

November 16, 2020

Town of Conception Bay South Planning and Development Department 11 Remembrance Square, Conception Bay South, NL A1W 3J1

To Whom It May Concern,

Please find enclosed Ocean Choice's Land Use Impact Assessment Report (LUIAR) in response to the Town of Conception Bay South's Terms of Reference for Ocean Choice's proposed development in Long Pond Harbour.

Over the last several years, Ocean Choice has worked with the responsible regulatory authorities and industry experts to ensure compliance with necessary federal and provincial regulations. In addition, significant independent research and analysis has been conducted by industry experts to support development efforts as well as to meet regulatory and municipal requirements. Details of these approvals and associated research reports have been outlined throughout this report as well as the attached appendices.

The project is located on the southern portion of the Long Pond Port, off Terminal Road in an existing commercial area. Ocean Choice's plan will see just over 1.7 hectares (17,228 m²) of new land developed that will house:

- 90-metre long marginal wharf;
- Laydown and parking area;
- Cold storage building infrastructure (approximately 36,000 ft²).

As a result of feedback from area residents as well as from the Navigable Waters Division of Transport Canada, Ocean Choice has adjusted its development plan that has resulted in the following:

- Removed just over 32 ft. (10 m.) from the east side of the development, providing recreational boaters with an approximate 100 ft. (30.1 m.) marked channel for safe navigation. The channel will be as deep as the existing channel
- Removed 78 ft. (24 m.) from the northeast side of the development, providing additional navigation on this side of the development.
- Moved the access road to the property back towards the southern portion of the Harbour –
 an area that is not currently being utilized due to shallow water depths.
- Changed the angle of the proposed wharf to provide additional clearance between Ocean Choice's property and the adjacent property.



I would like to point out that these changes to the development plan have resulted in Ocean Choice submitting a formal request to the Long Pond Harbour Authority (LPHA) to slightly revise the waterlot to accommodate moving the access road back towards the southern portion of the harbour. Ocean Choice is still awaiting confirmation from the LPHA on this item; therefore the proposed development being submitted by Ocean Choice is based on the project being developed within Ocean Choice's existing waterlot. If Ocean Choice's request to the LPHA is approved, the Company will move the access road to the southern part of the boundary of the new waterlot.

It is also important to note, that the reports provided by various experts in this submission are based on Ocean Choice's previous design and waterlot area. With this being said, we have been assured that moving the access road to the south of the harbour will not have any impact on the findings of these reports.

As you are aware over the last several months Ocean Choice has been answering questions and addressing concerns from interested parties. This is something that we remain committed to doing. We look forward to working with the Town of Conception Bay South to host a public consultation in relation to the Land Use Impact Assessment Report that is within the guidelines of COVID-19 health and safety guidelines.

If you have any additional questions or require any clarification of the materials included in this report, please do not hesitate to contact me.

Ocean Choice looks forward to working with the Town of Conception Bay South and to being a valued member of the business community.

Sincerely,

Blaine Sullivan

President, Ocean Choice



Ocean Choice Long Pond Development Land Use Impact Assessment Report



Presented By:

Ocean Choice International Contact: Blaine Sullivan bsullivan@oceanchoice.com

Phone: 709-782-5661 Fax: 709-368-2260 1315 Topsail Road, St. John's, NL, A1B 3N4

Presented To:

Town of Conception Bay South Planning and Development Department

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- Appendix D: Wharf Construction Design Drawings and Specifications, Long Pond, NL, Prepared by AFN Engineering Inc., July, 2020.
- Appendix E: Long Pond Harbour Development Stakeholder Communications Plan, October 2020.
- Appendix F: Technical Memo, Infill for New Cold Storage Building and Associated Dredging, Long Pond, Manuals, NL, Prepared by Stantec Consulting Inc., September, 2020.
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- Appendix L: Noise Assessment for Ocean Choice International Prepared by Dallas Mercer Consulting, October 2020.
- Appendix M: Traffic Impact Statement for Ocean Choice International Cold Storage Facility, Terminal Road, Conception Bay South, NL Prepared by Harbourside Transportation Consultants. September 2020.

Appendix N: Geotechnical Factual Report, Long Pond, NL, Prepared by Fracflow Consultants Inc., June, 2019.

Appendix O: Water and Sewer Servicing and Anticipated Storm Flows from upstream Catchment Areas, Prepared by Progressive Engineering & Consulting Inc., September, 2020.

Appendix P: Ocean Choice application to Navigable Waters Division of Transport Canada, Prepared by Ocean Choice International, October, 2020.

Appendix Q: Regulatory Permits, Letters of Advice and Approval Letters.

Appendix R: Long Pond, NL, Transect Survey, Prepared by Seaforce Diving Limited, August, 2018.

Appendix S: Rock Properties and Block Sizes at the Waste Rock Slopes Trinity Resources Mine Site, Long Pond, CBS, NL, Prepared by Fracflow Consultants Inc., February, 2019.

Executive Summary

This document has been prepared in response to the Town of Conception Bay South's (CBS) Municipal Plan Land Use policy 4.3.8 for the provision of a Land Use Impact Assessment Report (LUIAR), attached as Appendix A. The purpose of the LUIAR is to assess any significant impacts a development may have on the urban environment and/or surrounding lands or neighborhood. For Ocean Choice, this report is the culmination of approximately seven years of discussions, consultations, planning and analysis relating to the development in Long Pond Harbour.

In preparation of Ocean Choice's LUIAR for the Long Pond Harbour Development, the Company has commissioned several technical reports and research studies; as well extensive consultation with technical experts has been undertaken.

Ocean Choice has also been actively engaged in rigorous federal, provincial and municipal regulatory approvals for the development. The Company is committed to following and adhering to the regulatory process that is deemed necessary by the appropriate authorities. This includes all three levels of government.

Ocean Choice is a family-owned and operated Newfoundland and Labrador company that employs over 1,700 people in 300 communities throughout the province. The Company operates five fish processing plants and six offshore fishing vessels, and it sources seafood from over 1,900 independent fishers from across the province. With sales offices around the globe, the company sells a diversified range of seafood to over 400 customers in 30 countries around the world.

Ocean Choice is looking to invest approximately \$15 million in a new development in Long Pond Harbour. The development will see just over 1.7 hectares (17,228 m²) of new land developed for the:

- construction of an approximate 90-metre wharf for the loading and offloading of frozen-at-sea products from five of Ocean Choice's offshore fishing vessels; and
- construction of a 36,000 square foot cold storage facility that will store the frozen-at-sea product from the Company's offshore fishing vessels in its frozen state until the product is shipped to global markets.

Ocean Choice's development is expected to create 30 to 40 new, full-time jobs in the cold storage facility, which will be focused on offloading and loading of vessels, storage and product sorting, and the shipment of products. Additional incremental employment opportunities are expected through spin-off business opportunities for supply services in the area as well as additional economic benefits to other local businesses in the area. In addition, incremental employment opportunities will be created during the start-up construction phase of the project with over a \$15 million investment.

Introduction

Ocean Choice is a family-owned and operated Newfoundland and Labrador company that employs over 1,700 people in 300 communities throughout the province. The Company operates five fish processing plants and six offshore fishing vessels, and it sources seafood from over 1,900 independent fishers from across the province. With sales offices around the globe, the company sells a diversified range of seafood to over 400 customers in 30 countries around the world.

Ocean Choice has been advancing a proposed \$15 million investment in Long Pond, Conception Bay South (CBS) for the development of new land, a 90-metre wharf as well as the construction of a new cold storage facility.

The development is located on the southern portion of the harbour, off Terminal Road in an existing commercial area. Long Pond Harbour is the ideal location for a new cold storage facility, as it is centrally located with convenient access to shipping routes and local businesses that support the sector. Long Pond Harbour is also a well-known commercial harbour that supports numerous industries, while also being home to seasonal recreational boating activity. The harbour has always balanced commercial activity with recreational use.

Key elements of the development include:

- New Land: The waterlot for the proposed development (previous Transport Canada Port) was purchased by Ocean Choice in April of 2018 from the Long Pond Harbour Authority (LPHA). The Company's proposed development will see approximately 17,228 m² (approximately 1.7 hectares) of new land developed.
 - A survey of the waterlot conducted by Allnorth NL Surveyors in 2018 is provided and attached as Appendix B. The current proposal is based on the development being completed within this current waterlot.
 - O Based on feedback received from the Navigable Waters Division of Transport Canada and feedback from area residents, Ocean Choice adjusted the development plan for the project. The changes to the development plan have resulted in Ocean Choice submitting a formal request to the LPHA to slightly revise the waterlot to move the access road to the property back towards the southern portion of the Harbour. The new waterlot survey conducted by Allnorth NL Surveyors is attached as Appendix C. If the proposed land swap is approved by the LPHA, the access road will be moved to the southern part of the boundary.
- Wharf: New 90-metre treated timber crib marginal wharf, complete with concrete deck to accommodate five of Ocean Choice's offshore fishing vessels.

• **Cold Storage:** New highly automated cold storage infrastructure to support Ocean Choice's frozen-at-sea products. Product will be stored at the cold storage facility in its frozen state until it is shipped to global markets.

Ocean Choice is making this investment to fulfill its own production requirements and to consolidate its existing cold storage. The M.V. Calvert (the Company's new vessel) is expected to occupy up to 30 percent of the annual capacity at the new cold storage infrastructure in Long Pond. Ocean Choice is making this investment to fulfill its own production capacity requirements and will not be focused on setting the business up as a competitive alternative to existing cold storage facilities.

The following report has been prepared to address the Town of Conception Bay South's (CBS) Municipal Plan Land Use policy 4.3.8 for provision of a LUIAR. The purpose of the LUIAR is to assess any significant impacts the development may have on the urban environment and/or surrounding lands or neighborhood. The format of the report follows the reporting requirements outlined in Section B of the Terms of Reference (TOR) for the Land Use Impact Assessment Report prepared by the Town of CBS (See Appendix A).

Figures 1 - 3: Show the proposed development location as well as measurements from various land points within the Harbour in Long Pond. Design drawings associated with the wharf construction and infilling are attached as Appendix D.

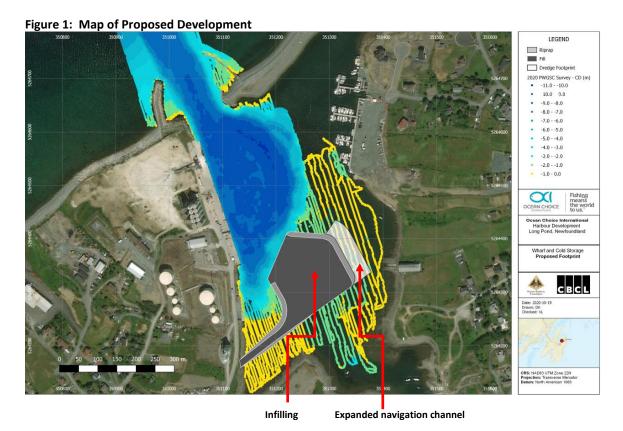
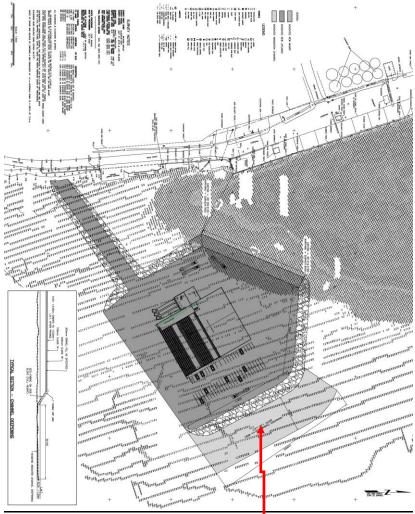


Figure 2 and 3: Project Footprint in Long Pond





Expanded navigation channel

Ocean Choice has engaged in a diligent public communications strategy in an effort to provide interested individuals with the opportunity to express views and thoughts on the proposed Long Pond development. In light of the ongoing COVID-19 pandemic, Ocean Choice has provided individuals with alternative means to provide input on the development. Appendix E provides an overview of the communication activities that Ocean Choice has been carrying out as a result of the inability to conduct a Town Hall forum due to COVID-19 restrictions.

As discussed in public communication on this proposed development, there is an opportunity for an expansion to the wharf side of the development at some point in the future to enable a second vessel berth if required. This is the 2.5 hectares that was included in the proposed development plan to the federal and provincial regulatory authorities. Ocean Choice has no current plans for such an expansion, as the existing proposed development contained in this proposal meets the company's existing cold storage and offloading needs.

Section 1: Site Conditions

1.1 Consultants and Agencies

Ocean Choice's LUIAR is based on many years of working with experts in various technical fields, ranging from specialized engineers to industrial hygienists. Below is a list of the consultants and agencies, including their relevant expertise that provided input into the development of Ocean Choice's LUIAR:

- AFN Engineering Inc.: Prepared the engineering drawings and specifications for the wharf design and construction. AFN Engineering Inc. offers a wide range of services, including: Environmental Engineering; Project and Construction Management; Materials Engineering, Testing and Inspection; Structural and Marine Engineering; Municipal Engineering; Feasibility Studies; Fisheries and Resource Development; Surveying and Mapping; and Transportation Engineering.
- Allnorth NL Surveyors: Carried out the survey for the waterlot. Allnorth NL Surveyors is a Registered Land Surveying partnership providing Legal Land Surveying services in Newfoundland and Labrador. Allnorth NL Surveyor's land surveying team is led by Ray Guy, N.L.S., A.L.S. (retired), and Nick Pardy, N.L.S. Allnorth NL Surveyors personnel are dedicated to safety in all aspects of their work and are members of the Newfoundland & Labrador Construction Safety Association (NLCSA), Canadian Home Builders' Association (CHBA) NL, and Newfoundland & Labrador Oil & Gas Industries Association (NOIA).
- CBCL Limited: Prepared the Coastal Modelling Study. For 65 years, CBCL Limited (CBCL) has been a respected and trusted firm, delivering multidiscipline engineering and technical services throughout Canada and around the world. CBCL has several decades of experience in marine and coastal planning, modeling and engineering projects, with completion of successful consultancies throughout Canada and internationally. Over the last 20 years, CBCL's Halifax-based Coastal Engineering Team has successfully completed a very wide range of projects within Atlantic Canada's extremely diverse coastlines, in multi-seasonal climates, and in both heavily urbanized and rural areas, including several studies of Long Pond Harbour
- Dallas Mercer Consultants: Prepared the Noise Assessment. Founded in 2002,
 Dallas Mercer Consulting (DMC) is a disability and safety management company,
 specializing in workplace injury, non-occupational leave management,
 occupational health & safety consulting and training, as well as industrial hygiene
 services.

- Fracflow Consultants Inc.: Prepared the Geotechnical Study. With over 38 years of experience, Fracflow Consultants Inc. is an environmental, hydrogeological, and geotechnical engineering company operating around the world from its main offices in Dartmouth, NS and St. John's, NL, and a satellite operation in Corner Brook. Fracflow provides consulting services in the following areas of science and engineering: Hydrogeology, Ground Water and Surface Water Hydrology; Environmental Engineering and Site Remediation; Environmental Impact Assessments and Baseline Studies; Geotechnical Engineering and Soil Mechanics; Mine Dewatering and Minewater Management; Geological Engineering and Rock Mechanics; Foundation Design and Engineering; and Project Management.
- Harbourside Transportation Consultants: Prepared the Traffic Impact
 Statement. Harbourside Transportation Consultants is an Atlantic Canadian
 engineering firm that specializes in the analysis, design, project management,
 public consultation and construction implementation of transportation
 infrastructure projects, with an emphasis on traffic analysis, transportation
 planning and transportation design, including highways, signalized intersections,
 interchanges and roundabouts.
- Progressive Engineering and Consulting Inc.: Prepared Water and Sewer
 Servicing and Anticipated Store Flows from Upstream as well they prepared the
 Contour Map of Long Pond Harbour. Formed in 2012, Progressive Engineering
 and Consulting Inc., provides a wide range of engineering and technical services
 including: concept development; feasibility studies; marine works;
 water/wastewater management; hydraulic modeling; infrastructure studies and
 site development.
- Sea-Force Diving Limited: Prepared the Transect Survey. Since 1996, Sea-Force Diving Ltd. has been serving customers in the areas of inshore, near shore and offshore diving operations. As a commercial diving contractor specializing in all types of underwater work, the company has grown substantially over the years and now employs 20 plus management, support staff, and divers. Sea-Force has the latest in marine cameras for digital photos and HD video. Their experienced management team has a combined 100 years of diving related operations, and their divers and dive superintendents rank among the most experienced in their field of work.
- Stantec Consulting Inc.: Prepared a Technical Memo for the development.
 Stantec Consulting Inc. is a global engineering firm that specializes in
 Architecture & Interior Design; Buildings Engineering; Community Development;
 Geomatics; Geotechnical Engineering & Materials Testing; Landscape
 Architecture; and Power Engineering & Design.

• Fisheries and Marine Institute of Memorial University: Provided input and support on the development of the Marine Fish Habitat Compensation Plan, particularly related to the habitat offset measures associated with the reef ball program. Marine Institute researchers will provide oversight and support on the reef ball construction and deployment as well as lead the monitoring and reporting over the next number of years. Marine Institute researchers in the Centre for Fisheries Ecosystems Research (CFER) have tremendous experience in this area; and they currently have an active reef ball research program in the Placentia Bay area.

1.2 Technical Reports and Research Studies

In preparation of Ocean Choice's LUIAR for the Long Pond Harbour Development, the Company has commissioned several technical reports and research studies; as well extensive consultation with technical experts has been undertaken.

Reports prepared as part of this LUIAR exercise include:

- Terms of Reference for Land Use Impact Assessment: Proposed Harbour Infill Project, Town of Conception Bay South, October, 2020. Attached as Appendix A.
- 2. Survey of Ocean Choice's Waterlot in Conception Bay South. Prepared by Allnorth NL Surveyors, January, 2018. **Attached as Appendix B.**
- Survey of Ocean Choice International Waterlot in Conception Bay South.
 Prepared by Allnorth NL Surveyors, November, 2020. Attached as Appendix C.
- 4. Wharf Construction Design Drawings and Specifications, Long Pond, NL. Prepared by AFN Engineering Inc., July, 2020. **Attached as Appendix D.**
- 5. Long Pond Harbour Development Stakeholder Communications Plan. Prepared by Ocean Choice, October, 2020. **Attached as Appendix E.**
- Technical Memo, Infill for New Cold Storage Building and Associated Dredging, Long Pond, Manuals, NL. Prepared by Stantec Consulting Inc., September, 2020.
 Attached as Appendix F.
- Coastal Modeling Study for the Ocean Choice International Development at Long Pond, Newfoundland. Prepared by CBCL Limited, October 2020. Attached as Appendix G.
- 8. Bathymetric Survey of Long Pond Harbour, Prepared by AFN Engineering Inc., July, 2020 and Bathymetic Survey of the Yacht Club Channel Commissioned by

- Public Works and Government Services Canada in October, 2012. **Attached as Appendix H.**
- 9. Contour Map of Long Pond Harbour. Prepared by Progressive Engineering & Consulting Inc., September, 2020. **Attached as Appendix I.**
- 10. Coastal Engineering Study Conceptual Design of East Breakwater Upgrade. Prepared by CBCL Limited, January 2019. **Attached as Appendix J.**
- 11. Coastal Engineering Study Conceptual Design of East Breakwater Upgrade. Prepared by CBCL Limited, August, 2018. **Attached as Appendix K.**
- 12. Noise Assessment for Ocean Choice. Prepared by Dallas Mercer Consulting, October, 2020. **Attached as Appendix L.**
- 13. Traffic Impact Statement for Ocean Choice's Cold Storage Facility, Terminal Road, Conception Bay South, NL. Prepared by Harbourside Transportation Consultants, September, 2020. **Attached as Appendix M.**
- 14. Geotechnical Factual Report, Long Pond, NL. Prepared by Fracflow Consultants Inc., June, 2019. **Attached as Appendix N.**
- 15. Water and Sewer Servicing and Anticipated Storm Flows from Upstream Catchment Areas. Prepared by Progressive Engineering & Consulting Inc., September, 2020. **Attached as Appendix O.**
- 16. Application to Navigable Waters Division of Transport Canada. Prepared by Ocean Choice, October, 2020. **Attached as Appendix P.**
- 17. Regulatory Permits and Letters of Advice. Attached as Appendix Q
- 18. Long Pond, NL, Transect Survey. Prepared by Sea-Force Diving Limited, August, 2018. **Attached as Appendix R.**
- Rock Properties and Block Sizes at the Waste Rock Slopes Trinity Resources Mine Site, Long Pond, CBS, NL. Prepared by Fracflow Consultants Inc., February, 2019.
 Attached as Appendix S.

1.3 Existing Site Conditions

Site specific information has been collected for the general area of Conception Bay South, including the entrance to the Long Pond Harbour, the area of the development as well as the small boat basin. This information includes aerial photos, topographic

surveys, legal land boundaries, harbour nautical charts, bathymetric surveys as well as information relating to wind, wave, currents, water levels/tides and river discharge. The particulars requested have been provided in Appendices.

The Town of Conception Bay South (CBS) is located on the southern shore of Conception Bay on the Avalon Peninsula, approximately 20 kilometers from St. John's. Incorporated in 1973, CBS consists of nine communities (Topsail, Chamberlains, Manuels, Long Pond, Foxtrap, Kelligrews, Upper Gullies, Lawrence Pond, and Seal Cove). With a population of approximately 27,000 and a base of commercial and industrial development as well as recreational, public health and educational infrastructure, the town is one of the fastest growing municipalities in Newfoundland and Labrador.

Long Pond Harbour is a well-known commercial harbour that supports numerous industries while also being home to seasonal recreational boating activity. The harbour has always balanced commercial activity with recreational use. Today, the harbour is owned and operated by the Long Pond Harbour Authority (LPHA).

The Long Pond Harbour Authority (LPHA) evolved as part of the Port Divestiture Program of Transport Canada. The Port was divested to the LPHA on March 30, 2013, who has managed the Port since this time. Historically under the ownership of Transport Canada, Long Pond served various cargo, government, tug, tanker and fishing vessels (including international vessels). The major users during Transport Canada's operational time, which continue today under the Long Pond Harbour Authority, are:

- St. Lawrence Cement (formerly North Star Cement);
- Country Ribbon (formerly IPL Feeds Limited);
- Woodward Group of Companies;
- Fisheries and Oceans Canada (Coast Guard);
- Newfoundland Pyrophyllite;
- PD Enterprises;
- Sunset Key Marina;
- Royal Newfoundland Yacht Club;
- Private Boat House;
- Commercial Vessels; and
- Recreational and commercial fishers/boaters.

Ocean Choice's development is located on the southern portion of the Long Pond Port, off Terminal Road in the existing commercial area of the harbour.

1.4 Aerial Photos

Aerial photographs were obtained from the Provincial Air Photo and Map Library at the Howley Building in St. John's. The aerial photos were reviewed in an attempt to better understand the historical development throughout the Port. Based on the review, the Port was initially developed in the 1960s and has since undergone various expansion and upgrades throughout the history of it being maintained by Transport Canada. Through the review by various experts, there does not appear to be any change in topography that would suggest potential sediment movement throughout the harbour. Transport Canada's database shows the original date of construction and various bathymetric surveys between the 1960s and 2012, showing harbour depths relatively unchanged.

1.5 Topographic surveys

A full topographic survey associated with the development site is included in the design drawings included in Appendix D. With respect to the overall harbour and surrounding lands, refer to the full contour mapping details provided in Appendix M.

1.6 Legal Land Boundaries

Details on Ocean Choice's Waterlot ownership are outlined in Section 2 of this document and a survey of the waterlot that was conducted by Allnorth NL Surveyors in 2018 is provided in Appendix B. As a result of Ocean Choice's application to Navigable Waters and feedback received, Ocean Choice modified its development plan, resulting in a proposed land swap between the LPHA and Ocean Choice. The new survey showing the new waterlot is in Appendix C.

1.7 Bathymetric Surveys

Details on the bathymetry for the area of the development is contained in the CBCL report attached as Appendix G. The full bathymetric survey of the harbour is included in Appendix H. Also for reference is bathymetry of the channel leading into the Royal Newfoundland Yacht Club, which was completed at a time when the harbour was under the administrative control of Transport Canada. It is understood that a more recent survey of this channel was completed in 2020 on behalf of the town of CBS; however, Ocean Choice did not have access to this survey.

1.8 Wind, Wave, Currents, Water Levels/Tides and River Discharge

The wind, wave, current, water levels/tides and river discharge are well documented for Long Pond Harbour, both prior to and following divestiture from Transport Canada to the Long Pond Harbour Authority. Refer to the CBCL Coastal study report and Progressive Engineering basin modelling for specific data (Appendix G and O).

Given the development is in a tidal zone, Ocean Choice's development will not cause any significant local changes to the surrounding properties impacting users. This has been verified by the Coastal Modeling Study conducted by CBCL with the key findings detailed in Section 5 of this document and attached as Appendix G.

The CBCL hydrology and hydraulic analysis did not identify additional incremental flood risk as a result of the proposed development. The hydrodynamic (HD) numerical modeling conducted by CBCL indicated the 'Depth averaged discharge and velocity magnitudes remain unchanged near Conway's Brook and Sobey's Stream outlets as result of this development.'

The report further indicates 'The new OCI development does not significantly increase or alter current velocities throughout the basin'. From a wave agitation standpoint the report modeling indicates 'Wave height increases with sea level rise are negligible to low throughout the LPH basin for the 2100 time horizon (i.e. in the order of 1cm compared to 2020 wave heights for a 1-year return period storm condition).

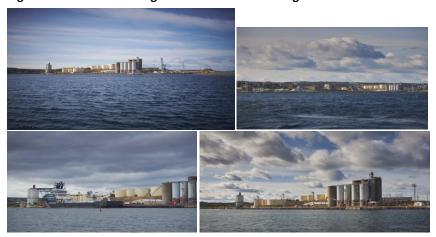
Section 2: Surrounding Land Use

2.1 Existing Land Use

As outlined in Section 2 of this document, there is a significant amount of industrial, commercial and recreational use in the surrounding harbour area. Ocean Choice is committed to working with existing commercial businesses, residential property owners as well as recreational boaters who currently use the area to develop the area in a manner that complements and supports the commercial and recreational use of the Harbour.

The Long Pond Harbour boundary includes the marine terminal wharf, east breakwater and training wall, west breakwater as well as related buildings and offices. The harbour area has been dredged several times over the years to maintain desired depths and to accommodate larger commercial vessels that utilize the Port. The most recent dredging programs were reportedly conducted in 1985, 1988/89 and 1995.

Figure 4: Photos of Existing Commercial Area of Long Pond Harbour



The marine terminal marginal wharf is adjacent to Terminal Road and is 245 m long and 12.5 m wide. The terminal wharf has equipment owned and operated by neighboring property owners under contract to the Long Pond Harbour Authority (LPHA). This equipment is generally used to support industrial activity on the wharf including: the cement shipping terminal, Country Ribbon feed silos, petroleum product transfers as well as Trinity Resource pyrophyllite loading.

The west breakwater is a mound structure that is approximately 90 m long by 6 m wide protecting the western side of the approach channel. The retaining wall is a timber cribwork structure measuring 42.4 m long by 4.5 m wide.

The positioning of Ocean Choice's development in the south, west of the harbour will not have any negative impact to the existing commercial vessel activity on this side of the harbour. There is sufficient turning clearance in front of Ocean Choice's property for vessels that currently utilize this area. In addition, to increase the amount of clearance between Ocean Choice's development and the adjacent property, the Company adjusted the angle of the proposed 90-metre marginal wharf, providing a 55-metre clearance between the development and the adjacent property.

The east breakwater is a finger pier structure that is 105 m long by 5 m wide. Users of the Royal Newfoundland Yacht Club follow a channel behind the east breakwater until they reach the club. While Yacht club users will be able to see Ocean Choice's wharf and cold storage facility as they enter the channel, the development will have no impact on their ability to continue to navigate to and from the Yacht Club.

Currently, the harbour is used by seasonal recreational boaters and fishers who access the harbour from wharfs on Perrin's Road and the Town of Conception Bay South's public launch area, which is also located on Perrin's Road. These boaters currently navigate from lower Long Pond, passing through the Long Pond basin. To ensure these boaters can continue to safely navigate the area, the Company, as part of its

development plan is constructing a safe, navigation channel on the east side of the property that will be as deep as the channel currently used by these boaters. Following advice from the Navigable Waters Division of Transport Canada and feedback from residents in the area, Ocean Choice will create a 100 foot (30.1 metres) marked channel on the east side of its property. The current channel opening between the marker bouys for the Royal Newfoundland Yacht Club is 60.45 feet (18.4 metres), which is sufficient for boats that are much larger than those passing by the east side of Ocean Choice's development.

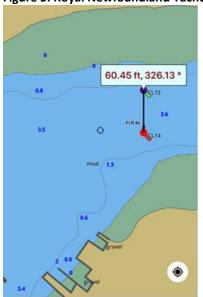


Figure 5: Royal Newfoundland Yacht Club Marked Channel

In terms of leased private water lots, there are five active water lot leases around the shoreline of the Long Pond public harbour. Of particular note, only two of the five water lots are within proximity to the proposed infill project area. It should also be noted that throughout the process of developing this report there were no known hazard areas identified.

There are also a number of recreational private boat moorings in proximity to the proposed infill area.

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Figure: 6: Map of the Development.

2.2 Views and Visual Impacts

Ocean Choice's development is located in the southwest portion of the harbour off Terminal Road, the existing commercial area of the harbour. Ocean Choice believes the proposed development will fit in well with the commercial and recreational usage in the port.

Over the last several weeks, Ocean Choice has been working with a local, professional architect to develop renditions of the proposed cold storage building in relation to the existing site (see page 21). The proposed building has a modern, nautical look and feel to highlight Newfoundland and Labrador's cultural connection with the ocean and the fishery. The development will enhance sight lines and provide an overall improved visual aesthetics of the harbour area, particularly for property owners who currently have a view of the oil and grain silos some of which are over 100 feet high. The overall height of the cold storage building will average 43 feet. The nearest residential property is approximately 283 meters from the site.

Figures 7, 8 and 9: Renderings of the proposed design, including views from Sunset Key Marina and Perrins Road. While the final design of the building is not finalized, the designs are a representation of what the development may look like. Ocean Choice may continue to tweak the design.

Figure 7: Building and Property Renditions



Possible design being considered for the cold storage infrastructure, which could continue to be refined.

Figure 8: View from Sunset Key Marine



Possible design being considered for the cold storage infrastructure, which could continue to be refined.

John hearn architect

Figure 9: View from Perrins Road

Possible design being considered for the cold storage infrastructure, which could continue to be refined.

2.3 Cold Storage Operations

Cold storage operations are very different than a fish processing facility. Many seafood cold storage facilities in Newfoundland and Labrador are located within the heart of communities with minimal disruption to community life.

2.3.1 Noise

There is very little noise associated with a cold storage facility due to the nature of the work at these sites (i.e., a forklift is used for loading and offloading vessels and for loading product on trucks for shipment to markets worldwide). Cold storage operation noise levels are modest overall, as demonstrated from other cold storage facilities on the Avalon Peninsula that are operating directly in communities.

At Ocean Choice's proposed development, the offloading/loading of vessels will take place on the wharf side of the development, which is on the commercial side of the harbour facing the Long Pond Gut. In addition, the cold storage building itself will act as a noise barrier between the vessels and the residential side of the harbour.

Earlier this fall, Ocean Choice had an independent noise assessment conducted by Dallas Mercer Consulting. The assessment involved noise measurements collected on September 24, 2020, at Harbour Grace Cold Storage during the offloading of the

Newfoundland Lynx one of Ocean Choice's offshore fishing vessels. Spot check measurements were conducted regarding noise levels generated from the offloading and loading of the vessel and the cold storage area.

Figure 10 below provides a summary of the results of the area measurements collected on the day of the assessment. The following is the overall conclusions as reported by Dallas Mercer Consulting:

'Noise levels collected on the wharf area and surrounding community during the assessment were below the Workplace 8-hour TLV of 85 dBA. Most were also below the guideline of 65 dBA during the daytime hours. Only the pedestrian walkway on the wharf was above the 65 dBA guideline. It was observed and documented that once measurements were taken of the actual work site and in the surrounding community, noise levels were well below the TLV of 85dBA and all but one were below 65 dBA. It was observed that during the taking of the measurements, noise generated from the offloading procedure did not transfer into the community'.

Figure 10: Area Noise Measurements

Area	Sound Level Measurement (dBA)		
Wharf Area – Pedestrian Walkway	71.5		
Covid-19 Pre-Screening Trailer	67.7		
Entrance to Parking Lot – Main Road (public vehicles passing)	60.0		
200 Meters away from work site (public vehicles passing)	53.5		
300 Meters away from work site (public vehicles passing)	52.1		
400 Meters away from work site (public vehicles passing)	53.9		

Full details on the noise study and methodology can be found in Appendix L.

It is also estimated that on average four trucks per day will be required to ship products to market. These trucks will enter the site on the Terminal Road side of the development and will also load the product (using a forklift) on the Terminal Road side.

An independent Traffic Impact Statement conducted by Harbourside Transportation Consultants also noted that 'increased noise relating to traffic along Terminal Road should be minimal as the increased volumes are relatively low and there are no significant grades or other geometric features that should require hard acceleration/deceleration' (See Appendix M).

2.3.2 Traffic

Ocean Choice contracted Harbourside Transportation Consultants to conduct a Traffic Impact Statement for the development. The following assumptions relating to the

operations of the cold storage facility both during regular office hours as well as during vessel landings where provided to Harbourside Transportation Consultants:

Daily Operations (8am to 5pm):

Facility Operations: 5 employeesAdministration: 3 employees

Outbound Shipments: 2-6 trucks depending on landings

 Vessel Landing Operations: Operations at times when a vessel arrives at the facility (approximately 60 times a year). A vessel is typically docked for 2 to 3 days per landing. These activities are in addition to the daily operations identified above:

Vessel Offloading: 16 employees per shift (8 or 12-hr shift)

Vessel Crew: 25 employeesVessel Supply Deliveries: 5 trucks

o Fuel Delivery: 7 trucks

The traffic assessment completed by Harbourside Transportation Consultants is based on the assumptions listed above; and includes a summary of anticipated traffic activity once the site is fully operational. The assessment also includes trip generation estimates based on the vessel landing schedule for the facility.

When a vessel is in port, work at the site including the equipment used for the work will be centered on vessel offloading, outbound product shipments, vessel deliveries (food, packaging, parts, lubes, etc.) and fuel deliveries. Figure 11 below is taken from the Harbourside Transportation Consultants Traffic Impact Statement and provides an overview of the anticipated level of equipment traffic when a vessel is in Port.

Figure 11: Daily Trip Generation Estimates – Vessel in Port Operations Weekday

Operations	Quantity		Weekday (veh/day)		
			Total	In	Out
Regular	8	Employees	16	8	8
Facility/Administration					
Outbound Shipments	6	Trucks	12	6	6
Vessel Offloading	32	Employees	64	32	32
Vessel Crew	25	Employees	50	25	25
Vessel Delivery	5	Trucks	10	5	5
Fuel Delivery	7	Trucks	14	7	7
Total Trips Generated				83	83

Ocean Choice estimates that approximately five vessels will land and be offloaded every month. Typically, a vessel is in port for two to three days per landing. The anticipated daily trip generation estimates will be far less when a vessel is not in port.

The report concludes with the following summary statement:

'It is anticipated that vehicle trips associated with regular operations and at times when a vessel arrives at the facility can be accommodated on Terminal Road and at the signalized intersection with no significant impact on existing traffic operations.'

Full details on the Harbourside Transportation Consultants report can be found attached in Appendix M.

2.3.3 Odour

Ocean Choice's wharf and cold storage facility will be offloading, sorting and storing finished packaged frozen-at-sea product, ready for market from the Company's offshore fishing vessels. Many seafood cold storage facilities in Newfoundland and Labrador are located within the heart of the communities. There is no fish odour generated from these types of operations. As a result, there is very little risk of any marine odour from the activity. Figure 12 below illustrates a recent offloading from the M.V. Calvert. As demonstrated in the figure, offloaded product is in a finished form. It is packaged and frozen for distribution to global markets.



Figure 12: Picture of Product Offloading from M.V. Calvert

2.3.4 Overnight Operation

On average four shipments of frozen-at-sea products will be shipped to global markets on a daily basis. With respect to vessel traffic, Ocean Choice will be landing five of its offshore fishing vessels at the site monthly with an estimated 60 landings annually (an

average of five landings per month). While some vessels will land outside of regular business hours; there is not a lot of noise associated with this process.

2.3.5 Lights

Most of the activity at the site will take place on the Terminal Road side of the development and the wharf side of the development that is facing north into the harbour, both of which are already commercial areas. The site will not generate any more light than is already common for this area of the harbour. The development will be safety lit. To ensure safe operations at the site, the area will be safely lit; as well there will be outdoor lighting on the Terminal Road side and on the wharf side of the development.

2.3.6 Offal and Waste

The Cold Storage facility will not generate offal, as no product will be processed at the facility. Ocean Choice will also follow all the provincial and municipal by-laws with respect to the proper disposal of waste.

2.4 Marine Activity

With the addition of the M.V. Calvert to its fleet earlier this year, Ocean Choice now has five offshore vessels operating out of Newfoundland and Labrador. These vessels range in size from 49 to 74 metres; and depending on the size and species harvested, fishing trips can range from three to five weeks in duration.

Based on the overall number of vessels and duration at sea, it's expected that there will be approximately five vessel landings per month at the facility. The general duration for a landing is two to three days, which will result in a relatively modest level of marine traffic associated with the development.

2.5 Construction Activity

Ocean Choice is committed to putting in place safeguards and measures to minimize the impacts to area residents, property owners and businesses during the construction phase of the development. Ocean Choice will use qualified and certified contractors throughout the development and all contractors will be mandated to follow all regulatory authority protocols.

The Construction Period is expected to be 2020/2021 for the infilling and wharf and 2021/2022 for the cold storage building. Key elements of the development include:

 Construction of a new treated timber crib wharf on a rock mattress, complete with a reinforced concrete deck.

- Supply and installation of conduit, electrical systems, mooring bollards, shoreline bollard complete with foundations, structural timber for coping, wheelguard, wheelguard blocking, fenders, ladders and associated hardware for new wharf construction.
- Supply and installation of rock/gravel fill for uplands development, topped with granulars and pavement.
- Deepening of a channel in front of wharf and for small boat users to safely pass through on the east side of the site.
- Supply of concrete reef balls to meet DFO Habitat Compensation Plan requirements.
- Provisions for water/sewer services.
- Construction of a new cold storage building.

2.6 Traffic, Noise, Dust and Airborne Pollutants

2.6.1 Traffic

Like with any development, as a result of increased construction related traffic there will be some short-term inconveniences during the construction period for motorists. For the safety of area residents and those who use Terminal Road, Ocean Choice will share its construction schedule with households and businesses in the area.

Approximately 100 truckloads of rock per day will be transported from the quarry on Minerals Road to the Long Pond construction site. To maximize the quantity per truck load, which in turn will reduce the overall number of truck loads and reduce exhaust emissions, the majority of this material will be transported via semi-dump trucks/trailers. Haul trucks will be timely spaced to optimize efficiency for the loading process. This effort will also minimize possible traffic flow issues that are often present with large numbers of trucks in immediate sequence. In addition, Jake Brakes will not be used within town limits as an effort to reduce noise pollution.

A variety of equipment will be utilized during the construction of the wharf and rock uplands, including but not limited to a sectional barge as well as long reach excavators, regular boom excavators, excavator mounted hydraulic compactors, dump trucks and rollers. Ocean Choice will work with its contractors to ensure safety measures are adhered to when the required equipment is moved to the site, is used at the site, and removed from the site once construction is completed.

2.6.2 **Noise**

Where possible, Ocean Choice will implement measures to reduce the impact of construction-related noise on the surrounding community during the construction phase of the project. This will include focused construction activity during daylight hours and minimizing operations after dark where possible; as well as minimizing any conflicting activity that would affect boaters where possible during the boating season.

Hand tools such as gas powered drills and chainsaws will be used during the wharf construction. Contractors will be required to ensure that these tools have properly maintained exhausts to reduce noise pollution for area residents; and the Town of Conception Bay South's Noise and Nuisance Regulations will be followed.

Note that during compacting of the fill material during dynamic compaction methods, the expected noise levels are estimated to be 80 to 90 dB at 30 m to 40m and this level is expected to have a significant reduction as the noise travels over water. Where appropriate the construction contractor will be required to monitor noise levels based on current CSA standard for testing, and modify work methodologies (particularly those associated with the drop weight) to minimize noise levels in accordance with governing regulations. Further details are contained in the Stantec Consulting Ltd. attached as Appendix F.

Figure 13: Estimated dBA sound levels Extrapolated for Distance

Distance	Estimated Sound Level
(m)	(dBA)
40	90
50	88
100	80
300	63
500	41

Given the above table, noise related issues as a result of compaction will be greatly reduced for local residents given the distance from the project development site.

2.6.3 Dust and Airborne Pollutants

During construction minor localized air emissions will occur from operating heavy equipment and temporary operation of generator sets. Additionally, construction related traffic and various construction activities (such as excavation) have the potential to create short-term nuisance dust effects in the immediate vicinity of the project.

Dust mitigation measures will be in effect during the construction period such as road cleaning that will be implemented periodically as required; especially at the entrance to

the site on Terminal Road where most dust is expected. Light watering of the dirt roads and of the construction site will also be used to as a means to mitigate dust, as required.

Ocean Choice plans to implement good site practices during construction including:

- Maintaining equipment in good running condition and in compliance with regulatory requirements;
- Protecting stockpiles of construction material with a barrier or windscreen and in the event of dry conditions and excessive dust watering of source areas and covering loads of construction materials during transport; and
- Detailed measures to address potential construction accidents and malfunctions, such as fuel spills, sediment discharges, erosion/overflow of sediment traps and other events will be specified in contingency plans and an environmental management plan, which will be developed prior to starting any work at the site.

Section 3: Land and Marine Traffic

3.1 During Construction

As noted in the above section, there will be an increase in construction-related traffic during the construction phase of the development.

Given the nature of the work, excavators mounted on work barges, dump scows, and dump trucks will be used during construction, however this equipment will be confined to the general area of the new wharf construction and have no impact on the existing harbour users. The proposed equipment for this project is no different from heavy equipment used at any typical small craft harbour development site and is no different from the equipment historically seen at the Long Pond facility that was used for repairs and upgrades to the main terminal wharf when it was under the ownership of Transport Canada.

With respect to land traffic, a significant amount of rock will be hauled to the site from the Trinity Resources' mine site at 250 Minerals Road. The haul distance is approximately 20 minutes per truck and the route is a northwest straight run from 250 Minerals Road followed by one turn onto Terminal Road to the work site. Approximately, 100 truckloads of rock per day will be transported from the quarry on Minerals Road to the Long Pond construction site.

3.2 **During Operations**

As noted in Section 2.3 of this report, an independent traffic assessment was completed by Harbourside Transportation Consultants. The traffic assessment concluded that the traffic associated with regular operations of the cold storage; and the traffic associated

with vessel landings can be accommodated on Terminal Road and at the signalized intersection with no significant impact on existing traffic operations.

The Harbourside Transportation Consultants report can be found in Appendix M.

3.3 Construction and Operating Equipment

A variety of equipment will be utilized during the construction of the wharf and rock uplands, including but not limited to a sectional barge and long reach excavators, regular boom excavators, dump trucks and rollers.

Construction will generally be phased as follows:

- Excavation using a long reach excavator to firm bottom prior to placing rock on the north side of the development.
- Preparation of crib seats by excavating and removing all loose material including silt, clay, sand and gravel from the infill area to expose required depth, bedrock or firm bottom.
- Preparation of the building foundation footprint by excavating and removing all loose material including silt, clay, sand, and gravel from the infill area to expose bedrock or firm bottom. The excavation outer limit for the building foundation will be to the extent of the rock placement area required to achieve a 1H:1V slope from one meter outside of building foundation perimeter footing. This will vary depending on the depth to firm bottom. All material within the building foundation excavation outer limits will be removed to bedrock or firm bottom.
- Rock as it is dumped will be periodically leveled and pushed into the Ocean Choice property using an excavator to an elevation of approximately +1.0 meter above low tide.
- The rock will be compacted using an 11-ton vibratory roller compactor as the rock is placed in 0.5m thick lifts from above +1.0 m elevation to finished grade.
 Dynamic compaction techniques will also be used for the compaction of rockfill under building footprint.
- Rock protection is required on the outer perimeter side slopes of the development. Prior to the installation of rip rap, all side slopes will be covered with 1 full height layer of geofabric.
- Cribs will be constructed on-shore, launched into position and ballasted in place. The wharf construction will be standard construction, following typical guidelines employed by DFO Small Craft Harbours. Final construction will consist of a fendered wharf face, ladders, mooring bollards and a concrete deck.

 The building foundation associated with the cold storage facility will be standard construction using conventional concrete foundations.

During construction, perimeter control measures and sedimentation barriers will be put in place to avoid siltation of water bodies. Construction will be carried out during times of light precipitation and the construction site will be shut down when precipitation is heavy. All contractors working at the site will be required to have Health and Safety Plans as well as the appropriate Environmental Protection Plans prior to commencing any work at the site.

During construction, the lighting used will minimize potential for bird collisions. If migratory bird nests are found, they will be undisturbed until nesting is complete and construction minimized in the immediate area of nesting.

Section 4: Flood Risk Analysis

4.1 Hydrology and Hydraulics

The hydrology and hydraulic profile of the Long Pond area surrounding the proposed development is profiled in the CBCL report entitled 'Coastal Modeling Study Ocean Choice International Development - Long Pond, Newfoundland' attached as Appendix G. This includes an analysis of flood flow in the area as well as water surface profiles for a number of flood event scenarios. Additional information relating to the hydrology and hydraulics in the area can be found in additional CBCL reports produced in 2018 and 2019 attached as Appendices J and K.

The CBCL hydrology and hydraulic analysis did not identify additional incremental flood risk as a result of the proposed development.

The hydrodynamic (HD) numerical modeling conducted by CBCL indicated the 'Depth averaged discharge and velocity magnitudes remain unchanged near Conway's Brook and Sobey's Stream outlets as a result of this development.' The report further indicates 'The new OCI development does not significantly increase or alter current velocities throughout the basin'. From a wave agitation standpoint the report modeling indicates 'Wave height increases with sea level rise are negligible to low throughout the LPH basin for the 2100 time horizon (i.e. in the order of 1cm compared to 2020 wave heights for a 1-year return period storm condition).

Progressive Engineering & Consultants conducted analysis of both the Conway's Brook and Sobey's Stream water flows into the Long Pond Harbour. This report is attached as Appendix O.

4.2 Topographic and Bathymetric Mapping

The CBCL study noted above uses several sources of bathymetric data as part of its assessment including DFO and CBCL. CBCL also used Environment Canada surge analysis of the Canadian East coast in its study to model extreme water levels and tidal events. Details relating to the topographic and bathometric mapping for the area can be found in Appendices G and H.

4.3 Climate Change and Inundation Mapping

The CBCL study provides a thorough overview of the potential impacts of climate change on flooding in the area. The study noted that 'The Intergovernmental Panel on Climate Change's Fifth Assessment Report (IPCC AR5 2013) estimated that the upper-bound Global Mean SLR could be in the order of 1.0 m by year 2100'.

Global climate change is affecting all coastal environments, including the Long Pond area. According to the CBCL Coastal Study, while climate change has the risk of increasing sea levels in the area by one meter by the year 2100, Ocean Choice's development does not add incremental risk to the area. The key point identified in the study is that 'The design should allow flexibility to accommodate future upgrades for adaptation'.

The CBCL Coastal Study also did not identify any significant flood risk from the two river systems that have a very low flow velocity overall. As indicated previously hydrodynamic numerical modeling noted that 'Depth averaged discharge and velocity magnitudes remain unchanged near Conway's Brook and Sobey's Stream outlets'.

Section 5: Flood Risk Mitigation

5.1 Impacts to Users

Ocean Choice retained the services of CBCL Limited Consulting Engineers to conduct a coastal engineering study for the development, which looked at, among other things, possible flooding to the area as a result of the development. As illustrated in the CBCL Coastal Study, Ocean Choice's development does not change the dynamics of flood risk in the Long Pond area or further adversely affect surrounding users of the area. Further information is contained in the CBCL Limited Consulting report attached as Appendix G.

5.2 Emergency Access in the Event of Inundation

While no inundation of this property is expected given its elevation relative to the existing tidal zone, Ocean Choice will develop a flood emergency response plan. This plan will be developed in consultation with the appropriate experts to reduce potential

property damage and business interruption and to ensure the safety of employees, residents and other property owners in the area. The plan will include protocols for emergency access to the facility, proactive monitoring of water levels, maintenance of critical infrastructure (i.e. electrical, computer, communications, etc.) and an evacuation plan for the site.

5.3 Environmental Emergencies

The risk of an environmental emergency occurring as a result of Ocean Choice's proposed development is considered to be low.

The only known spill risk is related to vessel operations at the wharf. All of Ocean Choice's vessels already have in place spill response plans. Ocean Choice, as part of its existing vessel operations, has equipped each of its vessels with a spill boom. In the event of an oil spill, Ocean Choice's trained crew will activate the spill boom to slow and contain the spill. Based on Ocean Choice's vessel operations, the potential for such an occurrence is unlikely; however, the Company has the infrastructure and trained crew in place as a safety precaution. Ocean Choice also has a signed contract with Eastern Canada Response Corporation, a reputable company with extensive experience managing spills, who in the unlikely event of an oil spill will provide response.

During the construction phase of the development, all contractors will be required to follow provincial and municipal environmental regulations applicable to their respective industries and activities.

5.4 Protection of Electrical Systems

All power and electrical systems, including backup generators will be protected through the installation of ground fault interceptors and other redundancies. In addition, the development will be at an elevation level well above any flood expectation given tidal levels in the area.

5.5 Protection of Water Sewer Systems in the Event of Flooding

Water will be supplied to the development from the existing water distribution system. The sanitary sewer will be complete with concrete pre-cast manholes and will convey sanitary sewer flows from the new building to Terminal Road where a sanitary sewer lift station will be installed. A backwater prevention valve will be installed into the sewer line to prevent sewer backflows and preventative measures will also be established to protect the water supply in the unlikely event of flooding.

Storm water runoff for the site will primarily be conveyed to the surrounding ocean via overland flow. Care will also be taken to ensure grading around the site promotes positive drainage to the ocean. Further details on the water and sewer systems for the development can be found in Appendix K.

Section 6: Geotechnical Review

6.1 General

The geotechnical conditions within the harbour are well understood and well documented, with numerous investigations and design work carried out on the Terminal Wharf when under the ownership of Transport Canada. With respect to Ocean Choice's planned development, the Company engaged Fracflow Consultants to complete a geotechnical borehole investigation on two separate occasions. The subsurface conditions found by Fracflow are described in the geotechnical report appended to this document. In general, the subsurface soil conditions consist of a 1 to 6 m thick layer of very soft sediments (the DCPT sank under its own weight) that is underlain by a relatively firm layer of organic and sandy sediment which in turn is underlain by a relatively strong but thinly layered shale bedrock.

6.2 Rock Fill Placement

Ocean Choice will be obtaining the rock required for this project from the Trinity Resources Mine Site on Mineral Road in CBS. Ocean Choice engaged Fracflow Consultants Inc. to investigate the rock available at this site and provide recommendations for its suitability. Fracflow's technical memo related to this investigation is attached as Appendix S. In general, the Fracflow memo confirmed that the rock is not soluble. The most abundant rock is the pyrophyllite, which can be used for regular rock fill. The less abundant pink rhyolite or altered rhyolite with grey rhyolite is suitable for crib fill and rip rap.

Ocean Choice recognizes that uncontrolled movement/displacement of the very soft sediments, identified in the Fracflow investigation, during infilling operations (sometimes referred to as a "mud wave"), is possible. Since this effect is difficult to quantify, Ocean Choice engaged Fracflow Consultants Inc. to develop a preliminary rock placement procedure for end dumping activities. The rock placement procedure ensures any potential displacement of loose soils "or mudwave" stays within the infilled area itself and does not encroach outside the perimeter of the infilling operations. In general terms, the perimeter will be excavated and clean rock fill placed to create a berm prior to end dumping into the loose soils within the bermed area. Refer to 5.0 of the Fracflow appended report for rock fill placement procedures which will be followed during this project. At all times, Ocean Choice's intent is to ensure no shoaling of areas outside the infilling footprint, and if this happens, the material will be removed for disposal at an approved location.

Stantec were subsequently engaged to review recommendations for fill placement (as prepared by Fracflow) and explore options for providing suitable bearing capacities for building foundations using dynamic compaction techniques (the Stantec memo report is included in Appendix F).

6.3 Sediment Environmental Samples

Fracflow's report includes borehole/pencone logs and the results of the sediment samples which were tested for a variety of parameters including hydrocarbons, metals and polycyclic aromatic hydrocarbons. The sediment sample results indicate that any dredged spoils would be suitable for fill or disposal. Ocean Choice will follow the appropriate regulatory process with respect to sediment disposal.

Section 7: Water and Sanitary Services

The proposed plan for Ocean Choice's development is to service the site with water via a connection to the existing 200mm ductile iron water main located on Terminal Road. The new water main connection will be a 200mm diameter ductile iron pipe (or similar approved material). To ensure optimal water flow and to avoid dead-ends, the new water main connection will be installed via the site's access road and it will continue around the new building to form a continuous loop.

Ocean Choice plans to use a 200mm diameter off 200mm diameter tapping sleeve and valve to connect to the existing 200mm water main. This will avoid interruption to the existing water service to the area. In addition, main line valves will be positioned on the new water main that will allow Ocean Choice to strategically shut-off water to the site without impacting existing water users, should maintenance on the new water main need to be performed in the future.

Ocean Choice will ensure that all fire safety regulations for the site are adhered to. This includes the installation of fire hydrants around the site at 45m intervals to ensure proper fire protection for the new building. The building will have an interior fire suppression system in the form of a wet sprinkler. In addition, an exterior hose connection will be supplied to allow the local fire department to boost system pressures, if required.

System demand is estimated to be 5.87I/s which is derived based on the assumption that sanitary sewer generation rates represent 90% of water demand. See Appendix O for additional information.

The sanitary sewer system will be designed in accordance with the latest edition of the Guidelines for Design, Construction and Operation of Water and Sewerage Systems, published by the Government of Newfoundland and Labrador's Department of Environment and Conservation. Calculations have been completed to determine a peak wet weather flow of 5.34l/s and also to determine the appropriate pipe sizing for the development. A 200mm PVC sanitary sewer, complete with concrete pre-cast manholes will convey sanitary sewer flows from the new building to Terminal Road where a sanitary sewer lift station will be installed. The lift station will convey flows via a new

force main to the nearest gravity sewer capable of receiving additional flow, which is located at the intersection of Terminal Road and Route 60. See Appendix O for additional information.

During construction portable restrooms and portable handwashing stations that are standard to construction sites will be used. A local firm will be contracted to provide these services and to ensure regular maintenance and servicing is carried-out throughout the construction phase of the project. During construction there will be no reliance on the municipal system.

Section 8: Storm Water Assessment

Storm water runoff for the site will primarily be conveyed to the surrounding ocean via overland flow. Ocean Choice will ensure that grading around the site promotes positive drainage to the ocean. It is anticipated that there will be a depression in the grading in the area for loading/off-loading of the transport trucks. To ensure no pooling of water in this area, a catch basin will be installed with a short section of pipe to a headwall that will discharge the water to the ocean. A connection for the building's roof drains will also be accommodated at this location. See Appendix O for additional information.

Ocean Choice is not aware of any municipal or provincial requirements for the examination of storm water effluent quality or the requirement to implement controls. This appears to be above and beyond what is currently required in the provincial and municipal development regulations. If Ocean Choice is to consider this, it would need direction from the Town/Province on what standards are to be used to firstly evaluate the stormwater effluent quality and secondly to design control devices to improve storm water effluent quality prior to releasing it into the ocean. Ocean Choice is committed to any and all requirements that would typically be imposed by regulatory bodies for stormwater management.

In lieu of the above statement, Ocean Choice has not examined the 1:10, 1:20 and 1:100 AEP rainfall durations as the necessity to use this data would need clarification from the Town as it relates to stormwater effluent quality and the implementation of control devices. At this point Ocean Choice is not proposing to use a storm sewer network, with the exception of a single catch basin to collect runoff at the loading/offloading area.

Section 9: Regulatory Approvals and Authorizations

Over the last several years, Ocean Choice has been actively engaged in rigorous federal, provincial and municipal regulatory approvals for the development. The Company is committed to following and adhering to the regulatory process that is deemed necessary by the appropriate authorities. This includes all three levels of government.

Regulatory approvals and authorizations include:

- Government of Newfoundland and Labrador: Department of Environment and Conservation – Environmental Assessment Determination: Ocean Choice received notification from the Government of Newfoundland and Labrador's Department of Environment and Conservation on September 20, 2018 confirming that Environmental Assessment registration for the development is not required under Section 47 of the Environmental Protection Act.
- Environment and Climate Change Canada Assessment: Ocean Choice received a letter from Environment and Climate Change Canada's Environmental Protection Operations Directorate on May 1, 2019 providing guidance to support the environmental management process of the proposed development.
- Town of Conception Bay South Approval in Principle: The Town of CBS provided a letter to Ocean Choice on August 19, 2020 providing approval in principle to construct a wharf and infill a waterbody located on Terminal Road, Long Pond subject to addressing the conditions outlined in the letter.
- Department of Fisheries and Oceans (DFO): Marine Fish Habitat Compensation Plan – Fisheries Act Authorization: Ocean Choice received authorization from DFO on September 18, 2020 to proceed with its long pond in-fill and wharf construction as well as the associated marine fish habitat compensation plan.
- Government of Newfoundland and Labrador: Department of Environment and Conservation Permit to Alter a Body of Water: Ocean Choice received a letter from the Government of Newfoundland and Labrador's Department of Environment and Conservation with the permit providing authorization to alter a body of water, based on Ocean Choice's previous development plan. Based on the current development plan, Ocean Choice has submitted a new request to the Department of Environment and Conservation for a Permit to Alter a Body of Water. Once this permit is received, Ocean Choice will provide a copy to the Town of Conception Bay South's Planning and Development Department.
- Long Pond Harbour Authority (LPHA) Letter of support from the LPHA for the development dated September 22, 2020.
- Transport Canada: Navigable Waters Division Navigable Waters Protection:
 In August 2020, Ocean Choice made an application to the Minister of Transport, pursuant to the Canadian Navigable Waters Act for the development. At this time, as per the process under the Act, Ocean Choice started the public consultation process for the application. Based on feedback from the Navigable Waters Division of Transport Canada following the public consultation process (closed on September 20, 2020), Ocean Choice resubmitted a public application

under the Act. Details of the application are available on the public registry and are consistent with the plans outlined in this application. The application submitted to Transport Canada is attached to this document as Appendix P.

All of the above regulatory approvals and authorizations are available in Appendix P and Q.

Section 10: Traffic Impact Assessment

10.1 Vehicle Traffic

Ocean Choice contracted Harbourside Transportation Consultants to conduct a Traffic Impact Statement for the development. The report concludes with the following summary statement:

'It is anticipated that vehicle trips associated with regular operations and at times when a vessel arrives at the facility can be accommodated on Terminal Road and at the signalized intersection with no significant impact on existing traffic operations.'

Additional details relating to the traffic that will be generated once the facility is operational can be found in Section 3 of this report; and a copy of Harbourside Transportation Consultants report can be found in Appendix M.

10.2 Marine Traffic

With the addition of the M.V. Calvert to its fleet earlier this year, Ocean Choice now has five offshore fishing vessels operating out of Newfoundland and Labrador. These vessels range in size from 49 to 74 metres; and depending on the size and species harvested, fishing trips can range from three to five weeks in duration.

Based on the overall number of vessels and duration at sea it's expected that there will be approximately five vessel landings and offloading's per month at the facility. The general duration for a landing is two-to-three days, which will result in a relatively modest level of marine traffic created in the area from the development.

10.3 Pedestrian Movement

While there are residential properties at the beginning of Terminal Road, due to the commercial nature of this area, it is anticipated that there will be very little pedestrian movement in the area of Ocean Choice's development.

Ocean Choice's development will see 30 to 40 new, full time positions created, which will not increase pedestrian movement in the area of Terminal Road, as these

individuals will park their vehicles on Ocean Choice's property (the newly developed land) and proceed to work. As crew members travel to and from the area for their sailings, they will also park on Ocean Choice's property and will therefore have no impact on pedestrian movement in the area.

Section 11: Public Engagement

Ocean Choice is committed to being open and accessible; this includes listening to the comments and concerns of those interested in the Long Pond Harbour development. In light of the ongoing COVID-19 pandemic and restrictions associated with public gatherings, Ocean Choice put in place alternative measures to provide the public with the ability to ask questions and engage with the Company about the development.

Since August, Ocean Choice has held several meetings with interested parties including residential property owners and commercial businesses in the area, local business associations and government officials, to name a few. In addition, Ocean Choice has setup a website where up-to-date information relating to the development has been posted. The site also provides interested parties with the ability to submit questions, which are then posted along with the answers to the site. A representative from Ocean Choice has also been very active on social media, responding to comments and questions.

In September, the Company also sent an information flyer to approximately 300 property owners in the immediate and surrounding area of the development. The flyer provided an overview of the development as well as information relating to Ocean Choice's website.

Ocean Choice will continue to communicate information relating to the development while also listening and addressing questions as the development continues to move through the regulatory process.

Additional details on Ocean Choice's Long Pond Harbour Development Communication Plan can be found attached to this document as Appendix E.

The plan provides an overview of the public engagement and communications activities to date as well as plans to be carried out during the decision and permitting phase of Ocean Choice's proposed Long Pond development. The Company will continue to engage and communicate with the public throughout the construction phase of the development and once the site, wharf and cold storage is built and ready for operation.

Section 12: Regulatory Approvals and Authorizations

Ocean Choice is adhering to all of the federal, provincial and municipal regulatory approval processes required for the Long Pond Harbour Development. A list of all of the approvals and authorizations received for the development can be found in Section 9.0 of this report. Ocean Choice anticipates a response from Navigable Waters late November. Ocean Choice will provide this authorization to the Town of Conception Bay South upon receipt of the permit from Navigable Waters.

Section 13: Marine and Terrestrial Environment

Over the last several years, Ocean Choice has been diligently working with the proper regulatory authorities and government bodies to ensure the Long Pond Development is adhering to the required environmental guidelines. The authorities that Ocean Choice consulted with and received authorizations/approvals from with respect to the marine and terrestrial environment include: the Department of Fisheries and Oceans, Environment and Climate Change Canada and the Government of Newfoundland and Labrador's Department of Environment and Conservation. Ocean Choice will adhere to all of the regulations and mitigation plans that are deemed appropriate at the federal, provincial and municipal levels of government.

In August 2018, Ocean Choice contracted Sea-Force Diving to complete a habitat survey of the area for the development. To determine the extent of marine life and the conditions of the seafloor, Sea-Force Diving performed 13 transect swims at 15m apart within the proposed backfill site. Video recordings and pictures were taken, which were used to identify the marine life and underwater conditions of the area.

The following is a summary of Sea-Force Diving's report, and a copy of the report is included in Appendix R:

- The ocean floor in area of the proposed infill site consists of soft silt and sand, which is covered with marine grass comparable to eel grass; and
- The marine life noted throughout the study area varied, and consisted of sea snails, jelly fish, starfish, flatfish, crabs, etc.

As a follow-up to Sea-Force's habitat survey, a researcher at the Fisheries and Marine Institute of Memorial University reviewed all of the available video transect data from the survey to identify the species in the area. The most common species identified as part of the video survey were Cunners and Jonah crab.

Based on the marine habitat identified in the proposed project site, Ocean Choice has developed a Marine Fish Habitat Compensation Plan in cooperation with the Department of Fisheries and Oceans. The plan has been developed through a two-year

consultative process with DFO. Ocean Choice received authorization and approval from DFO for the habitat compensation plan in September 2020, as an acceptable offset plan for the development.

The primary offset measure is to create new habitat in Conception Bay through the creation of artificial reefs. The plan will see the creation of double the habitat displaced from Ocean Choice's development in Long Pond. To ensure that the offsetting measures are functioning as designed and expected, Ocean Choice's plan also includes a DFO mandated five-year monitoring program.

A Reef Ball is a designed artificial reef that mimics the structure and function of a natural reef, creating habitat and space and promotes circulation of water and maximized exposure to sunlight. Reef Balls enhance habitat for fish and other marine organisms (taken from www.reefball.org) and enhance the productivity and habitat complexity of the area (DFO 2016).

Artificial Reefs may be constructed for a variety of reasons, each with potential benefits depending on intended goals. Artificial reefs are designed to create, enhance or restore marine habitat by fostering ecosystem growth by providing food sources, shelter and protection to shellfish and fish species, promoting algal growth, and serve a potential spawning habitat as well (taken from www.clean.ns.ca/programs/water/reef-balls).

