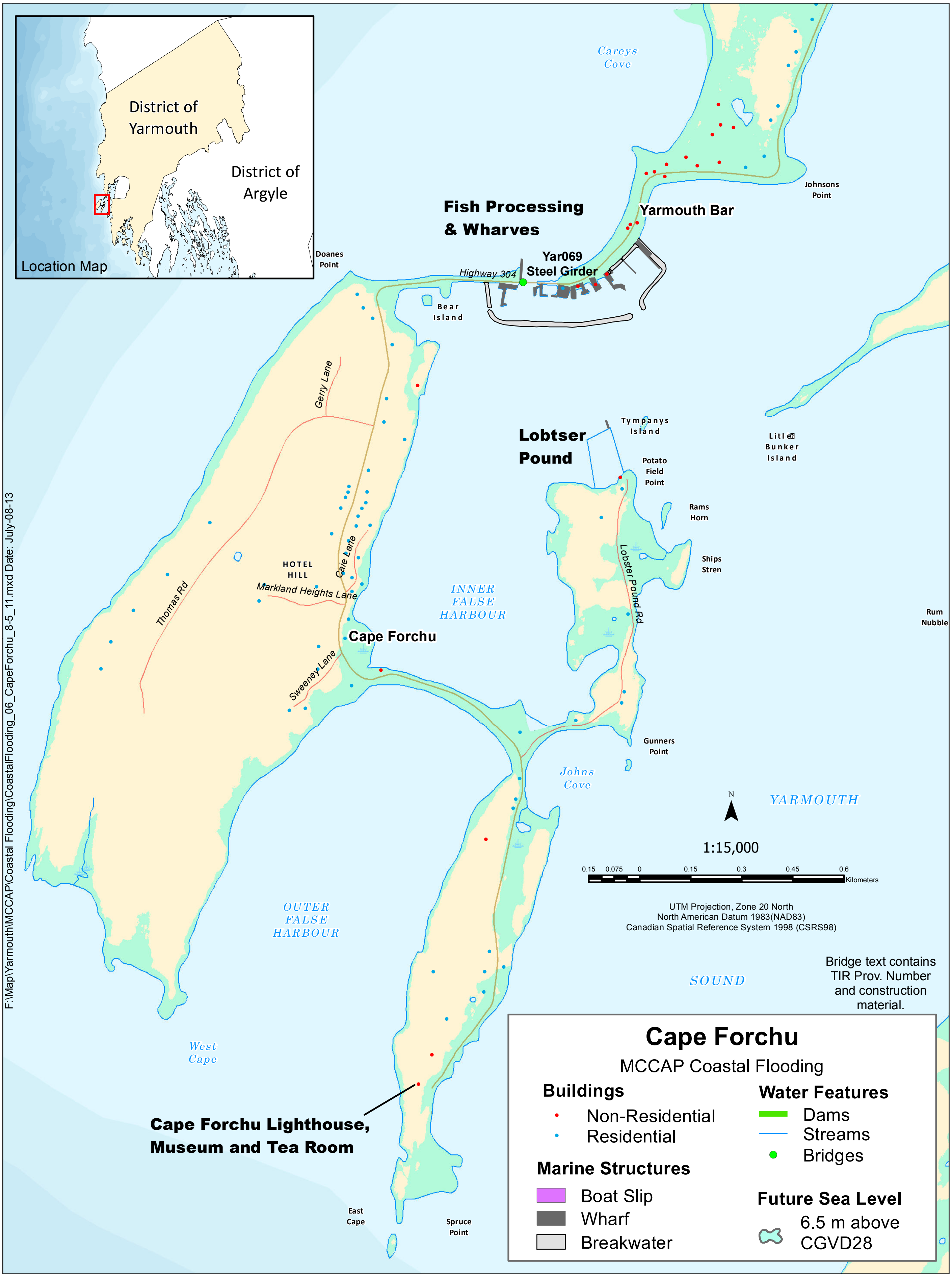


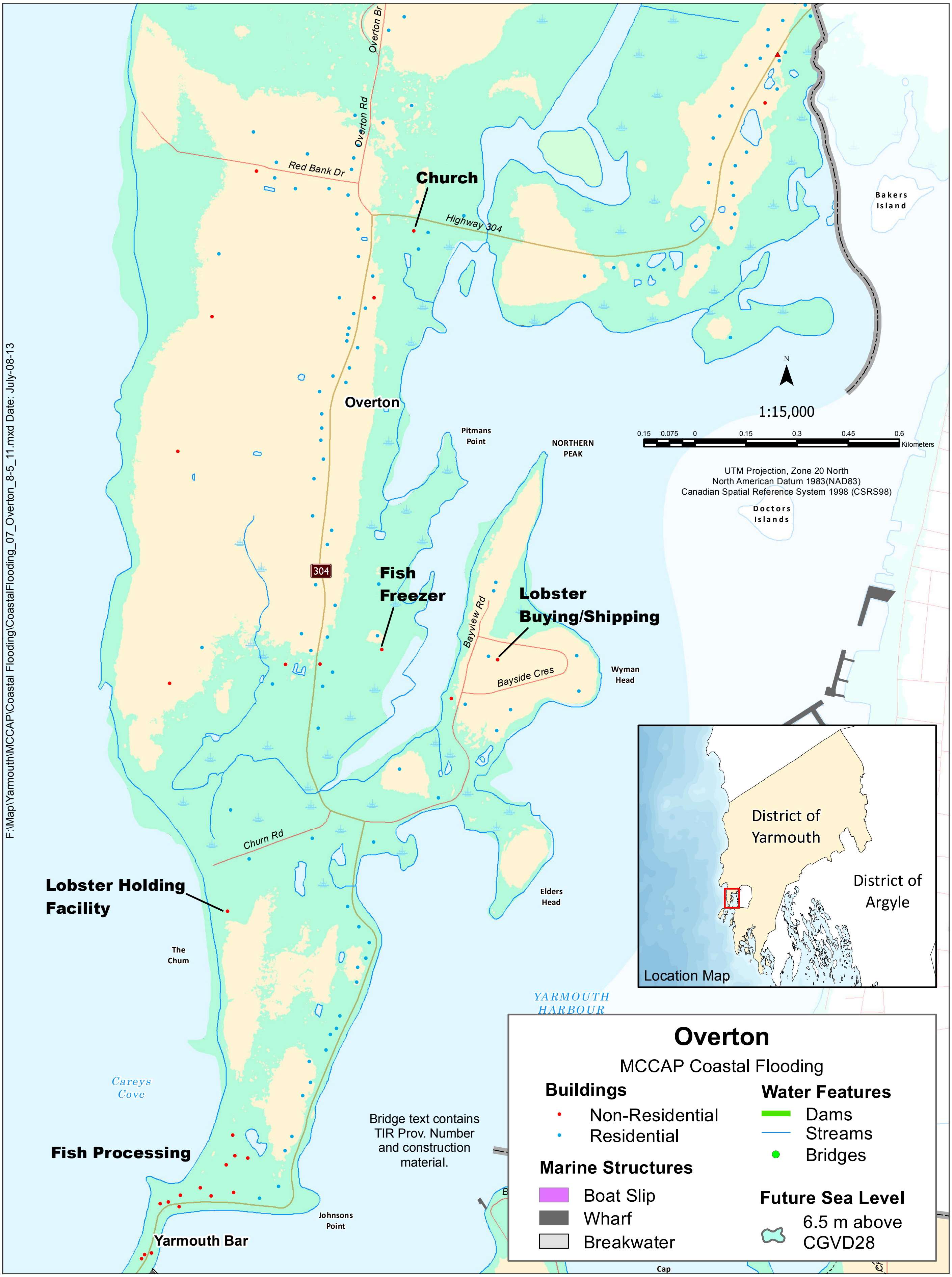
F:\Map\Yarmouth\MCCAP\Coastal Flooding\CoastalFlooding_02_Melbourne1_8-5_11.mxd Date: July-08-13

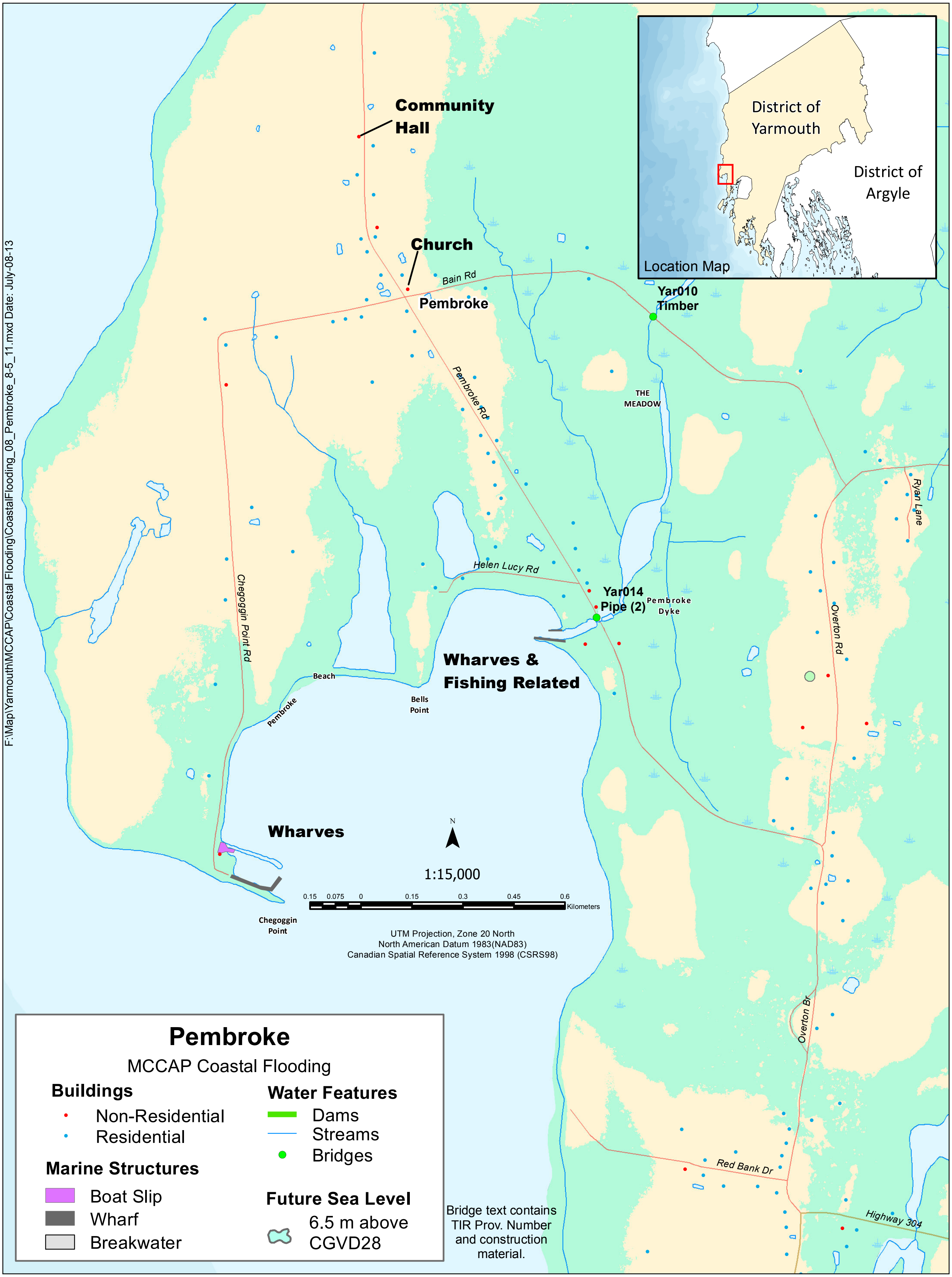

District of
Yarmouth
District of
Argyle
Location Map
N
1:15,000
0.15 0.075 0 0.15 0.3 0.45 0.6
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Melbourne Rd
Beveridge Rd
Melbourne
Lake
Dunn
Lake
Up The Hill Lane
Melbourne
Mill Creek Rd
William Allen Rd
F:\Map\Yarmouth\MCCAP\Coastal Flooding\CoastalFlooding_03_Melbourne2_8-5_11.mxd Date: July-08-13
Bridge text contains
TIR Prov. Number
and construction
material.
Melbourne 2
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Marine Structures
Boat Slip
Wharf
Breakwater
Water Features
Dams
Streams
Bridges
Future Sea Level
6.5 m above
CGVD28


F:\Map\Yarmouth\MCCAP\Coastal Flooding\CoastalFlooding_04_Arcadia_8-5_11.mxd Date: July-08-13
1:10,000
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Location Map
District of Yarmouth
District of Argyle
Arcadia Auto Repair
Church
Arcadia
Ground Search and Rescue
Yar055 Concrete
Metal Pro Machine Shop
Post Office
Arcadia School
Pump Stations
Gordon Muise Service Centre
Arcadia Convenience Store
Highway 3
The Last Rd
River Lane
Arcadia Station Rd
Small Gains Rd
Chebogue Rd
Dunhams Landing Rd
Kinney Hill Rd
MacDonald Rd
Peth Rd
Highway 334
Melbourne Rd
Jacquards Cnr
Arcadia
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Marine Structures
Boat Slip
Wharf
Breakwater
Water Features
Dams
Streams
Bridges
Future Sea Level
6.5 m above CGVD28
Bridge text contains TIR Prov. Number and construction material.

