Climate Change and Architectural Conservation Resiliency:
How to Measure Environmental Impacts on Historic Sites
and their Surrounding Communities

by

Etienne Bérubé

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Etienne Bérubé

Abstract

Climate change is becoming an increasingly impactful reality in Canada. According to the Canada's Changing Climate Report 2019¹ published by the federal government, Canada is warming up twice as fast than any other region on Earth. These fast changes will transform our physical environment and threaten our architectural heritage and infrastructures.

Through research done with Professor Mariana Esponda over the last year at Carleton University, a number of climate change factors have been found which affect different Canadian regions and heritage sites. While some sites are affected by one or two threats related to their location, we singled out one region that is influenced by many factors at the same time. Forillon National Park in the Gaspésie Peninsula is at the forefront of climate change.

Today, the region is threatened by many effects. Intensifying weather conditions expose fragile centuries-old materials to unprecedented extremes. The accelerated freeze-thaw cycle throughout the seasons affects the stability of the ground, which undermines the building's structural integrity. The higher humidity levels increase the growth of mold and fungus in wood materials. In addition, more frequent hurricanes reaching the peninsula have a much more devastating effect on the coastline since the protective ice layer isn't permanently present anymore.

Directed by Professor Mariana Esponda and Professor Mario Santana Quintero, the proposed research seeks to study architectural heritage site's adaptability and resiliency towards climate change and identify what the risks are. Most historic buildings in Forillon National Park sit vacant all year round, making them more vulnerable to our changing environment. Solutions found from studying Forillon could be adapted to other historic sites across the country. This research has the potential to provide solutions to our changing environment at a macro-scale by focusing on micro elements in highly specific conditions.

Key words

Heritage	Climate Change	Community	Architecture
- Historic Sites	- Nature	- Gaspésie	- Mitigation and strategies
- Values	- Landscape	- Fishery	- Design
- Community	- Climate Vulnerability Index	- Tourism	- Resilience
- Forillon	- Risk Mitigation	- Sustainability	- Adaptability
- Function	- Risk Assessment	- Land use	- Conservation
		- Expropriation	

¹ Environment and Climate Change Canada, "Canada's Changing Climate Report 2019", April 2, 2019. Accessed August 15, 2019. <https://changingclimate.ca/CCCR2019/>

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List of Abbreviations

CDG – Côte-de-Gaspé

CVI – Climate Vulnerability Index

ESC – Economic, social, cultural

FNP – Forillon National Park

GSA – General Services Administration

HONO – The Heart of Neolithic Orkney

ICOMOS – International Council on Monuments and Sites

IUCN – International Union for Conservation of Nature

ICCROM – International Centre for the Study of the Preservation and Restoration of Cultural Property

NHS – National Historic Sites of Canada

NP – National Park of Canada

OUV – Outstanding Universal Values

RCM – Regional County Municipalities

RLICC – Raymond Lemaire International Centre for Conservation

RNUP – Rouge National Urban Park

UQAR – Université du Québec à Rimouski

WH – World Heritage

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1. Forillon Peninsula – Introduction

Figure 1: Map of Gaspésie Peninsula, with Forillon Peninsula at its end.

1.1. Forillon Peninsula – Historical Introduction

Figure 2: Forillon's timeline.

The first signs of human presence on the Gaspésie Peninsula and Forillon dates back 8,000 years ago to the Mi'gmaqs. It was reported by multiple European explorers that the Mi'gmaqs occupied a land that stretched from what is now known as Nova Scotia, Prince Edward Island to the north of New Brunswick. More specifically, according to community knowledge, "les ancêtres ont habité sur cette pointe [Forillon], de Cap Gaspé en passant par l'Anse aux Sauvages ou Indian Cove [Anse-aux-Amérindiens] jusqu'à Penouille"² (La Parlouër, Violette, and Devoe 2018). In 1534, the French explorer Jacques Cartier arrived in Gaspé where he planted a cross, claiming the land for the French king (Mimeault 1997).

² "The ancestors lived on this point [Forillon], from Cap Gaspé via Anse aux Sauvages or Indian Cove [Anse-aux-Amérindiens] to Penouille." Translated in Google Translate

Figure 3: Jacques Cartier's first voyage to Canada in 1534

Source: <https://www.pc.gc.ca/en/lhn-nhs/qc/cartierbrebeuf/culture/Histoire-history/evenement-event/cartier/a> (accessed 01-20-2020).

The fishing industry was already well established in Gaspésie when Jacques Cartier arrived. The fishermen present in the area, mostly Basques, Bretons, and Normans, practiced seasonal fishing. They came by ship in the spring, worked all summer and left once began fall (La Parlouër, Violette, and Devoe 2018).

[Les pêcheries de morue] attiraient quelques navires européens sur les rives de la Gaspésie et il arrivait même parfois que certains de ces navigateurs s'y établissent. Toutefois, même pour ces résidents permanents, le Canada n'était presque rien de plus qu'un littoral car leurs établissements s'étendaient toujours en vue de la mer³ (Lee 1980).

³ "[The cod fisheries] attracted a few European vessels to the shores of the Gaspé and it sometimes even happened that some of these navigators settled there. However, even to these permanent residents, Canada was little more than a coastline as their settlements always stretched out in sight of the sea." Translated by the author

The type of fishery practiced in Gaspé Bay was “dry”. Unlike wet fishery, which cleans the fish onboard the ship, dry fishery happens on land near the fishing zone. In the business of trading cod fish, it was routine at the time to dry fish under the sun to sell them dried (see figure 4). The pebble beaches in Gaspé Bay were represented exactly what those fishermen needed, offering large amounts of sun and lots of flat and clean places to process their products. This kind of beach was called in French “grave”. “Grande-Grave”, one of the first villages to be established in Gaspé Bay, was simply the description of this long pebble beach (La Parlouër, Violette, and Devoe 2018).

Figure 4: Fish drying on a pebble beach in Gaspésie, in early 20th century
Source: Samson 1980.

The bay also offered better environmental conditions, as the Forillon peninsula acts as a barrier to the cold current coming from the North through the Gulf of St-Lawrence. This is why, many ships coming from Europe chose this bay as a resting place after a long trip across the Atlantic Ocean. The crews could rest, fix damage, refill on drinkable water, or

even hide from an enemy. Even though the area had a lot to offer, Gaspé Bay remained only a temporary settlement for a long time (Lee 1980).

The fishing industry became year-round after the Conquest of New France by the British, 1758-1760. Two companies opened in Grande-Grave not long after 1763, founded by two men from the Jersey and Guernsey Islands, which would provide permanent jobs and contribute to the establishment of a long-lasting community (La Parlouër, Violette, and Devoe 2018). After that, the fishing industry in Gaspésie would reach its peak in 1866, “[...] occupant 5 242 pêcheurs par an, environ 1 000 marins et 2 600 bateaux. Le comté de Gaspé compte alors 14 242 habitants”⁴ (Grandbois 1983).

Since incomes from fishing was rather small, many fishermen practiced agriculture on their land. This was achieved at a small scale, as it was only meant to feed their families. The land division followed the seigneurial canvas, which created narrow lots of land connected to a waterway. This allowed for a kind of lifestyle which supported both fishing and agriculture (La Parlouër, Violette, and Devoe 2018).

⁴ “On the eve of Confederation [1867], the cod trade reached its peak, employing 5,242 fishermen per year, around 1,000 sailors and 2,600 boats. The county of Gaspé then had 14,242 inhabitants.” (Translated by the author)

Figure 5: Plan of the township of Cape Rosier showing the granted and unconceded lands in the front ranges, March 1858

Source: BAnQ Québec,

<https://numerique.banq.qc.ca/patrimoine/details/52327/3140149?docsearchtext=cap-rosier> (accessed 01-21-2021), Fonds Ministère des Terres et Forêts Publications et archives gouvernementales.

Figure 6: Gaspé county, 1930

Source: BAnQ,

<https://numerique.banq.qc.ca/patrimoine/details/52327/2244836?docsearchtext=gasp> (accessed 01-21-2021), Ministère des terres et forêts, Savary, Chs. (Charles), Compagnie aérienne franco-canadienne.

Figure 7: Gaspé county, 1954

Source: BAnQ,

<https://numerique.banq.qc.ca/patrimoine/details/52327/2246371?docsearchtext=gasp>
(accessed 01-21-2021), Ministère des terres et forêts, Dallaire, Réal, cartographe.

From 1880 onwards, the fish market started to decline. The closing of various international cod fish markets worsened the situation, forcing a diversification of the regional industry. Now forestry, public works, and agriculture were introduced into the area. Many families decided to move elsewhere (La Parlouër, Violette, and Devoe 2018).

1.2. FNP – Expropriations and relocation of the population

"The harmony between the man, the land and the sea"

Forillon National Park's theme,
Parks Canada

Figure 8: Forillon National Park map, 2020

Source: <https://www.pc.gc.ca/en/pn-np/qc/forillon/visit/GuideCartes-GuideMap>.

The fishing industry continued to decrease until the 1960s and unemployment in Gaspésie reached high numbers. To rectify the situation, the provincial and federal governments worked together to set up a program of rational optimization of the land (mise en valeur rationnelle de l'espace) (Babin 2015). The result of this intervention was the creation the Forillon National Park (FNP) for Parks Canada which would operate as a

major tourism infrastructure to increase the flux of visitors to the area, generate new jobs and preserve valuable natural and cultural heritage elements (Grandbois 1983).

280 families were forced to move out of their homes. The expropriated land totalled 244,8 km², including 4,4 km² of coastal land, many cottages, businesses, commercial buildings, churches, and cemeteries. A first phase of demolition removed most of the buildings which were located within the boundaries of the new park. Exceptions were made for a few buildings judged worthy of keeping for their architectural value (La Parlouër, Violette, and Devoe 2018).

Figure 9: Demolished house in Forillon, 1970s
Source: Babin 2015.

Relocation of the population was carried out in order to avoid random population dispersion around the park. While some families moved far away to Montreal, Quebec

City or Rimouski, others chose the low-income-units which had been provided to the expropriated in Cap-des-Rosiers and York (Babin 2015).

Figure 10: Postal card of Cap-des-Rosier in the 1960s

Source: Photo: Al Cassidy. Musée de la Gaspésie. Fonds Robert Fortin. P54/1a/6/1.

Figure 11: Photo of Cap-des-Rosier in summer 2020

Source: <https://cimtchau.ca/nouvelles/il-y-a-50-ans-225-familles-etaient-expropriees-a-forillon/> (accessed 01-20-2021).

2. Approach and Methodology

2.1 The Research Project

Table 1: Thesis Framework.

Contextual studies have shown that Forillon National Park (FNP) is on the front line of climate change. This project proposes to study the connection between architectural heritage sites and their communities. It will explore how they can work together to improve their adaptability and resiliency towards the effects of climate change. Our approach, explained in this section, will measure the impact of climate change on FNP's historic buildings, as well as on its community. Our methodology utilizes a number of tools that have already been developed (Climate Vulnerability Index, Nara-Grid, Value-

based assessment table) (see tables 1 and 2). The design phase of this thesis, based on findings from other contextual studies, will address issues related to climate change.

The design phase will operate on a two-scale approach in order to address and mitigate issues: micro and macro, illustrating the multi-level impacts of this phenomenon.

Combined together, the assessment and design create a new assessment tool to assess the reality of FNP, making them effective.

This thesis has two aspects:

- Studying and measuring the impacts of climate change in the heritage field;
- Exploring mitigation strategies through land planning and rehabilitation.

With this project, we will also be trying to answer the following questions:

- What are the impacts of climate change on historic sites and their communities?
- How can we improve for both their adaptability and sustainability for a more resilient future?

Figure 12: Thesis structure.

Table 2: Framework of documents.

This thesis is an academic project carried out by a single student. However, a number of contributors participated in the success of this research. The thesis advisors, Mariana Esponda and Mario Santana Quintero, contributed extensively throughout the entire project. Parks Canada was also a major participant. From this organization, Emilie Devoe helped with the site survey, Lidia Miller and Christine Legault participated in the research of precedents.

2.2 Literature Review

An extensive literature review was done at the beginning of this thesis in order to understand the site's context. This first study began with a reading of historical documents, followed by economic, political, and social documents. These texts helped to shed light on the challenges that the community had been through in the previous centuries.

After this, a review of Forillon National Park's climate change was undertaken. The reading was done in tandem with the Climate Vulnerability Index (CVI), a tool which assesses and measures a historic site and community vulnerability towards climate change. A list of all documents consulted is provided at the end of this thesis in the Bibliography section.

A careful review of FNP's *Management Plan 2010* (Parks Canada 2010a) was also achieved. However, after evaluation of its potential contribution to this research, it was decided with the thesis supervisors to focus instead on the impact of climate change and adaptation, which the *Management Plan* did not provide much information.

Also, prior to this thesis, a quick survey of Canadian historic sites affected by climate change was done (see figure 13). Categorized under two groups, currently threatened and potentially threatened, this survey highlighted four different threats: sea level rise, thawing of permafrost, coastal/riverbank erosion and temperature rise. FNP is affected

by three of those (see section 2.4.3), making it an interesting case study for Canadian historic sites.

Figure 13: Canadian historic sites affected by climate change.

Buildings of heritage value will be exposed to increasing strain, since most materials will deteriorate more quickly in a warmer and damper climate. Rising sea level, more storm flooding and increasing coastal erosion could threaten coastal buildings in vulnerable areas. In addition to the gradual change over the course of time, climate change will lead to more frequent extreme weather, which can cause acute damage to both heritage buildings and other cultural heritage sites. (Nordic Council of Ministers 2011)

The *Canada's Changing Climate Report*, published by the Canadian federal government in 2019, clearly states the urgency of the situation. In 10 key points, the document highlights the main headlines:

- Canada's climate has warmed and will warm further in the future, driven by human influence.
- Both past and future warming in Canada is, on average, about double the magnitude of global warming.
- Oceans surrounding Canada have warmed, become more acidic, and less oxygenated, consistent with observed global ocean changes over the past century.
- The effects of widespread warming are evident in many parts of Canada and are projected to intensify in the future.
- Precipitation is projected to increase for most of Canada, on average, although summer rainfall may decrease in some areas.
- The seasonal availability of freshwater is changing, with an increased risk of water supply shortages in summer.
- A warmer climate will intensify some weather extremes in the future.
- Canadian areas of the Arctic and Atlantic Oceans have experienced longer and more widespread sea-ice-free conditions.
- Coastal flooding is expected to increase in many areas of Canada due to local sea level rise.
- The rate and magnitude of climate change under high versus low emission scenarios project two very different futures for Canada.

(Bush and Flato 2019)

2.3 Site Recording

The Guidelines always begin with a recommendation on understanding the character-defining element and how it contributes to the heritage value of the historic place. Next are recommendations on documenting the character-defining elements before beginning project work. An overall assessment of their physical condition, using methods that respect the principle of minimal intervention, should always begin at this level.

(Parks Canada 2010b)

Site recording was done at Forillon National Park last August 2020 over a period of 7 days. Collaboration with Parks Canada allowed us to access the park and historic

buildings in order to record information on their current condition. Recording was done

with the intention of evaluating at the macro and micro level the current status of the park as a whole, while focusing on the Bartlett property.

With its remaining historic buildings, cemeteries, and cultural landscape, FNP is still a site which holds an incredible amount of historic value, tangible and intangible.

Historic Photos

Figure 14: Forillon Peninsula and Cap-Gaspé, 1927

Source: BAnQ Québec, Fonds Ministère des Terres et Forêts Publication et archives gouvernementales.

Figure 15: Photograph of houses along the south side of Forillon peninsula, 1930s

Source: Musée de la Gaspésie, Fonds Cornélius Brotherton. P141/1/5/54/2.

Context Photos

Figure 16: View of Forillon Peninsula.