Artificial reefs may also be used as a means of mitigating habitat loss (Adams et a. 2006) and are accepted as one method of offsetting lost fish habitat in coastal habitats (Christensen and Wroblewski 2014).

Reef Balls are the world's leading designed artificial reef modules. The Department of Fisheries and Oceans (DFO) has acknowledged reef balls as a recognized method of remediation and habitat compensation and offset projects such as the Atlantic Reef ball Program (www.clean.ns.ca/programs/water/reef-balls), and the Ogden Point Breakwater project (http://www.salishsea.ca/reefballs/FinalReefballs.pdf). More than 6,000 projects have used this reef ball design worldwide, including eastern Canada projects in Halifax Harbor and Cape Breton Island (www.reefball.org).

As part of the Habitat Compensation Plan, Ocean Choice is also partnering with Memorial University researchers to create an outreach program that will see real-time observation of the reef ball site. This outreach program will be developed with a focus on youth engagement in local K to 12 schools as well as academic research with post-secondary institutions.

Details on the DFO authorization are contained in this document and attached as Appendix Q.

13.1 Migratory Birds and Species at Risk

Environment and Climate Change Canada (ECCC) has reviewed the proposed project in accordance with its mandated interests and expertise stemming from its responsibilities under the Migratory Birds Convention Act, the Species at Risk Act, Section 36 of the Fisheries Act, and the Canadian Environmental Protection Act. In accordance to their legislation, ECCC has offered guidance to support the environmental management process of the development (See Appendix Q). This guidance includes, among other things, the following:

- Using beneficial management practices for working on shorelines.
- Ensuring precautions and implementing contingency plans associated with fuel leaks and/or spills.
- Provisions for wildlife response activities to ensure that any potential pollution incidents affecting wildlife are effectively and consistently mitigated.
- Mitigation measures and monitoring associated with migratory birds subject to potential incidents.
- Measures to diminish the risk of introducing invasive species during all project phases.
- Contingency plans if old dredge spoils have been known to attract migratory birds such as Piping Plovers and other species of ground nesting birds such as Terns or Killdeer.
- Contingency plans to prevent migratory birds from light attraction.
- Reporting of sitings (although considered unlikely) of the following species at risk: Red Crossbill (percna subspecies, Endangered), and Olive-sided Flycatcher (Threatened).
- Provisions to compensate for loss of eelgrass beds. Reference Appendix Q for Ocean Choice's requirement to complete compensation plans under DFO Habitat letters of advice.
- Measures to protect the environment during the disturbance of substrate during in-water activities that increase sediment concentrations and turbidity in the water column.

Section 14: Emissions

During the development Ocean Choice and any contractors working on the development will ensure that the proper procedures and best practices will be maintained to reduce pollutants to the environment.

Considerations to reduce emissions associated with the development include the following:

site planning;

- construction and building materials used;
- minimizing vehicle traffic congestion during construction;
- minimizing distances travelled for delivery of construction materials;
- utilizing "green" building materials; and
- constructing buildings to maximize energy efficiency.

Ocean Choice is committed to and will ensure that its contractors will work with the authorities to identify any parameters which should be followed in conjunction with this development.

Section 15: Construction Expenditures, Employment and Local Economic Benefits

15.1 Construction Expenditures

Ocean Choice is committed to investing approximately \$15 million during the construction and start-up phase of the development. This \$15 million will create further economic spin-off and employment opportunities for the area, as Ocean Choice awards contracts and purchases supply to support this phase of the development.

During construction of the wharf, infill area and the cold storage building, Ocean Choice will be using regional contractors for the supply and installation of all infrastructure. It is Ocean Choice's intent to award separate contracts for:

- the wharf/infill area;
- the paving of the uplands; and
- the construction of the cold storage building.

15.2 Employment and Local Economic Benefits

Ocean Choice's new modern cold storage facility will increase the province's cold storage capacity, provide local employment opportunities and create spin-off business opportunities for the Town of Conception Bay South and the surrounding area. Key employment and economic benefits resulting from Ocean Choice's development are as follows:

- New Job Creation: 30-40 new, full-time positions will be created to support the
 cold storage facility, the loading and offloading of five of Ocean Choice's offshore
 fishing vessels and crew changeovers. These positions range from management,
 supervisors, maintenance, forklift operators, inventory control and sorting of
 product as it is offloaded, stored and shipped just to name a few.
- Spin-Off Business Opportunities: A cold storage facility generates new
 opportunities for local businesses within the community to provide support
 services for the facility, the vessels landing at the site as well as to the crew

members who will be travelling back and forth to the community. For example, Ocean Choice's newest offshore fishing vessel – the MV Calvert – is expected to generate over \$13 million in economic spin-off. This includes fuel, groceries and other supplies for the vessel as well as vessel maintenance and other services required.

- Other Incremental Economic Benefits: There will be additional economic benefits to other local businesses in the area including incremental interest in residential properties from new employees as well as offshore vessel crew members that may wish to live closer to their crew change site. The operation will also see 30 to 40 new, full-time positions as well as several hundred crew members travelling to the area. These individuals will spend money within the Town of Conception Bay South (i.e., visiting restaurants, gas stations, etc.).
- **Community Investment:** Giving back to communities in Newfoundland and Labrador is a priority for Ocean Choice. The Company makes every effort possible to be a valued corporate citizen by actively supporting organizations in the communities where we operate and where our employees live.

Section 16: Pre-Development Hydrodynamic Model

There are two river systems that convey flows into the area of Long Pond Harbour adjacent to the proposed development. The main contribution of flow comes from the Conway's Book river system. The catchment area for this system is 1105 Ha and consists primarily of forested areas with some low density development making up the remainder.

The other stream (Sobey's Stream), relative to Conway's Brook, is quite small at 32 Ha. It consists of a marshy area, adjacent to the Heritage Square Retirement Living facility, which discharges to a stream that slowly meanders the rear properties on the east side of Terminal Road before discharging into the harbour.

Both catchment areas were modelled by Progressive Engineering & Consultants Inc., using latest version of the XPSWMM software (See Appendix O).

Contour Mapping of the site is provided in Appendices D and I.

The CBCL study also conducted hydrodynamic modeling to adequately characterize existing conditions. Where possible the hydrodynamic model shall be calibrated using site specific information obtained through a combination of information gathering and field data collection. Further details on the results of the modeling can be found in Appendix G.

Section 17: Post-Development Hydrodynamic Model

Ocean Choice understands that concerns have been raised by some local residents as to the potential for flooding and other adverse impacts as a result of this development. Based on these concerns, Ocean Choice retained the services of CBCL Limited Consulting Engineers to conduct a coastal engineering study for the development. Details on the work conducted as part of this contract include: the potential impact that the development may have on wave action in the harbour; tidal hydrodynamics; potential for erosion and sedimentation; and potential for flooding.

As Atlantic Canada's largest and most experienced professional coastal engineering consultants, CBCL has tremendous knowledge and expertise in conducting coastal engineering studies and modelling. In addition to this experience, their team of engineers is already familiar with the Long Pond area, as they have previously conducted a Coastal Engineering Study Conceptual design of East Breakwater Upgrade in Long Pond commissioned by the Harbour Authority.

The study completed by CBCL for Ocean Choice's Long Pond Development looked at the following:

- Wave agitation in the harbour that may result from the large area to be infilled;
- Potential for erosion and sedimentation from harbour narrowing;
- Impacts the infilled area may have on currents within the harbour, particularly
 where the harbour will be narrowed between the east shoreline and the east
 side of the infilled area;
- Potential flooding risks and ice jam formation in and around long pond harbour as a result of the OCI development; and
- Information on water levels, tides and sea level rise.

Figures 14 and 15: Provide an illustration of the proposed development site in relation to other locations of interest in Long Pond Harbour.

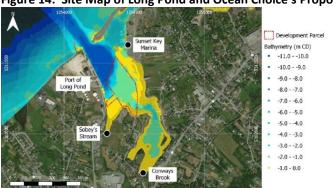


Figure 14: Site Map of Long Pond and Ocean Choice's Proposed Development

*Please Note: The Development Parcel outlined in red is the waterlot.





A copy of the CBCL Coastal Modeling Study is attached to this document as Appendix G. The report provides detailed modeling and analysis that were used by CBCL to develop its list of outcomes and conclusions. Key conclusions based on the projects objectives are summarized as follows:

 Wave Agitation in the Harbour: Wave model analysis determined that wave conditions at the entry of the harbour will remain unchanged as a result of Ocean Choice's development; therefore keeping navigation conditions between the two existing breakwaters identical to those experienced today.

The wave energy is significantly reduced to the south of the development due to the 'shadowing' effect of the new land. This could have a positive effect, protecting the shoreline of the basin south of Ocean Choice's development.

Potential wave height increases in front of the PD Enterprises Wharf are anticipated to be negligible (i.e. less than 2cm). Some very modest wave height

increases could occur at Sunset Key Marina but are well within acceptable international standards.

According to the report, the overall impact that the development will have on the wave action within the harbour is negligible: 'Wave height increases with sea level rise are negligible to low throughout the LPH basin for the 2100 time horizon (i.e. 5-10 cm for a 1-year return period storm condition)'.

Impacts on Currents within the Harbour: The study simulated water levels and currents in a hydrodynamic (HD) numerical model. Simulations conducted in all areas of the harbour determined either slightly reduced, unchanged circumstances or very minor increases in velocity.
 Current velocities and associated navigation conditions in the channel north of Sunset Key Marina and at the entrance of the Long Pond Harbour remain unchanged as a result of Ocean Choice's development.

At the dock of the existing marine terminal, the currents are projected to be slightly lower. While currents on the east side of Ocean Choice's development will be slightly higher, they are still low ranging between 0.05 m/s to 0.10 m/s (0.10 knots to 0.20 knots). Depth averaged discharge and velocity magnitudes remain unchanged near Conway's Brook and Sobey's Stream outlets.

 Potential for Erosion and Sedimentation: The modeling exercise conducted determined that sediment change within Long Pond would remain relatively unchanged as a result of Ocean Choice's development compared to existing conditions.

The lack of wave driven sediment transport and the low-energy tidally driven sediment dynamics result in a relatively stable environment.

The new Ocean Choice development does not significantly increase or alter current velocities throughout the basin, and therefore sediment types and sediment accretion or deposition patterns within the harbour are unlikely to be significantly modified as a result of Ocean Choice's development.

Potential Flooding Risk from Ice Jam Formation: The study noted that the
presence of ice in Long Pond Harbour is very rare and an actual freeze-up of the
harbour has not occurred in recent history. Furthermore, the type of ice that
could form in the harbour is not likely to form an ice jam, primarily due to
current flow.

The conditions in the Long Pond Harbour basin are not well suited to mass ice formation and subsequent ice jam formation.

It is also important to note that the CBCL Report also states that there will be little to no increase in currents and the movement of sediment is unlikely therefore there will be no impact to the shoreline.

Section 18: Hydrodynamic Model for the Barachois (North of Inner and Outer Long Pond)

Section 17 above provides a detailed summary of any anticipated changes in wave, current, water levels/tides and sediment transport identified in the post development hydrodynamic model. The study concludes that the proposed development will have negligible impact on the surrounding area. While the study focused primarily on the potential impacts within the harbour it would be logical to conclude that the results could easily be extrapolated to include the Barachois area which would be further removed from the proposed development. With respect to this issue the lead author from the CBCL report noted:

'I do however think that the flood risk analysis of the breakwaters and barachois is unwarranted as these processes are driven by the effects from offshore by the ocean and not by what is going on in the harbour. The inner harbour development has no impacts on the exterior breakwater and barachois....'. (Email correspondence from Danker Kolijn, M.Sc., P.Eng. | Group Lead, Coastal Engineering. October 1, 2020).

Section 19: Dredging and Sweeping

The Long Pond harbour has been dredged several times in the past to maintain the desired depths to accommodate larger commercial vessels that currently use the port. The most recent dredging programs were reportedly conducted in 1985, 1988/89 and 1995. The water depth with the turning radius fronting Ocean Choice's marginal wharf is current at - 8.2m L.N.T.

Dredging requirements associated with crib seat excavation activities are defined in the wharf design drawings attached in Appendix D. In addition, where required, sweeping using a weighted beam (as a form of dredging) for the small boat channel will be completed to ensure access to the small boat basin south of the developed property. Sweeping of the small boat channel will be to a depth of -1.2m L.N.T.

The development will not impact sediment movement in the harbor and hence no maintenance dredging of the harbour or nearby marinas will be required.

Ocean Choice is committed to following the regulatory guidelines and standards using qualified contractors.

Section 20: Navigational Channel Industry Standards

Typical Small Craft Harbour guidelines for channel width is five times the beam width of the design vessel. The World Association for Waterborne Transport Infrastructure (PIANC) generally established the guideline for channel width as four times the beam width of the design vessel for "no passing vessels" and seven times the beam width of the design vessel for "passing vessels".

For the development in Long Pond Harbour, Ocean Choice is committed to the recommendations provided by Transport Canada's Navigable Waters division, which are more stringent than the above noted guidance. The recommendation from Transport Canada is that a channel width of 30.1m on the east side of the development be constructed to provide safe navigation for existing boat users. In addition, aids to navigation will be clearly marked to define this channel. The required depth of the channel is set at -1.2m with respect to low normal tide, to match the existing water depths along the approach area to the small boat basin which is outside the current development.

Section 21: Proposed Navigation Channel Compared to Existing Channels

Bathymetric and topographic data to the south of the development, towards the small boat basin, as well as the north channel leading into the Royal Newfoundland Yacht Club (which is well north of the development site), is appended to this document.

For comparison purposes, the established minimum width required for the navigation channel along the east side of Ocean Choice's development is 30.1m. The current channel opening between the marker bouys for the Royal Newfoundland Yacht Club is 60.45 feet (18.4 metres), which is sufficient for boats that are much larger than those passing by the east side of Ocean Choice's development.

Reference drawings showing widths and depths relative to low normal tide for all areas outside Ocean Choice's development are in Appendix D.

Conclusion

For some time now, Ocean Choice has been advancing this proposed initiative in Long Pond, Conception Bay South. This report is a culmination of several years of discussion and planning starting in 2013 following initial discussions with the Long Pond Harbour Authority (LPHA). Expressions of Interest (EOI's) were issued by the LPHA for the development of this commercial harbour in 2014 and again in 2017. Following this process in 2017, Ocean Choice reengaged the LPHA on a proposed development for the area.

This LUIAR has been prepared to address the Town of Conception Bay South's (CBS) Municipal Plan Land Use policy 4.3.8 for provision of a Land Use Impact Assessment Report (LUIAR). The Ocean Choice proposed development in Long Pond Harbour has been developed in compliance with the Municipal Plan and the uses within the Industrial General Zone and has been issued an Approval in Principle in accordance with the Town's Development Regulations subject to the completion and acceptance of this LUIAR.

The project will see the development of new land, a 90-metre wharf as well as the construction of a new cold storage facility. The Company's proposed development will see approximately 17,228 square meters (approximately 1.7 hectares) of new land developed. Regulatory authorizations provide flexibility for Ocean Choice to increase the development space to 2.5 hectares if required at some point.

The development site has been conceptualized to complement the existing harbour infrastructure in the area. The Town of CBS and the LPHA have been actively engaged in discussions around this economic development activity. Furthermore, direct consultations have been held with interested residents, business owners and stakeholders in the community and others are anticipated as part of this LUIAR process.

Extensive discussions have also taken place with the responsible regulatory authorities and industry experts over the past several years to ensure compliance with necessary federal and provincial regulations. In addition, significant independent research and analysis has been conducted by industry experts to support development efforts as well as to meet regulatory and municipal requirements. Details of these approvals and associated research reports have been outlined throughout this report as well as the attached appendices.

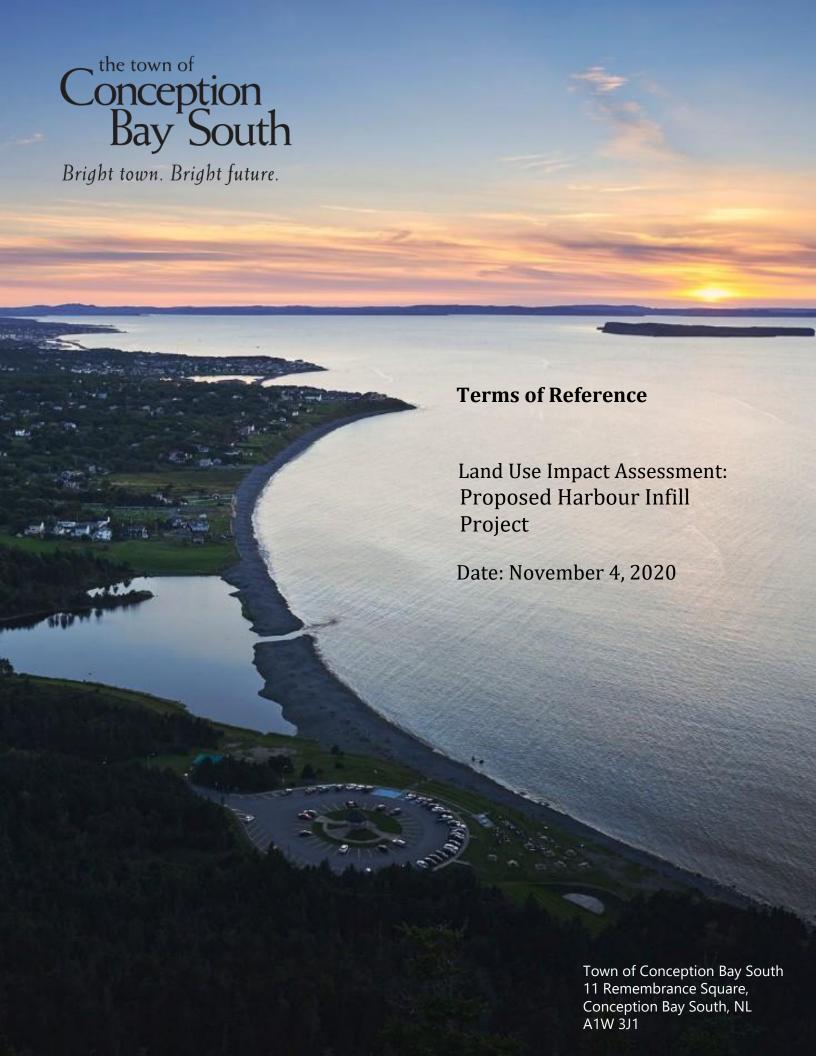
Ocean Choice has also developed a habitat offsetting measure to create new habitat in Conception Bay through the creation of artificial reefs. The plan will see the creation of double the habitat displaced from Ocean Choice's development in Long Pond. As part of the Habitat Compensation Plan, Ocean Choice is also partnering with Memorial University researchers to create an outreach program that will see real-time observation of the reef ball site as well as youth engagement in local K to 12 schools.

From an economic standpoint, this development is expected to create 30-40 new full-time jobs in the cold storage facility, which will be focused on offloading, storage and product sorting. Additional incremental employment opportunities are expected through spin-off business opportunities for supply services in the area as well as additional economic benefits to other local businesses in the area. In addition, incremental employment opportunities will be created

during the start-up construction phase of the project with over a \$15 million investment during this phase of the project. This is a significant investment in Newfoundland and Labrador's economy at a time when the province is facing economic difficulties.

Ocean Choice is committed to this development and looks forward to advancing the project and will continue to work with the Town of CBS and other regulatory authorities throughout the process of the development.

Appendix A



TERMS OF REFERENCE

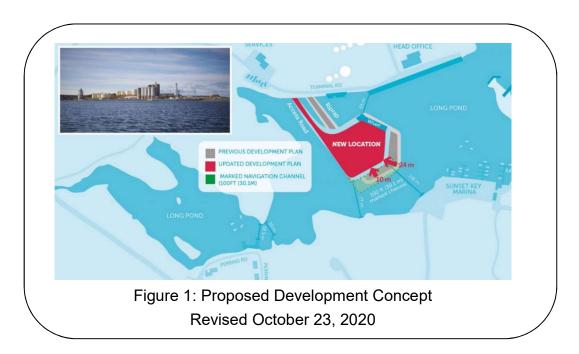
Requirements for Land Use Impact Assessment Report Terminal Road, Long Pond Town of Conception Bay South

Issued to the Applicant November 4, 2020

BACKGROUND

Ocean Choice International is proposing a development that could see the initial development of new land created by infilling 1.7ha (~4 acres) at the west end of Long Pond, Conception Bay South. The development proposal includes a new 90-metre wharf on the infilled land. Ocean Choice notes that a cold storage facility and office building may be built on the infilled land in the future. Ocean Choice also notes that future expansion of the infill area could increase by an additional 0.8ha, so that the total infilled area could be a maximum of 2.5ha¹.

A new navigable channel is proposed to the east of the project to provide continued marine access from the southern portion of Long Pond, also known as Lower Long Pond, near Perrins Road.



Ocean Choice supplied the image in Figure 1 to illustrate the proposed development they

¹ This sentence was edited for clarity on October 8, 2020.

Terms of Reference Land Use Impact Assessment Report Proposed Infilling Project Terminal Road, Long Pond

wish the Town to consider at this time.

If Ocean Choice pursues development of a further 0.8ha of infill in the future, the Town would have to assess the expansion at that time. Similarly, the application before the Town does not include the future building to house the cold storage facility and offices. Therefore, the Land Use Assessment Impact Report is not required to address specific factors solely related to that building. Any building(s) proposed for the site will have to be assessed in consideration of the zoning requirements for buildings such as setbacks from property boundaries and height.

The proposed development is within the Long Pond Harbour and the Town's Municipal Plan includes policies that relate to industrial development in the area. Policy 5.5.3(1) of the Municipal Plan states:

Lands around the port at Long Pond and smaller existing general industrial sites within the Town are designated General Industry. Lands designated for Industrial use are intended to accommodate a mix of industrial uses, including wholesaling, manufacturing, distribution, communications, warehousing, marine-related industrial uses, service stations and bulk storage uses. Uses and activities related to the processing or transporting of mined material and recycling uses may also be considered in areas designated and zoned for general industrial use. Generally, retail commercial uses shall not be permitted in the Industrial General designation unless they directly service the industrial uses or their employees or they are accessory to the industrial use, i.e., a factory sales outlet.

The Town's Development Regulations implement the policies of the Municipal Plan and if the area is infilled, the adjacent Industrial General zoning would extend to the infilled land.

The proposal complies with intent of industrial policies of the Municipal Plan and uses that are permitted in the Industrial General Zone. The Town therefore issued an Approval in Principle in accordance with the Town's Development Regulations subject to a number of conditions, including that the applicant complete a Land Use Impact Assessment Report. Before any development can proceed, the Town will have to consider the Land Use Impact Assessment Report, and if deemed acceptable, a final development approval would be required.

The shoreline of Long Pond is identified as high and moderate geological hazard risk on the Environmental Overlay Map of the Conception Bay South Municipal Plan. The moderate and high-risk areas are illustrated by orange (moderate) and high (red) in the excerpt from the Town's Geographic Information System in Figure 2. Figure 2 also includes the property boundary (outlined in blue) for the overall land / water lot held by Ocean Choice.

The high-risk area coincides with the immediate shoreline and low-lying areas adjacent to

the shoreline. The moderate and high-risk geological hazard classifications are derived from a report and hazard map prepared by the Geological Survey Division of the Department of Natural Resources with the Government of Newfoundland and Labrador². The report recommended further study, analysis and delineation of the hazard areas identified to confirm site specific conditions when proposed development is considered within the moderate and high hazard areas.

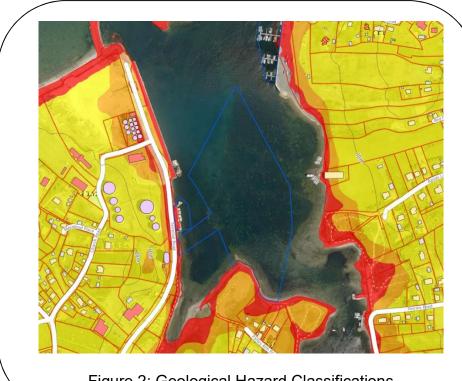


Figure 2: Geological Hazard Classifications Conception Bay South Municipal Plan

The Town's Municipal Plan also includes statements regarding the need for further studies and information when proposals may have impacts on the natural environment. The Municipal Plan provides a mechanism for a Land Use Impact Assessment Report to assist with identifying potential impacts and how those impacts could or should be mitigated.

The purpose of a Land Use Impact Assessment Report is to assess both the long-term and short-term implications in the vicinity of the proposed development and to recommend appropriate cost-effective mitigation measures to address any adverse effects caused by the development.

Policy 4.3.8 of the Town of Conception Bay South Municipal Plan outlines under what scenarios a land use assessment report would be required and what it is to include. Policy

² Batterson M. and Stapleton N. 2011. Report on Vulnerability to Geological Hazard in the Town of Conception Bay South. Geological Survey Division, Department of Natural Resources.

4.3.8 states:

Where a development or use is proposed that cannot be adequately evaluated, the Town may require the preparation of a Land Use Assessment Report. A Land Use Assessment Report is a report prepared by suitably qualified persons to assess any significant impacts a use or development may have on the urban environment and/or surrounding lands or neighborhood.

The report and any supporting documentation shall be prepared at the expense of the developer unless otherwise determined by Council. The report shall evaluate the impacts identified in a Terms of Reference prepared by the Town, evaluate their importance and recommend measures of control and mitigation where appropriate.

Additionally, policy 4.3.14 of the Municipal Plan relates to "Natural Hazard Areas", and states:

Anticipating and addressing the impacts of climate change will become increasingly important over the planning period. Of particular importance is the identification of lands that are susceptible to geological hazards such as low-lying coastal areas and areas of steep slopes. Schedule A – Environmental Overlay Map identifies areas vulnerable to geological hazard in Conception Bay South based on work carried out by the Geological Survey Division, Department of Natural Resources.

- 1) Residential development shall be prohibited in areas identified in Schedule A (of the Municipal Plan) as high hazard.
- Residential development may be considered in areas identified as moderate hazard subject to site specific study to determine the level of hazard risk and suitability of the site for development.
- 3) In areas identified as moderate or high hazard, development of commercial, industrial or other non-residential uses may require a site specific study, prepared by suitably qualified persons to evaluate the level of hazard risk, taking into consideration the susceptibility of the proposed development to storm surges. Such studies will consider elevation, topography and erodibility (geomorphology).
- 4) Development in any area identified as moderate or high hazard may also be required to assess the biophysical impact on the coastal ecosystem including the potential to contaminate (such as, hazardous materials storage), harmful disruption of natural habitats and disruption of natural coastal processes such as littoral drift.
- 5) In approving a development in an area with known or potential hazard, the Town may require additional engineering design or other measures to mitigate identified hazards as a condition of development. In any event, no private development in an area of known or potential hazard risk shall result in public

Terms of Reference Land Use Impact Assessment Report Proposed Infilling Project Terminal Road, Long Pond

liability or public cost.

6) The Town will continue to monitor and address the impacts of climate change and, where necessary, introduce new standards and operational approaches to reduce climate change impacts."

The Town of Conception Bay South Development Regulations provide requirements for how the Town should manage the development, review and consideration of a Land Use Impact Assessment Report.

Section 4.15 of the Town Development Regulations, titled: "Land Use Impact Assessment" states:

- 1. Assessment Required The Authority may require a Land Use Impact Assessment to evaluate any proposed land use or development that affects the policies contained in the Municipal Plan.
- 2. Terms of Reference The Terms of Reference for a Land Use Impact Assessment shall be prepared and approved by the Authority.
- 3. Impact Assessment Report The report and any supporting studies shall be prepared at the expense of the applicant unless otherwise determined by the Authority.
- Mitigation Plan The report shall identify significant impacts, evaluate their importance, and recommend measures of control or mitigation, where appropriate.
- 5. Public Review –The Authority shall provide adequate time for public review and comment with regards to the items to be addressed in the Terms of Reference for the Land Use Impact Assessment. The Authority may provide an opportunity for public review and comment on the Land Use Impact Assessment report prior to its approval.

The Town developed and made public an initial draft of the Terms of Reference in July 2020. After receiving and considering input from the public, the Town developed a Revised Draft Terms of Reference that was made available to the public on October 5, 2020. Council determined that, in consideration of the significant interest in the project, further feedback would be sought from the public and stakeholders on the Revised Draft Terms of Reference. Council sought and accepted comments and suggestions on the revised Draft Terms of Reference through direct mail to approximately 400 property and business owners in the Long Pond area, publication of notices in the October 8 and 15, 2020 editions of the Shoreline, a notice on the Town's website and notifications posted to the Town's social media channels.

As a result of the public consultation process, the Town received submissions from 20 individuals and three businesses. Several of the individuals and two of the businesses

Terms of Reference Land Use Impact Assessment Report Proposed Infilling Project Terminal Road, Long Pond

submitted several representations to the Town.

All of the representations were reviewed by Town staff, Stantec Consulting and Council's Planning and Development Committee. As a result of the review of the representations, the Committee added the following content to this document:

- Requirement that information about a potential mud wave be described.
- Requirement that the LUIAR include information on any potential impacts to the channel to Inner Long Pond with respect to shoreline stability, sedimentation and erosion created by any changes in tides, currents and flow velocities.

Apart from the requirements to be included in the Land Use Impact Assessment Report, the Town also sought information or will engage consultants to review the following questions prior to making a final decision on development of the project:

- Economic impact of the proposed development on the local economy.
- Clarification on status of any proposals from other upland property owners for new or expanded water lot leases from the Long Pond Harbour Authority.

The Town has also decided that there will be further public and stakeholder consultation upon submission of the Land Use Impact Assessment Report before Council makes a final development decision on the application.

TERMS OF REFERENCE

A. GENERAL REQUIREMENTS

- 1. Property description, name of owners, legal description, street address/geographical location, including a location map depicting the property location and any other regionally significant information;
- 2. Acknowledgement that the report is prepared for the Town of Conception Bay South as a pre-condition for the consideration of final development approval and any construction or building permits;
- The report must be prepared for and at the expense of the owner of the subject property and the qualified persons conducting the report have not acted for or as an agent of the Town of Conception Bay South in the preparation of the report.

B. REPORT REQUIREMENTS

The report shall provide a detailed description of the project, including concept plans, details on construction plans and timelines. Details during construction should include impacts on local transportation infrastructure and anticipated work schedules, etc.

The proponent shall identify impacts, and if present, outline necessary efforts to mitigate those impacts on all aspects of the proposed project. All information is to be submitted under one report in a form that can be reproduced in hard and digital copy for dissemination and review. The numbering and ordering scheme used in the report shall correspond with that used in this Terms of Reference and a copy of this Terms of Reference shall be included as part of the report.

A list of those persons/agencies who prepared the Land Use Impact Assessment Report shall be provided as part of the report. The list should include the expertise of each person or agency relevant to the assessment. Given the complexity of potential impacts to the site and area properties along with upstream and downstream impacts, the Town expects that the analysis be performed by suitably qualified persons with expertise in hydrologic engineering and/or flood risk mapping in consideration of climate change impacts.

In addition, the following technical items shall be addressed by the proponent at its expense:

- 1. A description of the site conditions (including reference to technical reports, research studies and/or technical experts), that were reviewed/consulted to evaluate elevation, topography, geomorphology, etc. Evaluate the level of hazard and/or risk in relation to the areas susceptible to flooding, storm surges, erosion and the suitability/acceptability of the site for the proposed use.
- 2. A description of surrounding land uses emphasizing their relationship to the project site and describing any effects, positive or negative, that may result from the proposed project, including but not limited to: views and visual impacts, noise exposure, exposure to dust or other airborne pollutants and influence on marine activity emanating from any such existing land use.
- A description of expected changes to the volume and nature of land and marine traffic anticipated during construction and after completion of the project.
- 4. Provide flood risk analysis for the site and adjacent lands, including the breakwaters and barachois, that considers and includes:
 - a. Hydrology (determining flood flows);
 - b. Hydraulics (water surface profiles for the 1:10, 1:20 and 1:100 AEP flood events);
 - c. Topographic and bathymetric mapping (delineated flood levels on the flood plain);
 - d. Impacts of climate change on potential flood impacts such as

- increased frequency and duration of precipitation events;
- e. Inundation mapping (indicating the depth of flooding); and
- f. Total future development within the contributing basin based on current zoning.
- 5. Provide details on how any flood risk to the site will be mitigated, and details of how properties along the shoreline of the harbour will be protected from dangers associated with flood risk, including:
 - a. Impacts to existing users of the port (commercial and recreational) in relation to passage by water to the inner waters beyond the infill area and impacts on the existing marina facility;
 - b. Emergency access to and egress from the site in the event of inundation:
 - c. A description of the potential environmental emergencies that have potential to occur during construction and operation, and an overview of response planning / mitigation measures;
 - d. Protection of any primary or secondary electrical supply systems;
 - e. Measures to reduce or eliminate sewerage contamination of the building and potable water systems in the event of flooding; and impacts on contributory streams that flow into the harbour running parallel to Terminal Road.
- 6. Geotechnical review that summarizes existing available information and provides recommendations for further detailed geotechnical investigation. It should also comment on typical geotechnical considerations for the construction of this development that may include: bearing capacities, gradation and characteristics of the infill material, slope stability and erosion protection measures that consider the output from the hydrodynamic modeling completed for this development. Depending on the proposed infill construction method, a description and quantification of any type of 'mud wave' that would be created through the displacement of seabed material.³
- 7. Provide the expected potable water and sanitary sewer average daily and peak flows for the development, both during construction and for the permanent facilities.
- 8. Provide a storm water assessment report that addresses how stormwater will be managed for the proposed development. The report shall consider climate change and examine the 1:10, 1:20 and 1:100 AEP rainfall durations. The proponent shall also comment on the expected stormwater effluent quality and address any controls needed to ensure contaminated stormwater is not discharged into the

Page **8** of **11**

³ Added as a result of consultation on the Revised Draft Terms of Reference.

environment.

- 9. Any correspondence, or previously issued approvals, from applicable regulatory bodies.
- 10. Provide a traffic impact assessment that addresses any changes in vehicular, marine and pedestrian movements that result from this development. Baseline data must be obtained to confirm existing conditions for traffic, marine and pedestrian movements. The vehicular traffic impact assessment shall extend to and include the intersection of Terminal Road and the Conception Bay South Highway and consider vehicular traffic volumes and any geometric upgrades required on the road network.
- 11. A summary of consultation with stakeholders and the public completed as of the date that the report is submitted for consideration by the Town.
- 12. Provide a list of regulatory approvals required from federal and/or provincial agencies required for the construction and operation of the project, including but not limited to Fisheries and Oceans Canada, Transport Canada, Environment and Climate Change Canada, and various divisions within the provincial Department of Environment, Climate Change, and Municipalities, as well as the Town of Conception Bay South.
- 13. Provide information on the marine and terrestrial environment that will be affected by the project, including direct and indirect effects, including both migratory and resident species, and potential species at risk / species of conservation concern. Include a description of habitat types both within the footprint of the project, as well as regional context.
- 14. Provide an inventory of emissions, including but not limited to: airborne particulate, light, noise and vibrations anticipated from construction and operation of the project
- 15. Provide a summary of construction expenditures and operation employment impacts and revenues to local economy / the Town of Conception Bay South.
- 16. Complete a pre-development hydrodynamic model to adequately characterize existing conditions. The model should analyze scenarios that include normal flows from Conway's Brook as well as the AEP flood events included in Item 4.1 in the terms of reference. The model output

shall provide detailed information on the wave, current, water levels/tides and sediment transport in the harbour. The pre-development hydrodynamic model shall be calibrated using site specific information obtained through a combination of information gathering and field data collection.

- 17. Complete a post-development hydrodynamic model that includes construction of the development concept to predict future conditions. The model should analyze the same scenarios outlined in the pre-development model with the addition of climate change impacts. The modeling report shall provide detailed information on the wind, wave, current, water levels/tides and sediment transport in the harbour to allow the Town to identify all potential impacts in and around the harbour, as well as the shoreline. The proponent shall use the results of the numerical simulations to evaluate potential impacts of ice-jams on flooding.
- 18. Provide commentary on how any changes in wave, current, water levels/tides and sediment transport identified in the post development hydrodynamic model will impact the barachois along the north of inner and outer Long Pond.⁴
- 19. Assess dredging requirements for the construction phase and any potential requirement for harbour maintenance dredging, including the access to nearby marinas.
- 20. Employ industry standard guidelines (e.g. PIANC, Small Craft Harbours) to design the proposed navigational channel.
- 21. A comparison of the proposed navigable channel to southern Long Pond near Perrins Road with respect to width, depth and turning radii to the existing navigable channels to the same location and the navigable channel to the eastern portion of Long Pond (along and beyond the Royal Newfoundland Yacht Club).

C. DOCUMENTS TO BE INCLUDED

All documents required under Section B – Report Requirements plus,

- 1. Inclusion of a Location Plan showing the location of the proposed development in relation to the surrounding area;
- 2. Definition of a Study Area encompassing all land and water areas surrounding the proposed project that may reasonably be expected to be affected by its

⁴ Added as a result of consultation on the Revised Draft Terms of Reference.

Terms of Reference Land Use Impact Assessment Report Proposed Infilling Project Terminal Road, Long Pond

undertaking;

- 3. Inclusion of a Detailed Site Plan showing the location of the proposed wharf and structure relative to the surrounding property boundaries;
- 4. Inclusion of a site plan that depicts the limits of infill within Long Pond and shows existing bathymetry both within and surrounding the project.
- 5. 3D Rendering of the proposed development with images at a number of viewpoints.
- 6. Inclusion of a vulnerability area and topographical overlay map showing the proposed development in relation to natural hazards areas;
- 7. Inclusion of a proposed grading and servicing plan.

SUBMISSION

A. SUBMISSIONS SHOULD INCLUDE:

- a. A digital copy of the report in PDF format.
- b. Digital copies of all maps and plans produced in AutoCAD or ARC GIS compatible file formats.

B. SUBMISSION SHOULD BE SENT TO:

Planning and Development Department 11 Remembrance Square P.O. Box 14040, Stn. Manuels, Conception Bay South, NL A1W 3J1 planning@conceptionbaysouth.ca

Appendix B

Allnorth NL Surveyors

Newfoundland Land Surveyors

December 14, 2017 Revised January 16, 2018 Job No. 17NL0545-000-2120-003

DESCRIPTION

Ocean Choice International East of Terminal Road

Conception Bay South, NL

All that piece or parcel of land situate and being East of Terminal Road, at Conception Bay South, Newfoundland and Labrador and being bounded and abutted as follows, that is to say:

BEGINNING at a point East of Terminal Road, said point having coordinates of North 5 263 910.493 metres and East 306 517.830 metres in the Modified Three Degree Transverse Mercator Projection for the province of Newfoundland and Labrador, Zone One:

THENCE running along the waters of Long Pond Harbour, North 52° 31' 57" East, 85.519 metres; thence North 29° 59' 41" West, 63.415 metres; thence North 35° 31' 18" West, 25.634 metres; thence North 27° 50' 41" East, 203.905 metres; thence South 28° 23' 29" East, 229.412 metres; thence South 02° 47' 10" East, 85.640 metres; thence South 11° 17' 31" West, 148.720 metres;

THENCE turning and running along the sinuosities of the ordinary high water mark of the waters of Long Pond Harbour, 50.9 metres, more or less, having a chord bearing and distance of, North 57° 17' 48" West, 46.550 metres;

THENCE turning and running along the sinuosities of the ordinary high water mark of the waters of Long Pond Harbour as surveyed by Craig Nightingale Surveys Limited, Plan No. 473302 dated April 15th 2002, and along the land of 11327 NL Inc. (Roll 2530 Frame 1475), 96.3 metres, more or less, having a chord bearing and distance of, North 48° 03' 55" West, 67.497 metres;

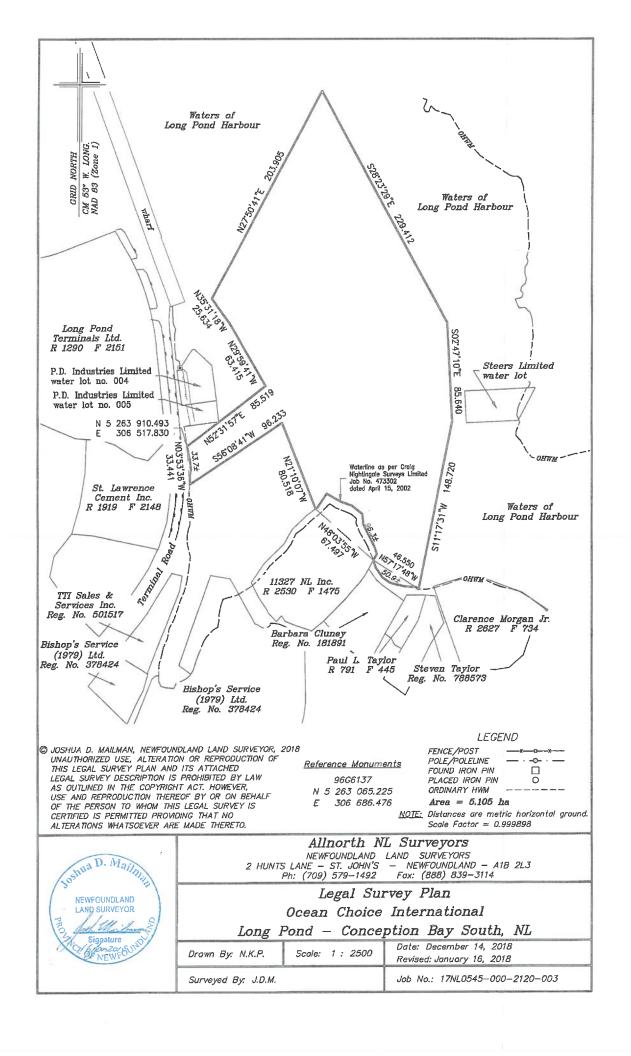
THENCE turning and running along the waters of Long Pond Harbour, North 21° 10' 07" West, 80.518 metres; thence South 56° 08' 41" West, 96.233 metres;

THENCE turning and running along the sinuosities of the ordinary high water mark of the waters of Long Pond Harbour, 33.7 metres, more or less, having a chord bearing and distance of, North 03° 53' 36" West, 33.441 metres, more or less, to the point of commencement and containing an area of 5.105 hectares, more or less, as shown on the attached plan, Job No. 17NL0545-000-2120-003 dated December 14, 2017 and revised on January 16, 2018.

All bearings are grid bearings referred to Grid North. All distances are horizontal ground distances.

NEWFOUNDLAND
LAND SURVEYOR
Signature
Configuration
Newfoundland
Land Surveyor

Joshua D. Mailman, NLS



Appendix C

Appendix C: Disclaimer

The waterlot for the proposed development (previous Transport Canada Port) was purchased by Ocean Choice in April of 2018 from the Long Pond Harbour Authority (LPHA). The Company's proposed development will see approximately 17,228 m² (approximately 1.7 hectares) of new land developed.

A survey of the waterlot conducted by Allnorth NL Surveyors in 2018 is provided and attached as Appendix B. The current proposal is based on the development being completed within this current waterlot.

Based on feedback received from the Navigable Waters Division of Transport Canada and feedback from area residents, Ocean Choice adjusted the development plan for the project. The changes to the development plan have resulted in Ocean Choice submitting a formal request to the LPHA to slightly revise the waterlot to move the access road to the property back towards the southern portion of the Harbour.

If the proposed land swap is approved by the LPHA, the access road will be moved to the southern part of the boundary.

Allnorth NL Surveyors

Newfoundland Land Surveyors

November 6, 2020 Job No. 2003211-000-2120-000-Rev0

DESCRIPTION

Terminal Road

Conception Bay South, NL

All that piece or parcel of land covered by water, situate and being on the Eastern side of Terminal Road, at Conception Bay South, Newfoundland and Labrador and being bounded and abutted as follows, that is to say:

BEGINNING at a point East of Terminal Road (20.12 metres wide), said point having coordinates of North 5 263 873.360 metres and East 306 519.840 metres in the Modified Three Degree Transverse Mercator Projection for the province of Newfoundland and Labrador, Zone One;

THENCE running along the waters of Long Pond Harbour, North 46° 10' 10" East, 84.245 metres; thence on the arc of a counterclockwise curve 13.505 metres long having a radius of 10.000 meters on a chord bearing and distance of North 07° 28' 59" East, 12.502 metres; thence on the arc of a counterclockwise curve 76.359 metres long having a radius of 435.572 meters on a chord bearing and distance of North 31° 12' 13" West, 76.262 metres; thence North 22° 11' 37" East, 217.187 metres; thence South 29° 52' 00" East, 198.617 metres; thence South 14° 56' 34" East, 104.886 metres; thence South 09° 49' 01" West, 153.898 metres;

THENCE turning and running along the sinuosities of the ordinary high water mark of the waters of Long Pond Harbour, 56.9 metres, more or less, having a chord bearing and distance of North 60° 42' 22" West, 51.805 metres;

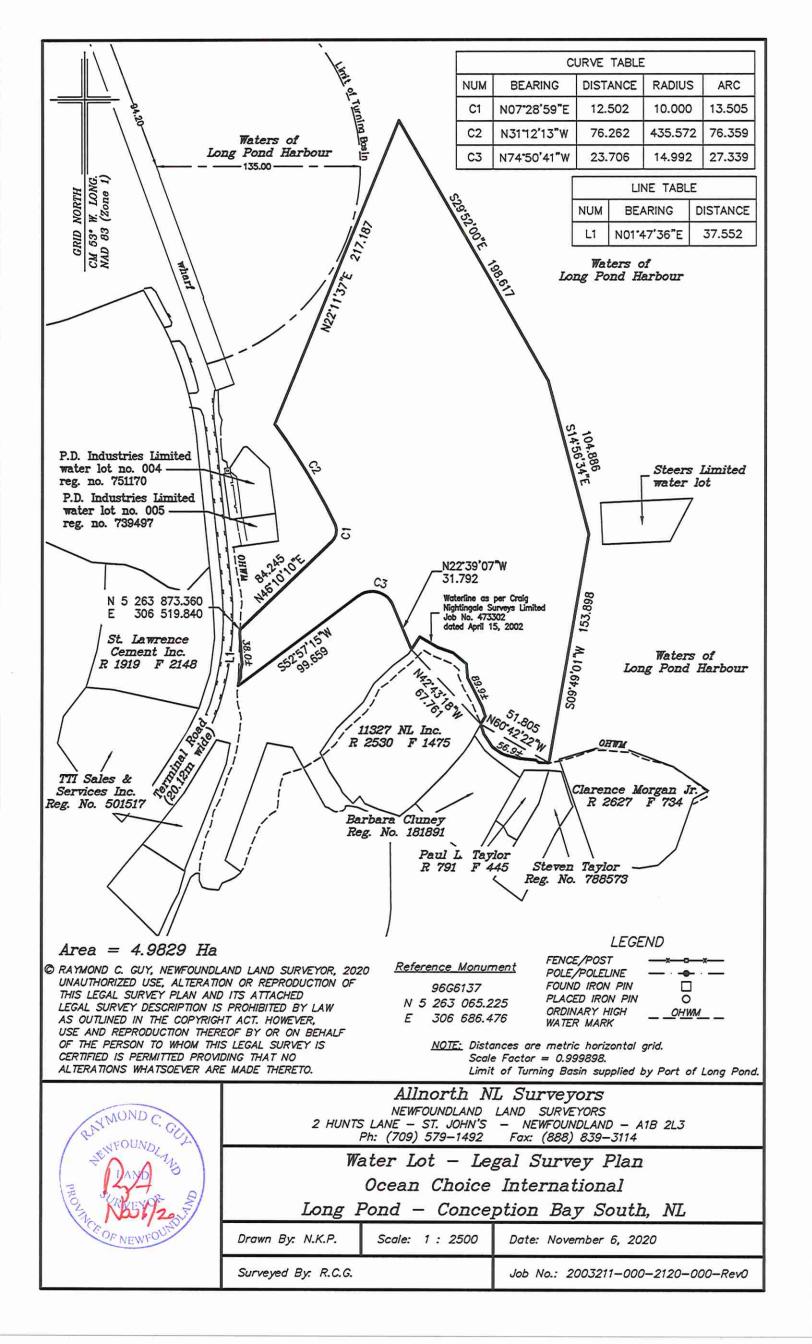
THENCE turning and running along the land of 11327 NL Inc. (Roll 2530 Frame 1475), coincident with the sinuosities of the ordinary high water mark of the waters of Long Pond Harbour, as surveyed by Craig Nightingale Surveys Limited, Plan No. 473302 dated April 15th 2002, 89.9 metres, more or less, having a chord bearing and distance of North 42° 43' 18" West, 67.761 metres;

THENCE turning and running along the waters of Long Pond Harbour, North 22° 39' 07" West, 31.792 metres; thence on the arc of a counterclockwise curve 27.339 metres long having a radius of 14.992 meters on a chord bearing and distance of North 74° 50' 41" West, 23.706 metres; thence South 52° 57' 15" West, 99.659 metres;

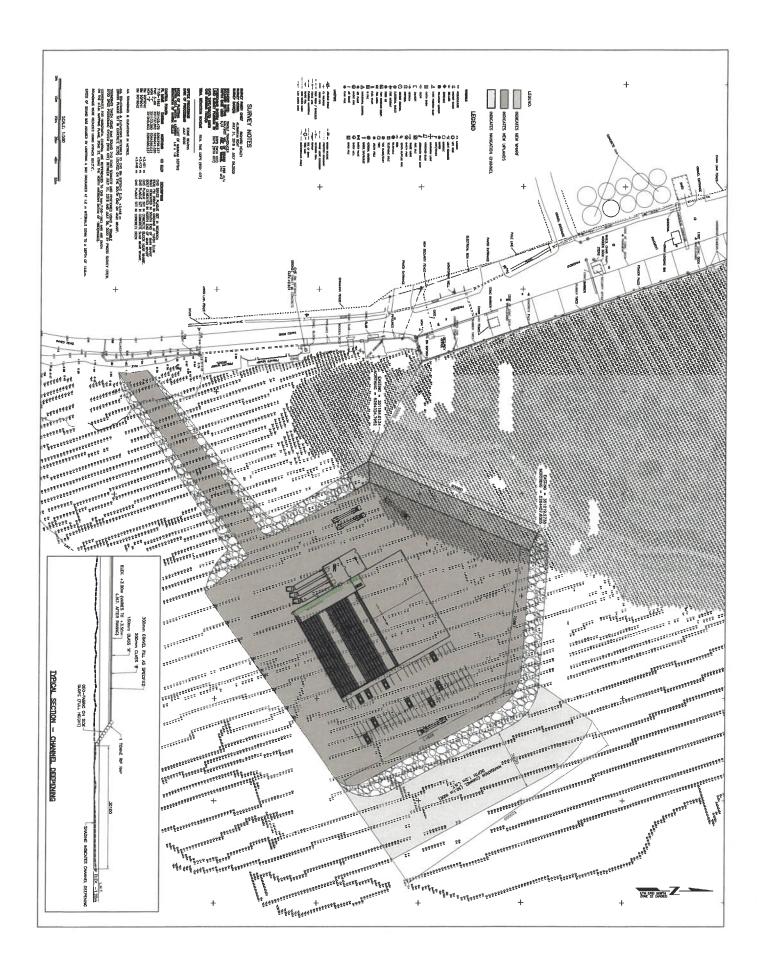
THENCE turning and running along the eastern limit of Terminal Road, coincident with the ordinary high water mark of the waters of Long Pond Harbour, 38.0 metres, more or less, having a chord bearing and distance of North 01° 47' 36" East, 37.552 metres, more or less, to the point of commencement and containing an area of 4.9829 hectares, more or less, as shown on the attached plan, Job No. 2003211-000-2120-000-Rev0 dated November 6, 2020.

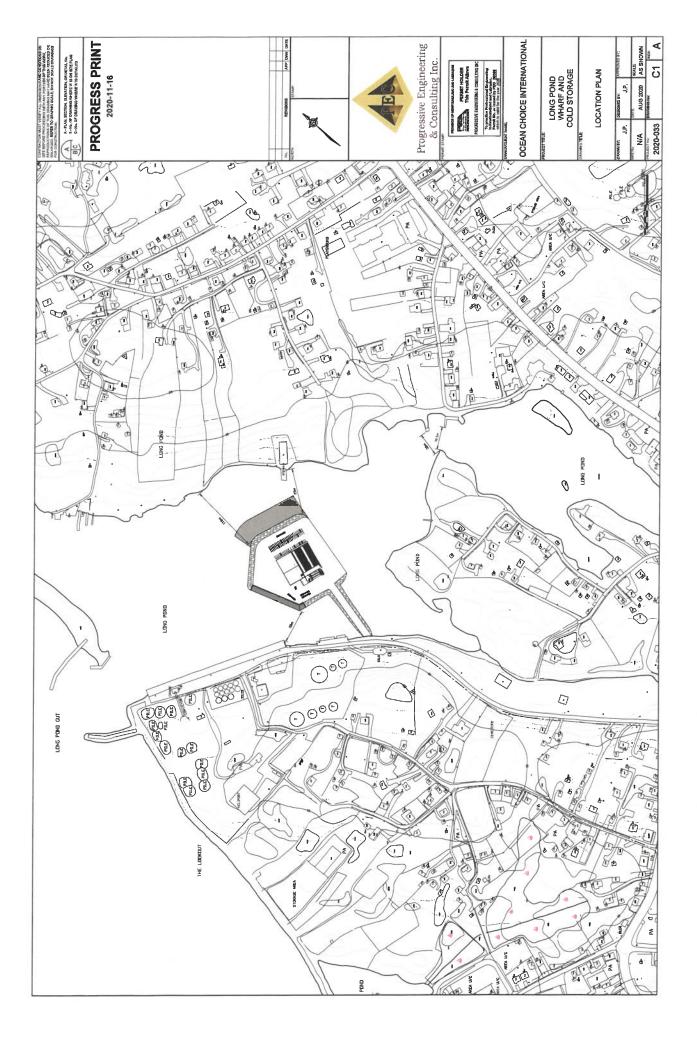
All bearings are grid bearings referred to Grid North. All distances are horizontal grid distances.