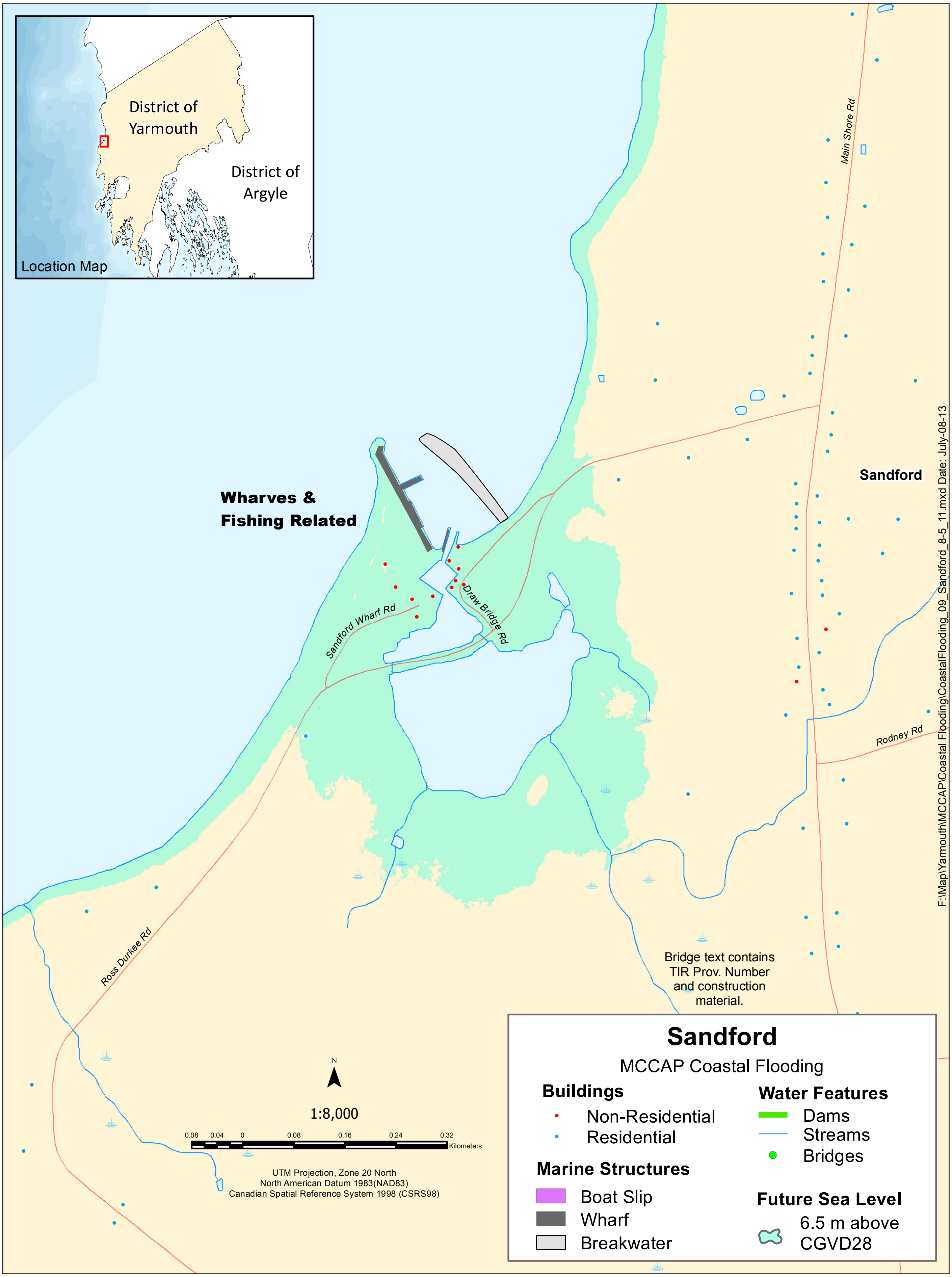

Highway 304
Johnsons Point
Bunker Island
Bulk Oil Storage
Litle Thrum Cap
Thrum Cap
Bunkers Island Rd
Chebogue Rd
Litle Bunker Island
N
1:15,000
0.15 0.075 0 0.15 0.3 0.45 0.6
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Rams Horn
Ships Stren
Rum Nubble
Meadow View Lane
Wyman Rd
Sand Beach
Courtney Lane
Yar080 Concrete
YARMOUTH
SOUND
Yar128 Concrete
Sunday Point Rd
Kellys Cove
Bridge text contains TIR Prov. Number and construction material.
District of Yarmouth
District of Argyle
Location Map
Sand Beach
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Water Features
Dams
Streams
Bridges
Marine Structures
Boat Slip
Wharf
Breakwater
Future Sea Level
6.5 m above CGVD28
F:\Map\YarmouthMCCAP\Coastal Flooding\CoastalFlooding_05_SandBeach_8-5_11.mxd Date: July-08-13


Cape Forchu
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Marine Structures
Boat Slip
Wharf
Breakwater
Water Features
Dams
Streams
Bridges
Future Sea Level
6.5 m above CGVD28
Location Map
District of Yarmouth
District of Argyle
Fish Processing & Wharves
Yarmouth Bar
Yar069 Steel Girder
Highway 304
Lobtser Pound
Cape Forchu
Cape Forchu Lighthouse, Museum and Tea Room
INNER FALSE HARBOUR
OUTER FALSE HARBOUR
YARMOUTH
SOUND
Careys Cove
Johns Cove
West Cape
East Cape
Spruce Point
Doanes Point
Bear Island
Johnsons Point
Tympanys Island
Potato Field Point
Rams Horn
Ships Stren
Gunners Point
Rum Nubble
HOTEL HILL
Gerry Lane
Thomas Rd
Markland Heights Lane
Sweeney Lane
Lobster Pound Rd
1:15,000
0.15 0.075 0 0.15 0.3 0.45 0.6 Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Bridge text contains TIR Prov. Number and construction material.
F:\Map\Yarmouth\MCCAP\Coastal Flooding\CoastalFlooding_06_CapeForchu_8-5_11.mxd Date: July-08-13

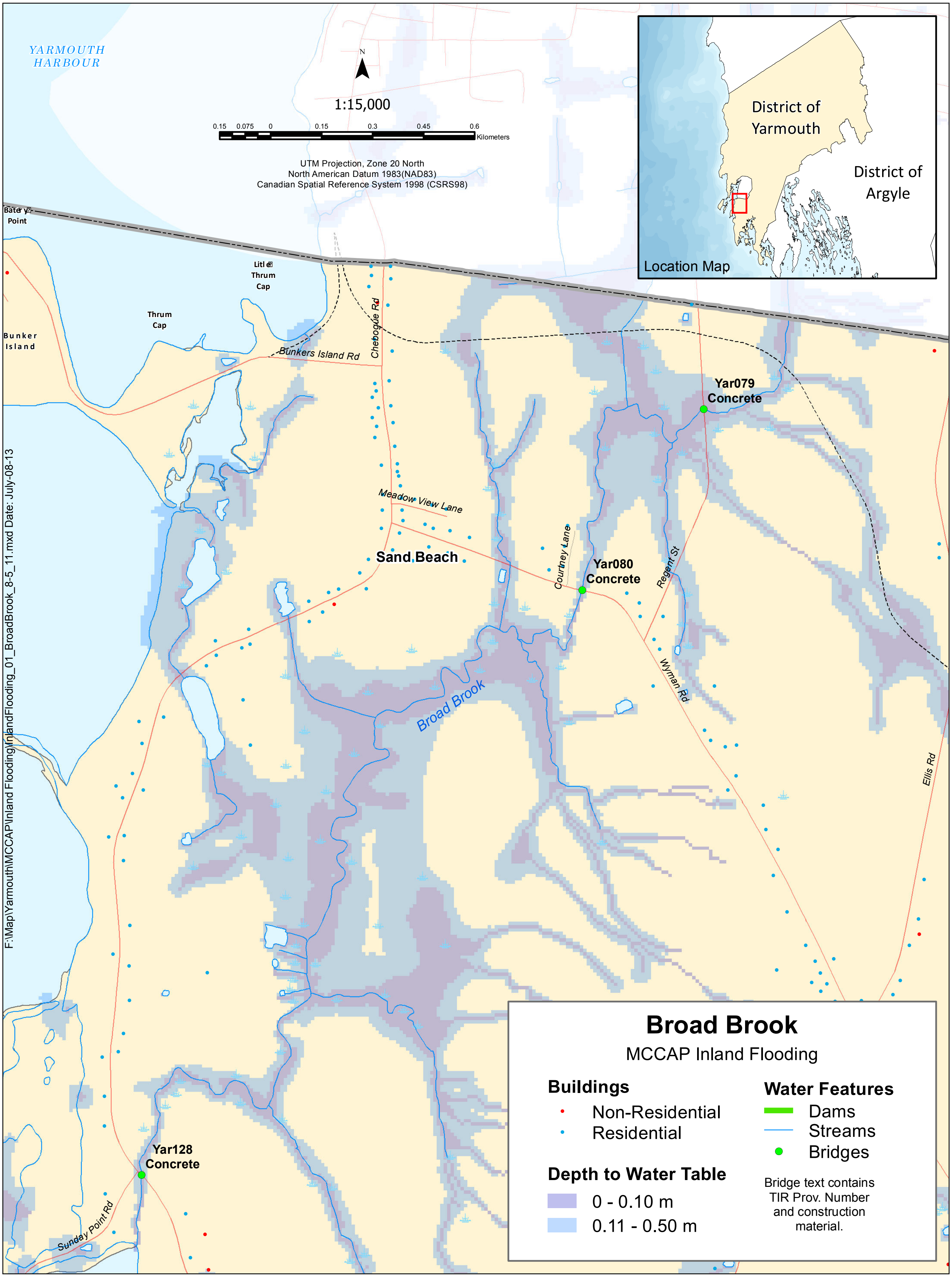

F:\Map\Yarmouth\MCCAP\Coastal Flooding\CoastalFlooding_07_Overton_8-5_11.mxd Date: July-08-13
Overton Br
Overton Rd
Red Bank Dr
Church
Highway 304
Bakers Island
Overton
Pitmans Point
NORTHERN PEAK
1:15,000
0.15 0.075 0 0.15 0.3 0.45 0.6 Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Doctors Islands
304
Fish Freezer
Lobster Buying/Shipping
Bayview Rd
Bayside Cres
Wyman Head
District of Yarmouth
District of Argyle
Location Map
Churn Rd
Lobster Holding Facility
Elders Head
The Chum
YARMOUTH HARBOUR
Carevs Cove
Bridge text contains TIR Prov. Number and construction material.
Fish Processing
Johnsons Point
Yarmouth Bar
Cap
Overton
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Water Features
Dams
Streams
Bridges
Marine Structures
Boat Slip
Wharf
Breakwater
Future Sea Level
6.5 m above CGVD28