Figure 18: View near Grande-Grave.

Figure 17: View of Forillon Peninsula from Cap-aux-Os Beach.

Figure 19: View of shore from Xavier-Blanchette's House.

Figure 20: Joseph Gavey property.

Figure 21: Daniel Gavey house.

Figure 22: Elias Gavey property.

Figure 25: Interior of St-Peter's Anglican Church.

Figure 23: Alfred Dolbel house.

Figure 26: View of the harbor.

Figure 24: St. Peter's Anglican Church.

Figure 27: Xavier Blanchette property.

Bartlett Property – Context

Site recording was done more extensively at the Bartlett property, with the intent to use it as a micro design intervention for this thesis. Character defining elements for the property will be explained in section 2.4.2, in order to mitigate climate change impacts on the house. The property bears the name of the first owner, Charles-Philip Bartlett. He was born in Jersey in 1850 and moved to Canada in 1864. He worked as an agent for the Fruing company, established down the hill at the harbor. He and his wife Amelia Charlotte Gavey had 9 children with (La Parlouër, Violette, and Devoe 2018).

When Bartlett arrived in Grande-Grave, his lot was still in its natural state, covered with trees. The trees were cut and used for different purposes: white birch for fence posts and maple for fire logs. Three buildings were built on the premises in 1906-1907: a house, a barn, and a shed. They were made of cedar, fir, cherry tree and birch, all from the same lot (La Parlouër, Violette, and Devoe 2018).

The Bartlett property is a long narrow piece of land, connected to water, with a main road dividing it. It is located in the heart of what used to be Grande-Grave. Like most buildings in the region, it is located on a steep hill. As of summer 2020, it has been unoccupied since the expropriation in 1970.

Figure 28: Bartlett Property
Source: La Parlouër, Violette, and Devoe 2018.

Figure 29: Bartlett house, 1970s
Source: http://ip51.icomos.org/~fleblanc/projects/1971-1979_PC/p_pc_forillon.html (accessed 02-02-21).

Figure 30: Bartlett house and barn from north-west side.

Figure 32: Bartlett House.

Figure 31: Bartlett property viewed from the north side.

Figure 33: View of Joseph Gavey property, and Bartlett in the far back.

Bartlett House

Figure 34: Bartlett house, front elevation, aerial view.

Figure 35: Bartlett house, front view.

Figure 36: Bartlett house, rear view.

Figure 37: Bartlett house, small living room.

Figure 38: Bedroom on the second level.

Figure 39: Bartlett house, main staircase.

Figure 40: Wood cabinet in the main living room.

Bartlett House – Basement Level

Figure 42: Basement, mold.

Figure 45: Basement, mold.

Figure 43: Basement, mold on the subfloor.

Figure 46: Basement, mold on the subfloor.

Figure 44: Basement, mold.

Figure 47: Basement, mold on a beam.

Figure 48: Basement fallen posts.

Figure 51: Basement, diagonal crack on rear foundation wall (north-east side), see # 12 in plan.

Figure 49: Basement, crack in foundation, rear wall (south-east side).

Figure 52: Basement, vertical crack in Foundation - Rear wall (north-east side).

Figure 50: Basement, vertical crack in foundation on south-east wall, see # 11 in plan.

Figure 53: Basement, V-shaped crack in foundation, rear wall (north-east side).

Figure 54: Basement, vertical crack on rear foundation wall (north-east side).

Figure 55: Masonry foundation with major cracks seen from outside.

Figure 56: Basement, floating post.

Figure 57: Basement, floating post close-up.

- 1-2-3. Water stains, see photo #58
- 4. Water stain, no photo
- 5. Water stain on wall, see photos #60
- 6. Water stain on floor, see photo #57

The ground level showed many signs of water damage, probably from roof leaks. Since the type of survey accomplished was non-intrusive, it wasn't possible to verify the extent of the water damage in the walls. It wasn't clear if this was an ongoing situation. Besides these issues, the interior was still in its original state and in good condition, meaning that most of the finishes and woodwork could probably be preserved.

Figure 58: Bartlett house ground-level plan.

Figure 59: Ground-level, water stains in large living room.

Figure 60: Ground-level, water stain in small living room.

Figure 61: Ground-level, water stain in small living room.

Figure 62: Ground-level, Water Stain on floor of small living room.

Figure 63: Bartlett house, upper-level plan.

Figure 64: Upper-level, Water Damage along chimney in bedroom.

Figure 66: Upper-level, water stains in bedroom.

Figure 67: Upper-level, water damage in bedroom.

Figure 65: Upper-level, Water Damage under window in bedroom.

Bartlett Barn

Figure 68: Bartlett's barn.

Figure 70: Broken up concrete foundation - rear wall - north side.

Figure 69: Unstable concrete foundation - rear wall - north side.

Figure 71: Interior shifting foundation.

Like most barns, the Bartlett barn isn't insulated and wasn't built to be airtight. The exterior wood siding shows its age, but with proper roof water management the aging effect can be slowed down. However, the foundation shows greater signs of deterioration. In figure 70, we can see how the rear foundational wall is rounding up and starting to move down the hill. Figure 69 shows the north foundation wall tilting at an angle. Figure 71 is an interior wood foundation shifting, probably caused by the weight of the barn on an unstable ground.

Bartlett's Shed

Figure 72: Bartlett's shed.

Figure 75: shifting and sinking foundation.

Figure 73: Shifting foundation.

Figure 76: sinking foundation.

Figure 74: Shifting foundation.

The shed, built with similar materials and assembling techniques as the barn, is in a similar condition. The exterior walls show their age but could still be maintained for several years if water management from the roof is well dealt with. Compared to the barn, the building is much lighter, but has the same issue with its foundation, which shifts under the weight of the building.

2.4 Climate Vulnerability Index

Climate change is the fastest growing global threat to World Heritage (WH). Many WH properties around the world are already experiencing significant negative impacts, damage and degradation.

In most cases, climate change impacts result in a degradation of the values that collectively comprise the Outstanding Universal Value for World Heritage properties (Day et al. 2019).

Figure 77: CVI cover page for HONO 2017.

It is expected that climate change effects on World Heritage sites will worsen over time (Day et al. 2019). In order to properly measure and assess the consecutive impacts, a methodology is required. The reason behind choosing the Climate Vulnerability Index (CVI) is that, aside from assessing heritage values, it also measures community

vulnerability toward their threat: “The CVI differs from previous vulnerability assessments by evaluating both Outstanding Universal Value (OUV) vulnerability and Community Vulnerability (the latter being based on the economic, social and cultural dependencies related to the WH [World Heritage] property and the adaptive capacity to cope with climate change) that is applicable to all WH properties” (Day et al. 2019). This holistic approach offers a broader view. Also, since Forillon National Park is not on the list of World Heritage sites, this research will refer to Heritage Values (HV) instead of Outstanding Universal Values (OUV).

Community vulnerability assessments in relation to historic sites had not been measured until the CVI in 2017. The CVI was initiated following the update of the World Heritage Convention’s 2007 climate policy, through the collaborative work of ICOMOS, IUCN, ICCROM, the World Heritage Centre and the German Federal Agency for Nature Conservation. It was then implemented at a workshop for the first time as Natural World property in Shark Bay, Australia in September 2018. The Heart of Neolithic Orkney (HONO), a 5,000-year-old heritage site in Scotland, was then chosen as first Cultural World property assessment in 2019. The findings of the CVI assessment on HONO brought a better understanding of the situation regarding its vulnerability. As explained in Table 3, the three key climate drivers have a real impact on the site. Table 4, the economic, social, and cultural assessment tool evaluates these values. These tables are created following a number of criteria, which are available in Appendix C.

Table 3: Rapid assessment of OUV Vulnerability to identify three key climate drivers for HONO. Assessed values of exposure, sensitivity and adaptive capacity contribute to derived outcomes for potential impact and OUV Vulnerability. Colours refer to the elements of the CVI framework.

Source: Day et al. 2019.

Key climate drivers	Sea Level Change	Precipitation Change	Storm Intensity and Frequency
Exposure	Very likely	Very likely	Possible
Temporal scale	On-going	On-going	Frequent
Trend	Moderate increase	Moderate increase	Slow increase
Exposure	Very likely ○○○○●	Very likely ○○○○●	Likely ○○○●○
Sensitivity	High-Very high	High-Very high	High-Very high
Spatial scale	Extensive	Localised	Extensive
Compounding factors	Medium-High probability	High probability	Medium probability
Sensitivity	Very high ○○○○●	Very high ○○○○●	Very high ○○○○●
Potential Impact	Extreme ○○○●	Extreme ○○○●	Extreme ○○○●
Local management response	Moderate	Moderate	Moderate
Scientific/technical support	High	High	High
Effectiveness	Low	Medium	Low-Medium
Adaptive Capacity	Moderate ○●○	High ○○●	Moderate ○●○
OUV Vulnerability	High ○○●	Moderate ○●○	High ○○●
Combined OUV Vulnerability	High ○○●		

Table 4: Rapid assessment of Community Vulnerability to identify three key climate drivers for HONO. Assessed values of economic, social and cultural (ESC) dependency (sensitivity, ranging from negative to positive) and adaptive capacity contribute to derived outcomes for ESC potential impact and Community Vulnerability.

Source: Day et al. 2019.

Economic	Moderate-negative
Social	High-negative
Cultural	Moderate-negative
ESC dependency	[-] ○●○○ Moderate-negative ○○○○ [+]
ESC potential impact	High ○○○●
Economic	High
Social	Moderate
Cultural	High
ESC adaptive capacity	High ○○●
Community Vulnerability	Moderate ○●○

The results of the HONO assessment are summarized as follow by Day et al.:

Potential impact from each of these key drivers [sea level change, precipitation change and storm intensity and frequency] was scored in the highest category (Extreme). Despite adaptive capacity to mitigate impacts being assessed as moderate-to-high, the OUV Vulnerability was nevertheless determined to be in the highest category (High). Impacts from the key climate drivers were judged as likely to lead to a negative future impact at a moderate level on the economic, social and cultural aspects of the community surrounding the Orkney WH site, resulting in a high level of potential impact on the community (Day et al. 2019).

Figure 78: Example of site damage by increased rainfall and visitors at Ring of Brodgar.

Nonetheless, the authors bring a nuance, that “[...] the adaptive capacity of the community was determined to currently be at a high level, the overall Community Vulnerability was assessed to be in the middle category (Moderate).” This variation shows how community presence near a historic site is valuable, as it can diminish the impacts of climate change.

Today, the CVI is still in a pilot phase and it has proven to be a “transparent and repeatable framework for rapid assessment of climate impacts on heritage properties” (Day et al. 2019). Its unique approach to measuring community vulnerability to climate change will surely bring new valuable information to FNP’s authorities.

2.4.1 Why was the Climate Vulnerability Index Chosen for Forillon National Park?

Although Forillon National Park’s context differs from the Heart of Neolithic Orkney, some elements are present on many levels in both cases. First and foremost, FNP and HONO are both affected by similar climate change effects and have both compiled extensive data (Parker et al. 2017). They are both located in an important cultural landscape with a strong connection to the character-defining elements of the historic sites. Also, while HONO has strong support from ICOMOS, CCHWG and others, FNP has the help of Parks Canada and Université du Québec à Rimouski (UQAR). However, the main reason for applying the CVI to FNP is its capacity to evaluate community vulnerability toward environmental threats (Day et al. 2019). Since FNP’s community was expropriated in 1970, the evaluation of FNP’s current closest community is of high interest. Its heritage sites are unoccupied and neglected, worsening damages. Therefore, it is expected that a Climate Vulnerability Index assessment of FNP will bring new light and new information.

Because so much of our heritage exists among people and communities and is bound up with social interactions and cultural identity and cohesion, it is clear that climate-change impacts are not only physical phenomena (Cassar 2009).

As previously explained, building on the CVI findings the design intervention of this research will push the research further by developing a macro and micro design intervention. We will apply the CVI method to the macro level (the entire Park) to study the impact on the landscape and on the community. Then, based on the site recordings, we will suggest on the micro level different mitigation strategies. This will be done on one of FNP's former properties that is believed to be the best subject for this research. Charles-Philip Bartlett's lot in Grande-Grave shows little interventions done since the expropriation in 1970. During a site survey in August 2020, many signs of deterioration were present. While some damage was probably due to the long 50-year inoccupancy of the house, others were most likely due to the harsher climates.

Through the reading of the CVI method by Day, it has been observed that a number of evaluations are somewhat subjective. Furthermore, the evaluation of the severity of the climate change report is left to the reader's own interpretation. For this reason, we believe that the CVI methodology could be improved. Nonetheless, this new tool is still a fascinating first version instrument to bring light to the correlation between communities, historic sites, and climate change. In a world moving fast toward a new reality, this methodology is a great contribution in the heritage field.

2.4.2 Identifying FNP's Heritage Values

Forillon National Park includes in its boundaries 20 historic buildings spread throughout.

Those remaining constructions are still standing today for two reasons:

- 1- They were selected upon the creation of the park to be preserved because of their aesthetic value (La Parlouër, Violette, and Devoe 2018);
- 2- They passed the test of time, after a long 50-year inoccupancy.

Table 5: List of historic buildings in FNP, as of 2020.

Buildings	Year	Vacant (Y/N)	Materials	Location	FHBRO⁵
Alfred-Dolbel (House)	1890	Seasonal Museum	Wood & masonry	Grande-Grave	Designated (2001)
Bartlett (House)	1906-1907	Yes	Wood & masonry	Grande-Grave	Designated (2001)
Bartlett (Barn)	1907	Yes	Wood & masonry	Grande-Grave	N/A
Bartlett (Shed)	1907	Yes	Wood	Grande-Grave	N/A
Cannon Shelter	N/A	N/A	Wood	Cap Gaspé	N/A
Joseph-Gavey (House)	1895	Yes	Wood & masonry	Grande-Grave	Designated (2001)
Joseph-Gavey (Barn)	1867	Yes	Wood & masonry	Grande-Grave	N/A
Joseph-Gavey (Shed)	1867	Yes	Wood	Grande-Grave	N/A
Daniel-Gavey (House)	1869	Yes	Wood & masonry	Grande-Grave	Designated (2001)
Daniel-Gavey (Barn)	1916	Yes	Wood & masonry	Grande-Grave	N/A
Elias-Gavey (House)	1889	Yes	Wood & masonry	Grande-Grave	Designated (2001)
Elias-Gavey (Barn)	1889	Yes	Wood & masonry	Grande-Grave	N/A
Elias-Gavey (Shed)	1890	Yes	Wood	Grande-Grave	N/A
Grange Hormidas-Element	1910	No (Warehouse)	Wood	Cap-des-Rosiers	N/A
Hyman House and Store	1864	Seasonal Museum	Wood & masonry	Grande-Grave	Designated (2001)
Hyman Warehouse	1865	Seasonal Museum	Wood & masonry	Grande-Grave	Designated (2001)
St-Peter's Anglican Church	1864-1885	Yes	Wood & masonry	Petit-Gaspé	Designated (1993)
Xavier-Blanchette (House)	1901	Seasonal Museum	Wood & masonry	Grande-Grave	Designated (2001)
Xavier-Blanchette (Barn)	1915	Seasonal Museum	Wood	Grande-Grave	Designated (2001)
Xavier-Blanchette (Shed)	1888	Seasonal Museum	Wood	Grande-Grave	Designated (2001)

⁵ Designation based on historical, architectural, and environmental values.

