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FLOOD RESISTING INFRASTRUCTURE IN THE TOWN OF PLACENTIA

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ABSTRACT

Placentia is a small town located on the western coast of the Avalon Peninsula of Newfoundland and Labrador, consisting of the amalgamated communities of Dunville, Argentia, Freshwater, Jerseyside and Townside. The French first settled Placentia early in the 17th century, utilizing the large rocky beach for drying their cod. Today, the town has an approximate population of

3500 people. The town has a history of flooding, aggravated by urban development over the past 15 to 25 years into the area directly behind the beach.

Located on a flood plain with an average elevation of approximately 0m above seawater, the downtown area of Placentia is prone to feeling the direct effects of harsh storms including flooding and intense runoff. In response to these environmental conditions, two pieces of infrastructure have been built in order to holdback the seawater.

Placentia currently consist of a steel, timber, and stone breakwater which was constructed in the 1960's and extended in the 1990's, as well as steel sheet pile floodwall which is located on the backside of the town.

The following paper will highlight the reason for choosing such forms of flood prevention infrastructure, as well as future considerations to improving the infrastructure due changes in climate.

Figure 1: Map of Newfoundland showing location of Placentia (Source: www.placentia.ca)

INTRODUCTION

Placentia is located on the Avalon Peninsula of the province of Newfoundland and Labrador, on Canada's east coast. Approximately 100 km southwest of the province's capital St. John's (roughly 80 min drive), Placentia is stretched across a coastal-forested area. The well-sheltered port at Placentia made it an easy choice for early fishing settlement. The vast stone-covered beach made the area an ideal location for drying fish caught by the early French, Spanish and Portuguese fisherman.

Today Placentia has a population of approximately 3500 people. The town can be accessed from either the Argentia Access Road, which connects from the Trans Canada Highway (TCH), from

the Colinet Road, which also connects to the TCH via Salmonier Line, or by the North Sydney-Argentia ferry.

The community includes Dunville, which forms the northeastern section of the town and is connected to downtown by a lift bridge. Dunville was the area of the town that obtained heavy flooding causing multiple road washouts during the tropical hurricane Chantal in 2007. Chantal washed out bridges and submerged roads, basements and parking lots. The downtown area of Placentia was able to escape the storm without any serious flooding. However, Placentia has been known to experience frequent storms, which have caused serious flooding in low-lying areas. Hurricane Chantal is clear proof that the local marine infrastructure is capable of resisting flooding. Specific infrastructures highlighted in this paper are the beach road breakwater, and the steel floodwall located on the backside of the town.

MAIN BREAKWATER

The breakwater is located along the west side of the town adjacent to the beach, and is owned by the town of Placentia. It is constructed from stone, used creosoted railway ties, and pressure-treated wood. A boardwalk runs along the top, which is popular spot for locals to enjoy a walk with a pleasant view of Placentia Bay. Construction was response to repeated flooding between 1960 and 1989. There has been no flooding of downtown Placentia since the breakwater was built.

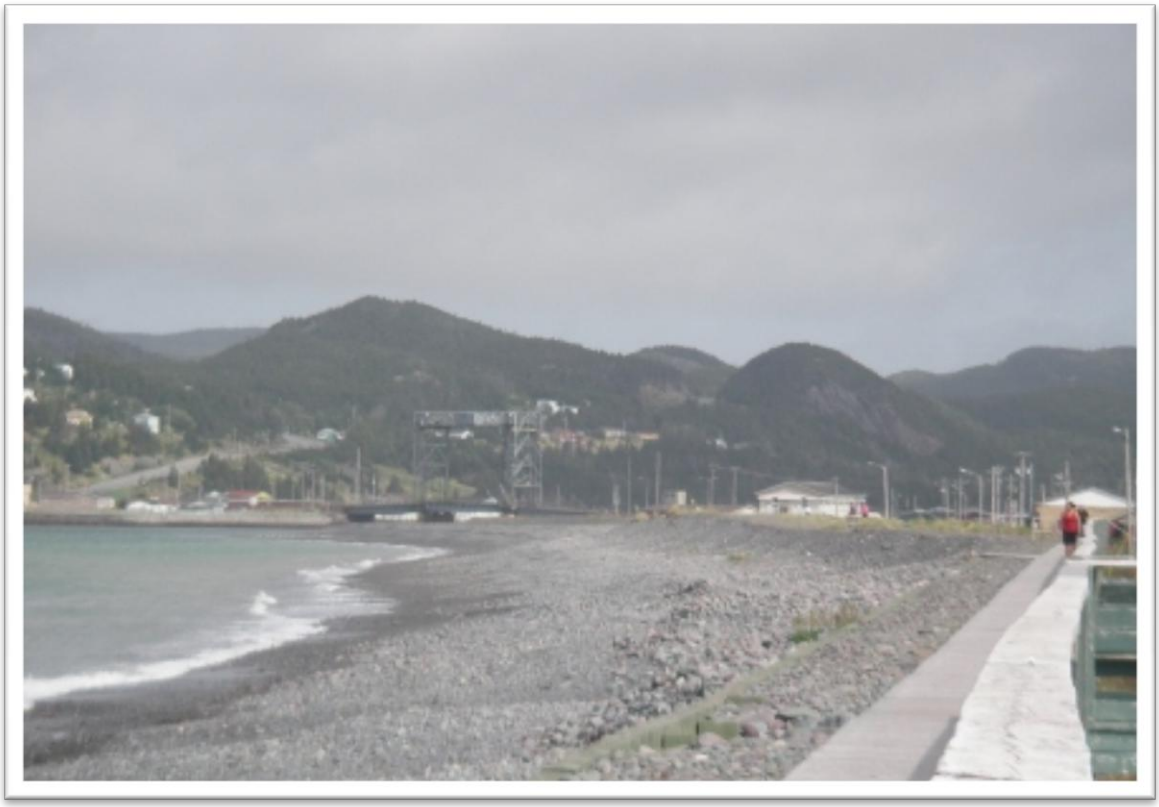

Figure 2: Placentia breakwater and boardwalk looking northeast.
(Source: www.placentia.ca)