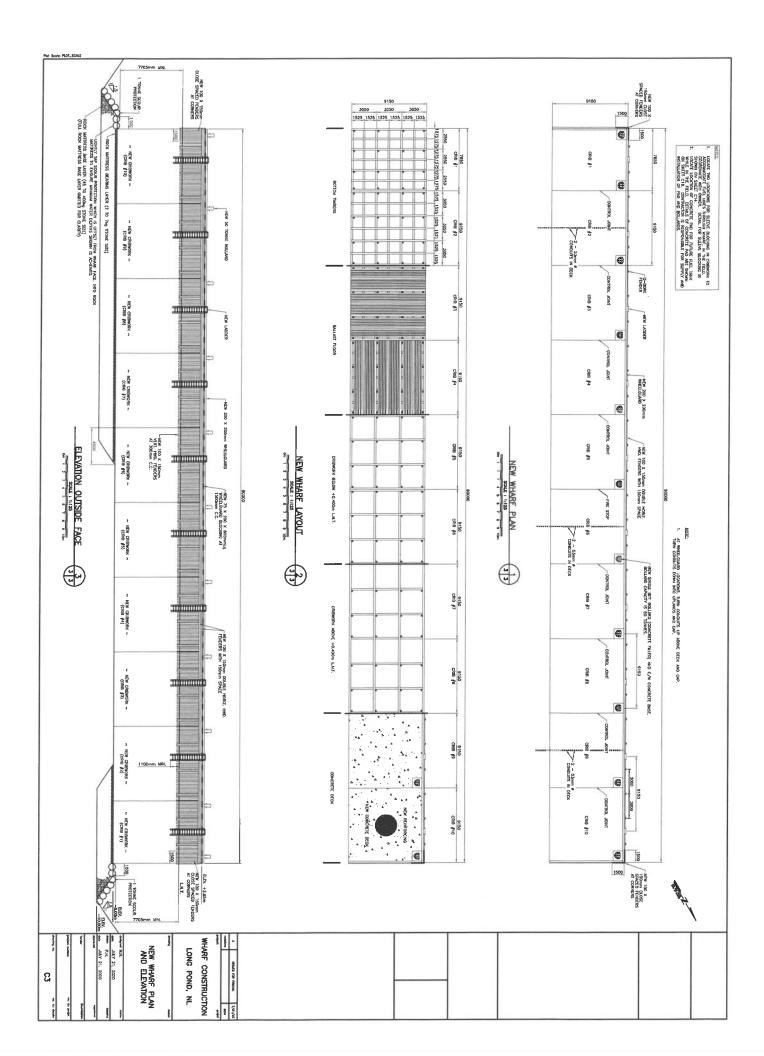
Raymond C. Guy, NLS

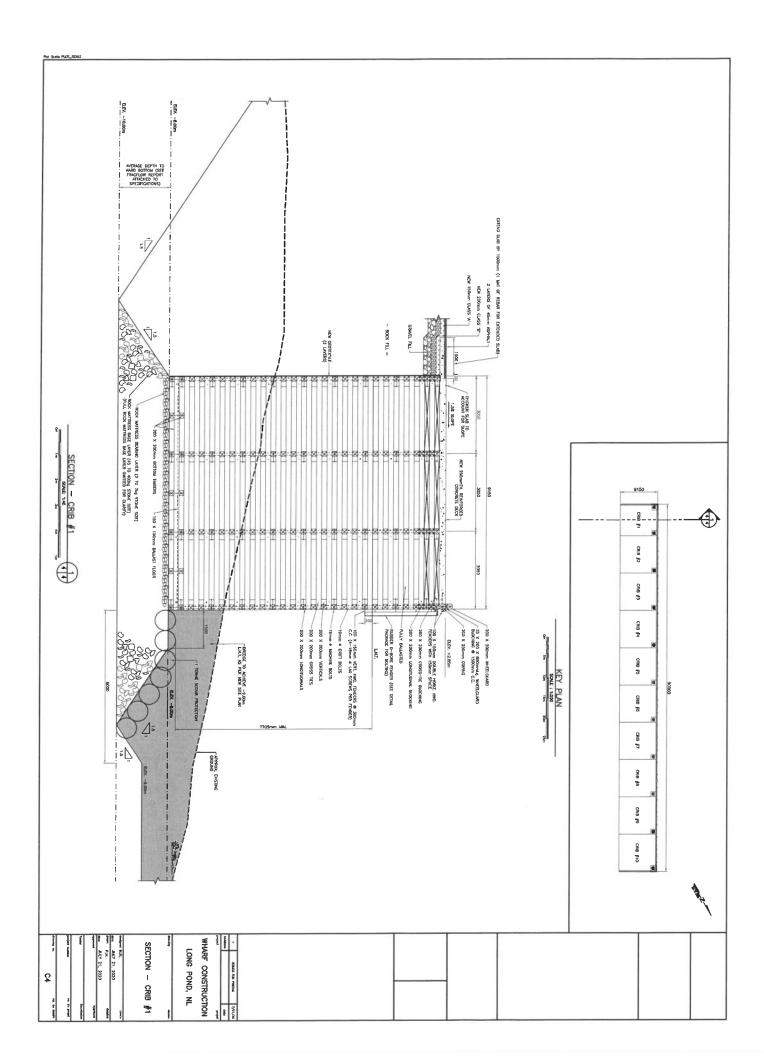


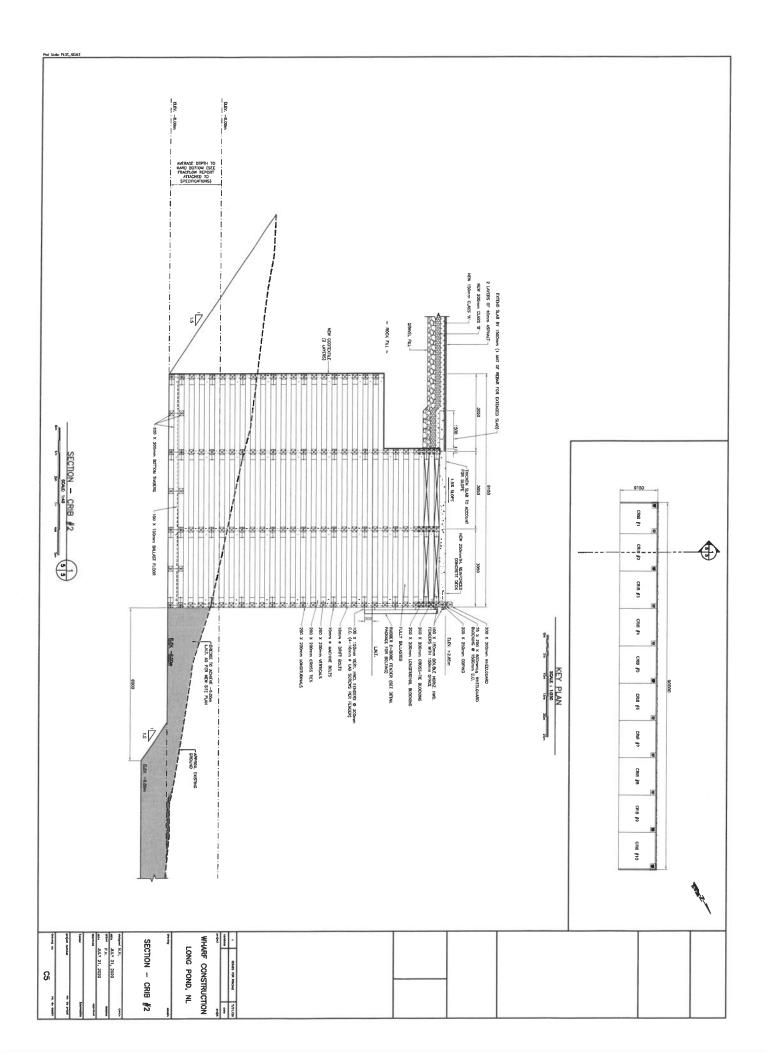
Appendix D

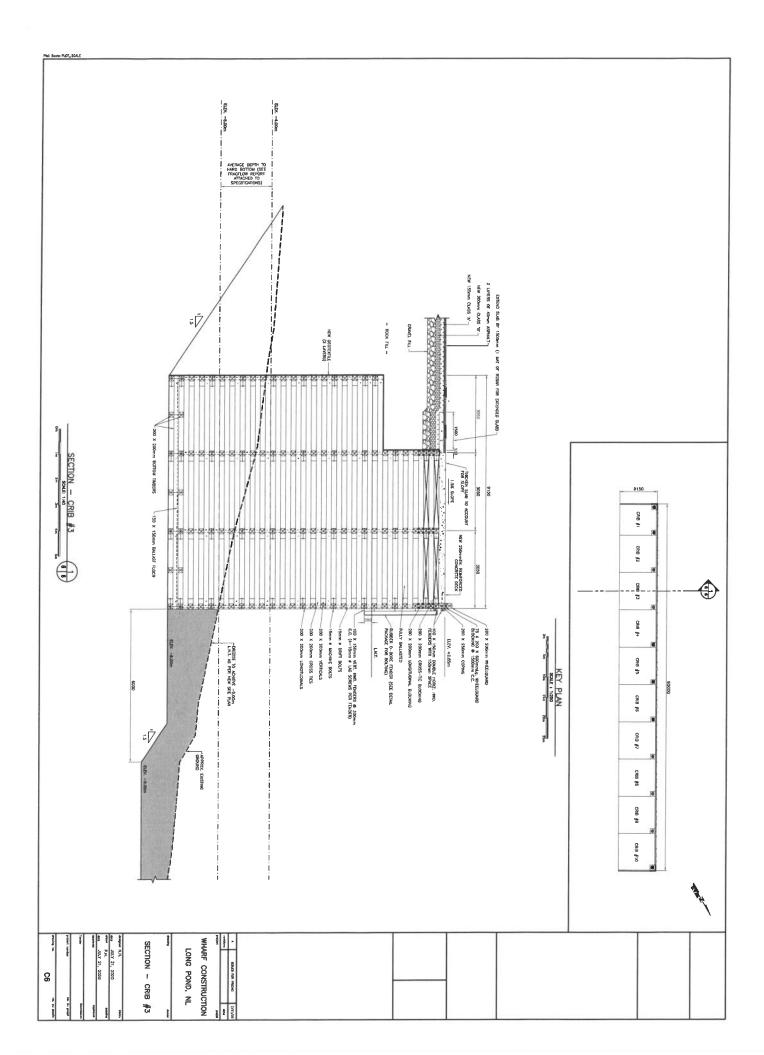


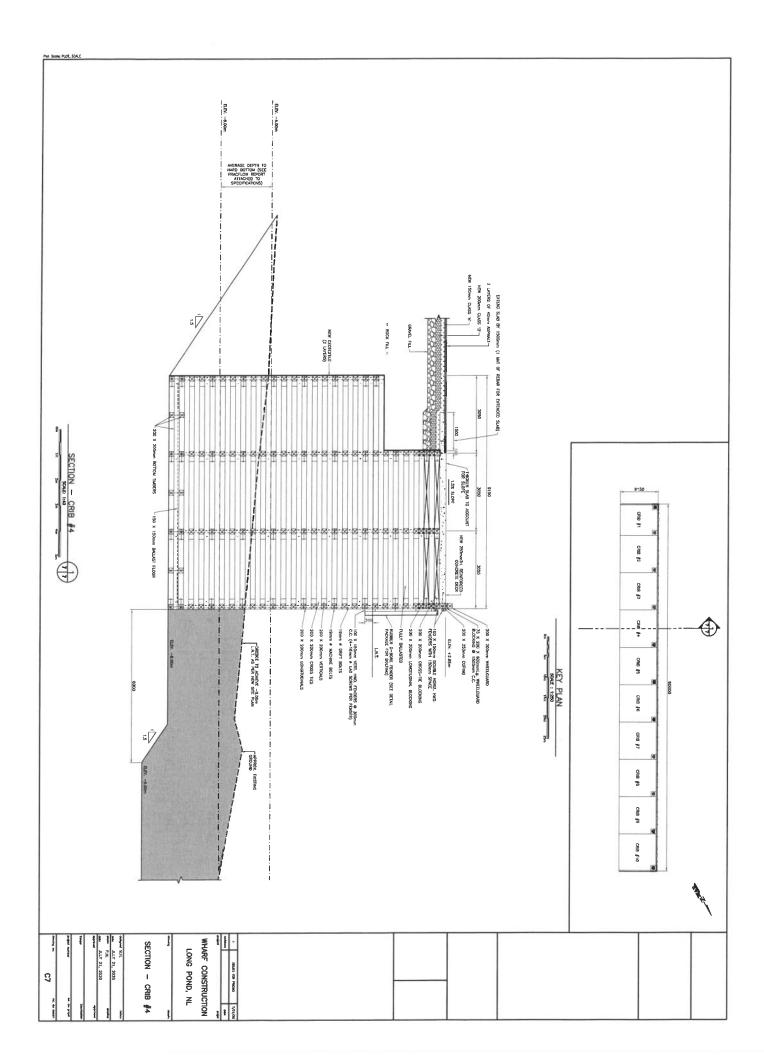


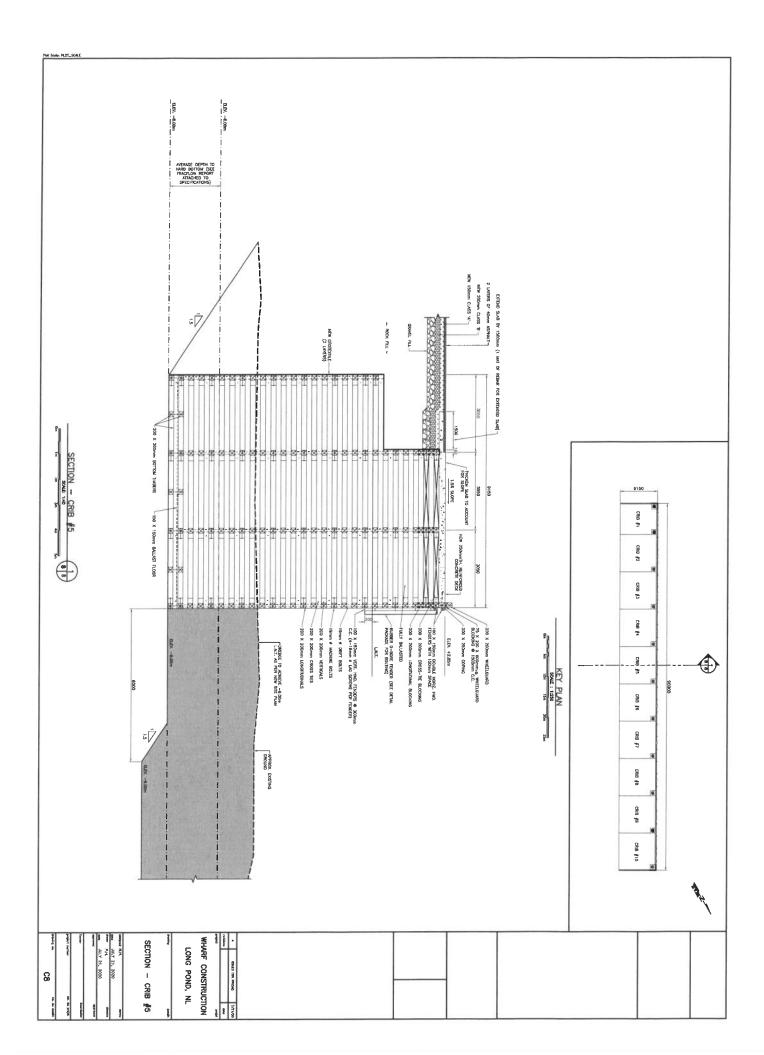


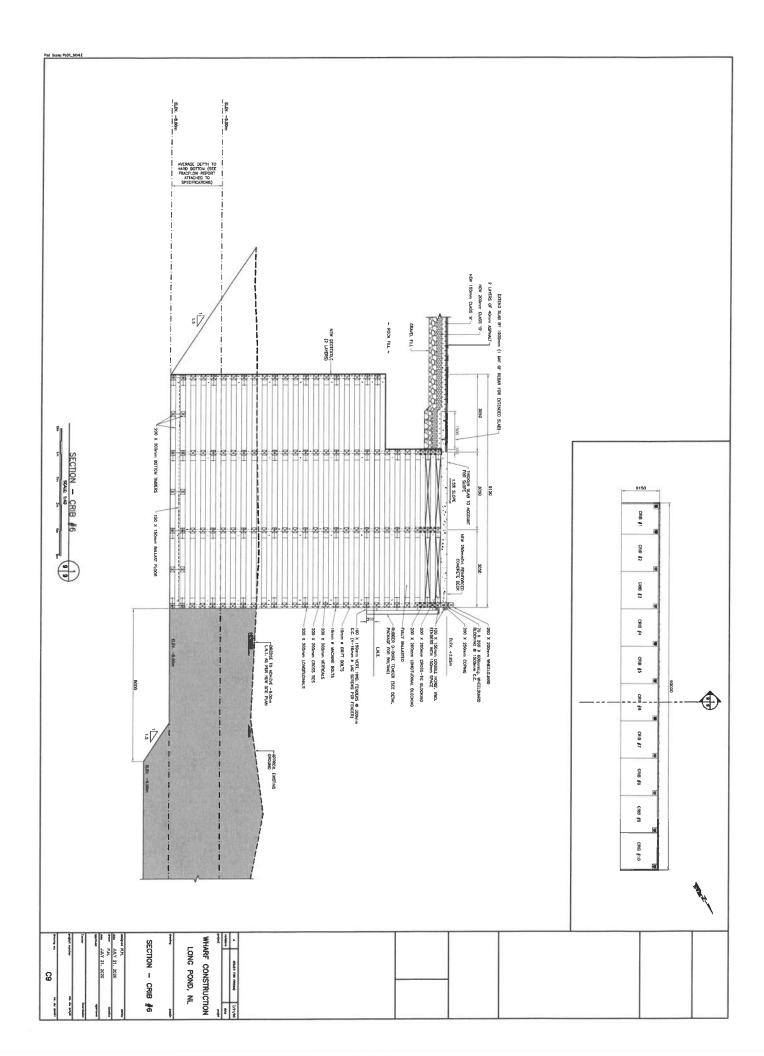


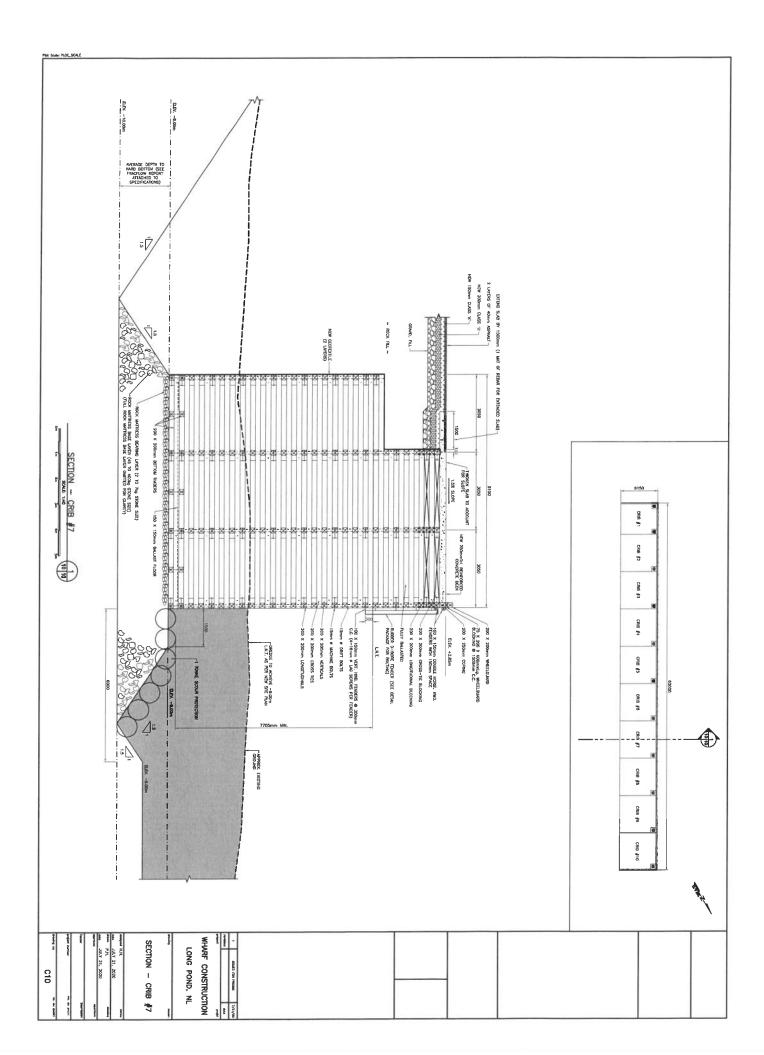


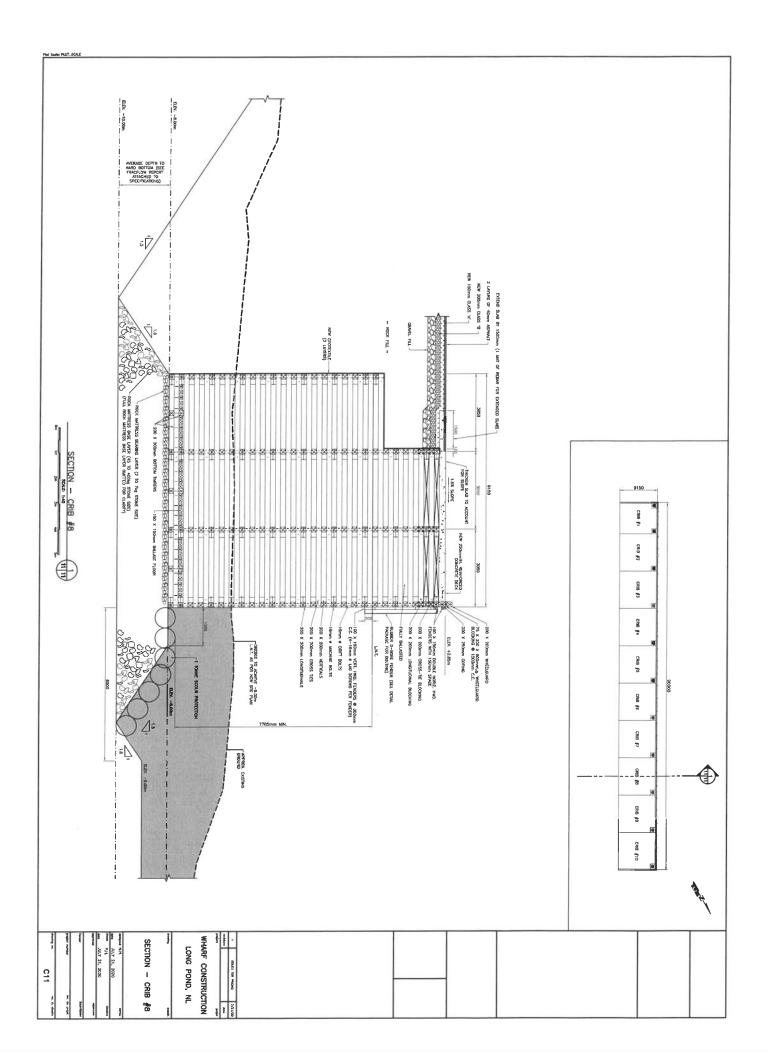


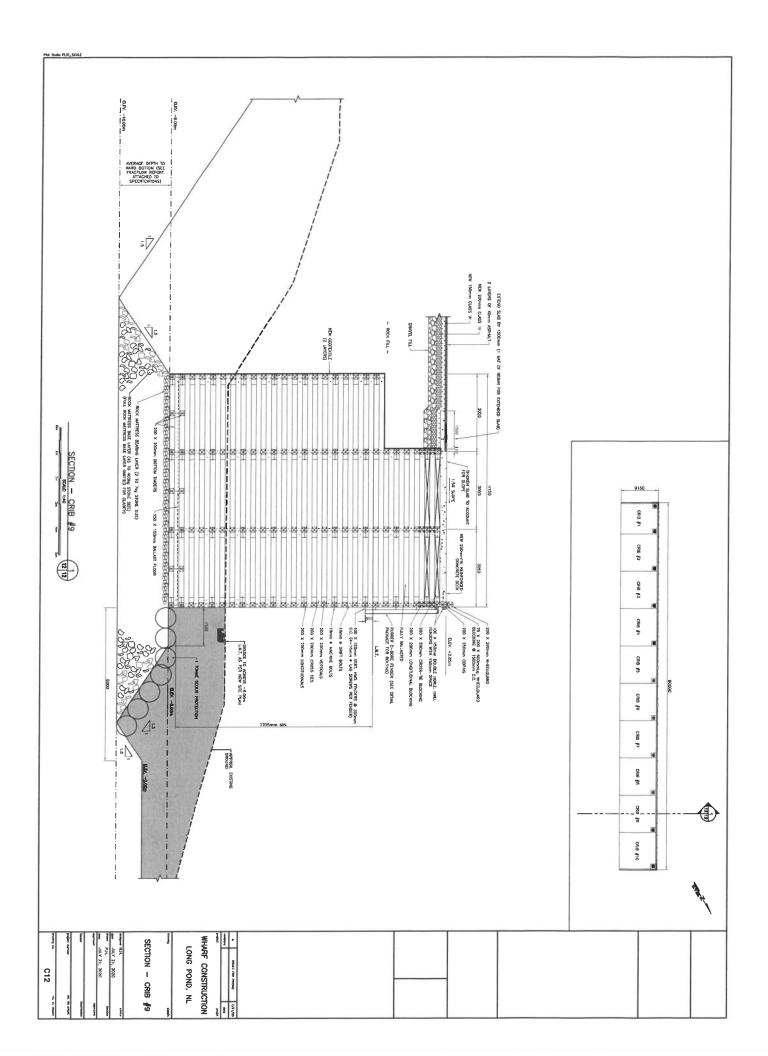


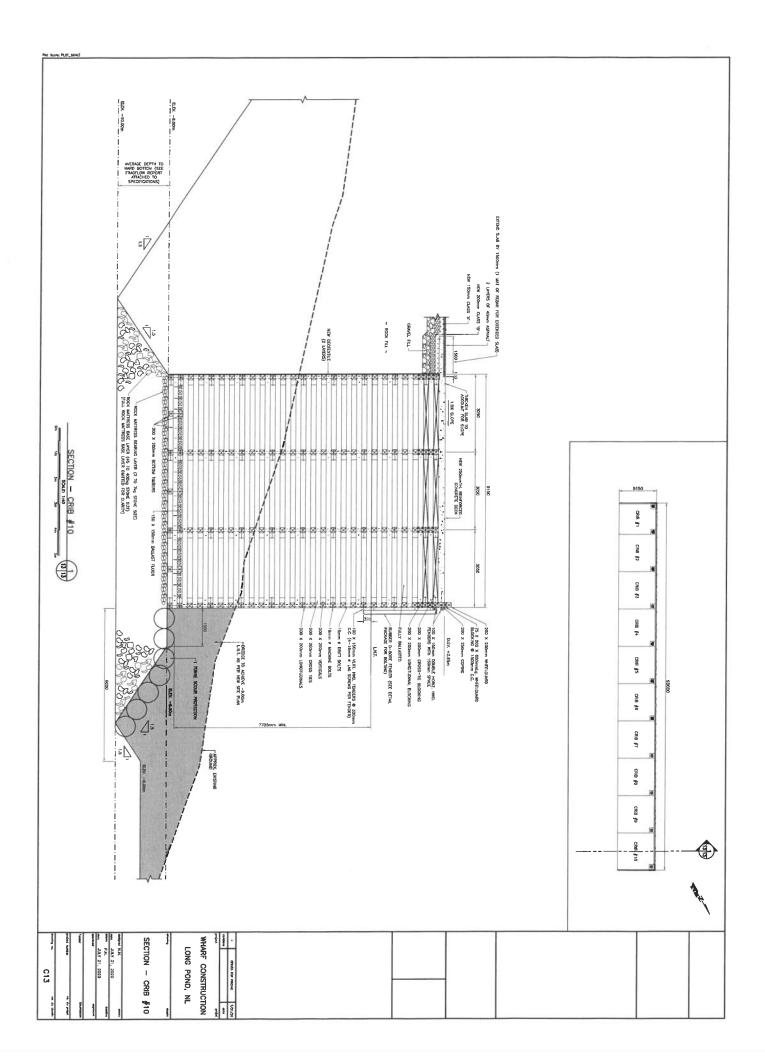












Appendix E



Long Pond Harbour Development

Stakeholder Communications Plan

This plan outlines the stakeholder engagement/communications activities that will be carried out during the decision and permitting phase of Ocean Choice's proposed Long Pond Development. A separate plan will be developed for the construction phase of the development and for when the site, wharf and cold storage is built and ready for operation. There will need to be some tactical communications with key stakeholders throughout the construction of the project.

Goal:

To create an economic hub in Long Pond to support the offshore fishing sector while being a good corporate citizen and neighbor. We are committed to working with businesses, residents and the Town Council.

Objectives:

- In light of ongoing COVID-19 pandemic restrictions find innovative ways to ensure public engagement and consultation.
- Proactively engage and consult with key stakeholders throughout the decision and permitting phase of the development and openly answer their questions.
- Communicate that Ocean Choice, through continued investment, is committed to the future of the fishery and making investments that drive economic benefits in communities throughout NL.
- Inform and engage key stakeholders in a meaningful and consultative manner that provides factual information about the development while listening to and considering their views and concerns.
- Collaborate with the Town of CBS to provide residents with pertinent and consistent information relating to the project.
- Engage Ocean Choice employees with timely information.

Key Stakeholders:

- Town of CBS Mayor, Council Members, etc.
- Long Pond Harbour Authority Staff and Board
- Local Businesses that utilize the Harbour Trinity Resources, Woodward's Oil, Country Ribbon Inc., CRH, Sunset Marina, etc.
- Federal MPs Ken McDonald
- Local MHA Barry Petten
- Recreational Boaters
- Residents (in the immediate area)
- Media
- Ocean Choice Employees

Ocean Choice Quick Facts:

 Ocean Choice is a family-owned and operated Newfoundland and Labrador company that employs over 1,700 people in 300 communities throughout the province – mostly from rural communities.

- The Company operates five fish processing plants, it operates six offshore fishing vessels, and it sources seafood from over 1900 independent fishers across the province.
- Ocean Choice has developed a strong market position through its global distribution network with sales offices in seven countries and three continents.

Long Pond Quick Facts:

- New modern facility that will increase the provinces cold storage capacity while providing local employment and spin-off business opportunities for the Town of Conception Bay South.
- Significant Local Investment: Approximately \$15 million in the start-up phase creating local job opportunities.
- New Job Creation: 30 to 40 new jobs will be created once the cold storage facility is operational.
- Spin-Off Business Opportunities: New opportunities for supply services in the area.

Long Pond Development Current Status:

- Ocean Choice is currently finalizing the business plan for the development; and a decision to proceed has not yet been made.
- The Company is working through the regulatory approval process.
- Any work that the Company carries out, either during the construction phase of the development or
 once operational, will be undertaken with the view to minimize any potential disruptions to existing use
 of the area both commercial and recreational use.
- Ocean Choice is actively meeting and listening to stakeholders in the area.

Approach & Timeline:

- Ocean Choice is committed to proactively meeting with key stakeholders located in the area of the development.
- To support more meaningful and constructive conversations with stakeholders, a targeted approach in which Ocean Choice will meet one-on-one (or in small groups) with individual businesses and citizens will be undertaken. This approach is also in line with existing COVID-19 protocols.
- Ocean Choice will also answer any questions raised by stakeholders who are interested in the project.
- Meetings with Key Stakeholders commenced the week of August 24th, 2020.

Communication Materials:

- Stakeholder Presentation
- Frequently Asked Questions
- Direct Mail
- Webpage

Activity	Description		Timeline	
External Communications				
Federal MP (Ken McDonald)	Presentation and Q&A Session with Ken McDonald.		August 28 th	
	Since the initial meeting with Ken, several follow-up conversations have taken place to provide updates and to answer questions.		Ongoing	
Area Property Owners	Several in-person and telephone meetings held with property owners in the area.		Started late August and is still ongoing.	

		1
	Direct mail sent to 240 property owners in the immediate and surrounding area of the proposed development. See Appendix A: Proposed Long Pond Development Direct Mail	Week of September 21 st
	Long Pond Harbour webpage launched. The sited includes details relating to the proposed development and also includes a FAQ section in which interested parties can submit questions. The answers to all questions are posted to this section.	Week of September 21 st
	Answering questions and posting the responses to Ocean Choice's Long Pond Development webpage.	Ongoing
Royal Newfoundland Yacht Club (Five members of the Board)	Met with 5 members of the board (Steve Chafe, Dave Young, Moya Cahill, Anderson Noel and Sean Gillespie) who were bringing forward the views of their members. Several follow-up conversations have been held with interested parties, including the Board from the Yacht Club.	September 10 th
Long Pond Harbour Authority	Ongoing updates with Jim House, Executive Director of the Harbour Authority.	Ongoing
	Presentation and Q&A session with the Long Pond Harbour Authority Board.	September 21 st
	Presentation and Q&A session with the Long Pond Harbour Authority Board – New Adjusted Plan	October 30 th
Presentation to the Conception Bay South Town Council & Development Committee	Presentation and Q&A session with the Town Council and Members of the Development Committee. (Mayor French did not attend meeting). Ocean Choice will also be available to answer questions and provide information to Council Members on an ongoing basis.	September 22 nd
Conception Bay Area	Presentation and Q&A session with the Chamber Board.	September 23 rd
Provincial Minister of	Presentation and Q&A session with Minister Bennett.	September 23 rd
Environment (Minister Bennett)		
MHA (Barry Petten)	Presentation and Q&A Session with Barry Petten.	September 25 th
Commercial Businesses in the Area	TTi Sales and Services Compass Limited GMP Auto Ltd. Trinity Resources (John Hurley) Woodward Group (Fred Constantine) PD Industries (Paul Dalton)	Started early September and still Ongoing

3

	CHR			
	Sunset Key Marina			
	Others			
Recreational Boaters	One-on-one meetings with recreational boaters that utilize	Ongoing		
	the area.			
Other Business and	Meeting with other business and community leaders from Ongoing			
Community Leaders	Conception Bay South.			
Social Media	The Company has been actively engaged and responded	Ongoing		
	with interested parties on social media, including responding to questions and misinformation being posted			
	to the Advocates for the Responsible Development of Long			
	Pond Facebook Page.			
Media Relations	Carried out several interviews with local media outlets.	Ongoing		
	Issued a News Release announcing that the Company is	October, 14 th		
	adapting its plan for the proposed development.			
	Issued a News Release announcing Ocean Choice's			
	adjusted development plan.			
Internal Communications				
Email Communication	Provided an update on the proposed development, which	Week of		
	included a copy of the Direct Mail as well as a link to the	September 21 st		
	website.			
		Ongoing		

Appendix F

Stantec Consulting Ltd. 141 Kelsey Drive, St. John's NL A1B 0L2



September 15, 2020 File: 121623320

Attention: Mr. Neil Hunt AFN Engineering Inc. 29 Brad Gushue Crescent St. John's, NL A1H 0A3

nhunt@afnengineering.ca

Dear Mr. Hunt,

Reference: Infill for the New Cold Storage Building and Associated Dredging, Long Pond, Manuels, NL (Rev. 2)

INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by AFN Engineering Inc. (AFN) to provide geotechnical design input for the proposed infilling and construction of a new cold storage building in Long Pond Harbour, Manuels, NL. The following documents were provided by AFN to Stantec for review:

- 1. "Geotechnical Factual Report, Long Pond, Manuels, NL" by Fracflow Consultants Inc., June 2019.
- 2. "Technical Memorandum, Rock Properties and Block Sizes of Waste Rock Slopes Trinity Resources Mine Site, Long Pond, CBS, NL" by Fracflow Consultants Inc., February 2019.
- "OCI Wharf and Uplands Construction, Long Pond, CBS, NL, Rock Placement Plan" by RJG Construction Ltd., July 23, 3030.
- 4. "Pallet Layout" by Ocean Choice International, August 11, 2020.

The scope of work specified by AFN is to address dredging and infilling associated with the proposed cold storage building. This letter report presents Stantec's recommendations for dynamic compaction alternative for site development based on the conference call of August 19, 2020 and supersedes our preliminary letter issued on August 18, 2020.

BACKGROUND

The proposed land reclamation and wharf construction in the Long Pond Harbour consists of the construction of a 90 m long marginal timber crib wharf, land reclamation for the new OCI building and associated parking area and roadways.

The geotechnical investigations were carried out by Fracflow in 2018 and 2019 for the proposed development and primarily consisted of performing Dynamic Cone Penetration testing (DCPT). Figure A1 from Fracflow factual report (2019) shows the proposed development and locations of DCPT and boreholes performed in 2018 and 2019.

Reference: Infill for the New Cold Storage Building and Associated Dredging, Long Pond, Manuels, NL (Rev. 2)

The soil conditions within the building footprint can be inferred from DCPT and boreholes as noted in Table 1 below. In the Fracflow (2019) report, very soft soils were inferred to have a DCPT blow count of 1 or less for 150 mm penetration. While firm soils were inferred to have a blow count of great than 5, but less than 15 for 150 mm penetration. The hard material was classified on the basis of blow counts of greater than 15 blows for 150 mm penetration. Stantec has interpreted the top of hard layer ignoring upper zones of material with 15 blows per 150 mm to account for friction mobilized on the rods which results in higher penetration resistance. All elevations are with respect to LNT.

Table 1 Inferred Subsurface Conditions – Cold Storage Building

DCPT	Harbour Bottom (Elevation)	Top of Hard Layer (Elevation)	End of Hold (Elevation)
9	-1.26 m	-5.0 m	-5.5 m (refusal)
10	-1.07 m	-4.4 m	-5.33 m (refusal)
11	-4.15 m	-5.5 m	-6.5 m (refusal)
12	-1.22 m	-8.8 m	-9.3 m (refusal)
13	-1.49 m	-8.8 m	-9.0 m (refusal)
14	-1.25 m	-6.2 m	-6.83 m (refusal)
16	-0.944 m	-8.6 m	-9.04 m (refusal)

DREDGING, ROCKFILL PLACEMENT AND COMPACTION

It is recommended that all ocean bottom soils to the top of hard layer should be dredged. To account for the removal of all very soft and firm soils within the zone of stress influence of the building, the footprint should be increased on all sides by 10 m for dredging and replacement with rockfill.

It is recommended that well-graded 200 mm minus rockfill material be placed below elevation +1.0 m. The rockfill materials can be placed to this elevation by end-dumping and then densified using the "dynamic compaction" method. The thickness of loose rockfill below +1.0 m elevation is estimated to vary between 7.5 m and 12 m with an approximate average thickness of 10 m. The dynamic compaction procedure consists of repeatedly raising and dropping a heavy weight on a grid pattern over the area to be compacted. The degree of densification achieved is directly related to energy applied per drop, grid spacing and number of drops at each grid point.

Our preliminary analysis indicates that effective compaction can be achieved with an 18-tonne tamper with a drop height of 17 m. For the first pass of dynamic compaction, a grid pattern of 6 m x 6m is estimated with a final spacing of 3 m x 3m after second pass. For the first pass 8 to 10 drops at each grid point are estimated followed by 5 to 7 drops during the second pass. The magnitude of settlement at grid points needs to be monitored to determine if maximum compaction is achieved. The ground vibration and noise levels should be monitored to ensure that the work is carried out to meet the environmental guidelines. The available data from case studies indicates that peak particle velocities at 10 m from the source of dynamic compaction point would be in the range of 10 mm to 20 mm/second. The data on noise levels due to dynamic compaction is rather limited but is estimated to be 80 to 90 dB at 30 m to 40 m. These estimated

September 15, 2020 Mr. Neil Hunt Page 3 of 3

Reference:

Infill for the New Cold Storage Building and Associated Dredging, Long Pond, Manuels, NL (Rev. 2)

values need to be reviewed once the details of the tamper, height of fall and number of drops at each grid point have been finalized.

The 200 mm minus rockfill material above elevation +1.0 m should be placed in 300 mm thick lifts and compacted to achieve 90% of relative density using a heavy highway vibratory compactor (10 tonne) to reach an elevation of +2.4 m. The top 600 mm above elevation +1.4 m should consist of 150 mm minus material placed in 300 mm lifts and compacted to achieve 90% relative density.

The entire footprint of the building at elevation 3.0 m should be surcharged with a 3 m thick fill pad and settlements monitored to confirm the uniformity of compaction and to mitigate estimated settlements under slab loading reported in the following section.

SETTLEMENT ANALYSIS - SLAB-ON-GRADE/FOOTING OPTION

The settlement of the well compacted rockfill placed to a final elevation of +3.0 m is estimated to be 15 mm under a uniform surcharge loading of 70 kPa from the floor loading of cold storage building. With placement of 3 m surcharge, the slab will settle less than 15 mm under final slab loading. In addition, long term creep of rockfill over a period of 20 years is estimated to be 15 mm.

The strip/spread foundations should be structurally separated from the slab and designed for ULS bearing resistance of 250 kPa and SLS pressure of 150 kPa. The footings should be constructed below anticipated frost depth. Settlements of the order of 25 mm should be anticipated for the recommended SLS pressure.

This report was prepared by Arun Valsangkar, Ph.D., P.Eng. and reviewed and approved by the undersigned. Should any additional information be required, please do not hesitate to contact our office at your convenience.

Regards,

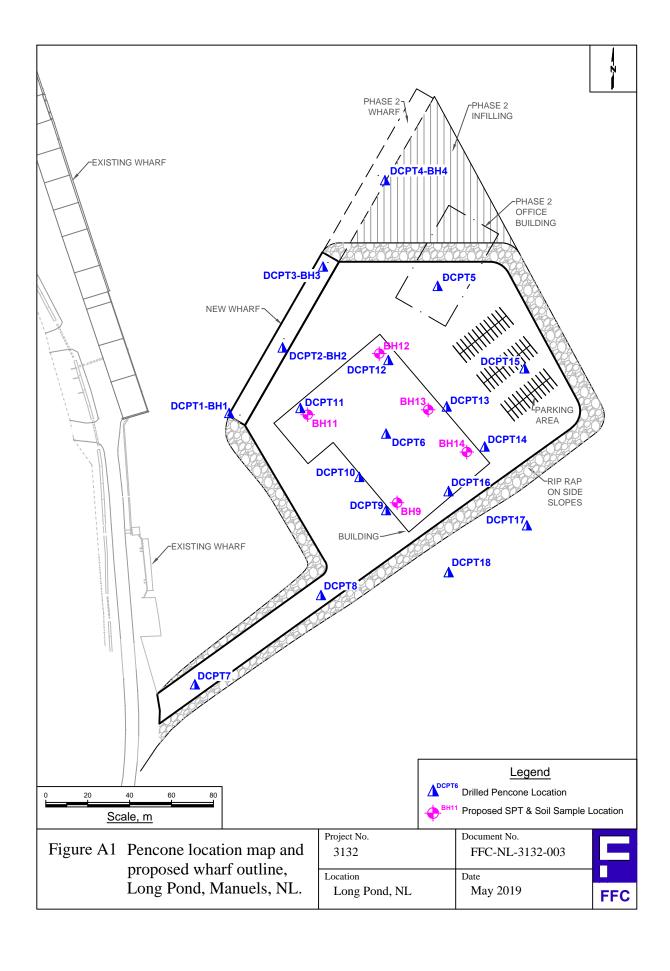
Stantec Consulting Ltd.

Sterling Parsons, M.Eng., P.Eng.

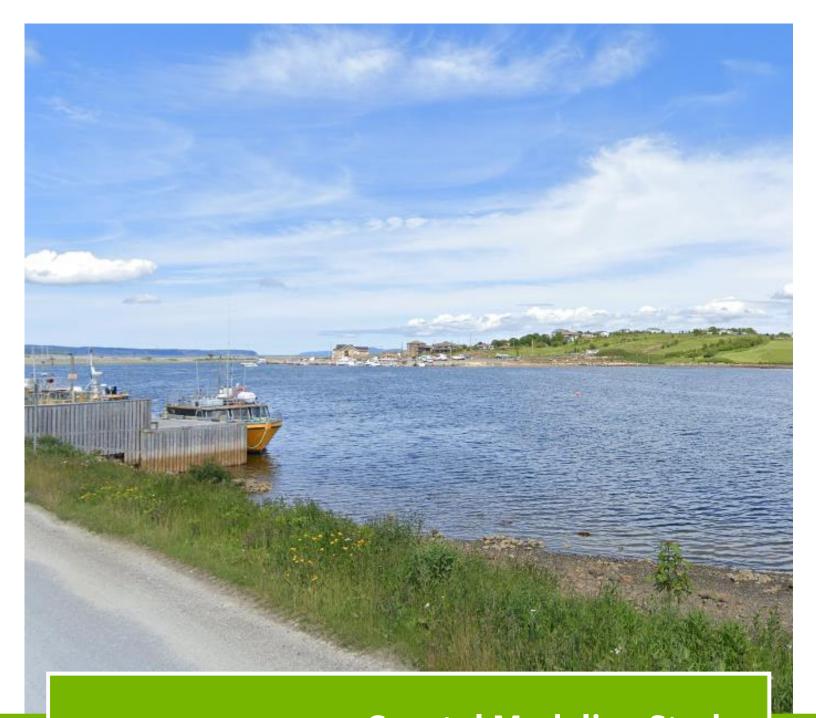
Principal, Senior Geotechnical Engineer

Direct: (709) 576-1458 Mobile: (709) 682-1352 Sterling.Parsons@stantec.com

Attachments: Fracflow Figure A1



Appendix G



Coastal Modeling Study Ocean Choice International Development Long Pond, Newfoundland





Fishing means the world to us."

1.0	Final Report		Vincent Leys	Oct. 29, 2020	Danker Kolijn
	Issue or	Revision	Reviewed By:	Date	Issued By:
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October 29, 2020

Blaine Sullivan, President Ocean Choice International 1315 Topsail Rd St. John's, NL, A1B 3N4 T 709.782.6244 bsullivan@oceanchoice.com

Dear Mr. Sullivan:

RE: Coastal Modeling Study for the Ocean Choice International Development at Long Pond, Newfoundland

CBCL Limited (CBCL) is pleased to present our coastal modeling study to investigate potential impacts of a proposed land reclamation for the future Ocean Choice International (OCI) wharf and cold storage facility at Long Pond Harbour in Conception Bay South, Newfoundland.

As Atlantic Canada's largest and most experienced professional coastal engineering consultant, we are pleased to provide our services for the OCI development project at Long Pond. For reference, please find our extensive team experience and resumes appended to this report.

Should you have any questions regarding the content of this report, please contact the undersigned.

Yours very truly, CBCL Limited

Prepared By:

Danker Kolijn, M.Sc., M.Eng., P.Eng. Group Lead, Coastal Engineering

Direct: 902-421-7241, Ext. 2586

E-Mail: dkolijn@cbcl.ca

Reviewed By:

Vincent Leys, PMP, M.Sc., P.Eng.

Senior Coastal Engineer

Direct: 902-421-7241, Ext. 2508

E-Mail: vincentl@cbcl.ca

cc: Neil Hunt, P.Eng., M.A.Sc., nhunt@afnengineering.ca, tel: (709) 748-7175

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- A MSC50 Offshore Wind and Wave Data
- B Regional Sea Ice Data
- C Corporate Information & Resumes



Chapter 1 Introduction

1.1 Purpose of the Study

Ocean Choice International (OCI) are considering a development in Long Pond Harbour which consists of a crib wharf and infilling for a parking lot and cold storage building. As part of the Town of Conception Bay South's requirement for a Land Use Impact Assessment, OCI have been asked to provide information on:

- Wave agitation in and around long pond harbour as a result of the OCI development;
- Potential for erosion and sedimentation from harbour narrowing;
- Impacts the infilled area may have on currents within the harbour, particularly where the harbour will be narrowed between the east shoreline and the east side of the infilled area;
- Potential flooding risks and ice jam formation in and around long pond harbour as a result of the OCI development; and
- Information on water levels, tides and sea level rise.

1.2 Site Description

Long Pond Harbour is situated on Newfoundland's Avalon Peninsula on the shore of Conception Bay. The OCI project site is located in the Long Pond Harbour within the limits of the development parcel (Figure 1-1) between the Port of Long Pond and Sunset Key Marina. The existing harbour is dredged to a depth of -9.0 m CD and protected by two breakwater structures located at the entrance. The southern half of the harbour is relatively shallow, ranging in depth from -1.0 m to -2.0 m CD. The Long Pond Harbour basin is protected by a barrier beach systems, which extends eastward to the Royal Newfoundland Yacht Club which is situated in the adjacent Long Pond basin.

Two streams divert into the Long Pond Harbour (LPH) from the south (Conway's Brook) and southwest (Sobey's Stream). The future location of the OCI development is depicted in Figure 1-2.



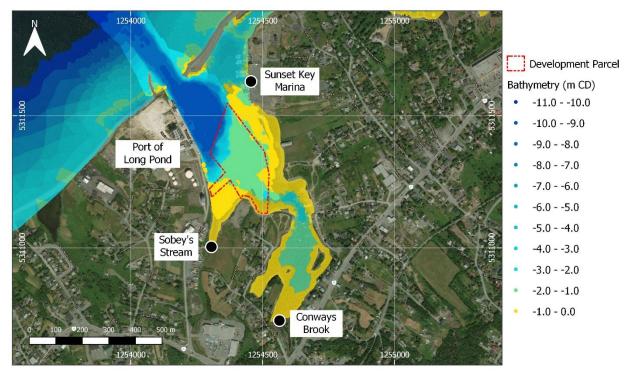


Figure 1-1: Site map of Long Pond & OCI Development Parcel



Figure 1-2: Locations of Interest in the Long Pond Harbour

1.3 Scope of Work

To resolve the requirements set out by the Town of Conception Bay South, the coastal modeling study includes three (3) main tasks:

WAVE MODELING

CBCL previously completed a wave study in the Long Pond Harbour Authority (2018) for which a calibrated numerical wave model was developed in the DHI Mike21 modelling



- suite. In this study we use the calibrated wave model will to simulate 2D wave fields within the harbour basin with and without the planned OCI development.
- Outputs for a 1-year return period storm are compared to existing wave conditions in the basin and differences documented, notably from potential reflection coming from the new infill.
- The effect of sea level rise on the wave climate are investigated with the wave model.

HYDRODYNAMIC MODELING

- In this report we present harbour hydrodynamics using the Mike21 HD modelling suite to describe tidal currents in the harbour with and without the proposed OCI development.
- Existing and anticipated tidal currents are presented and compared to assess navigation impacts.
- ▶ There is concern that the project may impact potential flooding in the lower pond, notably from combined high runoff and ice jams. Ice jam potential is investigated and potential risks identified.

SEDIMENTATION POTENTIAL

- This report provides insight to sedimentation and erosion potential using the output from the current (HD) models.
- A comparison or pre- and post-project tidal current conditions will identify areas of potential weakening of tidal currents, which may encourage sedimentation if there is suspended sediment in the water column.



Chapter 2 Background Analysis

The following section outlines the background information and data to support the numerical modelling investigation for the Land Use Impact Assessment, and consists of:

- OCI development summary,
- Description of bathymetric data sources,
- Presentation of design water levels including sea level rise,
- Offshore wind and wave climate schematization, and
- Winter icing impacts in the inner harbour.

2.1 OCI Development Summary

OCI plans to develop the site as depicted in Phase 1 of Figure 2-1. If OCI requires additional berthage in the future, additional modelling of Phase 2 has been completed for comparative purposes (Figure 2-1). At this time, it is not anticipated that Phase 2 will be developed, and model results are provided for demonstration purposes only. In summary, each phase consists of:

- ▶ PHASE 1: A land reclamation of 17,000 m², accessible via a corridor towards the west. The area is design for parking, a cold storage building and berthage for shipping along a 90m long quay wall. The reclaimed area will be built up to an elevation of approximately +3.5 m CD, and protected on all sides with an armour stone revetment. A navigation channel for small vessels will be dredged along the eastern extents of the reclaimed area to a depth of -1.2 m CD.
- **PHASE 2:** Would add an extra 90 m of quay wall for a total of 180 m and some additional land reclamation.

Both phases are assessed in this report.



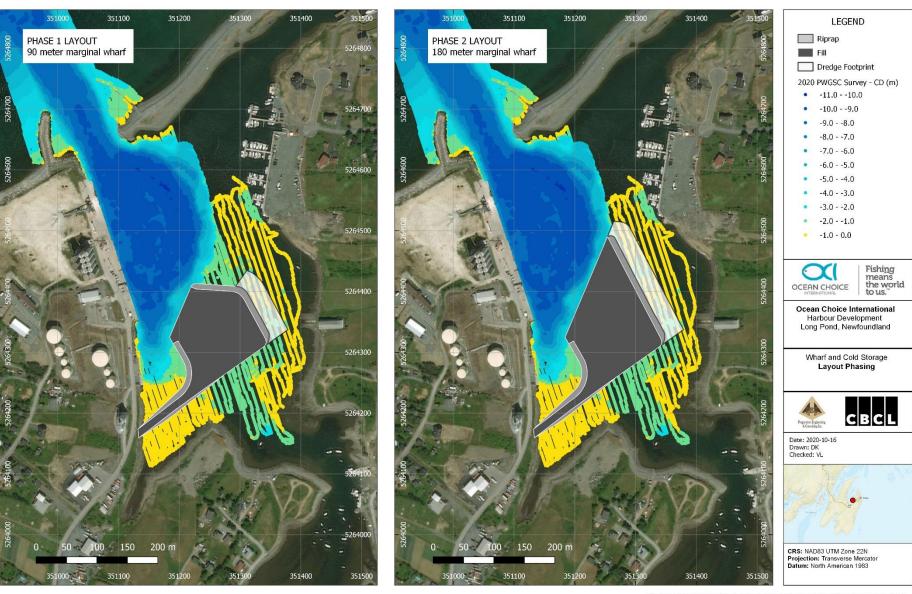


Figure 2-1: Proposed OCI Development Layout 1 and Layout 2



2.2 Bathymetric Data Consolidation

Three sources of bathymetric data are used in this assessment, these are:

- ▶ DFO-SCH data collected in July 2018 and July 2020 using a single-beam survey method, completed with a real time DGPS using a Hypack 2013″A″ and Navi Sound 210 Echo Sounder, where all soundings & elevations are reffered to CHS BM 90F9042 Elev. +3.448m. This data is deposited in Figure 2-1.
- Data collected by CBCL in 2015 using a single-beam survey method, where all soundings & elevations are reffered to CHS BM 90F9042 Elev. +3.448 m.
- For numerical modelling purposes, offshore hydrographic data is supplemented with nautical chart information obtained from the Canadian Hydrographic Service (CHS).

2.3 Water Levels

2.3.1 Tides and Storm Surge

Design water levels at LPH require understanding of local tides, storm surge, and future sea-level rise. For conceptual design purposes, tidal elevations were sourced from the 2017 Canadian Tide and Current tables produced by the Canadian Hydrographic Service (Table 2-1).

Storm surges are created by meteorological effects on sea level, such as wind set-up¹ and low atmospheric pressure, and can be defined as the difference between the observed water level during a storm and the predicted astronomical tide. The closest long-term record

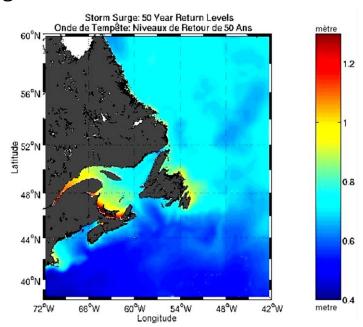


Figure 2-2: Environment Canada Storm Surge Predictions (50yr RTP)

of water levels is available at St. Johns (ECCC Station: 905). This record is located on the Atlantic coast and surge residual values would differ significantly from those observed at the southern limit of the more sheltered Conception Bay.

As such, the Environment Canada surge analysis of the Canadian East coast was used in this study. The model was validated using a combination of historical tide gauge observations and water level modeling tools assembled by Bernier et Thompson (2006).

¹ Wind set-up refers to the increase in mean water level along the coast due to shoreward wind stresses on the water surface.



Output from this analysis is presented in Figure 2-2 for a 50-yr return period surge simulation.

Using the Environment Canada Storm Surge predictions and the HHWLT elevation, extreme values for design and numerical modelling purposes are presented in Table 2-1.

Table 2-1: Extreme Water Levels and Tidal Elevations

Extreme Water Levels [m CD]					
Return Period	Extreme Value [m CD] [HHWLT + Surge]				
100-yr	2.60				
50-yr	2.50				
10-yr	2.25				
1-yr	2.00				
Tide [m CD]				
HHWLT	1.5				
HHWMT	1.2				
MWL	0.6				
LLWMT	0.4				
LLWLT	0.1				

2.3.2 Sea Level Rise

A typical design life for coastal infrastructure is 75 years for a breakwater type structure and 40 years for a wharf structure. A mid-life refurbishment is typically performed for each type of structure. For long-term planning purposes, a longer horizon may have to be considered, at least to year 2100. By that time, the site will have experienced significant Sea Level Rise (SLR) caused by climate change. As a result, extreme water levels with a low return period today will be very common in a few decades.

Consensus Intermediate SLR Projections

The Intergovernmental Panel on Climate Change's Fifth Assessment Report (IPCC AR5 2013) estimated that the upper-bound Global Mean SLR could **be in the order of 1.0 m by year 2100**. This projection using process-based models was for Representative Concentration Pathways RCP 8.5 high-emission scenario. To derive Relative SLR, the Department of Fisheries and Oceans Canada (DFO) then developed the online Canadian Extreme Water Level Adaptation Tool (CAN-EWLAT), based on work by James et al. (2014) accounting for local factors. CAN-EWLAT is a science-based planning tool for climate change adaptation of coastal infrastructure related to future water-level extremes, based on IPCC AR5 projections improved upon by incorporating information on land subsidence measured with high-precision GPS instruments. It was developed to provide SLR allowances for DFO harbours across Canada. Allowances are estimates of changes in the elevation of a site that would maintain the same frequency of inundation that the site has experienced historically. Updated global estimates from the IPCC's Special Report on the Ocean and



Cryosphere in a Changing Climate (SROCC report, Oppenheimer et al 2019) remain generally consistent with AR5.

Table 2-2: CAN-EWLAT IPCC 2013 RCP8.5 Scenario – Long Pond Harbour

Climate		CAN	-EWLAT,	Long P	ond Har	bour, NI	LD - SLF	R [m]	
Scenario	2020	2030	2040	2050	2060	2070	2080	2090	2100
Model RCP8.5	0.05	0.12	0.18	0.28	0.38	0.5	0.65	0.8	0.97

Upper-End Projections with High Uncertainty

Potential rapid Greenland and West Antarctic Ice Sheet (AIS) reduction may add a significant amount to long-term SLR in addition to the AR5 projections. The modeled AIS contribution from the 2019 SROCC report is an extra 0.12 m (0.03–0.28) by year 2100, with acknowledgment that results from recent probabilistic and semi-empirical projections are much higher, such as DFO Han et al. 2016, or NOAA Sweet et al. 2017. These upper-end SLR projections are based on probabilistic projections of the factors driving GMSL rise, which is different than the process-based model approach from IPCC AR5 or SROCC. The Greenan et al. report for Canada (2018, based on James et al. 2014) propose to add an additional 0.65 m by 2100 of Global Mean SLR to AR5 RCP8.5.

In conclusion, a SLR of at least 1.0 m is likely to occur within the coming century, even if the timeline remains uncertain. As a result, maintenance intervals for coastal infrastructure are expected to shorten, and flooding probabilities will significantly increase. The design should allow flexibility to accommodate future upgrades for adaptation.

2.4 Wind and Wave Climate

Wind and wave inputs to the study are based on a recent 61-year wind and wave hindcast referred to as 'MSC50'. The MSC50 project was funded by the Climate Research Division of Environment Canada and the Federal Program of Energy Research and Development and is provided for this study by Environment Canada. This dataset spans the period January 1954 to December 2018, and contains hourly time series of wind (speed, direction) and significant waves² (height, period, direction). The MSC50 hindcast was developed by Oceanweather Inc. and is distributed by Environment Canada (Swail et al., 2006). Statistics are presented in Appendix A and indicate that the prevailing waves are from the north and northeast.

² The significant wave height (Hsig) is the common parameter for characterizing the energy in a wave field. Hsig represents the average of the third highest waves over a given time period, and is a good approximation of the 'typical' wave height.



A Peak-Over-Threshold³ (POT) analysis was performed to isolate the largest storm events in the MSC50 data set at a point just north of Conception Bay. The relevant (most likely to present extreme conditions) wave incidence angles were selected for the POT. At the mouth of Conception Bay the offshore MSC50 wave height data was split into directional bins (45°) and analyzed in a clockwise direction from 0° – 360°. The output from the POT was then used to derive wave height return periods⁴ (1-, 10-, 100-yr) using an extreme-value-analysis (EVA) where the POT data is fitted to a Weibull distribution. The results of the EVA for a 1-year return period (RTP) event with additional parameters (water levels & wind) are presented below (Table 2-3).

Table 2-3: Multidirectional offshore MSC50 EVA for a 1-year return period

Wave Direction	Degrees	Wave Height [Hs -m]	Peak Wave Period [Tp - sec]	Wind Speed [m/s]	Wind Speed [km/h]
North	0	3.41	11.55	17.71	63.8
Northeast	45	3.30	12.22	16.36	58.9
East	90	1.81	11.74	14.9	53.6
South	180	2.08	7.67	17.93	64.5
Southwest	225	2.56	6.29	19.43	69.9
West	270	2.59	6.07	20.11	72.4
Northwest	315	2.73	6.59	18.62	67.0
Southeast	135	1.80	8.75	16.63	59.9

2.5 Winter Sea Ice

During the winter months the Long Pond Harbour is occasionally exposed to seasonal winter sea ice conditions. From photographic evidence and anecdotal information it is noted that:

- The harbour is predominantly open and little to no ice formation occurs in the northern half of the harbour near the marine terminal;
- The southern extent of the harbour occasionally freezes up as sheet ice, usually as a thin layer; and
- Some sea ice occasionally penetrates the harbour entrance, this is usually in the form of "grey-ice" and contains small bergy bits. An image in the harbour of this phenomenon is depicted in Figure 2-3.

 $^{^4}$ The N-year return value represents the value that is exceeded on average once every N years.



³ The 'Peak-Over-Threshold' procedure selects statistically independent storm peaks occurring more than 48 hours apart. An extreme value distribution is then fitted to the population of storm peaks for extrapolating extreme events and their associated return periods.

According to the Government of Canada sea ice climatic atlas (Appendix B), which uses a 30-year ice record (Env. Canada, 2013), offshore sea ice conditions at LPH can be characterized by:

- SEA ICE TYPE: Offshore sea ice at LPH predominantly consists of "grey-ice", which can be described as young ice which is 10-15 cm thick, less elastic than nilas ice and breaks on swell. It usually rafts under pressure. The ice depicted in Figure 2-3 is a combination of grey-ice and slightly larger grey-white seasonal ice.
- OFFSHORE ICE COVERAGE: Offshore grey-ice in Conception Bay South during the most severe sea ice conditions can be expected to occur 15-30% of the time during the month of March, based on a 30-yr sea ice observation record (1981 2010).



Figure 2-3: Long Pond Harbour Grey
Sea Ice Drifts

The presence of ice in LPH is of interest due to

Sea Ice Drifts

the potential of ice jam formation. An ice jam is a stationary accumulation of ice that restricts flow. Ice jams can cause considerable increases in upstream water levels, introducing potential flood risk. The types of ice jams include freezeup jams, made primarily of frazil ice; breakup jams, made primarily of fragmented ice pieces; and combinations of both. The types of ice as described by USACE and their relationship with ice jams (USACE, 2005) are:

- ▶ SHEET ICE. The ice that forms in calm water, such as lakes or reservoirs, or in slow-moving river reaches where the flow velocity is less than 0.5 m/s (~1 knot), is termed sheet ice. Ice crystals formed at the water surface freeze together into skim ice that gradually thickens downward as heat is transferred from the water to the air through the ice layer. Sheet ice usually originates first along the banks and expands toward the center of the water body.
- **FRAZIL ICE.** Frazil ice consists of small particles of ice formed in highly turbulent, supercooled water, such as river rapids or riffles, during cold conditions when the heat loss from the water to the atmosphere is very high. Frazil particles join together to form flocs that eventually rise to the surface where they form frazil pans or floes. Frazil is often described as slush ice because of its appearance.

At LPH the most commonly observed type of ice in the southern portion of the harbour near the two (2) water courses (Conway's Brook, and Sobey's Stream) is sheet ice, which forms due to the very low current velocities (< 0.5 m/s, < 1 knot). In the northern portion of LPH the more common type of ice is grey and white-grey seasonal sea ice which floats into



the harbour as small bergy bits. Frazil ice is unlikely to form in the harbour due to presence of warmer sea water, and slow currents. Ice jams are predominant formed in the presence of frazil ice and require a combination of conditions including; a shallow bed, a gradient or slope, and a series of constrictions. The potential for ice jam formation as a result of the land reclamation, and potential flood impacts from the two water courses behind an ice jam formation, is further assessed in Section 3.3.



Chapter 3 Numerical Modelling

Numerical models are a valuable tool in wave agitation, hydrodynamic and sedimentation studies. Several models can be used to investigate existing and projected conditions in the LPH basin. Typically the project requirements dictate the types of models that are utilized in a study. In this study we use the Danish Hydraulic Institute (DHI) 2020 model release of the MIKE 21modelling suite. Both a Spectral Wave (SW) and Hydrodynamic (HD) model will be used to investigate wave agitation and hydrodynamics for existing conditions and the proposed layouts. Model type and application areas are summarized in Table 3-1, with associated key inputs and outputs.

Table 3-1: Summary of Models Applied in Study

AREA OF APPLICATION	MODEL	OBJECTIVE	INPUTS & CALIBRATION	OUTPUTS
Regional wave transformati on, wind wave growth.	Spectral wave model DHI MIKE21 SW.	Comparison of wind wave agitation in LPH with and without the OCI facility.	 MSC50 hindcast CHS tide tables CECCC storm surge modelling 2018 CBCL wave monitoring. 	Wave climate in LPH with and without OCI facility.
Water levels and tidal currents and sediment.	Hydrodyn amic model MIKE21 HD.	 Determine Water levels and current speeds with and without OCI facility. Use current speeds to determine sediment transport dynamics. 	DFO Webtide prediction water levels.	Water levels and currents with and without OCI facility.

The following information is presented in this chapter:

- **SPECTRAL WAVE MODELLING:** a wave calibrated model is used to compare wave conditions throughout LPH with and without the OCI facility.
- ► HYDRODYNAMIC MODELLING: A model driven by tidal currents is used to investigate changes to currents in the LPH as a result of building the OCI facility. Localized changes



- to currents can impact navigation, sedimentation (scour or deposition of sediment), and the formation of seasonal sea ice.
- ▶ **ICE JAM POTENTIAL:** Changes to the LPH may introduce the potential for ice jams and flooding, as a result of outflow blockage from Sobey's Stream and Conway's Brook. Ice jam potential is discussed and risks identified.

3.1 Spectral Wave Model

The computationally efficient MIKE 21 SW model was used in fully spectral mode with a quasistationary time-domain approach (i.e. steady state) to generate a regional wave climate in Conception Bay. The model simulates the following physical phenomena:

- Refraction and shoaling due to depth variations.
- Dissipation due to depth-induced wave breaking A typical breaking coefficient of 0.8 was assumed (i.e. the ration of breaking wave height / water depth).
- Dissipation due to bottom friction (a typical bottom roughness of 0.04 m was assumed).
- Dissipation due to white-capping.
- One-time reflection from coastal structures (wave energy buildup from multiple reflections cannot be modeled).
- Non-linear wave-wave interaction.
- Wind-wave growth (the uncoupled formulation recommended by Danish Hydraulic Institute (DHI) for small-scale coastal applications was used).

The Mike21 SW model uses a triangular unstructured mesh, which has the advantage of resolving nearshore areas of interest with very high levels of detail and precision, whereas deeper offshore areas are resolved at a lower resolution. Such a model configuration is computationally cheaper, yet doesn't compromise nearshore details such as berths and breakwater structures, where shoreline reflection occurs. The model includes both triangular and rectangular features, where triangles are a suitable structure for resolving complex nearshore features and infrastructure, and rectangles offer improved performance in areas such as the harbour entrance and channel east of the proposed OCI development.

3.1.1 Model Calibration

The SW model is calibrated using two (2) RBR wave gauges deployed on October 12th, 2018, outside and inside the harbour basin. The instruments were recovered on November 21st, 2018 after a large storm event which was recorded on November 15th to 16th. The following observations were made from the data:

During the deployment, one large storm event was observed (H_{sig} > 1.0 m outside the harbour), while multiple smaller storms were also observed (H_{sig} > 0.5 m outside the harbour). The largest storm was used for calibration of the numerical model, while a smaller storm was used to validate the model. These storms were able to give insight into the wave heights in and around the harbour.



- It was possible to correlate high winds at St John's International Airport with the larger storm events detected within the harbour, as the site is impacted highly by windgenerated waves.
- No long period waves were observed within the harbour.

Bell Island is situated approximately 9 km northeast of LPH and plays an important role in sheltering the facility from high-energy Atlantic swell. The effect of Bell Island on breaking swell energy can be identified in Figure 3-1, where long period wave energy is visible north of Bell Island (~12 seconds), and short-period wave energy is generated south of Bell Island (~3-4 seconds). During the measurement period, extreme conditions were attributed to a storm from WNW where waves were generated across Conception Bay.

1-YEAR RETURN PERIOD OFFSHORE WAVE CONDITIONS, WATER LEVEL AT +1.9m CD (HHWLT+ STORM SURGE), WAVE INCIDENCE AT 45°

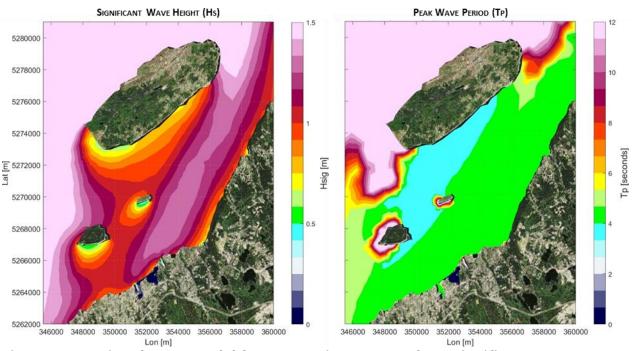


Figure 3-1: Regional wave model for Conception Bay South (r - significant wave height, L - peak wave period).

Using the length of the fetch between the western shore of Conception Bay and LPH, it is possible to estimate the maximum wave heights that could be experienced at the harbour for storm events such as that seen on November 15th. Based on the observed wind speeds of 85 km/hr (equivalent to a 5 year return storm from NW) and assuming a constant wind direction of 300° (WNW), the harbour would be expected to experience incident wave heights of up to 1.6 m. This is consistent with the measured observations at the site. For the worst case scenario, assuming waves coming directly from the Northwest and 100-year storm winds, the site could be exposed to incident wave heights of 2.5 m.



The wave model was calibrated for peak storm conditions observed on November 15th, with the model being validated using a smaller storm occurring on November 5th. Wave conditions from NOAA WW3 were used as boundary conditions for the SW model. The model can be considered calibrated as the model error achieved (Table 3.3) is minimal.

Table 3.3: Comparison of MIKE21 Wave Heights with Observations

	Novem	ber 15th	Novem	ber 5 th	
Parameter	outside	inside	outside	inside	
	Harbour	Harbour	Harbour	Harbour	
Observed	1.22 m	0.88 m	0.76	0.69	
Modeled	1.25 m	0.93 m	0.80	0.72	
% Model Error	+2.3	+5.4	+5.9	-4.6	

3.1.2 Comparison of Options

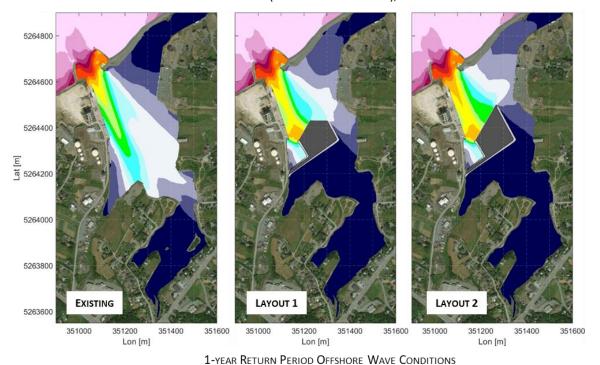
Using the calibrated wave model, conditions for the 1-year return period storm event were modelled with and without sea level rise, using the inputs presented in Table 2-3. The layout depicted in Figure 3-2 is shifted slightly north of the layout presented in Figure 2-1, due to a design modification which was introduced after numerical modelling was completed. The modelling outcomes depicted in Figure 3-2 are anticipated to be representative and identical to those generated for the layout presented in Figure 2-1.

The results are depicted in Figure 3-2 for the highest 1-year incident wave conditions, where offshore winds are coming from the north at 64 km/h. The top three panels display conditions without sea level rise, and the bottom three panels include 1 metre of sea level rise, as discussed in Section 2.3.2 of this report. From Figure 3-2 we can observe the following:

- Wave conditions directly at the entrance of LPH between the two breakwaters remain unchanged;
- Navigation conditions into the harbour to the existing marine terminal remain relatively unchanged;
- Wave conditions south of the proposed OCI development are reduced to a negligible magnitude, compared to existing conditions;
- The new quay wall produces some reflections which slightly increases wave energy along the existing marine terminal (4-18 cm increase in wave height under 2020 SLR conditions for the 1-year return period storm);
- Some wave energy is deflected east towards Sunset Key Marina (5-10 cm increase in wave height under 2020 SLR conditions for the 1-year return period storm);
- ▶ 1 metre of sea level rise (2100) results in greater wave energy penetration into LPH and a slight increase in wave heights (3-10 cm) throughout the basin compared to the conditions which would be experienced in 2020; and
- The 90 m extension of Layout 2 to a total length of 180 m results in slightly higher wave energy along the existing marine terminal and Sunset Kay Marina compared to Layout 1.



1-year Return Period Offshore Wave Conditions Water Level at +1.9m CD (HHWLT + storm surge), Wave Incidence at 0°



WATER LEVEL AT +2.87m CD (HHWLT + STORM SURGE + SEA LEVEL RISE), WAVE INCIDENCE AT 0°

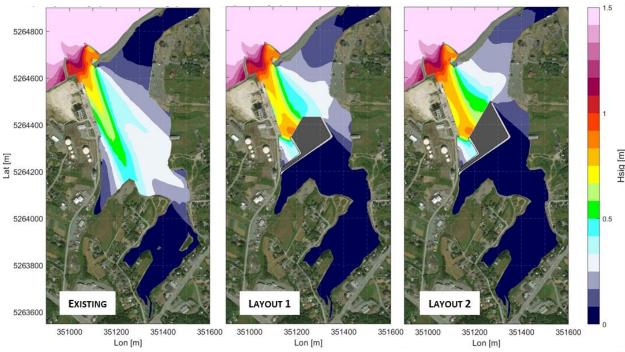
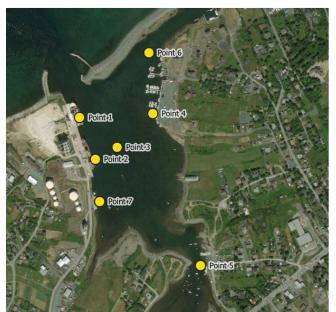


Figure 3-2: Comparison of existing conditions and layout 1 and 2

To better assess the actual magnitudes of change within the LPH basin, six (6) points at key locations were selected for assessment (Figure 3-3) and results presented in Table 3-2.