For the Heart of Neolithic Orkney, the authors of the Climate Vulnerability Index used the Statement of Outstanding Universal Value to determine the key World Heritage (WH) values. However, for this research, the Nara-Grid was chosen instead, since Forillon National Park doesn't possess any WH values. The evaluation tool was developed in 1994 at the Raymond Lemaire International Centre for Conservation (R.L.I.C.C) based on the Nara Document on Authenticity (Van Balen 2008). Its strengths lie in the following elements:

Depending on the nature of the cultural heritage, its cultural context, and its evolution through time, authenticity judgements may be linked to the worth of a great variety of sources of information. *Aspects* of sources may include form and design, materials, and substance, use and function, traditions and techniques, location and setting, and spirit and feeling, and other internal and external factors. The use of these sources permits elaboration of the specific artistic, historic, social, and scientific *dimensions* of the cultural heritage being examined (Van Balen 2008).

By looking at many fields and expertise's, the Nara-Grid will highlight specific elements on the sites that are more important to preserve than others. Also, the grid will facilitate the decision-making process that will follow in the design phase.

Table 6: Nara-Grid for Forillon National Park according to values from FHBRO's Statement of Significance and EVRC, Source: Parks Canada 2015.

Aspects of the Sources	Dimensions of Heritage			
	Artistic	Historic	Social	Scientific
<u>Form & design</u>	6 residential complexes, 1 commercial complex, 1 church, 6 barns, 2 harbors, 4 sheds and 1 coastal battery.	- Exterior walls and interior layouts of historic buildings display tradition of vernacular housing in the province of Quebec.	- Properties along the coast feature a social and economic system based on fishery, agriculture and forestry.	- Ship navigation aid infrastructures at Cap Gaspé and Cap-des-Rosiers, showing the strategic position Forillon peninsula occupies between

	<ul style="list-style-type: none"> - Land organization linked to the history of Eastern Canada. - The main road traveling east-west along the southern coastline is an important part of the history of the region. - Creation of a National Park in 1970, which had an important impact on the local remaining infrastructures. - Exterior water pumps near the houses. - Presence in Gaspé Bay of military defensive systems (Fort Péninsule) from the Second World War. - Remains of mass tourism infrastructures from the former provincial park Cap-Bon-Ami created in 1949, now integrated into FNP.	<ul style="list-style-type: none"> - Land organization is based on the Seigneurial system (long narrow lot of land perpendicular to a waterway), a social structure that is still visible today.	<p>the St. Lawrence Gulf and Gaspé Bay.</p> <p>Photo source : https://ici.radio-canada.ca/nouvelle/1412835/abri-canon-phare-cap-gaspe-falaise-patrimoine (accessed 01-19-2021)</p>
<p><u>Materials & substance</u></p>	<ul style="list-style-type: none"> - Even though some buildings have water damage, they are overall well-preserved and still display their original material (except for some house basements).	<ul style="list-style-type: none"> - The wood used for the constructions was taken from neighboring forests; - Some of the beams in the basements display axe marks, showing the technique of how they were shaped into building materials. 	<ul style="list-style-type: none"> - The construction of new properties was typically done through neighborhood mutual aid. These constructions still standing today are examples of such work. 	<p>N/A</p>

<u>Use and functions</u>	<p>- The orientation of the properties, perpendicular to the coastline, is a testimony of a land organization based on fishery.</p> <p>- The land layout shows how occupants relied on multidisciplinary occupation (fishery, agriculture and forestry).</p>	<p>- The area is a vestige of the cod fish fishery practiced from the 18th century until the first half of the 20th century.</p> <p>- Reminder of a former fishing region.</p> <p>- Former occupants of the houses took part in the Grande-Grave fishing industry.</p> <p>- Remains / artefacts of whale-hunting activity on the Penouille peninsula.</p> <p>- Exterior water pumps near houses.</p> <p>- Presence of domestic plants around the houses, sign of former gardens.</p>	<p>- The property layouts and their proximity to each other connected by trails shows a tight social connection between families.</p> <p>- The landscape shows signs of an economic system focused on the complementary activities of fishery, agriculture and forestry.</p> <p>- FNP participates actively in the tourism industry and in sustainable development through creation of local jobs.</p> <p>- The secondary road passing behind the houses reminds us of the close relationships between families.</p>	<p>- The property's layout and organization helps to better understand how the occupants used the land and the sea for living.</p> <p>- With its many programs (conservation, education, and public awareness), FNP has the potential to raise environmental preservation.</p>
<u>Tradition, techniques & workmanship</u>	<p>- High level of craftsmanship for the houses with exterior ornaments and interior woodwork.</p>	<p>- The Neoclassical style was traditional residential construction in the area.</p>	N/A	<p>- Constructions are a display of different techniques of constructions used at the time.</p>

<u>Location & settings</u>	<ul style="list-style-type: none"> - The rough aspect of the ground and greenery around the property exhibits the original agricultural use of the land.	<ul style="list-style-type: none"> - The area is associated with the theme of cod fishery.	<ul style="list-style-type: none"> - The trails connecting the properties show the close relationships between families - Points of view and visual connections between specific locations. 	<ul style="list-style-type: none"> - Ties and links have been created between the scientific community and surrounding land managers in order to preserve regional biodiversity and ecological integrity around the park.
<u>Spirit & feeling</u>	<ul style="list-style-type: none"> - The connection of the buildings with the sea gives a strong connection with nature. 	<ul style="list-style-type: none"> - The names of villages and communities are from descriptions of the area (Grande-Grave, Anse-Blanchette, Petit-Gaspé, Cap Gaspé, etc.). 	<ul style="list-style-type: none"> - The properties are part of a visual “string of buildings” on the coast, a reminder of the main source of income in the area. 	N/A

Red: High, Yellow: medium, Green: low

Table 7: Nara-Grid for Bartlett property according to values from FHBRO's Statement of Significance and EVRC. Source: Parks Canada 2015.

Aspects of the Sources	Dimensions of Heritage			
	Artistic	Historic	Social	Scientific
<u>Form & design</u>	<ul style="list-style-type: none"> - Neoclassical vernacular style for the layout and the elevations of the house. <ul style="list-style-type: none"> - The broken roofline influenced by the Second-Empire Style.	<ul style="list-style-type: none"> - An example of a vernacular form, common in Gaspé, influenced by Neoclassical New England houses. - The buildings' style represents the preservation of a tradition in architecture between the mid-19th and early 20th centuries.	<ul style="list-style-type: none"> - The property sits among other buildings along the coast and highlights a social and economic system based on fishery, agriculture and forestry. <ul style="list-style-type: none"> - The shape of the land is based on the seigneurial system (long narrow lot of land connected to a waterway). 	N/A

<u>Materials & substance</u>	<p>- Even though the buildings have some water damage, overall they are well-preserved and still have of their original material (except for the house's basement - concrete foundation built in the 1980s).</p>	<p>- The wood used for the constructions was taken from the neighboring forest.</p> <p>- Some of the beams in the basement display marks of axes, showing the technic of how they were shaped into building materials.</p>	<p>- The construction of new property was typically done through neighborhood mutual aid. These constructions are examples of such work.</p>	N/A
<u>Use and functions</u>	<p>- The orientation of the property, perpendicular to the coastline, displays a land organization based on fishery.</p> <p>- The land layout shows how occupants relied on a multidisciplinary occupation (fishery, agriculture and forestry).</p>	<p>- The area is a vestige of the cod fish fishery practiced from the 18th until the first half of the 20th century.</p> <p>- Reminder of a former fishing region.</p> <p>- The former occupant of the house took part in the Grande-Grave fishing industry.</p>	<p>- The property layouts and their proximity connected by trails show a tight social connection between families.</p>	<p>- The property's layout and organization helped to better understand how the occupants used the land and the sea to live.</p>
<u>Tradition, techniques & workmanship</u>	<p>- High level of craftsmanship for the house for its exterior ornaments and interior woodwork on the 1st and 2nd floors.</p>	<p>- Neoclassical New England elevations</p>	N/A	<p>- The constructions are a collection displaying different techniques of</p>

	<p>- The Neoclassical was a reflection of traditional residential construction in the area.</p>			constructions used at the time.
<u>Location & settings</u>	<p>- The rough aspect of the ground and greenery around the property exhibits the original agricultural use of the land.</p>	<p>- The property is associated with the theme of cod fishery.</p>	<p>- The trails leading to the neighboring properties shows the close relationships between families.</p>	N/A
<u>Spirit & feeling</u>	<p>- The relationship of the land with the sea gives a strong connection with nature.</p>	<p>- The property is named after one of its former occupants, Charles Philip Bartlett, bookkeeping clerk at the Fruing Company.</p>	<p>- Along with other buildings, the property is part of a visual "string of buildings" on the coast, reminder of the former main source of income in the area.</p>	N/A

Red: High, Yellow: medium, Green: low

Recognition Statute: Treasury Board Policy on Management of Real Property

Designation Date: 2001-11-01

Dates: 1906 to 1907 (Construction)

Custodian: Parks Canada

As demonstrated in the Nara-Grid, the heritage buildings are important historic remains of Grande-Grave. Many of them have already been lost, making the remaining ones ever

more valuable. The destruction of a single one could translate as a loss of a tangible witness of the past.

2.4.2.1 Heritage Values and Parks Canada

In order to understand how Forillon National Park's historic sites are managed, we need to understand how Parks Canada has categorized them. Parks Canada classifies their parks into three major typology (House of Commons 2017):

- National Park of Canada (NP)
- National Historic Sites of Canada (NHS)
- National Marine Conservation Areas of Canada

FNP falls under the category National Parks of Canada. The description of NP by the federal agency is as follow:

Parks Canada has responsibilities under the *Canada National Parks Act* (2000) to protect and conserve nationally significant representative natural areas and to ensure national parks are maintained and made use of so as to leave them unimpaired for future generations.⁶

This description clearly shows that the preservation of historic sites and values doesn't fall within the given mandate. However, the agency has recognized that the history of FNP is worth maintaining. FNP's historic sites are remains of this history. It is also recognized by Parks Canada that "les bâtiments non-utilisés de Grande-Grave font

⁶ Parks Canada, Parks Canada Framework, https://www.pc.gc.ca/leg/docs/pc/rpts/rve-par/89/index_e.asp (accessed 01-27-2021)

Figure 79: View of the peninsula from Cap-Bon-Ami
Source: <https://i2.wp.com/www.campinggriffon.com/wp-content/uploads/2017/01/DSC00580.jpg?w=2000&ssl=1>
(accessed 03-07-2021).

partie intégrante du paysage culturel de ce secteur du parc. »⁷ (Parks Canada 2019a) Furthermore, a report published in 2018 by the same agency highlights the importance of the historic values :

Les paysages culturels de Grande-Grave sont indissociables de la vie

économique, sociale et culturelle de ses habitants jusqu'à la création du parc en 1970. Cette date marque à la fois une rupture dans le paysage et un tournant dans son évolution. L'expulsion de ses habitants, la démolition ou l'abandon de certains éléments physiques (bâtiments, champs, jardins, etc.) constituent les marques tangibles de cette rupture. Toutefois, la conservation et l'usage de certains bâtiments dans le cadre des activités du parc, ainsi que la présence de cimetières toujours actifs (où l'on inhume toujours des défunts), témoignent de l'évolution d'un lieu encore porteur d'histoire⁸ (La Parlouër, Violette, and Devoe 2018).

Categorizing FNP under this class of parks can be understood when considering the beautiful geology of the area. With the Appalachian Mountains ending suddenly at the Gulf of St. Lawrence, and the views of Mount Notre-Dame and Megantic, Forillon peninsula creates a dramatic scenery where land and water meet in full confrontation.

⁷ "The unused buildings in Grande-Grave are an integral part of the cultural landscape of this sector of the park." (Translated by the author)

⁸ "The cultural landscapes of Grande-Grave are inseparable from the economic, social and cultural life of its inhabitants until the park was created in 1970. This date marks both a break in the landscape and a turning point in its development. The eviction of its inhabitants, the demolition or abandonment of certain physical elements (buildings, fields, gardens, etc.) are tangible signs of this rupture. However, the conservation and use of certain buildings within the framework of the park's activities, as well as the presence of cemeteries that are still active (where the dead are still buried), testify to the evolution of a place that is still the bearer of history." (Translated by the author)

Also, it should be noted that there are some 225 species of birds, ten different ecological milieu and some rare plants. The historic value of the area was also acknowledged (Babin 2015), but was somehow lost in the process.

2.4.3. Identifying Key Driver Environmental Changes

Reading a report published in 2017, *Adaptation aux changements climatiques au Parc National de Forillon: contexte et base de connaissances*⁹, it is possible to understand the extend of climate change on Forillon National Park between the present time and the next century. In order to complete a Climate Vulnerability Index assessment of FNP, 3-key driver changes must be chosen. For FNP, the three threats chosen were based on the previously cited document (Parker et al. 2017). These key driver changes are:

1. Air temperature change: Average temperatures have increased by 2.5°C since 1916, which is noticeable throughout every season, but more so in winter. Long-term predictions for 2071-2100 estimates another increase between 4 to 8°C in winter and 3 to 7°C in summer. Winters will become warmer, allowing some forest pests and pathogens to survive and invade the area. This temperature increase has also caused the annual sea-ice coverage to reduce on average by 1.53% by year since 1998. This also affects the freeze-up duration. Since 1982 freeze-up is delayed by 10

⁹ *Adaptation to climate change in Forillon National Park: context and knowledge base*, translated by the author

to 20 days and melting is advanced by 20 to 30 days. Long-term reductions estimate that the maximum annual concentration will be of 67% by 2041-2071 (Parker et al. 2017).

Table 8: Temperature change recorded from 1916 until 2016 at the Gaspé climatological station
 “*” = statistically significant trend ($P < 0,05$)
 Source: Parker et al. 2017.

Figure 80: Average annual temperature relative to the reference level 1980-2010,
Source: Parker et al. 2017.

2. Sea level change: Sea level will increase between 30 to 75 cm in the Gulf of St. Lawrence by 2100. This will increase coastal erosion and flood some low-land sensitive areas. This effect will worsen the impacts of storm intensity and of reduction of ice coverage in the gulf. In FNP, the ground is known to be moderately sensitive in general. However, some areas with gentle slopes are

composed of softer, more vulnerable materials. Regarding coastal erosion, we can see in Figure 81 that FNP is located in a moderate zone. However, combining this effect with other impacts, such as storm intensity and decrease of glacial coverage increases the risk of water flooding and coastal erosion, which could place some historic buildings in FNP in a precarious situation (Parker et al. 2017).

Table 9: Height of elevation according to sea level: Rivière-au-Renard (Québec)
Source: Parker et al. 2017.

Figure 81: "Preliminary map of coastal sensitivity to climate change. Sensitivity is based on coastal materials, landforms, relief, ground ice, wave height, tidal range, recent trends in sea ice concentration, and projected sea level rise to 2050. Data provided by Natural Resources Canada". Source: Parker and Nantel 2017.

3. Precipitation change: Annual precipitation has increased by 33% since 1916, which happens more in fall and winter by increase of 65%. Projections shows that summers will be drier and longer, augmenting fire forest risks. While periods of snow cover might be reduced by 45 and 75 days, rain on snow increase chances of water flooding are more frequent. All of this will affect level and water flow in waterways. It is estimated that frequency and intensity of extreme precipitations will increase in cycles. What might have happened every 100 years will happen every 25 years according to a long-term prediction of 2050-2010 (Parker et al. 2017).

Table 10: Precipitation change recorded from 1916 until 2013 at the Gaspé climatological station (7052605)
 “*” = statistically significant trend ($P < 0,05$), Source: Parker et al. 2017.

Figure 82: Total annual precipitation - change from 1980-2010 baseline, Source: Parker et al. 2017.

Although the CVI methodology requires to select only three climate change drivers, it is essential to highlight that the region is affected by others climatic phenomenon. As specified by Parker et al., their combined effects worsen each individual. Furthermore, it

is our opinion that limiting the analysis to the 3-key drivers diminishes the portrait of the whole situation.

See other tables and figures on climate change in FNP in Appendix A.

2.4.4 Applying the Climate Vulnerability Index to Forillon National Park

Figure 83: The CVI framework. Source: Day et al. 2019.