The breakwater, which receives continuous wave action, runs parallel to the main beach along Beach Road and forms the western limit of development for the downtown peninsula section of Placentia. Its purpose is to deflect storm surge seawater along the western edge of the community. The typical elevation of the breakwater is about 6m, and under normal conditions the top of the breakwater is between 2 and 4 meters above beach sediment on the seaward side.

A disastrous failure of the breakwater would result in definite flooding of this area of Placentia. To date the breakwater has prevented flooding, although spray and slush have been known to occasionally reach the beach road. Future climate factors of interest regarding the effectiveness of the breakwater are:

- Sea level elevation change
- Storm surge seawater elevation change

STEEL SHEET PILE FLOODWALL

The steel sheet pile floodwall along the backside of the downtown area of Placentia was constructed in 1993. At the location of the floodwall, the geodetic elevation is 0 m and typical tide is 1.2 m under calm conditions. The floodwall has a top elevation of 2.2 m at typical sections, has so far has been effective in conveying the deflected storm-surge water away from the town. Similar to the breakwater, climate factors that are most important when assessing the integrity of the floodwall are; sea-level elevation change, and storm-surge sea water elevation change (associated with wind speed).

Catastrophic failure of the floodwall would most likely flood much of the downtown Placentia area. With the potential for a large wave to pass over the top of the wall with changing climates and rising sea levels, the extensions of the height of the wall would be recommended.

The quantity of seawater passing over the floodwall, onto the road or property on the other side, has not reached unacceptable levels, and this is so true since the wall has been constructed.

Figure 3: Sheet pile floodwall along the backside of Placentia (Source: www.heritage.nf.ca)

CLIMATE CHANGE CONSIDERATIONS

Natural climate change can be observed throughout Newfoundland and Labrador. Climate change and variation since 1850 have resulted from a combination of natural and human-induced causes, with warming in North America since 1845. Overall, between 1948 and 2005, Atlantic Canada has warmed by approximately 0.3°C. For eastern Newfoundland, future climate changes differ due to the influence of the Labrador Current.

The changing climate will bring increased pressure upon the coastline and onshore infrastructure through coastal erosion, increased frequency and magnitude of storm events, storm surges, and sea level rise. Such changes will need to be considered for estimating the life expectancy of such coastal infrastructure. As for the Placentia breakwater and floodwall, the two most important climates changes to consider are changes in sea level elevation as well as changes in storm surge wave elevation. Climate-model projections, provided by OURANOS, forecast the following changes in sea state elevations for the breakwater and floodwater in Placentia by 2050.

Climate event for breakwater	Current Levels	Predicted for 2050	Predicted Change
Sea level elevation	0.00 m	0.15 m	+ 0.15 m
Storm surge wave elevation	7.00 m	7.25 m	+ 0.25 m
Combined elevations	7.00 m	7.40 m	+ 0.40 m

Figure 4: Break Water Elevation Changes (Source: ADAPTING TO CLIMATE CHANGE – Canada's First National Engineering Vulnerability Assessment of Public Infrastructure, 2008. Engineers Canada)

Climate event for flood wall	Current Levels	Predicted for 2050	Predicted Change
Sea level elevation	0.00 m	0.15 m	+ 0.15 m
Storm surge wave elevation	5.00 m	5.15 m	+ 0.15 m
Combined elevations	5.00 m	5.30 m	+ 0.30 m

Figure 5: Flood Wall Elevation Changes (Source: ADAPTING TO CLIMATE CHANGE – Canada's First National Engineering Vulnerability Assessment of Public Infrastructure, 2008. Engineers Canada)

Figure 6: Extremely high tides against the Placentia sheet pile Flood wall (Source: www.downhomelife.com).

CONCLUSION

Today Placentia is equipped with two pieces of marine infrastructure that is proven to protect the town from flooding damage. This is evident from the knowledge of repeated flooding before the structures were built, but no subsequent flooding has taken place since. With worldwide evidence of global warming and changing climates, changes in sea level elevation and storm-surge wave elevation pose as the biggest threat to the integrity and efficiency of these structures. To protect the town of Placentia for many years to come, the breakwater and floodwall should be improved upon if it seems that any of these climate changes could potentially cause the seawater to breech these structures.

REFERENCES

[1] Cameron Consulting Incorporated, "Engineering Vulnerability Assessment of Public Infrastructure, Appendix B-2, Town of Placentia, Newfoundland" 2008

[2] Canadian Council of Professional Engineers, "Adapting to Climate Change, Canada's First National Engineering Vulnerability Assessment of Public Infrastructure" 2008

[3] http://www.placentia.ca

[4] http://www.heritage.nf.ca

[5] http://downhomelife.com