Location	Lon (m)	Lat (m)
Point 1	351089.9	5264542.8
Point 2	351139.9	5264408.9
Point 3	351210.9	5264447.3
Point 4	351324.9	5264555.6
Point 5	351478.5	5264066.8
Point 6	351312.1	5264751.1
Point 7	351148.6	5264270.4

Figure 3-3: Points of interest

From Table 3-2 we can observe that for a 1-yr return period storm:

- The greatest change in wave heights occur along the existing marine terminal quay wall (points 1, 2, 3), although these increases are small (i.e. 4 22 cm in 2020 and 4 23 cm in 2100);
- A wave height reduction of 13-16 cm can be anticipated south of the OCI development (point 5) relative to existing conditions;
- ▶ East of the OCI development at Sunset Kay Marina (points 4, 6) wave heights can increase by less than 10 cm compared to existing conditions, up to an Hs of 0.25 m (by 2100). The future wave height would still be below the American Society of Civil Engineers (ASCE, 2000) recommended 0.3 m threshold for small craft, which is a yearly maximum wave event for "good" wave conditions; and
- Wave height increases with sea level rise are negligible to low throughout the LPH basin for the 2100 time horizon (all points i.e. in the order of 1cm).
- Potential wave height increases in front of the PD Enterprises Wharf (Point 7) are anticipated to be negligible (i.e. less than 2cm).

Table 3-2: Significant wave heights at points of interest

Scenario		HHWLT + Surge						urge + S	SLR (210	00)
WL		+1	.9m CD				+2.	87m CI)	
Layout	Existing	Existing Layout 1			out 2	Existing	Lay	out 1	Layo	out 2
Parameter	Hc (m)	Hs	ΔHs	Hs	ΔHs	Hs (m)	Hs	ΔHs	Hs	ΔHs
Parameter	Hs (m)	(m)	(m)	(m)	(m)	П5 (III)	(m)	(m)	(m)	(m)
Point 1	0.71	0.74	0.04	0.78	0.07	0.75	0.78	0.04	0.82	0.08
Point 2	0.55	0.72	0.17	0.72	0.17	0.58	0.76	0.18	0.76	0.18
Point 3	0.34	0.46	0.13	0.56	0.22	0.36	0.49	0.14	0.59	0.23
Point 4	0.16	0.24	0.08	0.21	0.06	0.17	0.25	0.09	0.22	0.05



Pc	oint 5	0.14	0.02	-0.13	0.01	-0.13	0.17	0.02	-0.15	0.01	-0.16
Pc	oint 6	0.05	0.10	0.05	0.15	0.10	0.05	0.11	0.06	0.16	0.11
Pc	oint 7	0.18	0.21	0.02	0.20	0.02	0.20	0.22	0.03	0.22	0.02

3.2 Hydrodynamic Modelling

A depth average hydrodynamic (HD) model has been developed of the Long Pond harbour to:

- Determine the changes in flows and current speeds if the OCI development is introduced in the LPH, relative to existing conditions;
- Interpret the HD model current velocity output near the proposed OCI development to determine whether there may be changes to sediment erosion or accretion at key locations in LPH;
- Use HD model output to determine if the OCI development creates adverse navigation conditions in LPH; and
- Use HD model output to determine the potential for localized currents to generate ice jam conditions and other impacts from floating sea ice.

It should be noted that the HD model was not calibrated to water level observations or locally measured currents, as these were not available. Modelled currents in shallow water are highly dependent on accurately resolved bathymetric features and the appropriate timing of water level fluctuations. The HD model was generated using the high-resolution 2020 bathymetric surveys, which offers a relatively complete interpretation of the LPH basin and bathymetric features. The uncalibrated model is most powerful in its comparative capacity, when the modifications are compared to the simulated baseline condition. Wave driven currents are not incorporated in this model, as the wave climate is very mild within the LPH basin, and any wave driven currents would likely be much smaller than those generated by tides.

The Mike21 HD model was used to simulate tidal water levels and currents in LPH over a 14-day period (bottom panel of Figure 3-4), using a representative offshore tidal signal generated by DFO's Webtide at LPH. The 14-day periods captures a neap and spring tide cycle. Model results for peak ebb (outgoing tide) and flood (incoming tide) conditions during the 14-day period are depicted for existing conditions in Figure 3-4. These results for depth averaged currents indicate:

- Inside LPH there are relatively low currents, especially towards the south of the basin, where current speeds are no higher than 0.07 m/s (~0.1 knot);
- Current speed increases in areas with constructions, such as the harbour entrance, and the channel which runs north of the Sunset Kay marina; and
- There are strong ebb currents which run parallel to the existing marine terminal. These currents align with the channel entrance and are therefore aligned with navigation into and out of the facility.



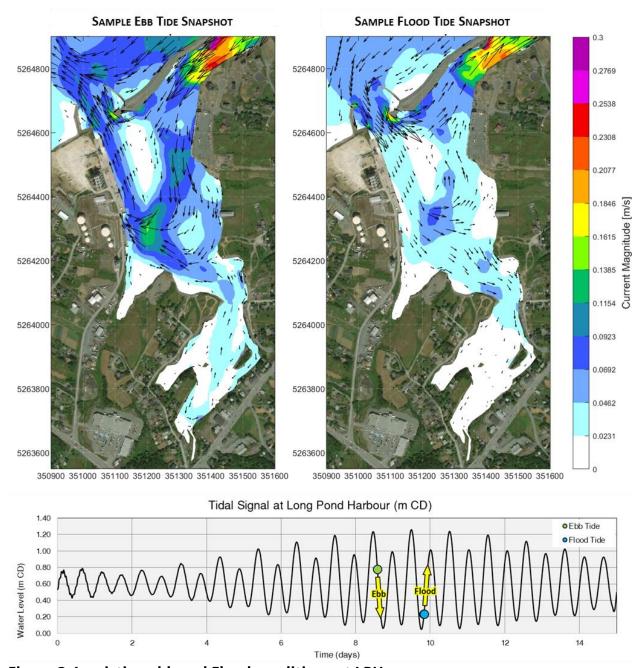


Figure 3-4: existing ebb and Flood conditions at LPH.

3.2.1 Comparison of Options

Ebb and flood conditions for layout 1 and 2 are depicted in Figure 3-5 using the same input tidal signal depicted in the bottom panel of Figure 3-4. For comparative purposes, the output of depth averaged current speeds depicted in Figure 3-5 are displayed for the identical time-step presented in Figure 3-4. Tidal exchange or depth-averaged discharge at select locations of interest are depicted in Figure 3-6 for a 10-day period, during the peak spring tide, when tidal exchange is greatest in LPH. The layouts depicted in Figure 3-5 are shifted slightly north of the layout presented in Figure 2-1, due to a design modification which was introduced after numerical modelling was completed. The modelling outcomes depicted in Figure 3-5



are anticipated to be representative and identical to those generated for the layout presented in Figure 2-1. Figure 3-4

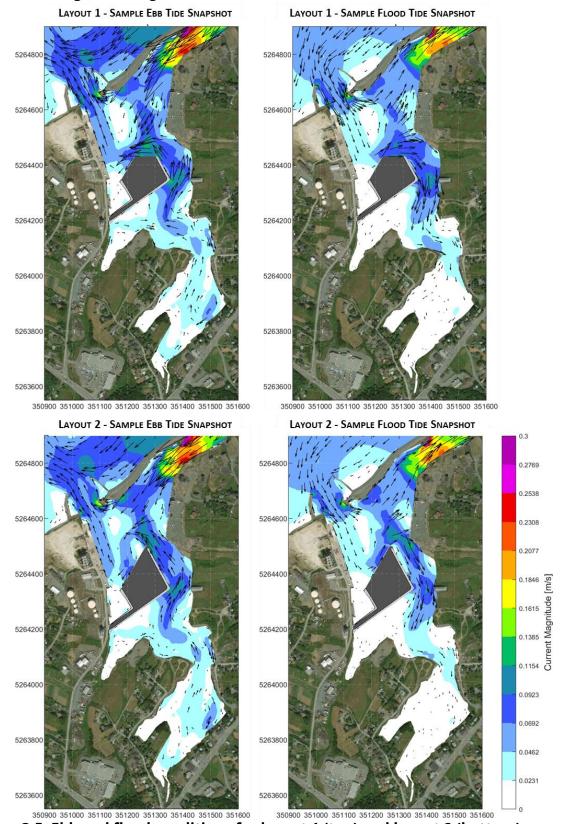


Figure 3-5: Ebb and flood conditions for layout 1 (top) and layout 2 (bottom).



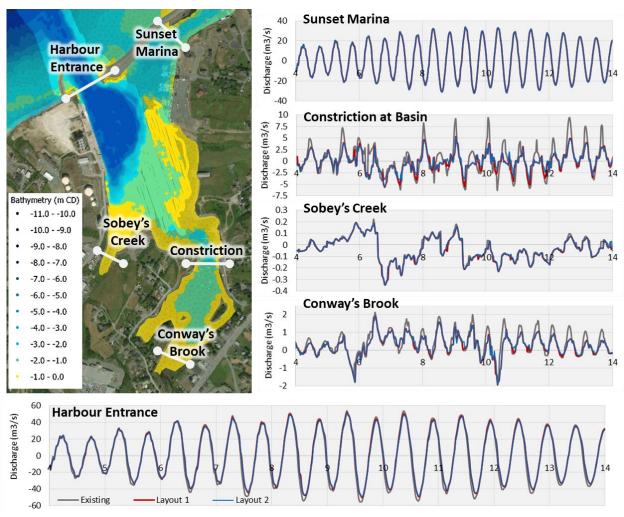


Figure 3-6: Depth average cross sectional flows at key locations in LPH for existing and proposed conditions.

The following notable observations can be made from Figure 3-5 and Figure 3-6:

- Current velocities in the channel north of Sunset Kay Marina remain unchanged for both layouts on ebb and flood tides relative to existing conditions. This is also evident in the discharge plot at Sunset Kay Marina, where the discharge for the existing situation and layout 1 & 2 are the same. Navigation conditions in this area therefore remain unchanged.
- Depth averaged current velocities and patterns at the entrance of LPH on the ebb and flood tide are nearly identical for layout 1 and 2, compared to existing conditions. The discharge magnitude on the ebb tide is slightly less with layout 1 and 2 compared to existing conditions due to the reduction of water mass or volume exchanged in the LPH basin, as a result of the land reclamation. The reduction in discharge magnitude is



- anticipated to have a negligible impact on hydrodynamics and navigation through the LPH entrance.
- Currents are anticipated to increase between the narrowing of the land reclamation and the eastern shoreline of the LPH basin. Although the currents are slightly higher with the introduction of the OCI facility, depth averaged currents are still relatively low ranging between 0.05 m/s to 0.10 m/s (0.10 knots to 0.20 knots).
- The discharge through the constriction at the end of Perrins Road and the private docks is reduced with the introduction of the OCI facility, relative to existing conditions. Further south in the LPH basin, the depth average discharge magnitudes remain relatively unchanged near Conway's Brook and Sobey's Stream.
- Current velocities along the dock of the existing marine terminal are slightly lower with the introduction of the OCI facility, relative to existing conditions. The current direction is parallel to the marine terminal docks for all scenarios and would not adversely impact navigation conditions at the facility as it pertains to currents.
- Depth averaged currents in the southern half of the LPH basin remain very low and relatively unchanged compared to existing conditions.

3.2.2 Sediment Transport Potential

In this section we consider potential changes to marine sediment accretion and erosion in the LPH basin as a result of introducing the OCI development. To assess potential impacts to the LPH sediment transport regime, we consider changes to the tidally driven current velocities in the LPH water column, and the potential consequences these currents have on sediment transport. We do not consider wave driven sediment transport, as wave characteristics throughout LPH are too mild to transport significant volumes of sediment. To assess impacts to sedimentation we must understand sediment type on the LPH bottom, and the mobilization thresholds for this sediment to move within the water column.

Overburden on the LPH bed is characterized by outwash deposits of gravel, sand and silt of varying thickness overlying bedrock (Henderson, 1972). Bedrock in the area consists of black and greenish grey shale, underlined by breccia, from both the Elliot Cove and Manuels River Groups (Water Resources Division, 1984). A geotechnical report from Fracflow Consultants Inc. (2019), at Long Pond assessed subsurface conditions at the footprint of the future OCI facility. Notable findings, relevant to a sedimentation study are:

- A very soft sediment layer was found to exist at a 1.01 to 4.78 m thickness in non-dredged areas, and 0.23 to 0.35 m in dredged areas near the existing wharf. This soft sediment layer was underlain by a weak to moderately firm organic and sandy sediment layer which was in turn underlain by a relatively strong, thinly layered, shale unit. The bottom of the soft sediment and the top of the more load bearing layer.
- Due to previous dredging along the northwestern edge of the site, the current harbour bottom and overburden thickness are highly variable, from 0.23 m to 4.78 m. The grain size analysis captures the outwash deposits and some bedrock.



▶ Based on the Atterberg Limit data and the hydrometer tests, the soft sediment consists primarily of silt with very little clay particles.

A diving crew was mobilized to Long Pond (Sea-Force Diving, 2018) and performed 13 transect swims at 15m apart to determine the extent of marine life and seafloor conditions in area of interest. Imagery from the survey is depicted in Figure 3-7 and indicates that the seafloor consists of soft silt and sand largely covered with a soft marine grass and occasional kelp beds.

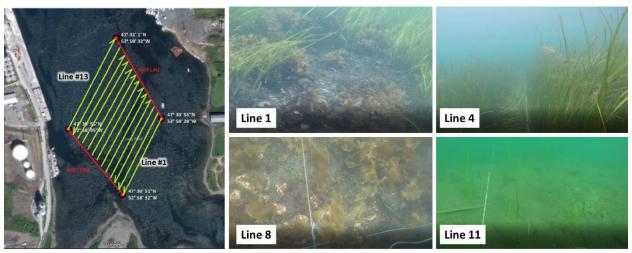


Figure 3-7: LPH bottom conditions at select conditions

Given that the bed conditions in LPH primarily consist of fine sand and silt, we can determine the velocity threshold for particle traction using the Nolvin (1946) and Hjulstrom (1939) relationships presented on the Wentworth sediment scale (Williams, S.J. et al 2006) in Table 3-3 below.

Table 3-3: The Wentworth Sediment Scale

		Siev	e Size	Thre	shold Ve	elocity for t	raction
Siz	ze Terms	ASTM No. (U.S.	Particle Size (mm)	(Nolvin	, 1946)	(Hjulstro 1m abov	
		Standard)	(ISO 565/3310-1)	cm/s	m/s	cm/s	m/s
	oulders & Cobbles	-	-	200		-	-
	Very	2 1/2"	63	150	1.50		
	Coarse	1 1/4"	31.5	150	1.50	_	-
70	Coarse	1 1/4"	31.5	100	1.00		
eb	Coarse	5/8"	16	100	1.00	-	-
Pebbles	Medium	5/8"	16	100	1.00	-	-
S	n Medium	5/16"	8	80	0.80	-	-
	F:	5/16"	8	70	0.70		
	Fine	5	4	70	0.70	-	-



	Very fine	5	4	60	0.60	100	1.00		
	very fifte	10	2	50	0.50	100	1.00		
	Very	10	2	40	0.40	50	0.50		
	Coarse	18	1	40	0.40	30	0.30		
	Coarco	18	1	30	0.30	40	0.40		
	Coarse	35	0.5	30	0.30	40	0.40		
	Medium	35	0.5	25	0.25	30	0.30		
S	ς Integral	60	0.25	25	0.25	30	0.30		
Sand	Fine	60	0.25	20	0.20	26	0.26		
	_ Fine	120	0.125	20	0.20	20	0.26		
	Vory Fine	120	0.125	Minimum (Inman, 1949).			949).		
	Very Fine	230	0.063						
	Coarse	230	0.063						
	Coarse	400	0.038	Note:	The rel	ation betw	een the		
Silt	Medium			_	_	traction tr			
	Fine			and the velocity depends on the					
	Very Fine	400	0.038	_		he bottom			
Clay				velo		leasured, a y factors.	among		

Using the threshold velocities for particle traction in Table 3-3, the bed level characteristics of the LPH basin, and depth averaged current velocities across transect locations of interest presented in Figure 3-8, the following observations can be made:

- Depth averaged velocity at Sunset Marina, the LPH entrance, Conway's Brook and Sobey's Creek remain relatively unchanged, and therefore sediment transport characteristics at these locations are anticipated to be similar to existing conditions.
- Low depth average current velocities (<0.6 m/s, < 1.2 knots) at the harbour constriction, Conway's Brook and Sobey's Creek support the accumulation of silt and clay at these locations, which is allowed to settle as a result of low current velocities.
- ▶ At the harbour construction there is a projected decrease in depth averaged water velocity of approximately 0.02 m/s (~0.04 knots) from the peak velocities of 0.06 m/s (~0.12 knots). The threshold velocity of traction transitions from coarse to medium silt within this projected current velocity reduction. Such a small change will likely not impact sediment accretion or erosion patterns in this area of the LPH basin.
- Depth averaged current velocities at the harbour entrance and near the sunset marina are associated with fine sand (>0.1 m/s, >0.2 knots) morphology, which is consistent with observations of sandy bottom towards the northern portion of LPH near the entrance.
- Current velocities between the proposed OCI development and the eastern shoreline will likely double in some areas due to the constriction of flow. Velocities in the order of 0.05 m/s (0.10 knots) are projected to increase to ~0.10 m/s (~0.2 knots). It is important to note that these current velocities are considered to be low. Sedimentation in this area may transition from coarse silt and very fine sand, to an area of fine sand. Initially,



post construction, very fine silt material may be displaced from this area and replaced by very fine sandy bottom. Dense bottom vegetation which has been observed in the area may reduce the transition of a silty to fine sandy bottom. It is therefore anticipated that slight to negligible adverse sedimentation will occur at this location as a result of introducing the OCI facility.

Current velocities remain relatively unchanged in front of the existing wharf. As such, existing sedimentation patterns at this location are likely to remain unchanged.

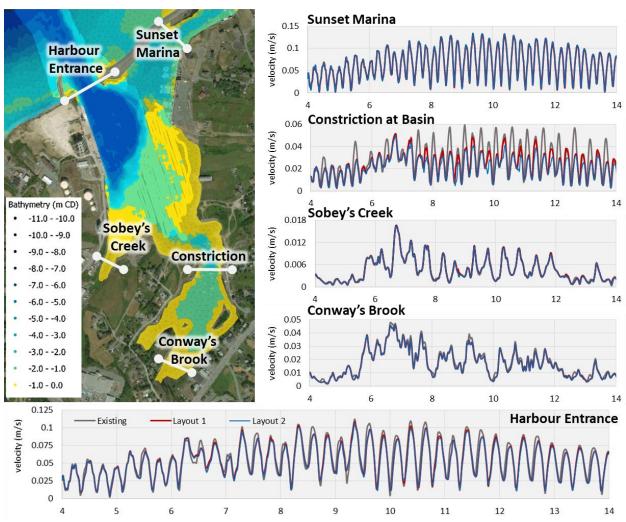


Figure 3-8: Depth averaged current velocities across transect locations of interest

3.3 Ice Jam Potential

As described in Section 2.5 of this report, the presence of ice in LPH is very rare. The freeze-up of LPH has not occurred in recent history. Instead, most ice action is limited to the occasional penetration of offshore grey-ice in the LPH basin, which can be described as young ice which is highly fragmented (Figure 2-3). This type of ice is unlikely to form an ice jam within the harbour. Instead a larger ice event would be required to form an ice jam capable of blocking river outflow from the harbour into the ocean. If river outflows from



sources such as Conway's Brook and Sobey's Creek are effectively blocked by an ice jam, a rainfall event could result in flooding of the lower half of the LPH basin. It is anticipated that such an event is unlikely to occur for the following reasons (USACE, 2005):

- The tidally driven currents result in a constant flow and movement of water in and out of the LPH basin. For mass ice formation to occur, the water would have to be both very cool and very calm, with little to no surface currents. The conditions in LPH basin are therefore not well suited to mass ice formation.
- At LPH the most likely type of ice formation in the southern portion of the harbour would consist of sheet ice, which forms due to the very low current velocities in the water column (< 0.5 m/s, < 1.0 knots). Frazil ice is more commonly associated with ice jams, compared to sheet ice.
- Frazil ice is unlikely to form in the harbour due to presence of warmer sea water, and low velocity currents. Ice jams are predominant formed in the presence of frazil ice and require a combination of conditions including; a shallow bed, a gradient or slope, and a series of constrictions. The LPH basin remains relatively open and has a negligible slope in areas where there are some minor constrictions. Additionally, in those areas with constrictions, surface current velocities increase, and freeze-up is therefore unlikely. Conditions in the LPH are therefore not conducive to ice jam formation.

The potential for ice jam formation as a result of the land reclamation is considered to be very low to negligible. Given the lack of evidence of historical icing of the entire LPH basin, as well as the existing and forecasted hydrodynamic conditions in the basin, the formation of ice jams is considered to be unlikely.



Chapter 4 Conclusions

This coastal modeling study has been completed to support the Land Use Impact Assessment outlined by the Town of Conception Bay South, for the planned OCI development at Long Pond Harbour. OCI plans to develop the site as depicted in Phase 1 of this study. At this time, it is not anticipated that Phase 2 will be developed, and model results for Phase 2 are provided for demonstration purposes only. The conclusions from this study are summarized below.

WAVE AGITATION IN THE HARBOUR – A 2D spectral wave model was used to simulate a 1-year return period storm event within the LPH basin. It was found that wave conditions at the harbour entrance remain unchanged, therefore keeping navigation conditions between the two existing breakwaters identical to those experienced today. The wave energy is significantly reduced south of the proposed development due to the "shadowing" effect of the OCI land reclamation area. This could have a positive effect, protecting the shoreline of the LPH basin south of the proposed development. Potential wave height increases in front of the PV Enterprises Wharf are anticipated to be negligible (i.e. less than 2cm). The greatest change in wave heights occur along the existing marine terminal quay wall, although these increases are small (i.e. 4-20 cm for a 1-year return period storm condition). East of the OCI development at Sunset Kay Marina wave heights increase slightly but are still below the American Society of Civil Engineers (ASCE, 2000) recommend 0.3 m threshold for small craft. Wave height increases with sea level rise are negligible to low throughout the LPH basin for the 2100 time horizon (i.e. in the order of 1cm compared to 2020 wave heights for a 1-year return period storm condition).

IMPACTS ON CURRENTS WITHIN THE HARBOUR – Water levels and currents were simulated in a hydrodynamic (HD) numerical model. Current velocities and associated navigation conditions in the channel north of Sunset Kay Marina and at the LPH entrance were found to remain unchanged with the introduction of the OCI development. At the dock of the existing marine terminal the currents are projected to be slightly lower, while remaining parallel to the marine terminal. Currents are anticipated to increase between the narrowing of the land reclamation and the eastern shoreline of the LPH basin. Although the currents are slightly higher, they are still low ranging between 0.05 m/s to 0.10 m/s (0.10 knots to 0.20 knots). Depth averaged discharge and velocity magnitudes remain unchanged near Conway's Brook and Sobey's Stream outlets.



POTENTIAL FOR EROSION AND SEDIMENTATION – The modelled current velocities throughout the LPH basin support the type of sediment naturally found on the LPH bed. These consist primarily of silts and fine sand. Using the 2D depth averaged current velocity outputs, observed sediment characteristics within the LPH basin, and the Wentworth sediment scale (Williams, S.J. et al 2006) for the threshold of sediment traction; we found that sediment transport within the LPH basin would remain relatively unchanged compared to existing conditions. The lack of wave driven sediment transport, and the low-energy tidally driven sediment dynamics result in a relatively stable environment. The new OCI development does not significant increase or alter current velocities throughout the basin, and therefore sediment types and sediment accretion or deposition patterns within the harbour are unlikely to be significantly modified by the OCI development. Localized bed-level changes not captured in the model may occur to a limited extent.

POTENTIAL FLOODING RISKS FROM ICE JAM FORMATION – Most ice action in LPH is limited to the occasional penetration of offshore grey-ice in the basin, which can be described as young ice which is highly fragmented. This type of ice is unlikely to form an ice jam within the harbour due to its transport on the tidally driven currents, which provide a constant flow and movement of water in and out of the LPH basin. For mass ice formation to occur, the water would have to be both very cool and very calm, with little to no surface currents. In areas where the reclamation will produce constrictions, surface current velocities increase, and freeze-up is therefore unlikely. There are also no rapid changes in bed level slope on which ice jams could form, as is typical in a riverine environment. The conditions in LPH basin are therefore not well suited to mass ice formation and subsequent ice jam formation.

Should you have any questions regarding the content of this report, please contact the undersigned.

Yours very truly,

Prepared by:

Danker Kolijn, P.Eng., M.Sc., M.Eng.

Coastal Engineer

Direct: 902-421-7241, Ext. 2586

E-Mail: dkolijn@cbcl.ca

Reviewed by:

Vincent Leys, M.Sc., P.Eng Senior Coastal Engineer

Direct: 902-421-7241, Ext. 2508

E-Mail: vincentl@cbcl.ca

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 Geological Survey of Canada, Open file 7737, 72pp. https://doi.org/10.4095/295574
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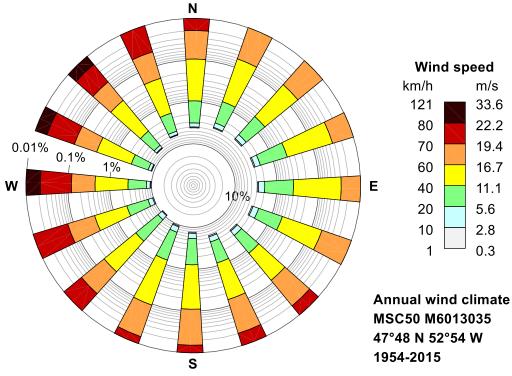
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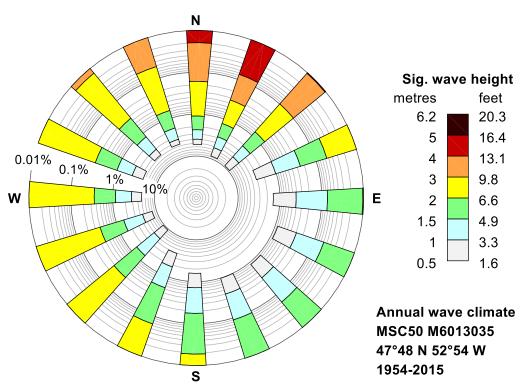
APPENDIX A

MSC50 Offshore Wind and Wave Data



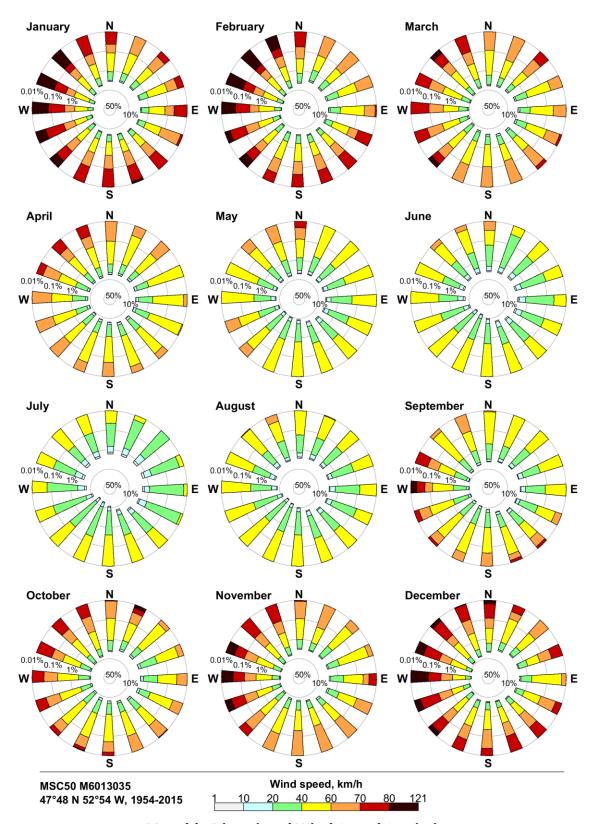


Annual Directional Wind Speed Statistics



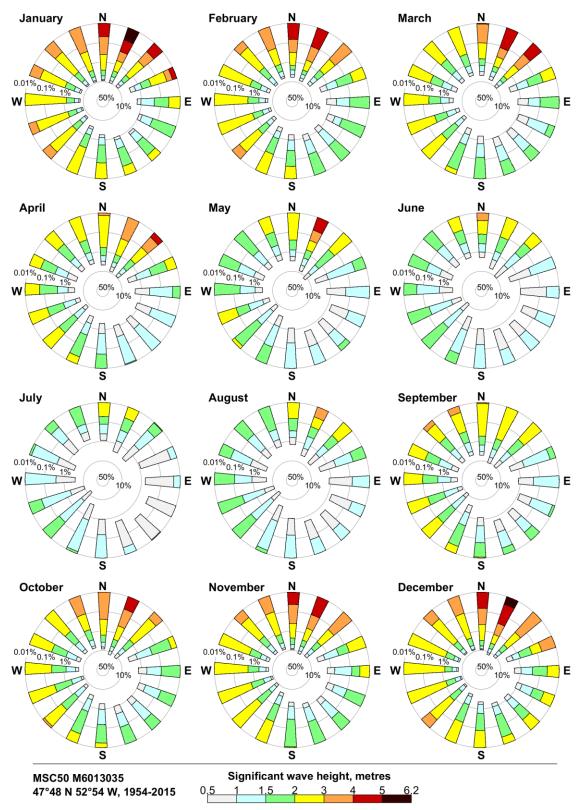
Annual Directional Wave Height Statistics





Monthly Directional Wind Speed Statistics





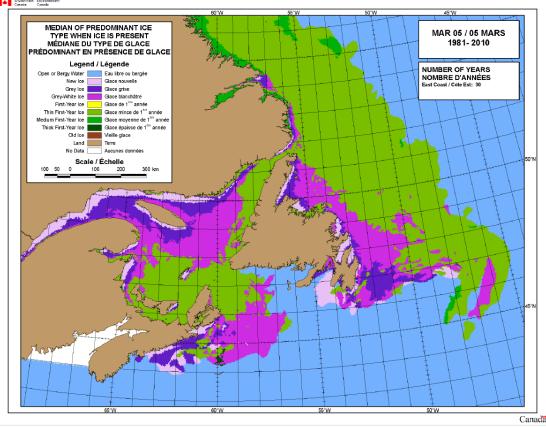
Monthly Directional Wave Height Statistics

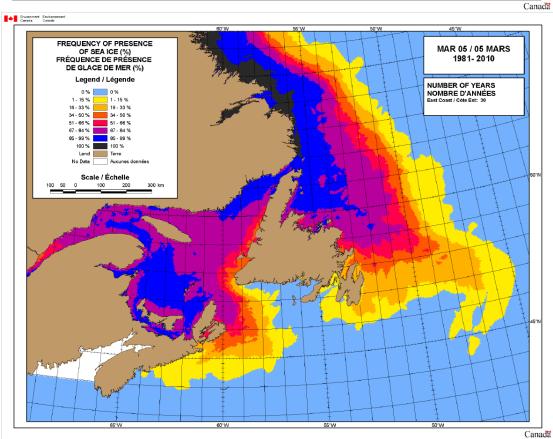


APPENDIX B

Regional Sea Ice Data







APPENDIX C

Corporate Information & Resumes

CBCL Limited

For 65 years, CBCL Limited (CBCL) has been a respected and trusted firm, delivering multidiscipline engineering and technical services throughout Canada and around the world. We foster mutual success with our clients, value our

employees, and strive to contribute to the communities in which we live and work.

We are proud to be recognized as an industry leader in Coastal Engineering for implementing innovative, industry-leading, science based designs and methods.

Creating today, committed to tomorrow, summarizes our focus on environmental responsibility. We endeavor to go beyond conventional fundamentals of functionality to include due consideration of the short and long-term social and environmental effectiveness and sustainability of a project.

Since 1955, CBCL has developed into the largest employee owned multidisciplinary engineering and environmental consulting firm in Atlantic Canada. With a staff compliment of more than 370 engineers, technicians and support staff in nine offices in Atlantic Canada and Ottawa, Ontario, we deliver high quality professional services to our clients throughout the region, across Canada, and internationally. CBCL has participated in international projects for more than forty five years and has completed projects in over ninety countries and territories around the world.

CBCL provides professional consulting services in a number of sectors including Marine & Coastal, Municipal Services, Water & Wastewater, Buildings, Industry & Manufacturing, Energy & Power, Oil & Gas, Transportation & Bridges, and Earth & Environment.









Coastal Services

CBCL has several decades of experience in marine and coastal planning, modeling and engineering projects, with completion of successful consultancies throughout Canada and internationally. Over the last 20 years, CBCL's Halifax-based Coastal Engineering Team has successfully completed a very wide range of projects within Atlantic Canada's extremely diverse coastlines, in multi-seasonal climates, and in both heavily urbanized and rural areas. We frequently participate in national and international conferences, stakeholder meetings, and workshops with end-users and clients.

CBCL's team is also regularly trained and stays up to date on the latest software and leading research development. As an example, the National Research Council of Canada contacted CBCL directly to complete an Atlantic-Canada wide review of flood studies and modelling techniques used to support the Research Council's current effort to update the National Building Code. We are proud to be recognized as an industry leader in the region for implementing innovative, industry-leading science-based designs and methods. Specifically, the CBCL Coastal Engineering team has expertise in the following key categories:

COASTAL PROCESSES AND GEOMORPHOLOGY

- Numerical modelling of waves, currents, tides, and storm surge.
- Sediment / Mud Transport.
- Geomorphology and long-term modeling of sandy tidal inlets.
- Flooding and overtopping analysis.

COASTAL STRUCTURES AND RESTORATION

- Shoreline stabilization and erosion control.
- Shoreline and waterfront access.
- Natural and nature based living shorelines.
- Dune building, nature-based solutions.
- Coastal and marine structures (breakwaters, seawalls, revetments, wharves, marine terminals, waterfronts).

ENVIRONMENTAL INVESTIGATIONS & PERMITTING

- Water quality studies.
- Flushing studies.
- Receiving water impact studies.
- Dredging studies.

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION

- Climate vulnerability & risk assessments.
- Climate change projections.
- Development of risk criteria and evaluation metrics.
- Adaptation assessments.
- Climate change workshops & education.
- Coastal infrastructure risk assessments.

PLANNING, POLICY AND REGULATORY

- Flood mapping guidelines.
- Municipal climate change action plans.
- Infrastructure planning.
- Coastal community adaptation tools.

FIELD INVESTIGATIONS

- Shoreline erosion assessment.
- Wave, current, tide gauge monitoring.
- Sediment sampling.
- Bathymetric surveys. Infrastructure / shoreline assessments.



Vincent LEYS MSC, PENG, PMP SENIOR COASTAL ENGINEER



AREAS OF EXPERTISE

Coastal Processes and Engineering, Climate Change Adaptation

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Member of the Associations of Professional Engineers in the Canadian Provinces of Nova Scotia, New Brunswick, Newfoundland and Labrador, Prince Edward Island Certified Project Management Professional (PMP) with Project Management Institute

EDUCATION

2005	Coastal Engineering Certificate Program, Old Dominion University, VA
2000	M.Sc. in Ocean and Offshore Technology, Cranfield University, UK
1999	B.Sc. in Ocean Engineering, Ecole Centrale de Marseille, France, a French 'Grande Ecole'

PROFESSIONAL TRAINING

2019	Climate Change Risk Assessment to Infrastructure with PIEVC Protocol – Engineers Canada
2016	Geotechnical Engineering Fundamentals, EPIC
2012	Inspection, Repair and Rehabilitation of Marine Structures, EPIC
2011	Applied Climate Change Program, University of Prince Edward Island
2007	Integrated Coastal Zone Management, UNESCO-IHE

EXPERIENCE

Vincent Leys, CBCL's Coastal Engineering Technical Lead since 2004, has 20 years' experience as a coastal engineer in Atlantic Canada, the Caribbean, Africa and Europe. He has led a vast array of diverse coastal vulnerability and climate change adaptation projects, advising on coastal processes and infrastructure solutions across many different coastal environments subject to long-term climate change impacts, from huge Fundy tidal ranges and mudflats, to exposed eroding sandy shores in the Gulf of St Lawrence, or fishing outposts open to ice drifts and Atlantic hurricanes. He directly contributed to marine and coastal infrastructure of aggregate construction value exceeding \$50 million.

Vincent Leys also has extensive experience translating his technical expertise into accessible public presentations and documents, as well as informing planning and policy. He provided technical expertise to many recent regional efforts towards improved coastal planning and vulnerability assessments, such as the NS Flood Mapping Guidelines (2019), the Coastal Community Adaptation toolkit (ACASA 2016), NS MCCAPs (2015), the NS Fisheries infrastructure vulnerability assessment tool (2011) or the NS State of the Coast report (2009). His work has been featured in numerous publications and conferences. Key projects are organized by relevant knowledge, skills and expertise in the following areas:

Area of Expertise	Indicator
Coastal Engineering.	CEng
Geomorphology.	Geom
Development of policy or regulatory frameworks and translating technical expertise	Tools / Public
into tools and public documents.	
Risk assessment and management including criteria development and evaluation	RA
metrics.	

COASTAL ENGINEERING AND GEOMORPHOLOGY

COASTAL EROSION RISK ASSESSMENT AT QUEENSLAND, LAWRENCETOWN, CHEZZETCOOK AND MARTINIQUE BEACHES — 2018, NS — Project Manager. Assessment of coastal geomorphology, coastal modeling of flood and erosion risks with sea level rise, cost estimates for intervention, <u>public meetings and report</u>. At Queensland Beach, the study led to design for temporary (Phase 1) and long-term restoration of popular South Shore beach park for resilience to sea level rise and storm surge. Phase 1 construction successfully completed 2019, which consisted in (1) raising road and parking lot, (2) move road to the back to minimize storm damage, (3) armourstone berm to mitigate wave overtopping, (4) public access pathways. Phase 2 (long-term) to include complete road relocation, and new sand nourishment and dune restoration. Reference: Clinton. Pinks@novascotia.ca, Project Manager, 902 893 0746

CEng Geom Public RA

• PEI NATIONAL PARK SHORELINE MONITORING AND COASTAL ZONE MANAGEMENT PLAN 2019-2021 (ONGOING) — Project Manager. Two-year field measurement program (5 tide gauges, offshore current and wave measurements), coastal modeling, development of concept solutions for long-term sustainable Coastal Zone Management Plan to mitigate climate change and sea level rise threats to a prime coastal National Park. Project funded under Transportation Asset Risk Assessment (TARA) federal initiative. Reference: Parks Canada, debra.hickey@pc.gc.ca, (902) 209-5940

CEng Geom RA

• FUNDY NATIONAL PARK SHORE PROTECTION AT HIGHWAY 114 AND BEACH, ALMA, NB 2016-2018 - Project Manager. Field measurements, numerical modeling, concept evaluation, detailed design and specs for beach restoration and shore protection of 1 km shoreline at Park entrance. Construction was completed on budget and schedule in the spring of 2018, earning high client satisfaction and public praise for protecting the highway while maintaining enjoyable public beach access and views.

Reference: Parks Canada debra.hickey@pc.gc.ca 902 407 7812

CEng Geom

• PEGGY'S COVE COASTAL FLOOD RISK STUDY (DEVELOP NS, 2019-2020) — Project Manager. High-res wave runup modeling and flood maps for present and future climate change coastal storm events. See <u>Hurricane Bill simulation</u>. Risk assessment to drive implementation of the Master Plan and design of new coastal infrastructure at Nova Scotia's top tourist destination. Reference: Develop NS, eva.parada@developns.ca. 902 818 3321

CEng RA

COASTAL ENGINEERING STUDIES FOR 70+ FEDERAL FACILITIES (YEAR 2000 TO PRESENT, DFO/TRANSPORT
 CANADA) — Field data collection, consulting with local stakeholders, modeling of wave processes,
 currents, storm surges and sediment transport for reduced maintenance dredging, cost-benefit
 analyses, engineering design for breakwaters, shore protection, climate change adaptation for
 infrastructure construction aggregate value exceeding \$50 million, including:

CEng Geom

- Nova Scotia Assessment of Maughers Beach breakwater and McNabs Island shoreline stability, Halifax Harbour, Dingwall tide gate study, wave monitoring/modeling and new breakwaters/wharves at Jeddore, Cheticamp, Pictou Landing, Three-Fathom Harbour, Cape John, Caribou, Petit-de-Grat, Judique, Wedgeport, New Harbour, Stoney Island, Murphys Pond, Parkers Cove, Canso, Gunning Cove, Upper Port LaTour, Lower Sandy Point, Saulnierville, Meteghan, Lockeport, Glace Bay, Neil's Harbour, South Bar, Centreville, Tiverton, Little River. Reference: PSPC Project Manager, Kate. McCarthy@pwgsc-tpsgc.gc.ca, 902 880 1062
- PRINCE EDWARD ISLAND —Coastal modeling, detailed design and tender documents for channel realignment and shore protection at Tignish, sediment transport modeling at Malpeque, Nine Mile Creek, Summerside, West Point, Wood Islands, new sediment by-pass breakwater design at Skinners Pond, North Lake and Naufrage, modeling of sedimentation and Ferry propwash impacts at Souris Harbour. Reference: DFO PM, Patrick.Mazerolle@dfo-mpo.gc.ca, 506 863 9872
- NEW BRUNSWICK —Morphological modeling at multiple tidal inlets in Pigeon Hill, Miramichi Bay and <u>Tabusintac Bay</u> resulting in large savings in maintenance dredging, new breakwaters, wharves at Shippegan, Miller Brook, New Mills, Leonardville, Lameque, Caraquet, Maces Bay, 5 sites on Grand Manan Island, Alma, 3D modeling of flows and sedimentation at 4 sites in <u>Saint John Harbour incl. Reversing Falls</u>. *Reference: DFO PM, Raymond.losier@dfo-mpo.gc.ca, 506 227 5298*
- QUEBEC Inspection and repairs at Rivière-au-Renard and Gros Cacouna berm breakwaters; wave modeling for breakwater design at Harrington Harbour.

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Vincent LEYS

- NEWFOUNDLAND AND LABRADOR Port-aux-Basques breakwater condition assessment (Marine Atlantic Ferry Terminal), Eddies Cove, new berm breakwater design at Cow Head, Bay de Verde, Lark Harbour, harbour flushing studies at St Brides, Makkovik, Cartwright, wharf encasement projects at Burin, Shoal Cove, wave study at Ochre Pit Cove, coastal structures to mitigate sedimentation at Forteau, Lourdes, Parsons Pond. Reference: DFO, paul.curran@dfo-mpo.gc.ca, 709 772 6660
- **TRURO FLOOD MITIGATION STUDY (NS 2015)** Technical lead on coastal hydrodynamic and sediment transport modeling component to assess present issues and recommend mitigation measures, report. The project won Honorable Mention for Lieutenant Governor's Award for Excellence in Engineering.
- HALIFAX NORTHWEST ARM WATERFRONT PROTECTION AND LIVING SHORELINES (NS) Lead coastal engineer.
 Restoration of 1.2km of waterfront promenade using mix of living shorelines, beach and rock
 revetments. Phase 1 (Horseshoe island) successfully completed in 2018, using a mix of purposedesigned granite stone walls, revetments and beach access. Phase 2 (Regatta Point 2021) will
 incorporate hybrid nature-based protection features including living shorelines in the form of salt
 marshes and rock sills. Reference: Jeff Spares sparesj@halifax.ca, 902 490 7141
- LA PLANCHE RIVER ABOITEAU DESIGN AND CONSTRUCTION (BAY OF FUNDY, NS 2016) Hydrodynamic and sediment transport studies, design recommendations, construction advice for by-pass tidal channels.
- MAHONE BAY SHORELINE PROTECTION AND ENHANCEMENT (NS 2015) Lead coastal engineer for options to
 protect Mahone Bay's popular waterfront from storms and sea level rise. Included
 recommendations on Living Shoreline options that were well received at public meetings.
- **DOMINION BEACH RECONSTRUCTION (NS 2013)** Surveying, modeling, lead designer, tender drawings and specifications for a sand-buried rock dyke to rebuild Sydney's most popular Provincial Park beach.
- TURKS AND CAICOS EMERALD BAY ENVIRONMENTAL IMPACT ASSESSMENT Senior advisor for coastal
 engineering study on proposed beach rehabilitation south of Providenciales.
- TRINIDAD CAP-DE-VILLE BEACH AND SHORELINE PROTECTION Site visits, coastal engineering studies for multiple options including rock revetment and breach breakwaters, detailed design for long-term shoreline stability and storm damage mitigation.

RISK ASSESSMENTS, TOOLS AND PUBLIC DOCUMENTS FOR CLIMATE CHANGE ADAPTATION

- Nova Scotia Municipal Floodline Mapping Standard and Guidelines (2019-2020) Coastal Expert.
 Developed technical guidance and specifications for assessment of coastal processes as inputs to Municipal flood mapping to be used across NS.
- TRANSPORTATION ASSETS RISK ASSESSMENT (TARA) FOR CLIMATE CHANGE AT 9 SITES ACROSS ATLANTIC CANADA (TRANSPORT CANADA-PWGSC, 2018-2019) Project Manager Site workshops, risk assessments, supervision of climate change data analyses and engineering team, to develop recommendations for 6 Ferry Terminals, Confederation Bridge, 2 Airports. Developed site-specific "Asset Action Plans" as tools to summarize key asset data, climate risks and recommendations. Based on Engineers Canada PIEVC Risk Assessment Protocol adapted to local sites. References: PSPC Terry. Walsh@pwgsc-tpsgc.gc.ca, 902 830 4134, Transport Canada, lorne.beaver@tc.gc.ca, 902 499 0398
- CLIMATE CHANGE PROJECTIONS FOR THE NATIONAL CAPITAL REGION (2020, NCC AND CITY OF OTTAWA). Project Manager. Coordinated scientific and stakeholder consultation teams to develop relevant set of 178 climate indices fur use by municipal decision makers. Supervised preparation of accessible data reports to be released to the public for inputs into future vulnerability assessments (data plots, renderings, and other infographics). References: Emily Rideout, NCC, Emily.Rideout@ncc-ccn.ca (613) 239-5678 # 5641, Julia Robinson, julia.robinson@ottawa.ca (613) 795-9514
- GREEN SHORES FOR SHORELINE DEVELOPMENT CREDITS AND RATINGS GUIDE (2019). Technical advisor, editor.
 Development of Green Shores coastal property rating system for application in Atlantic Canada.
 Reference: DG Blair, Stewardship Centre for BC 604 230 9734 dg@stewardshipcentrebc.ca

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Tools, Public

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Vincent LEYS

ENGINEERING GUIDANCE FOR COASTAL COMMUNITY ADAPTATION TOOLKIT (CBCL and UPEI, Dalhousie U., St Mary's U., for Atlantic Climate Adaptation Solutions Association, 2014-15) — Project Team built a decision key for selecting sustainable coastal adaptation strategies (planning and engineering). Advised on cost estimates for adaptation strategies at selected pilot sites. Principal Investigator for engineering component of the project. http://atlanticadaptation.ca Reference: Adam Fenech, PhD. Director of UPEI Climate Lab, afenech@upei.ca 902 394 6993

RA

Workshop on Climate Change and Codes Adaptation, National Research Council Canada (2020).

Presented data gaps and approaches for adaptive hydraulic infrastructure design approaches to include in Canadian Building Code, with a perspective from Atlantic Canada. NRC, Jan 2017 then Feb 2020, Ottawa (by invitation only). Reference: NRC Ahmed Attar, PhD. 613 993 3807 - ahmed.attar@nrc-cnrc.gc.ca

Public

• CLIMATE CHANGE VULNERABILITY AND ADAPTATION ASSESSMENT OF FISHERIES INFRASTRUCTURE (NS 2011) — Development of a 'Climate Change Adaptation Toolkit' for fisheries and aquaculture infrastructure. Site assessments within six pilot study areas - http://atlanticadaptation.ca/node/218

Tools RA

• MUNICIPAL CLIMATE CHANGE ACTION PLANS (NS 2013-15) — Lead coastal expert on MCCAPs for Cape Breton, Port Hawkesbury, Victoria, Inverness, Lunenburg, Annapolis Royal.

Public

Nova Scotia State of the Coast Report (NS Provincial Oceans Network 2009) – Lead Technical Author
of 'Sea Level Rise and Storm Events' (Chap. 9) Reference: NS Provincial Director of Planning,
gordon.smith@novascotia.ca, 902 424 7918

Public

• **SEDIMENT TRANSPORT WORKSHOP INSTRUCTOR (PWGSC 2010)** — Developed and presented a primer on coastal processes modeling at a technical workshop for Federal Environmental Assessment Officers.

Public

CONFERENCE PRESENTATIONS

- Leys V. 2019. Climate resilience and adaptation of Small Craft Harbours in Newfoundland and Labrador. NEIA Coastal Erosion Workshop, St. John's NL. Nov 2019.
- Leys V. 2019. Engineering Aspects of Nature-Based Shorelines. Living shorelines workshop, UPEI
- Leys V. 2019. Coastal Engineering Practice through Case Studies. Guest lecture at Queens University, Kingston ON, Nov 2019.
- Leys V. 2016. <u>Engineering considerations for coastal adaptation: Recent examples from Atlantic Canada</u>. Presented at 2016 Livable Cities Forum, Halifax.
- Leys V. 2016. <u>Storm Impacts on McNabs Island: Recent Examples & Potential Future</u>. Presented at Friends of McNab'sIsland Society AGM, 13 Apr 2016
- Leys V., Wilson A., Fernandez V. 2016. <u>Truro flood study</u> Solutions for managing large runoff, rising Fundy tides, sedimentation and ice jams. Presented at 2016 Coastal Zone Canada Conference, Toronto.
- Leys, V., Giffin R., Pursnani S., Wilson A. 2016. <u>Design and construction of a new aboiteau on the LaPlanche Tidal River, Bay of Fundy</u>: Climate Change, Hydraulic and Coastal Engineering Considerations. Presented at Climate Change Adaptation and Infrastructure Conference, Moncton NB, Feb 2016.
- Leys V., Smith G., Fisher G. 2014. Preparing Climate Change Action Plans for Nova Scotia Municipalities Lessons Learned. Presented at Coastal Zone Canada 2014, Halifax.
- Stark N., Hatcher B., Hatcher M., Leys V., Kopf A. 2013. <u>In-situ localization and quantification of sediment deposits after dredging and disposal interventions in Sydney Harbour, Canada, using a dynamic penetrometer</u> 2014 ASCE Geo-Congress, Atlanta.
- Leys V. 2013. <u>A Tool to Assess Coastal Infrastructure Relevant to the Fishing & Aquaculture Industries.</u>
 Presented at UPEI, May 2013, Planning for Risk under a Changing Climate Conference.
- Leys V. 2012 <u>Sydney Harbour Dredging Project</u>: A Coastal Engineering Perspective on the Confined Disposal Facility. Presented at the 37th CLRA/ACRSD National Conf., Sydney, NS, Sept 2012
- Leys V. 2012. Wave Climate and Coastal Protection at Cheticamp. Presented at the Cheticamp Climate Change Adaptation Workshop, Ecology Action Centre, 14 Feb 2012.
- Leys, V., 2007. <u>3D Flow and sediment transport modeling at the Reversing Falls</u> Saint John Harbour, New Brunswick. Presented at MTS/IEEE Oceans Conference, Vancouver BC, Canada, Oct 2007.

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Vincent LEYS

PEER REVIEWED PUBLICATIONS AND PAPERS

- Leys V., Fernandez V., Kolijn D. 2018. <u>Resonant oscillations in small craft harbours: observations and mitigation modeling examples from Atlantic Canada.</u> 36th Int'l Conf. on Coastal Eng., Baltimore.
- Leys V., Lehmann M. 2016. <u>Multi-inlet migration modeling for navigation channel management in Tabusintac Bay, Eastern Canada</u>. 35th Int'l Conf. on Coastal Eng. ICCE 2016, Istanbul.
- Leys V., Manuel P., Van Proosdij D. (lead authors) 2016. <u>Adapting to Climate Change in Coastal</u>
 <u>Communities of the Atlantic Provinces, Canada: Land Use Planning and Engineering and Natural</u>
 Approaches. Prepared for ACASA, NRCan No. AP291.
- Leys V., Mulligan R.P. 2011. <u>Modeling Coastal Sediment Transport for Harbour Planning: Selected Case</u>
 <u>Studies</u> in: Sediment Transport. ISBN: 978-953-7619-X-X. INTECH Open Access Publisher. May 2011.
- Leys V. 2009. Sea Level Rise and Storm Events. In J. Walmsley (Ed.), The 2009 State of Nova Scotia's Coast Technical Report (pp. 160-176). ISBN: 978-1-55457-327-1.
- Dorvinen J., Stark N., Hatcher B., Hatcher M., Leys V., Kopf A. 2017. In Situ Assessment of Sediment Erosion and Consolidation State Using a Free-Fall Penetrometer: Sydney Harbour, Nova Scotia. J. of Waterway, Port, Coastal, and Ocean Eng. Mar2018 Vol 144, Issue 2

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P.ENG, M.Sc., M.ENG. GROUP LEAD, COASTAL ENGINEERING



AREAS OF SPECIALTY

Coastal Engineering, Coastal Zone Management, Climate Change Adaptation & Vulnerability, Shoreline Infrastructure, Project Management, Water Quality for Coastal Systems, PIEVC, Infrastructure Delivery Models

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Member of the Association of Professional Engineers of Ontario Member of Engineers Nova Scotia Board of Directors – Coastal Zone Canada Lead Community of Practice – Living Shorelines, Coastal Zone Canada Member of the Royal Netherlands Society of Engineers (KIVI)

EDUCATION

2014	M.Sc. in Coastal Engineering, Technical University of Delft, NL
2012	M.Eng. in Civil Engineering, University of British Columbia, CAN
2011	B.Sc. in Civil Engineering, Queen's University, CAN

PROFESSIONAL TRAINING

2019	PMP Project Management Boot Camp, CAN
2018	Integrating Climate Risk into Infrastructure Development: The PIEVC Protocol, CAN
2018	Understanding Our Changing Climate: Asset Management for Engineers, CAN
2018	Inspection, Repair and Rehabilitation of Marine Structures, EPIC, CAN
2017	NOAA Wave Watch III Training, University of Maryland, USA
2015	Business Management courses, University of Ottawa, CAN
2014	Deltares DELWAQ water quality modelling course, San Francisco, USA
2013	Ports and Maritime planning courses, ESITC Caen, FR
2012	Arctic Oil & Gas Engineering courses, UNIS, NO

EXPERIENCE

Danker Kolijn is the Group Lead at CBCL for Coastal Engineering. Mr. Kolijn has managed coastal engineering and multidisciplinary civil engineering projects both in Nova Scotia, Canada and abroad. Mr. Kolijn has over eight (8) years of experience in the coastal engineering discipline and has specialized in coastal zone management and shoreline protection, climate change adaptation & vulnerability, shoreline infrastructure, and nearshore coastal water quality and receiving water studies. In Nova Scotia, Mr. Kolijn has worked on a range of coastal studies for both Municipal, Provincial and Federal Clients, working on the variety of Provincial coastlines; from the extreme tidal region of the Bay of Fundy, to the sandy and sea ice prone Northumberland Strait, to the exposed Atlantic shorelines of Cape Breton and the Nova Scotia south shore.

Mr. Kolijn has experience integrating various engineering disciplines into multi-year coastal engineering design projects, including the development of feasibility studies to detailed designs, construction specifications, infrastructure delivery models, and stakeholder engagement throughout the project lifecycle. Mr. Kolijn has also developed construction supervision and construction plans for coastal protection projects. Technically, Mr. Kolijn has worked extensively with a range of coastal engineering numerical modelling tools and programs to develop coastal engineering projects, such as the industry

recognized Delft3D and Mike21 numerical modelling software packages. Mr. Kolijn has facilitated and managed participatory workshops which address a combination of technical, policy, institutional, environmental, economic and social considerations in complex settings, such as disaster recovery and adaptation workshops following the 2017 Caribbean Hurricanes, or workshops to support the 2019-2021 development of the new Atlantic Water and Waste Water Guidelines, which incorporate climate change.

Mr. Kolijn holds a seat on the Board of Directors of the Coastal Zone Canada Association and is on the executive committee of the bi-national community of practice for living shorelines, which also incorporates climate change topics as they pertain to national coastal resilience and adaptation. Mr. Kolijn regularly presents at national and international conferences, where most recently he presented on climate change adaptation strategies for Caribbean Coastal Communities at events in Panama, Jamaica, St. Kitts, and Florida, and at the national Coastal Zone Canada Conference in St. John's Newfoundland.

COASTAL ENGINEERING

- COASTAL ENGINEERING STUDIES AT ATLANTIC CANADA HARBOURS (GOVERNMENT OF CANADA) Managed and
 worked on project teams to develop small-craft-harbour infrastructure upgrades, repairs and marine
 facility expansion. Projects require the study of metocean conditions, study of shoreline erosion and
 coastal protection, assessment of existing problems and concerns, consultation with local stakeholders
 and the client, measurement of waves and currents, and generating solutions and engineering designs
 including 2D and 3D wave, tidal and sediment transport models, engineering drawings, cost estimates
 and presenting the anticipated performance of the structure. Projects were located at:
 - NOVA SCOTIA: Cheticamp, Saulnierville, Meteghan, Digby, South Bar, Neils Harbour, Ingalls Head,
 Glace Bay and Centreville.
 - New Brunswick: Pigeon Hill, St. John's Ferry and Seeleys Cove.
 - PRINCE EDWARD ISLAND: Naufrage, North Lake and Seacow Pond.
 - NEWFOUNDLAND & LABRADOR: Ochre Pit Cove, Green Island, Long Pond Harbour, Bay de Verde, St. Bride's Harbour, Seal Cove, Coombs Cove, Torbay, O'Donnell, Forteau, Charlottetown.
- HALIFAX SOUTH SHORE BEACH STUDIES, NOVA SCOTIA (NSDNR) In the fall and winter of 2017 / 2018 a
 number of severe storms caused significant damages to Miseners Long Beach, Queensland Beach,
 Lawrencetown Beach, and Maritinque Beach on the South shore of Nova Scotia. Emergency
 rehabilitation works and longer term management strategies were developed which incorporated
 the effects of climate change such as increased storm frequency/intensity and sea level rise.
- COASTAL FLOOD PROTECTION LUNENBURG WASTE WATER TREATMENT PLANT, NOVA SCOTIA (TOWN OF LUNENBURG) – Mr. Kolijn was the project manager to develop a coastal flood protection solution for the waste water treatment plant, in the Town of Lunenburg, after it was flooded during the passage of Hurricane Dorian in 2019. As part of this study Mr. Kolijn assessed extreme design water levels, conducted a site investigation including the installation of water level monitoring devices, and developed three (3) concept solutions to protect the Plant from coastal flooding.
- Shubenacadie Tidal River Dispersion Modelling, Nova Scotia (Alton Gas) Mr. Kolijn was the project manager for the development of a numerical model of the tidal Shubenacadie River to simulate and assess impacts of brine diversion and dilution in the tidal river, as part of a gas-storage project. The river has a tidal bore with complex water level and salinity variations. The model was used to assess brine release scenarios and impacts on upstream and downstream habitat.
- PRINCE EDWARD ISLAND SHORELINE MANAGEMENT PLAN, MONITORING & COASTAL ADAPTATION, PARKS CANADA.
 Together with the Client (Parks Canada), Mr. Kolijn developed a work plan as part of the Federal
 Transportation Asset Risk Assessment (TARA) program to manage shoreline erosion and climate
 risk(s) along the 60km shoreline of PEI National Park. The study involved monitoring of
 waves/currents using ADCPs, water level measurements, successive topographic and bathymetric
 surveys including topo-bathy LiDAR. The outputs from the field program were used to identify
 vulnerable and at risk infrastructure both in the short- to long-term.

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- FUNDY PARK SHORELINE STABILIZATION AND ENGINEERING DESIGN, FUNDY NATIONAL PARK (PARKS CANADA) Mr.
 Kolijn assisted in the design of shoreline stabilization works at Fundy National Park in New
 Brunswick Canada. The design was supported by detailed sediment transport and wave modelling.
 The final design was prepared as a tender package for construction including final construction
 drawings and specifications.
- MARGARETSVILLE SHORELINE EROSION & BREAKWATER PROTECTION, NOVA SCOTIA (MARGARETSVILLE SHORE SOCIETY) - Mr. Kolijn was the project manager for an investigation which included analysis of longterm shoreline erosion and risk to properties in Margaretsville, NS, as well as rehabilitating an existing wharf. Mr. Kolijn led field studies, consultation, numerical modelling, historical shoreline evolution analysis, engineering design and the preparation of a cost estimate to rehabilitate the existing breakwater, and wharf.
- LAMEQUE SHIPPAGAN, NEW BRUNSWICK (DEPARTMENT OF TRANSPORTATION & INFRASTRUCTURE) For the design of a new bridge crossing at Lameque, Mr. Kolijn managed field deployment of water level gauges throughout the greater Shippagan region, conducted ADCP riverboat transect surveys at the bridge location, and facilitated bathymetric sounding work. Numerical modelling was used to investigate the proposed changes to the waterway for several bridge concepts.
- COASTAL STUDY AT SAINT JOHN FERRY TERMINAL (GOVERNMENT OF CANADA) Mr. Kolijn assisted in the deployment of wave gauges to investigate agitation concerns at the Digby ferry terminal in St. John. Interviews were conducted with the vessel captains to understand agitation concerns. Based on collected data and interviews, a series of numerical models were developed to investigate agitation and to present solutions. Cost estimates and preliminary designs of the solutions were provided.
- REVETMENT CONSTRUCTION & ARMOURSTONE OVERSIGHT SYDNEY INTERNATIONAL COAL TERMINAL (NOVA SCOTIA POWER INC.) Mr. Kolijn completed a series of inspections during construction phases of a revetment at a coal loading terminal. A round of QA/QC was completed at the quarry and the construction site. Mr. Kolijn worked with the contractor to resolve operational and production challenges for both stone production and revetment construction.
- SANTA MARTHA BEACH DEVELOPMENT, CURACAO (IHDG) Mr. Kolijn was the project manager for
 developing a detailed coastal engineering design and construction specifications/plan for a 1km long
 beach feature at a future all-inclusive resort development. The project included field
 reconnaissance, wave monitoring, numerical modelling of wave, water level, and sediment transport
 processes, and the preliminary and detailed designs of the beach nourishment/shoreline solution.
- GRAND TURK MARINA, NAVIGATION CHANNEL AND BEACH DESIGN, TURKS AND CAICOS ISLANDS, (NCPA LTD.) —
 Mr. Kolijn was the project manager for the investigation of a navigation channel to access a planned
 mega-yacht harbour on the island of Grand Turk. The project included consultation with local
 regulators and residents, extensive fieldwork including ADCP, water level and wave monitoring,
 development of safe, resilient and sustainable navigation infrastructure, and supporting services to
 the project EIA/EMP process.
- AVILA BEACH RESTORATION, CURACAO (AVILA RESORTS) Mr. Kolijn provided Avila Resorts with recommendations for shoreline and beach enhancement at their existing beach which was suffering from erosion and wave exposure.
- PLAYA GRANDE COASTAL MARINA & DETAILED BREAKWATER DESIGN, DOMINICAN REPUBLIC (DOLPHIN CAPITAL INVESTORS) Mr. Kolijn conducted a site inspection of extensive coastal erosion at the Playa Grande Golf Course, in the north of the Dominican Republic. The site is exposed to Atlantic swell and required engineering design and solutions to rehabilitate and stabilize the eroding bluffs and cliff system. CBCL developed detaield engineering designs and construction specfications to remediate the greatest shoreline erosion risks at the property. The solution presented had the added value of creating a small yacthing marina from which new commercial oppertunities could be explored.
- EMERALD BAY COASTAL ASSESSMENT, TURKS AND CAICOS ISLANDS (SWA ENVIRONMENTAL) Mr. Kolijn performed a site inspection, numerical modelling and preliminary engineering design for the rehabilitation, nourishment and stabilization of a parcel of coastal property along the Caicos Bank of Providenciales.