One of the key elements of the Climate Vulnerability Index is the 8-level risk assessment with the 3-key climate drivers (Figure 83). This tool uses a set of evaluation tables (available in Appendix C), which measures the impacts of climate change on the Heritage Values (HV) (Table 15). Key-climate drivers are entered into the assessment table and evaluated, compared to climate change impacts documentation previously cited, with each assessment level. More importantly, the second part of this assessment (Table 16) will also evaluate how resilient Forillon National Park's community is towards

environmental threats. In order to do so, an extensive analysis of its economic, social, and cultural context had to be done.

2.4.5 Economic Context

Figure 84: Map showing 5 of the 8 Regional County Municipalities in Gaspésie peninsula
Source: <http://www.complicegim.ca/> (accessed 01-20-2021).

Forillon National Park is located in a peninsula that is composed of 8 Regional County Municipalities (RCM), which all rely more or less on similar industries, making this region one homogenous area. FNP is located in the RCM of Côte-de-Gaspé (CDG) (figure 84). For this analysis, we compared data at two and three levels. We looked at how CDG performs on its own, and compared it with the whole peninsula, and the province of Quebec.

Economically, the Gaspésie peninsula relies essentially on 3 industries: fishery, forestry and tourism (Babin 2015). According to a report published by the Government of

Québec in 2018 (Ministère de l’Agriculture des Pêcheries et de l’Alimentation 2018), employment related to the fishery industry in the Gaspésie peninsula is constantly decreasing. The number of fishermen went from 600 in 1990 to 465 in 2000 and to 370 in 2016. The forestry industry hasn’t performed much better. A report produced by the Government of Canada shows that the Annual Average Growth Rate in the Gaspésie peninsula has been of -0.2% during 2018-2020¹⁰. Another study done by the Government of Québec states that in 2015 forestry jobs represents only 2.2% of all jobs in the Gaspésie region (Ministère des Forêts de la Faune et des Parcs 2019).

Table 11: Employment data, according to Statistic Canada.

	Côte-de-Gaspé	Gaspésie	Province of Québec
Unemployment rate 2016	12.4%	15.3%	7.2%
Average annual income in 2015	32,157\$	28,473\$	32,975\$

When we look at unemployment rate and average annual income (Table 11), we can see that CDG is doing slightly better than the whole Gaspésie region. However, if we compare this with the provincial average rate of 7.2%, it is clear that the economic situation could be better.

¹⁰ Government of Canada, “Quebec Sectoral Profile 2018-2020: Forestry and Logging”, 2018, https://www.nt.jobbank.gc.ca/content_pieces-eng.do?cid=11243&lang=eng [accessed 02-19-2021]

Figure 85: Promotionnel image for Gaspé Tour Lines, 1951. Source : Musée de la Gaspésie, Collection Mireille Éthier. P158/1.

Figure 86: Advertisement image on a touristic website
Source:
<https://www.parcourscanada.com/blogue/road-trip-gaspesie-3-parcs-a-decouvrir/> (accessed 01-28-2021).

On the other hand, the tourist industry is doing better than ever. The Gaspésie peninsula is known in Québec for its famous “Tour de la Gaspésie” (Tour of Gaspésie) (Figure 85), an 885-km loop bringing visitors all around the peninsula. In 2019, the region received 535,000 visitors, generating some 271 million dollars in revenue¹¹. From this, FNP gets a fair share of visitors. From 2011-2012 to 2015-2016, the number of visitors went up from 126,066 to 145,678, a 19% increase (Parcs Canada 2017). Multiple recreation services are offered (Parks Canada 2019a):

- Hiking
- Whale watching cruise
- Underwater diving and free diving
- Camping
- Kayaking
- Cycling
- Fishing
- Kites
- Nature and history interpretation activities
- Activities for explorers
- Historic site visits
- Red chair
- Events
- Winter activities

¹¹ Radio-Canada, “Une autre saison record pour le tourisme en Gaspésie”, 2019, <https://ici.radio-canada.ca/nouvelle/1407406/tourisme-gaspesie-record-saison> (accessed 01-27-2021)

Furthermore, a report published in 2014 highlights these following elements for the tourist industry in Gaspésie for 2011 (Consultants OPR 2014):

- 7,338 jobs
- Represents 1 job out of 5
- Tourism is the second most important employer

The report also produced an interesting table showing the economic benefits for each region per sector of interest. This table shows that CDG is the second wealthiest RCM for tourist incomes and that the biggest contributor is the natural milieu, with an economic benefit of 10,421,739\$.

Table 12: Economic benefits in dollars for each region per sector. Source: Consultants OPR 2014.

RCM	Water	Natural milieu	Human construction	Lifestyle	Total
La Mitis	0	1,585,550	20,053	520,516	2,126,119
Matane	1,796,180	2,327,184	4,858	84,339	4,212,561
Haute-Gaspésie	433,078	13,771,507	184,161	0	14,388,746
Cote-de-Gaspé	149,861	10,421,739	102,302	444,379	11,118,281
Rocher-Percé	3,101,719	2,950	0	75,439	3,180,108
Bonaventure	1,739,623	541,655	0	266,085	2,547,363
Avignon	112,639	212,358	0	92,451	417,448
Matapédia	1,386,343	571,913	12,462	0	1,970,718
Total	8,719,443	29,434,856	323,836	1,483,209	39,961,344

However, when we consider that the entire facility of FNP most likely falls under the Natural milieu, being a National Park of Canada, we can deduct that human

constructions contributions in the CDG are not completely accurate. Visitors pay an admission fee at the park's gate and gain access to the entire facility. Furthermore, Grande-Grave holds within its historic buildings a great deal of intangible values, tied to the historic, social, and cultural roots of the region: "Les paysages culturels de Grande-Grave, inestimables témoins de ces communautés humaines aujourd'hui dispersées, déplacées ou disparues, comptent parmi les derniers vestiges des établissements de pêche qui caractérisaient jadis le littoral de la Gaspésie et de l'Est du Canada"¹² (La Parlouër, Violette, and Devoe 2018). Losing historic remains in FNP could translate into a loss of identity for the region, which is difficult to quantify in dollars.

Also, this rapid context study shows a strong similarity with the Heart of Neolithic Orkney. Similar to Day's research findings, FNP is quite dependant on the tourist industry, as it is a major economic contributor to the region.

2.4.6 Social and Cultural Context

In the Regional County Municipalities of Côte-de-Gaspé regarding age groups, data from Statistics Canada shows that 64.4% of the population falls within the 15-64 years-old category. While the 0-14-year group represents 13.2%, the 65-year-old and over

¹² "The cultural landscapes of Grande-Grave, invaluable witnesses of communities today dispersed, displaced or disappeared, are among the last vestiges of the fishing establishments that once characterized the coastline of Gaspé and eastern Canada." (Translated by the author)

represents 22.5%. The average age of the population is 46.4 years old. It is also a fact that the population is decreasing (Table 13). Census shows a quite homogenous population, with regards to mother tongue, with the majority speaking French (Table 14).

Table 13: Population census in 2016 from Statistic Canada.

	Côte-de-Gaspé	Gaspésie
Population in 2016	17,117 (17,985 in 2011) ¹³	90,031 (94,079 in 2011) ¹⁴

Table 14: Mother tongue from Statistic Canada.

Mother tongue	Côte-de-Gaspé	Gaspésie
French	14,965	79,550
English	1,600	8,055
Algonquian languages (Mi'kmaq)	0	455
Inuit languages	0	5
Afro-Asiatic languages	10	55
Austro-Asiatic languages	5	30
Austronesian languages	5	15
Creole languages	5	10
Indo-European languages	40	165
Japanese	0	10
Niger-Congo languages	15	25
Sign languages	0	5

¹³ Statistics Canada, "Census Profile, 2016 Census. La Côte-de-Gaspé, Municipalité Régionale de Comté, Quebec and Quebec.", 2019, <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CD&Code1=2403&Geo2=PR&Code2=24&SearchText=La%20Cote-de-Gaspe&SearchType=Begin&SearchPR=01&B1=All&TABID=1&type=0>, (accessed 01-21-2021)

¹⁴ Statistics Canada, "Census Profile, 2016 Census. Gaspésie-Iles-de-la-Madeleine, Quebec and Quebec", 2019, <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=ER&Code1=2410&Geo2=PR&Code2=24&SearchText=Gaspesie&SearchType=Begin&SearchPR=01&B1=All&TABID=1&type=0>, (accessed 01-21-2021)

Sino-Tibetan languages	5	25
Tai-Kadia languages	5	10
Uralic languages	0	5

2.4.7 Findings from the Climate Vulnerability Index Applied to Forillon National Park

Table 15: Rapid assessment of HV Vulnerability in FNP to identified 3-key climate drivers. Assessed values of exposure, sensitivity and adaptive capacity contribute to derived outcomes for potential impact and HV Vulnerability. Colours refer to the elements of the CVI framework. Source: Day et al. 2019.

	Key climate drivers	Air temperature change	Sea level change	Precipitation change
	Exposure	Very likely	Likely	Very likely
	Temporal scale	On-going	On-going	On-going
	Trend	Moderate increase	Moderate increase	Moderate increase
	Exposure	Very likely ○○○●	Likely ○●○○	Very likely ○○○●
	Sensitivity	Very sensitive	Moderate	Very sensitive
	Spatial scale	Localized-Extensive	Restricted	Extensive
	Compounding factors	High probability	Medium probability	High probability
	Sensitivity	Very high ○○○●	Moderate ○●○○	Very high ○○○●
	Potential Impact	Extreme ○○○●	Moderate ○●○○	Extreme ○○○●
	Local management response	Low capacity	Low capacity	Low capacity
	Scientific/technical support	High level of support	High level of support	High level of support
	Effectiveness	Low level of effectiveness	Low level of effectiveness	Low level of effectiveness
	Adaptive Capacity	Low ●○○	Moderate ○●○	Low ●○○
	HV Vulnerability	High ○●●	Moderate ○●○	High ○●●
	Combined HV Vulnerability	high ○●●		

Table 16: Rapid assessment of Community Vulnerability to identified 3-key climate drivers. Assessed values of economic, social and cultural (ESC) dependency (sensitivity, ranging from negative to positive) and adaptive capacity contribute to derived outcomes for ESC impacts Source: Day et al. 2019.

Economic	High-negative
Social	High-negative
Cultural	Moderate-negative
ESC dependency	[-] ●○○○ High-negative ○○○○ [+]
ESC potential impact	High ○●●
Economic	Moderate
Social	Low
cultural	Low
ESC adaptive capacity	Low ●○○
Community vulnerability	High ○●●

It had already been established that climate change impacts greatly Forillon National Park. Phenomenon affecting the region have been documented for years and it is no secret that the peninsula will continue to be shaped by this unavoidable reality. However, the assessment of impacts on Heritage Values (Table 15) brings new information regarding exposure, sensitivity, potential impact, and the adaptive capacity for historic sites. This evaluation gives us a first portrait of the actual situation in FNP. With a Heritage Value vulnerability ranking at “high” for air temperature change, “moderate” for sea level change, and “high” for precipitation change, the obvious conclusion is that FNP’s historic sites are vulnerable and at risk. Also, considering that most buildings are unoccupied since the creation of the park in 1970, we could even suggest that the remaining constructions are at risk of disappearing in the near future if nothing is done.

Furthermore, as demonstrated with the Economic, Social and Cultural (ESC) rapid assessment (Table 16), we now understand that the region relies heavily on the touristic industry. From our economic review, it was established that the main contributor to the Regional County Municipalities of Côte-de-Gaspé was the Natural milieu, which hides away contributions from human construction economic benefits. We can understand from this that FNP's theme, National Parks of Canada, does not give justice to all its attributes. The Bartlett and Gavey's properties sit unoccupied since the creation of FNP in 1970. So much could be done with them:

Smaller heritage sites may be modest in appearance, but they are still worthy of conservation. They may not attract large numbers of visitors like Stonehenge or the Acropolis but they are capable of providing socio-economic advantages for local communities and transferring knowledge of the past to future generations (Grimwade and Carter 2000).

*Figure 87: Toll booth at the south gate
Source: Google Street View.*

Another conclusion from this assessment is that we come to realize that there is a clear division between the community and FNP. Beside the border surrounding the perimeter, gates with toll booths reinforce this

division (Figure 87). Since the expropriation in 1970, we can see that the subject of ownership is sensitive for expropriated families. Parks Canada gives free passes to

expropriates now up to the 6th generation¹⁵, but the reality is that those families still have to go through the toll booth, explain, and prove their eligibility. This is process that reinforces the status of ownership by Parks Canada. Some of those families still visit the cemeteries. The division does not help healing the wounds from the expropriation, people who were uprooted from their homes and underpaid for their sacrifice (Babin 2015). Reinstating the park as a free place would help mourning the expropriation. The division between FNP and the community should be minimized, and a community should be reestablished within the boundaries of the park. The territory needs to be fully inhabited and occupied, in order to care for our past and history.

The impacts of climate change on FNP were undoubtedly known and well documented. The assessment tool used for this thesis brought new knowledge regarding the important correlation between FNP's environmental threats, its historic sites and its community.

Although the CVI method is quite thorough, based on research and documents, the process relies on subjectivity when transferring objective data into the evaluation tables. Unlike the research for the Heart of Neolithic of Orkney, this thesis didn't include a workshop, where several opinions and points of view were discussed over a panel of

¹⁵ Parks Canada, "Forillon National Park. Year in Review – 2020", 2020, <https://www.pc.gc.ca/en/pn-np/qc/forillon/info/gestion/retro-review-2020?fbclid=IwAR16ZowaK9dUWAtxhNszAw1WvbnapaDVoQy0MUyQyfaeGIQFFW1Ax5GvwEE> (accessed 03-08-2021)

stakeholders. This thesis however was composed, as previously mentioned, by an academic research team, Parks Canada and a member from the Gaspésie region.

3. Design Intervention

Following the Climate Vulnerability Index assessment, this thesis proposes to further push the work on climate change and use lessons learned with a design intervention that will improve resiliency. As explained in the CVI conclusion (section 2.4.7), a macro-scale intervention is needed in order to correct the mistakes of the past. Combined with this, a micro-scale intervention will be used directly on the buildings. This section unfolds as follows:

- 3.1 Standards and Guidelines

- 3.2 Macro-scale Intervention (with study of precedents)

- 3.3 Micro-scale Intervention (with study of precedents)

3.1. Guidelines and principals

These guidelines and principals will unfold at every level of the design phase. The selected standards have been chosen for their notoriety in their respective fields, but also because they are the right fit for this context of research. For a list of all conservation standards which applies to Forillon National Park, see Appendix D.

3.1.1 Standards and Guidelines for the Conservation of Historic Places in Canada

The first guideline for this heritage context is *Canada's Historic Places, Standards and Guidelines for the Conservation of Historic Places in Canada*, published in 2010, which “[...] is a tool to help users decide how best to conserve historic places” (Parks Canada 2010b).

Paired with the Nara-Grid, this guideline will bring us valuable knowledge about conservation in Canada and on “[...] all actions or processes aimed at safeguarding the character-defining elements of an historic place to retain its heritage value and extend its physical life” (Parks Canada 2010b). More precisely, the grid will indicate where some conservation guidelines must be applied, such as:

- 1- Conserve the heritage value of an historic place.
- 2- Conserve changes to an historic place that, over time, have become character-defining elements in their own right.

Three main conservation actions are explained in the document: *Preservation*, *Rehabilitation and Restoration*.