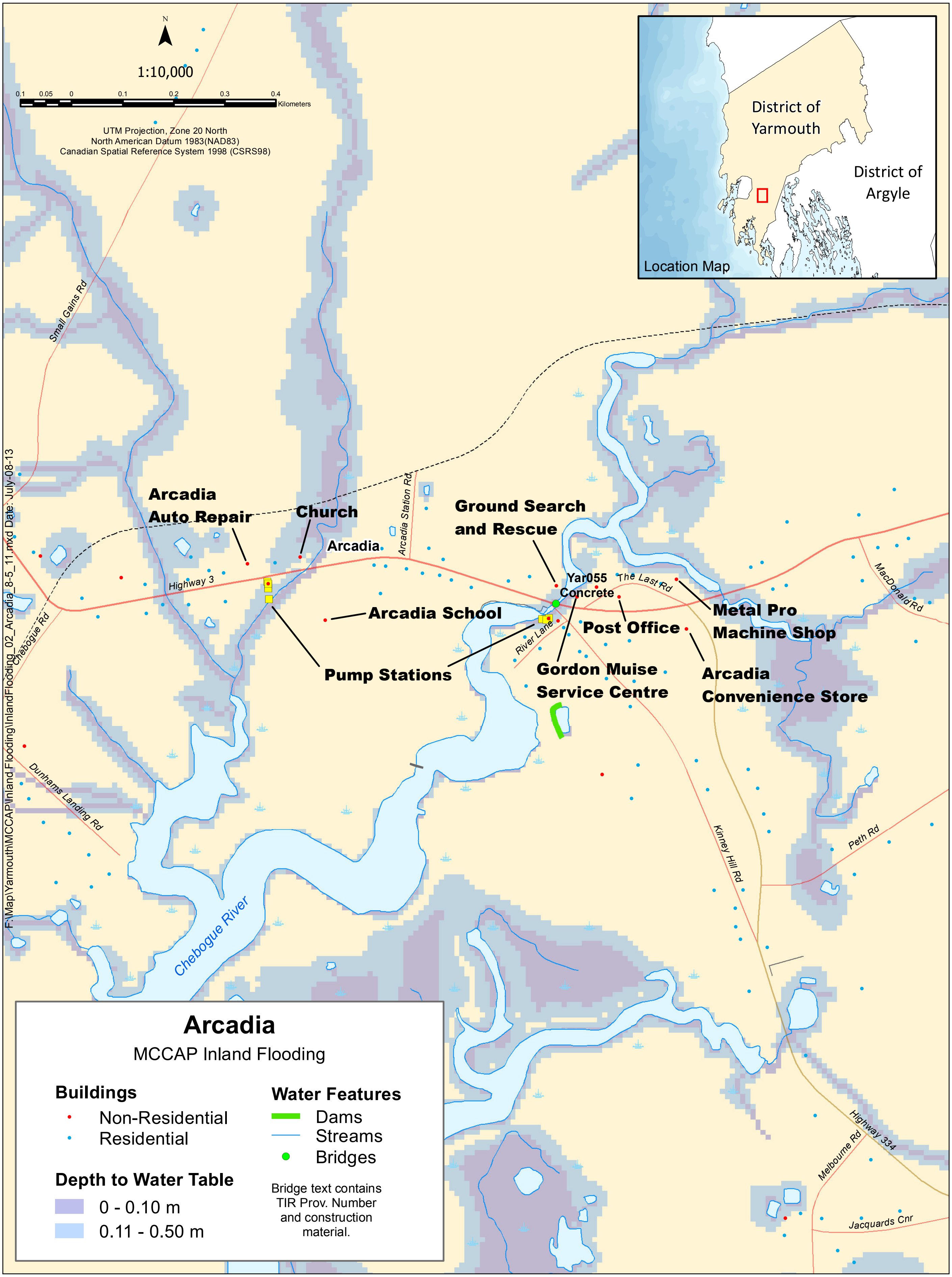
Pembroke
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Marine Structures
Boat Slip
Wharf
Breakwater
Water Features
Dams
Streams
Bridges
Future Sea Level
6.5 m above CGVD28
Bridge text contains TIR Prov. Number and construction material.
Community Hall
Church
Pembroke
Bain Rd
Pembroke Rd
Helen Lucy Rd
Chegoggin Point Rd
Yar010 Timber
Yar014 Pipe (2)
Pembroke Dyke
THE MEADOW
Ryan Lane
Overton Rd
Overton Br
Red Bank Dr
Highway 304
Wharves & Fishing Related
Wharves
Beach
Pembroke
Bells Point
Chegoggin Point
N
1:15,000
0.15 0.075 0 0.15 0.3 0.45 0.6
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Location Map
District of Yarmouth
District of Argyle
F:\Map\Yarmouth\MCCAP\Coastal Flooding\CoastalFlooding_08_Pembroke_8-5_11.mxd Date: July-08-13


District of Yarmouth
District of Argyle
Location Map
Main Shore Rd
Sandford
Wharves & Fishing Related
Sandford Wharf Rd
Draw Bridge Rd
Rodney Rd
Ross Durkee Rd
Bridge text contains TIR Prov. Number and construction material.
F:\Map\Yarmouth\MCCAP\CoastalFlooding\CoastalFlooding_09_Sandford_8-5_11.mxd Date: July-08-13
N
1:8,000
0.08 0.04 0 0.08 0.16 0.24 0.32
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Sandford
MCCAP Coastal Flooding
Buildings
Non-Residential
Residential
Water Features
Dams
Streams
Bridges
Marine Structures
Boat Slip
Wharf
Breakwater
Future Sea Level
6.5 m above CGVD28

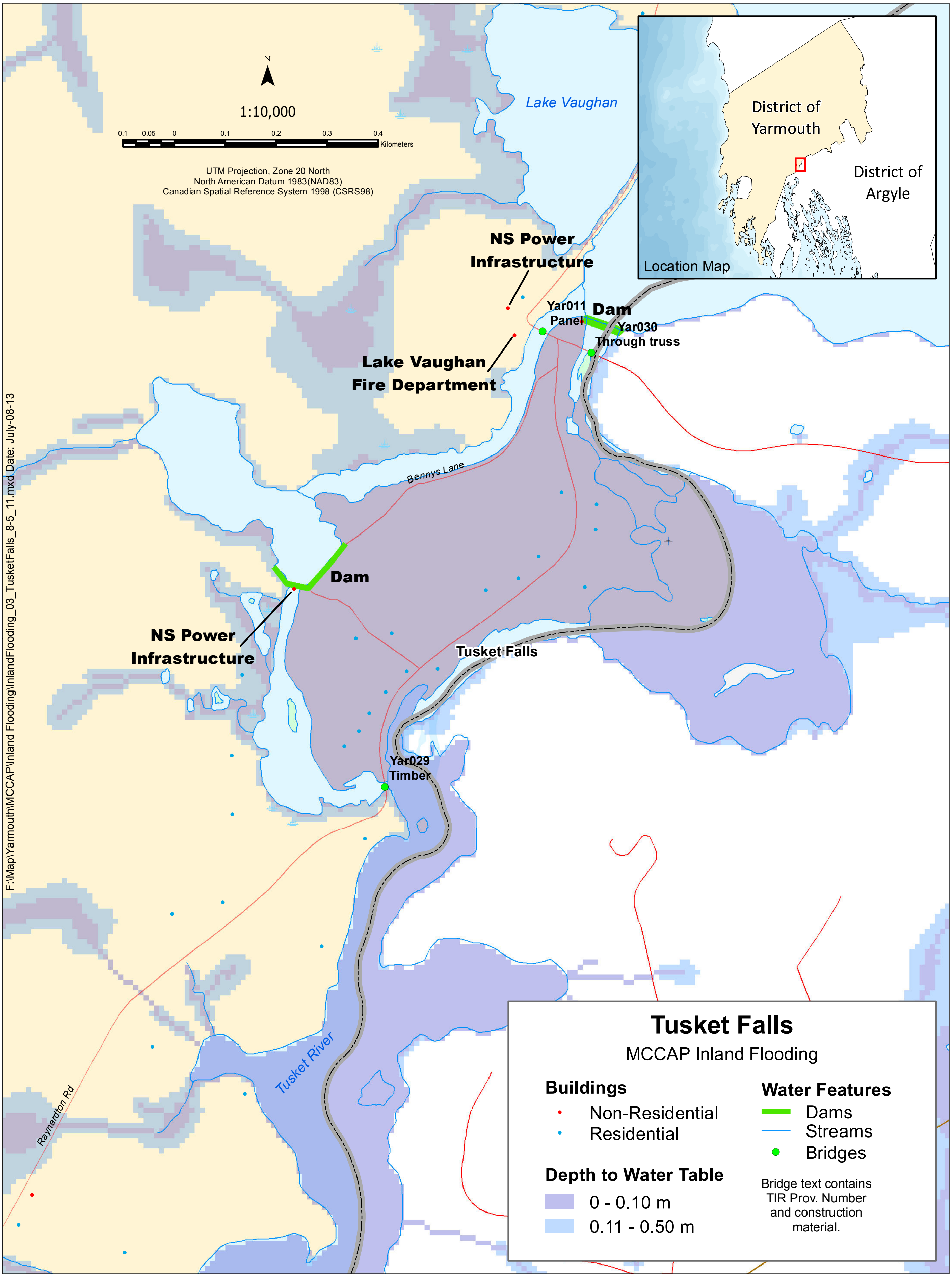
Appendix C: Inland Flood Maps



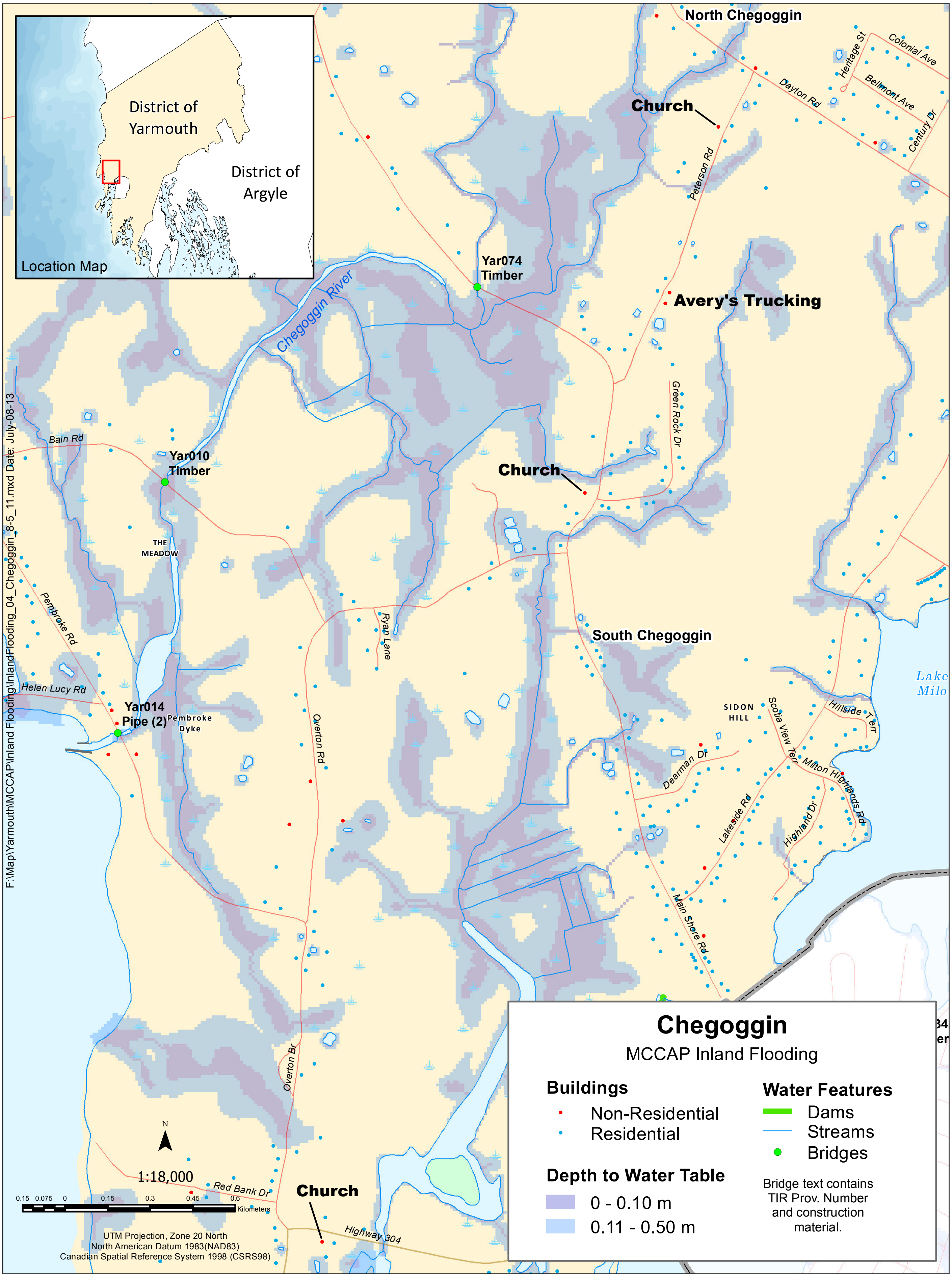
YARMOUTH HARBOUR
1:15,000
0.15 0.075 0 0.15 0.3 0.45 0.6 Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
District of Yarmouth
District of Argyle
Location Map
Batery Point
Litle Thrum Cap
Thrum Cap
Bunker Island
Bunkers Island Rd
Chebogue Rd
Yar079 Concrete
Meadow View Lane
Sand Beach
Courtney Lane
Yar080 Concrete
Regent St
Wyman Rd
Broad Brook
Ellis Rd
Yar128 Concrete
Sunday Point Rd
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_01_BroadBrook_8-5_11.mxd Date: July-08-13
Broad Brook
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.