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- THOMPSON COVE, TURKS AND CAICOS ISLANDS (PRIVATE CLIENT) CBCL Limited assisted the client with
 permitting and planning applications for beach stabilization and development. A site visit was
 conducted and application drawings prepared for the TCI Planning Department.
- LEEWARD COVE CONDOMINIUM DEVELOPMENT, ST. KITTS AND NEVIS (PRIVATE CLIENT) An eroding shoreline at
 a condominium development in St. Kitts resulted in the destruction of beach infrastructure and
 placed the property at risk. CBCL conducted a site investigation, sediment sampling, beach profile
 measurements, wave modelling, XBeach cross-shore dune modelling, and development of
 stabilization concepts.
- RIDEAU RIVER WATER QUALITY MODEL STUDY, CANADA (CITY OF OTTAWA) As part of an effort to quantify water quality indicators along the Rideau River in the greater Ottawa area, Mr. Kolijn undertook a number of numerical modeling tasks. Discharge in the Rideau River was modeled to estimate extents of Total Phosphorous and *E.Coli* plumes.
- TORONTO WATERFRONT LAKESHORE BOULEVARD BREAKWATER INSPECTION (TORONTO REGIONAL CONSERVATION AUTHORITY) - Mr. Kolijn inspected 4 kilometers of waterfront breakwater infrastructure using UAV technology. The project required close coordination with NAV Canada to coordinate aerial inspection near the Billy Bishop International Airport. The inspection was based on seamless orthoimagery, survey control on the breakwater, and a 3-dimensional model of the structure.
- COASTAL ZONE MANAGEMENT & ENGINEERING STUDY AT CAP-DE-VILLE, TRINIDAD & TOBAGO (NIPCO) Mr.
 Kolijn assisted in the design of shoreline protection along a stretch of eroding coastline at Cap-De-Ville Trinidad. The coastal protection measures incorporate effects of climate change, hurricanes, and considers recreational use, aesthetics and economic activities in the area.
- POROUS DIKE INTAKE STRUCTURE BAILLY GENERATING STATION, USA (WISCONSIN ELECTRIC POWER) As part of
 the design development process, Mr. Kolijn performed various numerical desktop studies analyzing
 the flow-through and stability performance of the porous dike. Design and construction
 recommendations were made using the hydrodynamic analysis.
- COASTAL RISK ASSESSMENT AND MANAGEMENT PROGRAM (CRMP), BARBADOS (IDB) Developed 2D and 3D computational water quality, wave, circulation and surface-flow models at various locations in Barbados, incorporating a wide range of environmental drivers, modeling the impact with and without climate change stressors. Conducted institutional strengthening workshop with various government agencies including training courses and workshops focusing on island water security.
- ARTIFICIAL OYSTER REEFS, THE NETHERLANDS (RIJKSWATERSTAAT) As part of an estuary stabilization program, Mr. Kolijn managed the coordination and installation of natural sediment traps using oysters in an intertidal region in the Netherlands.

MULTI-DISCIPLINARY PROJECT MANAGEMENT

- PLACENCIA LAGOON NUTRIENT FATE STUDY, BELIZE (BWS CDB) Mr. Kolijn is the project manager for a
 (\$1M +) nutrient fate study in the Placencia Lagoon, Belize to determine the citing of a future
 wastewater treatment plant. Responsibilities include managing sub-consultants, a 12-month surface
 ground and lagoon water quality monitoring campaign, collection of microalgae for stable isotope analysis to determine nutrient distribution in the lagoon, an order-1 hydrographic survey,
 coordinating extensive ground, surface, oceanic and coastal processes modelling in Delft-3D,
 PCSWMM and Mike FEFLOW, reviewing climate modelling with researchers and experts, and
 facilitating various workshops and deliverables.
- PORT REDEVELOPMENT AND MASTER PLANNING, TURKS AND CAICOS ISLANDS (TCI PORTS) Mr. Kolijn was the
 project manager for a port master planning consultancy at South Dock in the Turks and Caicos
 Islands. The project had three central themes, Economics, Infrastructure, and Master Planning. A 30
 year planning window was used, where more than 40 stakeholders were interviewed, economic
 projections for the island were established, and financing strategies developed to fund the port.
 Preliminary designs and cost estimates for the first two (2) phases were developed by CBCL, and
 infrastructure delivery models assessed with the Client. A regional Port fact finding mission was

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- completed with the Port to incorporate regional best practices. CBCL also assisted in tendering and project implementation processes.
- POST-HURRICANE SHORELINE AND INFRASTRUCTURE CONDITION ASSESSMENT, TURKS AND CAICOS ISLANDS (GOVTCI) —
 Mr. Kolijn was the project manager to assess beach loss and coastal infrastructure condition, after the
 passage of Hurricanes Maria and Irma on South Caicos, Grand Turk and Providenciales. The project
 concluded with an inventory of asset and natural resource condition, recommended steps to mitigate
 immediate, mid- and long- term vulnerabilities, and general guidance on enhanced coastal zone
 management in the face of climate change and future hurricane conditions.

PORT INFRASTRUCTURE & MASTER PLANNING

- VARDY'S ISLAND PORT-AUX-BASQUES CHANNEL DESIGN, NEWFOUNDLAND (MARINE ATLANTIC) Mr. Kolijn
 designed a re-aligned one-way arrival and departure channel for the Port-aux-Basques ferry
 terminal using PIANC 2014 guidelines. A UAV survey was also completed to assess existing
 infrastructure affected by the re-alignment of the channel.
- MIRAMICHI NAVIGATION CHANNEL DESIGN (GROUPE DESGAGNÉS INC.) Mr. Kolijn managed the design of a
 new multi-user shipping channel using PIANC 2014 guidelines. Environmental information was
 sourced from a detailed hydrodynamic and sediment transport numerical model. The channel
 design was presented in a series of drawings and discussed with vessel Pilots, the Canadian Coast
 Guard and the client. Feedback was incorporated for final channel design.
- SYDNEY CRUISE BERTH DESIGN, NOVA SCOTIA, CANADA (CBRM) Mr. Kolijn performed wave load
 calculations on a proposed cruise berth structure using the American Association of State Highway
 and Transportation, Guide Specifications for Bridges Vulnerable to Coastal Storms. A number of
 scenarios were assessed to determine a combination of slamming, uplift, horizontal and vertical
 wave forces on the structure.
- PORT INFRASTRUCTURE INSPECTION, TURKS AND CAICOS ISLANDS (TCI PORTS) Mr. Kolijn visited the ports in Grand Turk, South Caicos, and Grand Turk to inspect infrastructure condition.
- NAVIGATION AND CHANNEL OPTIMIZATION STUDY, PORT HEDLAND, AUSTRALIA (BHP) Mr. Kolijn participated in the study of a vessel departure and arrival dredging study and performed various analytical tasks associated with navigation and channel design. Results from the SimFlex model were assessed.
- DIGBY HARBOUR BUSINESS AND INFRASTRUCTURE PLAN (DIGBY HARBOUR PORT AUTHORITY) As part of a port
 master planning strategy, Mr. Kolijn estimated future climate change impacts and wave conditions
 for a number of proposed port layouts.
- PORT OF SUMMERSIDE DREDGING STUDY (SUMMERSIDE PORT CORPORATION INC.) As part of the port
 maintenance plan, Mr. Kolijn investigated the disposal of dredge material in a series of numerical
 models to understand dredge material dispersal upon placement at disposal sites. The study
 supported environmental approvals required to complete dredging at the port.

CLIMATE CHANGE ADAPTATION & WATER RESOURCES INFRASTRUCTURE

- INCORPORATING CLIMATE RESILIENCE FOR MUNICIPAL INFRASTRUCTURE INTO THE UPDATES FOR EXISTING ATLANTIC
 CANADA WATER AND WASTEWATER DESIGN GUIDELINES, ATLANTIC CANADA WATER & WASTEWATER ASSOCIATION,
 2019 (ONGOING). Mr. Kolijn is the lead for Climate Resilience and Adaptation. The objectives of the
 project are to incorporate climate resilience when investigating, designing, approving, constructing,
 and operating municipal water and wastewater infrastructure in Atlantic Canada. Mr. Kolijn is
 responsible for including a new chapter on Climate Resilience into each of the Guidelines, update of
 the existing sections to include climate resilience requirements, and to build climate adaptation
 capacity through training workshops, webinars and dissemination of information.
- TRANSPORTATION ASSETS RISK ASSESSMENT (TARA) TO CLIMATE CHANGE VULNERABILITIES AND RISKS, TRANSPORT
 CANADA. Assisted with the development of workshop structure through PIEVC training to identify
 climate change vulnerabilities and risks, at 9 key transportation infrastructure assets in Atlantic
 Canada including 2 airports and 6 ferry terminals and the Confederation Bridge.

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- CONSULTANCY TO DEVELOP ADAPTATION MEASURES TO COUNTER THE EFFECTS OF CLIMATE CHANGE WITH A FOCUS
 ON WATER RESOURCE MANAGEMENT AND FLOOD RESILIENCE, BARBADOS (USAID) Mr. Kolijn developed a
 number of surface water models including complex 2D HEC-RAS stream flow models containing a
 variety of existing and proposed infrastructure features. These models incorporated the anticipated
 effects of climate change. The drainage structures were sized and designed to a level appropriate
 for inclusion in the numerical model.
- LAKE ERIE NEARSHORE WATERS BASELINE ASSESSMENT EFFECTS OF CLIMATE CHANGE AND INVASIVE SPECIES,
 CANADA (ENVIRONMENT AND CLIMATE CHANGE CANADA) Investigation of storm surges along Lake Erie
 from Long Point to Fort Erie and the effects of climate change on water levels, coastal erosion,
 species, social and economic factors. Additional activates included UAV flights to catalog the
 shoreline ecology and type.

OCEANOGRAPHY, NUMERICAL MODELING AND SOFTWARE DEVELOPMENT

- UAV USE IN COASTAL ENGINEERING RAINING COURSE, BAHAMAS Mr. Kolijn led a 2 day workshop to
 develop shoreline and coastal monitoring methods using UAV technology and photogrammetry
 programs.
- FLNG HEADING AND DOWNTIME ANALYSIS, MIDDLE EAST Heading analysis of a FLNG with tidal and current influences to facilitate mooring of LNG vessels.
- Extensive experience with coastal numerical models including DHI MIKE21, SWAN, Delft3D, HYCOM/NCOM, DELWAQ, XBEACH, and development of in-house models with MATLAB.

PUBLICATIONS AND CONFERENCES

- J. A. Daraio, A. Amponsah, D. Kolijn, 2020, Incorporating Climate Change in Water Resources Infrastructure Design under Uncertainty, Adaptation Canada 2020, Vancouver, Canada
- Kolijn D., 2019, Port Redevelopment and Modernization, a Caribbean Perspective on Port Master Planning, Financing Structures and Project Delivery, Strategic Session of P.M.A.C. 22nd Annual General Meeting, Fort Lauderdale, USA
- Kolijn D., 2019, Climate-Resilient Coastal Natural Infrastructure Workshop, Panel Discussion Nature-Based Adaptations, NRCAN, St. Mary's University, Halifax, Canada.
- Kolijn D., 2018, Bottom-up Approaches to Climate Vulnerability Risk in Asset Management and Infrastructure Development a Caribbean Perspective, Curacao Maduro & Curiel's Bank Speaker Series, 2018 Willemstad, Curacao
- Leys, V., Kolijn D., Fernandez V., 2018, Small Craft Harbour Design: Engineering Methods And Insights To Improving Functionality, Maintenance And Safety Of Existing And New SCH Facilities In Atlantic Canada, CZC 2018 Conference & Young Professional's Forum St. John's Newfoundland.
- Kolijn D., Zuzek P., Clark G., SA-1 Special Announcement, Cold Regions Living Shorelines (CRLS)

 Community of Practice (CoP), CZC 2018 Conference & Young Professional's Forum St. John's Newfoundland, www.ccadaptation.ca/en/crlscop
- Kolijn D., 2018, Mitigating Excessive Wave Agitation and Swell Conditions in Caribbean Port Facilities, Strategic Sessions, 21st Annual General Meeting Port Management Association Of The Caribbean, Jamaica
- Kolijn D., 2018, Building cost-effective in-house port asset inspection and inventory tracking capacity using unmanned aerial vehicle technology, Technical Sessions, 21st Annual General Meeting Port Management Association of the Caribbean, Jamaica
- v. Berkel J., Kofoed-Hansen H., Kolijn D., 2018, Developing and Maintaining Hospitality Infrastructure, DHI Webinar Series, https://youtu.be/TR74dn-pCUk
- Kolijn D., 2018, Lessons learnt from 2017 hurricane season and future harbour designs to cope with climate change, Port Management Association of the Caribbean, PMAC-Portside Port management workshop, Panama

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- Kolijn D., 2017, Resilient Coastal Infrastructure & Tourism Industry Adaptation In the face of climate change, Climate Smart Sustainable Tourism Forum, Innovative Models and Best Practices in Sustainable Tourism, St. Kitts
- Kolijn D., Fullarton M., Scott D., MacLennan D., 2016, Ottawa River Water Quality Model Improvement Study, International Symposium on Outfall Systems, Ottawa, Ontario
- Kolijn D. 2015, Artificial underwater structures as a coral reef canopies: hydrodynamic and ecological connectivity, Scientific meeting of the Association of Marine Laboratories of the Caribbean, Curacao
- Kolijn D. 2014, Effectiveness of a multipurpose artificial underwater structure as a coral reef canopy, Young Coastal Scientists and Engineers Conference North America, Newark, DE, USA

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AREAS OF SPECIALTY

Coastal Engineering, Coastal monitoring and beach management, Marine scour and sediment transport processes.

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Member of Engineers Nova Scotia

EDUCATION

BASc Civil Engineering, Queen's University, CAN
 MASc Civil Engineering, Queen's University, CAN

PROFESSIONAL TRAINING

2018 Deltares Delft3D waves, hydrodynamics, and morphodynamics modelling courses, Delft, NL

2016 Coastal management and processes course, Wallingford, UK

EXPERIENCE

Esther Gomes joined CBCL Limited as a Coastal Engineer in Training in 2018, bringing with her over 2 years of international experience relating to sediment transport concerns in marine and coastal environments. Ms. Gomes has contributed to a wide variety of projects including beach morphology and management, port and harbour design, marine scour, and other sediment transport concerns with experience in data collection and analysis; design, management and operation of physical models; and numerical modelling of morphological responses. She has over 4 years of experience with oceanographic instrumentation and data collection, including the configuration, processing, analysis, and presentation of data. Ms. Gomes has international experience in coastline and beach management studies including the use of numerical models, historic data analysis, and design of beach stabilization structures for areas including Canada, the United Kingdom, and the Caribbean.

Relevant projects that Ms. Gomes has participated in are as follows:

- SHORELINE MONITORING AND COASTAL MANAGEMENT PLAN, PEI, CANADA (PARKS CANADA, ONGOING) —
 Comprehensive monitoring program along the north shore of Prince Edward Island to support the
 development of a shoreline management plan for the National Park. Ms. Gomes is the lead field
 technician, overseeing the 2-year monitoring program including the collection of multidirectional
 wave measurements, current profiles, water level monitoring, bathymetry, and topographic
 surveying. The project includes data analysis and numerical modelling of waves, hydrodynamics,
 hurricanes, sediment transport, beach erosion and shoreline position.
- COASTAL ENGINEERING STUDIES AT ATLANTIC CANADA HARBOURS (GOVERNMENT OF CANADA, 2018-2020) —
 Contributed and developed 2D wave, tidal circulation and sediment transport models at South Bar,
 Glace Bay, Lower East Pubnico, Tiverton, and Centreville SCHs. Tasks involved include the study of
 metocean conditions, assessment of existing problems and concerns, consultation with local
 stakeholders and the client, field program involving measurement of waves and currents, and
 generating solutions and engineering designs including engineering drawings, cost estimates and
 presenting the anticipated performance of the structure.
- WATER TREATMENT PLANT FLOOD STUDY, NS, CANADA (TOWN OF LUNENBURG, 2020) Ms. Gomes was part of
 a project team working to evaluate wave and storm surge related flooding to a water treatment
 plant. CBCL's large-scale hurricane model was utilized in this study to simulate storm surge along
 Nova Scotia's South Shore.

- HALIFAX HARBOUR COASTAL STUDY, NS, CANADA (TOWN OF LUNENBURG, 2020) Ms. Gomes was part of a
 project team investigating long-term flooding in the Halifax Harbour related to sea level rise. Crossshore numerical wave modelling was completed to determine wave run-up limits to support future
 developments and mitigate SLR impacts.
- PORT-AUX-BASQUES NAVIGATION IMPROVEMENTS, NL, CANADA (MARINE ATLANTIC, 2020) Field monitoring campaign to collect oceanographic data within Port-aux-Basques harbour to support a navigation assessment. Ms. Gomes was the lead field technician in deploying a bottom mounted ADCP to measure directional wave parameters and current profiles, and four pressure gauges to monitor water levels and wave parameters.
- HYDRODYNAMIC BRIDGE ASSESSMENT, NB, CANADA (NB DEPARTMENT OF TRANSPORTATION & INFRASTRUCTURE, 2020) – Development of coupled hydrodynamic-sediment transport numerical model to investigate complex regime surrounding the Acadian Peninsula in NB. Configuration options for updated bridge and dully layouts were evaluated based on their impacts to the tidal propagation through the system and any significant changes to sediment transport patterns.
- COASTAL REVETMENT DESIGN, NB, CANADA (NB DEPARTMENT OF TRANSPORTATION & INFRASTRUCTURE 2020) —
 Assessment of local conditions and redesign of coastal roadside revetment that sustained significant
 damage during Hurricane Dorian.
- OYSTER BED BRIDGE DESIGN, PEI, CANADA (PEI DEPARTMENT OF TRANSPORTATION, INFRASTRUCTURE & ENERGY 2019) – Ms. Gomes was part of a project team to develop replacement bridge options in PEI. Ms. Gomes completed hydrodynamic modelling of the region to determine design water levels and tidal current speeds to support design considerations.
- CLIMATE CHANGE IMPACTS AND PROJECTIONS FOR THE NATIONAL CAPITAL REGION, ON, CANADA (NATIONAL
 CAPITAL COMMISSION, 2019) Analysis of climate projections and indices to evaluate the impacts of
 climate change on the region of Ottawa with attention to a wide variety of sectors and stakeholders.
 Climate model ensembles were investigated to develop a tailored list of indices and graphical
 representations.
- LAMEQUE SHIPPAGAN TIDAL STUDY, NB, CANADA (DEPARTMENT OF TRANSPORTATION & INFRASTRUCTURE, 2018) —
 Hydraulic and sediment transport assessment Shippagan Bay to aide in the design of a new bridge
 crossing at Lameque. Assisted field data collection of water level gauges and ADCP riverboat
 transect surveys. Ms. Gomes developed the hydrodynamic and sediment transport models of the
 area to investigate the existing regimes.
- COASTAL STUDY FOR FISHING SLIPWAY OPTIONS, NL, CANADA (GOVERNMENT OF CANADA, 2018) Assessment of
 historic shoreline positions and beach erosion at a gravel beach in Newfoundland. Ms. Gomes
 analysed historic data in the area and carried out numerical modelling studies to predict future
 changes to shoreline position and beach profile evolution. Longshore sediment transport trends
 were investigated to determine the most appropriate location to construct a slipway structure for
 day fishing.
- TRANSPORTATION ASSETS RISK ASSESSMENTS TO CLIMATE CHANGE, CANADA (GOVERNMENT OF CANADA, 2018) —
 Investigation of climate change vulnerabilities and risks to 9 transportation assets located in Atlantic
 Canada. Ms. Gomes manipulated and analysed data from global and regional climate models
 relevant to the concerns tailored to each asset.
- CLIFF EROSION AND COASTAL STABILIZATION, DOMINICAN REPUBLIC (2019) Assessment of coastal design solutions for the stabilization of cliff section in Dominican Republic. Ms. Gomes developed a largescale hydrodynamic model of the Caribbean region to model historic and projected future hurricanes and their impact on the study site.
- SHORELINE STABILIZATION, ST KITTS AND NEVIS (2019) Evaluation of a beach stabilization structure for a sandy beach on St Kitts. Study included historic review of shoreline position, wave and current modelling to investigate the sediment transport and hydrodynamic regimes of the area.

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Esther GOMES

- PORT REDEVELOPMENT AND MASTER PLANNING, TURKS AND CAICOS ISLANDS (TCI PORTS, 2018) Development
 of a Port Masterplan for South Dock in the Turks and Caicos Islands. Ms. Gomes was a contributing
 team member in the infrastructure planning and risk assessment strategies for the port.
- REMEDIATION OF A SEABED-LAID PIPELINE, VIETNAM (2018) Assessment of sediment transport potential and free-span development along 200km of a seabed laid pipeline in the South China Sea including providing advice on remedial works to prevent structural damage to pipeline.
- LIQUEFACTION AND SCOUR ASSESSMENT OF A DESALINATION PLANT OUTFALL, MIDDLE EAST (2018) Liquefaction
 and scour assessments for proposed intake and outfall structures and pipeline located in the Red
 Sea.
- BEACH MONITORING STUDY, UNITED KINGDOM (2017) Desk based study involving the presentation, analysis, and interpretation of beach monitoring data collected annually from a port and surrounding beach in England. Ms. Gomes was the technical lead and project
- OFFSHORE WIND FARM SCOUR PROTECTION, NORTH SEA (2017) Physical modelling of a preliminary design
 of the scour protection system in combination with the foundation design to assess performance in
 terms of scour development.
- OFFSHORE WIND FARM SCOUR MONITORING STUDY, UNITED KINGDOM (2017) Historic review of the sediment morphology and mobility in a Scottish wind farm in order to predict changes in bed level over the next 20 years. A series of acoustic sensors mounted on wind turbine monopiles produced a high-temporal-resolution dataset of marine scour at the monopile foundation for analysis and interpretation.
- COASTAL AND ENVIRONMENTAL IMPROVEMENTS ON WELSH BEACH, UNITED KINGDOM (2017) Desk study of
 historic sediment transport in the region and development of a beach management plan including
 update to the local council Tidal Flood Risk Assessment for the area to satisfy the coastal defense
 and amenity requirements of the Local Authority.

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AREAS OF SPECIALTY

Coastal Engineering, Wave Modeling

EDUCATION

2014 M.A.Sc. in Civil Engineering, University of Ottawa, Canada 2011 B.A.Sc. in Civil Engineering, University of Ottawa, Canada

PROFESSIONAL TRAINING

2018 Delft3D – User Days: Coastal Hydrodynamics Modelling, Delft, NL

2018 Delft3D – User Days: Environmental Modelling, Delft, NL

2015 Numerical and Experimental Modelling and Control of Wave Energy Converters, Nantes, FR

EXPERIENCE

Ms. Piché has 2 year of scientific and engineering consulting experience in Canada. Prior to joining CBCL in 2018, Ms. Piché was a research student at the National Research Council of Canada. She has provided scientific and engineering expertise on a wide variety of coastal projects. Highlights include:

COASTAL ENGINEERING

- COASTAL ENGINEERING STUDIES AT ATLANTIC CANADA HARBOURS (GOVERNMENT OF CANADA) Modeling of
 wave, currents and sediment transport, engineering design for breakwaters and wharfs. Project
 required the study of metocean conditions, assessment of existing problems and concerns,
 consultation with local stakeholders and the client, measurement of waves, and modeling the
 existing wave conditions.
 - NB Ingalls Head.
 - NS Neils Harbour, Margaretsville, Centreville.
 - NFL Charlottetown, Coombs Cove, Torbay, O'Donnells.
- COASTAL STUDY AT SAINT JOHN FERRY TERMINAL (GOVERNMENT OF CANADA) Ms. Piché assisted in the
 modeling of wave agitation, and mud transport to investigate agitation concerns at the Digby ferry
 terminal in St. John, NB. A series of numerical models were developed to investigate agitation and
 sediment transport and to present solutions. Cost estimates and preliminary designs of the solutions
 were provided.
- WAVE CLIMATE AND RESOURCE MODELING (NATIONAL RESEARCH COUNCIL) Ms. Piché conducted a 10 year hindcast of the wave climate and power resource along the western coast of Vancouver Island using SWAN as part of her PhD research. This process included analysis of long-term trends and climate within the region.
- Avon River Aboiteau and Causeway Replacement Design Development of a hydrodynamic model of
 the Avon River and surrounding areas for phase 1 of the project using MIKE. Modeling of the fishway
 structure using openFoam to assess the potential for fish passage.

FLOOD MITIGATION AND RIVER MODELING

ASSESSMENT OF CANADIAN FLOODPLAIN MAPPING AND SUPPORTING DATASETS (NATIONAL RESEARCH COUNCIL) —
 Assessment of the state of floodplain mapping within the Territories and the collection of relevant
 datasets for potential future modeling.

Steffanie PICHÉ

- LIVERPOOL COASTAL FLOODING MITIGATION STUDY (REGION OF QUEENS MUNICIPALITY) Assessment of the tidal
 elevations including storm surge and climate change to delineate coastal floodlines for the City of
 Liverpool.
- INLAND FLOODPLAIN MAPPING (MUNICIPALITY OF THE DISTRICT OF LUNENBURG) Comprehensive flood
 assessment for the municipality of the districts of Lunenburg and Chester to determine the 1-20 year
 and 1-100 year floodlines. Project required the study of precipitation and flow conditions,

OCEANOGRAPHY AND NUMERICAL MODELING

 Extensive experience with coastal and hydraulic numerical models including DHI MIKE21, PCSWMM, and SWAN.

PUBLICATIONS

Piche. S., Nistor, I., Murty, T., (2013). Propagation and Attenuation of Tsunami-Induced Bores over Wetlands, International Journal of Ecology and Development, IJED, (accepted, in print), 18 p.

CONFERENCES

- Piche. S., and Nistor, I., (2013). Modeling of the Attenuation of Hydraulic Bores by Coastal Forests using the SPH Method, 2013 Annual Conf. of the Canadian Society of Civil Eng., CSCE, Montreal, Canada.
- Piche, S., Nistor, I., Murty, T., (2014). Numerical Modeling of Debris Impacts Using the SPH Method, 34th International Conf. on Coastal Engineering, ICCE, Seoul, South Korea.
- Cornett, A., Toupin, M., Baker. S., Piche, S., Nistor, I., (2014). Appraisal of IEC Standards for Wave and Tidal Energy Resource Assessment, International Conference on Ocean Energy, ICOE 2014, Halifax, Canada.
- Piche, S., Cornett, A., Baker. S., Nistor, I., (2015). Appraisal of the IEC Technical Specification for Assessment of Wave Energy Resources, ASME 34th International Conference on Ocean, Offshore and Arctic Engineering, OMAE, St. John's, Canada EWTEC.
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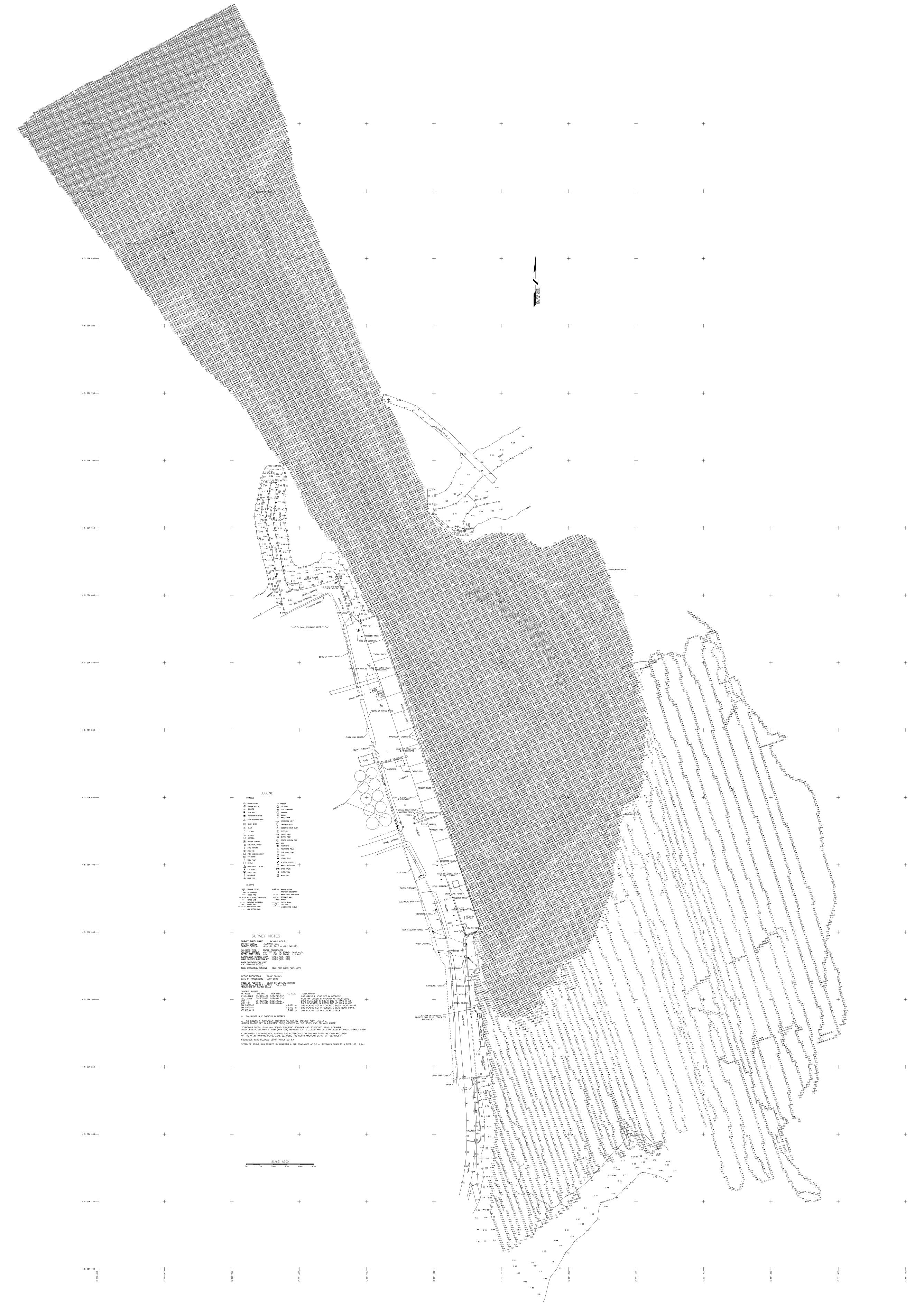
CBCL Limited Page 2 of 2

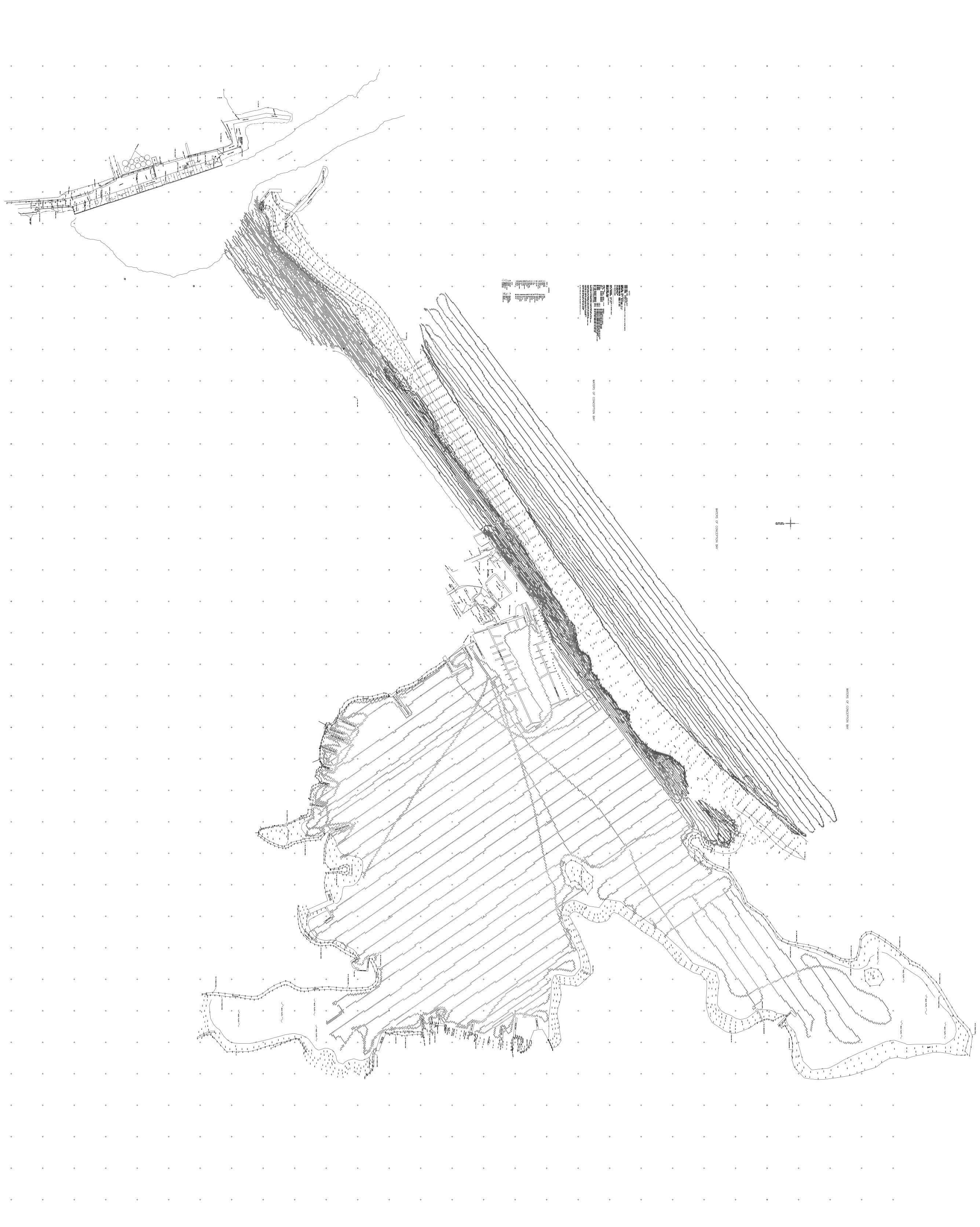


Solutions today | Tomorrow (n) mind

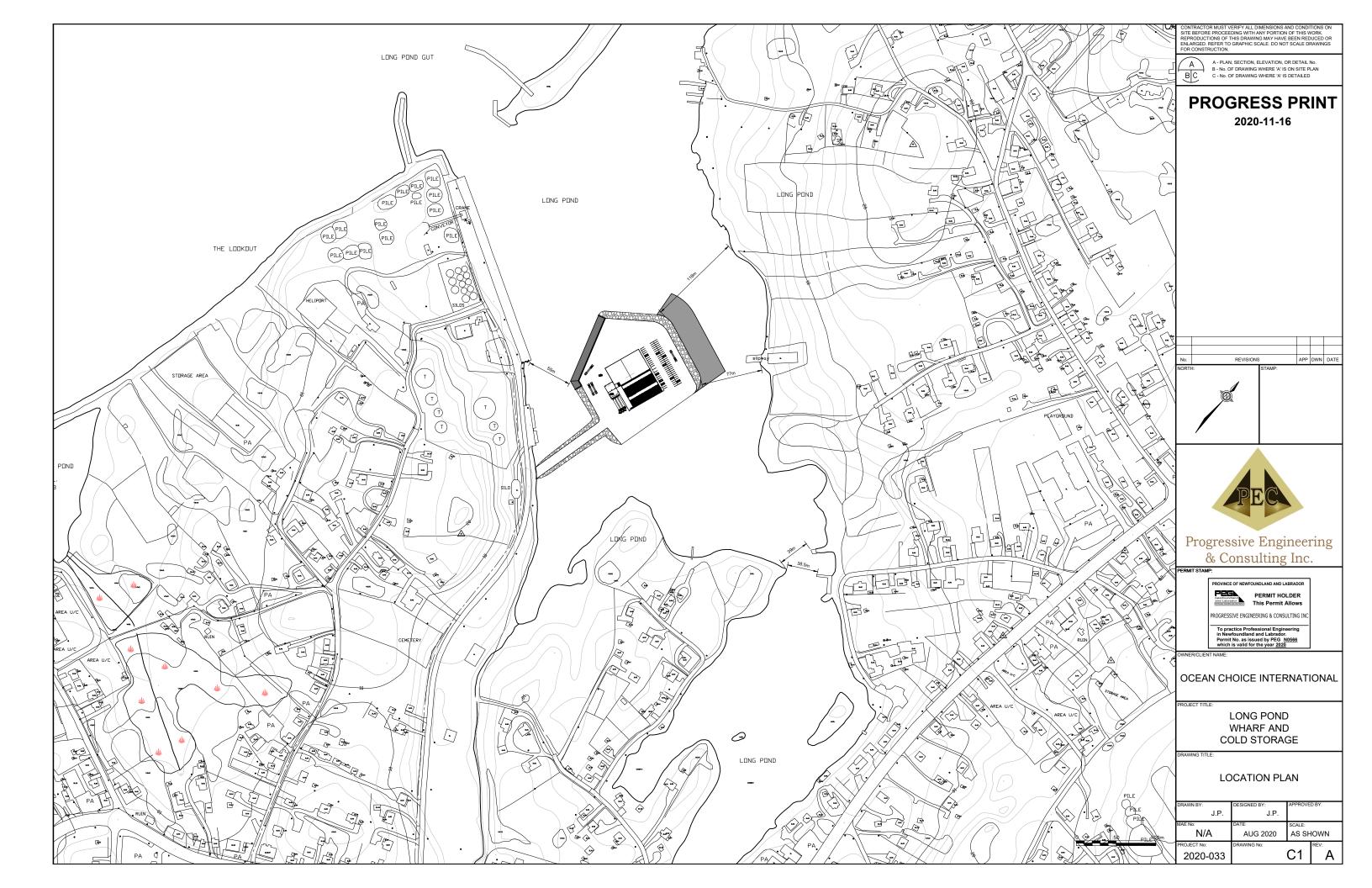


Appendix H





Appendix I



Appendix J



Coastal Engineering Study Conceptual Design of East Breakwater Upgrade



Model Calibration & Conceptual Breakwater Design Update St John's, CBCL

Monday, 28th January, 2019

Calvin Hollet, calvinh@cbcl.ca Danker Kolijn, dkolijn@cbcl.ca



- 1. Review of 2018 Coastal Engineering Study
- 2. Discussion on risk & uncertainty
- 3. Wave gauge deployment & findings

- 4. Model calibration
- 5. Design validation
- 6. Next steps





The Situation

Existing Conditions

- 2015: CBCL conducted a detailed engineering inspection of the LPHA facilities.
 - recommended conceptual design options to rehabilitate East breakwater structure.
- 2018: CBCL completed conceptual coastal engineering study.









Review

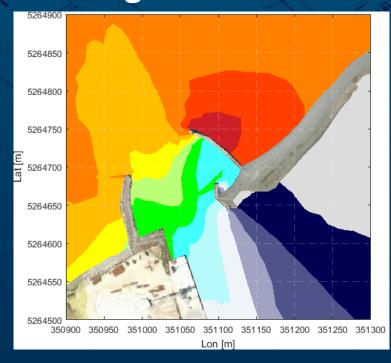
Three rehabilitation options considered:

- Option 1: Encapsulating the existing breakwater with armourstone.
- Option 2: Removing half of the existing breakwater and encapsulating the remaining half with armourstone.
- Option 3: Complete removal of the breakwater.

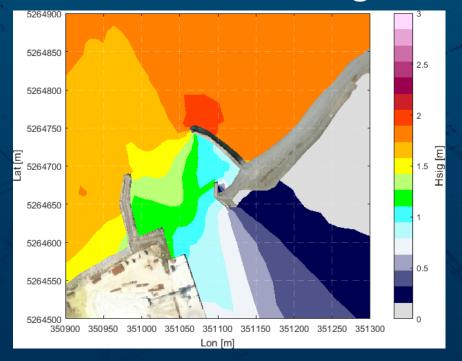


Findings

Existing Conditions

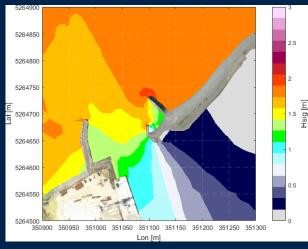


OPTION 1 (preferred) Breakwater – full length

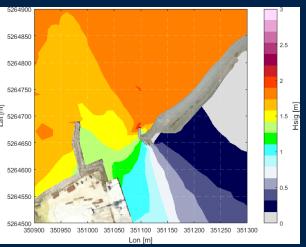


other options

OPTION 2 Breakwater – ½ length



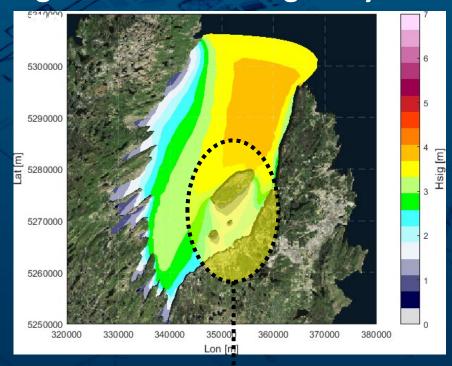
OPTION 3
Breakwater – removed



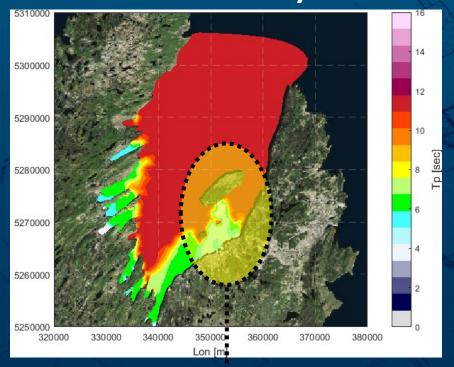


Design Conditions

Significant Wave Height:1-year



Peak Wave Period:1-year RTP

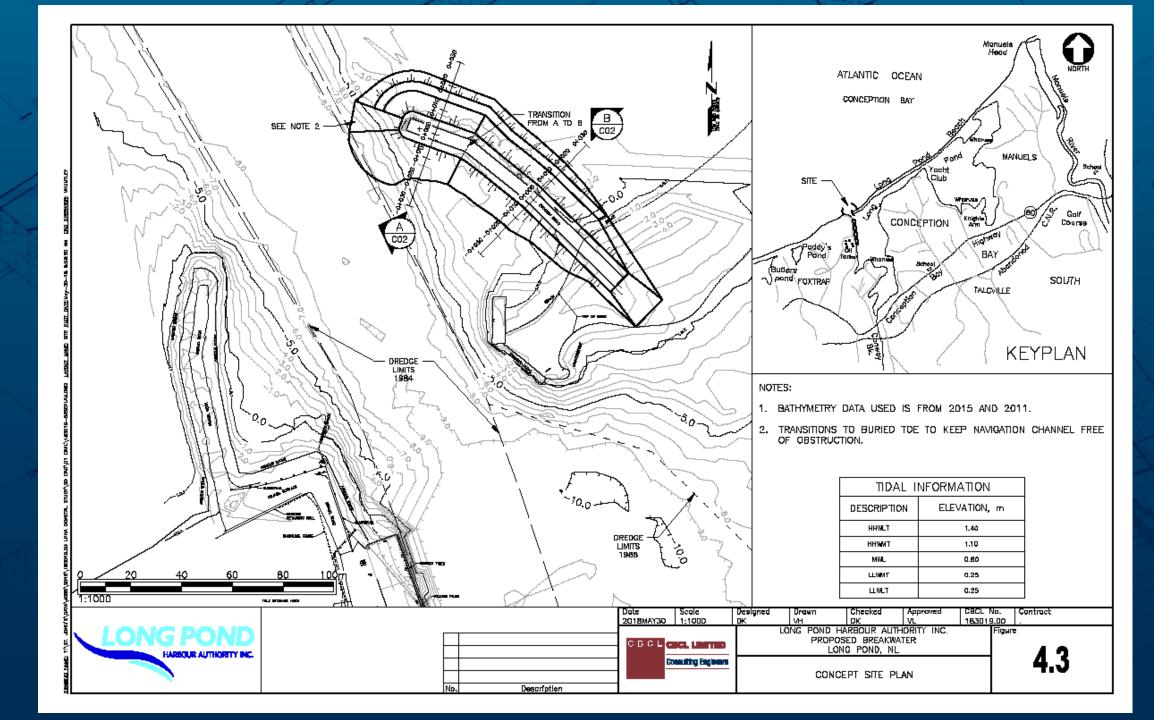


Model uncertainty between Bell Island and LPH introduces significant design <u>risk</u>

Design parameters

Significant wave height H _{sig}	2.80 m
Mean wave period T _{m1,0}	6.00 s
Specified Grading Head	5 – 7 tor
Specified Grading Trunk	3 – 5 tor
Armour Crest Elevation	5.35 m (
Crest Width	5.00 m
Filter Layer Head	600 kg
Filter Layer Trunk	400 kg







Recommendation

Suggested recommendations prior to a detailed design:

 Conduct a wave measuring campaign to calibrate the numerical models.



- 2. Assess the structural capacity of the existing structure to bear the armour stone cap loading.
- 3. Conduct a more detailed bathymetric survey and topo to refine conceptual drawings.
- 4. Investigate bed conditions & geotechnical suitability at the proposed structure footprint.





PHASE 2

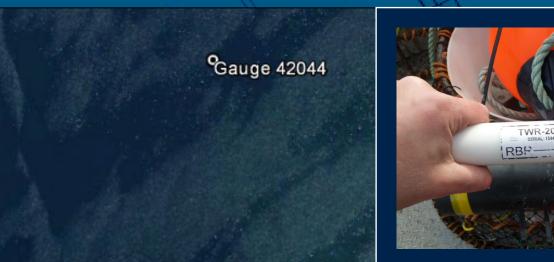
Wave Measurement Campaign + Model Calibration & Design Validation



Wave Measurement Campaign

Deployment

- Deployed from October 12th, 2018 to November 21st.
- Large storm event recorded on November 15th to 16th.





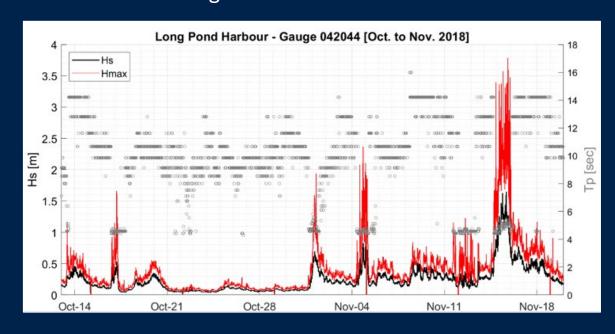




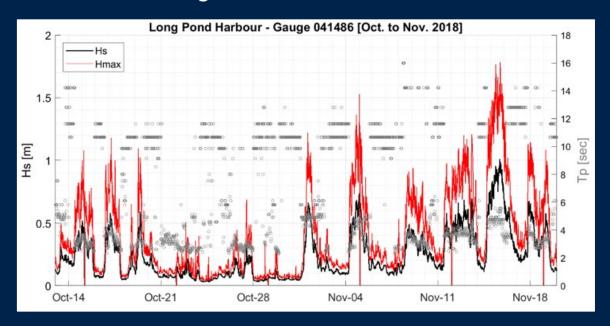
Wave Measurement Campaign

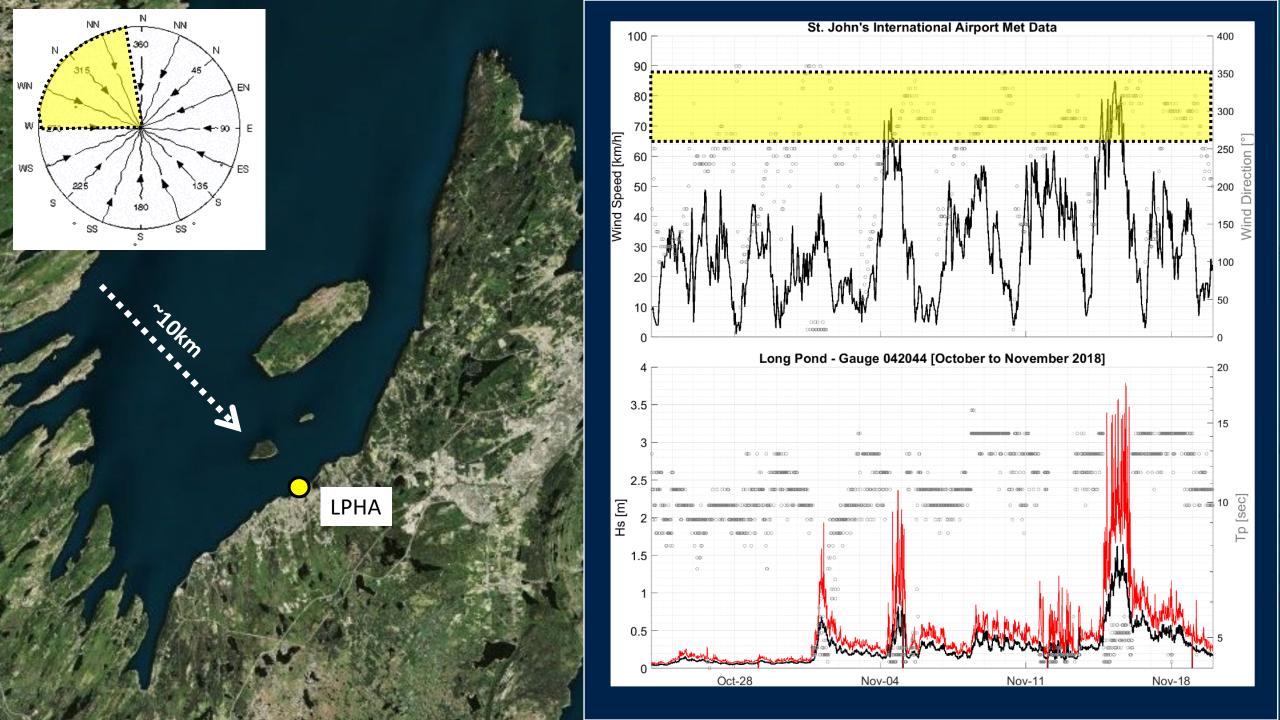
Results

Outer Harbor Gauge



Inner Harbor Gauge



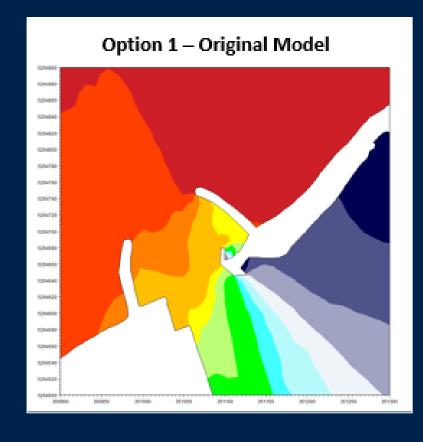


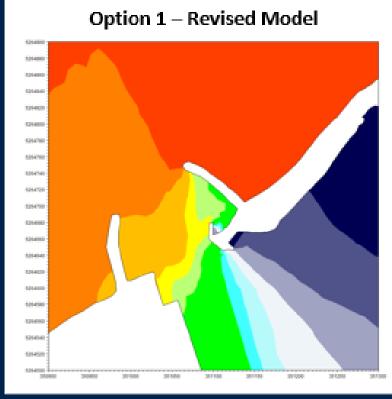


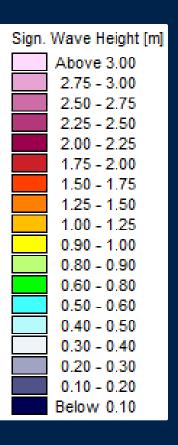
Model Calibration

Results

- Took 42 modelling iterations to get the conditions right
- Over-estimated waves by 20% for 100-year condition









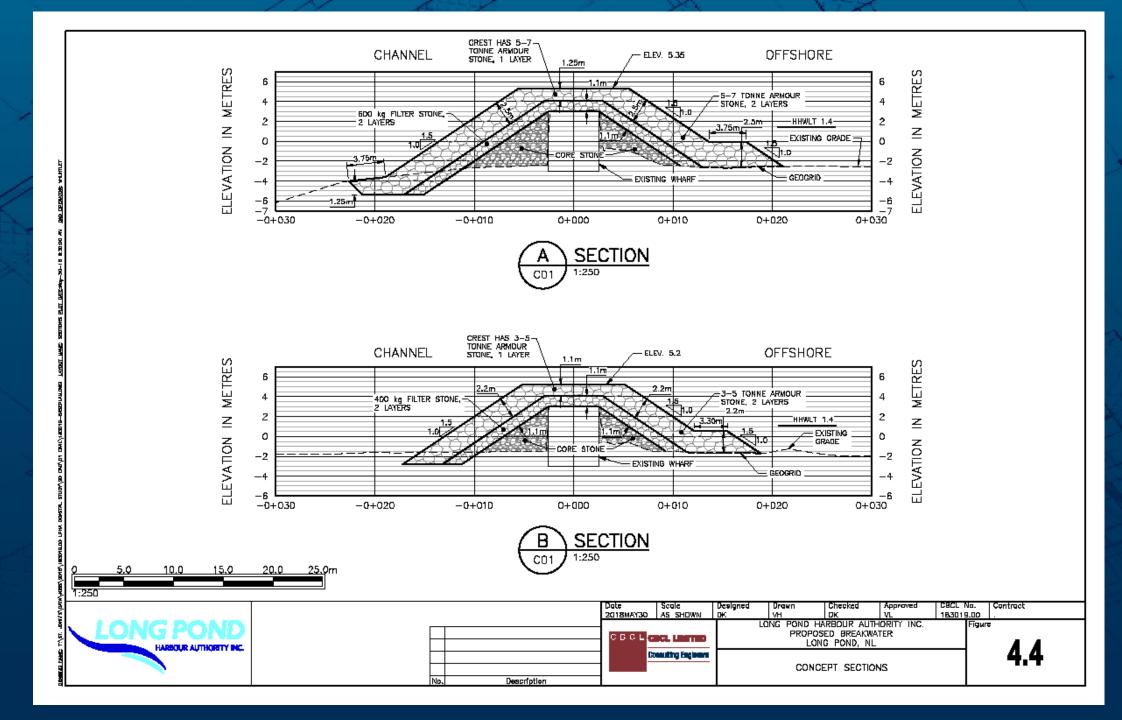
Design Validation

Results

Design risk and uncertainty have been mitigated.

Design Parameters	Unit	Original Design	Revised Design
Significant wave height H _{sig} – Head	m	2.80	2.30
Significant wave height H _{sig} – Trunk	m	2.70	2.20
Mean wave period T _{m1,0}	S	6.00	7.50
Specified Grading Head	Т	5 – 7	5 – 7
Specified Grading Trunk	Т	3 – 5	3 – 5
Filter Layer Head	kg	600	600
Filter Layer Trunk	kg	400	400

Energy Component





Coastal engineering study

Conclusions

Suggested recommendations for a detailed design:

- 1. Conduct a wave measuridg campaign to calibrate the numerical models.
- 2. Assess the structural capacity of the existing structure to bear the armour stone cap loading.
- 3. Conduct a more detailed bathymetric survey and topo to refine conceptual drawings.
- 4. Investigate bed conditions & geotechnical suitability at the proposed structure footprint.



Coastal Engineering Study Conceptual Design of East Breakwater Upgrade

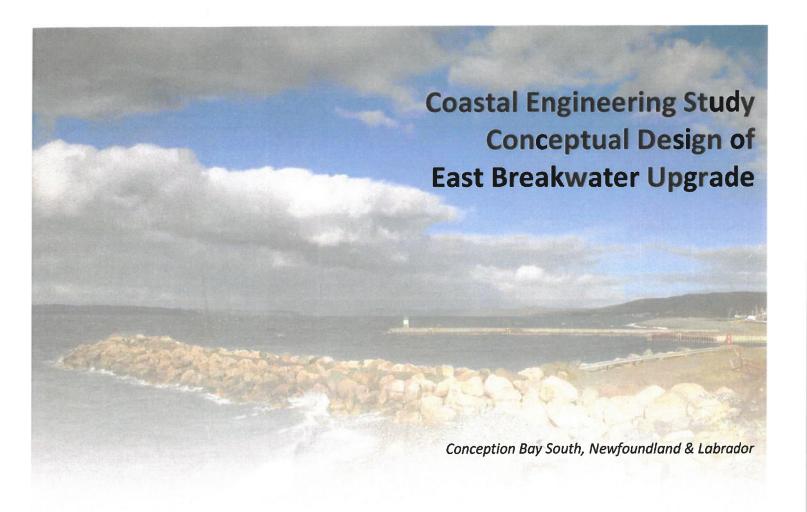


Model Calibration & Conceptual Breakwater Design Update St John's, CBCL

Monday, 28th January, 2019

Calvin Hollet, calvinh@cbcl.ca Danker Kolijn, dkolijn@cbcl.ca

Appendix K









183019.00 • Final Report • August 2018

ISO 9001 Registered Company Prepared for:

Long Pond Harbour

Authority Inc.



				A
Final Report		Vincent Leys	2018/08/03	Danker Kolijn
Draft Report		Vincent Leys	2018/05/31	Danker Kolijn
	Issue or Revision	Reviewed By:	Date	Issued By:
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PO Box 606

August 3rd, 2018

Mr. Jim House, C.D., M.B.A.
Business Manager
Long Pond Harbour Authority Inc.
96 Terminal Road
Conception Bay South, NL A1X 7B6

Dear Mr. House:

RE: Coastal Engineering Study – Conceptual Design of East Breakwater Upgrade

CBCL Limited (CBCL) is pleased to present our report outlining the rehabilitation of the East Breakwater at Long Pond Harbour in Conception Bay South, Newfoundland.

The report, and its proposed solution, is intended to help guide Long Pond Harbour Authority (LPHA) towards selecting a strategy for the East Breakwater rehabilitation.

Should you have any questions regarding the content of this report, please contact the undersigned.

Yours very truly,

CBCL Limited

Prepared By:

Danker Kolijn, M.Sc., M.Eng., P.Eng.

Coastal Engineer

Direct: 902-421-7241, Ext. 2586

E-Mail: dkolijn@cbcl.ca

Project No.: 183019.00

Reviewed By:

Vincent Leys, M.Sc., P.Eng. Senior Coastal Engineer

Direct: 902-421-7241, Ext. 2508

E-Mail: vincentl@cbcl.ca



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EXECUTIVE SUMMARY

CBCL was commissioned by the Long Pond Harbour Authority Inc. (LPHA) to conduct a coastal engineering study of the East breakwater to determine the required actions for its rehabilitation. This report explores three rehabilitation options:

- 1. Option 1: Encapsulating the existing breakwater with armourstone.
- 2. **Option 2:** Removing half of the existing breakwater and encapsulating the remaining half with armourstone.
- 3. Option 3: Complete removal of the breakwater.

The investigation accounted for navigational safety, wave agitation in the basin, required resources for implementation, ease of construction/practicality, and anticipated maintenance requirements.

We recommend to encapsulate the existing East Breakwater in armourstone. Option 1 reduces the wave climate intensity at the harbour entrance, while maintaining similar conditions at the Long Pond Harbour (LPH) to the modelled baseline conditions. Both Option 2 and 3 would result in more wave energy penetrating into LPH, potentially increasing user downtime, and disrupting existing operations.

The preferred concept strikes a balance between the various competing interests and challenges associated with the project. The follow features of the proposed structure include, but are not limited to:

- 1. The extension does not require extensive modification to existing infrastructure.
- 2. The existing currents at the LPH entrance are anticipated to remain relatively unchanged. As a result, the associated sediment transport regime is anticipated to follow existing conditions.
- 3. Footprint of the structure will not impede on the existing navigation channel.
- 4. The construction can be completed from shore and likely does not require mobilization of marine support vessels.
- 5. A wide crest width of 5m allows for future modifications and potential heightening of the structure if desired, to account for sea-level-rise.
- 6. Wave conditions at the LPH are anticipated to remain relatively unchanged with a potential to increase wave dampening at the rubblemound interface.
- 7. Maintenance requirements for the rubblemound structure are anticipated to be lower than for the existing East Breakwater structure.

The proposed breakwater was sized to a 100-year design event and resulted in the dimensions listed in Table 5-1.

Table 0-1: Summary of Design Parameters (100-yr return period)

Design Parameters	Unit	Breakwater			
Recommended Stone Specifications					
Specified Grading Head	Т	5 – 7			
Specified Grading Trunk	Т	3 – 5			
Armour Layer Thickness (5 – 7 T)	m	2.50			
Armour Layer Thickness (3 – 5 T)	m	2.20			
Armour Crest Elevation	m CD	5.35			
Crest Width	m	5.00			
Filter Layer Head	kg	600			
Filter Layer Trunk	kg	400			
Filter Layer Thickness Head	m	1.20			
Filter Layer Thickness Trunk	m	1.00			

In this conceptual design phase it is estimated that the rehabilitation of the Eastern Breakwater with armourstone would cost \$3,726,000.

As this is a conceptual design of the east breakwater, the following recommendations are suggested during or prior to a detailed design:

- Conduct a wave measuring campaign at LPH to calibrate the numerical models used in this study. It
 is important to note that the model used in this study could not be calibrated and validated to eventspecific data.
- Assess the structural capacity of the existing structure to bear the armour stone cap loading.
- Conduct a more detailed bathymetric survey and topo at the existing structure to refine conceptual drawings and improve modelling performance.
- Investigate bed conditions & geotechnical suitability at the proposed structure footprint.

CHAPTER 1 INTRODUCTION

1.1 Purpose of the Study

In 2015, CBCL conducted a detailed engineering inspection of the LPHA facilities and recommended conceptual design options for the East breakwater be developed (CBCL, 2016). CBCL has now been commissioned by the Long Pond Harbour Authority Inc. (LPHA) to conduct a coastal engineering study of the East breakwater to develop conceptual designs options for structural rehabilitation. The following report explores three rehabilitation options:

- 1. Option 1: Encapsulating the existing breakwater with armourstone.
- 2. **Option 2:** Removing half of the existing breakwater and encapsulating the remaining half with armourstone.
- 3. Option 3: Complete removal of the breakwater.

Changing the infrastructure at the entrance of the LPH can result in a noticeable impact on inner harbour wave-agitation, currents and sedimentation patterns. This study intends to identify the physical processes for each of the options listed previously; and provides conceptual level recommendations for the sizing, position and estimated opinion of cost of the recommended conceptual option.

1.2 Site Description

Long Pond Harbour (LPH) is located in Conception Bay South, Newfoundland. The harbour is relatively sheltered, as a result of its position relative to Bell Island, approximately 8.5km to the north of the harbour entrance. The harbour itself is regionally known for its safe anchorage during storm activity and provides two (2) relatively sheltered basins on its eastern and western limits. The LPH Terminal is the largest infrastructure feature in the port and lies just southwest of the harbour entrance. The entrance currently has a rubblemound type breakwater to the west (West Breakwater: Figure 1-1) and a jetty (vertical wall) type breakwater to the east (East Breakwater: Figure 1-1).

The breakwater subject to analysis and conceptual design is the jetty to the west.

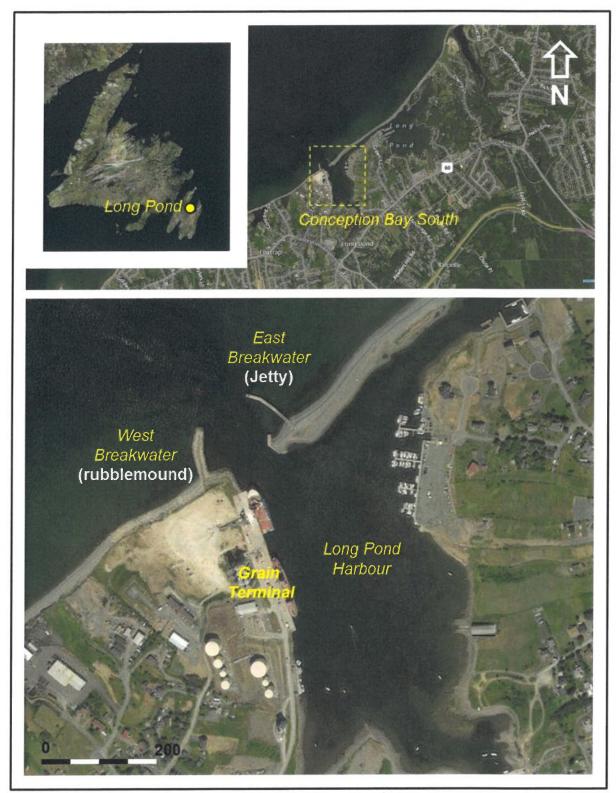


Figure 1-1: Long Pond Harbour Facilities & Layout

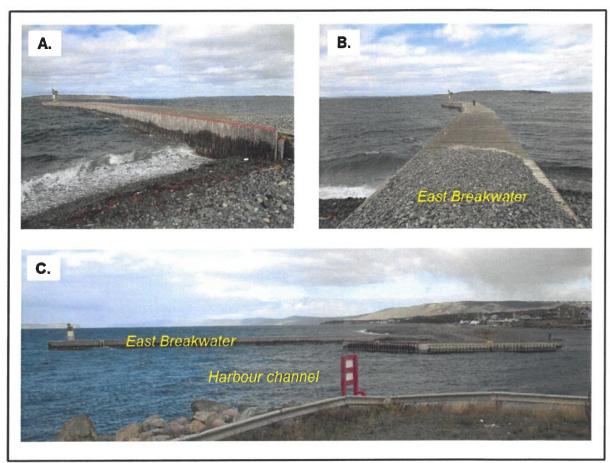


Figure 1-2: Existing East Breakwater

The east breakwater is depicted in greater detail in Figure 1-2 where the following observations can be made:

- The tip of the structure hooks inwards at a slight angle towards the northwest.
- The surface of the structure is covered in timber decking.
- Vertical faces are covered in timber elements which appear to be deteriorating and in need of refurbishment.
- A spilling beach is located between the harbour channel and the trunk of the eastern breakwater.
- A navigation aid sits at the end of the breakwater to mark the breakwater extents.