3.1.1.1 Preservation

“Preservation involves protecting, maintaining and stabilizing the existing form, material and integrity of an historic place or individual component, while protecting its heritage value” (Parks Canada 2010b). While FNP’s historic sites have been under a preservation project since the creation of the park (La Parlouër, Violette, and Devoe 2018), it is no secret that the buildings have been degrading due to their inoccupancy. Despite their conditions, preservation is still possible, since they fulfill the guideline requirements (Parks Canada 2010b):

- a- Materials, features, and spaces of the historic place are essentially intact and convey the historic significance, without need of extensive repair or replacement;
- b- Depiction during a particular period in its history is not appropriate; and,
- c- Continuation or new use does not require extensive alterations or additions.

3.1.1.2 Rehabilitation

“Rehabilitation involves the sensitive adaptation of an historic place or individual component for a continuing or compatible contemporary use, while protecting its heritage value” (Parks Canada 2010b). Considering FNP’s historic building condition, a rehabilitation will be required. Most of the design interventions will follow this treatment. The area was completely expropriated in 1970, which made all lands and

buildings idle. This was a major cause of the degradation of both the cultural landscape and the historic buildings.

3.1.1.3 Restoration

“Restoration involves accurately revealing, recovering or representing the state of an historic place or individual component as it appeared at a particular period in its history, while protecting its heritage value” (Parks Canada 2010b). This third rule doesn’t fully apply to FNP, however some features may need to be restored, such as visual connections within the cultural landscape. Since the creation of the park in 1970, nature has grown back significantly, and some elements might be threatened:

De plus, la présence d’arbres au sud de la route principale obstrue la vue sur la petite grave qui se trouvait en contrebas de l’ancien lot 36 et qui a justifié l’installation de John Gavey (le père d’Elias, Daniel et Joseph). De même, la présence de ces arbres le long du côté sud de la route principale empêche d’avoir le même point de vue sur le secteur du havre que les propriétaires de l’époque. Cette vue, qui permettait aussi l’observation des activités de pêche dans le havre, expliquerait en partie l’installation de John Gavey dans ce secteur¹⁶ (La Parlouër, Violette, and Devoe 2018).

[...] les ensembles bâtis domestiques et commercial forment une composante marquante de ces paysages, ils acquièrent leur véritable signification patrimoniale lorsqu’ils sont mis en relation avec d’autres éléments visuels

¹⁶ “In addition, the presence of trees south of the main road obstructs the view of the small grave which was located below the old lot 36 and which justified the installation of John Gavey (Elias' father, Daniel and Joseph). Likewise, the presence of these trees along the south side of the main road precludes having the same view of the harbor area as the owners of the time. This view, which also allowed the observation of fishing activities in the harbor, would partly explain John Gavey's installation in this area.” Translated by the author.

(morphologie, percées visuelles, etc.) et culturels (église, cimetières, etc.) du paysage¹⁷ (La Parlouër, Violette, and Devoe 2018).

The restoration of the visual connections would follow the conservation guideline regarding visual relationship, as “they pertain to the visual relationships between an observer and a landscape or landscape feature (a views-cape) or between the relative dimensions of landscape features (scale)” (Parks Canada 2010b).

Figure 88: Postal card of Forillon, 1950-1960.
Source: Musée de la Gaspésie. Fonds Robert Fortin.
P54/1a/11/4.

Figure 90: Postal card of Cap-des-Rosiers before the creation of the park, 1960s.
Source: Fonds Robert Fortin. P54/1a/6/1. Musée de la Gaspésie. Photo: Al Cassidy.
Musée de la Gaspésie. Z-31.

Figure 89: Same view, summer 2020.

Figure 91: Cap-des-Rosiers, summer 2020
Source : <https://www.lesoleil.com/actualite/en-region/50-ans-en-2020-lindigne-saga-de-forillon-20de0c577c3899edc64148486ef72b99> (accessed 01-27-2021).

¹⁷ “[...] the domestic and commercial built complexes form a striking component of these landscapes, they acquire their true heritage significance when they are put in relation with other visual elements (morphology, visual openings, etc.) and cultural (church, cemeteries, etc.) of the landscape.” Translated by the author.

Visual connectivity between the Bartlett and Gavey properties is also obstructed. The context echoes the close relationship between these related families, an important historical fact (La Parlouër, Violette, and Devoe 2018).

It is essential to specify that “reconstruction, or reconstitution of a disappeared historic place, is not considered conservation [...]”, according to the Canadian guidelines. For this reason, this research will not explore these two options, even though many valuable buildings have been destroyed or lost since the creation of the park.

3.1.2 LEED v4 for Neighborhood Development and U.N.’s 17 Sustainable Development Goals

LEED v4 for Neighborhood Development, published by the U.S. Green Building Council in 2018, will be used to ensure that sustainable development will be done in Forillon National Park. The standards will deal with the establishment of a new community.

Also, some of United Nation’s Sustainable Development Goals will be followed¹⁸:

- Good health and well-being
- Clean water and sanitation
- Reduced inequalities
- Sustainable cities and communities
- Responsible consumption and production
- Climate action
- Life on land
- Peace, justice and strong institutions
- Partnership for the goals

¹⁸ United Nations, Department of Economic and Social Affairs. Sustainable Development. “The 17 Goals”, <https://sdgs.un.org/goals> (accessed 03-30-2021)

3.1.3 GSA Historic Preservation Technical Documents

The U.S. General Services Administration (GSA) provides an extensive database on how to preserve and restore different materials on historic sites.

Reference: U.S. General Services Administration, “Historic Preservation Technical Documents”, 2017, <https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-documents> (accessed 02-20-2021)

3.2 Macro-Scale – Study of Precedents

3.2.1 Macro-Scale Precedent – Rouge National Urban Park, 2019

With its area of 244.8 km², Forillon National Park needs a macro-scale intervention which can accentuate its best attributes and make better use of them. As previously stated, the current management of the parks is under National Park of Canada, which doesn't promote all of its assets.

The first precedent is Rouge National Urban Park (RNUP) in Ontario. RNUP is a large territory which is also owned and managed by Parks Canada. It regroups different types of landscapes, including farms, communities, a zoo, and natural landscapes. It is also the first urban park to be owned by Parks Canada. The goal of this project was to “protect

and manage this remarkable landscape” (Parks Canada 2019b). Spanning a 10-year period, the project objectives are to:

- Maintain the park’s ecological integrity
- Introduce improved park farmscape stewardship
- Conserve and interpret cultural landscape and archeology
- Provide a powerful gateway experience for the visitors
- Serve as a vital and dynamic meeting place for diverse communities

One of the strategies used for RNUP that could be transferred to FNP is the creation of management area concepts, which “[covers] smaller geographic areas to provide more area – and site – specific direction” (Parks Canada 2019b).

Area 1: The Heart of Park Biodiversity

Area 2: A Dynamic Toronto and Pickering Park Gateway

Area 3: A Markham Gateway to Park Heritage

Area 4: A Growing Park

Area 5: A Tranquil Escape from the City

Area 6: The Park Periphery

Figure 92: Six management area concepts for RNUP

Source: Parks Canada 2019b.

3.2.2 Macro-Scale Precedent – Ottawa’s Greenbelt, 2013

Ottawa’s Greenbelt offers a similar management area concept. As explained in the Master Plan, “the Concept Plan is elaborated through the Greenbelt’s Land Designations. The proposed land designations are a ‘classification’ which assigns landscape character and uses to define land areas across the Greenbelt. Areas are classified according to their desired role, whether to protect biodiversity, maintain agricultural resources, or accommodate permanent facilities” (National Capital Commission 2013).

Table 17: Greenbelt Land Designations
Source: National Capital Commission 2013.

GREENBELT ROLES	LAND DESIGNATIONS	ROLE COMPONENTS
Natural Environment	1. Core Natural Area	
	2. Natural Link	
Sustainable Agriculture	3. Agriculture	
Capital Experiences and Recreation		May occur in all designations
Facilities	4. Federal Facility and Operations	
	5. Non-Federal Facility and Operations	
		Transportation Infrastructure is an overlay (see Chapter 7 Sector Plans and Appendix C)

Figure 93: Ottawa's Greenbelt concept plan
Source: National Capital Commission 2013.

3.2.3 Macro-Scale Intervention

3.2.3.1 Creating a New Management Area Concept for Forillon National Park

Rouge National Urban Park and Ottawa's Greenbelt offer interesting attributes for Forillon National Park. Their area concepts improve asset management. The following 4 figures (figures 94-97) show FNP's community evolution, with an emphasis on Grande-Grave, from before the creation of the park, until 1970-2021, the post-expropriation era.

We can see that in 1930 (figure 94) a community was well established in the area. Many municipalities existed at the end of the peninsula, with Petit-Gaspé, Grande-Grave, Anse-St-George, and Indian Cove.

Fast forward to 1970-2021, those communities have disappeared, and only a few villages remain in the area, Cap-aux-Os and Cap-des-Rosiers. People have been pushed back to the boundaries of the park. Gates with toll booth manage entries (Figure 96 and 97).

Figure 95.

What is left today of Grande-Grave could lead one to believe that it is now a ghost village disconnected from civilization. A workshop done by Laval University students in summer 2015 worked to identify remaining communities around the park (Figure 98), and the connections between them (Figure 99). To get a clearer portrait of these communities, they also wrote a list of strengths and weaknesses (Table 18) (Université Laval 2015).

FORCES ET FAIBLESSES DU TERRITOIRE DE LA PÉNINSULE DE FORILLON / STRENGTHS AND WEAKNESSES OF THE FORILLON PENINSULA

Figure 98: Remaining communities around FNP, 1970-2021
Source: Université Laval 2015.

Figure 99: Conceptual connections between communities
Source: Université Laval 2015.

Table 18: Strengthens and weaknesses for FNP
Source: Université Laval 2015.

Strengths	Weaknesses
<ul style="list-style-type: none"> - Natural and informal networking - People know each other - Organization of parties by the community - Inter-village participation - Round tables - Presence of lighthouses - Diversity of services - Cap-des-Rosier's ice cream - Shrimp industry in Anse-au-Griffon - Complementary and diversified organizations - Petite École Inn and recent investments - Recreational activity Beaches - Pilgrimages - Interpretation center in the park - Repair of route 132 by 2016 - Multiple activities in the park and alternative accommodation product, new building of 'welcome to Penouille, etc. - The location - Tourism - Multiple villages surrounding the park - Interaction between visitors - Proximity to water - Proximity to the city of Gaspé - Proximity to the city of Percé - Existence of a "unifying" centre in each village - Strong identity - Short distances to travel compared to metropolitan areas - The park, a popular destination for families from the greater Gaspé area - Exotism of the Park - Beautiful houses in Grande-Grave - Conservation of the history of the Robin people 	<ul style="list-style-type: none"> - Devitalization of the village and lack of services - Linearity of the village of Cap-aux-Os - Exorbitant land prices - Summer vs. winter unequal supply of services - Decline in the cross-country ski trails - Low participation of the expropriated - The park [FNP] (limited development, constraints) - Destruction of nature near undeveloped paths (Route du Banc) - Bedroom communities - Precariousness of local businesses - Fragile services - Decrease in the vernacular economy - Reluctance towards intergenerational interactions - Difficulty in integrating neo-Gaspésians - Distances to be covered - Poor quality of internet service - Show cruise passengers the Dollorama - Lack of transport for tourists - Quays not suitable for large boats - Conservation of the territory - Too repetitive interpretation - Lack of infrastructure for a richer clientele

Their findings were highly significant:

One of the key conclusions of the workshop held with citizens and key stakeholders on 15 May 2015 [...] was the importance of conceiving a project that went well beyond the rehabilitation of the Bartlett and Gavey houses [in Grande-Grave]. During this public consultation, discussion centered on Forillon National Park of Canada, and more importantly on the Gaspé region as a whole, rather than just the buildings in the Grand Grave sector. This underscored the necessity to integrate the proposed interventions in a wider perspective, to consider a much larger scope than develop an isolated project (Université Laval 2015).

Also, adding to the Climate Vulnerability Index assessment, a community should be reinstated in the park. The return of some form of permanent population could bring new life and improve Forillon National Park's resiliency toward climate change.

It might seem tempting to fall into the nostalgia of the past. However, this thesis doesn't intend to reconstruct what was once Grande-Grave. Instead, the goal is to utilize what is left of it to its best capacity in order to show its history.

Integrating a new community asks the question "for whom", and who should have the right to the expropriated land. Considering the historical and social context, the issue is quite delicate. Expropriated families did not get a fair price for a sacrifice they didn't want to make in the first place. Still in 2010, 40 years later, descendants of the expropriates brought a lawsuit against the governments for better recognition of their sacrifice (Babin 2015). This shows that the matter is far from being resolved.

This thesis does not claim to be able to correct such a sensitive issue. In the context of climate change and architectural research, this thesis aims to focus on the battle against environmental threats that could take away all physical remains left of expropriates' history. We aim to find a suitable hypothetical solution for the matter being studied.

Figure 100: the Grenier family at a cottage on Pointe Penouille in early 1960s
Source : Musée de la Gaspésie. [Fonds Famille Grenier de Gaspé](#). P273/1/238B.

Figure 101: Family bathing in FNP around 1900s.
Source: Musée de la Gaspésie. [Collection Marcel Lamoureux](#). P77/2.

Regarding reintroducing a community into FNP, expropriated families who wish to move back into FNP could be the first ones to do so. However, considering the remoteness of the location, the new community would need to be financially independent. Gaspé, the nearest major town with a population of 14,568 in 2016¹⁹, is 30 km away, a 35-minute drive. The need for travelling to work would have to be minimized.

¹⁹ Statistics Canada, "Census Profile, 2016 Census. Gaspé, Quebec and Gaspé Ville, Quebec." 2019, <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=F&Geo1=POPC&Code1=1064&Geo2=CSD&Code2=2403005&Data=Count&SearchText=Gaspé&SearchType=Begins&SearchPR=01&B1=All&TABID=1> (accessed 03-27-2021)

With Covid-19 crisis, the tendency is for people to move out of cities. A survey published by Radio-Canada in Fall 2020, showed that 42% of people are thinking seriously about leaving the large metropolitan area of Montreal. Motivations for moving are 25% for working from home, and 46% for green spaces²⁰. Such clientele could very well live in FNP.

The plan for reintegrating a community into Forillon National Park would use similar guidelines as Rouge National Urban Park and Ottawa's Greenbelt with area concepts.

1. Tourist / Recreation infrastructures to provide a unique experience and a well coordinated cohabitation between visitors and permanent residents
2. Historic Area for the conservation and interpretation of the history and culture of the region
3. Residential / Commercial Area to provide a resilient and sustainable society
4. Natural Area for ecological integrity

These new area concepts would bring new permanent functions to the historic sites.

Also, it would ensure a year-round presence in the area, which would make maintenance much easier and constant.

A new residential grid would pay tribute to the cultural landscape (see figure 106) and be a reminder of the past. The design maintains a visual connection with the sea (see section in figures 107-108) while allowing for development. The conception of the new design follows these steps:

²⁰ Radio-Canada, "De nombreux Montréalais songent à quitter la métropole", 2020, <https://ici.radio-canada.ca/nouvelle/1743954/montrealais-quittent-metropole-sondage> (accessed 03-13-2021)

- 1- Analysis of former seigneurial grid, in order to create a template, which is still visible from the sky (see figure 105);
- 2- Subdivision of the old grid into a smaller one in select areas (see figure 105);
- 3- Preservation of specific character defining elements of the cultural landscape for the new implementation, such as visual connection with the sea, implementation on a slope, houses somewhat distance from the road (see figure 107);
- 4- Implementation of mitigation strategies in order to minimize climate change impact with the new constructions, such as water irrigation along roads, prevention of ground erosion with trees (see figure 108);

Area Concepts for FNP

Figure 104.

Figure 106.

Management Area Concepts

- 1. Tourist / Recreation area
- 2. Historic Area
- 3. Community Area
- 4. Natural Area

Projected Site Occupancy - Scale 1 : 2,500

New residential lot influenced by the cultural landscape

Figure 107.