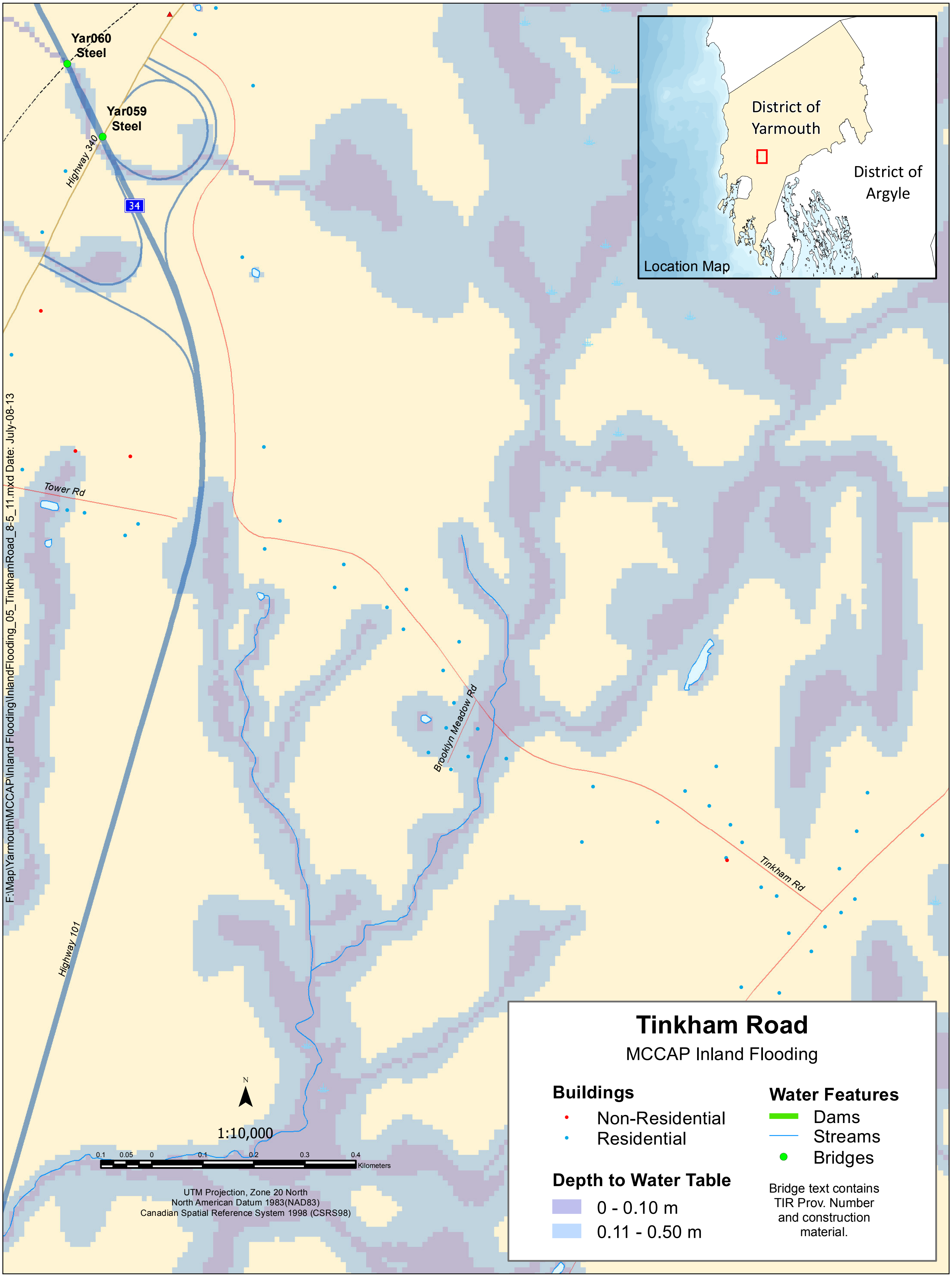


1:10,000
0.1 0.05 0 0.1 0.2 0.3 0.4
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
District of Yarmouth
District of Argyle
Location Map
Arcadia Auto Repair
Church
Arcadia
Ground Search and Rescue
Yar055 Concrete
The Last Rd
Metal Pro Machine Shop
Post Office
Arcadia School
Pump Stations
Gordon Muise Service Centre
Arcadia Convenience Store
Highway 3
Small Gains Rd
Arcadia Station Rd
Chebogue Rd
River Lane
Dunhams Landing Rd
Kinney Hill Rd
MacDonald Rd
Peth Rd
Chebogue River
Highway 334
Melbourne Rd
Jacquards Cnr
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_02_Arcadia_8-5_11.mxd Date: July-08-13
Arcadia
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.

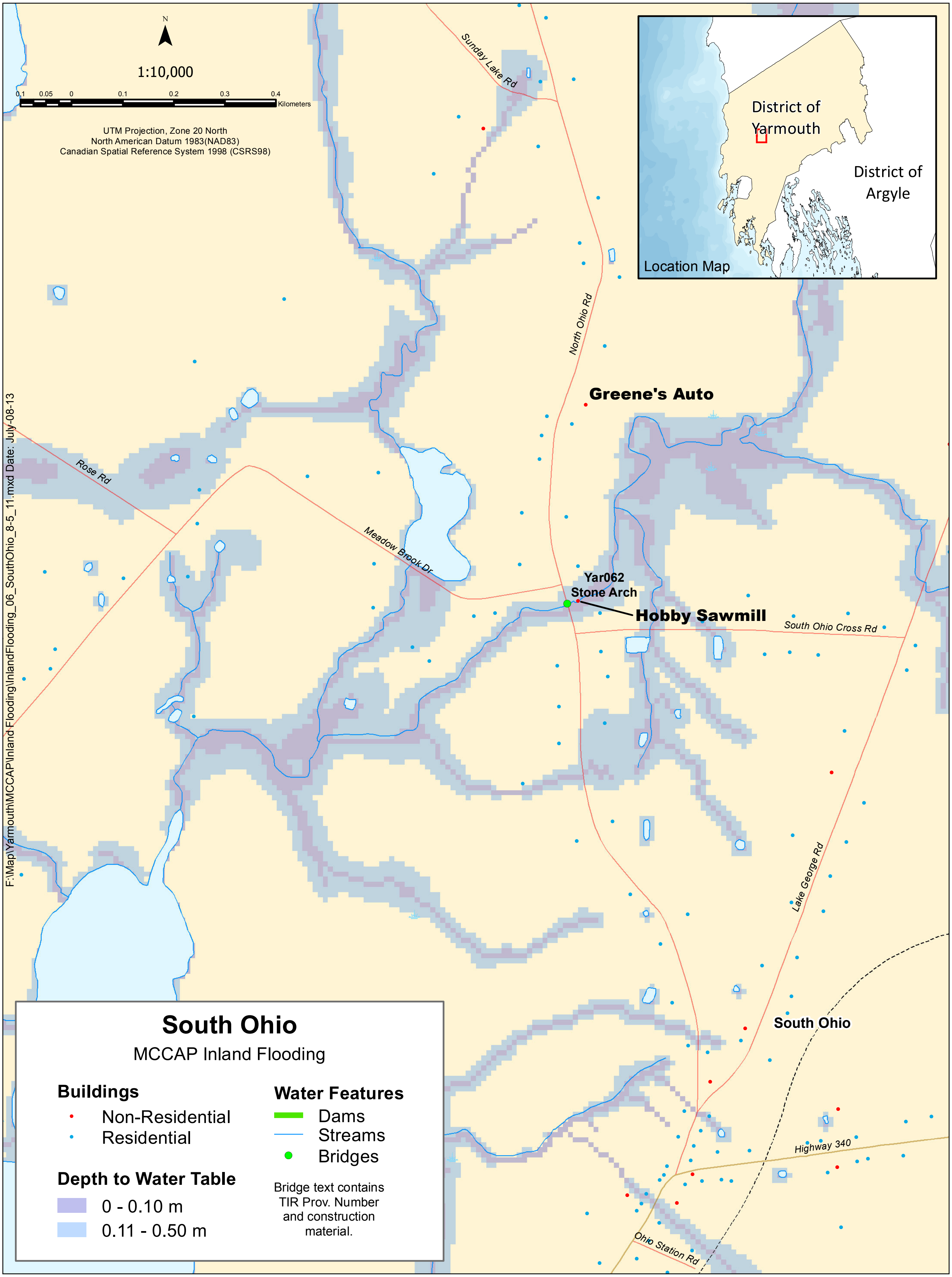


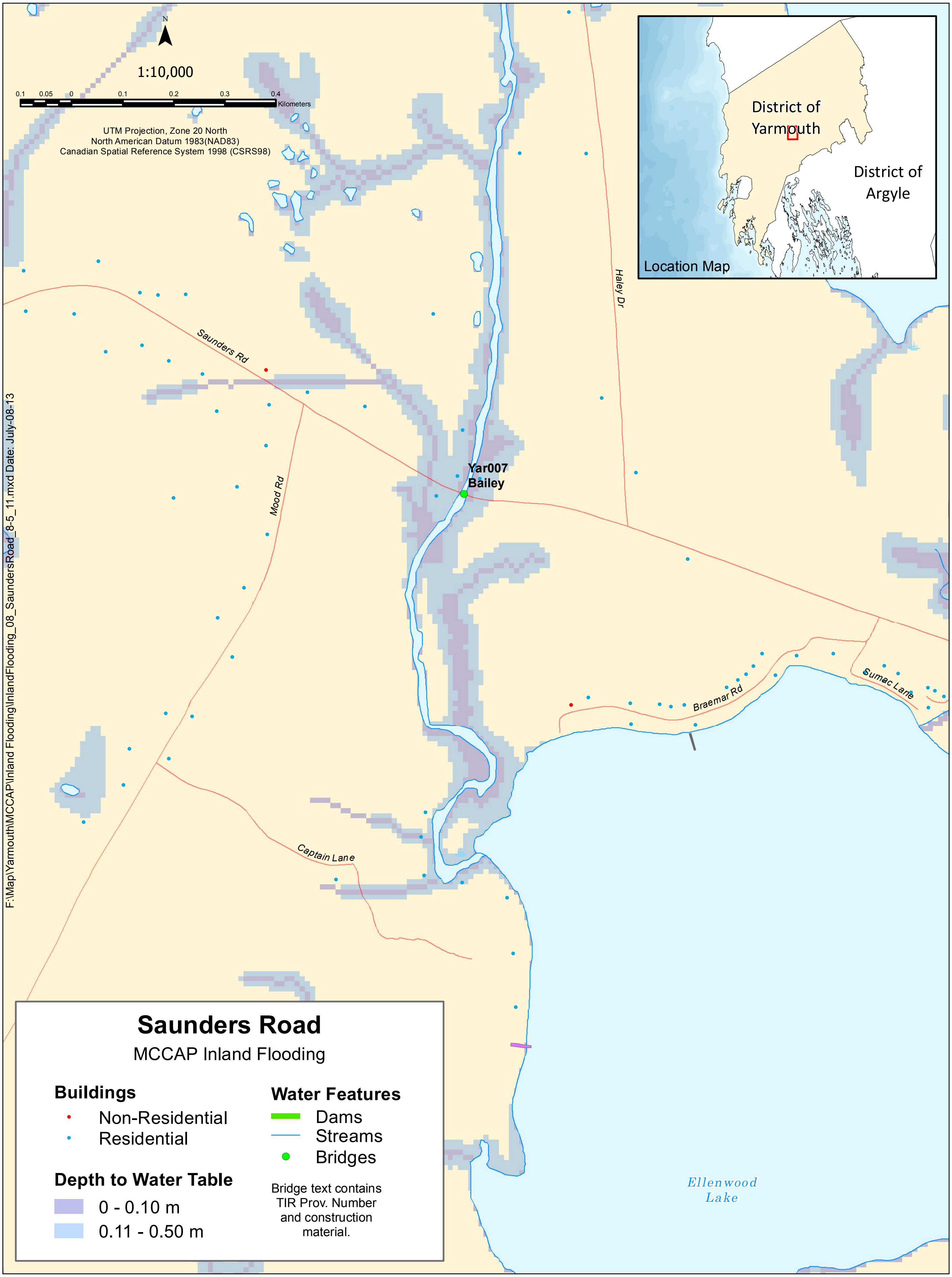
N
1:10,000
0.1 0.05 0 0.1 0.2 0.3 0.4
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Lake Vaughan
District of Yarmouth
District of Argyle
Location Map
NS Power Infrastructure
Yar011 Panel
Dam
Yar030 Through truss
Lake Vaughan Fire Department
Bennys Lane
Dam
NS Power Infrastructure
Tusket Falls
Yar029 Timber
Tusket River
Raynardton Rd
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_03_TusketFalls_8-5_11.mxd Date: July-08-13
Tusket Falls
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.


Chegoggin
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.
Location Map
District of Yarmouth
District of Argyle
North Chegoggin
Church
Avery's Trucking
South Chegoggin
Chegoggin River
Yar074 Timber
Yar010 Timber
Yar014 Pipe (2)
Pembroke Dyke
THE MEADOW
SIDON HILL
Lake Milo
Bain Rd
Pembroke Rd
Helen Lucy Rd
Overton Rd
Overton Br
Ryan Lane
Green Rock Dr
Peterson Rd
Dayton Rd
Heritage St
Colonial Ave
Bellmont Ave
Century Dr
Dearman Dr
Scotia View Terr
Hillside Terr
Milton Highlands Rd
Lakeside Rd
Highland Dr
Main Shore Rd
Red Bank Dr
Highway 304
N
1:18,000
0.15 0.075 0 0.15 0.3 0.45 0.6
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_04_Chegoggin_8-5_11.mxd Date: July-08-13