1.3 Scope of Work

Given the requirements and desired outcome of the study, the scope of the consultancy includes the following items.

- 1. Review of relevant data sets for investigation and client consultation.
- 2. **Coastal modeling** including extreme water levels, wave climates and meteorological conditions. Investigation of currents to determine impacts on sedimentation and scour potential.
- 3. **Conceptual Design** (e.g., layouts, crest elevation, cross sections, stone sizes, bottom elevation, toe protection, etc.) of the suggested measure or structure to rehabilitate the eastern breakwater.

4. **Costing** at a conceptual level to determine resource requirements for rehabilitating the eastern breakwater.

Throughout the report, the reader is reminded that there are three major challenges when modifying harbour facilities, including:

- 1. Determining the required dimensions of wave attenuation structures to meet desired objectives for safe berthing, while avoiding excessive costs due to over-conservative design.
- 2. Ensuring accuracy in the wave information, which can be achieved by a long-term offshore hindcast and reliable nearshore modeling, often backed up by wave gauge observations.
- 3. Ensuring minimal undesired coastal effects due to wave reflection, and/or long wave processes.

CBCL is satisfied that it is reasonably able to address these challenges for the LPHA. The following report outlines the methodology used to provide a conceptual rehabilitation design of the East Breakwater.

CHAPTER 2 BACKGROUND ANALYSES

2.1 Sources of Previous Information

The 2015 detailed CBCL engineering inspections provided a detailed report of conditions at the LPH facility. Pictures, notes, drawings and bathymetric survey information collected as part of the 2015 study were disseminated and incorporated into this study where necessary. The LPHA was consulted for input on key design parameters where necessary on a case-by-case basis.

2.2 Bathymetry Surveys

In 2015, CBCL conducted a single-beam hydrographic survey of the LPH facility. The output from this survey is depicted in Figure 2-1 where the dredge area in front of the LPH Terminal can be easily identified at a depth of -10 to -9m CD. The LPH basin is relatively shallow at 0-2m below CD. The channel extending out of LPH into deeper water directly north of the channel is 9-10m deep (CD), where the natural seabed is 3-4m deep (CD).

For numerical modelling purposes, the 2015 survey was supplemented with nautical chart information obtained from the Canadian Hydrographic Service (CHS).

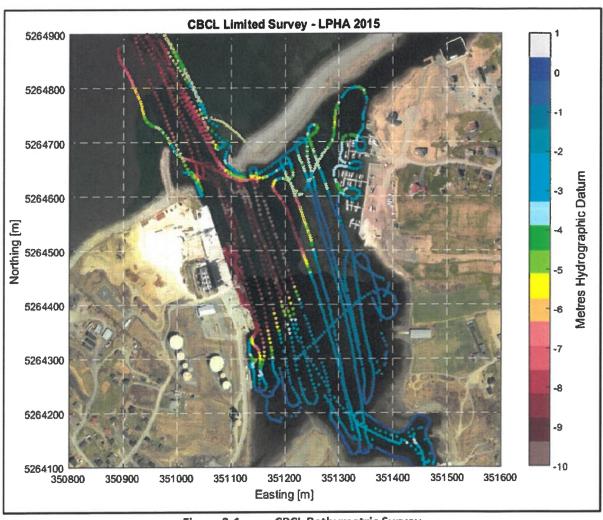


Figure 2-1: CBCL Bathymetric Survey

2.3 Water Levels

Design water levels at LPH require understanding of local tides, storm surge, and future sea-level rise. For conceptual design purposes, tidal elevations were sourced from the 2017 Canadian Tide and Current tables produced by the Canadian Hydrographic Service (Table 2-1).

Storm surges are created by meteorological effects on sea level, such as wind set-up¹ and low atmospheric pressure, and can be defined as the difference between the observed water level during a storm and the predicted astronomical tide. The closest long-term record of water levels is available at St. Johns (ECCC Station: 905). This record is located on the Atlantic coast and surge residual values would differ significantly from those observed at the southern limit of the more sheltered Conception Bay.

¹ Wind set-up refers to the increase in mean water level along the coast due to shoreward wind stresses on the water surface.

As such, the Environment Canada surge analysis of the Canadian East coast was used in this study. The model was validated using a combination of historical tide gauge observations and water level modeling tools assembled by Bernier et Thompson (2006). Output from this analysis is presented in Figure 2-2 for a 50-yr return period surge simulation.

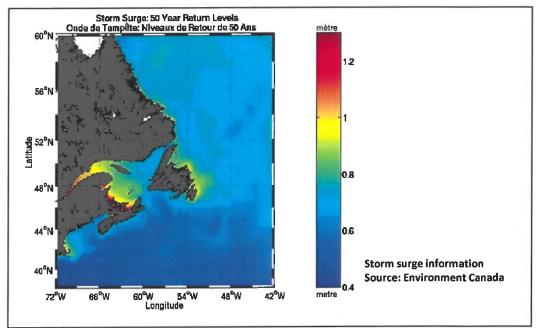


Figure 2-2: Environment Canada Storm Surge Predictions

Using the Environment Canada Storm Surge predictions and the HHWLT elevation, extreme values for design and numerical modelling purposes are presented in Table 2-1.

Table 2-1: Extreme Water Levels and Tidal Elevations

Extreme Wate	r Levels [m CD]
Return Period	Extreme Value
100-yr	2.50
50-yr	2.40
10-yr	2.15
, 1-yr	1.90
Tide [m CD]
HHWLT	1.40
HHWMT	1.10
MWL	0.60
LLWMT	0.25
LLWLT	0.05

2.3.1 Sea Level Rise

A typical design life for coastal infrastructure is 75 years for a breakwater type structure and 40 years for a wharf structure. A mid-life refurbishment is typically performed for each type of structure. For long-

term planning purposes, a longer horizon may have to be considered, at least to year 2100. By that time, the site will have experienced significant Sea Level Rise (SLR) caused by climate change. As a result, extreme water levels with a low return period today will be very common in a few decades.

The Intergovernmental Panel on Climate Change's Fifth Assessment Report (IPCC AR5 2013) estimated that the upper-bound Global Mean SLR could be in the order of 1.0 m by year 2100. This upper-bound projection was for Representative Concentration Pathways RCP8.5 scenario, i.e. business-as-usual, high-emission case. At the time there was insufficient evidence to evaluate the probability of specific levels above this 1.0 m projection. DFO then developed the online Canadian Extreme Water Level Adaptation tool (CAN-EWLAT), based on the study by Zhai et al. (2014) accounting for local factors. CAN-EWLAT is a science-based planning tool for climate change adaptation of coastal infrastructure related to future water-level extremes. It was developed to provide SLR allowances for DFO harbours across Canada. Allowances are estimates of changes in the elevation of a site that would maintain the same frequency of inundation that the site has experienced historically. CAN-EWLAT was used as a benchmark to forecast relative SLR at LPH. For the year 2100, the tool estimates an upper-bound relative SLR of approximately 1.00 m for the IPCC 2013 RCP8.5 scenario, as defined in 2013.

Table 2-2: CAN-EWLAT IPCC 2013 RCP8.5 Scenario – Long Pond Harbour

Climate			CAN-EWL	AT, Long F	ond Harb	our, NFLC	- SLR [m]		
Scenario	2020	2030	2040	2050	2060	2070	2080	2090	2100
Model RCP8.5	0.05	0.12	0.18	0.28	0.38	0.5	0.65	0.8	0.97

However, studies subsequent to the IPCC 2013 and DFO 2014 study suggests that previous Global Mean Sea Level (GMSL) predictions are too modest. These studies updated the scientifically supported upperend GMSL projections, including recent studies of the potential for rapid ice melt in Greenland and Antarctica. DFO's Han et al. study (2016) revisited projections to include Higher Scenarios. Subsequently, a 2017 NOAA publication (Sweet W. et al, 2017) present a year 2100 GMSL forecast range discretized into six GMSL rise scenarios: a Low (0.3m), Intermediate-Low (0.5m), Intermediate (1.0m), Intermediate-High (1.5m), High (2.0m) and Extreme (2.5m). A key finding was that along regions of the Northeast Atlantic (Virginia coast and northward), regional SLR is projected to be greater than the updated global average for almost all future scenarios (e.g. by 0.3 to 0.5 m under the Intermediate scenario by year 2100). Finally, studies indicate that the human carbon footprint to date has already committed Earth to a long-term GMSL rise of approximately 1.7 m (Clark et al, 2015).

Given these findings, the 2014 DFO estimates based on IPCC AR5 RCP8.5 can now be considered *Intermediate* projections, with *High* and *Extreme* SLR scenarios to range 1.0 to 1.5 m higher than previously anticipated.

In conclusion, a SLR of at least 1.0 m is likely to occur within the coming century, even if the timeline remains uncertain. As a result, maintenance intervals for coastal infrastructure are expected to shorten, and flooding probabilities will significantly increase. The design should allow flexibility to accommodate future upgrades for adaptation.

2.4 Wind and Wave Climate

Wind and wave inputs to the study are based on a recent 61-year wind and wave hindcast referred to as 'MSC50'. The MSC50 project was funded by the Climate Research Division of Environment Canada and the Federal Program of Energy Research and Development and is provided for this study by Environment Canada. This dataset spans the period January 1954 to December 2015, and contains hourly time series of wind (speed, direction) and significant waves² (height, period, direction). The MSC50 hindcast was developed by Oceanweather Inc. and is distributed by Environment Canada (Swail et al., 2006). Statistics are presented in Appendix A and indicate that the prevailing waves are from the north and northeast.

A Peak-Over-Threshold³ (POT) analysis was performed to isolate the largest storm events in the MSC50 data set at a point just north of Conception Bay. The relevant (most likely to present extreme conditions) wave incidence angles were selected for the POT. At the mouth of Conception Bay the offshore MSC50 wave height data was split into directional bins (45°) and analyzed in a clockwise direction from 0° – 360°. The output from the POT was then used to derive wave height return periods⁴ (1-, 10-, 100-yr) using an extreme-value-analysis (EVA) where the POT data is fitted to a Weibull distribution. The results of the EVA with additional parameters (water levels & wind) are presented below (Table 2-3).

Table 2-3: Conception Bay Offshore MSC50 Directional Extreme-Value-Analysis

Wave Direction	Degrees	Return Period [year]	Wave Height [Hs -m]	Peak Wave Period [Tp - sec]	Wind Speed [m/s]
NODTIL	0	1	3.41	11.55	17.71
NORTH	0	100	5.96	16.72	22.72
NORTHEACT	45	1	3.30	12.22	16.36
NORTHEAST	45	100	6.42	15.14	22.32
FACT	90	1	1.81	11.74	14.9
EAST	90	100	3.06	15.09	19.64
	180	1	2.08	7.67	17.93
SOUTH	180	100	3.13	11.1	20.94
COLITINATET	225	1	2.56	6.29	19.43
SOUTHWEST	225	100	3.62	6.77	24.54
MECT	270	1	2.59	6.07	20.11
WEST	270	100	3.34	6.26	24.44
NORTHWEST	315	1	2.73	6.59	18.62
NORTHWEST	315	100	4.18	6.4	24.19
COLITHEACT	135	1	1.80	8.75	16.63
SOUTHEAST	135	100	2.91	15.68	18.73

² The significant wave height (Hsig) is the common parameter for characterizing the energy in a wave field. Hsig represents the average of the third highest waves over a given time period, and is a good approximation of the 'typical' wave height.

³ The 'Peak-Over-Threshold' procedure selects statistically independent storm peaks occurring more than 48 hours apart. An extreme value distribution is then fitted to the population of storm peaks for extrapolating extreme events and their associated return periods.

⁴ The N-year return value represents the value that is exceeded on average once every N years.

CHAPTER 3 WAVE MODELLING

Numerical models are a valuable design tool in wave agitation and breakwater design studies. Several models can be used to investigate existing and projected wave agitation in LPH basin. Typically the project requirements and existing wave climate dictate the types of models that are utilized in a study. In the present case both a Spectral Wave (SW) and Hydrodynamic (HD) model will be used to investigate the effect of short-period wind generated waves and swell propagation towards LPH and at the East Breakwater. Model type and application areas are summarized in Table 3-1, with associated key inputs and outputs.

Table 3-1: Summary of Models Applied in Study

Area of Application	Model	Objective	Inputs & Calibration	Outputs
Regional wave transformation, wind wave growth.	Spectral wave model DHI MIKE21 SW.	Nearshore transformation and wind wave growth up to harbour entrance.	MSC50 hindcast, CHS tide tables, ECCC storm surge modelling.	Wave climate at harbour entrance.
Water levels and tidal currents.	Hydrodynamic model MIKE21 HD.	Water levels and current speed.	Webtide predictions.	Water levels and currents at the Harbour.

3.1 Spectral Wave Model

The computationally efficient MIKE 21 SW model was used in fully spectral mode with a quasi-stationary time-domain approach (i.e. steady state) to generate a regional wave climate in Conception Bay (Figure 3-1). The MSC50 data input point is identified in Figure 3-1.

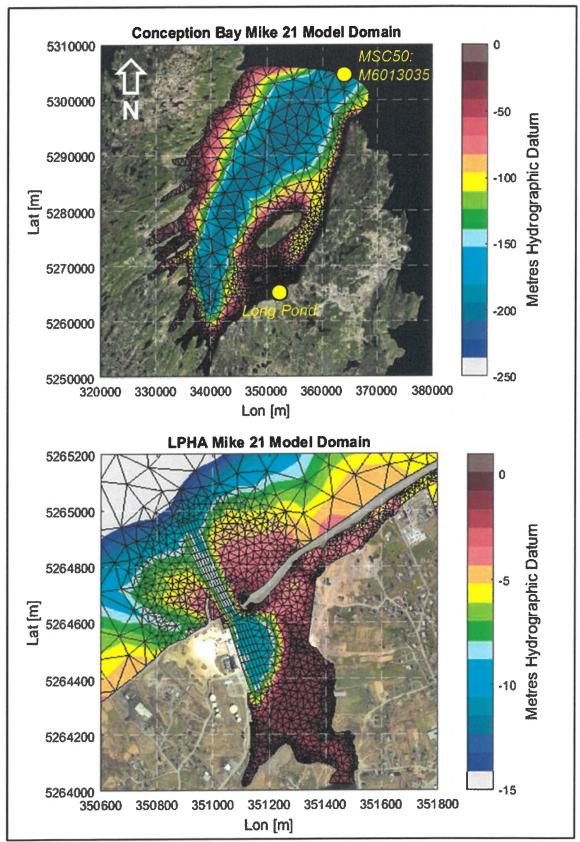


Figure 3-1: Conception Bay Model & Long Pond Harbour Detail

The model simulates the following physical phenomena:

- Refraction and shoaling due to depth variations.
- Dissipation due to depth-induced wave breaking A typical breaking coefficient of 0.8 was assumed (i.e. the ration of breaking wave height / water depth).
- Dissipation due to bottom friction (a typical bottom roughness of 0.04 m was assumed).
- Dissipation due to white-capping.
- One-time reflection from coastal structures (wave energy buildup from multiple reflections cannot be modeled).
- Non-linear wave-wave interaction.
- Wind-wave growth (the uncoupled formulation recommended by Danish Hydraulic Institute (DHI) for small-scale coastal applications was used).

The Mike21 SW model uses a triangular unstructured mesh, which has the advantage of resolving nearshore areas of interest with very high levels of detail and precision, whereas deeper offshore areas are resolved at a lower resolution. Such a model configuration is computationally cheaper, yet doesn't compromise nearshore details such as berths and breakwater structures, where shoreline reflection occurs. The model includes both triangular and rectangular features, where triangles are a suitable structure for resolving complex nearshore features and infrastructure, and rectangles offer improved performance in areas such as channels (bottom panel Figure 3-1).

3.1.1 Model Calibration

The Mike21 model was not calibrated to wave observations at the project location, and no historic wave-data was available for interpretation and analysis. Subsequently, the model could not be fully calibrated and validated to event-specific data. In previous studies, experience has shown that the validated MSC50 offshore data provides satisfactory indicative output of wave climates in the nearshore, prior to more detailed investigations.

It should be noted that for harbour agitation studies it is highly recommended to measure the wave climate within and just outside of the harbour to calibrate the numerical model. Complex nearshore wave transformation processes can significantly influence the local wave climate, which requires careful tuning and calibration in a numerical modelling application.

3.2 Existing Conditions

Simulations for the conditions summarized in Table 2-3 were generated using the Mike21 SW model. Results for significant wave height (Hs) and peak wave period (Tp) for the Conception Bay and LPH are depicted in Figure 3-2 for a 1-year return period event where the primary wave direction is from the north (0°). The output depicted in Figure 3-2 represents the "worst-case" or most severe conditions anticipated at LPH in a 1-year period. Observations from the results include, but are not limited to:

- LPH appears to lie within the "shadow" of Bell Island, resulting in relatively moderate wave conditions.
- The offshore wave peak wave period of 12 seconds, which translates to swell type waves, do not translate to the LPH site. Instead, the LPH entrance is exposed to shorter period waves in the order of 5-6 seconds (Tp).

 Significant wave heights at the LPH entrance are in the order of 1-2m, whereas in the basin they range from 0.10m to 0.50m, where the northern extents of the LPH terminal may reach significant wave heights of up to 0.80m.

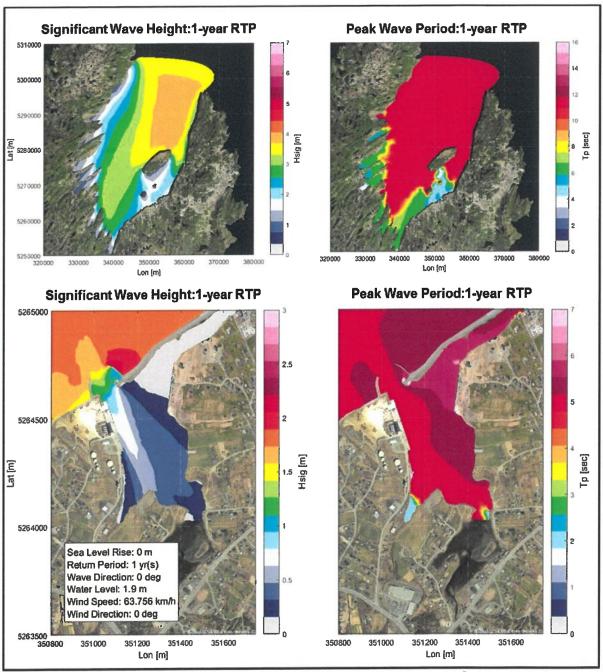


Figure 3-2: Baseline Wave Modelling at Conception Bay & LPH

It should be noted that the wave heights indicated in Figure 3-2 are based on uncalibrated results, therefore the actual wave heights along the marginal wharf at the LPH terminal are unknown. For the purposes of this investigation, the model baseline depicted in Figure 3-2 will be most useful in a

comparative analysis, where impacts from layout modifications are compared to this baseline. It is highly recommended to validate the model outputs to measured data in a detailed design phase.

3.3 Proposed Layouts

The baseline presented in Figure 3-2 will be compared to three (3) rehabilitation strategies for the East Breakwater. These include (Figure 3-3):

- 1. **Option 1:** Encapsulating the existing breakwater with armourstone.
- 2. **Option 2:** Removing half of the existing breakwater and encapsulating the remaining half with armourstone.
- 3. Option 3: Complete removal of the breakwater.

To reduce wave agitation in the channel and at the mouth of the LPH entrance, it is recommended to avoid structures with a vertical face. The following principles are recommended to reduce wave agitation (Goda, 2000):

- The impact of wave reflections from vertical faces (wharves or vertical breakwaters) should be carefully considered.
- The harbour should have a broad interior (as opposed to long and narrow) to encourage wave dispersion and minimize multiple reflections.
- Mooring basins and service areas should be located in areas that cannot be viewed directly from the harbour entrance.
- Wave absorbing slopes should be provided at the following locations:
 - Along the waterfront section directly facing the harbour entrance.
 - Within the inner mooring basin, to dissipate the remainder of the wave energy.

Given the above recommendations, Options 1 and 2 (Figure 3-3), leverage a rubblemound cap to absorb wave energy, and Option 3 (Figure 3-3) removes the existing breakwater, replacing it with a spilling beach similar to the shoreline east of the existing structure. Such measures are meant to reduce the wave energy at or near the LPH entrance.

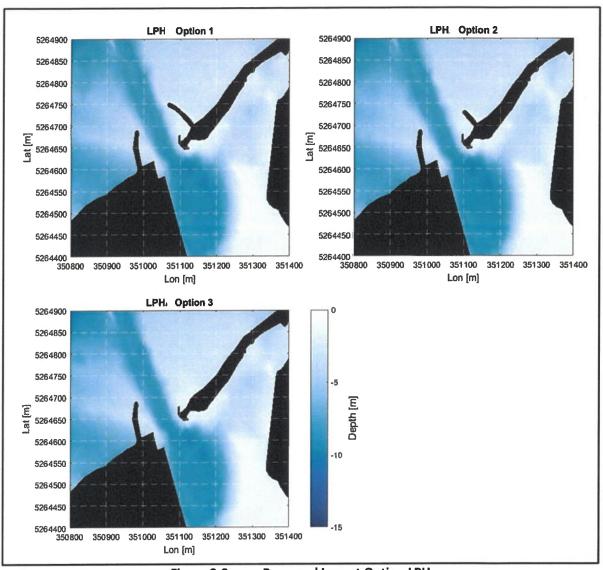


Figure 3-3: Proposed Layout Option LPH

The results for each concept, including existing conditions, for a 1-year return period event where the wave direction is from the north (0°) , are plotted in **Figure 3-4**. Several observations can be made from the model output, including:

- Encapsulating the existing breakwater in rubble (Option 1) slightly reduces wave energy along the
 outside of the structure, as more energy is absorbed by the rubblemound structure than the existing
 vertical timber face.
- Reducing the breakwater to half of its length allows for more wave energy to penetrate into the LPH harbour and increase wave agitation along the LPH terminal marginal wharf.
- Completely removing the breakwater results in similar conditions to those experienced when the breakwater is reduced to half of its length.

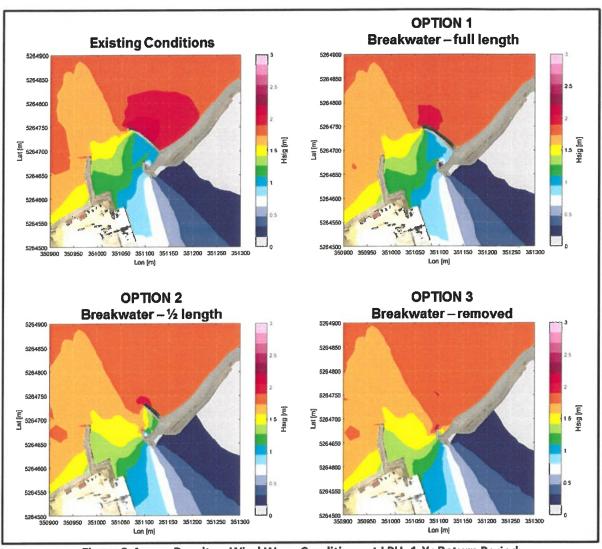


Figure 3-4: Results – Wind Wave Conditions at LPH: 1-Yr Return Period

3.4 Wave Modelling Conclusions

Option 1 is the preferred configuration, as it reduces the wave climate intensity at the harbour entrance, while maintaining similar conditions at the LPH terminal relative to the modelled baseline conditions. Both Option 2 and 3 result in more wave energy penetrating into LPH, potentially increasing user downtime, and disrupting existing operations. The encasement of the eastern breakwater with rubble will also reduce the wave heights at the seaward side of the structure due to the dissipation of energy on the sloped armour stone material.

3.5 Harbour Entrance Hydrodynamics

The Mike21 HD or Hydrodynamic model was used to compare typical ebb and flood conditions found at the LPH entrance. Hydrodynamics for Option 1 were modelled and compared relative to existing conditions, as Option 1 was selected as the preferred layout upon completing the wave agitation modelling.

The simulation of currents at the LPH entrance can assist in determining whether the modification of the eastern breakwater will influence existing sediment transport conditions. It is our understanding that sedimentation at the harbour entrance is relatively modest, and little maintenance dredging has historically been required. The modification of a harbour entrance and/or infrastructure can result in changes of the local sediment transport regime. Localized scour or deposition of sediment can result in costly maintenance programs.

Currents during ebb and flood were simulated in Figure 3-5. The results indicate that no significant changes to current direction and magnitude would be experienced at the LPH entrance due to rubblemound modification to the eastern breakwater.

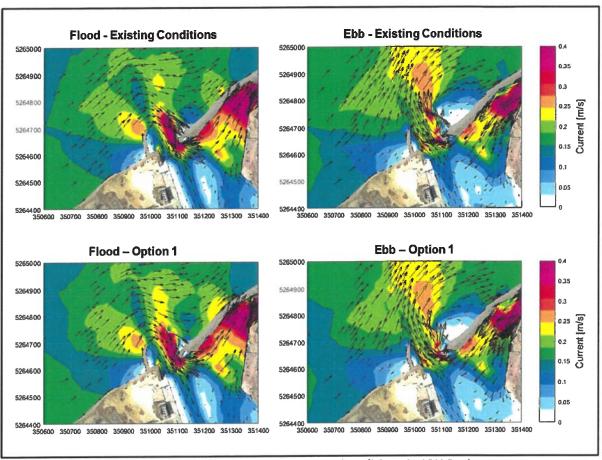


Figure 3-5: Results – Wind Wave Conditions in LPH Basin

It should be noted that the HD model was not calibrated to water level observations or locally measured currents. Modelled currents in shallow water are highly dependent on accurately resolved bathymetric features and the appropriate timing of water level fluctuations. The HD model was generated using the 2015 single beam survey, which is relatively sparse. Therefore, the current magnitude and direction may differ in reality when compared to the model results. As previously stated, the uncalibrated model is most powerful in its comparative capacity, when the modifications are compared to the simulated baseline condition. In this case, no significant change in conditions is detected.

CHAPTER 4 CONCEPTUAL DESIGN

4.1 Armour Stone Sizing

Breakwaters are exposed to very complex hydrodynamic forces due to wave interaction with a porous and irregular structure. Key parameters that are critically important to the structure's performance include its cross-sectional geometry and the characteristics of its stone layers, in particular its armour stone size, shape, quality and placement. The coastal engineering methodologies applied in this chapter apply to armour stone layers. Various assumptions were made during the conceptual design of the breakwater, which include:

- This report does not examine the question of geotechnical slope stability of the whole structure, which is outside the scope of this study.
- Armour stone sizes were calculated following coastal engineering methodologies that were developed by researchers to establish projected armour layer damage as a function of design wave height.
- The LPHA reported no significant winter ice cover. As such, we did not analyze winter ice forces on the structure as part of the design process.
- We understand that vessels do not moor directly behind the east breakwater structure. The nature
 and position of the breakwater therefore allows for overtopping without significant consequences
 to harbour operations. Additionally, the crest width of the existing structure (~5.0m) is wider than
 the minimum crest width requirement for a conventional rubblemound of comparable size and
 dimensions. A wider crest width typically lowers overtopping volume. As such, there is no need to
 complete a probabilistic overtopping analysis.

The East Breakwater rehabilitation is designed to meet a 100-year return period event. Output from the numerical wave model for the worst-case 100-year return period condition at the East Breakwater is illustrated in Figure 4-1 where offshore waves are coming from the north, and 100-yr sea level rise has been accounted for.

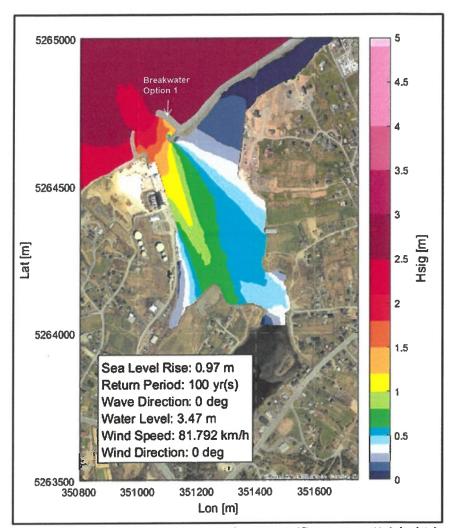


Figure 4-1: 100-Year Design Conditions Significant Wave Height (Hs)

4.1.1 Wave Impacts

The supporting calculations were performed using the Van der Meer 1988 breakwater stability equations, as summarized in the CIRIA 2007 Rock Manual. The equations estimate the required stone size based on design parameters including wave climate and desired amount of damage to the armoured slope. The dimensionless damage number S is defined as:

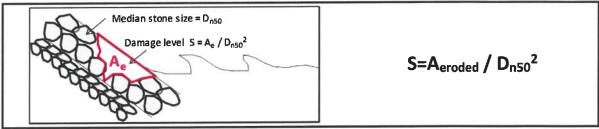


Figure 4-2: Definition of Damage Level in Armour Stone Sizing Calculations

Where A_{eroded} (m²) is the area of the armour stone face that is damaged and D_{n50} is the median diameter of the armour stone (Figure 4-2). Conventional armour stone breakwaters are typically designed based on S=2 (minimal damage). Input parameters and outputs for the armour stone stability calculations are listed in Table 4-1. The 100-year wave conditions were used for design of the armour stone structure.

Table 4-1: Armour Stone Sizing Calculations for Breakwater Option 1

Design Parameters	Unit	Break	water
Inputs for Van de Meer Wave Stal Calculations	bility	Head	Trunk
Water level	m CD	3.47	3.47
Bottom elevation	m CD	-2.50	-2.00
Significant wave height H _{sig}	m	2.80	2.70
Mean wave period T _{m1,0}	s	6.00	6.00
Storm duration	hours	10	10
S damage level	-	2 = minim	al damage
P permeability	-	0.40	0.40
Seaside slope	-	1.5H:1.0V	1.5H:1.0V
Water density	kg/m³	10	25
Rock density	kg/m³	26	50
Armour stone weight safety factor h _f	-	1.25	1.00
Outputs from Va	ın de Meer Wa	ve Stability Calculation	ns
H _{2%}	m	3.92	3.78
Nz - number of waves	-	6550	6550
Eta - Surf-sim. parameter	-	2.74	2.79
Deep or shallow-water equations	-	shallow	Shallow
Cplunging	-	8.4	8.4
Csurging	-	1.30	1.30
Type of breaker	-	plunging	Plunging
Armour stone W ₅₀ (with overtopping)	kg	5,900	4,400
Recom	mended Stone	Specifications	
Specified grading	T	5-7 T	3-5 T
Specified W ₅₀	kg	6,000	4,000
Armour layer - Dn ₅₀	m	1.30	1.10
Armour layer thickness	m	2.50	2.20
Crest width		3.90	3.40
3 stone sizes minimum	m	5.50	3.40
Filter layer - $W_{50f} = W_{50armour}/10$	Kg	600	400
Filter layer - Dn ₅₀	m	0.60	0.50
Filter layer thickness	m	1.20	1.00

We recommended the use of a conventional 1.5H: 1.0V slope on the structure, as sea ice is not a concern, and wave conditions do not require a berm type breakwater or milder slope configuration to dissipate significant wave energy. We recommend a 5-7 T primary armourstone gradation at the head of the structure and a 3-5 T primary armourstone gradation along the trunk. A single layer of armour is recommended on top of the existing breakwater, as the existing crest is wider (5m) than the required 3.90 – 3.40 m crest width as per CIRIA 2007 Rock Manual design standards.

4.1.2 Scour and Toe Design

The toe is an important feature, providing support for the armour, protection against bottom scour, and preventing potential undermining of the structure which could lead to slump or failure. Typically, the cost of the toe is relatively small compared with the cost of overall armour placement, therefore it is recommended to design the toe on a conservative basis. As demonstrated in the modelling of hydrodynamics at the LPH entrance in Section 3.5, the existing current magnitude will remain mostly unchanged in light of the proposed changes to the Eastern Breakwater.

Scour protection requirements were investigated based on references from CIRIA (2007) and CEM (2006). The following key elements are highlighted:

- Stone Size If the armourstone in the toe has the same size as the armourstone of the cover layer of the sloping front face, the toe is likely to be most stable and design assumed conservative.
- Toe Berm vs. Excavation CIRIA (2007) demonstrates that excavation is generally preferred over a toe berm in shallow areas with high scour potential. At LPH we recommend placing the toe above the bed for the majority of the structure profile. We do not have sufficient information regarding the bottom material at the breakwater to determine whether the bed is composed of mud, sand or bedrock. A "keyed-in" toe would be a relatively costly feature in a region of bedrock. Therefore we have optimized the design to reduce the length of "keyed-in" toe. In the interest of conserving the existing channel alignment and width, we recommend to "key-in" the toe at the section of breakwater which runs parallel to the channel. A "keyed-in" toe would reduce the intrusion footprint of the structure on the existing channel, in addition to reducing navigation hazards for vessels which drift towards the vessel toe during low tide.
- Toe Width Scour can be assumed to be greatest within one-quarter wavelength of the foot of the armour structure. Pilarczyk & Zeidler (1996) recommend that the horizontal length of scour protection placed in front of the breakwater should not be less than twice the wave height. Van der Meer, d'Angremond, and Gerding, (1995) define a standard toe size as 3-5 stones wide for high scour areas. At LPH we propose the use of primary armour as the toe material, which is 3 5 T and therefore conservative.
- Toe Thickness The toe should be at least as thick as the anticipated scour depth. Van der Meer,
 d'Angremond, and Gerding, (1995) define a standard toe size as 2-3 stones thick (CEM Table VI-5-46
 and VI-5-47). Based on CBCL's experience, in areas where the armour stone diameter equals or
 exceeds the anticipated scour depth, one may use an excavated toe option with one layer of
 primary armour.

In summary, for the proposed breakwater, we propose a conservative design for the toe on the exposed outer side of the structure, to be constructed three (3) stones wide, consisting of two (2) layers of primary armour. Along the channel we propose to "key-in" the toe, as to reduce the intrusion of the structure on the existing channel and to remove a potential navigation hazard for large draft vessels entering the facility at low tide.

4.2 Material Requirements

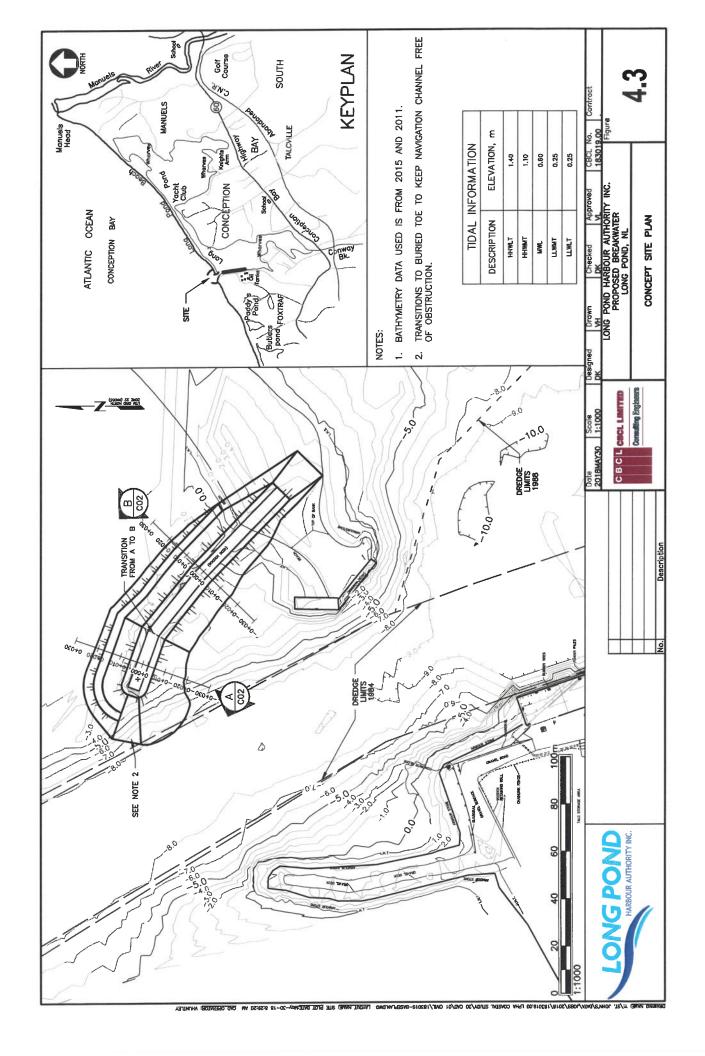
The volume and associated total mass of each material type to construct the new breakwater are specified in Table 4-2:

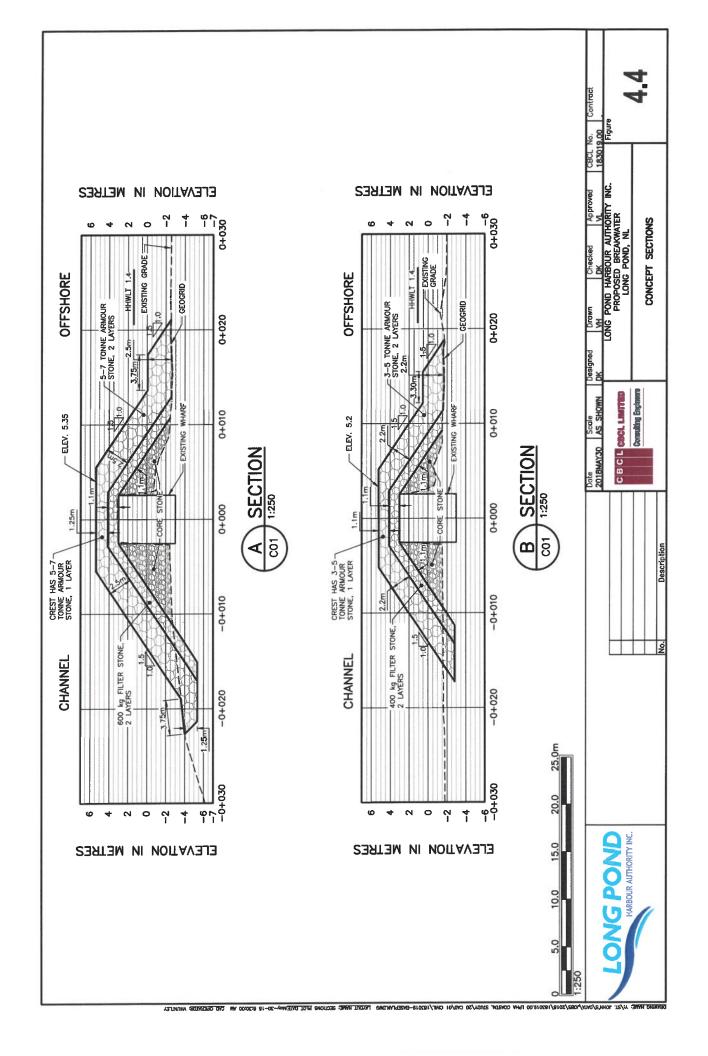
Table 4-2: Material Requirements

Material	Volume (m³)	Conversion from m ³ to Tonne	Mass (Tonne)
Primary Armour	14,100	1.9	26,790
Filter Layer	4,200	1.9	7,980
Core Material	8,000	2.2	17,600
Geogrid		2,100 m ²	

The final recommended design is sketched in Figure 4-3 and Figure 4-4. There are several notable features in the proposed concept design. These are:

- The existing structure is to remain in place, with the wooden decking to be removed during construction.
- We assume that the existing wharf can sustain the load of one (1) primary armour stone layer to cap the structure.
- A transition from a "keyed-in" toe feature to a toe placed on the bed occurs at "Note 2 Figure 4.4" where the breakwater profile and channel alignment diverge.
- The head of the breakwater is constructed with larger 5 7 T primary armour, whereas the more sheltered trunk in shallow water is constructed with 3 5 T primary armour.
- A single layer of primary armour will be placed on top of the existing structure.
- Geogrid material is to be placed below the toe features where practical.





4.3 Conceptual Level Costing

In this conceptual design phase it is estimated that the rehabilitation of the Eastern Breakwater with armourstone will cost \$3,726,000. The breakdown of the conceptual level costing is presented below.



OPINION OF PROBABLE DESIGN AND CONSTRUCTION COST Long Pond Harbour Authority Inc.
Proposed Breakwater
Concepte Site Plans and Sections

DATE:	29/05/2018
CBCL FILE No.:	183019.00
PREPARED BY:	TMD/DK
EST. DESCRIPTION :	Class D

No.	DESCRIPTION	Unit	Qty	Unit Price	Amounts
	CONSTRUCTION COSTS				naganagan ga pa pa ma és du pa na akudapapah (danka badar mapa né pa h
1	Mobilization	LS	1	\$ 44,000	\$ 44,000
2	Environmental Protection	LS	1	\$ 36,000	\$ 36,000
3	Demo - Remove Exsiting Deck and Dispose	LS	1	\$ 54,000	\$ 54,000
4	Dredging to Key in Rock	LS	1	\$ 313,000	\$ 313,000
5	Geogrid	LS	1	\$ 21,000	\$ 21,000
6	Core Stone	LS	1	\$ 578,000	\$ 578,000
7	Filter Stone	LS	1	\$ 260,000	\$ 260,000
8	Armour Stone	LS	1	\$ 1,260,000	\$ 1,260,000

	SUB-TOTAL - DIRECT CONSTRUCTION CO	OSTS			\$2,566,000
W M H W W W W W W W W W W W W W W W W W	Contractor Overhead and Fees			7884484	Included
	SUB-TOTAL - DIRECT CONSTRUCTION CO	OSTS		FREALES	\$2,566,000
	Design Development Contingency - Note 1		20%		\$513,000
	Construction Contingency - Note 2		10%		\$308,000
	Escalation / Inflation (Based on 2018 Dollars) - Note 3				Not Incl.
	Location Factor - Note 4	-HH		***************************************	Not Incl.
X [6]	TOTAL - DIRECT & INDIRECT CONSTRUCTION COSTS with CONTING	ENCY			\$3,387,000
	Engineering & Geotechnical		10%		\$339,000
	TOTAL - DESIGN and CONSTRU	CTION			\$3,726,000

THIS OPINION OF PROBABLE COSTS IS PRESENTED ON THE BASIS OF EXPERIENCE, QUALIFICATIONS, AND BEST JUDGEMENT. IT HAS BEEN PREPARED IN ACCORDANCE WITH ACCEPTABLE PRINCIPLES AND PRACTICES. MARKET TRENDS, NON-COMPETITIVE BIDDING SITUATIONS, UNFORESEEN LABOUR AND MATERIAL ADJUSTMENTS AND THE LIKE ARE BEYOND THE CONTROL OF CBCL LIMITED. AS SUCH WE CANNOT WARRANT OR GUARANTEE THAT ACTUAL COSTS WILL NOT VARY FROM THE OPINION PROVIDED.

Note 1	A Design Development Contingency is intended to allow for growth of quantities, increase material costs and the like as the
	work is better defined in the future.
Note 2	A Construction Contingency is intended to allow for the cost of additional work that is over and above the original tendered
	construction contract price.
Note 3	The Escalation/Inflation allowance is provided to account for anticipated increases in construction costs from the
	time that the budget is prepared until the time when construction costs for the project are determined.
Note 4	The Location Factor is provided to account for anticipated variances between construction costs at the location of the
	project and historical construction costs data used to prepare the budget.

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CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

CBCL was commissioned by the Long Pond Harbour Authority Inc. (LPHA) to conduct a coastal engineering study of the East breakwater to determine the required actions for its rehabilitation. The proposed breakwater rehabilitation accounts for navigational safety, wave agitation in the basin, required resources for implementation, ease of construction/practicality, and anticipated maintenance requirements.

5.1 Conclusions

It was found that Option 1, which encapsulates the existing East Breakwater in armourstone, is the preferred configuration. It reduces the wave climate intensity at the harbour entrance, while maintaining similar conditions at the LPH terminal relative to the modelled baseline conditions. Both Option 2 and 3 would result in more wave energy penetrating into LPH, potentially increasing user downtime, and disrupting existing operations. The encasement of the eastern breakwater with rubble will also reduce the wave heights at the seaward side of the structure due to the dissipation of energy on the sloped armour stone material.

The preferred concept strikes a balance between the various competing interests and challenges associated with the project. The follow features of the proposed structure include, but are not limited to:

- The extension does not require extensive modification to existing infrastructure.
- The existing currents at the LPH entrance are anticipated to remain relatively unchanged. As a result, the associated sediment transport regime is anticipated to follow existing conditions.
- Footprint of the structure will not impede on the existing navigation channel.
- The construction can be completed from shore and likely does not require mobilization of marine support vessels.
- A wide crest width of 5m allows for future modifications and potential heightening of the structure if desired, to account for sea-level-rise.
- Wave conditions at the LPH are anticipated to remain relatively unchanged with a potential to increase wave dampening at the rubblemound interface.
- Maintenance requirements for the rubblemound structure are anticipated to be lower than for the existing East Breakwater structure.

The proposed breakwater was sized to a 100-year design event and resulted in the dimensions listed in Table 5-1.

Table 5-1: Summary of Design Parameters (100-yr Return Period)

Design Parameters	Unit	Breakwater			
Recommended	Stone Specifications				
Specified Grading Head T 5-7					
Specified Grading Trunk	T	3-5			
Armour Layer Thickness (5 – 7 T)	m	2.50			
Armour Layer Thickness (3 – 5 T)	m	2.20			
Armour Crest Elevation	m CD	5.35			
Crest Width	m	5.00			
Filter Layer Head	kg	600			
Filter Layer Trunk	kg	400			
Filter Layer Thickness Head	m	1.20			
Filter Layer Thickness Trunk	m	1.00			

5.2 Recommendations

As this is a conceptual design of the east breakwater, the following recommendations are suggested prior for the detailed design phase of the project:

- Conduct a wave measuring campaign at LPH to calibrate the numerical models used in this study. It
 is important to note that the model used in this study could not be calibrated and validated to eventspecific data. For harbour studies it is highly recommended to measure the wave climate within and just
 outside the facility to better understand complex nearshore wave transformation processes which can
 significantly influence a local wave climate.
- Assess the structural capacity of the existing structure to bear the armour stone cap loading.
- Conduct a more detailed bathymetric survey and topo at the existing structure to refine conceptual
 drawings and improve modelling performance. The HD model was generated using the 2015 single
 beam survey, which is relatively sparse. Therefore, the current magnitude and direction may differ
 in reality when compared to the model results. Modelled currents in shallow water are highly
 dependent on accurately resolved bathymetric features and the appropriate timing of water level
 fluctuations.
- Investigate bed conditions & geotechnical suitability at the proposed structure footprint to determine if bedrock or sand is present. The bed material type will have a considerable impact on total construction cost.

Should you have any questions regarding the content of this report, please contact the undersigned.

Yours very truly,

Prepared by:

Danker Kolijn, P.Eng., M.Sc., M.Eng.

Coastal Engineer

Direct: 902-421-7241, Ext. 2586

E-Mail: dkolijn@cbcl.ca

Reviewed by:

Vincent Leys, M.Sc., P.Eng Senior Coastal Engineer

Direct: 902-421-7241, Ext. 2508

E-Mail: vincentl@cbcl.ca

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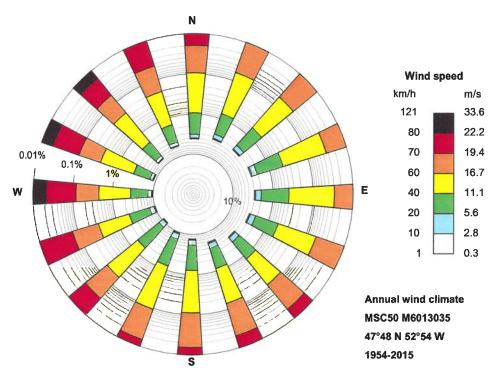
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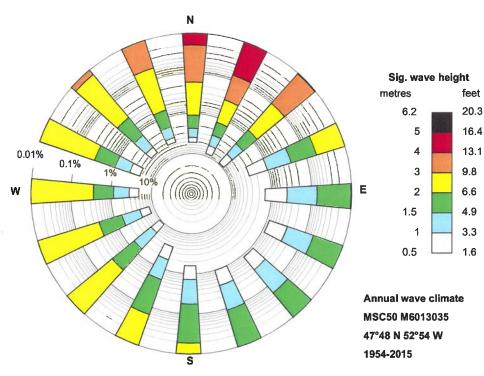
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MSC50 Offshore Wind and Wave Data

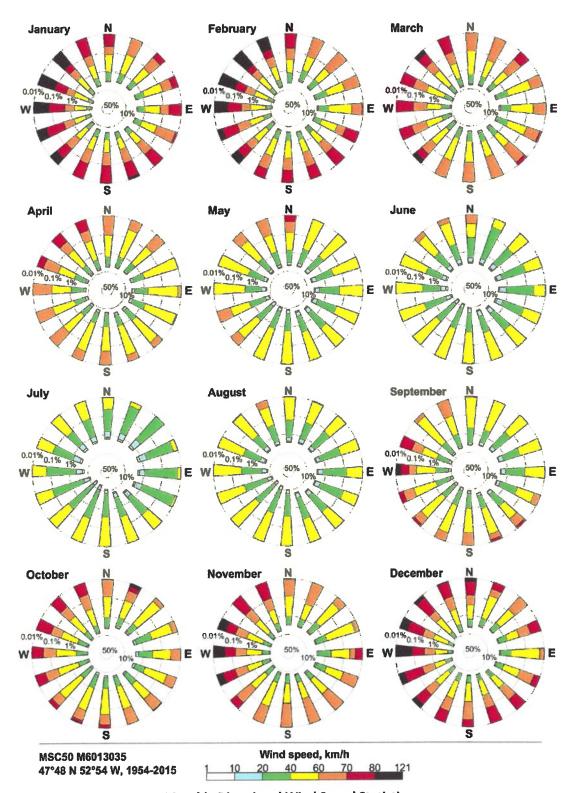


Annual Directional Wind Speed Statistics



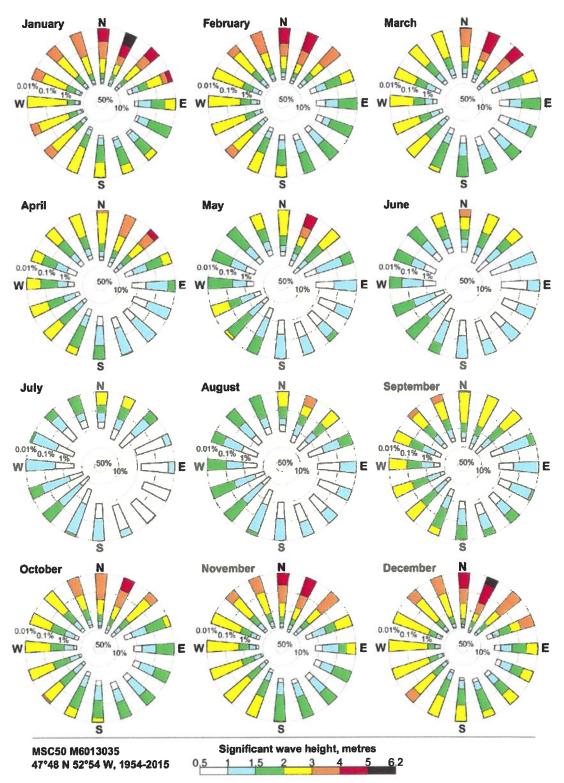
Annual Directional Wave Height Statistics

CBCL Limited Appendices



Monthly Directional Wind Speed Statistics

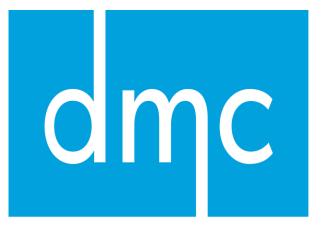
CBCL Limited Appendices



Monthly Directional Wave Height Statistics

CBCL Limited Appendices

Appendix L



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Employer focused. Results driven.

NOISE ASSESSMENT

Ocean Choice International St. John's, NL

Report Date: October 1, 2020

1.0 Introduction

Dallas Mercer Consulting Inc. (DMC) was contracted by Blaine Sullivan, President/COO and Martin Sullivan, CEO of Ocean Choice International (OCI) in St. John's, NL to conduct Instantaneous (spot check) noise measurements at the offloading facility and cold storage located in Harbour Grace, NL.

The purpose of the report is to emulate the noise levels associated with the Ocean Choice proposed Long Pond Cold Storage facility in Conception Bay South. Harbour Grace located was selected because Harbour Grace Cold Storage located at 123 Water Street in the community of Harbour Grace has been in operation since 1994.

The assessment was conducted by Kim Rose, Industrial Hygiene Technician with DMC on Sep 24, 2020 and overseen by Helen Mersereau, CIH, Senior Industrial Hygienist.

2.0 Noise Exposure and Health Effects

Noise is unwanted sound and it is one of the most common occupational health hazards. Work related hearing loss continues to be a critical workplace health and safety issue. Noise-induced hearing loss is fully preventable, but once acquired, hearing loss is permanent and irreversible. Auditory health effects related to noise exposure include acoustic trauma, tinnitus, temporary hearing loss also known as temporary threshold shift, and permanent hearing loss or permanent threshold shift. Noise-induced hearing loss is a cumulative and irreversible process, and both the level of noise, frequency and exposure time over a worker's employment history are important factors.

There are no regulations in Newfoundland and Labrador regarding noise emissions. However, in 1997 the Province prepared the document Model Noise Control By-Laws to provide uniformity and guidance on handling noise related problems (NLDEL, 1997). Very few, if any, of the municipalities have adopted the use of the Model Noise Control By-Laws guidance document even though it has been finalized and available for use for over twenty years. Due to the lack of support for the document, guidelines typically used by other municipal and provincial regulatory agencies were reviewed and noise guidelines for the Province of Nova Scotia are included and used for comparison in the following section.

The Province of Nova Scotia uses the following guidelines for acceptable equivalent continuous sound levels (Leq) (NSDOE, 1989):

Leq of 65 dBA between 0700 to 1900 hours; Leq of 60 dBA between 1900 to 2300 hours; and Leg of 55 dBA between 2300 to 0700 hours.

3.0 Methodology

Noise measurements were conducted in accordance with the A-weighted scale which mimics the sensitivity of the human ear to various frequencies. It is the scale that best predicts noise induced hearing loss. Sound level meters set to the A-weighted scale, slow response, are best used to compare directly to the legislated limits, set by provincial or federal authorities. Noise measurements made with the A-weighted scale are designated dBA. In other words, this weighting scale most closely approximates human hearing.

The measurements were collected with the use of a 3M Sound Examiner (SN SE402IS10556), a Type 2 sound level meter programmed to a slow response and A-weighting network. The sound level meter was factory calibrated within the last year and was field calibrated on site prior to use and verified post use, with the 3M AC-300 calibrator (SN AC300006789).

4.0 Area Monitoring Results

The spot check measurements were conducted regarding noise level concerns, generated from vessels and cold storage area, for the general public around the area. Table 1 presents the results of the area measurements collected on the day of the assessment. On the day of measurement, all conditions were determined to be typical of a normal day of operation. The measurements were taken with the industrial hygiene technician standing from various areas of the operation and throughout the community. The spot check measurements were taken five (5) feet from the ground, vertically with the wind screen attached.

During the time of assessment, product from the NF Lynx was being offloaded by Harbour Grace Cold Storage employees. Noise sources that were observed on the vessel and surrounding work area were multiple forklifts, cranes, two (2) transport trucks receiving product for transportation and multiple vehicles traveling to and from the wharf area.

It was communicated by Fred Osbourne, Engineer with the NF Lynx that the equipment running at the time of the assessment consisted of the following:

- Generator
- Refrigeration Compressor
- Air Start Compressor
- Domestic Refrigerator
- Middle Crane

On the day of the assessment, it was a cloudy day, with wind (km/h) of 28W and wind gust (km/h) of 54. Once the industrial hygiene technician departed the cold storage area to retrieve spot check measurements from surrounding areas of the community, noise generated items that were observed were trees and public transport.

It was communicated that the height of the Harbour Grace Cold Storage facility is maximum 32-34 feet. The proposed facility in Long Pond will be 43 feet high. Facilities in this area can act as a sound barrier which will decrease sound levels to nearby areas.

Table 1 – Area Noise Measurements (September 24, 2020)

Area	Sound Level Measurement (dBA)
Wharf Area – Pedestrian Walkway	71.5
Covid-19 Pre-Screening Trailer	67.7
Entrance to Parking Lot – Main Road (public vehicles passing)	60.0
200 Meters away from work site (public vehicles passing)	53.5
300 Meters away from work site (public vehicles passing)	52.1
400 Meters away from work site (public vehicles passing)	53.9

5.0 Conclusions

Noise levels collected on the wharf area and surrounding community during the assessment were below the Workplace 8-hour TLV of 85 dBA. Most were also below the guideline of 65 dBA during the daytime hours. Only the pedestrian walkway on the wharf was above the 65 dBA guideline. It was observed and documented that once measurements were taken of the actual work site and in the surrounding community, noise levels were well below the TLV of 85dBA and all but one were below 65 dBA. It was observed that during the taking of the measurements, noise generated from the offloading procedure did not transfer into the community.

October 1, 2020 Project No. IHP-0265 Dallas Mercer Consulting Inc.

Based on drawings provided by OCI, the orientation of the building or activities on a site can affect the impact of noise. The building or activity area for the Long Pond facility will be oriented towards the commercial side of Terminal Road in Conception Bay South. The location of the building will provide noise protection as the site plan for Long Pond has a wharf, offloading and the cold storage facility facing the commercial side. The orientation of the buildings and activity on the proposed Long Pond site appears to be oriented in such a way as to reduce noise impacts.

6.0 Recommendations

Based on the findings of this assessment, including but not limited to, noise measurements and observations at the time of the monitoring, no actions are required, as the community measurements were below the 65 dBA guideline. This report was prepared by Dallas Mercer Consulting Inc. (DMC) for the sole benefit of the client. DMC accepts no liability and/or damages incurred by any third party that uses information obtained from this report. The findings contained in this report are based upon conditions as they were observed at the time of the assessment. No assurance is made regarding changes in conditions subsequent to the time of the assessment.

If you have any questions regarding this report, I can be contacted via phone at (709) 364-3900, ext. 101, or by email at krose@dmconsulting.ca.

Kind Regards,

Written by: Helen Mersereau, MHSc, CIH, ROH, CRSP

Senior Industrial Hygienist

Holen Meiserean

Appendix M

8 Rowan Street, Suite 301 PO Box 23169 St. John's, NL A1B 4J9 Tel: 709-579-6435

www.harboursidetransportation.com

November 11, 2020

Ms. Paula Kieley Ocean Choice International 1315 Topsail Road, P.O. Box 8190 St. John's, NL, Canada A1B 3N4



Project No. 202075

Re: Traffic Impact Statement for Ocean Choice International Cold Storage Facility, Terminal Road, Conception Bay South, NL

Ms. Kieley,

Harbourside Transportation Consultants has completed a traffic impact statement relating to Ocean Choice International's development application for the construction of a new wharf and cold storage facility at Long Pond harbour in Conception Bay South, Newfoundland and Labrador.

Site Context: The site is located along Terminal Road in Conception Bay South. The site context is illustrated in Figure 1.



Figure 1: Site Context



Terminal Road is a local roadway that runs north-south from Route 60 to the end of Long Pond Harbour. Terminal Road has a narrow two-lane cross section and a speed limit of 40 km/h (Figure 2).

Route 60 is a minor arterial roadway that runs east-west throughout the centre of Conception Bay South. Route 60 has a four-lane cross section with sidewalks on the north side of the roadway (Figure 3). Route 60 has a posted speed limit of 50 km/hr.

The intersection of Route 60 and Terminal Road is a signalized intersection. The intersection is located approximately 1.3 kilometres from Route 2 via the Minerals Road interchange.



Figure 2: Terminal Road



Figure 3: Route 60



Proposed Development: The proposed development includes the construction of a new wharf and cold storage facility. The proposed cold storage facility will have a gross floor area of approximately 36,000 square feet. The proposed site plan for the facility is shown in Figure 4. Ocean Choice International (OCI) has indicated that traffic associated with operations at the site are anticipated to include:

Daily operations (8am to 5pm):

Facility operations: 5 employees Administration: 3 employees

Outbound shipments: 2-6 trucks depending on landings

Operations at times when a vessel arrives at the facility (approximately 60 times a year). These activities are in addition to the daily operations identified above:

Vessel offloading: 16 employees per shift (8 or 12-hr shift)

Vessel crew: 25 employees Vessel supply deliveries: 5 trucks

Fuel delivery: 7 trucks

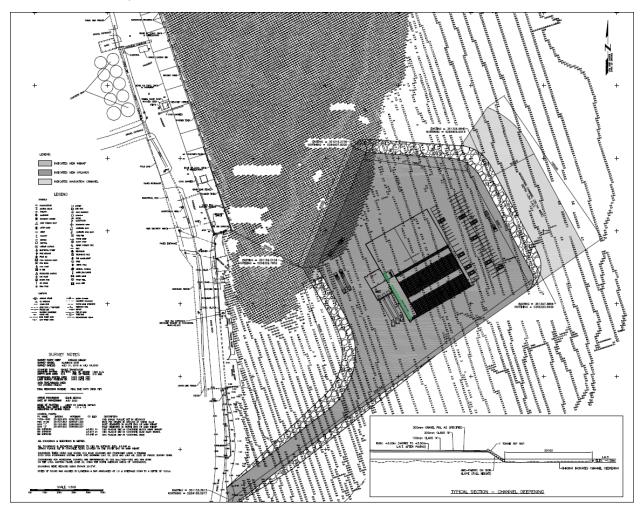


Figure 4: Proposed Site Plan



Proposed Site Plan Review: No significant traffic related issues are noted on the proposed site plan with respect to the proposed access point and site circulation for the types of vehicles that are anticipated to use the site. The proposed access point should be designed to meet the Town of Conception Bay South's requirements with respect to width and turning radii. There is nothing apparent on the proposed site plan that would suggest that these criteria cannot be satisfied. There appears to be ample parking provided for the anticipated traffic volumes at the site (discussed below).

Proposed Access Point Review: The proposed facility will be accessed via a new access road constructed off Terminal Road. The approximate location of the proposed site access is shown in Figure 5. The stopping sight distance on Terminal Road and turning sight distance at the site access were reviewed to ensure the Transportation Association of Canada's (TAC) *Geometric Design Guide for Canadian Roads* sight distance requirements are met.

The minimum stopping sight distance requirement for roadways with a design speed of 40 km/hr is 50 metres. Approximate measurements for stopping sight distance on Terminal Road indicate that the stopping sight distance requirement is met in both directions.

The minimum turning sight distance requirements for two-lane roadways with a design speed of 40 km/hr are:

Turning sight distance requirement for left-turn from stop:
 Turning sight distance requirement for right-turn from stop:
 75 metres

There is over 150 metres of sight distance looking to the right of the site access (Figure 6) and approximately 105 metres of sight distance looking to the left if the site access(Figure 7). Approximate measurements for turning sight distance at the site access indicate that the turning sight distance requirements will be met in both directions.



Figure 5: Area of Proposed Site Access





Figure 6: View Looking to the Right of Proposed Access



Figure 7: View Looking to the Left of Proposed Access



Trip Generation: Trip generation estimates were quantified based on the anticipated facility operations provided by Ocean Choice International. Trip generation estimates were quantified for regular operations and for times when a vessel arrives at the facility which is expected to occur approximately 60 times a year.

The daily trip generation estimates during regular operations are summarized in Table 1 and the weekday morning and afternoon peak hour trip generation estimates are summarized in Table 2. The proposed facility is expected to generate a total of 28 trips during a typical weekday (14 trips entering, 14 trips exiting). Of these daily trips, 10 vehicle trips are expected in the morning peak hour (9 trips entering, 1 trip exiting) and 10 vehicle trips are expected in the afternoon peak hour (1 trip entering, 9 trips exiting).

Table 1: Daily Trip Generation Estimates - Regular Operations Weekday

Operations		Quantity	Weekday (veh/day		
Operations	,	Quantity	Total	In	Out
Regular Facility/Administration	8	Employees	16	8	8
Outbound Shipments	6	Trucks	12	6	6
То	28	14	14		

Table 2: Trip Generation Estimates - Regular Operations Weekday Peak Hours

Onevetions	,	D a matitus	AM I	AM Peak (veh/hr)			PM Peak(veh/hr)		
Operations	,	Quantity	Total	In	Out	Total	In	Out	
Regular Facility/Administration	8	Employees	8	8	0	8	0	8	
Outbound Shipments	6	Trucks	2	1	1	2	1	1	
Total Trips Generated			10	9	1	10	1	9	

The daily trip generation estimates for times when a vessel arrives at the facility are summarized in Table 3. With regular operations and a vessel in port, the proposed facility is expected to generate a total of 166 trips during a weekday (83 trips entering, 83 trips exiting). The majority of vehicle trips associated with the vessel offloading are expected to occur during off-peak hours.