Sea and Microclimate

The perpendicularity of the houses with the sea highlights the strong relationship the former residents of the area had with nature. The south side of the peninsula is also sheltered from the harsh wind and northern current, creating a microclimate. Also, the angle of the hill allows the sunrays to hit the ground at a perfect angle to optimize growth of crops. For this reason, no other orientation of the new properties should be done.

Figure 108.

3.3 Micro-Scale Intervention

The first aspect of a micro-scale intervention would be to deal with the rehabilitation of the Bartlett property. The 3-key climate drivers previously mentioned have had numerous impacts on this building. According to a report published by the Nordic Council of Ministers in 2011, a collaborative work of Nordic European countries, climate change can affect historic buildings in many ways (Nordic Council of Ministers 2011):

- Threat on timber: risk of rot, pest, biological growth, and faster decomposition through humidity increase;
- Frost damage at the foundation: freeze/thaw cycles increase with milder temperature in winter. Buildings become more wet, which means more cracking;
- Storm tides: The anticipated increases in both sea level and storm activity will lead to higher storm tides being measured in the future. This means that damage to heritage buildings caused by storm tides could occur more frequently. With a higher sea level in the future, less extreme tides could also lead to damage;
- Extreme weather and precipitation: An increase in extreme rainfall episodes could lead to the more frequent incidence of damp in buildings and an increase in damp damage. [...] Large volumes of rain falling over a short period could cause water penetration and damp in buildings, leading to damp- related damage;
- Wind: Future projections for wind are subject to a great deal of uncertainty. There will probably be more strong winds and storm activity than before, and this could cause structural damage to buildings. [...] This will result in an increase in driving rain, which strikes the buildings horizontally, increasing damp levels in walls and the risk of damp-related damage.

Many of these conditions have been found in Forillon National Park and several interventions would be necessary in order to resolve those issues. As a second step, an adaptive reuse of the buildings with a new program is necessary. Having been

unoccupied since 1970, it will be of utmost importance to find a permanent suitable function for these buildings.

Figure 109: Key plan.

3.3.1 Rehabilitation

3.3.1.1 Study of Precedents – Shelburne Barrel Factory, Nova Scotia, 2019

One historic building which is similar to the Bartlett house is the Barrel Factory in Shelburne, Nova Scotia. As seen in figure 110, extensive repairs were done to the property in order to deal with water issues. Built in 1917 on a historic dock street, the factory suffered yearly flooding because of higher water levels. To improve the factory's resiliency, the construction was raised, and a new foundation and floor were built. New shingles were also put it to improve the building's waterproofing.²¹

Figure 110: Envelope and foundation restoration

Source: <https://www.saltwire.com/lifestyles/shelburne-barrel-factory-getting-a-new-lease-on-life-294637/>.

3.3.2 Rehabilitating the Bartlett property

3.3.2.1 Actual Conditions

²¹ Kathy Johnson, "Shelbourne Barrel Factory getting a new lease on life", 2019, <https://www.saltwire.com/atlantic-canada/lifestyles/shelburne-barrel-factory-getting-a-new-lease-on-life-294637/> (accessed 02-20-2021)

Bartlett House Façades

Figure 111.

North-East Façade

South-East Façade

South-West Façade

North-West Façade

The first intent of preservationists is to consider a balanced approach towards the conservation of historic materials, regardless of the date of construction of the building. [...] The benefit is an approach in which the owner is not burdened with reinvesting in failed systems but which provides a more balanced approach where building retention is a viable solution (Utter et al. 2017).

The following Value-based assessment table (Table 19) is taken from an article in the APT Bulletin on the rehabilitation of the Art and Architecture Building at University of Illinois at Chicago. The previous quote summarizes the approach the authors took toward rehabilitation. Although the tool they have produced was meant for colleges and universities built between 1965 and 1975, it presents interesting evaluation assets on architectural elements. This table offers “a values-based approach, together with a rigorous investigation to understand the overall condition of the building and how it should be preserved [...]” (Utter et al. 2017). For this paper we used the table to assess the evolution of each façade of the Bartlett house, in order to understand which elements failed, and which didn’t.

Table 19: Value-based Assessment of Various Façade Elements. Source: Utter et al. 2017.

General	Specific Element	Form	Technological Merits	Condition	Integrity	Notes
North-East Façade	Vertical wood siding	3	3	2	3	
	Cedar shingles	3	3	3	3	
	Horizontal wood siding	3	3	2	3	Needs new coat of paint. Worse condition near junction with roof
	Corner post (lumber)	3	3	2	3	
	Wood windows (glass and sashes)	3	2	3	3	
	Window frame (wood)	3	3	3	3	

	Windowsill & apron (wood)	3	2	2	3	In good condition, but aprons need new coat of paint
	Wood gutters	3	1	2	3	Original system, but has many flaws (continuity and support system failed in many places)
	Fascia (wood)	2	1	2	3	Traces of water drips
	Paint	D	D	D	D	Failed many places
	Foundation (concrete)	N/A	N/A	N/A	N/A	Not original material. Barely or not visible from interior and exterior
South-East Façade	Horizontal wood siding	3	2	2	3	Some pieces are missing, a few holes made by pests
	Corner post (lumber)	3	3	2	2	
	Wood windows (glass and sashes)	3	3	2	3	
	Window frame (wood)	3	2	2	2	Water damage at the lower part
	Roof fascia	3	2	2	2	Show water damage
	Gable vent	1	3	3	1	Most likely not original
	Porch (wood)	3	2	2	1	Most likely not original
	Railing (wood)	3	2	2	1	Most likely not original
	Columns (wood)	3	2	3	1	Most likely not original
	Wood lace (wood)	3	3	3	1	Most likely not original
	Stairs (wood)	3	2	1	3	Most likely not original
	Paint	D	D	D	D	Failed many places
	Foundation (concrete)	D	D	D	D	Not original material
South-West Façade	Horizontal wood siding	3	2	3	3	Performed better, protected by porch
	Corner post (lumber)	3	3	3	2	
	Wood windows (glass and sashes)	3	3	3	3	Performed better, protected by porch
	Window frame (wood)	3	3	3	2	Performed better, protected by porch
	Roof + porch fascia	3	3	3	3	
	Porch (wood)	3	2	3	1	Most likely not original
	Railing (wood)	3	2	2	1	Most likely not original
	Stairs (wood)	3	2	1	1	Most likely not original
	Paint	3	2	3	1	Performed better where protected by porch
	Foundation (concrete)	D	D	D	D	Not original material
	Foundation (masonry)	D	D	D	D	Original foundation
North-West Façade	Horizontal wood siding	3	2	1	3	
	Corner post (lumber)	3	1	1	3	More deteriorated than other sides
	Wood windows (glass and sashes)	3	3	2	3	

	Window frame (wood)	3	3	2	3	
	Roof + porch fascia	3	2	2	2	
	Gable vent	1	3	3	1	Most likely not original
	Porch (wood)	3	2	3	1	Most likely not original
	Railing (wood)	3	2	2	1	Most likely not original
	Paint	D	D	D	D	Failed many places
	Foundation (concrete)	D	D	D	D	Not original material
	Foundation (masonry)	D	D	D	D	Original foundation
Roof	Profile steel roofing	2	3	2	1	Most likely not original
	Dormers	3	2	2	3	
	Chimney	N/A	N/A	N/A	N/A	Could not be examined up close. Might be a source of water infiltration

Key: 1. Low 2. Moderate 3. Excellent D. Detrimental N/A Not Available

The site survey was non-intrusive, so some details could not be evaluated, such as nails and screws, concealed structural elements, insulation, attic conditions, etc.

From this assessment, we can conclude the following arguments:

- Elements protected from weather are in a better state (i.e., under the porch);
- Elements on the south-east and south-west façades are more deteriorated;
- Wood is only protected by paint against the elements, which has failed in many areas;
- Most of original material still performs very well considering its age (wood window frames and sashes, wood sidings, dormers).

Also, different issues have been documented in the interior of the house during site recording, see section 2.3. By dealing with the building envelope issues, interior condition should be stabilized.

3.3.2.2 Recommendations for Rehabilitation – Exterior

Foundation – masonry:

Figure 112: Basement plan.

Figure 113: Cracked masonry at foundation.

Of the original foundation, only two partial walls remain (see red lines in figure 112).

Also, the original masonry is in very bad condition. The walls could not be fully evaluated, because of difficulty to access it from the interior, but it appeared that its structural integrity is severely compromised. Cracks found were quite large and showed movement. It could not be confirmed whether this was a past or an ongoing situation, but it is suspected to still be occurring. Extensive repair would have to be done, probably demounting, and rebuilding the entire walls.

Figure 114: Crack on concrete foundation on south-east façade.

Foundation – concrete:

Reports on cracks evolution had not been released in time for this research. However, several cracks were found in the concrete

foundation as well (refer to site

recording, section 2.3). It was not possible to establish whether deterioration was still occurring, but it was suspected to be ongoing. Some of the cracks are diagonal corner crack “that run from one joint to its perpendicular joint at the corner of a slab”²² According to GSA, these kinds of cracks can lead to curling or warping of the wall, which can both be caused by a void space underneath the foundation. Neither of these phenomena had been noticed at Bartlett, but careful monitoring should be done. Depending on the severity of the situation, it might be more suitable to rebuild an entirely new foundation.

²² U.S. General Services Administration, “Types of Cracks in Concrete and Typical Causes”, 2017, https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/%0bpreservation-tools-resources/technical-documents?Form_Load=88348 (accessed 03-14-2021)

Profile steel roofing and fascia:

Figure 115: Bartlett's roof
Source: collaboration with Parks Canada.

Figure 116: Bartlett house roof with shingles, possibly from 1970s

Source:
http://ip51.icomos.org/~fleblanc/projects/1971-1979_PC/p_pc_forillon.html (accessed 02-23-2021).

One of the key elements in this rehabilitation is to ensure that no water gets inside the house. It has been noticed during site recording that several areas were damaged from water infiltration, probably from the roof. Ensuring that the roof is watertight is crucial in order to keep the interior dry. The roof could not be inspected closely, only aerial photos were taken. Judging from them, it seemed to be in moderate condition. Closer evaluation would have to be done.

The current profile steel sheet roof is most likely not the original one. A photo (possibly from the 1970s) shows a dark shingled roof, most likely not the original either. This material seems to be doing well and is more durable against strong winds. Changing for a more rustic look, such as cedar shingles might not be suitable at the moment. The embodied energy spent in the making and installation of this roof has yet to be spent

through its lifespan. Waiting for a new roof that needs to be installed might be more ecologically responsible.

Regarding the fascia, adding a flashing with a drip edge of the same material as the roof could improve durability. This solution would keep water off the wood more efficiently. However, from a conservation point of view, such a modification would not be suitable.

Gutters

Figure 117: Wood gutter showing mold and fungus at the bottom.

Figure 118: Discontinuous wood gutter and broken support to the left.

The gutters on the south-east façade are an essential part of the water management strategy around the house that needs to be maintained and improved. It has been noticed that the original system (still in place) has many flaws. The original material, wood, is rotting away at the bottom of the gutter, creating possible leaks. Also, the wood supports have broken off at some places. During a visit to the Xavier-Blanchette house, a near by heritage site on FNP, it was noticed that one of the supports had also

fallen off as well. This seems to be a recurring situation with this system. As previously stated, the region is subject to receiving more precipitation, thus more water to manage (Parker et al. 2017). In order to improve the durability of the system, we suggest the changes shown in figures 119 and 120. Introducing redundancy by adding galvanized steel, would ensure that the system still works should the wood give way.

Figure 119: Gutter detail.

Figure 120: Part of the south-east elevation with its gutter.

Figure 121: Shingles on the north-east façade.

Shingles:

Singles on north-east façade of the house are generally in good condition. If repair needed, replacement of the damaged units would be the best option. However, original material, configuration, detailing and installation

would have to be determined²³. Luckily, this side of the house seemed to be sheltered from the wind, as there was far less damage.

Horizontal and vertical wood sidings and corner post:

Figure 122: Missing wood siding on the south-east façade.

Most of damage could be avoided if a repainting maintenance routine were set up. Wood sidings that are beyond repair should be replaced by same material, configuration, detailing and installation as the original. Before repainting,

preparing wood surfaces is required. “Wood surfaces scheduled to be finished with an opaque finish shall either be stripped or sanded as required to produce a smooth substrate for application of the new coatings.”²⁴

²³ National Park Service. U. S. Department of the Interior. “The Repair and Replacement of Historic Wooden Shingle Roof”, 1989, <https://www.nps.gov/tps/how-to-preserve/briefs/19-wooden-shingle-roofs.htm#deteriorated> (accessed 02-23-2021)

²⁴ U.S. General Services Administration, “Surface Preparation for Painting Wood”, 2016, https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-documents?Form_Load=88441 (accessed 02-23-2021)

Windows and sashes:

Figure 123: Dormer on the north-east façade.

Windows were in moderate condition. A routine maintenance could extend their lifespan for several years. This step should be done before any interior work, in order to ensure that no water gets inside. The GSA guidelines suggest the following steps for repair:

1. Examination, survey, and condition assessment of windows.
2. Removal of existing sash, trim, etc.
3. Repair of deteriorated wood through the use of epoxies, dutchmen and/or the replacement of new wood to match existing appearance.
4. Painting/refinishing sash and trim.
5. Installation of repaired sash.²⁵

It is also essential to keep debris out of the window frames. Clean frames will improve air tightness and efficiency.

²⁵ U.S. General Services Administration, "Rehabilitating Wood Windows", 2017, https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-documents?Form_Load=88071 (accessed 02-23-2021)

Porch and stairs (wood):

Figure 124: Porch on the south-west façade.

The current wood porch, including stairs, railings and posts, are most likely not the original ones. Some deteriorations was noticed where they were more exposed to weather (see figure 124). To rehabilitate those elements, a

fresh coat of paint and a replacement of damaged members should be sufficient.

Paint:

Figure 125: North-west façade.

Figure 126: South-east façade.

The house needs a new coat of paint, especially north-west façades and on the south-east. As previously stated, a maintenance routine would ensure continuous care and fix issues before they could deteriorate further.

3.3.2.3 Recommendations for Rehabilitation – Interior

Basement

Moisture and fungus

Rot and fungi were noticed in many places on the beams and subfloor of the ground level. If the wood members to be repaired are non-structural, epoxy consolidant could be used in order to keep the original elements. However, if the member is structural, then replacement of the entire piece is preferred, as epoxy doesn't work well under tension.²⁶ This may seem as a loss of a character-defining element of the house, but the basement is an unfinished space, too shallow for any function. For this reason, replacement of the original elements of the basement is reasonable.

Ground and Upper Level

Stained Floors

The stains are mostly from water that had found its way through the walls from the roof. Before doing any interior repair, close evaluation and repair of the roof would have to be done. Since the wood floor is still the original, good practice is to keep them, and simply sand away the stains (Peterson 2008).

²⁶ U.S. General Services Administration, "Epoxy Repair for Deterioration and Decay in Wooden Members", 2017, https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-documents?Form_Load=88139 (accessed 02-23-2021)

Floor – Board Cupping

Some cupping has been noticed on the floors, but at a low-moderate level. This is probably caused by the humidity trapped in the basement. The sanding carried out in order to remove water stains would also resolve this issue. However, humidity levels in the basement must be resolved first.

3.3.3 Adaptive Reuse

3.3.3.1 Study of Precedent – Laval University 2015 Workshop for Forillon National Park

L’une des principaux facteurs contribuant à la pérennité d’un bâtiment est son utilisation courante. Considérant les ressources humaines, matérielles et financières actuelles de l’Unité de gestion de la Gaspésie, un défi important, pour l’ensemble des bâtiments non utilisés de ce secteur, sera de leur conférer une vocation qui soit à la fois compatible avec leurs caractéristiques patrimoniales et la mission du parc national Forillon, et susceptible de générer les revenus nécessaires à leur entretien et leur conservation à long terme²⁷ (La Parlouër, Violette, and Devoe 2018).