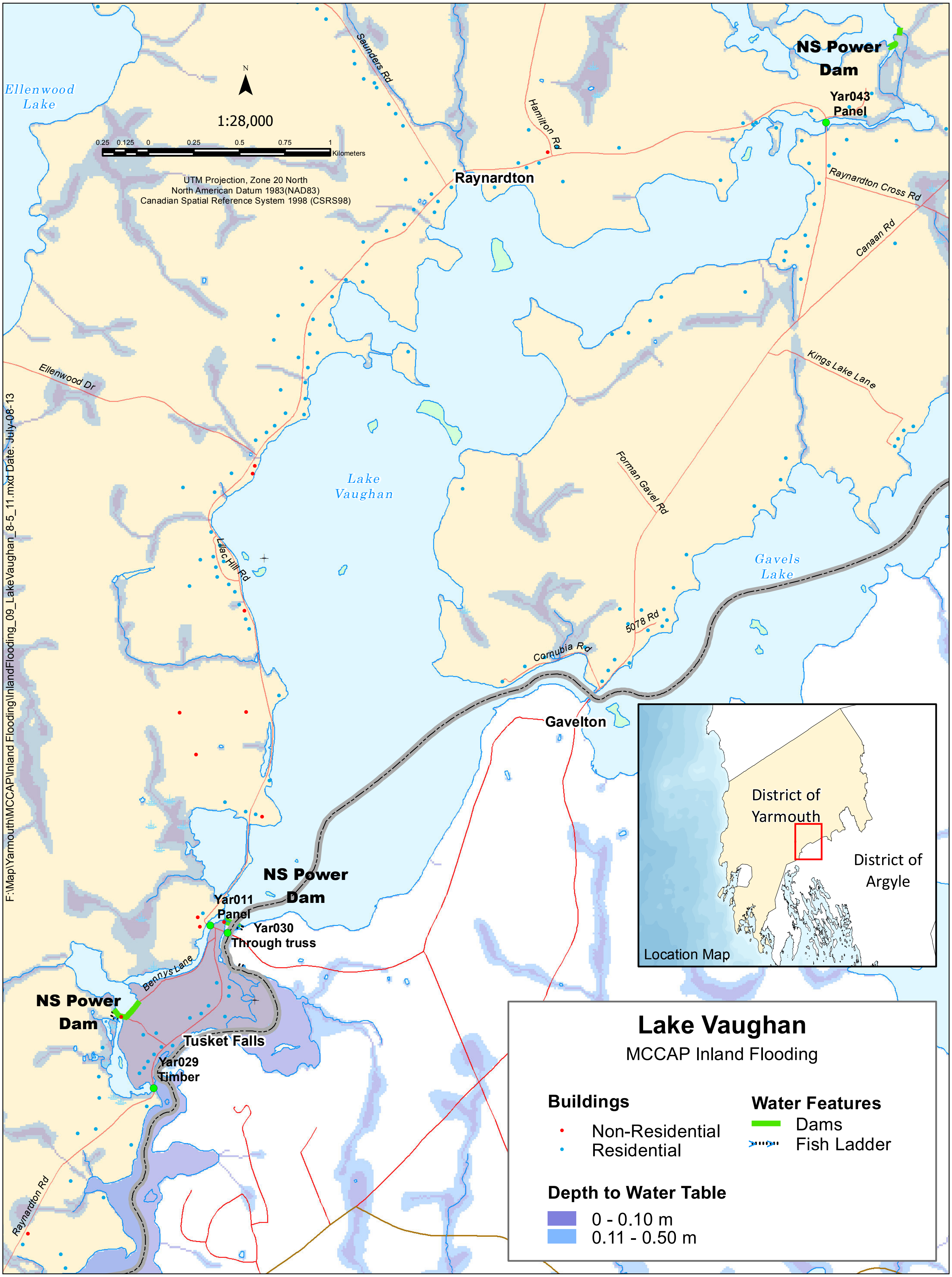


Yar060
Steel
Yar059
Steel
Highway 340
34
Tower Rd
Brooklyn Meadow Rd
Tinkham Rd
Highway 101
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_05_TinkhamRoad_8-5_11.mxd Date: July-08-13
District of
Yarmouth
District of
Argyle
Location Map
Tinkham Road
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains
TIR Prov. Number
and construction
material.
N
1:10,000
0.1 0.05 0 0.1 0.2 0.3 0.4
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)


South Ohio
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.
N
1:10,000
0.1 0.05 0 0.1 0.2 0.3 0.4 Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
District of Yarmouth
District of Argyle
Location Map
Greene's Auto
Yar062
Stone Arch
Hobby Sawmill
South Ohio
Sunday Lake Rd
North Ohio Rd
Rose Rd
Meadow Brook Dr
South Ohio Cross Rd
Lake George Rd
Highway 340
Ohio Station Rd
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_06_SouthOhio_8-5_11.mxd Date: July-08-13



1:10,000
0.1 0.05 0 0.1 0.2 0.3 0.4 Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
District of Yarmouth
District of Argyle
Location Map
Saunders Rd
Haley Dr
Mood Rd
Yar007 Bailey
Braemar Rd
Sumac Lane
Captain Lane
Ellenwood Lake
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_08_SaundersRoad_8-5_11.mxd Date: July-08-13
Saunders Road
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.



Lake Vaughan
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Water Features
Dams
Fish Ladder
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
1:28,000
0.25 0.125 0 0.25 0.5 0.75 1 Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Ellenwood Lake
Lake Vaughan
Gavels Lake
Raynardton
Gavelton
Tusket Falls
NS Power Dam
Yar043 Panel
Yar011 Panel
Yar030 Through truss
Yar029 Timber
Saunders Rd
Hamilton Rd
Raynardton Cross Rd
Canaan Rd
Kings Lake Lane
Ellenwood Dr
Forman Gavel Rd
Lilac Hill Rd
5078 Rd
Cornubia Rd
Bennys Lane
Raynardton Rd
District of Yarmouth
District of Argyle
Location Map
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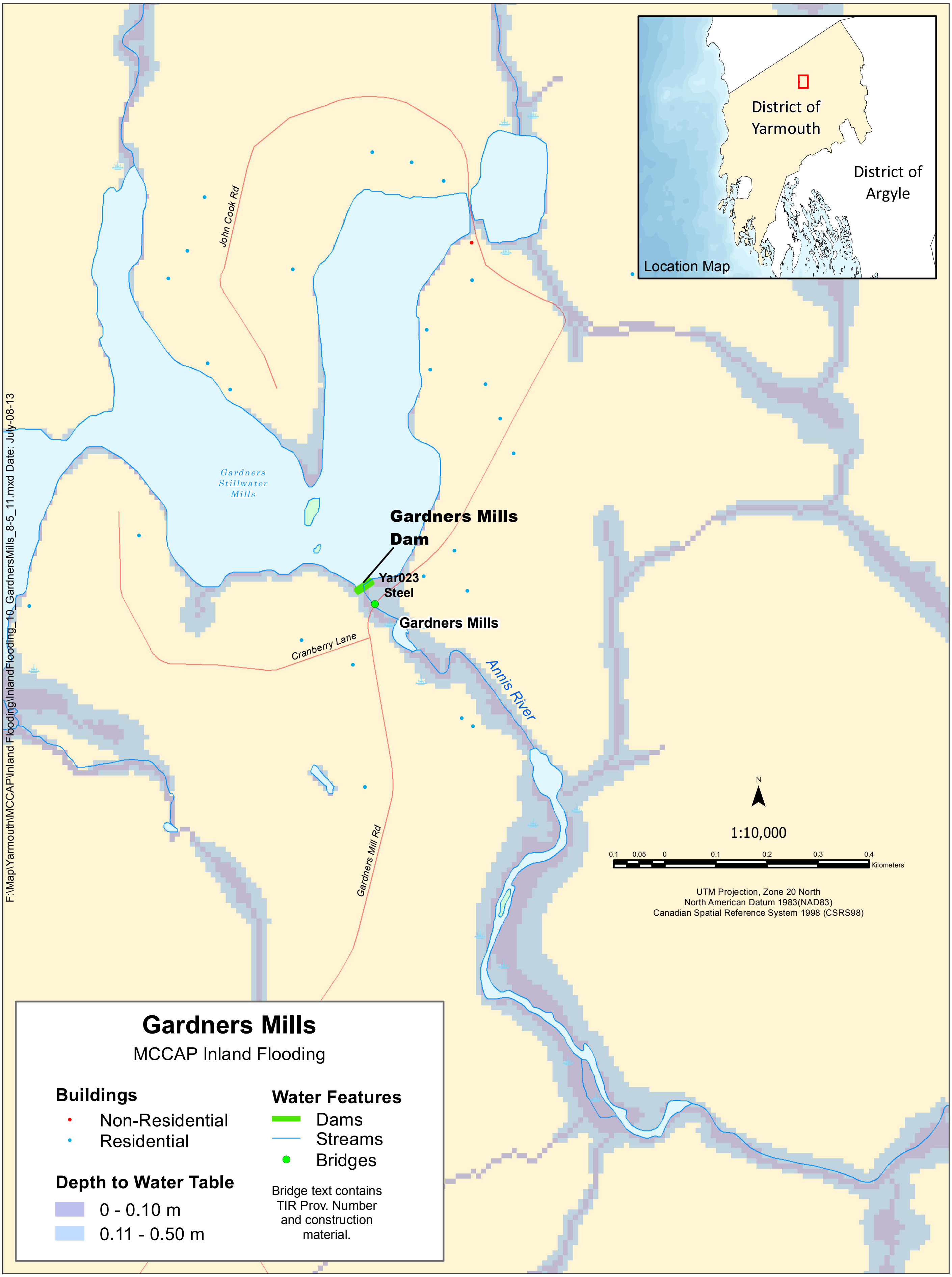
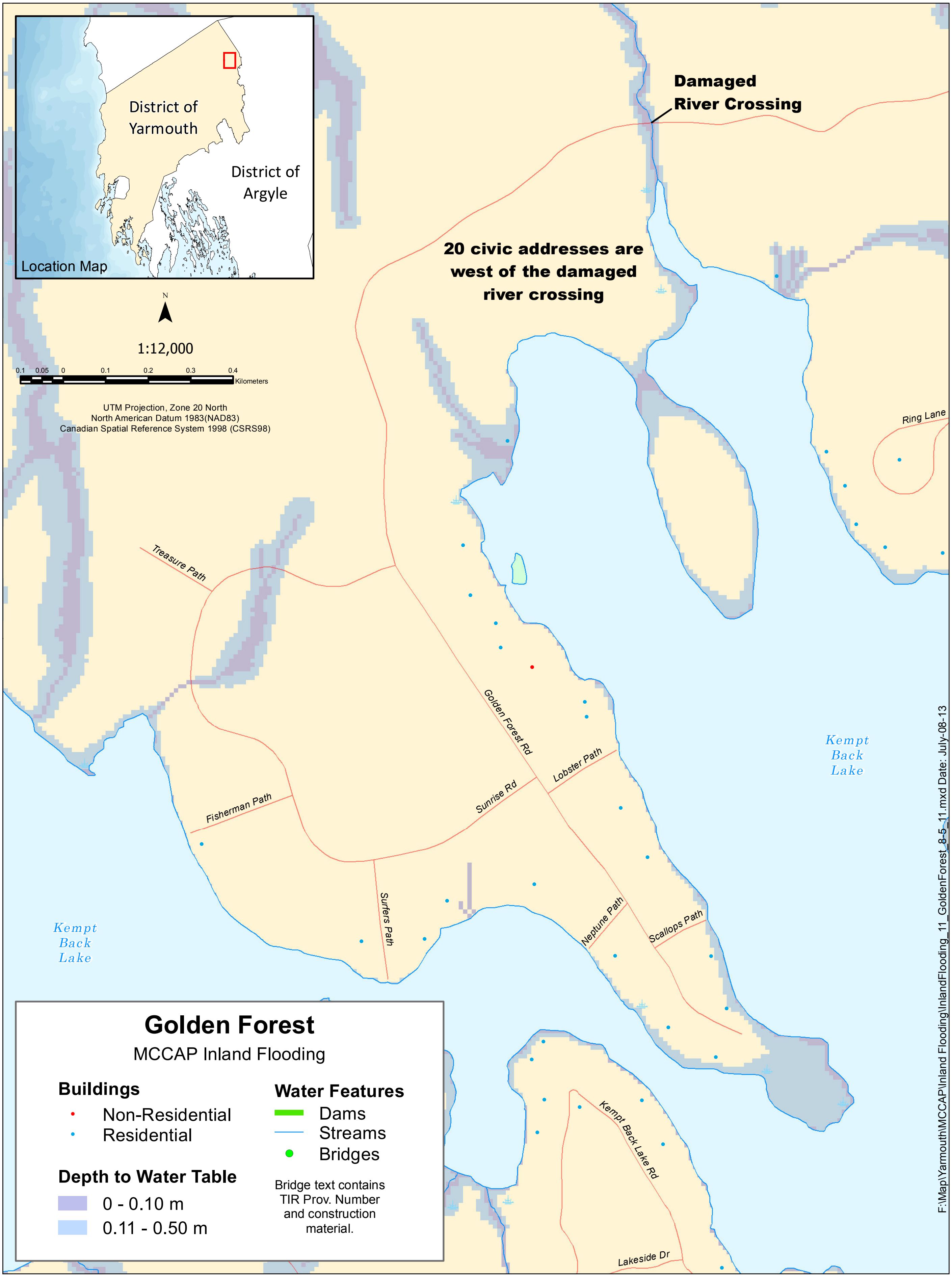
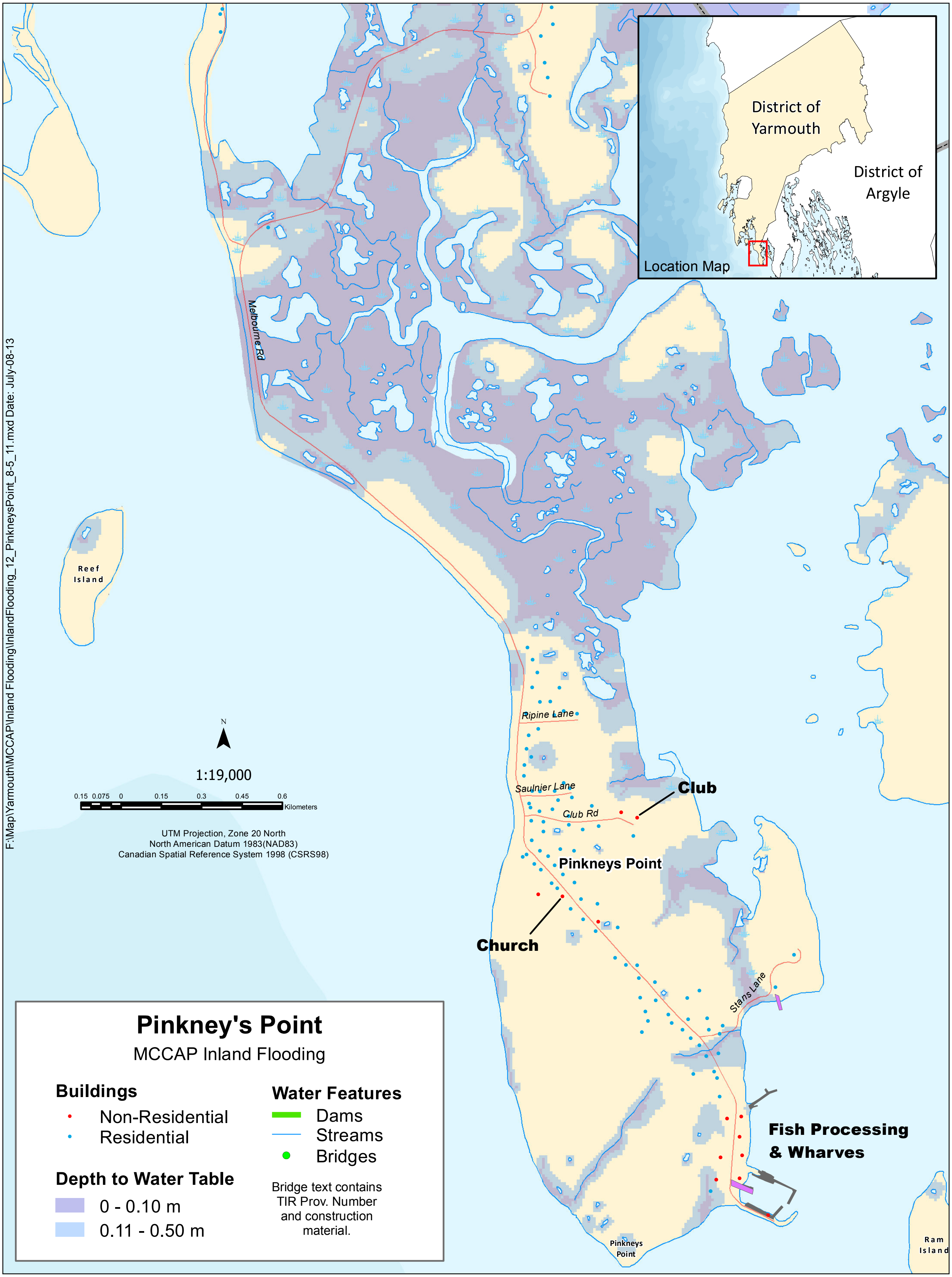
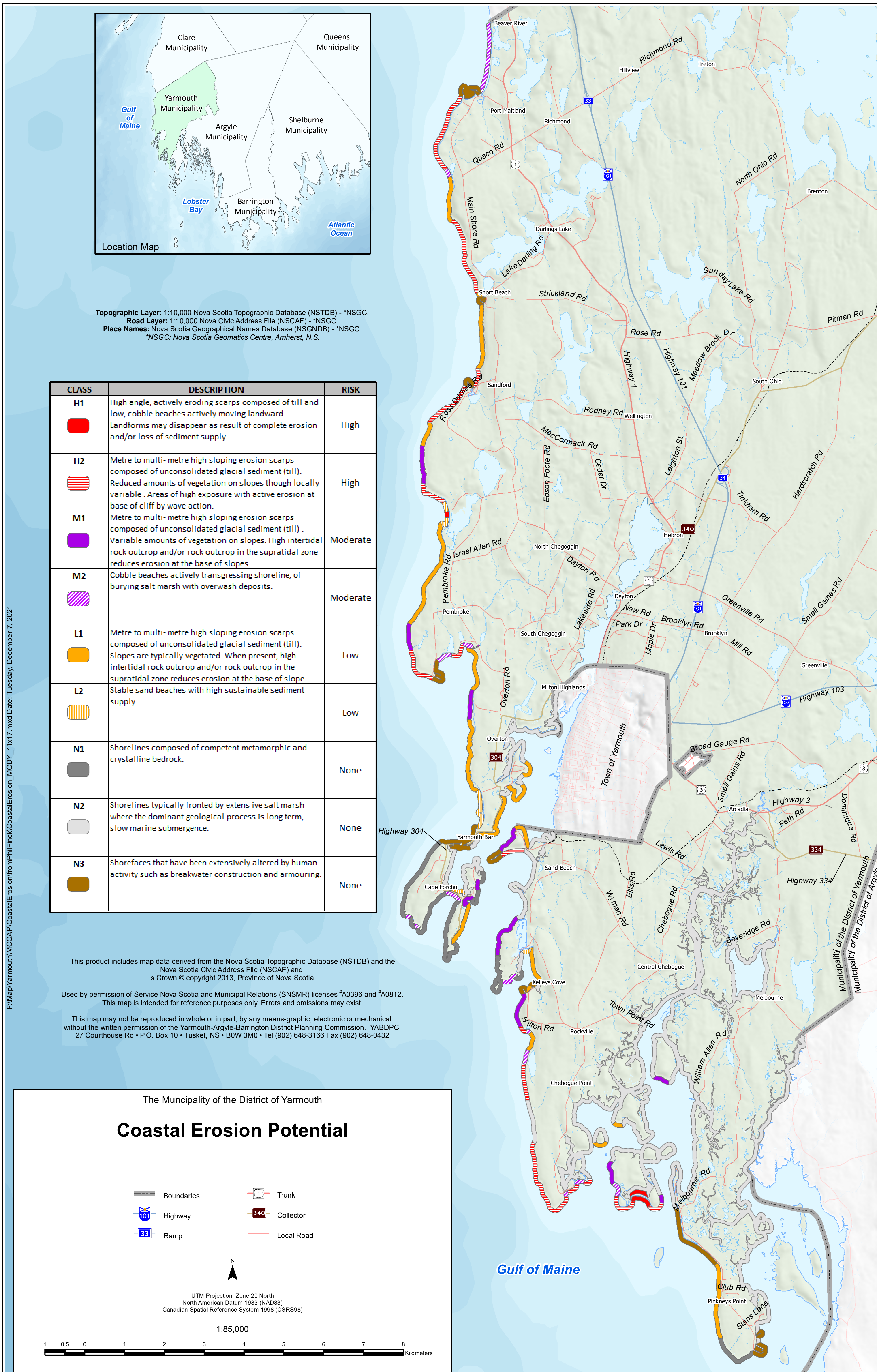