Table 3: Daily Trip Generation Estimates – Vessel in Port Operations Weekday

Operations)antitu	Weekday (veh/day		
Operations	Quantity		Total	In	Out
Regular Facility/Administration	8	Employees	16	8	8
Outbound Shipments	6	Trucks	12	6	6
Vessel Offloading	32	Employees	64	32	32
Vessel Crew	25	Employees	50	25	25
Vessel Delivery	5	Trucks	10	5	5
Fuel Delivery	7 Trucks		14	7	7
То	166	83	83		

For comparison purposes, the vehicle trip generation estimates for the development were also quantified using trip generation rates from the Institute of Transportation Engineers (ITE) *Trip Generation Manual (10th edition)*. Land use code 150 - Warehousing was used. While there is a land use code for cold storage, 157 - High-Cube Cold Storage Warehouse, the manual describes a high-cube warehouse (HCW) as a building that typically has at least 200,000 gross square feet of floor area. Given the size of the proposed



facility, the general warehouse land use code which allows trips to be estimated either by gross floor area or by the number of employees is considered to be more appropriate.

The daily trip generation estimates are summarized in Table 4 and the weekday morning and afternoon peak hour trip generation estimates are summarized in Table 5. The ITE trip generation rates result in slightly higher daily trips, with an additional 12 trips per day, and slightly lower volumes during the peak hours, with five fewer trips. By comparison, the estimated traffic volumes resulting from the activity that OCI anticipates on the site appear to be very reasonable.

Table 4: Daily Trip Generation Estimates - ITE Weekday

Land Use		Quantity	Wee	kday (ve	eh/d)
Land Ose	Quantity		Total	In	Out
150 Warehousing	8 Employees		40	20	20

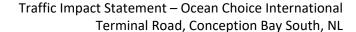
Table 5: Trip Generation Estimates - ITE Weekday Peak Hours

Land Use		Quantity		AM Peak (veh/hr) PM Peak(veh/h			n/hr)	
Land Use	Quantity		Total	In	Out	Total	In	Out
150 Warehousing	8	Employees	5	4	1	5	2	3

Anticipated Impacts: This is a high-level qualitative assessment and, as such, no analytical capacity calculations have been completed. Qualitatively, it is noted that segments of Terminal Road are currently in poor condition. There is no curb and gutter on Terminal Road North of the existing Sobeys access point and no dedicated pedestrian facilities (i.e. sidewalks, marked crosswalks, etc.) North of the intersection with Route 60. There are some residential properties that are accessed via Terminal Road, however much of the existing traffic on Terminal Road, particularly North of the Sobeys access point, is likely commercial in nature. It is anticipated that pedestrian volumes are and will continue to be very low. While the anticipated trip generation rates are also relatively low, much of the new traffic will be commercial in nature and the developer should work in unison with the Town to ensure that the street condition is such that adequate asphalt width (minimum 6.6 metres recommended) is provided and that shoulders are wide enough and maintained such that pedestrians do have an area to walk off street.

Some residents of the area have publicly indicated that there are concerns of increased noise associated with the facility and with increased traffic. Harbourside cannot comment as to the facility operations, however increased noise relating to traffic along Terminal Road should be minimal as the increased volumes are relatively low and there are no significant grades or other geometric features that should require hard acceleration/deceleration. Commercial vehicle drivers will have to be mindful of using engine brakes within the residential area, this is rarely an issue that cannot be addressed at a local level and is also well within Ocean Choice International's control should an issue ever arise.

The majority of traffic generated by the proposed facility is expected to travel to/from Route 2 via Minerals Road/Route 60 and access Terminal Road via the signalized intersection. Recent changes to the signal timings at the intersection of Route 60 and Terminal Road (completed by Harbourside) indicate that the signalized intersection operates at acceptable levels of service during the morning and afternoon peaks hours and also that there is residual capacity at the intersection. It is anticipated that the vehicle trips associated with regular operations and at times when a vessel arrives at the facility can be





accommodated on Terminal Road and at the signalized intersection with no significant impact on existing traffic operations.

If you have any questions or would like to further discuss any aspect of the comments above, please feel free to contact the undersigned at your convenience.

Best Regards,

Harbourside Transportation Consultants

Mark Stuckless, P. Eng.

Senior Transportation Engineer

Tel: (709) 579-6435

Email: mstuckless@harboursideengineering.ca

cc: Mr. Jon Pawson, P. Tech. - Progressive Engineering & Consulting Inc.

Appendix N

GEOTECHNICAL FACTUAL REPORT LONG POND, MANUELS, NL

(FFC File: 3132)

Prepared by:

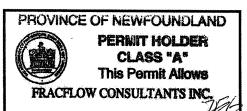
FRACFLOW CONSULTANTS INC. 154 Major's Path St. John's, NL A1A 5A1

Submitted to:

Ocean Choice International 1315 Topsail Road, P. O. Box 8190 St. John's, NL A1B 3N4

and

AFN Engineering Inc. 1243 Kenmount Road Paradise, NL A1L 0V8



To practice Professional Engineering in Newfoundland and Labrador.

Permit No. as issued by APEGN D0169 which is valid for the year 2019.

June 2019



Preface

AFN Engineering Inc. retained Fracflow Consultants Inc. on behalf of Ocean Choice International to undertake a marine geotechnical site investigation at the Long Pond site in Manuels, NL. This investigation was conducted in accordance with standard practices and includes any stipulations outlined or agreed to by AFN Engineering Inc.

The preliminary geotechnical investigation for the Long Pond site project consisted of six (6) Dynamic Cone Penetration Tests (DCPTs) driven from a barge using a Pencone and a drop hammer. The fieldwork for this investigation was conducted between December 8 and 14, 2018. Environmental samples were collected at four (4) of the six (6) locations. Four (4) of the Dynamic Cone Penetration Tests were driven in or close to or along the edge of the area that had been dredged and two (2) of the DCPTs were driven in the area that had not been dredged.

The more recent scope of work for the Long Pond Site consisted of five (5) boreholes with Standard Penetration Tests, and Dynamic Cone Penetration Tests drilled and driven from a barge, as well as seven (7) Dynamic Cone Penetration Tests. The fieldwork for this investigation was conducted between late March and late April, 209. The revised scope of work due to inclement weather, sea ice conditions, high winds, and seabed soil consisted of twelve (12) Dynamic Cone Penetration Tests, and three (3) Standard Penetration Tests. Environmental samples were collected at three (3) of the five (5) boreholes. Two (2) of the Dynamic Cone Penetration Tests were completed close to the dredged areas and ten (10) were completed in an area that had not been dredged.

The subsurface soil conditions that have been inferred from the previous Dynamic Cone Penetration Test blow counts are in agreement with those that were encountered in December 2018. The very soft sediment layer (Pencone sank under own weight) was found to be 1.01 to 4.78 m in thickness in non-dredged areas, and 0.23 to 0.35 m in dredged areas near the existing wharf. This soft sediment layer was underlain by a weak to moderately firm organic and

sandy sediment layer which was in turn underlain by a relatively strong, thinly layered, shale unit. The bottom of the soft sediment and the top of the more load bearing layer (referenced to consistent blow counts of more than 2 per 150 mm) varied across the site, from 1.52 m for DCPT8, to 8.40 m for DCPT12 and DCPT13. The depths for refusal (defined as consistent blow counts greater than 50 per 50 mm) of four (4) of the DCPTs ranged from -7.70 m LNT to -9.30 m LNT.

Contour maps have been constructed that show (1) the water depth below LNT, (2) the depth below LNT to the top of the firm layer as defined by blow counts of 5 or greater, (3) the depth below LNT to the top of the hard layer or what is considered to be the top surface of the weathered shale layer, and (4) the thickness of the very soft layer through which the DCPT and rods sank under their own weight.

Based on the depth to the firm layer with blow counts in excess of 15 per 150 mm, it is estimated that approximately 300,000 cubic metres of rock or 540,000 tons will be required to fill the area that was outlined to bring the working surface to approximately 3 m above LNT. This assumes that the space between the rock blocks will have a porosity of approximately 25% to 40%.

The site is partly bounded on the west by a pilot boat berth and on the northwest side by the boat turning basin and the main large boat wharf. The east side will have to provide a channel for small boat passage to the bottom or south end of the harbour. Based on these considerations, a preliminary approach to rock placement has been provided.

It is expected that the various building foundation options will require excavation of the overburden to firm ground or to the top of the weathered shale bedrock. Once the building foundation options have been finalized and the preferred option selected, the rock placement procedures will be modified to accommodate the building foundation construction.

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1.0 INTRODUCTION

AFN Engineering Inc. retained Fracflow Consultants Inc. on behalf of Ocean Choice International to undertake a marine geotechnical site investigation at the Long Pond site in Manuels, NL. This investigation was conducted according to standard practices and included any stipulations outlined by and agreed to by AFN Engineering Inc.

The original scope of the preliminary work for the Long Pond site project consisted of six (6) boreholes with Dynamic Cone Penetration Tests (DCPTs) drilled from a barge. The fieldwork for this investigation was conducted between December 8 and 14, 2018, and the revised scope, due to adverse weather conditions, consisted of driving six (6) DCPTs from a barge. Environmental samples were collected at four (4) of the six (6) locations, as shown in **Table 1.3**. The subsurface soil conditions have been inferred from the DCPT blow counts that were recorded during the field program and laboratory analysis of the samples collected. Four (4) of the DCPTs were driven close to the edge of the area that had been dredged and two (2) of the DCPTs were driven in the area that had not been dredged. The subsurface soil conditions consists of a 1 to 6 m thick layer of very soft sediments (the DCPT sank under its own weight) that is underlain by a relatively firm layer of organic and sandy sediment which in turn is underlain by a relatively strong but thinly layered shale bedrock. The findings of this preliminary field study are also found in Report FFC-NL-3132-001.

The more recent scope of marine geotechnical work that was proposed for the Long Pond Site consisted of five (5) boreholes drilled with Standard Penetration Tests (SPTs), and Dynamic Cone Penetration Tests (DCPTs) driven from a barge, as well as seven (7) DCPTs. The field work for this investigation was conducted between March 20 and April 23, 2019. The scope of work was revised scope due to inclement weather, sea ice conditions, high winds, and seabed soil and consisted of twelve (12) DCPTs, and three (3) SPTs that were used to core the shale bedrock. Environmental samples were collected at three (3) of the five (5) boreholes using a standard split-spoon system as part of SPTs. The summary description of these marine sediment

samples can be found in **Table 1.4**. Two (2) of the DCPTs were driven at locations close to the edge of the dredged areas and ten (10) were driven in an area that had not been dredged. The primary goals were to map the depth to the top of the shale layer, the thickness of the upper soft sediment layer and the thickness of the firmer organic-sand layer that rests on the bedrock surface. In addition, the SPTs were driven to collect relatively undisturbed samples of the underlying shale bedrock and to record the blow counts that were required to drive the SPT into the shale bedrock.

The depths for refusal of the DCPTs in seven (7) of the DCPT locations ranged from -5.33 m LNT to -9.30 m LNT. The other five (5) DCPTs were terminated when the soft layer had been penetrated, at depths from -2.72 m LNT to -7.70 m LNT. The bedrock description is based on historical maps of the local geology and the DCPT blow counts recorded. A summary of the field work that was conducted is provided in **Table 1.1** and **Table 1.2**.

The subsurface soil conditions were categorized by firmness using the DCPT blow counts required to advance 150 mm. The top of the very soft sediment layer was defined from the weighted tape depth reading to where the DCPT stopped sinking under its own weight. The thickness of the soft layer below the very soft layer was defined where blow counts of one to five (1 BC < 5) were recorded. A firm sediment layer was present below the soft layer and was defined by blow counts that ranged from five to fifteen (5 BC < 15) blow counts. The last layer into which the DCPT was driven was denoted as the hard layer, generally with blow counts of fifteen or greater (BC >15). Based on the material that was recovered in the split spoons, the upper part of the firm layer is considered to be weathered shale bedrock.

The subsurface soil conditions have been inferred from the previous DCPT blow counts were in agreement with those that were encountered in December 2018. The very soft sediment layer was found to be 0.23 to 4.78 m in thickness, with an intervening soft layer which is underlain by a weak to moderately strong shale bedrock. The depth below LNT to the bottom of the very soft sediment and the top of the soft layer (referenced above) varied across the site, from 1.05 m at

DCPT7 to 5.59 m at DCPT14. Blow counts greater than fifteen (15) were used to confirm that the underlying bedrock had been penetrated. Based on the local geology, the DCPT blow counts, and the difficulty experienced in retracting the DCPTs at the completion of the DCPT penetration, it was concluded that a weak to moderately strong bedrock such as shale had been penetrated by the DCPTs. This conclusion was confirmed by the relatively undisturbed shale bedrock that was recovered in the split spoon samples.

This report contains a factual presentation and full disclosure of all findings of the subsurface investigation. The following sections provide: (1) a description of the site and the general geology of the area; (2) a summary of the investigative procedures used; and (3) the inferred bearing capacity of the soil conditions. Appended to this report is a site plan showing the borehole locations, the detailed geotechnical logs for each DCPT and results of all analysis performed on the samples collected.

Table 1.1 Summary of Previous Dynamic Cone Penetration Tests, Long Pond, Manuels, NL.

DCPT#	DCPT Distance Driven (m)	Water Depth below LNT (m)	Elevation of DCPT final depth (LNT m)	Comments
DCPT1-BH1	0.51	-6.97	-8.49	Refusal not achieved, bedrock penetrated
DCPT2-BH2	5.62	-4.89	-12.31	Refusal not achieved, bedrock penetrated.
DСРТ3-ВН3	5.78	-5.18	-12.28	Refusal not achieved, bedrock penetrated.
DCPT4-BH4	4.37	-4.34	-12.00	Refusal at -12.00 m LNT
DCPT5-BH5	2.80	-1.29	-7.98	Refusal not achieved, bedrock penetrated.
DCPT6-BH6	3.36	-2.14	-9.26	Refusal at -9.26 m LNT

Table 1.2 Summary of Dynamic Cone Penetration Tests, Long Pond, Manuels, NL.

DCPT#	DCPT Distance Driven (m)	Water Depth below LNT (m)	Elevation of DCPT final depth (LNT m)	Comments
DCPT7	2.58	-0.04	-4.23	No-refusal, 61 blow counts for 0.15 m
DCPT8	1.67	-0.82	-2.72	No-refusal, 72 blow counts for 0.15 m
DCPT9	1.00	-1.26	-5.50	Refusal achieved, 72 blow counts for 0.09 m
DCPT10	1.77	-1.07	-5.33	Refusal achieved, 53blow counts for 0.1 m
DCPT11	1.98	-4.15	-6.48	Refusal achieved, 53 blow counts for 0.03 m
DCPT12	4.43	-1.22	-9.30	Refusal achieved, 52 blow counts for 0.03 m
DCPT13	3.66	-1.49	-9.00	Refusal achieved, 52 blow counts for 0.01 m
DCPT14	1.24	-1.25	-6.83	Refusal achieved, 52 blow counts for 0.03 m
DCPT15	1.82	-0.81	-6.96	No-refusal, 52 blow counts for 0.15 m
DCPT16	3.83	-0.94	-9.05	Refusal, 52 blow counts for 0.05 m
DCPT17	1.72	-0.82	-6.54	Refusal, 52 blow counts for 0.05 m
DCPT18	2.28	-0.63	-7.70	No-refusal, 65 blow counts for 0.15 m

Table 1.3 Summary of Previous Sampling Depths for the Marine Sediment Samples.

Sample ID	Sampling Date	Sample Type	Sampling Depth (m below seabed)
3132-BH3-SS1 (DCPT3)	December 12, 2018	Soil	0 to 3.0
3132-BH4-SS1 (DCPT4)	December 12, 2018	Soil	0 to 1.5
3132-BH5-SS1 (DCPT5)	December 12, 2018	Soil	0 to 1.5
3132-BH6-SS1 (DCPT6)	December 8, 2018	Soil	0 to 3.0

Table 1.4 Summary of Sampling Depths for the second set Marine Sediment Samples.

Sample ID	Sampling Date	Sample Type	Sampling Depth (m below seabed)
3132-PC9-SS1	April 23, 2019	Soil	0 to 3.16
3132-PC11-SS1	April 11, 2019	Soil	0 to 1.02
3132-PC13-SS1	April 23, 2019	Soil	0 to 4.09

2.0 SITE DESCRIPTION AND GENERAL GEOLOGY

Long Pond is located in Manuels to the West of Manuels River in Conception Bay. Long Pond currently houses the Sunset Key Marina on the Northeastern bank and a barge loading dock on the Northwestern bank. Overburden in the area is characterized by outwash deposits of gravel, sand and silt of varying thickness overlying bedrock (Henderson, 1972). Bedrock in the area consists of black and greenish grey shale, underlined by breccia, from both the Elliot Cove and Manuels River Groups (Water Resources Division, 1984).

3.0 INVESTIGATIVE PROCEDURES

At the Long Pond site, for this second field investigation, DCPTs were driven from a barge at twelve (12) locations, environmental samples were collected at three (3) of these locations, and three (3) split-spoon were driven at the locations where the environmental samples were collected. The DCPT and environmental sample locations are shown on the site plan in **Appendix A**.

3.1 Dynamic Cone Penetration Tests

The twelve (12) Dynamic Cone Penetration Tests (DCPTs) that were completed during this current investigation consisted of driving the pencone into the ground using a 63.5 kg weight falling a distance of 760 mm and the number of blow counts recorded for each 150 mm increment the cone advanced. The cone was driven into the soil until refusal occurred (52 blows per 50 mm or equivalent) at (8) locations but terminated at the other four (4) locations due to once the DCPT had been driven 600 mm or more into weak bedrock (DCPT blow counts of 15 or more). Moderately strong bedrock (DCPT blow counts of 20 or more) was encountered at each location where the normal refusal conditions were not met. At the location DCPT7, the depth driven into this moderately strong bedrock was 0.91 m, DCPT8 was driven 0.76 m, DCPT15 was driven 0.61 m, and DCPT18 was driven 0.30 m).

3.2 Standard Penetration Test

The three (3) Standard Penetration Tests (SPTs) that were conducted during this investigation consisted of driving a split spoon into the bedrock layers using a 63.5 kg weight falling a distance of 760 mm and the number of blows required to advance 150 mm increments is

recorded as the blow counts. The split spoon was initially advanced without the inclusion of the sand trap, followed by a slow retraction of the split spoon to allow maximum collection of fine silty sediments. Samples that were collected for grain size analysis were placed in mason jars, while environmental samples were placed within laboratory supplied bottles.

3.3 Laboratory Analysis

At the Long Pond site three (3) continuous SPTs taken at BH9, BH11, and BH13 yielded eleven (11) grain size samples, and three (3) environmental samples. The specific depths of each sample can be found in **Table 1.4** and **Table 4.1**.

Previous harbour bottom samples underwent grain size analysis using mechanical sieves and hydrometers, and Atterberg limit test to determine both grain size distribution, and liquid and plastic limits of the soil. Current split spoon samples underwent grain size analysis using mechanical sieves, and hydrometer methods. The grain size distribution results can be found in **Appendix D**. The environmental sample was submitted for laboratory analysis using the standard marine sediment analytical program, including analysis for available metals, mercury, Tier I: BTEX/TPH, PAHs and PCBs. The laboratory data are provided in **Appendix C**.

3.4 Grain Size Analysis

The soil samples were analyzed in Fracflow's soil laboratory. The samples were decanted, then dried using ambient air, and then dried in the oven to obtain moisture content. The samples were mechanically sieved using a standard set of sieves. Samples then underwent a secondary selection for hydrometer analysis based on the percent passing the No. 200 sieve. These results were then appended to the tabulated data from mechanical sieve analysis. The results were tabulated, classified, and are presented in **Appendix D**.

4.0 SUBSURFACE CONDITIONS AND CHARACTERIZATION

Subsurface characterization is based on the field data collected from the eighteen (18) Dynamic Cone Penetration Tests. Detailed logs showing the DCPT blow counts from which the geological conditions at each location are inferred are provided in **Appendix B**.

4.1 Soil Description

Overburden in the area is characterized by outwash deposits of gravel, sand and silt of varying thickness overlying bedrock (Henderson, 1972). The overburden on the harbour bottom, based on the DCPT blow counts, is very soft sediment that did not support the weight of the DCPT rods. Due to previous dredging along the northwestern edge of the at site, the current harbour bottom and overburden thickness are highly variable, from 0.23 m at DCPT8 to 4.78 m at DCPT18. The grain size analysis of BH11-SS2 captures the outwash deposits and some bedrock, and the distribution of grain sizes can be found in **Appendix D**.

Based on the Atterberg Limit data and the hydrometer tests (**Appendix D**), the soft sediment consists primarily of silt with very little clay particles.

4.2 Soil Sample Descriptions

Table 4.1 Soil Sample Summary.

SS# Depth below LNT (n		v LNT (m)	Comments	
33#	Start	Stop	Comments	
PC9-SS1	1.36	4.52	Dark grey silty sand	
PC9-SS2-1	4.52	5.33	Dark grey silt with trace sand, top 0.30 m of split-spoon	
PC9-SS2-2	4.52	5.33	Dark grey bedrock (shale) material with some gravel, and oran flakes, bottom 0.30 m of split-spoon	

SS#	Depth below LNT (m)		Comments
33#	Start	Stop	Comments
PC11-SS1	3.85	4.87	Wet, dark grey to brown, silty sand (harbour bottom)
PC11-SS2	4.87	5.47	Dark grey silty sand
PC11-SS3	5.47	6.41	Various bedrock layers
PC13-SS1-1	1.04	5.13	Greenish, brownish, dark grey silt with some fine sand, top 0.33 m of split-spoon
PC13-SS1-2	1.04	5.13	Brownish, grey silty sand. Sample dry, clumpy. Some fibrous materials, bottom 0.28 m of split-spoon
PC13-SS2	5.13	7.22	Brown, grey, black silt. Some fibrous materials and shells.
PC13-SS3-1	7.22	8.83	Brown, greenish grey, black silt. Some fibrous material, and wood chips, top 0.43 m of split-spoon
PC13-SS3-2	7.22	8.83	Dark grey to black bedrock material with gravel, bottom 0.18 m of split-spoon

The splitspoon samples PC-SS2 and PC13-SS3-1 contained fibrous materials, that were organic in nature, and the sample visually resembled a peat, possibly a post glacial marsh underlying the soft harbour bottom sediments in the area.

Split spoon samples with a SS#-1 or SS#-2 designation represented a sample that had a discrete visual change in sample layers. The samples were split across this layer change, and treated as separate samples for grain size analysis.

The topmost layer in the split spoon is light brown, silty, fractured shale. The next layer is dark brown silt to sand layer with small rocks 5 - 10 mm in size. This dark brown layer then transitions into a light brown silty layer with distinct layers of light brown to grey shale. The subsequent layer is brown silt to sand layer with dark grey fractured shale. The last layer represented in this split spoon is light brown silt to sand with dark grey to black fractured shale and rocks 5 to 25 mm in size. This is similar to both PC9-SS2-2 and PC13-SS3-2 which both contained dark grey fractured layers, indicating a fractured shale material. The shale is thinly layered.

4.3 Grain Size Distribution

The soil samples analyzed for grain size distribution showed mainly sand with some gravel, and trace silt/clay. From previous hydrometer analysis, it was concluded that there was minimal clay in the samples. Hydrometer analysis were conducted on more recent samples and the data confirmed this conclusion. The shape of what is referred to as the gravel fraction, based on size only, was sub-angular to very angular, and ranged in colour from grey to dark brown and actually consisted of pieces of the thin shale layers, resembling broken breccia to weathered shale. The grain size analysis data can be found in **Appendix D**.

4.4 Bedrock Description

Bedrock in the area consists of black and greenish grey shale, that is assumed to be underlain by a quartz rich breccia, from both the Elliot Cove and Manuels River Groups (Water Resources Division, 1984). The blow counts recorded indicate that the bedrock is weak to moderately strong below the overburden layer at varying depths and is inferred, from the depths to firm ground, to dip towards the Northwest. There is also a erosional depression in the bedrock beneath the soft sediments, in the upper weak to moderately strong bedrock, that trends towards the North-Northwest direction along DCPT12, DCPT13, and DCPT16. The upper bedrock layer at this location is assumed to consist primarily of highly fractured and weathered shale with a compressive strength that is estimated at 50 MPa or less, based on the split-spoon sample blow counts and rock samples recovered.

Photographs of the samples collected using the split-spoon are provided in **Appendix E**, **Figures E1** to **E3**.

5.0 PRELIMINARY ROCK PLACEMENT PROCEDURES

Appendix A provides the contour maps that show (1) **Figure A2** - the water depth below LNT, (2) **Figure A3** - the depth below LNT to the top of the firm layer as defined by blow counts of 5 or greater, (3) **Figure A4** - the depth below LNT to the top of the hard layer or what is considered to be the top surface of the weathered shale layer, and (4) **Figure A5** - the thickness of the very soft layer through which the DCPT and rods sank under their own weight.

Based on the depth to the firm layer with blow counts in excess of 15 per 150 mm, it is estimated that approximately 300,000 cubic metres of rock or 540,000 tons will be required to fill the area that was outlined to bring the working surface to approximately 3 m above LNT. This assumes that the space between the rock blocks will have a porosity of approximately 25% to 40%.

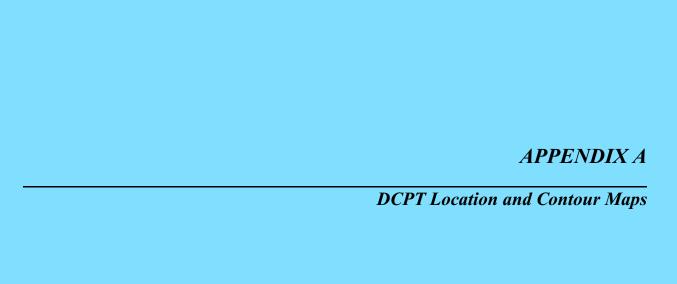
The site is partly bounded on the west by a pilot boat berth and on the northwest side by the boat turning basin and the main large boat wharf. The east side will have to provide a channel for small boat passage to the bottom or south end of the harbour. Based on these considerations, the following preliminary approach to rock placement is recommended:

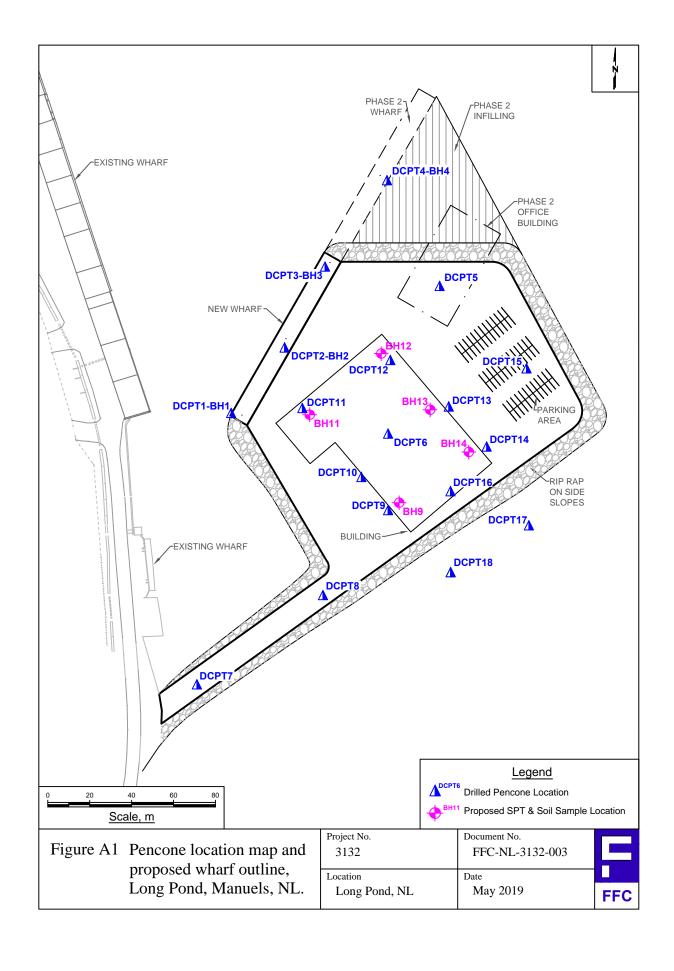
- 1. The road from the existing shoreline out to the main area or out to the DCPT8 location can be constructed by placing rock directly on the soft sediment with large rock (rip-rap) being placed using a long-reach excavator first on the northwest side of the road followed by large rock (rip-rap) being placed on the northeast side of the road. The rock on both sides should be advanced approximately one road width ahead of the rock being placed for the centre of the road. The goal is to prevent the soft sediment from creating a wave that is pushed towards the pilot boat wharf.
- 2. The boundary or perimeter road has to be constructed around the entire area to enclose and contain the soft sediment.

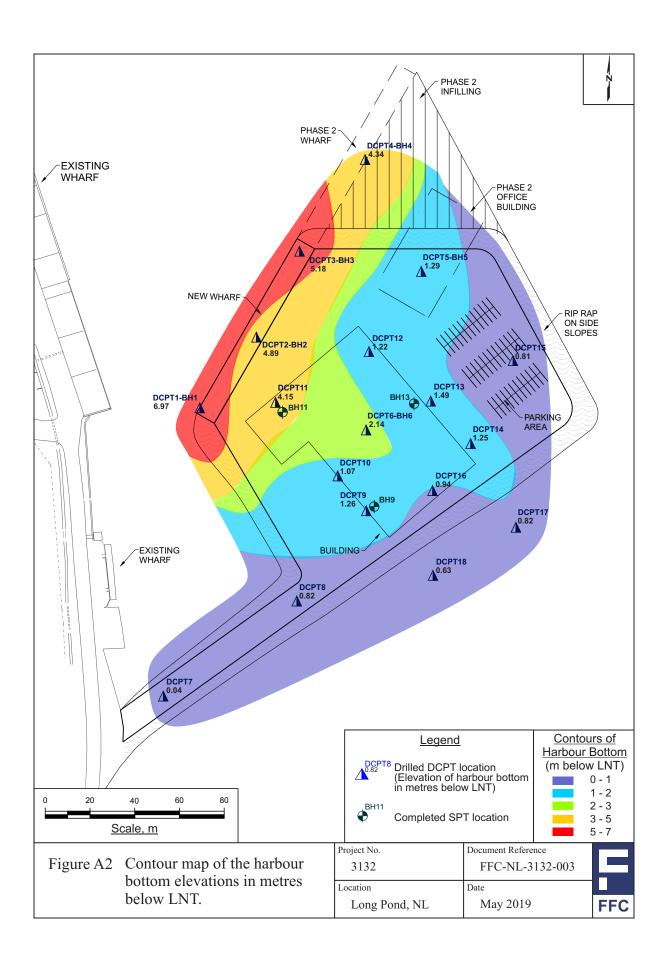
- 3. The first section of the perimeter road would extend from DCPT8 to DCPT1. Due to its proximity to the pilot boat wharf and to the southwest side of the proposed building, this section of road has to be advanced by excavating using a long reach excavator to remove the very soft and soft overburden material to the depth at which blow counts of 15 or greater were measured. The overburden material should be removed over a width that is 50% to 100% wider on each side than the proposed road surface width. The rock is to be placed as each road width section is excavated.
- 4. The perimeter road along the southeast side of the property should be constructed next, following the same excavation and rock placement procedures. For each section, rip-rap or large rock needs to be placed on the freeboard side of the berm or road.
- 5. For the section of the perimeter road that runs from DCPT1 to DCPT3, the perimeter road should be placed along the inside edge of the proposed wharf. The same excavation sequence should be followed for this road section. Before this section can be constructed, the proposed wharf design options should be confirmed to ensure that the rock placement process is compatible with the proposed wharf construction or design.
- 6. The northeast and north perimeter road sections have to be constructed last, and with the complete area enclosed the risk of a mud wave will be controlled.
- 7. It is expected that the various building foundation options will require excavation of the overburden to firm ground or to the top of the weathered shale bedrock. Once the building foundation options have been finalized and the preferred option selected, the rock placement procedures will be modified to accommodate the building foundation construction.

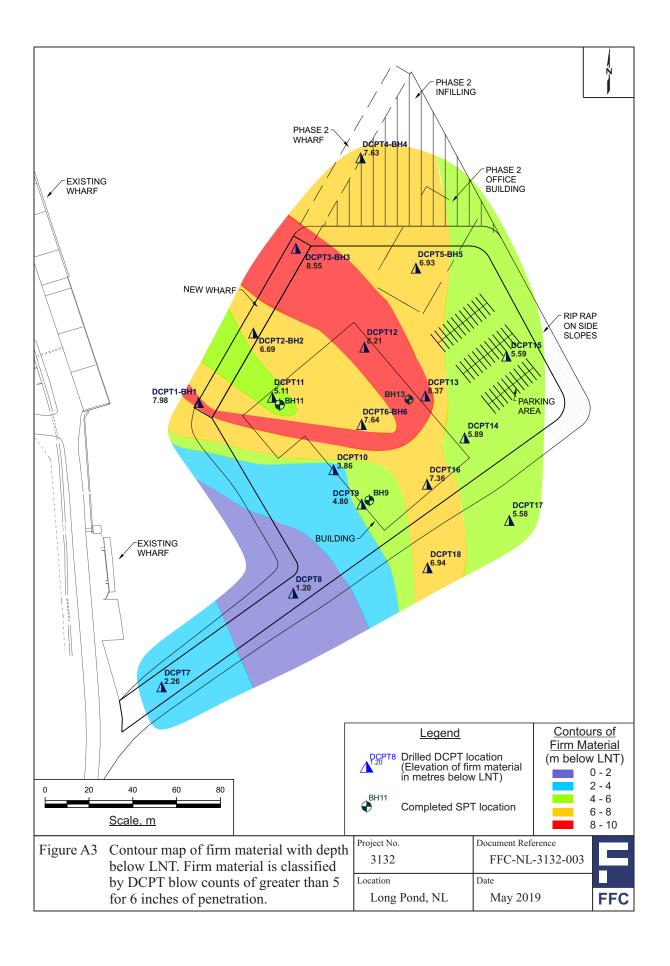
6.0 REFERENCES

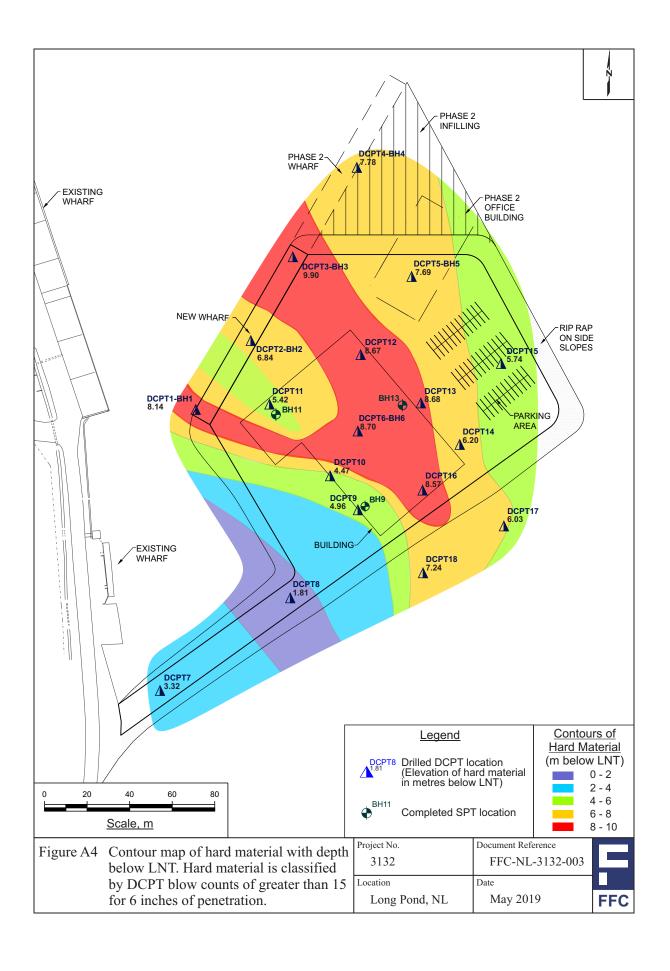
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- Water Resources Division, 1984. *Hydrogeology of the Avalon Peninsula Area*, Water Resources Report 2-6, Water Resources Division, Newfoundland Department of Environment.

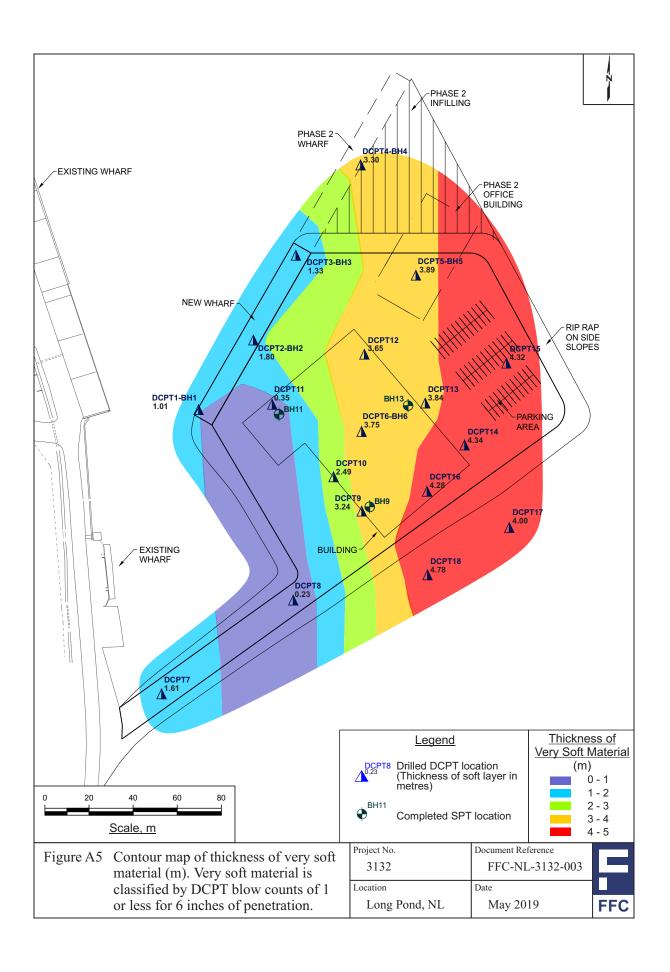












APPENDIX B

DCPT Logs

Log of Borehole: BH9

Client: OCI & AFN Engineering Inc.

Project No: 3132

Location: Long Pond, Manuels, NL

Date: April 23, 2019

		SUBSURFACE PROFILE			S	AMPL	.E					
Depth below LNT	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample No.	"N" Value	Recovery (%)	Modified TPH	Standard "N" Valu	ue per		m
0 m 0		0 m LNT	0								1	
### 0		Harbour Bottom (-1.36 m LNT)	-1.36							 		
5 6 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8		Split-spoon sank 2.51 m under own weight before SPT								 		
9111 3 10111 3 11111 121		Split-spoon sank additional 0.65 m under weight of hammer Marine Sediment Sample: 3132-PC9-SS1 Sample: PC9-SS1 CFEM: Silty Sand, trace Gravel, trace Clay		SS	1	0	12	<20∎				
13 4 14 1 14 1			-4.52							<u> </u>		
15 15 17 15 15 17 15 15 15 15 15 15 15 15 15 15 15 15 15		SPT: 2 / 1 / 7 / 31 / 87 Sample: PC9-SS2-1 (Top 0.30 m) CFEM: Silty Sand, some Gravel, trace Clay Sample: PC9-SS2-2 (Bottom 0.30 m) CFEM: Gravelly Sand, trace Silt/Clay	-5.33	SS	2	8	73					
18 19 6		End of Borehole										
21 22 22 22 22 22 22 22 22 22 22 22 22 2												
23 7											 	
25										 		

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Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270

Fax: (709) 753-5101

Drilling Method: NW Casing

Driller: Formation Drilling Ltd.

Datum: LNT

Project No: 3132

Client: OCI & AFN Engineering Inc.

Date: April 11, 2019

Log of Borehole: BH11

Location: Long Pond, Manuels, NL

SUBSURFACE PROFILE SAMPLE Standard Penetration Test Modified TPH Sample Type Recovery (%) Depth below LNT Elevation (m) "N" Value per 300 mm Sample No. Geologic Description "N" Value Symbol 20 40 60 80 0 0 m LNT 9 10-12 Harbour Bottom (-3.85 m LNT) -3.85 Split-spoon sank 0.56 m under weight of 13hammer SPT: 3 / 6 / 7 14 SS 0 35 <20 1 Marine Sediment Sample: 3132-PC11-SS1 15 Sample: PC11-SS1 CFEM: Sand, some Gravel, trace Silt/Clay -4.87 16 SPT: 4 / 6 / 14 / 11 Sample: PC11-SS2 SS 2 20 26 17 CFEM: Sand, trace Silt/Clay, trace Gravel -5.47 18-SPT: 15 / 26 / 33 / 72 / 88 / 54 19 Sample: PC11-SS3 SS 3 59 65 CFEM: Sand, some Gravel, trace Silt/Clay 20 -6.41 21 End of Borehole 22-23-24 25 26



Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: NW Casing

Driller: Formation Drilling Ltd.

Datum: LNT

Log of Borehole: BH13 Project No: 3132

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Date: April 23, 2019

		SUBSURFACE PROFILE			S	AMPL	.E		
Depth below LNT	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample No.	"N" Value	Recovery (%)	Modified TPH	Standard Penetration Test "N" Value per 300 mm
ft m		0 m LNT	0						
2 minute 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Harbour Bottom (-1.04 m LNT)	-1.04						
6 7 8 9 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Split-spoon sank 3.48 m under own weight before SPT Split-spoon sank additional 0.61 m under weight of hammer Marine Sediment Sample: 3132-PC13-SS1 Sample PC13-SS1-1 (Top 0.33 m) CFEM: Silty Sand Sample PC13-SS1-2 (Bottom 0.28 m) CFEM: Sand and Silt/Clay	-5.13	SS	1	0	100	43 ▮	
17 18 19 19 6 20 11 11 22 11 1		Split-spoon sank 0.72 m under own weight before SPT SPT: 2/1/1/1/1/1/2/1 Sample PC13-SS2 CFEM: Silt and Sand, trace Clay	-7.22	SS	2	2	29		
24 The state of th		Split-spoon sank 0.68 m under own weight before SPT SPT: 3/2/2/20/82 Sample PC13-SS3-1 (Top 0.43 m) CFEM: Silt and Sand, trace Clay, trace Gravel Sample PC13-SS3-2 (Bottom 0.18 m) CFEM: Gravel and Sand, trace Silt/Clay	-8.83	SS	3	4	38		
30 9 31 32 10 33 10		End of Borehole							

Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101

Drilling Method: NW Casing

Driller: Formation Drilling Ltd.

Datum: LNT

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT1-BH1

Project No: 3132

Date: December 8, 2018

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
ft m	0 m LNT	0		
6 7 8 9 10 11 12 13 14 15 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 20 14 15 16 17 18 19 20 21 20 14 15 16 17 18 19 20 21 20 15 16 17 18 19 20 21 20 15 16 17 18 19 20 21 20 15 16 17 18 19 20 21 20 15 16 16 16 17 18 19 20 21 20 15 16 16 16 16 16 16 16 16 16 16 16 16 16				
22 -	Harbour Bottom (-6.97 m LNT)	-6.97		
23 7 7 24 7 25 7 26 7	Pencone sank 1.01 m into soft sediment under own weight and weight of test hammer	-7.98	13	

Fracflow Consultants Inc. 154 Major's Path

St. John's, NL A1A 5A1 Phone: (709) 739-7270

Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT1-BH1

Project No: 3132

Date: December 8, 2018

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
27	DCPT: 13 / 33 / 39 / 30 for 0.05 m	-8.49	33 39	
28 29 30 31 32 33 32 33 34 40 41 42 43 44 45 46 41 44 42 43 44 45 46 41 41 41 41 41 41 41 41 41 41 41 41 41	End of Borehole	-8.49	39	
47 48 49 15 50 51 52				

Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT2-BH2

Project No: 3132

Date: December 8, 2018

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynami Blov 20	ic Cone F v Counts 40	Penetratio per 150 r 60	n Test nm 80
0 tt m	0 m LNT	0			- 		- $ -$
1 1 2 3 4 4 5 6 7 8 9 10 11 12 13 14 14 14 14 14 14 14 14 14 14 14 14 14					- 		-
15	Harbour Bottom (-4.89 m LNT)	-4.89					
15 17 18 19 19 19 19 20 19 19 20 23 19 25 24 25 26 29 20 20 20 20 20 20 20 20 20 20 20 20 20	Pencone sank 1.80 m into soft sediment under own weight and weight of test hammer	-6.69	5 15 19 19 17 28 20 22 23		- 		- +



Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT2-BH2

Project No: 3132

Date: December 8, 2018

▶ Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 41 41 41 41 41 41 41 41 41 41 41 41	DCPT: 5/15/19/19 /17/28/20/22 /23/25/23/41 /33/51/56/54 /40/48/31/37 /30/30/25/29 /37/29/36/33 /34/40/56/44 /49/54/41/36 /59 End of Borehole	-12.3	25 23 41 33 51 56 54 40 48 31 37 30 30 25 29 37 29 36 33 34 40 56 44 49 54 41 36 59	
41 42 43 43 44 45 46 47 48 49 50 51 52 52 52 52 52 52 52 52 52 52 52 52 52				



Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT3-BH3

Project No: 3132

Date: December 12, 2018

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynar Blo 20	mic Cone I ow Counts 40	Penetratio per 150 n 60	n Test nm 80
ft m	0 m LNT	0					
6 7 8 9 10 11 12 13 14 15 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 10 10 10 10 10 10 10 10 10 10 10 10 10	Harbour Bottom (-5.18 m LNT) Pencone sank 1.33 m into soft sediment under own weight and weight of test hammer	-5.18 -6.51	3 1 1 3 2 3 0				
26			2 3 2	 		_	<u> </u>

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Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT3-BH3

Project No: 3132

Date: December 12, 2018

281 291 301 9 DCPT: 3/1/1/3 11 3/1/1/3 11 3/2/3/0 for 0.23 m 9 10 1/2/3/2/3 331 10 1/2/3/2/3 331 10 1/2/3/2/3 331 10 1/2/3/2/3 331 10 1/2/3/2/3 331 10 1/2/3/2/3 331 341 341 351 361 11 1/29/36/34 End of Borehole End of Borehole	Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynam Blov 20	ic Cone I w Counts 40	Penetratio s per 150 n	n Test nm 80
	27 28 29 30 31 32 33 33 33 34 35 36 37 37 38 39 40 41 41 42 43 43 44 45 46 47 44 47 44 47 44 47 44 47 47 47 47 47	3/1/1/3 /2/3/0 for 0.23 m /2/3/2/3 /3/1/9/6 /5/5/7/10 /9/6/6/19 /21/21/23/32 Reposition (Overlap 0.11 m) /26/26/28/28 /33/38/34/31 /29/36/34	-12.3	3 3 1 9 6 5 5 7 10 9 6 6 6 19 21 21 23 26 28 28 28 33 34 31				



Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc,

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT4-BH4

Project No: 3132

Date: December 12, 2018

	0 m LNT		Blows per 150 mm	20	40	60	80
		0					
0 1 1 1 2 3 1 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Harbour Bottom (-4.34 m LNT)	-4.34					
15 16 5 17 18 19 19 10 6 21 11 11 12	Penconce sank 3.30 m into soft sediments under own weight and weight of test hammer	-7.63	5 23 34				-

Ε

Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc,

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT4-BH4

Project No: 3132

Date: December 12, 2018

▲ Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
27 28 29 30 31 32 33 34 35 36 37 38 39 11 12 12	DCPT: 5/23/34/23 /17/20/14/12 /12/16/15/24 /31/23/31/33 /48/46/52/39 /26/52/48/36 /44/55/58/53 /52 for 0.08 m (Refusal)	-12	23 17 20 14 12 16 15 24 31 23 31 33 48 46 52 39 26 52 48 36 44 55 58	
40 41 42 43 44 45 46 47 48 49 50 51 52 52	End of Borehole			



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Phone: (709) 739-7270 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT5-BH5

Project No: 3132

Date: December 12, 2018

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynar Blo 20	nic Cone I ow Counts 40	Penetratio s per 150 r 60	n Test mm 80
0 m 0	0 m LNT	0]
	Harbour Bottom (-1.29 m LNT)	-1.29			 		- - - - -
6 7 8 9 10 11 12 13 14 15 16 7 8 9 10 11 12 13 14 15 16 17 17 17 17 17 17 17 17 17 17 17 17 17	Pencone sank 3.89 m into soft sediment under own weight and weight of test hammer	-5.18	2				-
18 19 20 11 10 10 10 10 10 10 10 10 10 10 10 10	DCPT: 2/1/0/1 /1/1/1 /2 for 0.23 m /2/2/3/6 /3/9/11/14 /21/31 for 0.14 m End of Borehole	-7.99	2 1 0 1 1 1 1 2 2 2 2 3 6 3 9 11 14 21 31		-		- +



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Phone: (709) 739-7270

Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT6-BH6

Project No: 3132

Date: December 8, 2018

Depth	Geologic Description	o Elevation (m)	Blows per 150 mm	Dynam Blo 20	nic Cone F w Counts 40	Penetratio per 150 r 60	n Test nm 80
	0 m LNT	0					
3 1 4 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					_		_ _
5 1 6 1 2 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Harbour Bottom (-2.14 m LNT)	-2.14			-		-
## 1					— <u>† </u>	_ _	-
11 12 12 13 13 14	Pencone sank 3.75 m into soft sediment under own weight and weight of test hammer				<u> </u>		- _
14 14 15 16 17 16 17 17 17 17 17 17 17 17 17 17 17 17 17					- - - 		
18 19 19 6 6		-5.9	2		_		_
21			2 2 4 3 2		_	_	_ _
22 1 7 23 1 7 24 1 1 25 1			2 3 2 2 2		_		_
26			5 5 3	-	_ <u> </u>		_

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Phone: (709) 739-7270 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT6-BH6

Project No: 3132

Date: December 8, 2018

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
27 28 29 30 31 32 33 33 33 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 44 49 50 51 52 52	DCPT: 2/2 for 0.23 m /2/4/3/2 /2/3/2/2 /2/5/5/3 /5/5/4/4 /28/39/38 /52 for 0.10 m (Refusal) End of Borehole	-9.26	5 4 4 28 39 38 52	



Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT7

Project No: 3132

Date: March 20, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Blow 20	Cone F Counts 40	Penetration per 150 n	n Test nm 80
0 ft m	0 m LNT	0					
1 2 3 4 5 5	Harbour Bottom (-0.04 m LNT) Pencone sank 1.61 m into soft sediment under own weight	-1.65			 		-
6 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 14 15 16 17 18 19 20 21	DCPT: 3/4/3/4 /6/6/6/8 /10/11/11/20 /27/27/31/47 /61 for 0.15 m (Non-Refusal) End of Borehole	-4.24	3 4 3 4 6 6 6 8 10 11 11 20 27 27 31 47 61		+		-
22 1 7 23 1 7 24 1 1 2 25 1 1 2 26 1 1					 		- + - + -



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Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT8

Project No: 3132

Date: March 20, 2019

Depth	Geologic Description 0 m LNT	o Elevation (m)	Blows per 150 mm	Dynami Blov 20	c Cone F v Counts 40	Penetratio per 150 r 60	n Test mm 80
o 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 26 27 24 25 26 27 26 27 27 28 29 29 29 29 29 29 29 29 29 29 29 29 29	Harbour Bottom (-0.82 m LNT) Pencone sank 0.23 m into soft sediment under own weight DCPT: 2/5/4/11 /13/21/23/18 /22/46/72 for 0.15 m (Non-Refusal) End of Borehole	-0.818 -1.05	2 5 4 111 13 21 23 18 22 46 72				- +



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St. John's, NL A1A 5A1 Phone: (709) 739-7270

Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT9

Project No: 3132

Date: March 20, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynam Blo 20	nic Cone F w Counts 40	Penetration per 150 n 60	n Test nm 80
0 ft m	0 m LNT	0					
1 2 3 4 5 6 7 8 9 10 11 12 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Harbour Bottom (-1.26 m LNT) Pencone sank 3.24 m into soft sediment under own weight	-1.26					
13 4 14					_ _		_
15	DCPT·	-4.5	2				
16 5 17 5	DCPT: 2 / 1 / 5 / 28 / 31 / 49 / 72 for 0.09 m (Refusal)	<i></i>	5 28 31 49 72				
18 19 19 20	End of Borehole	-5.5	72		-		■+ -
21					_	 	_
23 7							
24 25 26 26					_ _ 		

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Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT10

Project No: 3132

Date: March 19, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynam Blo 20	iic Cone F w Counts 40	² enetratio per 150 r 60	n Test nm 80 '
0 = 0	0 m LNT	0					
0 11 2 3 4 5 6 7 8 9 10	Harbour Bottom (-1.07 m LNT) Pencone sank 2.49 m into soft sediment under own weight	-1.07					
114					i	i	i
12 13 4 14 15 16 17 17 17 17 17 17 17 17 17 17 17 17 17	DCPT: 2/1/10/7 /7/14/22/36 /52/44/41/53 for 0.10 m (Refusal)	-3.56 -5.33	2 1 10 7 7 7 14 22 36 52 44 41 53				- - -
18 19 10 6 20 11 11 11 11 11 11 11 11 11 11 11 11 11	End of Borehole				- +		- - - - - - - - - -



Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT11

Project No: 3132

Date: April 11, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynam Blo 20	nic Cone I w Counts 40	Penetratio per 150 n 60	n Test nm 80
0 = 0	0 m LNT	0					
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 14 14 14 14 14 14 14 14 14 14 14 14	Harbour Bottom (-4.15 m LNT) Pencone sank 0.35 m into soft sediment under own	-4.15					
	weight	-4.5					
15 17 18 19 10 10 10 10 10 10 10 10 10 10 10 10 10	DCPT: 3 / 6 / 4 / 4 / 7 / 12 / 15 / 34 / 16 / 17 / 21 / 20 / 24 for 0.15 m (Non-Refusal) End of Borehole	-6.48	3 6 4 7 12 15 34 16 17 20 21 24		- - - - - -		



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Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT12

Project No: 3132

Date: March 21, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynam Blo 20	nic Cone F w Counts 40	Penetratio per 150 r 60	n Test nm 80
0 ft m	0 m LNT	0					
6 7 8 9 10 11 12 13 14 14 14 14 14 14 14 14 14 14 14 14 14	Harbour Bottom (-1.22 m LNT) Pencone sank 3.65 m into soft sediment under own weight	-1.22					- - - - - - - - - - - - - - - - - - -
15=		-4.87					
15 16 17 18 19 10 10 10 10 10 10 10 10 10 10 10 10 10	DCPT: 1/1/1/1 /1/1/1/1 /3/3/3/2 /2/2/3/2 /2/2/3/2 /4	-8.06	1 1 1 1 1 1 1 1 1 1 3 3 3 3 2 2 2 2 2 2		- 		- - - - - - - - - - - - - - -



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Phone: (709) 739-7270

Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT12

Project No: 3132

Date: March 21, 2019

▶ Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
27 28 29 30 31 32 33 33 33 36 34 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 51 51 52 51 51 51 51 51 51 51 51 51 51 51 51 51	DCPT (cont'd): 4/5/6/10 /16/32/48/76 / 52 for 0.03 m (Refusal) End of Borehole	-9.3	4 5 6 10 16 32 48 76	

Drilling Method: Dynamic Cone Penetration Test



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Phone: (709) 739-7270 Fax: (709) 753-5101

e: (709) 739-7270 Driller: Formation Drilling Ltd.

Datum: Geodetic

Log of DCPT: DCPT13

Client: OCI & AFN Engineering Inc.

Project No: 3132

Location: Long Pond, Manuels, NL

Date: March 21, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynam Blov 20	ic Cone F w Counts 40	Penetration per 150 n	n Test nm 80
0 ft m	0 m LNT	0					
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 15 16 16 17 18 10 11 12 13 14 15 16 16 16 17 18 18 18 18 18 18 18 18 18 18 18 18 18	Harbour Bottom (-1.49 m LNT) Pencone sank 3.84 m into soft sediment under own weight	-1.49			- - - - - - - - - - 		
17 18 19 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	DCPT: 1/2/1/1 /2/2/2/2 /2/2/3/2 /2/3/2/3 /3/2	-5.33 -8.07	1 2 1 1 2 2 2 2 2 2 2 2 2 2 2 3 2 2 3 3 2 2 3 3 2 3 3 2 3 3 3 3 2 3		- 		- + - + - +



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Phone: (709) 739-7270

Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT13

Project No: 3132

Date: March 21, 2019

₩ Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 47 48 49 50 51 52 52 52 52 52 52 52 52 52 52 52 52 52	DCPT (cont'd): 2/4/6/10 /16/48/52 for 0.01 m (Refusal) End of Borehole	-8.97	2 4 6 10 16 48	

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Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT14

Project No: 3132

Date: March 21, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynan Blo 20	nic Cone F ow Counts 40	Penetratio per 150 r 60	n Test nm 80
0 ft m	0 m LNT	0					
6tt 1	Harbour Bottom (-1.25 m LNT)	-1.25			 		 -
12 13 14 14 15 16 17 17 18 18 18 18 18 18 18 18 18 18 18 18 18	Pencone sank 4.34 m into soft sediment under own weight	-5.59					-
19 19 6 20 21 11 11 12 12 12 12 12 12 12 12 12 12	DCPT: 2 / 2 / 7 / 12 / 24 / 22 / 11 / 46 / 52 for 0.03 m (Refusal)	-6.83	2 2 7 12 24 22 11 46			- - -	-
23 7 24 11 25 11 26 11 2	End of Borehole					 	- -

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Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT15

Project No: 3132

Date: March 19, 2019

tt m	Geologic Description 0 m LNT	o Elevation (m)	Blows per 150 mm	Dyna Bl 20	mic Cone I ow Counts 40	Penetratio per 150 r 60	n Test nm 80
0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							
] 2	Harbour Bottom (-0.81 m LNT)	-0.812					
2 10 10 11 11 12 13 14 15 16 16 17 18 19 10 11 11 11 11 11 11 11 11 11 11 11 11	Pencone sank 4.32 m into soft sediment under own weight	-5.13					
17 18 19 6 20 11 22 11 23 7 24 11 1 26 11	DCPT: 2/3/3/8 /15/21/31/17 /15/11/24/52 for 0.15 m (Non-Refusal) End of Borehole	-6.96	2 3 3 8 15 21 31 17 15 11 24 52				- - - - - - - - - - - - - - - -

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Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT16

Project No: 3132

Date: March 19, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynan Blo 20	nic Cone I ow Counts 40	Penetratio per 150 r 60	n Test nm 80
0 1 0	0 m LNT	0					
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Harbour Bottom (-0.94 m LNT)	-0.944			_ 	 	 -
6 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 17 17 18 19 10 11 12 13 14 15 16 17 17 17 17 17 17 17 17 17 17 17 17 17	Pencone sank 4.28 m into soft sediment under own weight	-5.23					-
18 19 19 6 20 11 11 12 22 23 17 24 25 26 26 27	DCPT: 2/1/1/2 /1/2/2/2 /2/2/3/3 /3/4/5/5 /6/7/9	-8.12	2 1 1 2 2 2 2 2 2 2 2 3 3 3 4 5 5 6 7				- + - + - +



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Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 2

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT16

Project No: 3132

Date: March 19, 2019

▲ Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynamic Cone Penetration Test Blow Counts per 150 mm
27 28 29 30 31 32 33 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 51 52 51 51 51 51 51 51 51 51 51 51 51 51 51	DCPT (Cont'd):	-9.04	9 8 7 35 74 162	



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Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 2 of 2

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT17

Project No: 3132

Date: March 19, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynan Blo 20	nic Cone I ow Counts 40	Penetratio s per 150 r 60	n Test nm 80
0 m 0	0 m LNT	0					
1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Harbour Bottom (-0.82 m LNT)	-0.818			 		 -
6 7 8 9 10 11 12 13 14 15 6 7 8 9 10 11 12 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15	Pencone sank 4.00 m into soft sediment under own weight	-4.82					-
16 15 17 18 19 19 10 10 10 10 10 10 10 10 10 10 10 10 10	DCPT: 2/2/1/1 /2/8/12/13 /15/15/27/52 for 0.05 m (Refusal) End of Borehole	-6.54	2 2 1 1 2 8 12 13 15 15 27			— — — — —	- + - +
24 1 25 1 26 1 26 1 26 1 26 1 26 1 26 1 26					_		-



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Phone: (709) 739-7270 Fax: (709) 753-5101 Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Client: OCI & AFN Engineering Inc.

Location: Long Pond, Manuels, NL

Log of DCPT: DCPT18

Project No: 3132

Date: March 19, 2019

Depth	Geologic Description	Elevation (m)	Blows per 150 mm	Dynar Blo 20	nic Cone I ow Counts 40	Penetratio s per 150 r 60	n Test nm 80
oft m	0 m LNT	0					
6 7 8 9 10 11 12 13 14 15 6 7 8 9 10 11 12 13 14 15 16 15 16 16 17 8 19 10 11 12 13 14 15 16 16 16 16 16 16 16 16 16 16 16 16 16	Harbour Bottom (-0.63 m LNT) Pencone sank 4.78 m into soft sediment under own weight	-0.635					- +
16 5		-5.42					
18 19 19 6 20 11 11 11 11 11 11 11 11 11 11 11 11 11	DCPT: 1/1/2/2 /1/1/2/2 /2/4/5/10 /15/30/65 for 0.15 m (Non-Refusal)	-7.7	1 1 2 2 1 1 1 2 2 2 2 4 5 10 15 30 65		- - - - - - -		- + -
26	End of Borehole						



Fracflow Consultants Inc. 154 Major's Path St. John's, NL A1A 5A1

St. John's, NL A1A 5A1 Phone: (709) 739-7270 Fax: (709) 753-5101

Driller: Formation Drilling Ltd.

Drilling Method: Dynamic Cone Penetration Test

Datum: Geodetic

Sheet: 1 of 1



Table C1 Analytical results of low level BTEX/TPH in soil samples, Long Pond, Manuels, NL.

	Project 3132 - Long Pond, Manuels Sampling Program								
Fracflow Sample ID			3132-PC9-SS1	3132-PC11-SS1	3132-PC13-SS1				
Sampling Date	Units	RDL	04/23/2019	04/11/2019	04/23/2019				
AGAT ID			150110	128521	150118				
Petroleum Hydrocarbons									
Benzene	mg/kg	0.03	<0.03	<0.03	<0.03				
Toluene	mg/kg	0.04	<0.04	<0.04	<0.04				
Ethylbenzene	mg/kg	0.03	<0.03	<0.03	<0.03				
Xylene (Total)	mg/kg	0.05	<0.05	<0.05	<0.05				
C6-C10 (less BTEX)	mg/kg	3	<3	<3	<3				
>C10-C16 Hydrocarbons	mg/kg	15	<15	<15	<15				
>C16-C21 Hydrocarbons	mg/kg	15	<15	<15	<15				
>C21-C32 Hydrocarbons	mg/kg	15	<15	<15	43				
Modified TPH (Tier 1)	mg/kg	20	<20	<20	43				
Resemblance Comment			NR	NR	UC				
Return to Baseline at C32			Υ	Y	Y				
Fractionation			N	N	N				
Surrogate Recovery (%)									
Isobutylbenzene - EPH	%		105	107	105				
Isobutylbenzene - VPH	%		90	118	93				
n-Dotriacontane - EPH	%		109	112	108				
% Moisture	%	0	36	22	61				

Comments: - RDL - Reported Detection Limit;

- Results are based on the dry weight of the soil.

LR - Lube Range

- Resemblance Comment Key:

FOF - Fuel Oil Fraction FR - Product in Fuel Oil Range GF - Gasoline Fraction GR - Product in Gasoline Range LOF - Lube Oil Fraction NA - Not Applicable
NR - No Resemblance
UC - Unidentified Compounds
WFOF - Weathered Fuel Oil Fraction
WGF - Weathered Gasoline Fraction

Table C2 Analytical results of available metals in soil samples, Long Pond, Manuels, NL.