As specified by La Parlouër et al., finding a function for Forillon National Park’s historic buildings is a crucial element in order to improve the building’s resiliency. This is standard 5 in Parks Canada’s conservation guidelines (Parks Canada 2010b). Criterion #3 will also be followed, as to find a function that will alter as little as possible the historic building.

The workshop completed by Laval University students in spring 2015 in FNP offers an excellent precedent. It highlighted the importance of a rehabilitation that would “integrate the proposed interventions in a wider perspective, to consider a much larger scope than develop an isolated project”, which would include the whole Gaspé region (Université Laval 2015).

²⁷ “One of the main factors contributing to the sustainability of a building is its current use. Considering the human, material and financial resources of the Gaspé Management Unit, a major challenge for all the unused buildings in this sector will be to give them a vocation that is both compatible with their historic characteristics and the mission of Forillon National Park, and likely to generate the income necessary for their maintenance and long-term conservation.” Translated by the author.

From their observation, they proposed a program that aimed to: “support the local economy and promote collective entrepreneurship by setting up a cooperative and two shops, which in turn will finance the maintenance, improvements and interpretation of the site and its buildings, as well as the development of new projects in Grande-Grave” (Université Laval 2015). The project suggested an adaptive reuse of the Bartlett and Gavey properties to be converted into a co-op, featuring a shop, a café, and rental cabins.

Figure 127: Bartlett House, ground and upper levels converted into a co-op with a shop and café
Source: Université Laval. 2015. “To Invest in One’s Landscape Is to Acknowledge Oneself in That Landscape.”
Québec.

This thesis suggests starting from the workshop findings, but with a context of a community living in FNP. As such, the Gavey houses would be transformed into rental cabins. The barns and sheds would also be used as seasonal buildings. However, the

Bartlett house would be used as a social centre. This would act as a point between the local community and the tourists who visit.

Figure 128.

Adaptive Reuse - New Functions

- 1. Social Centre
- 2. Rental Cabins
- 3. Seasonal buildings

Ground Level

1. Kitchen
2. Main Living room
3. Second living room
4. Office / bedroom
5. Summer kitchen

Figure 129: Bartlett House Plans.

Scale: 1/8" = 1"
Ground Level

- Existing walls
- Demolition
- New walls

1. Front desk / shop
2. Main meeting room
3. Lounge
4. Office
5. Kitchen

Upper Level

- 1. Bedroom
- 2. Master bedroom
- 3. Bedroom

Figure 130: Bartlett house plans.

- 1. Storage
- 2. Office

Scale: 1/8" = 1'
Upper Level

- Existing walls
- Demolition

Figure 131: Render of Grande-Grave with its new community.

The new constructions will follow the traditional neoclassical typology present in the region (see figure 132). With prescriptive typology and material, the new houses will respect the existing ones. As it can be seen in figure 132, this shape is interpreted in different ways by owners in order to suit them better their needs. Such flexibility will be possible.

Figure 132: Common typology in the area. Source: Google.

Furthermore, guidelines selected from the *LEED v4 for Neighborhood Development* will be followed, such as:

- Minimum building energy performance
- Construction activity pollution prevention
- Minimized site disturbance
- Rainwater management

3.4 Documentation

Upon the creation of the park, a larger number of buildings had been selected to be retained for later use. Unfortunately, some of them have been lost over the years (La Parlouër, Violette, and Devoe 2018). The loss of a building is a natural part of its life cycle. Documentation allows a part of it to be kept, so that its legacy can carry on in a

different form. For the Bartlett property, a photogrammetry of the exterior shell will serve as a documentation of those buildings.

South-East Elevation

North-West Elevation

West-North Elevation

East-South Elevation

South-East Elevation

North-West Elevation

West-North Elevation

East-South Elevation

Figure 134: Photogrammetry of the Bartlett barn.

4. Conclusion

Our built heritage is one of our most visible testimonies of the past. Our historic sites remind us of where we came from, what we have done and help us to remember the values we cherish. As everything has a beginning and an end, the deterioration and loss of these buildings is inevitable. Architectural conservation tries to make those physical memories last as long as possible. However, climate change presents unprecedented challenges and threatens our efforts.

Climate change is a growing concern for every society. Its physical and environmental effects are becoming more obvious every year. However, other effects on historic sites and communities are not yet fully understood. The Climate Vulnerability Index is a useful tool to begin to understand the correlations between environmental threats and community benefits. Forillon National Park's evaluation was a great demonstration of the Climate Vulnerability Index potential. Even though the assessment didn't bring new information about the environmental impacts, this thesis drew an initial picture of how vulnerable Forillon National Park's historic sites are without its community.

Furthermore, in the broad question of addressing climate change threats towards heritage sites, this project showed the necessity of seeking answers not just at one level of intervention, but on a multi-scale involvement: macro and micro. From landscape management intervention to gutter detailing, everything must be considered. At the same time, the use of different previously developed tools (Climate Vulnerability Index,

Nara-Grid, Value-based assessment table) enabled the creation of a new evaluation tool to assess the reality of Forillon National Park.

With regards to issues and challenges in Forillon National Park, this thesis only tackled the broad outlines of the problem. It highlights the importance of community presence in architectural conservation. The battle against climate change is for the people, therefore they must be part of the solution.

Appendix A – Other Climate Change Effects on Forillon National Park

Wind Speed

Table 20: Monthly average hourly wind speeds

"*" = statistically significant trend ($P < 0,05$)

Source: Parker et al. 2017.

Precipitation Change

Table 21: Reference base of total precipitation for the Gaspé climatological station from 1980-2011 for various return periods (T). For example, the different lines show that precipitation lasting 10 minutes occurs on average every 2 years at a height of 9mm, while for the same duration, precipitation at a height of 20mm only occurs 'every 100 years. Source: Parker et al. 2017.

Table 22: Height and duration of precipitation events with a recurrence of 5 years for the period 2050-2100. Source: Parker et al. 2017.

Table 23: Height and duration of precipitation events with a recurrence of 5 years for the period 2050-2100. Source: Parker et al. 2017.

IDF Graph: PPT – GEV – T: 100 Years

Station: GASPE A ID:7052605, Model: All Models, projection period: 2050 to 2100

Appendix B – Other Character Defining Elements Tools

Table 24: Key values for FNP with their assessed current condition and trend. Source: Day et al. 2019.

Key Values	Excerpts taken directly from the Statement of value	Current Condition and trend
(ii) important interchange of human values on town-planning of landscape design	<ul style="list-style-type: none"> - The land layout shows how occupants relied on a multidisciplinary occupation (fishery, agriculture and forestry); - The orientation of the property, perpendicular to the coastline, displays a land organization based on fishery; - The area is a vestige of the cod fish fishery practiced from the 18th until half of the 20th century - Reminder of a former fishing region 	→
(iii) exceptional testimony to a cultural tradition or to a civilization	<ul style="list-style-type: none"> - The property is associated with the theme of cod fishery - High level of craftsmanship for the house for its exterior ornaments and interior woodwork on the 1st and 2nd floors. - The constructions are a collection displaying different technics of constructions used at the time 	↘
(V) example of a traditional human settlement, land-use, or sea-use which is representative of a culture with the environment especially when it has become vulnerable under the impact of irreversible change	<ul style="list-style-type: none"> - Along with other buildings, the property is part of a visual “string of buildings” on the coast, reminder of the former main source of income in the area. 	↘
(Vii) to contain superlative areas of exceptional natural beauty and aesthetic importance	<ul style="list-style-type: none"> - The relationship of the buildings with the sea gives a strong connection with nature - The property sits among other buildings along the coast and highlights a social and economic system based on fishery, agriculture and forestry 	→

Evaluation standards. Source: Day et al. 2019.

Good	Good with some concerns	Significant concerns	Critical	
The site's values are in good condition and are likely to be maintained for the foreseeable future, provided that current conservation measures are maintained.	While some concerns exist, with minor additional conservation measures the site's values are likely to be essentially maintained over the long-term.	The site's values are threatened and/or may be showing signs of deterioration. Significant additional conservation measures are needed to maintain and/or restore values over the medium to long-term.	The site's values are severely threatened and/or deteriorating. Immediate large-scale additional conservation measures are needed to maintain and/or restore the site's values over the short to medium-term or the values may be lost.	Stable → Improving ↗ Deteriorating ↘

Appendix C – Climate Vulnerability Index Assessment Tools: List of tables used for the methodology

The 8-level risk assessment (exposure and sensitivity) with the 3-key climate drivers, according to Day et al.:

Table 25: Categorical levels for exposure, based on IPCC definitions. Source: Day et al. 2019.

Exposure % Based on IPCC	Level 1	Level 2	Level 3	Level 4	Level 5
	Very unlikely <10%	Unlikely 10-33%	Possible 34-66%	Likely 67-90%	Very likely >90%

Table 26: Categorical levels for sensitivity, based on IUCN definitions. Source: Day et al. 2019.

	Level 1	Level 2	Level 3	Level 4	Level 5
Sensitivity based on IUCN	Very low All key heritage values will remain essentially intact; overall condition of property is stable or improving	Low Some loss or alteration of a few of the key heritage values will occur, but not causing persistent or lasting effects on OUV	Moderate Some loss or alteration of some of the key heritage values will occur, but not causing a significant reduction of OUV	High Loss or alteration of many key WH values will occur, leading to a significant reduction of OUV	Very high Potential for major loss or substantial alteration of majority of key heritage values, leading to substantial reduction of OUV

Table 27: Modifiers to assessed exposure. Source: Day et al. 2019.

Modifier	Level 0	Level 1	Level 2	Level 3
Exposure				
Temporal scale The frequency of event exposure	Intermittent (<1 event/ decade)	Occasional (1-5 events/ decade)	Frequent (5-10 events/ decade)	On-going
Trend The recent trend of the key climate driver	Decrease/ static	Slow increase	Moderate increase	Rapid increase

Table 28: Modifiers to assessed sensitivity. Source: Day et al. 2019.

Modifier	Level 0	Level 1	Level 2	Level 3
Sensitivity				
Spatial scale Extent (%) of heritage property affected by climate driver at any one time	Restricted <10%	Localised 11–50%	Extensive 51–90%	Very widespread 91–100%
Compounding factors Is climate change likely to influence or interact with other non-climate stressors (e.g. invasive species) in the near future?	Very unlikely/unknown	Low probability	Medium probability	High probability

Table 29: Risk matrix to assess potential impact from exposure and sensitivity. Source: Day et al. 2019.

Modified Exposure	Modified Sensitivity				
	Very low	Low	Moderate	High	Very high
Very unlikely	Low	Low	Low	Low	Low
Unlikely	Low	Low	Moderate	Moderate	Moderate
Possible	Low	Moderate	Moderate	High	High
Likely	Low	Moderate	High	High	Extreme
Very likely	Low	Moderate	High	Extreme	Extreme

Table 30: Categorical levels for components of adaptive capacity; local management capacity and scientific/technical support only contribute to the overall adaptive capacity in the CVI process if they are assessed to be effective (lower section) in addressing the relevant key climate driver. Source: Day et al. 2019.

	Level 1	Level 2	Level 3	Level 4
Local Management Capacity (i.e. resources, budget, knowledge) for management to respond at local level	No capacity and/or resources	Low capacity	Moderate capacity	High capacity
Scientific/Technical Support for management at local level	No support and/or scientific understanding	Low level of support	Moderate level of support	High level of support
Effectiveness to address the climate driver Extent to which adaptive capacity will effectively address the driver	Very low/negligible level of effectiveness	Low level of effectiveness	Moderate level of effectiveness	High level of effectiveness

Table 31: Risk matrix to assess HV Vulnerability from potential impact and adaptive capacity. Source: Day et al. 2019.

Potential Impact	Adaptive Capacity		
	High	Moderate	Low
Low	Low	Low	Low
Moderate	Low	Moderate	Moderate
High	Moderate	Moderate	High
Extreme	Moderate	High	High

Table 32: Risk matrix to assess ESC potential impact from OUV Vulnerability and ESC dependency. Source: Day et al. 2019.

HV Vulnerability	ESC Dependency			
	Positive or minimal-negative	Low-negative	Moderate-negative	High-negative
Low	Low	Low	Low	Moderate
Moderate	Low	Low	Moderate	High
High	Low	Moderate	High	High

Table 33: Risk matrix to assess Community Vulnerability from ESC potential impact and ESC adaptive capacity.
Source: Day et al. 2019.

Potential Impact	ESC Adaptive Capacity High			
	High	Moderate	Low	Minimal
Low	Low	Low	Moderate	Moderate
Moderate	Low	Moderate	Moderate	High
High	Low	Moderate	High	High

Appendix D – Selected Standards and Guidelines

The followings are standards and guidelines taken from the Standards and Guidelines for the Conservation of Historic Places in Canada

General Standards for Preservation, Rehabilitation and Restoration from Standards and Guidelines for the Conservation of Historic Places in Canada

1. Conserve the heritage value of an historic place. Do not remove, replace or substantially alter its intact or repairable character- defining elements. Do not move a part of an historic place if its current location is a character-defining element.
2. Conserve changes to an historic place that, over time, have become character-defining elements in their own right.
3. Conserve heritage value by adopting an approach calling for minimal intervention.
4. Recognize each historic place as a physical record of its time, place and use. Do not create a false sense of historical development by adding elements from other historic places or other properties, or by combining features of the same property that never coexisted.
5. Find a use for an historic place that requires minimal or no change to its character-defining elements.
6. Protect and, if necessary, stabilize an historic place until any subsequent intervention is undertaken. Protect and preserve archaeological resources in place. Where there is potential for disturbing archaeological resources, take mitigation measures to limit damage and loss of information.
7. Evaluate the existing condition of character-defining elements to determine the appropriate intervention needed. Use the gentlest means possible for any intervention. Respect heritage value when undertaking an intervention.
8. Maintain character-defining elements on an ongoing basis. Repair character-defining elements by reinforcing their materials using recognized conservation methods. Replace in kind any extensively deteriorated or missing parts of character-defining elements, where there are surviving prototypes.
9. Make any intervention needed to preserve character-defining elements physically and visually compatible with the historic place and identifiable on close inspection. Document any intervention for future reference.
10. Repair rather than replace character-defining elements. Where character-defining elements are too severely deteriorated to repair, and where sufficient physical evidence exists, replace them with new elements that match the forms, materials and detailing of sound versions of the same elements. Where there is insufficient physical evidence, make the form, material and detailing of the new elements compatible with the character of the historic place.

11. Conserve the heritage value and character-defining elements when creating any new additions to an historic place or any related new construction. Make the new work physically and visually compatible with, subordinate to and distinguishable from the historic place.
12. Create any new additions or related new construction so that the essential form and integrity of an historic place will not be impaired if the new work is removed in the future.
13. Repair rather than replace character-defining elements from the restoration period. Where character-defining elements are too severely deteriorated to repair and where sufficient physical evidence exists, replace them with new elements that match the forms, materials and detailing of sound versions of the same elements.
14. Replace missing features from the restoration period with new features whose forms, materials and detailing are based on sufficient physical, documentary and/or oral evidence.

Guidelines for cultural landscapes

Evidence of Land Use: "These guidelines provide direction when the evidence of a land use has been identified as a character-defining element of an historic place. They apply specifically to the features that express or support a past or continuing land use when these features have been identified in a Statement of Significance. [...] land use refers to the human use of the natural environment. It includes activities that significantly modify aspects of the natural environment into a built environment, such as fields, pastures and settlements"

Evidence of traditional practices: "These guidelines provide direction when the evidence of a traditional practice has been identified as a character-defining element of an historic place. They apply specifically to the features that express or support a past or continuing traditional practice when these features have been identified in a Statement of Significance."