Location Map
District of Yarmouth
District of Argyle
John Cook Rd
Gardners Stillwater Mills
Gardners Mills Dam
Yar023 Steel
Gardners Mills
Cranberry Lane
Annis River
Gardners Mill Rd
N
1:10,000
0.1 0.05 0 0.1 0.2 0.3 0.4
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_10_GardnersMills_8-5_11.mxd Date: July-08-13
Gardners Mills
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.



Golden Forest
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.
Location Map
District of Yarmouth
District of Argyle
1:12,000
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
Damaged River Crossing
20 civic addresses are west of the damaged river crossing
Kempt Back Lake
Kempt Back Lake
Treasure Path
Golden Forest Rd
Lobster Path
Sunrise Rd
Fisherman Path
Surfers Path
Neptune Path
Scallops Path
Ring Lane
Kempt Back Lake Rd
Lakeside Dr
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_11_GoldenForest_8-5_11.mxd Date: July-08-13


Pinkney's Point
MCCAP Inland Flooding
Buildings
Non-Residential
Residential
Depth to Water Table
0 - 0.10 m
0.11 - 0.50 m
Water Features
Dams
Streams
Bridges
Bridge text contains TIR Prov. Number and construction material.
1:19,000
0.15 0.075 0 0.15 0.3 0.45 0.6
Kilometers
UTM Projection, Zone 20 North
North American Datum 1983(NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
N
District of Yarmouth
District of Argyle
Location Map
Melbourne Rd
Reef Island
Ripine Lane
Saulnier Lane
Club Rd
Club
Pinkneys Point
Church
Stans Lane
Fish Processing & Wharves
Pinkneys Point
Ram Island
F:\Map\Yarmouth\MCCAP\Inland Flooding\InlandFlooding_12_PinkneysPoint_8-5_11.mxd Date: July-08-13

Appendix D: Coastal Erosion Susceptibility Maps



The Muncipality of the District of Yarmouth

Coastal Erosion Potential

Topographic Layer: 1:10,000 Nova Scotia Topographic Database (NSTDB) - *NSGC.
Road Layer: 1:10,000 Nova Civic Address File (NSCAF) - *NSGC.
Place Names: Nova Scotia Geographical Names Database (NSGNDB) - *NSGC.
NSGC: Nova Scotia Geomatics Centre, Amherst, N.S.

CLASS	DESCRIPTION	RISK
H1	High angle, actively eroding scarps composed of till and low, cobble beaches actively moving landward. Landforms may disappear as result of complete erosion and/or loss of sediment supply.	High
H2	Metre to multi- metre high sloping erosion scarps composed of unconsolidated glacial sediment (till). Reduced amounts of vegetation on slopes though locally variable . Areas of high exposure with active erosion at base of cliff by wave action.	High
M1	Metre to multi- metre high sloping erosion scarps composed of unconsolidated glacial sediment (till) . Variable amounts of vegetation on slopes. High intertidal rock outcrop and/or rock outcrop in the supratidal zone reduces erosion at the base of slopes.	Moderate
M2	Cobble beaches actively transgressing shoreline; of burying salt marsh with overwash deposits.	Moderate
L1	Metre to multi- metre high sloping erosion scarps composed of unconsolidated glacial sediment (till). Slopes are typically vegetated. When present, high intertidal rock outcrop and/or rock outcrop in the supratidal zone reduces erosion at the base of slope.	Low
L2	Stable sand beaches with high sustainable sediment supply.	Low
N1	Shorelines composed of competent metamorphic and crystalline bedrock.	None
N2	Shorelines typically fronted by extens ive salt marsh where the dominant geological process is long term, slow marine submergence.	None
N3	Shorefaces that have been extensively altered by human activity such as breakwater construction and armouring.	None

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UTM Projection, Zone 20 North
North American Datum 1983 (NAD83)
Canadian Spatial Reference System 1998 (CSRS98)

1:85,000

F:\Map\Yarmouth\MCCAP\CoastalErosion\fromPhilFinck\CoastalErosion_MODY_11x17.mxd Date: Tuesday, December 7, 2021

Appendix E: Infrastructure Preliminary Risk Assessment

Climate Change Adaptation Plan

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Water System																				
Water Source (Wells, Surface Water, Other)	L	1	N	0	L	1	N	0	L	1	L	1	N	0	N	0	N	0	**4**	**L**
Water Treatment Plant	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Storage Facilities	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Pumping Facilities	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Distribution System	N	0	L	1	N	0	N	0	L	1	N	0	N	0	N	0	N	0	**2**	**L**
Individual Water Service Lines	N	0	L	1	N	0	N	0	L	1	N	0	N	0	N	0	N	0	**2**	**L**
Total	**1**		**2**		**1**		**0**		**3**		**1**		**0**		**0**		**0**		**8**	
Sanitary Sewer System																				
Wastewater Treatment Plant	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Buildings	N	0	N	0	N	0	N	0	L	1	L	1	N	0	N	0	N	0	**2**	**L**
Wastewater Gravity Sewer	L	1	N	0	L	1	N	0	L	1	N	0	N	0	N	0	N	0	**3**	**L**
Wastewater Pressure Sewer (Forcemain)	L	1	N	0	L	1	N	0	L	1	N	0	N	0	N	0	N	0	**3**	**L**
Pumping Stations	L	1	L	1	L	1	N	0	L	1	L	1	N	0	N	0	N	0	**5**	**L**
Total	**3**		**1**		**3**		**0**		**4**		**2**		**0**		**0**		**0**		**13**	

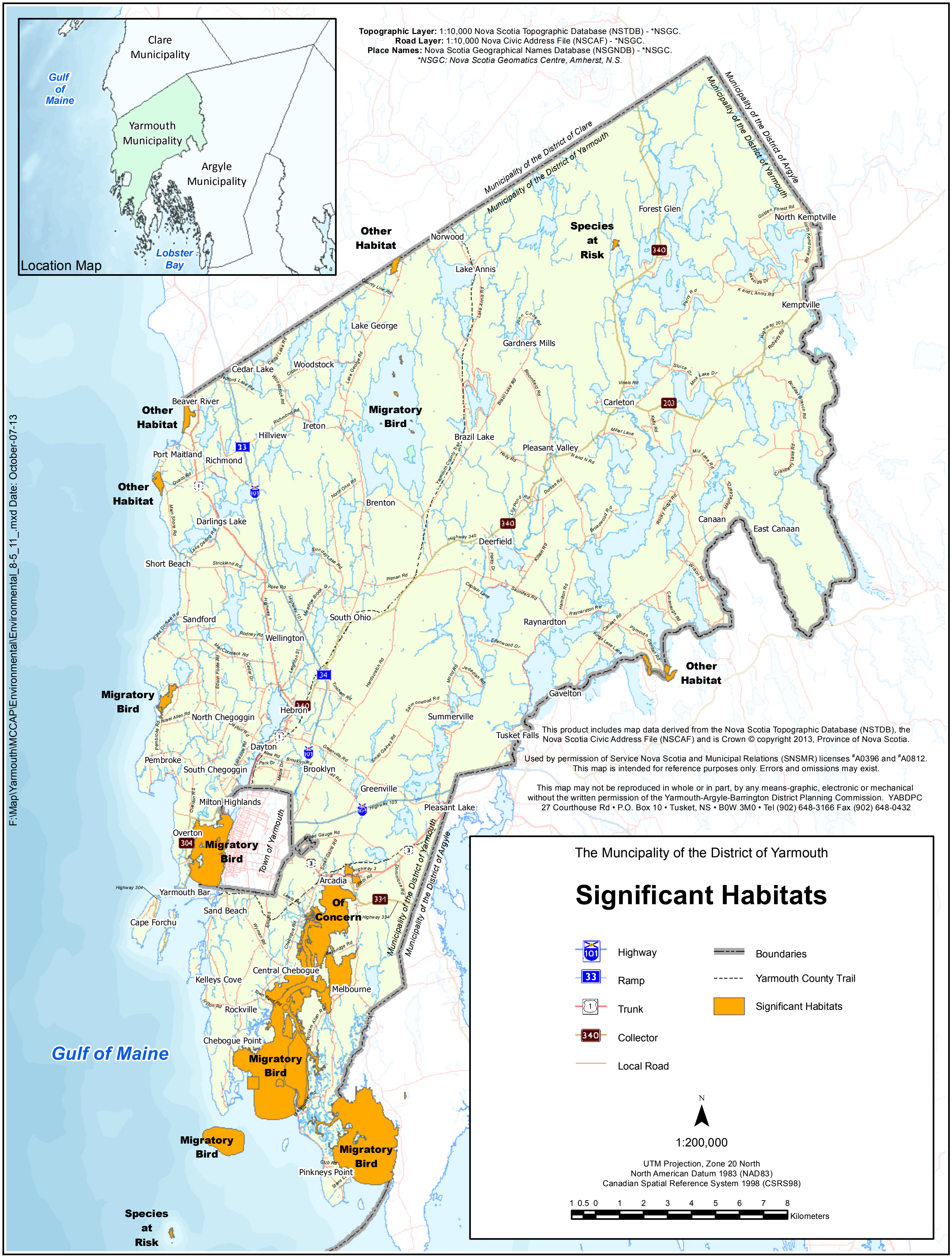
Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Storm Sewer System																				
Catchbasins	N	0	N	0	L	1	N	0	L	1	N	0	N	0	N	0	N	0	**2**	**L**
Manholes	N	0	N	0	L	1	N	0	L	1	N	0	N	0	N	0	N	0	**2**	**L**
Pipes	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**2**		**0**		**2**		**0**		**0**		**0**		**0**		**4**	
Municipal Buildings																				
Buildings	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**	
Landfills/Solid Waste Facilities																				
Flooding	N	0	L	1	L	1	N	0	N	0	N	0	N	0	N	0	N	0	**2**	**L**
Access Road	N	0	L	1	L	1	N	0	N	0	N	0	N	0	N	0	N	0	**2**	**L**
Leachate Collection	N	0	L	1	L	1	N	0	N	0	N	0	N	0	N	0	N	0	**2**	**L**
Leachate Treatment	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Buildings	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**3**		**3**		**0**		**0**		**0**		**0**		**0**		**0**		**6**	
Dams																				
Flooding	L	1	L	1	M	2	N	0	M	2	N	0	N	0	N	0	N	0	**6**	**L**
Control Gates	L	1	L	1	L	1	N	0	L	1	N	0	L	1	N	0	N	0	**5**	**L**
Access Road	L	1	L	1	L	1	N	0	L	1	N	0	N	0	N	0	N	0	**4**	**L**
Fish Passage	L	1	L	1	L	1	N	0	L	1	N	0	N	0	N	0	N	0	**4**	**L**

Municipal Asset	Sea Level Rise	Precipitation (extreme event)		Extreme Wind	Flooding	Temperature		Erosion	Earthquake	Total	Risk
		Snow	Rain			High	Low				
Total	**4**	**4**	**5**	**0**	**5**	**0**	**1**	**0**	**0**	**19**	

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Roads																				
Bridges	L	1	L	1	L	1	M	2	M	2	N	0	L	1	N	0	N	0	**8**	**L**
Traffic Signals	N	0	N	0	N	0	L	1	N	0	N	0	N	0	N	0	N	0	**1**	**L**
Street Lighting	N	0	N	0	N	0	L	1	N	0	N	0	N	0	N	0	N	0	**1**	**L**
Signs	N	0	N	0	N	0	L	1	N	0	N	0	N	0	N	0	N	0	**1**	**L**
Culverts	N	0	L	1	L	1	N	0	L	1	N	0	N	0	N	0	N	0	**3**	**L**
Sidewalks	N	0	L	1	N	0	N	0	L	1	N	0	L	1	N	0	N	0	**3**	**L**
Local Roads	L	1	L	1	L	1	N	0	M	2	N	0	L	1	N	0	N	0	**6**	**L**
Collectors	N	0	L	1	L	1	N	0	M	2	N	0	L	1	N	0	N	0	**5**	**L**
Total	**2**		**5**		**4**		**5**		**8**		**0**		**4**		**0**		**0**		**28**	

*Please note all of the drop boxes must be filled in for each of the asset classes

Appendix F: Significant Species and Habitat Map



Topographic Layer: 1:10,000 Nova Scotia Topographic Database (NSTDB) - *NSGC.
Road Layer: 1:10,000 Nova Civic Address File (NSCAF) - *NSGC.
Place Names: Nova Scotia Geographical Names Database (NSGNDB) - *NSGC.
*NSGC: Nova Scotia Geomatics Centre, Amherst, N.S.
Location Map
Clare Municipality
Yarmouth Municipality
Argyle Municipality
Gulf of Maine
Lobster Bay
Municipality of the District of Clare
Municipality of the District of Yarmouth
Municipality of the District of Argyle
Town of Yarmouth
Other Habitat
Species at Risk
Migratory Bird
Of Concern
Gulf of Maine
Norwood
Forest Glen
North Kemptville
Lake Annis
Kemptville
Lake George
Gardners Mills
Cedar Lake
Woodstock
Beaver River
Carleton
Ireton
Hillview
Brazil Lake
Port Maitland
Richmond
Pleasant Valley
Brenton
Darlings Lake
Canaan
East Canaan
Deerfield
Short Beach
South Ohio
Raynardton
Sandford
Wellington
Gavelton
Hebron
North Chegoggin
Summerville
Tusket Falls
Dayton
Pembroke
South Chegoggin
Brooklyn
Greenville
Milton Highlands
Pleasant Lake
Overton
Arcadia
Yarmouth Bar
Sand Beach
Cape Forchu
Central Chebogue
Kelleys Cove
Melbourne
Rockville
Chebogue Point
Pinkneys Point
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The Muncipality of the District of Yarmouth
Significant Habitats
Highway
Ramp
Trunk
Collector
Local Road
Boundaries
Yarmouth County Trail
Significant Habitats
N
1:200,000
UTM Projection, Zone 20 North
North American Datum 1983 (NAD83)
Canadian Spatial Reference System 1998 (CSRS98)
1 0.5 0 1 2 3 4 5 6 7 8
Kilometers
F:\Map\Yarmouth\MCCAP\Environmental\Environmental_8-5_11_.mxd Date: October-07-13

Appendix G: Bridges Inventory

Prov. Number	Bridge Name	Road	Location	Over	Structure Type
Yar005	Salmon River Bridge	Trunk #3	.45 km North East from Lakeview Cresent	Annis River	Timber
Yar006	Tusket Bridge	Trunk #3	.252 KM east of intersection of Raynardton Road & Trunk #3	Tusket Falls outlet	Steel
Yar007	Alders Bridge	Saunders Road	3.64km from Raynardton Road	Annis River	Bailey
Yar010	Bains Bridge	Bains Road	.64 from Shore Road	Chegoggin River	Timber
Yar011	Canal Bridge	Raynardton Road	.031 km West of intersection Lake Vaughn Road and Raynardton Road	NS Power Canal	Panel
Yar013	Carleton Bridge	Route #203	300 meters south of Route #340	Carleton River	Concrete Girder
Yar014	Pembrooke Bridge	Pembrooke Road	1.03km from Overton Road	Chegoggin River	Pipe (2)
Yar015	Crosby Bridge	Crosby Road	.10km East of Bloomfield Road	Annis River	Timber
Yar016	Durkee Bridge	Durkee Road	.3km east from Route #340	Annis River	Timber
Yar019	Robicheau Bridge	L&K Annis Road	125m. From Route#340	Carleton River	Timber
Yar023	Gardners Mill Bridge	Gardeners Mill Road	1.2 km NE of Bloomfield	Annis River	Steel
Yar025	Grey's Bridge	Grays Road	2.148kmW of Intersection of Route#203 & Grays Rd.	Tusket River	Through Truss
Yar026	Haley's Bridge	Haley Drive	0.1km South of Route 340	Annis River	Timber
Yar029	Hewitt Bridge	Raynardton Road	1.6km North of Hwy 103	Tusket Canal	Timber
Yar030	Hurlburt Falls Bridge	Lake Vaughn Road	.056km South of In. Raynardton & Vaughn Roads	Tusket Falls	Through truss
Yar034	Milton Bridge	Vancouver St.	0.1k West of Main St.	Yarmouth Harbour	Timber
Yar035	Mood Bridge	Mood Road	4.05km North of Hwy 103	Annis River	Timber
Yar038	Dayton Narrows Bridge	Dayton Road	100m. From Trunk 1 at Dayton	Dayton Lake	Timber
Yar039	Pleasant Valley #1 Bridge	Hamilton Road	200m. From Route 340	Annis River	Steel
Yar040	Pleasant Valley #2 Bridge	Route 340	7.14 km from Brazil Lake	Annis River	Timber
Yar041	Port Maitland Bridge	Main Shore Road	600m. North of Trunk #1 in Port Maitland	Tidal	Pony Truss
Yar042	Rankin Bridge	N. Kemptville Road	4.351km North of Int. N. Kemptville Road & Grays Rd.	Tusket River	Throuth Truss
Yar043	Raynardton Bridge	Raynardton Road	9.8km inland from Hwy. 103 at Tusket	Tusket River	Panel
Yar044	Sisco Bridge	Greenville Road	476m from Trunk #3	Annis River	Timber
Yar045	Wilson Falls Bridge	Wilson Road	3.319km East of Int. Canaan Rd. & Wilson Road	Tusket River	Throuth Truss
Yar051	Tusket River Bridge	Highway 103	0.4km from Raynardton Rd. on Hwy. 103	Tusket River	Concrete
Yar052	Annis River #1 Bridge	Highway 103	0.12km West from Mood Road	Annis River	Concrete
Yar053	Greenville Road O/P Bridge on 103	Greenville Road	1.79km from Trunk 3	Highway 103	Steel
Yar055	Arcadia Bridge	Trunk #3	1.0km East from Chebogue Road	Chebogue River	Concrete
Yar057	Greenville Road O/P Bridge on 101	Greenville Road	4.1km SE on Hwy 101 from Exit 35	Highway 101	Steel
Yar058	Joel Crowell Bridge	Cemetary Road	135 m from Leighton Road	Ohio	Timber
Yar059	Hebron 340 O/P Bridge on 101	Route 340	7.2km North of Exit 35 (Starrs Road)	Highway 101	Steel
Yar060	Hebron DAR O/P Bridge on 101	Route 340	0.157km East of Int.Route 340 & Hwy 101	Highway 101	Steel
Yar061	Ohio River Bridge	Highway 101	820m East of Route 340	Ohio Mill Stream	Concrete Box
Yar062	North Ohio Road Bridge	North Ohio Road	3.7km North of Hwy 101 Int.at Hebron (Exit 34)	Ohio Mill Stream	Stone Arch
Yar063	Richmond Road O/P Bridge on 101	Richmond Road	3.24km West of Digby/Yarmouth Co. Line	Highway 101	Concrete
Yar069	Cape Forchue Bridge	Route 304	2.12km from Bayview Rd. on Route 304	Tidal	Steel Girder
Yar070	Beaver Lake Bridge	Trunk 1	2.9km East of Exit 3 at Trunk 1	Beaver Lake Outlet	Stone Arch
Yar071	Allen's Brook Bridge	Main Shore Road	0.5km East of Darling Lake Road	Brook	Multi-plate
Yar072	Sandy Shaw Bridge	MacCormack Road	580m South of Main Shore Road	Chegoggin River	Timber
Yar073	Brown's Multiplate	Brown Road	0.2km inland from Main Shore Road	Chegoggin River	Multi-plate
Yar074	Chegoggin Marsh Bridge	Main Shore Road	3.71km from Trunk 1 at Yarmouth	Chegoggin River	Timber
Yar075	Hebron Bridge	Trunk 1	1.2km West of McCormack Road	Ohio Mill Stream	Concrete Box
Yar076	Happy Hollow Bridge	Happy Hollow Road	1.2km West of McCormack Road	Ohio Mill Stream	Stone Arch
Yar077	Meadow Brook Bridge	Brooklyn Road	1.64km from Trunk 1	Meadow Brook	Concrete Box
Yar078	Churchill's Mill Bridge	Small Gains Road	2.06km East of Hardscratch Road	Mill Lake Brook	Steel
Yar079	Broad Brook #1 Bridge	Regent St.	0.715km towards Yarmouth from Wyman Rd.	Broad Brook	Concrete
Yar080	Broad Brook #2 Bridge	Wyman Road	0.6km inland from Sand Beach	Concrete	Concrete
Yar092	Mill Bridge	K&L Annis Road	1.07km NE from Lake Annis Road	Annis Brook	Timber
Yar093	Jake's Land Bridge	Jake's Land	East (North) end of Road at Route203	Calling Meadow Brook	Timber
Yar103	Lake Annis Bridge	Lake Annis Road	0.105km E of Int. of Norwood Rd. & Lake Annis Rd.	Annis River	Timber
Yar112	Brook Bridge	Route 340	3.6km S of Brazil Lake Rd.	Hooper Lake Inlet	Concrete
Yar113	Holley Road Multiplate Bridge	Holley Road	2.6km from Brazil Lake Rd.	Brook	Multi-plate
Yar114	County Line Bridge	Highway 101	0.267km W of Beaver River Rd. on Hwy 101	Cedar Lake Brook	Concrete Pipe (2)
Yar115	Brooklyn Bridge	Highway 101	4.91km E of Int. of Starrs Rd. & Hwy 101	Brooklyn Stream	Concrete Pipe (2)
Yar116	Churchills Bridge	Highway 103	2.797km E of Int. of Hardscratch Rd. & Hwy 103	Chebogue River	Concrete Pipe (2)
Yar117	Coggins Bridge	Highway 101	8.805km E of Int. of Route 340 & Hwy 101	Coggins Brook	Concrete Pipe (2)
Yar118	Sunday Bridge	Highway 101	4.805km E of Int. Route 340 & Hwy 101	Sunday Brook	Concrete Pipe (2)
Yar120	Brooklyn Road Underpass	Brooklyn Road	Int. Brooklyn Rd. & Hwy 101	Highway 101	Concrete
Yar121	Dayton Road Culvert	Dayton Road	3.0km W of Trunk 1	Chegoggin River	Pipe (2)
Yar122	Rodney Road Culvert	Rodney Road	2.7km W of Trunk 1	Chegoggin River	Pipe (2)
Yar123	The Brothers	Route 203	5.8km from E Kemptville Rd.	Bear Brook	Concrete Box (2)
Yar124	Telford Lake Rd. Culvert	Telford Lake Road	150m from Digby County line	Telford Lake Brook	Triple Stone Box Culvert
Yar125	Two Island Lake Bridge	Crosby Road	1.0km East from Lake George Road	Two Island Lake Brook	Pipe (2)
Yar126	Fish Hatchery Bridge	Lake George Road	130m from Junction of Richmond Road	Hatchery Brook	Stone Arch
Yar127	Reserve Road Bridge	Broad Gauge Road (Reserve Road)	800m from Junction of Small Gains Rd.	Chebogue River	Concrete Pipe (3)
Yar128	Kelleys Cove Bridge	Chebogue Road	Int. at Sunday Point Rd. & Chebogue Rd.	Broad Brook	Concrete