Land patterns: "These guidelines provide direction when land patterns have been identified as character-defining elements of an historic place. Land pattern refers to the overall arrangement and interrelationship of the larger-scale aspects of a cultural land- scape, whether natural or human-made."

Spatial organization: "These guidelines provide direction when spatial organization has been identified as a character-defining element of an historic place. Spatial organization refers here to the arrangement of spaces in a cultural landscape."

Visual relationships: "These guidelines provide direction when visual relationships have been identified as a character-defining element of an historic place. They pertain to the visual relationships between an observer and a landscape or landscape feature (a views- cape) or between the relative dimensions of landscape features (scale)."

Landforms: "These guidelines provide direction when a landform has been identified as a character-defining element of an historic place. Landform refers to the shape of the Earth's surface at a particular place. Some naturally occurring landforms include mountains, hills,

canyons, valleys and plains. Human-made landforms include terraces, embankments, ramparts, berms, ditches and swales.”

Built features: “These guidelines provide direction when the built features of a cultural landscape have been identified as character-defining elements of an historic place. Built features can include archaeological remains; residential, commercial and institutional buildings; structures, such as dams or bridges; and caribou fences. A building may play a role as a character-defining element in a cultural landscape, in addition to having its own heritage value.”

Guidelines for Buildings

Exterior form: “These guidelines provide direction when a building’s exterior form is identified as a character-defining element of an historic place. They also give direction on how to minimize the impact of alterations and additions on the building’s exterior due to a change in use or regulations. Exterior form refers to a building’s orientation, scale, massing, composition, proportions, colour and texture. A building’s exterior form is also related to its surroundings, which includes spatial relationships with adjacent buildings, plazas or natural features, views, climatic considerations and circulation for vehicles and pedestrians.”

Interior arrangement: “These guidelines provide direction when a building’s interior arrangement is identified as a character-defining element of an historic place. They also give direction on how to minimize the impact on heritage value of additions or alterations to the building’s interior due to a change in use or regulations.”

Roofs: “These guidelines provide direction when a roof or roof element is identified as a character-defining element of an historic place. Roof assemblies include both visible elements, such as cupolas, turrets, cresting, chimneys, gutters, weathervanes, gables, eaves, parapets, dormers, soffits and fascias, and components, such as the cladding, substructure, insulation, vapour controls, flashing and ventilation, that are critical in providing a weatherproof enclosure for the building.”

Exterior walls: “These guidelines provide direction when exterior walls and their elements are identified as character-defining elements of an historic place. Exterior walls include foundation walls, structural masonry or log walls, and wood, concrete or steel framing with an exterior cladding, such as curtain-wall systems. The guidelines also provide direction on how to minimize the negative impact of additions or alterations on exterior walls.”

Windows, doors and storefronts: “These guidelines provide direction when windows, doors or storefronts are identified as character-defining elements of an historic place. They also give direction on how to minimize the impact of introducing a new element, or changing existing non- character-defining windows, doors and storefronts in an historic building.”

Entrances, porches and balconies: “These guidelines provide direction when entrances, porches and balconies are identified as a character-defining element of an historic place. Lobbies, vestibules, stairs, canopies, verandas, overhangs, widow’s walks and pergolas, and their

decorative and functional elements, such as pilasters, entablatures, fire escapes, lights and balustrades are also included, as well as features that allow access to the building by car, such as a drive-through, ramp, canopy or carport.”

Interior features: “These guidelines provide direction when a building’s interior features are identified as character-defining elements of an historic place. They also give direction on how to preserve those features through maintenance and repair, or when a change in use or regulations dictates the need for alterations or additions.”

Guidelines for materials

Wood and wood products: “These guidelines provide direction when wood and wood products are identified as character-defining elements of an historic place. They also give direction on maintaining, repairing and replacing wood or wood products.”

Masonry: “These guidelines provide direction when masonry is identified as a character-defining element of an historic place. They also give direction on maintaining, repairing and replacing masonry elements.”

LEED v4 for Neighborhood Development

Steep slope protection: “To minimize erosion, protect habitat, and reduce stress on natural water systems by preserving steep slopes in a natural, vegetated state.” (USGBC 2018)

“On any existing, previously developed slopes steeper than 15%, restore the slope area with native plants or non-invasive adapted plants, according to Table 1. In addition, on any existing, undeveloped slopes steeper than 15%, limit the development area according to Table 1.”

“For undeveloped slopes steeper than 40%, do not disturb portions of the project site within 50 feet (15 meters) horizontally of the top of the slope and 75 feet (23 meters) horizontally from the toe of the slope.”

Walkable Streets: “To promote transportation efficiency and reduce vehicle distance traveled. To improve public health by providing safe, appealing, and comfortable street environments that encourage daily physical activity and avoid pedestrian injuries.” (USGBC 2018)

See requirements regarding façades and entries: a. At least 80% of the total linear distance of building façades facing the circulation network in the project is no more than 25 feet (7.5 meters) from the property line.

b. At least 50% of the total linear distance of building façades facing the circulation network in the project is no more than 18 feet (5.5 meters) from the property line.

Ground-Level Use and Parking

j. Continuous sidewalks or equivalent provisions for walking are available along both sides of the entire circulation network within the project, including the project side of the circulation network bordering the project. Bicycle- and pedestrian-only paths meet this requirement. New sidewalks must be at least 10 feet (3 meters) wide on retail or mixed-use blocks and at least 5 feet (1.5 meters) wide on all other blocks. Note that these requirements specify wider sidewalks than required by NPD Prerequisite Walkable Streets. Alleys may be exempted.

k. If the project has ground-floor dwelling units, the principal level of at least 50% of those units has an elevated finished floor at least 24 inches (60 centimeters) above the sidewalk grade. Below-grade basement spaces and/or accessory dwelling units are exempt from this requirement.

Or other requirements

HOUSING TYPES AND AFFORDABILITY

“To promote socially equitable and engaging neighborhoods by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community.”

Option 2. Affordable Housing: “Include a proportion of new rental and/or for-sale dwelling units priced for households earning less than the area median income (AMI). Rental units must be maintained at affordable levels for a minimum of 15 years. Existing dwelling units are exempt from requirement calculations. Meet any combination of thresholds in Table 3, up to a maximum of 3 points.”

REDUCED PARKING FOOTPRINT

“To minimize the environmental harms associated with parking facilities, including automobile dependence, land consumption, and rainwater runoff.”

“For new nonresidential buildings and multiunit residential buildings, either do not build new off-street parking lots, or locate all new off-street surface parking lots at the side or rear, leaving building frontages facing the circulation network free of surface parking lots (alleys may be exempted).

Use no more than 20% of the total development footprint area for all new off-street surface parking facilities, with no individual surface parking lot larger than 2 acres (0.8 hectare). For the purposes of this credit, surface parking facilities include ground-level garages unless they are under habitable building space. Underground or multistory parking facilities can be used to provide additional spaces. On-street parking spaces are exempt from this limitation.

Provide preferred parking for carpool or shared-use vehicle parking spaces equivalent to at least 10% of the total off-street parking spaces for each nonresidential and mixed-use building on the site. Such parking spaces must be marked and within 200 feet (60 meters) walking distance of entrances to the building served.”

TRANSIT FACILITIES

Intent: “To encourage transit use and reduce vehicle distance traveled by providing safe, convenient, and comfortable transit waiting areas.”

ACCESS TO CIVIC AND PUBLIC SPACE

Intent: “To provide open space close to work and home that enhances community participation and improves public health.”

“Locate 90% of planned and existing dwelling units and nonresidential use entrances within a ¼ mile (400 meters) walk of at least one civic and passive use space. The spaces must be at least 1/6 acre (0.067 hectare) in area. Spaces less than 1 acre (0.4 hectare) must have a proportion no narrower than 1 unit of width to 4 units of length.

Projects larger than 10 acres (4 hectares) must have a median space size of at least 1 acre (0.4 hectare). Spaces over ½ acre (0.2 hectare) that are used to meet the 90% threshold are included in the median calculation.”

ACCESS TO RECREATION FACILITIES

Intent: “To enhance community participation and improve public health by providing recreational facilities close to work and home that facilitate physical activity and social networking.”

“Locate or design the project so that a publicly accessible outdoor recreation facility at least 1 acre (0.4 hectares) in area, or a publicly accessible indoor recreational facility of at least 25,000 square feet (2325 square meters), lies within a ½-mile (800-meter) walking distance of 90% of new and existing dwelling units and nonresidential use entrances. Outdoor recreation facilities must consist of physical improvements and may include “tot lots,” swimming pools, and sports fields, such as baseball diamonds.”

TREE-LINED AND SHADED STREETSCAPES

Intent: “To encourage walking and bicycling and discourage speeding. To reduce urban heat island effects, improve air quality, increase evapotranspiration, and reduce cooling loads in buildings.”

Requirements:

Option 2. Shaded Sidewalks

“Provide shade from trees or permanent structures over at least 40% of the total length of existing and planned sidewalks within or bordering the project (alleys may be exempted). Trees must provide shade within 10 years of landscape installation. Use the estimated crown diameter to calculate the length of sidewalk shaded.

AND For All Projects with Street Tree Plantings

From a registered landscape architect (or local equivalent for projects outside the U.S.), obtain a determination that planting details are appropriate to growing healthy trees, taking into account tree species, root medium, and width and soil volume of planter strips or wells, and that the selected tree species are not considered invasive in the project context according to USDA or the state agricultural extension service (or local equivalent for projects outside the U.S.).”

GIB PREREQUISITE: MINIMUM BUILDING ENERGY PERFORMANCE

Intent: “To encourage the design and construction of energy-efficient buildings that reduce air, water, and land pollution and environmental damage from energy production and consumption.”

Requirements: “The requirements apply to 90% of the total building floor area (rounded up to the next whole building) of all nonresidential buildings, mixed-use buildings, and multiunit residential buildings four stories or more constructed as part of the project or undergoing major renovations as part of the project. Each counted building must comply with one of the following options.”

GIB PREREQUISITE: CONSTRUCTION ACTIVITY POLLUTION PREVENTION

Intent: “To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust.”

Requirements:

Create and implement an erosion and sedimentation control plan for all new construction activities associated with the project. The plan must incorporate best management practices (BMPs) to control erosion and sedimentation in runoff from the entire project site during construction. The BMPs must be selected from EPA’s BMPs for construction and post-construction site runoff control.

The erosion and sedimentation control plan must list the BMPs employed and describe how the project team will do the following:

- preserve vegetation and mark clearing limits;
- establish and delineate construction access;
- control flow rates;
- install sediment controls;
- stabilize soils;
- prevent soil loss during construction;
- stockpile topsoil for reuse;
- protect slopes;
- protect drain inlets, all rainwater conveyance systems, and receiving water bodies;
- stabilize channels and outlets;
- control pollutants including dust and particulate matter;
- control dewatering;

- maintain the BMPs; and
- manage the erosion and sedimentation control plan.

GIB CREDIT: BUILDING REUSE

Intent: “To extend the life cycle of buildings and conserve resources, reduce waste, and reduce environmental harm from materials manufacturing and transport for new buildings.”

Requirements:

Case 2. More Than Five Buildings

For projects with more than five buildings undergoing major renovations, reuse 20% of the total surface area of such buildings (including structure and enclosure materials, as defined in Case 1).

For All Projects: Do not demolish any historic buildings or contributing buildings in a historic district, or portions thereof, or alter any cultural landscapes as part of the project.

GIB CREDIT: HISTORIC RESOURCE PRESERVATION AND ADAPTIVE REUSE

Intent: “To respect local and national landmarks and conserve material and cultural resources by encouraging the preservation and adaptive reuse of historic buildings and cultural landscapes.”

Requirements:

This credit is available to projects with at least one historic building, contributing building in a historic district, or cultural landscape on the project site.

Do not demolish any historic buildings or contributing buildings in a historic district, or portions thereof, or alter any cultural landscapes as part of the project.

An exception is granted only with approval from an appropriate review body. For buildings or landscapes listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings or landscapes listed in a state register or in the National Register of Historic Places (or equivalent for projects outside the U.S.), approval must appear in a programmatic agreement with the state historic preservation office or National Park Service (or local equivalent for projects outside the U.S.).

If any historic building or a contributing building in a historic district in the project site is to be altered (rehabilitated, preserved, or restored), use one of the following approaches for each building, as applicable.

- Building subject to local review. Obtain approval, in the form of a certificate of appropriateness, from a local historic preservation commission or architectural review board for any exterior alterations or additions.
- Building subject to state or federal review. If the building is subject to review by a state historic preservation office or the National Park Service (or equivalent body for projects

outside the U.S.), the alteration must meet the Secretary of the Interior's Standards for the Treatment of Historic Properties (or equivalent for projects outside the U.S.).

- Listed or eligible building not subject to review. If a building is listed or determined eligible but alteration is not subject to local, state, or federal review, include on the project team a preservation professional who meets the U.S. federal qualifications for historic architects or architectural historians (or a local equivalent for projects outside the U.S.). The preservation professional must confirm adherence to the Secretary of the Interior's Standards for the Treatment of Historic Properties, or a local equivalent for projects outside the U.S.

If a cultural landscape is to be rehabilitated, restored, or preserved, do so in accordance with the Guidelines for the Treatment of Cultural Landscapes or local equivalent for projects outside the U.S. whichever is more stringent.

GIB CREDIT: MINIMIZED SITE DISTURBANCE

Intent: "To preserve existing non-invasive trees, native plants, and pervious surfaces."

Requirements:

Option 1. Development Footprint on Previously Developed Land (1 point) Locate 100% of the development footprint and the construction impact zone on previously developed land.

For All Projects

Survey the site to identify the following:

- trees in good or excellent condition, as determined by an arborist certified by the International Society of Arboriculture (ISA) or local equivalent professional for projects outside the U.S.;
- any heritage or champion trees of special importance to the community because of their age, size, type, historical association, or horticultural value, as defined by a government forester;
- all trees larger than 6 inches (15 centimeters) in diameter at breast height (dbh, 4 feet 6 inches [1.4 meters] above ground); and
- any invasive plant species that affect trees present on the site, and whether those plants threaten the health of other trees to be preserved on the site, as determined by an ISA-certified arborist or local equivalent professional. .

Preserve the following trees that are also identified as in good or excellent condition:

- all heritage or champion trees and trees whose dbh exceeds 50% of the state champion dbh for the species;
- a minimum of 75% of all noninvasive trees (including the above) larger than 18 inches (45 centimeters) dbh; and

- a minimum of 25% of all noninvasive trees (including the above) larger than 12 inches (30 centimeters) dbh if deciduous and 6 inches (15 centimeters) dbh if coniferous.

Tree condition ratings must be determined by an ISA-certified arborist using ISA-approved assessment measures or by a local equivalent professional utilizing an equivalent methodology.

Develop a plan, in consultation with and approved by an ISA-certified arborist or equivalent, for the health of the trees, including fertilization and pruning, and for their protection during construction.

If an ISA-certified arborist or local equivalent professional has determined that any trees to be preserved are threatened by invasive vegetation, develop a plan to reduce the invasive vegetation. Stipulate in codes, covenants, and restrictions or other binding documents that the undisturbed area of the preserved trees will be protected from development by a private or governmental agency for the purpose of long-term conservation.

GIB CREDIT: RAINWATER MANAGEMENT

Intent: “To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.”

Requirements:

In a manner best replicating natural site hydrology processes, manage on site the runoff from the developed site for the percentile of regional or local rainfall events listed in Table 1, using low-impact development (LID) and green infrastructure.

Use daily rainfall data and the methodology in the U.S. Environmental Protection Agency (EPA) Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act to determine the percentile amounts listed in Table 1. The percentile rainfall event indicates the total volume to be retained on site.

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