Appendix H: Adaptation Actions Organized by Hazard

	Coastal flooding			
ID	Action idea	Impact	Lead Dept. / Agency	Priority
6a	Assess preparedness for Emergency Response for coastal flooding.	Risk to public safety	REMO	Low
6b	Establish a REMO protocol that uses 7m CGVD28 to the water line as the area indicating high risk vulnerability during a tropical storm / hurricane with an annual exceedance probability of 1% or less (i.e., 100 year return period storm). (Note that land use planning uses the 6.5m line to delineate flood risk, but this does *not* include wave action, so actual risk to safety is acknowledged by REMO as extending beyond 6.5m).	Risk to public safety, Displacement of residents due to property damage	REMO	Medium
6c	Investigate acquiring information that will provide accurate data supporting land use planning regulations for flood proofing new developments and providing elevation setback information based on the Vertical Allowances research completed by the Bedford Institute of Oceanography[1]. A vertical allowance would maintain the same level of risk of flooding events in the future as assumed under present conditions. Flood proofing is described in Best Management Practices for Climate Change Adaptation in Dykelands: Recommendations for Fundy ACAS Sites by van Proosdij and Page (2012) for the Atlantic Climate Solutions Association (ACASA).	Risks to public safety, dis	Planning	High
6d	Develop and determine how to efficiently make available a one-two page brief describing what is understood regarding the risk of overland flooding and susceptibility to erosion to citizens if requested.	Risks to public safety, dis	Planning	Low
6e	Establish a municipal policy that flood risk be taken into consideration for any municipal infrastructure given Plausible Upper Bound water level scenarios[1] (e.g., utilities located above the worst case flood elevation line).	Erosion, Property damage	Planning	Medium
6f	Establish a municipal policy that new municipal infrastructure in the coastal zone below 7.5m CGVD28 be assessed for food risk.	Property damage (municipal)	Planning; Public Works	Medium
6g	Establish a joint municipal and REMO protocol to conduct post-storm analysis using the template created by Heather MacKenzie-Carey (HMC-EMC Inc.) and Anne Warburton (Elemental Sustainability Consulting Ltd.) in conjunction with the Atlantic Storm Prediction Centre (Weather Preparedness Meteorologist, Bob Robichaud), and have REMO keep one copy for their records (i.e., useful for future emergency preparedness planning and municipal mapping exercises) and send one copy to the Atlantic Storm Prediction Centre care of Bob Robichaud.	Risks to public safety	REMO	Low
6h	Investigate and/or confirm the maintenance regime of the tide gate protecting the Port Maitland Sewage Treatment facility, and assess the maintenance is sufficient given water level projections for a 100 year return period storm in the 2055 climate normal (i.e., the 30 year period beginning in 2020).	Utility Disruption	Public Works	High

	Wildland fire			
ID	Action idea	Impact	Lead Dept. / Agency	Priority
2a	Initiate a regional effort to discuss with DNR contingency planning for wildland fires that occur prior to April 1st. Or during decreased water supply (drought) events.	Risks to public safety	REMO	Low

	Winter Storm			
ID	Action idea	Impact	Lead Dept. / Agency	Priority
4a	Secure/build a place to store road sand/salt.	Risks to public safety	Public Works	Low

	Inland flooding			
ID	**Action idea**	**Impact**	**Lead Dept. / Agency**	**Priority**
5a	Assess preparedness for Emergency Response to Inland Flooding.	Risks to public safety,	REMO	Low
5b	Establish a municpal policy that requires an inland flood risk assessment prior to the development of, or investment in, municipal infrastructure in areas considered vulnerable to inland flooding, or areas along waterways where inland flood risk is unknown.	Property Damage	Planning	Medium
5c	Support redundancy with mapping capabilities for Emergency Preparedness Planning and use in the Emergency Operations Centre (EOC) in collaboration with the Planning Department.	Risks to public safety	Planning/REMO	Low
5d	Support provincial messaging on Climate change trends that affect response, preparedness and mitigation to the general public audience.	Risks to public safety, displacement of residents due to property damage, property damage	REMO	Low

	Coastal Erosion			
ID	**Action idea**	**Impact**	**Lead Dept. / Agency**	**Priority**
7a	Hire a coastal geomorphologist or geoscientist to review a coastal erosion informational sheet in collaboration with municipal staff.	Displacement and/or economic impact on residents due to property damage, infrastructure damage / transporation disruption, loss of natural, public coastal spaces	Planning	Low
7b	Post the climate change (i.e. coastal risks) informational sheet on the municipal website.	Infrastructure Damage and Displacement	Planning	Low
7c	Consider adding to municipal planning strategy the intent to require coastal erosion site assessments for developments.	Property damage and Displacement	Planning	Low
7d	Consider hosting a seminar on armouring the coast, targeted to those employed in this work, and property owners who have, or are considering armouring as a coastal protection option.	Displacement and/or economic impact on residents due to property damage	Planning	Low
7e	Develop a project that assesses the historic rate of coastal erosion in the H2 and M1 areas, *and establishes* a long term system for measuring future rates of erosion in MoDY. This system, once in place, could be periodically updated at a very low cost (e.g., a yearly basis and if necessary after major storm events) by community volunteers and local land owners.	Displacement and/or economic impact on residents due to property damage, infrastructure damage / transporation disruption, loss of natural, public coastal spaces	Planning	Low

	Extreme heat			
ID	Action idea	Impact	Lead Dept. / Agency	Priority
8a	Assess preparedness for Emergency Response to extreme heat event	Risk to public safety	REMO	Low
8b	Address the safety of municipally coordinated outdoor recreation events during hot and very hot days as defined as days that are 30°C and 35°C respectively.	Risk to public safety	Recreation	Medium

	Constrained Emergency Preparedness and Response			
ID	Action idea	Impact	Lead Dept. / Agency	Priority
9a	Develop a process / mechanism by which a REMO representative has input on planning departments recommendations to Council	Reduced capabilties to mitigate, respond to and recover from a natural hazard	Planning/REMO	Medium
9b	Develop/strengthen mapping capabilities (redundancy) for Emergency Preparedness Planning and for use in the Emergency Operations Centre (EOC) in collaboration with Planning services and ensure the Planning / GIS Technician has EOC training (i.e., make sure more than one person is able to extract and print, or create needed mapping).	Reduced capabilties to mitigate, respond to and recover from a natural hazard	Planning/REMO	Medium
9c	Encourage / support the completion of Risk Reduction Reports as stated on page 18 of the Comprehensive Emergency Management Plan, and include a risk reduction analysis for all hazards included in the MCCAP, except coastal erosion.	Reduced capabilties to mitigate, respond to and recover from a natural hazard	REMO	Low
9d	Make available (e.g., in municipal buildings) or distribute (e.g., with municipal mailing) emergency preparedness fact sheets: http://www.gov.ns.ca/nse/resources/publications.asp#EMO	Reduced capabilties to mitigate, respond to and recover from a natural hazard	REMO	Low
9e	Pursue a means of securing access to fuel (e.g., storing fuel, reserving supply) for emergency use when large storm systems are predicted (i.e., storm impacts could extend beyond 72 hours).	Reduced capabilties to mitigate, respond to and recover from a natural hazard	REMO/Public Works	Medium
9f	Liase with airport authorities to ensure they have contingency plans for weather related events and a clear protocol establishing when to contact REMO if there is the possibility that local businesses, residents, services or infrastructure may be affected.	Reduced capabilties to mitigate, respond to and recover from a natural hazard	REMO	Low
9g	Inventory which fire halls / community halls have back up generators, and the size of the generators.	Reduced capabilties to mitigate, respond to and recover from a natural hazard	REMO	Low
9h	Contact TIR to get copy of incident report / database indicating location of road repairs in District of Yarmouth. Use this information as geographically referenced historical information for EMO planning (e.g., evacuation routes).	Reduced capabilties to mitigate, respond to and recover from a natural hazard	REMO	Low

	Organizational Adaptive Capacity			
ID	Action idea	Impact	Lead Dept. / Agency	Priority
11a	Consider participating in the Nova Scotia Geomatics Centre large scale mapping program to map that portion of the municipality for which LiDAR is currently not available. Program is a 50/50 cost share for 1:2000 scale ortho photomapping. (Per map tile, client cost is $750 and cost to the province is $750)*	Inability to cope with disasters and challenges without collapsing into a different state	Planning	High
11b	Meet with Town of Yarmouth and other key neighbouring municipalities to compare MCCAP action items and identify areas for collaboration.	Inability to cope with disasters and challenges without collapsing into a different state	Planning	Low
11c	Develop a process for progress reporting and annual review on priority adaptation actions stemming in the 2013 MCCAP.	Inability to cope with disasters and challenges without collapsing into a different state	Planning/Remo	Medium
11d	Revisit natural hazard analysis in the context of changing climate conditions by end of 2020, drawing from updated municipal efforts in watershed planning, potential new mapping capacities (e.g., additional LiDAR data) and updated findings regarding sea level rise, shifts in return period storms, Bay of Fundy tidal levels, projections for precipitation, provincial information/mapping resources for groundwater quantity and quality, etc.	Inability to cope with disasters and challenges without collapsing into a different state	Planning	Medium
11e	Develop planning and design standards and that take into consideration climate change projections.	Inability to cope with disasters and challenges without collapsing into a different state	Planning	High
11f	Council incorporate planning and design standards into bylaw.	Inability to cope with disasters and challenges without collapsing into a different state	Planning/Council	High
11g	Orientation session between municipal department staff and elected officials on the way climate change trends and projections affect both municipal infrastructure and staff roles and responsibilities.	Inability to cope with disasters and challenges without collapsing into a different state	Planning/REMO/Council	Medium
	* The deliverables are: digital orthophotgraphy mosaics , 2 metre contours, Lidar LAS files (all hits and bare earth classification), bare earth DEM, and an annotation data set. The deliverables are clipped into 1:2000 sheet tiles.			