	Project 3132 - Long Pond, Manuels Sampling Program									
Fracflow Sample ID			3132-PC9-SS1	3132-PC11-SS1	3132-PC13-SS1					
Sampling Date	Units	RDL	04/23/2019	04/11/2019	04/23/2019					
AGAT ID			150110	128521	150118					
Available Metals in Soil										
Aluminum	mg/kg	10	13600	25000	11600					
Antimony	mg/kg	1	<1	<1	<1					
Arsenic	mg/kg	1	34	32	14					
Barium	mg/kg	5	147	658	186					
Beryllium	mg/kg	2	<2	2	<2					
Boron	mg/kg	2	27	19	46					
Cadmium	mg/kg	0.3	<0.3	0.4	0.4					
Chromium	mg/kg	2	22	25	19					
Chromium, Hexavalent	mg/kg	0.5	<0.5	<0.5	<0.5					
Cobalt	mg/kg	1	5	90	7					
Copper	mg/kg	2	27	74	26					
Iron	mg/kg	50	38500	76500	24100					
Lead	mg/kg	0.5	15.1	14.9	14.8					
Lithium	mg/kg	5	29	89	38					
Manganese	mg/kg	2	510	16900	405					
Mercury	mg/kg	0.05	0.1	0.12	0.05					
Molybdenum	mg/kg	2	13	7	8					
Nickel	mg/kg	2	13	90	15					
Selenium	mg/kg	1	<1	2	<1					
Silver	mg/kg	0.5	<0.5	<0.5	<0.5					
Strontium	mg/kg	5	26	115	31					
Thallium	mg/kg	0.1	0.1	0.2	0.1					
Tin	mg/kg	2	4	4	5					
Uranium	mg/kg	0.1	1.8	5.6	2.6					
Vanadium	mg/kg	2	28	24	39					
Zinc	mg/kg	5	47	193	81					

Comments: - RDL - Reported Detection Limit;

⁻ Results are based on the dry weight of the soil.

Table C3 Analytical results of Polycyclic Aromatic Hydrocarbons and Polychlorinated Biphenyls in soil samples, Long Pond, Manuels, NL.

	Project 3132 - Long Pond, Manuels, NL Sampling Program								
Fracflow Sample ID			3132-PC9-SS1	3132-PC11-SS1	3132-PC13-SS1				
Sampling Date	Units	RDL	04/23/2019	04/11/2019	04/23/2019				
AGAT ID			150110	128521	150118				
Polycyclic Aromatic Hydrocarbon	s in Soil								
1-Methylnaphthalene	mg/kg	0.05	<0.05	<0.05	<0.05				
2-Methylnaphthalene	mg/kg	0.01	<0.01	<0.01	<0.01				
Acenaphthene	mg/kg	0.00671	0.00982	<0.00671	<0.00671				
Acenaphthylene	mg/kg	0.004	0.01	<0.004	<0.004				
Acridine	mg/kg	0.05	<0.05	<0.05	<0.05				
Anthracene	mg/kg	0.03	<0.03	<0.03	<0.03				
Benzo(a)anthracene	mg/kg	0.01	0.07	0.02	0.05				
Benzo(a)pyrene	mg/kg	0.01	0.04	<0.01	<0.01				
Benzo(b)fluoranthene	mg/kg	0.05	<0.05	<0.05	<0.05				
Benzo(b+j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1				
Benzo(e)pyrene	mg/kg	0.05	<0.05	<0.05	<0.05				
Benzo(ghi)perylene	mg/kg	0.01	<0.01	<0.01	<0.01				
Benzo(k)fluoranthene	mg/kg	0.01	0.02	<0.01	0.02				
Chrysene	mg/kg	0.01	0.06	0.02	0.14				
Dibenzo(a,h)anthracene	mg/kg	0.006	<0.006	<0.006	<0.006				
Fluoranthene	mg/kg	0.05	0.1	0.05	<0.05				
Fluorene	mg/kg	0.01	0.01	<0.01	0.01				
Indeno(1,2,3)pyrene	mg/kg	0.01	<0.01	<0.01	<0.01				
Naphthalene	mg/kg	0.01	<0.01	<0.01	<0.01				
Perylene	mg/kg	0.05	<0.05	<0.05	0.1				
Phenanthrene	mg/kg	0.03	0.05	<0.03	0.04				
Pyrene	mg/kg	0.05	0.07	<0.05	<0.05				
Quinoline	mg/kg	0.05	<0.05	<0.05	<0.05				
Nitrobenzene-d5	%		118	77	76				
2-Fluorobiphenyl	%		137	71	73				
Terphenyl-d14	%		119	72	62				
Total Polychlorinated Biphenyls i	n Soil - (PCE	3)		•					
Total Polychlorinated Biphenyls	mg/kg	0.02	<0.02	<0.02	<0.02				
Decachlorobiphenyl	%		109	125	115				

Comments: - RDL - Reported Detection Limit;

⁻ Results are based on the dry weight of the soil.



CLIENT NAME: FRACFLOW CONSULTANTS 154 MAJOR'S PATH ST. JOHN'S PATH, NL A1A5A1 (709) 739-7270

ATTENTION TO: John Gale

PROJECT: 3132, OCI Long Pond

AGAT WORK ORDER: 19K456277

SOIL ANALYSIS REVIEWED BY: Courtney O Brien, Data Reporter, B.Eng., EIT TRACE ORGANICS REVIEWED BY: Amy Hunter, Trace Organics Supervisor, B.Sc.

DATE REPORTED: Apr 22, 2019

PAGES (INCLUDING COVER): 16

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (709)747-8573

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories (V1)

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AGAT WORK ORDER: 19K456277 PROJECT: 3132, OCI Long Pond 57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale SAMPLED BY:

SAMI LING SITE.				SAIVII LLD BT.
			Availa	able Metals in Soil
DATE RECEIVED: 2019-04-12				DATE REPORTED: 2019-04-22
	S	AMPLE DESCRIPTION:	3132-PC11-SS1	
		SAMPLE TYPE:	Soil	
		DATE SAMPLED:	2019-04-11	
Parameter	Unit	G/S RDL	128521	
Aluminum	mg/kg	10	25000	
Antimony	mg/kg	1	<1	
Arsenic	mg/kg	1	32	
Barium	mg/kg	5	658	
Beryllium	mg/kg	2	2	
Boron	mg/kg	2	19	
Cadmium	mg/kg	0.3	0.4	
Chromium	mg/kg	2	25	
Cobalt	mg/kg	1	90	
Copper	mg/kg	2	74	
Iron	mg/kg	50	76500	
Lead	mg/kg	0.5	14.9	
Lithium	mg/kg	5	89	
Manganese	mg/kg	2	16900	
Molybdenum	mg/kg	2	7	
Nickel	mg/kg	2	90	
Selenium	mg/kg	1	2	
Silver	mg/kg	0.5	<0.5	
Strontium	mg/kg	5	115	
Thallium	mg/kg	0.1	0.2	
Tin	mg/kg	2	4	
Uranium	mg/kg	0.1	5.6	
Vanadium	mg/kg	2	24	
Zinc	mg/kg	5	193	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

128521 Results are based on the dry weight of the sample.

Analysis performed at AGAT Halifax (unless marked by *)





AGAT WORK ORDER: 19K456277 PROJECT: 3132, OCI Long Pond

57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale SAMPLED BY:

Hexavalent	Chror	mium	in	Soil
HEXAVAIEIIL	OHIO	muni	111	JUII

DATE RECEIVED: 2019-04-12 **DATE REPORTED: 2019-04-22**

SAMPLE DESCRIPTION: 3132-PC11-SS1

SAMPLE TYPE: Soil

DATE SAMPLED: 2019-04-11

RDL 128521

G/S Parameter Unit Chromium, Hexavalent mg/kg 0.5 < 0.5

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Halifax (unless marked by *)





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CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale SAMPLED BY:

N /			0 - 11
NACE	CIITY	ın	\sim
IVICI	cury		COLL
			• • • •

DATE RECEIVED: 2019-04-12 DATE REPORTED: 2019-04-22

SAMPLE DESCRIPTION: 3132-PC11-SS1

SAMPLE TYPE: Soil

DATE SAMPLED: 2019-04-11

DATE SAMPLED: 2019-04-11

 Parameter
 Unit
 G / S
 RDL
 128521

 Mercury
 mg/kg
 0.05
 0.12

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

128521 Results are based on the dry weight of the soil. Analysis performed at AGAT Halifax (unless marked by *)





ATTENTION TO: John Gale

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CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE: SAMPLED BY:

DATE RECEIVED: 2019-04-12 SAMPLE DESCRIPTION: 3132-PC11-SS1 DATE REPORTED: 2019-04-22

Atlantic RBCA Tier 1 Hydrocarbons in Soil (Version 3.1) - Field Preserved

		o,		0.02 . 0 00 .
		SAMPL	E TYPE:	Soil
		DATE SA	MPLED:	2019-04-11
Parameter	Unit	G/S	RDL	128521
Benzene	mg/kg		0.03	< 0.03
Toluene	mg/kg		0.04	< 0.04
Ethylbenzene	mg/kg		0.03	< 0.03
Xylene (Total)	mg/kg		0.05	< 0.05
C6-C10 (less BTEX)	mg/kg		3	<3
>C10-C16 Hydrocarbons	mg/kg		15	<15
>C16-C21 Hydrocarbons	mg/kg		15	<15
>C21-C32 Hydrocarbons	mg/kg		15	<15
Modified TPH (Tier 1)	mg/kg		20	<20
Resemblance Comment				NR
Return to Baseline at C32				Υ
Surrogate	Unit	Acceptable	Limits	
Isobutylbenzene - EPH	%	60-140)	107
Isobutylbenzene - VPH	%	60-140)	118
n-Dotriacontane - EPH	%	60-140)	112

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

128521 Results are based on the dry weight of the soil.

Resemblance Comment Key: GF - Gasoline Fraction

WGF - Weathered Gasoline Fraction GR - Product in Gasoline Range

FOF - Fuel Oil Fraction

WFOF - Weathered Fuel Oil Fraction FR - Product in Fuel Oil Range

LOF - Lube Oil Fraction LR - Lube Range

UC - Unidentified Compounds

NR - No Resemblance

NA - Not Applicable

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:

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CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale SAMPLED BY:

Moisture										
DATE RECEIVED: 2019-04-12	2				DATE REPORTED: 2019-04-22					
SAMPLE DESCRIPTION: 3132-PC11-SS1										
		SAME	PLE TYPE:	Soil						
		DATE S	SAMPLED:	2019-04-11						
Parameter	Unit	G/S	RDL	128521						
% Moisture	%		0	22						

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

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CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale SAMPLED BY:

Polycyclic	Aromatic H	ydrocarbons	in Soil

DATE RECEIVED: 2019-04-1	2			DATE REPORTED: 2019-04-
	5	SAMPLE DESCRIPTION:	3132-PC11-SS1	
		SAMPLE TYPE:	Soil	
		DATE SAMPLED:	2019-04-11	
Parameter	Unit	G/S RDL	128521	
1-Methylnaphthalene	mg/kg	0.05	<0.05	
2-Methylnaphthalene	mg/kg	0.01	<0.01	
Acenaphthene	mg/kg	0.00671	<0.00671	
Acenaphthylene	mg/kg	0.004	<0.004	
Acridine	mg/kg	0.05	<0.05	
Anthracene	mg/kg	0.03	<0.03	
Benzo(a)anthracene	mg/kg	0.01	0.02	
Benzo(a)pyrene	mg/kg	0.01	<0.01	
Benzo(b)fluoranthene	mg/kg	0.05	<0.05	
Benzo(b+j)fluoranthene	mg/kg	0.1	<0.1	
Benzo(e)pyrene	mg/kg	0.05	<0.05	
Benzo(ghi)perylene	mg/kg	0.01	<0.01	
Benzo(k)fluoranthene	mg/kg	0.01	<0.01	
Chrysene	mg/kg	0.01	0.02	
Dibenzo(a,h)anthracene	mg/kg	0.006	<0.006	
Fluoranthene	mg/kg	0.05	0.05	
Fluorene	mg/kg	0.01	<0.01	
Indeno(1,2,3)pyrene	mg/kg	0.01	<0.01	
Naphthalene	mg/kg	0.01	<0.01	
Perylene	mg/kg	0.05	<0.05	
Phenanthrene	mg/kg	0.03	<0.03	
Pyrene	mg/kg	0.05	<0.05	
Quinoline	mg/kg	0.05	<0.05	
Surrogate	Unit	Acceptable Limits		
Nitrobenzene-d5	%	50-140	77	
2-Fluorobiphenyl	%	50-140	71	
Terphenyl-d14	%	50-140	72	



AGAT WORK ORDER: 19K456277 PROJECT: 3132, OCI Long Pond

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CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale

SAMPLED BY:

Polycyclic Aromatic Hydrocarbons in Soil

DATE RECEIVED: 2019-04-12 **DATE REPORTED: 2019-04-22**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

128521 Results are based on the dry weight of the soil.

Benzo(b)fluoranthene may include contributions from benzo(j)fluoranthene, if also present in the sample.

Analysis performed at AGAT Halifax (unless marked by *)



ATTENTION TO: John Gale

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CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE: SAMPLED BY:

DATE RECEIVED: 2019-04-12 DATE REPORTED: 2019-04-

Total Polychlorinated Biphenyls in Soil - (PCB)

SAMPLE DESCRIPTION: 3132-PC11-SS1 SAMPLE TYPE: Soil DATE SAMPLED: 2019-04-11 G/S RDL 128521 Parameter Unit Total Polychlorinated Biphenyls mg/kg 0.02 < 0.02 Surrogate Unit Acceptable Limits Decachlorobiphenyl 50-130 125

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

128521 Results are based on the dry weight of the soil.

Analysis performed at AGAT Halifax (unless marked by *)

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 19K456277 PROJECT: 3132, OCI Long Pond ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

Soil Analysis															
RPT Date: Apr 22, 2019			DUPLICATE			REFERE	NCE MA	TERIAL	METHOD BLANK SPIKE			MATRIX SPIKE		IKE	
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value		ptable	Recovery	Lin	ptable nits	Recovery	Lin	eptable mits
		lu lu					Value	Lower	Upper		Lower	Upper		Lower	Upper
Available Metals in Soil															
Aluminum	4172019	128521	25000	23500	6.3%	< 10	98%	80%	120%	104%	80%	120%	NA	70%	130%
Antimony	4172019	128521	<1	<1	NA	< 1	84%	80%	120%	113%	80%	120%	NA	70%	130%
Arsenic	4172019	128521	32	32	0.5%	< 1	93%	80%	120%	96%	80%	120%	NA	70%	130%
Barium	4172019	128521	658	547	18.4%	< 5	91%	80%	120%	98%	80%	120%	NA	70%	130%
Beryllium	4172019	128521	2	2	NA	< 2	93%	80%	120%	97%	80%	120%	94%	70%	130%
Boron	4172019	128521	19	18	3.8%	< 2	100%	80%	120%	98%	80%	120%	74%	70%	130%
Cadmium	4172019	128521	0.4	0.4	NA	< 0.3	90%	80%	120%	92%	80%	120%	96%	70%	130%
Chromium	4172019	128521	25	24	1.9%	< 2	95%	80%	120%	87%	80%	120%	NA	70%	130%
Cobalt	4172019	128521	90	86	4.5%	< 1	92%	80%	120%	91%	80%	120%	NA	70%	130%
Copper	4172019	128521	74	70	4.9%	< 2	93%	80%	120%	92%	80%	120%	NA	70%	130%
Iron	4172019	128521	76500	70300	8.3%	< 50	106%	80%	120%	87%	80%	120%	NA	70%	130%
Lead	4172019	128521	14.9	15.3	2.3%	< 0.5	94%	80%	120%	99%	80%	120%	NA	70%	130%
Lithium	4172019	128521	89	89	0.3%	< 5	97%	70%	130%	95%	70%	130%	NA	70%	130%
Manganese	4172019	128521	16900	15300	9.9%	< 2	90%	80%	120%	89%	80%	120%	95%	70%	130%
Molybdenum	4172019	128521	7	7	NA	< 2	91%	80%	120%	89%	80%	120%	NA	70%	130%
Nickel	4172019	128521	90	82	9.4%	< 2	91%	80%	120%	93%	80%	120%	NA	70%	130%
Selenium	4172019	128521	2	2	NA	< 1	88%	80%	120%	93%	80%	120%	72%	70%	130%
Silver	4172019	128521	<0.5	<0.5	NA	< 0.5	91%	80%	120%	98%	80%	120%	82%	70%	130%
Strontium	4172019	128521	115	97	17.4%	< 5	88%	80%	120%	87%	80%	120%	NA	70%	130%
Thallium	4172019	128521	0.2	0.2	NA	< 0.1	92%	80%	120%	95%	80%	120%	NA	70%	130%
Tin	4172019	128521	4	3	NA	< 2	87%	80%	120%	90%	80%	120%	81%	70%	130%
Uranium	4172019	128521	5.6	4.2	29.3%	< 0.1	94%	80%	120%	96%	80%	120%	NA	70%	130%
Vanadium	4172019	128521	24	22	6.6%	< 2	92%	80%	120%	88%	80%	120%	NA	70%	130%
Zinc	4172019		193	189	2.3%	< 5	91%	80%	120%	86%	80%	120%	NA	70%	130%
Mercury in Soil															
Mercury	1	128521	0.10	0.12	NA	< 0.05	100%	70%	130%		70%	130%	94%	70%	130%
Wordury	1	120021	0.10	0.12	INA	< 0.05	100%	1070	130%		1070	130%	J+70	1070	100/0
Hexavalent Chromium in Soil															
Chromium, Hexavalent	1	128521	<0.5	<0.5	NA	< 0.5	100%	80%	120%	97%	80%	120%			

Certified By:



AGAT QUALITY ASSURANCE REPORT (V1)

Page 10 of 16

AGAT WORK ORDER: 19K456277

ATTENTION TO: John Gale

Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

PROJECT: 3132, OCI Long Pond

SAMPLING SITE: SAMPLED BY:

			Trac	e Or	gani	cs Ar	alys	is							
RPT Date: Apr 22, 2019			[DUPLICAT	E		REFEREN	NCE MA	TERIAL	METHOD	BLANK	SPIKE	MAT	RIX SPI	iKE
PARAMETER	Batch	Sample	Dup #1	Dup #2	RPD	Method Blank	Measured Value		ptable nits	Recovery	Lie	eptable mits	Recovery	l lin	eptable mits
	l ld ' ' V	value	Lower	Upper		Lower Uppe		·	Lower Uppe						
Atlantic RBCA Tier 1 Hydrocarbo	ns in Soil	(Version 3	.1) - Field	Preserve	d										
Benzene	1	128521	< 0.03	< 0.03	NA	< 0.03	86%	60%	140%	94%	60%	140%			
Toluene	1	128521	< 0.04	< 0.04	NA	< 0.04	88%	60%	140%	93%	60%	140%			
Ethylbenzene	1	128521	< 0.03	< 0.03	NA	< 0.03	91%	60%	140%	94%	60%	140%			
Xylene (Total)	1	128521	< 0.05	< 0.05	NA	< 0.05	108%	60%	140%	94%	60%	140%			
C6-C10 (less BTEX)	1	128521	< 3	< 3	NA	< 3	95%	60%	140%	108%	60%	140%	93%	30%	130%
>C10-C16 Hydrocarbons	1	128521	< 15	< 15	NA	< 15	118%	60%	140%	127%	60%	140%	127%	30%	130%
>C16-C21 Hydrocarbons	1	128521	< 15	< 15	NA	< 15	113%	60%	140%	127%	60%	140%	127%	30%	130%
>C21-C32 Hydrocarbons	1	128521	< 15	< 15	NA	< 15	119%	60%	140%	127%	60%	140%	127%	30%	130%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution. If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Polycyclic Aromatic Hydrocark	ons in Soil														
1-Methylnaphthalene	1	128521	< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	129%	50%	140%	100%	50%	140%
2-Methylnaphthalene	1	128521	< 0.01	< 0.01	NA	< 0.01	74%	50%	140%	129%	50%	140%	99%	50%	140%
Acenaphthene	1	128521	< 0.00671	< 0.00671	NA	< 0.00671	75%	50%	140%	121%	50%	140%	98%	50%	140%
Acenaphthylene	1	128521	< 0.004	< 0.004	NA	< 0.004	70%	50%	140%	116%	50%	140%	95%	50%	140%
Acridine	1	128521	< 0.05	< 0.05	NA	< 0.05	54%	50%	140%	91%	50%	140%	81%	50%	140%
Anthracene	1	128521	< 0.03	< 0.03	NA	< 0.03	65%	50%	140%	102%	50%	140%	88%	50%	140%
Benzo(a)anthracene	1	128521	0.02	0.02	NA	< 0.01	70%	50%	140%	102%	50%	140%	91%	50%	140%
Benzo(a)pyrene	1	128521	< 0.01	< 0.01	NA	< 0.01	62%	50%	140%	93%	50%	140%	82%	50%	140%
Benzo(b)fluoranthene	1	128521	< 0.05	< 0.05	NA	< 0.05	68%	50%	140%	85%	50%	140%	78%	50%	140%
Benzo(b+j)fluoranthene	1	128521	< 0.1	< 0.1	NA	< 0.1	57%	50%	140%	96%	50%	140%	84%	50%	140%
Benzo(e)pyrene	1	128521	< 0.05	< 0.05	NA	< 0.05	77%	50%	140%	106%	50%	140%	90%	50%	140%
Benzo(ghi)perylene	1	128521	< 0.01	< 0.01	NA	< 0.01	58%	50%	140%	77%	50%	140%	85%	50%	140%
Benzo(k)fluoranthene	1	128521	< 0.01	< 0.01	NA	< 0.01	66%	50%	140%	109%	50%	140%	85%	50%	140%
Chrysene	1	128521	0.02	0.01	NA	< 0.01	74%	50%	140%	111%	50%	140%	91%	50%	140%
Dibenzo(a,h)anthracene	1	128521	< 0.006	< 0.006	NA	< 0.006	51%	50%	140%	55%	50%	140%	85%	50%	140%
Fluoranthene	1	128521	0.05	<0.05	NA	< 0.05	74%	50%	140%	106%	50%	140%	89%	50%	140%
Fluorene	1	128521	< 0.01	< 0.01	NA	< 0.01	70%	50%	140%	112%	50%	140%	94%	50%	140%
Indeno(1,2,3)pyrene	1	128521	< 0.01	< 0.01	NA	< 0.01	58%	50%	140%	74%	50%	140%	82%	50%	140%
Naphthalene	1	128521	< 0.01	< 0.01	NA	< 0.01	71%	50%	140%	129%	50%	140%	101%	50%	140%
Perylene	1	128521	< 0.05	< 0.05	NA	< 0.05	75%	50%	140%	101%	50%	140%	89%	50%	140%
Phenanthrene	1	128521	< 0.03	< 0.03	NA	< 0.03	78%	50%	140%	113%	50%	140%	91%	50%	140%
Pyrene	1	128521	< 0.05	< 0.05	NA	< 0.05	73%	50%	140%	110%	50%	140%	90%	50%	140%
Quinoline	1	128521	< 0.05	< 0.05	NA	< 0.05	72%	50%	140%	121%	50%	140%	87%	50%	140%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution. If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Total Polychlorinated Biphenyls in Soil - (PCB)

Total Polychlorinated Biphenyls 1 128521 < 0.02 < 0.02 NA < 0.02 128% 60% 130% 89% 60% 130% NA 60% 130%

AGAT QUALITY ASSURANCE REPORT (V1)

Page 11 of 16

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.



Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 19K456277

PROJECT: 3132, OCI Long Pond

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis (Continued)															
RPT Date: Apr 22, 2019				UPLICAT	E		REFEREN	NCE MAT	ERIAL	METHOD	BLANK	SPIKE	MAT	RIX SPII	KE
PARAMETER	Batch	Sample	Dup #1	Dup #2	RPD	Method Blank	Measured	Accep Lim	ite	Recovery	Lin	ptable nits	Recovery	Lin	ptable nits
.,		ld					Value	Lower	Upper	,	Lower				Upper

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution. If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

any Hus

Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 19K456277 PROJECT: 3132, OCI Long Pond ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE		
Soil Analysis					
Aluminum	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Antimony	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Arsenic	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Barium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Beryllium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Boron	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Cadmium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Chromium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Cobalt	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Copper	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Iron	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Lead	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP-MS		
Lithium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP-MS		
Manganese	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Molybdenum	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Nickel	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Selenium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Silver	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Strontium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Thallium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Tin	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Uranium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Vanadium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Zinc	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Chromium, Hexavalent	INOR-121-6029	modified from SSSA BOOK 5, CH 25, P683	SPECTROPHOTOMETER		
Mercury	INOR-121-6101 & INOR-121-6107	Based on EPA 245.5 & SM 3112B	CV/AA		

Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS AGAT WORK ORDER: 19K456277
PROJECT: 3132, OCI Long Pond ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

IRanzana VOI-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Ranzana \/O -120-5013	Laboratories Tier 1	CC/MS
		GC/MS
11011000	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
HTDVIDED 7606	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
1XVIENE (10fal) VOI -120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
1(16-(11) (IASS RTEX)	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS/FID
1×C10-C16 Hydrocarbone ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
15C.16-C.21 HVdrocarnons	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
SC21-C32 Hydrocarbons ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Modified TPH (Tier 1) ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	CALCULATION
Resemblance Comment URG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS/FID
Refurn to Baseline at (137) (1864-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - EPH ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - VPH VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
In-Dotriacontane - EPH ()R(3-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
% Moisture C	Calculation	GRAVIMETRIC
' '	EPA SW846/3541/3510/8270C	GC/MS
' '	EPA SW846/3541/3510/8270C	GC/MS
Acenaphthene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Acenaphthylene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Acridine ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Anthracene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Benzo(a)anthracene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Benzo(a)pyrene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Benzo(b)fluoranthene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Benzo(b+j)fluoranthene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Benzo(e)pyrene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Benzo(ghi)perylene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Benzo(k)fluoranthene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Chrysene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Dibenzo(a,h)anthracene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
	EPA SW846/3541/3510/8270C	GC/MS
Fluorene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Indeno(1,2,3)pyrene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
Naphthalene ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS
	EPA SW846/3541/3510/8270C	GC/MS
	EPA SW846/3541/3510/8270C	GC/MS
	EPA SW846/3541/3510/8270C	GC/MS
Quinoline ORG-120-5104 E	EPA SW846/3541/3510/8270C	GC/MS



ATTENTION TO: John Gale

Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS AGAT WORK ORDER: 19K456277 PROJECT: 3132, OCI Long Pond

SAMPLING SITE: SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Nitrobenzene-d5	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
2-Fluorobiphenyl	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Terphenyl-d14	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Total Polychlorinated Biphenyls	ORG-120-5106	EPA SW846/8081/8080	GC/ECD
Decachlorobiphenyl	ORG-120-5106	EAP SW846 3510C/8080/8010	GC/ECD



Dartmouth, NS B3B 1M2

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Laboratory Use	Only	
Arrival Condition:	Good	□ Poor (see notes)
Arrival Temperatur	0. 91	93.9.5

Hold	Time:		
i ioiu	mine.	 -	

Chain of Custo	dy Record	183		P: 5	902.4	68.8	718	F: 90	2.46	8.8	924	A	\GA1	T Jol	b Nu	umb	er:	10	1K	4	SE	52	1	1	
Report Information			Report I	Information (Please print):				Rep	ort F	Forn	nat		Note	es:											
Company: Fracflow Con	sultants Inc. (NL)		1. Name	ne: John Gale (john_ffc@nfld.net)					Single	Sam	nle					CHARLE.								114.	
Contact: John Gale			— Email	Email: Eunjeong Seok (eunjeong_ffc@nfld.net) per page							1	Turnaround Time Required (TAT)													
Address: 154 Major's F	Path			2. Name: Karen Andrews (karen_ffc@nfld.net)						ole Sa age	mple	11						.o 7 w							
St. John's, N			Email	Email:																					
Phone: 709-739-7270	0 Fax: 709-75	3-5101	Regulat	Regulatory Requirements (Check):						Rush TAT Same day 1 day 2 days 3 days															
Client Project #: 3132, 0	OCI Long Pond	☑ List Gu	Guidelines on Report	auideline	es on R	eport		Expor	t:		1		_				•								
AGAT Quotation: S/O Please Note: If quotation number is	s not provided client will be billed fu		er 1		Coars	se	Dulad	do 4 M			<u>JL</u>		-				- 14 141								
Invoice To	Same	Yes ☑ / No				Fine		Drink Reg.		vate	r Sah	nple	: _	J Yes		⊴ No		alt W	ater	Sam	aple:] Yes	V	N
-	ws (karen_ffc@nfld.net)	· · · · · · · · · · · · · · · · · · ·	— ☐ Cor	dustrial NSEQS-Cont Sites ommercial HRM 101 es/Park Storm Water gricultural Wasta Water	ved	iss s Available		ine)	□ FOC - Miss	P205)	(avalent)		(I) Iow level	ctionation	×			(0)		Londo	kage	PN DMF			
Phone: PO/Credit Card#: 3965	Fax:			ediment	Field Filtered/Preserved	Total Diss		CBOD coarse/fine)		Phosphates (total as P205)	Chromium (Tri & Hexavalent)		Tier 1: TPH/BTEX (PIRI)	Tier 2: TPH/BTEX Fractionation	CCME-CWS TPH/BTEX		Oil & Grease (TOG)	BNAE EPA 625 - Miss		Amount Day	Marine Sediment Package Dioxins & Furans	iform MPN			(N/V)
Sample Identification	Date/Time Sampled	Sample Matrix	# Containers	Comments – Site/Sample Info. Sample Containment	Field Filt	Metals: □ Total	Mercury	☐ B0D Grain Size	□ TOC - Miss	hospha	hromiu	Phenois	ier 1: TF	ier 2: TP	CME-CV	voc	ii & Gre	BNAE EP	HA!		Marine Se	Fecal Coliform	Other:	Other:	Javardos
3132-PC11-SS1	Apr 11, 2019 / 10:40	Soil	2x40, 1x250 mL			V	-		Ë		~		7		0			_	-	✓ ≥	2		0	°	_
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Samples Relinquished By (Print Name):		Date/1		Samples Received By (Print Name):					D	ate/Tin	ne							\dashv		_1	_				_
Chris Piercey Samples Refinquisted By (Sign):		Ap	ril 12, 2019	Samples Received By (Sign):	1_				D	Ap	10	12	Vi	61			- Cller y - AG	- 1		Page	e 1		of 1		
Uno 1				11 Hamiles							13)_		١	White	е Сор	y- AGA	AT N	۷°:	FFC	31	32-C	COC	-02_	

Document ID: DIV-133-1501.002



CLIENT NAME: FRACFLOW CONSULTANTS 154 MAJOR'S PATH ST. JOHN'S PATH, NL A1A5A1 (709) 739-7270

ATTENTION TO: John Gale

PROJECT: 3132, OCI Long Pond

AGAT WORK ORDER: 19K459546

SOIL ANALYSIS REVIEWED BY: Michelle Hildebrand, Inorganics Analyst, B.Sc, P.Chem

TRACE ORGANICS REVIEWED BY: Amy Hunter, Trace Organics Supervisor, B.Sc.

DATE REPORTED: May 02, 2019

PAGES (INCLUDING COVER): 16

VERSION*: 1

Should	l you require any	/ information regarding	j this ana	ilysis plea	ase contact y	your client	t services repres	sentative at	$(709)7^{2}$	17-8573
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*NOTES	

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories (V1)

Page 1 of 16

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AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

57 Old Pennywell Road, Unit I

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale

SAMPLING SITE:					SAMPLED	BY:	
			A	vailable Metals	in Soil		
DATE RECEIVED: 2019-04-24						DATE REPORTED: 2019-05-02	
	5	SAMPLE DESCRIPTION:	3132-PC9-SS1	3132-PC13-SS1			
		SAMPLE TYPE:		Sediment			
		DATE SAMPLED:	2019-04-23	2019-04-23			
Parameter	Unit	G/S RDL	150110	150118			
Aluminum	mg/kg	10	13600	11600			
Antimony	mg/kg	1	<1	<1			
Arsenic	mg/kg	1	34	14			
Barium	mg/kg	5	147	186			
Beryllium	mg/kg	2	<2	<2			
Boron	mg/kg	2	27	46			
Cadmium	mg/kg	0.3	<0.3	0.4			
Chromium	mg/kg	2	22	19			
Cobalt	mg/kg	1	5	7			
Copper	mg/kg	2	27	26			
Iron	mg/kg	50	38500	24100			
Lead	mg/kg	0.5	15.1	14.8			
Lithium	mg/kg	5	29	38			
Manganese	mg/kg	2	510	405			
Molybdenum	mg/kg	2	13	8			
Nickel	mg/kg	2	13	15			
Selenium	mg/kg	1	<1	<1			
Silver	mg/kg	0.5	<0.5	<0.5			
Strontium	mg/kg	5	26	31			
Thallium	mg/kg	0.1	0.1	0.1			
Tin	mg/kg	2	4	5			
Uranium	mg/kg	0.1	1.8	2.6			
Vanadium	mg/kg	2	28	39			
Zinc	mg/kg	5	47	81			

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

150110-150118 Results are based on the dry weight of the sample.

Analysis performed at AGAT Halifax (unless marked by *)





AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond 57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale

SAMPLED BY:

					Chromium i	in Soil
DATE RECEIVED: 2019-04-24						DATE REPORTED: 2019-05-02
		SAMPLE DESC	RIPTION:	3132-PC9-SS1	3132-PC13-SS1	
		SAMP	LE TYPE:	Sediment	Sediment	
		DATE S	AMPLED:	2019-04-23	2019-04-23	
Parameter	Unit	G/S	RDL	150110	150118	
Chromium, Hexavalent	mg/kg		0.5	<0.5	<0.5	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Halifax (unless marked by *)





AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond 57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale SAMPLED BY:

						0.11
					Mercury in	Soil
DATE RECEIVED: 2019-04-24						DATE REPORTED: 2019-05-02
		SAMPLE DESC	CRIPTION:	3132-PC9-SS1	3132-PC13-SS1	
		SAME	PLE TYPE:	Sediment	Sediment	
		DATE S	SAMPLED:	2019-04-23	2019-04-23	
Parameter	Unit	G/S	RDL	150110	150118	
Mercury	mg/kg		0.05	0.10	0.05	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

150110-150118 Results are based on the dry weight of the soil. Analysis performed at AGAT Halifax (unless marked by *)





ATTENTION TO: John Gale

AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond

57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE: SAMPLED BY:

Atlantic RBCA Tier 1 Hydrocarbons in Soil (Version 3.1) - Field Presei
--

DATE RECEIVED: 2019-04-24					DATE REPORTED: 2019-05-02
	;	SAMPLE DESCRIPTION:	3132-PC9-SS1	3132-PC13-SS1	
		SAMPLE TYPE:	Sediment	Sediment	
		DATE SAMPLED:	2019-04-23	2019-04-23	
Parameter	Unit	G/S RDL	150110	150118	
Benzene	mg/kg	0.03	<0.03	<0.03	
Toluene	mg/kg	0.04	<0.04	<0.04	
Ethylbenzene	mg/kg	0.03	< 0.03	< 0.03	
Xylene (Total)	mg/kg	0.05	< 0.05	<0.05	
C6-C10 (less BTEX)	mg/kg	3	<3	<3	
>C10-C16 Hydrocarbons	mg/kg	15	<15	<15	
>C16-C21 Hydrocarbons	mg/kg	15	<15	<15	
>C21-C32 Hydrocarbons	mg/kg	15	<15	43	
Modified TPH (Tier 1)	mg/kg	20	<20	43	
Resemblance Comment			NR	UC	
Return to Baseline at C32			Υ	Υ	
Surrogate	Unit	Acceptable Limits			
Isobutylbenzene - EPH	%	60-140	105	105	
Isobutylbenzene - VPH	%	60-140	90	93	
n-Dotriacontane - EPH	%	60-140	109	108	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

150110-150118 Results are based on the dry weight of the soil.

Resemblance Comment Key: GF - Gasoline Fraction

WGF - Weathered Gasoline Fraction GR - Product in Gasoline Range

FOF - Fuel Oil Fraction

WFOF - Weathered Fuel Oil Fraction
FR - Product in Fuel Oil Range

LOF - Lube Oil Fraction

LR - Lube Range

UC - Unidentified Compounds

NR - No Resemblance

NA - Not Applicable

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:

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AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond 57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

ATTENTION TO: John Gale SAMPLED BY:

					Moistur	е
DATE RECEIVED: 2019-04-24						DATE REPORTED: 2019-05-02
		SAMPLE DESC	CRIPTION:	3132-PC9-SS1	3132-PC13-SS1	
		SAME	PLE TYPE:	Sediment	Sediment	
		DATE S	SAMPLED:	2019-04-23	2019-04-23	
Parameter	Unit	G/S	RDL	150110	150118	
% Moisture	%		0	36	61	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:

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AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond 57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

		F	Polycyclic A	Aromatic Hyd	drocarbons in Soil
DATE RECEIVED: 2019-04-24					DATE REPORTED: 2019-05-02
		SAMPLE DESCRIPTION: SAMPLE TYPE: DATE SAMPLED:	Sediment 2019-04-23	3132-PC13-SS1 Sediment 2019-04-23	
Parameter	Unit	G/S RDL	150110	150118	
1-Methylnaphthalene	mg/kg	0.05	<0.05	<0.05	
2-Methylnaphthalene	mg/kg	0.01	<0.01	<0.01	
Acenaphthene	mg/kg	0.00671	0.00982	<0.00671	
Acenaphthylene	mg/kg	0.004	0.010	<0.004	
Acridine	mg/kg	0.05	< 0.05	<0.05	
Anthracene	mg/kg	0.03	<0.03	<0.03	
Benzo(a)anthracene	mg/kg	0.01	0.07	0.05	
Benzo(a)pyrene	mg/kg	0.01	0.04	<0.01	
Benzo(b)fluoranthene	mg/kg	0.05	<0.05	<0.05	
Benzo(b+j)fluoranthene	mg/kg	0.1	<0.1	<0.1	
Benzo(e)pyrene	mg/kg	0.05	< 0.05	<0.05	
Benzo(ghi)perylene	mg/kg	0.01	<0.01	<0.01	
Benzo(k)fluoranthene	mg/kg	0.01	0.02	0.02	
Chrysene	mg/kg	0.01	0.06	0.14	
Dibenzo(a,h)anthracene	mg/kg	0.006	< 0.006	<0.006	
Fluoranthene	mg/kg	0.05	0.10	<0.05	
Fluorene	mg/kg	0.01	0.01	0.01	
Indeno(1,2,3)pyrene	mg/kg	0.01	<0.01	<0.01	
Naphthalene	mg/kg	0.01	<0.01	<0.01	
Perylene	mg/kg	0.05	< 0.05	0.10	
Phenanthrene	mg/kg	0.03	0.05	0.04	
Pyrene	mg/kg	0.05	0.07	<0.05	
Quinoline	mg/kg	0.05	<0.05	<0.05	
Surrogate	Unit	Acceptable Limits			
Nitrobenzene-d5	%	50-140	118	76	
2-Fluorobiphenyl	%	50-140	137	73	
Terphenyl-d14	%	50-140	119	62	

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ATTENTION TO: John Gale

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AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond 57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

Polycyclic Aromatic Hydrocarbons in Soil

DATE RECEIVED: 2019-04-24 DATE REPORTED: 2019-05-02

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

150110-150118 Results are based on the dry weight of the soil.

Benzo(b)fluoranthene may include contributions from benzo(j)fluoranthene, if also present in the sample.

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:

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AGAT WORK ORDER: 19K459546 PROJECT: 3132, OCI Long Pond

57 Old Pennywell Road, Unit I St. John's, NL CANADA A1E 6A8 TEL (709)747-8573 FAX (709 747-2139 http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS

SAMPLING SITE:

SAMPLED BY:

ATTENTION TO: John Gale

Total Polychlorinated Biphenyls in Soil - (PCB)												
DATE RECEIVED: 2019-04-24					DATE REPORTED: 2019-05-02							
		SAMPLE DESCRIPTION	N: 3132-PC9-SS1	3132-PC13-SS1								
		SAMPLE TY	PE: Sediment	Sediment								
		DATE SAMPLE	D: 2019-04-23	2019-04-23								
Parameter	Unit	G/S RDL	150110	150118								
Total Polychlorinated Biphenyls	mg/kg	0.02	< 0.02	<0.02								
Surrogate	Unit	Acceptable Limit	3									
Decachlorobiphenyl	%	50-130	109	115								

RDL - Reported Detection Limit; G / S - Guideline / Standard Comments:

150110-150118 Results are based on the dry weight of the soil.

Analysis performed at AGAT Halifax (unless marked by *)



Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

PROJECT: 3132, OCI Long Pond

ATTENTION TO: John Gale

AGAT WORK ORDER: 19K459546

SAMPLING SITE: SAMPLED BY:

Soil Analysis															
RPT Date: May 02, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acce Lin		Recovery		eptable mits
		lu	·					Lower	Upper		Lower	Upper]	Lower	Upper
Available Metals in Soil															
Aluminum	150118	150118	11600	11300	2.2%	< 10	112%	80%	120%	116%	80%	120%	NA	70%	130%
Antimony	150118	150118	<1	<1	NA	< 1	89%	80%	120%	120%	80%	120%	70%	70%	130%
Arsenic	150118	150118	14	13	11.3%	< 1	109%	80%	120%	115%	80%	120%	NA	70%	130%
Barium	150118	150118	186	158	16.5%	< 5	112%	80%	120%	114%	80%	120%	NA	70%	130%
Beryllium	150118	150118	<2	<2	NA	< 2	115%	80%	120%	118%	80%	120%	122%	70%	130%
Boron	150118	150118	46	46	0.3%	< 2	111%	80%	120%	117%	80%	120%	107%	70%	130%
Cadmium	150118	150118	0.4	0.4	NA	< 0.3	111%	80%	120%	112%	80%	120%	114%	70%	130%
Chromium	150118	150118	19	17	13.2%	< 2	120%	80%	120%	120%	80%	120%	NA	70%	130%
Cobalt	150118	150118	7	6	6.1%	< 1	108%	80%	120%	114%	80%	120%	NA	70%	130%
Copper	150118	150118	26	23	15.6%	< 2	111%	80%	120%	113%	80%	120%	NA	70%	130%
Iron	150118	150118	24100	23800	1.6%	< 50	115%	80%	120%	115%	80%	120%	NA	70%	130%
Lead	150118	150118	14.8	13.6	8.7%	< 0.5	107%	80%	120%	112%	80%	120%	NA	70%	130%
Lithium	150118	150118	38	35	9.2%	< 5	119%	70%	130%	124%	70%	130%	NA	70%	130%
Manganese	150118	150118	405	421	3.8%	< 2	112%	80%	120%	113%	80%	120%	NA	70%	130%
Molybdenum	150118	150118	8	7	NA	< 2	97%	80%	120%	103%	80%	120%	NA	70%	130%
Nickel	150118	150118	15	14	6.2%	< 2	108%	80%	120%	117%	80%	120%	NA	70%	130%
Selenium	150118	150118	<1	<1	NA	< 1	102%	80%	120%	101%	80%	120%	118%	70%	130%
Silver	150118	150118	<0.5	<0.5	NA	< 0.5	101%	80%	120%	108%	80%	120%	106%	70%	130%
Strontium	150118	150118	31	30	4.9%	< 5	100%	80%	120%	103%	80%	120%	NA	70%	130%
Thallium	150118	150118	0.1	<0.1	NA	< 0.1	106%	80%	120%	108%	80%	120%	75%	70%	130%
Tin	150118	150118	5	4	NA	< 2	110%	80%	120%	109%	80%	120%	123%	70%	130%
Uranium	150118	150118	2.6	2.4	6.1%	< 0.1	102%	80%	120%	108%	80%	120%	NA	70%	130%
Vanadium	150118	150118	39	36	8.6%	< 2	112%	80%	120%	116%	80%	120%	NA	70%	130%
Zinc	150118	150118	81	76	6.9%	< 5	109%	80%	120%	110%	80%	120%	NA	70%	130%
Mercury in Soil															
Mercury	1	150118	0.05	0.05	NA	< 0.05	88%	70%	130%		70%	130%	99%	70%	130%
Character in Call															
Chromium in Soil	4	450440	.0.5	.0.5	NIA	.0.5	4000/	0001	40007	000/	000/	40007			
Chromium, Hexavalent	1	150110	<0.5	<0.5	NA	< 0.5	102%	80%	120%	99%	80%	120%			

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AGAT QUALITY ASSURANCE REPORT (V1)

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

PROJECT: 3132, OCI Long Pond

AGAT WORK ORDER: 19K459546

ATTENTION TO: John Gale

SAMPLING SITE:	SAMPLED BY:														
			Trac	e Or	gani	cs Ar	nalys	is							
RPT Date: May 02, 2019	DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE				
PARAMETER	Batch	Sample	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	1 1 11	eptable mits
		ld						Lower	Upper		Lower	Upper		Lower	Upper
Atlantic RBCA Tier 1 Hydrocar	rbons in Soil	(Version 3	.1) - Field	Preserve	d		•								
Benzene	1	154884	< 0.03	< 0.03	NA	< 0.03	83%	60%	140%	91%	60%	140%			
Toluene	1	154884	< 0.04	< 0.04	NA	< 0.04	85%	60%	140%	87%	60%	140%			
Ethylbenzene	1	154884	< 0.03	< 0.03	NA	< 0.03	85%	60%	140%	85%	60%	140%			
Xylene (Total)	1	154884	< 0.05	< 0.05	NA	< 0.05	108%	60%	140%	88%	60%	140%			
C6-C10 (less BTEX)	1	154884	< 3	< 3	NA	< 3	83%	60%	140%	100%	60%	140%	101%	30%	130%
>C10-C16 Hydrocarbons	1	150110	< 15	< 15	NA	< 15	110%	60%	140%	100%	60%	140%	98%	30%	130%
>C16-C21 Hydrocarbons	1	150110	< 15	< 15	NA	< 15	117%	60%	140%	100%	60%	140%	98%	30%	130%
>C21-C32 Hydrocarbons	1	150110	< 15	< 15	NA	< 15	123%	60%	140%	100%	60%	140%	98%	30%	130%
Comments: If Matrix spike value is If RPD value is NA, the results of								ribution	١.						
Polycyclic Aromatic Hydrocarl	bons in Soil														
1-Methylnaphthalene	1	150110	< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	118%	50%	140%	NA	50%	140%
2-Methylnaphthalene	1	150110	< 0.01	< 0.01	NA	< 0.01	75%	50%	140%	117%	50%	140%	NA	50%	140%

Polycyclic Aromatic Hydrocarbons in Soil															
1-Methylnaphthalene	1	150110	< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	118%	50%	140%	NA	50%	140%
2-Methylnaphthalene	1	150110	< 0.01	< 0.01	NA	< 0.01	75%	50%	140%	117%	50%	140%	NA	50%	140%
Acenaphthene	1	150110	0.00982	0.00967	NA	< 0.00671	79%	50%	140%	109%	50%	140%	NA	50%	140%
Acenaphthylene	1	150110	0.010	0.010	NA	< 0.004	71%	50%	140%	97%	50%	140%	NA	50%	140%
Acridine	1	150110	< 0.05	< 0.05	NA	< 0.05	76%	50%	140%	114%	50%	140%	NA	50%	140%
Anthracene	1	150110	< 0.03	< 0.03	NA	< 0.03	73%	50%	140%	102%	50%	140%	NA	50%	140%
Benzo(a)anthracene	1	150110	0.07	0.08	13.3%	< 0.01	71%	50%	140%	97%	50%	140%	NA	50%	140%
Benzo(a)pyrene	1	150110	0.04	0.04	NA	< 0.01	66%	50%	140%	84%	50%	140%	NA	50%	140%
Benzo(b)fluoranthene	1	150110	< 0.05	0.05	NA	< 0.05	63%	50%	140%	85%	50%	140%	NA	50%	140%
Benzo(b+j)fluoranthene	1	150110	0.07	0.08	NA	< 0.1	67%	50%	140%	79%	50%	140%	NA	50%	140%
Benzo(e)pyrene	1	150110	< 0.05	< 0.05	NA	< 0.05	66%	50%	140%	89%	50%	140%	NA	50%	140%
Benzo(ghi)perylene	1	150110	< 0.01	< 0.01	NA	< 0.01	74%	50%	140%	79%	50%	140%	NA	50%	140%
Benzo(k)fluoranthene	1	150110	0.02	0.03	NA	< 0.01	66%	50%	140%	68%	50%	140%	NA	50%	140%
Chrysene	1	150110	0.06	0.07	15.4%	< 0.01	76%	50%	140%	100%	50%	140%	NA	50%	140%
Dibenzo(a,h)anthracene	1	150110	< 0.006	< 0.006	NA	< 0.006	67%	50%	140%	76%	50%	140%	NA	50%	140%
Fluoranthene	1	150110	0.10	0.11	NA	< 0.05	77%	50%	140%	102%	50%	140%	NA	50%	140%
Fluorene	1	150110	0.01	0.02	NA	< 0.01	77%	50%	140%	106%	50%	140%	NA	50%	140%
Indeno(1,2,3)pyrene	1	150110	< 0.01	< 0.01	NA	< 0.01	59%	50%	140%	79%	50%	140%	NA	50%	140%
Naphthalene	1	150110	< 0.01	< 0.01	NA	< 0.01	73%	50%	140%	113%	50%	140%	NA	50%	140%
Perylene	1	150110	< 0.05	< 0.05	NA	< 0.05	72%	50%	140%	98%	50%	140%	NA	50%	140%
Phenanthrene	1	150110	0.05	0.06	NA	< 0.03	80%	50%	140%	101%	50%	140%	NA	50%	140%
Pyrene	1	150110	0.07	0.08	NA	< 0.05	74%	50%	140%	102%	50%	140%	NA	50%	140%
Quinoline	1	150110	< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	118%	50%	140%	NA	50%	140%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution. If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Total Polychlorinated Biphenyls in Soil - (PCB)

Total Polychlorinated Biphenyls 1 150110 < 0.02 < 0.02 NA < 0.02 126% 60% 130% 102% 60% 130% 98% 60% 130%

AGAT QUALITY ASSURANCE REPORT (V1)

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AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.



Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 19K459546

PROJECT: 3132, OCI Long Pond

ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

Trace Organics Analysis (Continued)												
RPT Date: May 02, 2019 DUPLICATE REFERENCE MATERIAL METHOD BLANK SPIKE MATRIX SPIKE											RIX SPIKE	
PARAMETER	Batch	Sample	Dup #1	Dup #2	RPD	Method Blank	Measured	Acceptable Limits	Recovery	Acceptable Limits	Recovery	Acceptable Limits
		ld	- '	.,			Value	Lower Upper		Lower Uppe	r	Lower Upper

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution. If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

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Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 19K459546
PROJECT: 3132, OCI Long Pond

ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE		
Soil Analysis					
Aluminum	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Antimony	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Arsenic	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Barium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Beryllium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Boron	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Cadmium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Chromium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Cobalt	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Copper	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Iron	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Lead	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP-MS		
Lithium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP-MS		
Manganese	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Molybdenum	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Nickel	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Selenium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Silver	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Strontium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Thallium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Tin	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Uranium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Vanadium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Zinc	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS		
Chromium, Hexavalent	INOR-121-6029	modified from SSSA BOOK 5, CH 25, P683	SPECTROPHOTOMETER		
Mercury	INOR-121-6101 & INOR-121-6107	Based on EPA 245.5 & SM 3112B	CV/AA		

Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 19K459546
PROJECT: 3132, OCI Long Pond

ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE		
Trace Organics Analysis	1				
Benzene	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS		
Toluene	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS		
Ethylbenzene	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS		
Xylene (Total)	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS		
C6-C10 (less BTEX)	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS/FID		
>C10-C16 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID		
>C16-C21 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID		
>C21-C32 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID		
Modified TPH (Tier 1)	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	CALCULATION		
Resemblance Comment	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS/FID		
Return to Baseline at C32	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID		
Isobutylbenzene - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID		
Isobutylbenzene - VPH	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS		
n-Dotriacontane - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID		
% Moisture		Calculation	GRAVIMETRIC		
1-Methylnaphthalene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
2-Methylnaphthalene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Acenaphthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Acenaphthylene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Acridine	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Anthracene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Benzo(a)anthracene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Benzo(a)pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Benzo(b)fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Benzo(b+j)fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Benzo(e)pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Benzo(ghi)perylene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Benzo(k)fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Chrysene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Dibenzo(a,h)anthracene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Fluorene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Indeno(1,2,3)pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Naphthalene	ORG-120-5104	EPA SW846/3541/3510/8270C GC/MS			
Perylene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Phenanthrene	ORG-120-5104	EPA SW846/3541/3510/8270C GC/MS			
Pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		
Quinoline	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS		



Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS AGAT WORK ORDER: 19K459546

PROJECT: 3132, OCI Long Pond ATTENTION TO: John Gale

SAMPLING SITE: SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Nitrobenzene-d5	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
2-Fluorobiphenyl	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Terphenyl-d14	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Total Polychlorinated Biphenyls	ORG-120-5106	EPA SW846/8081/8080	GC/ECD
Decachlorobiphenyl	ORG-120-5106	EAP SW846 3510C/8080/8010	GC/ECD



Unit 122 • 11 Morris Drive Dartmouth, NS

B3B 1M2

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Laboratory Use (Only
Arrival Condition: Arrival Temperature	□ Good □ Poor (see notes) e: 5 · 8 · 3 · 4 · 3 · 5
Hold Time:	
AGAT Job Number:	19K459546

Chain	of	Custody	Record

Chain of Custody Record		P:	902.468.8	718	F: 9	02.46	8.89	24			ivui	nber	-	1_			\circ	10	1 (_
Report Information	- 11	ormation (Please print):			Rep	ort F	orma	it	Not	tes:										
Company: Fracflow Consultants Inc. (NL)	- 11	John Gale (john_ffc@nfld.net)				Single	Sample	,		-	*****									
Contact: John Gale		Turnaround Time Rec							equ	ired	(TA	J)								
Address: 154 Major's Path	2. Name: _	2. Name: Karen Andrews (karen_ffc@nfld.net) Whitiple Sample Regular TAT							V [5 to	7 wc	orkin	g da	ys	v.					
St. John's, NL	Email; _				V	Excel	Format			h TAT						□ 1				
Phone: 709-739-7270 Fax: 709-753-5101	Regulatory	y Requirements (Check):				Includ	ed		itus				2 day		•		. day 3 days	3		
Cilent Project #: 3132, OCI Long Pond		elines on Report 🔲 Do not list (Guidelines on R	eport		Export	:	H	ь.				,	•			_			
AGAT Quotation: S/O	PIRI Tier 1	☐ Res ☐ Pot		*					Date	Req	uired	:								
Please Note: If quotation number is not provided client will be billed full price for analys	□ Tier 2			se	Drini	dng V	/ater S	ampl	e: [] Yes	V	No	Salt	: Wa1	ter Sa	ampl	e:	□ Yr	es I	 7 N
Invoice To Same Yes ☑ / No	☐ Gas	☐ Fuel ☐ Lube			Reg.										_					
Company:	□ ссме	□ cdwq						1			Т	T	T	T	П				T	T
Contact: Karen Andrews (karen_ffc@nfld.net)	□ Industr		Available						<u></u>											
Address:	☐ Comme	ark IN HKINI 101	S Ava			8	2 2		w lev	ion							1	Ē		
		Storm Water			୍ର	W-	205 valer		Ĭ	ionat						9g		2		
Phone: Fax:	☐ FWAL ☐ Sedime		eserved Analysis		∑ e∕fin	□ FOC - Miss	l as F Hexa		(PIR	Fract	5	.	Miss			acka	1 -	Z N Z		
PO/Credit Card#: 3966		ent 🗆 other	ed/Pre Vater / Total		□ CBOD (coarse/1		s (tota (Tri &		/BTEX	/BTEX	ויווע	Grease (TOG)	625-1			ment	2			(X X
Sample Identification Date/Time Sampled Matrix	# Containers C	Comments - Site/Sample Info. Sample Containment	Field Filtered/Preserved Standard Water Analysis Metals: □ Total □ Diss	Mercury	□ B0D □ CB0D Grain Size (coarse/fine)	□ TOC - Miss	Phosphates (total as P205) Chromium (Tri & Hexavalent)	Phenols	Tier 1: TPH/BTEX (PIRI) □ low level	Tier 2: TPH/BTEX Fractionation	VOC		BNAE EPA 625 - Miss	PAH	PCB	Marine Sediment Package	Dioxins & I	recal colling	Other:	Hazardous (Y/N)
3132-PC9-SS1 Apr 11, 2019 / 10:10 Soil	2x40, 1x120 mL	Marine Sediment	L 0 ≥	_	<u> </u>		<u> </u>	-	F /	=	3 >	 	+=	4	<u>A</u>	Ξ	-	- 6	E	<u>=</u>
3132-PC13-SS1 Apr 23, 2019 / 12:55 Soil	2x40, 1x120 mL	Marine Sediment	V	V			V	-	V			1	+	V	V		+	+	+	+
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APPENDIX D Soils Laboratory Data

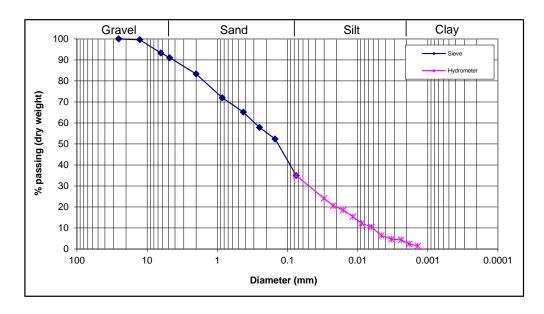
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC9-SS1

Depth below LNT: 1.36 - 4.52 m

Sieve Analysis

Dry weight of sample (g) = 299.05

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	1.19	0.40	0.40	99.60
1/4"	6.35	18.92	6.33	6.72	93.28
4	4.76	6.65	2.22	8.95	91.05
10	2.00	23.09	7.72	16.67	83.33
20	0.85	33.90	11.34	28.01	71.99
40	0.425	20.45	6.84	34.84	65.16
60	0.25	21.91	7.33	42.17	57.83
100	0.15	16.24	5.43	47.60	52.40
200	0.075	52.18	17.45	65.05	34.95
pan		104.52	34.95	100.00	
		299.05			



 $D_{10} = 0.0061$

 $D_{30} = 0.05$

Cu = 47.54

 $D_{60} = 0.29$

Cc = 1.41

USCS: SM (Silty sand) or SC (Clayey sand) or SC-SM (Silty clayey sand)

 $R_{200} = 65.05$

% Gravel = 8.95

 $R_4 = 8.95$

% Sand = 56.10

 $R_4/R_{200} = 0.14$

% Silt = 31.95

SF = 56.10

GF = 8.95

% Clay = 3.00

CFEM: Silty Sand, trace Gravel, trace Clay

GRAIN SIZE ANALYSIS-HYDROMETER

Project No.: 3132

Location of Project : Long Pond, Manuels, NL Sample No. : 3132-PC9-SS1

Description of Soil : Dark grey silty sand Depth below LNT : 1.36 - 4.52 m

Tested By: DN/ES Test Date: May 10, 2019

Hydrometer Analysis

Hydrometer Type: 152H Zero Correction: 8 Meniscus Correction: 1.0

Dispersing Agent: NaPO₄ Amount Used: 4% @ 125 ml

 G_s of Solids: 2.65 C.F. a: 1.0 (From Table 6-2)

Mass of Soil (g): 50.00 Control Sieve No.: 200 % finer than #200 from sieve analysis: 34.95

	1	2	3	5	4	6	7	8	9	10	11	12	13
Date	Time of	Elapsed	Temp.	Act. Hyd.	Temp. Corr.	Corr. Hyd.	Actual	Adjusted	Hyd. corr. for	L (cm)	L/t	K	D (mm)
	reading	Time, t(min.)	(°C)	Reading, R _a	Factor, $C_T(6-3)$	Reading, R _c	% Finer	% Finer	meniscus, R	{table 6-5}		{table 6-4}	
5/10/19	09:43	0	17.5	52				34.95					0.075
5/10/19	09:45	2	17.5	43	-0.6	34.4	68.8	24.0	44	9.10	4.550E+00	1.41E-02	3.008E-02
5/10/19	09:47	4	17.5	38	-0.6	29.4	58.8	20.6	39	9.90	2.475E+00	1.41E-02	2.218E-02
5/10/19	09:51	8	18	35	-0.5	26.5	53.0	18.5	36	10.40	1.300E+00	1.40E-02	1.596E-02
5/10/19	09:59	16	18	30.5	-0.5	22	44.0	15.4	31.5	11.15	6.969E-01	1.40E-02	1.169E-02
5/10/19	10:13	30	18	26	-0.5	17.5	35.0	12.2	27	11.90	3.967E-01	1.40E-02	8.817E-03
5/10/19	10:43	60	18	23.5	-0.5	15	30.0	10.5	24.5	12.30	2.050E-01	1.40E-02	6.339E-03
5/10/19	11:43	120	19	17.5	-0.3	9.2	18.4	6.4	18.5	13.25	1.104E-01	1.38E-02	4.586E-03
5/10/19	13:43	240	19	15	-0.3	6.7	13.4	4.7	16	13.70	5.708E-02	1.38E-02	3.297E-03
5/10/19	17:25	462	19	14.5	-0.3	6.2	12.4	4.3	15.5	13.75	2.976E-02	1.38E-02	2.381E-03
5/10/19	23:39	836	17.5	12	-0.6	3.4	6.8	2.4	13	14.20	1.699E-02	1.41E-02	1.838E-03
5/11/19	11:29	1546	16	11	-0.9	2.1	4.2	1.5	12	14.30	9.250E-03	1.44E-02	1.385E-03

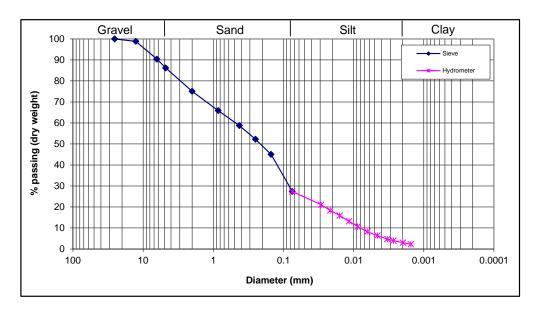
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC9-SS2-1

Depth below LNT: Top of 4.52 - 5.33 m

Sieve Analysis

Dry weight of sample (g) = 358.89

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	4.05	1.13	1.13	98.87
1/4"	6.35	30.49	8.50	9.62	90.38
4	4.76	15.05	4.19	13.82	86.18
10	2.00	39.79	11.09	24.90	75.10
20	0.85	33.17	9.24	34.15	65.85
40	0.425	25.46	7.09	41.24	58.76
60	0.25	23.48	6.54	47.78	52.22
100	0.15	25.88	7.21	54.99	45.01
200	0.075	63.29	17.63	72.63	27.37
pan		98.23	27.37	100.00	
		358.89			



 $D_{10} = 0.008$ $D_{30} = 0.084$ Cu = 61.25 $D_{60} = 0.49$ Cc = 1.80

USCS: SM (Silty sand) or SC (Clayey sand) or SC-SM (Silty clayey sand)

 $R_{200} = 72.63$ % Gravel = 13.82 $R_4 = 13.82$ % Sand = 58.81 $R_4/R_{200} = 0.19$ % Silt = 24.27 SF = 58.81 % Clay = 3.10

GRAIN SIZE ANALYSIS-HYDROMETER

Project No.: 3132

Location of Project: Long Pond, Manuels, NI Sample No.: 3132-PC9-SS2-1

Description of Soil : Dark grey silt with trace sand.

Depth below LNT : Top of 4.52 - 5.33 m

Tested By: DN/ES Test Date: May 14, 2019

Hydrometer Analysis

Hydrometer Type: 152H Zero Correction: 7 Meniscus Correction: 1.0

Dispersing Agent: NaPO₄ Amount Used: 4% @ 125 ml

 G_s of Solids: 2.65 C.F. a: 1.0 (From Table 6-2)

Mass of Soil (g): 50.00 Control Sieve No.: 200 % finer than #200 from sieve analysis: 27.37

(m.	1	2	3	5	4	6	7	8	9	10	11	12	13
Date	Time of	Elapsed	Temp.	Act. Hyd.	Temp. Corr.	Corr. Hyd.	Actual	Adjusted	Hyd. corr. for	L (cm)	L/t	K	D (mm)
	reading	Time, t(min.)	(°C)	Reading, Ra	Factor, $C_T(6-3)$	Reading, R _c	% Finer	% Finer	meniscus, R	{table 6-5}		{table 6-4}	
5/14/19	11:42	0	18	55.5				27.37					0.075
5/14/19	11:44	2	18	46	-0.5	38.5	77.0	21.1	47	8.60	4.300E+00	1.40E-02	2.903E-02
5/14/19	11:46	4	18	41	-0.5	33.5	67.0	18.3	42	9.40	2.350E+00	1.40E-02	2.146E-02
5/14/19	11:50	8	18	36.5	-0.5	29	58.0	15.9	37.5	10.15	1.269E+00	1.40E-02	1.577E-02
5/14/19	11:58	16	18	31.5	-0.5	24	48.0	13.1	32.5	11.00	6.875E-01	1.40E-02	1.161E-02
5/14/19	12:12	30	18	27	-0.5	19.5	39.0	10.7	28	11.70	3.900E-01	1.40E-02	8.743E-03
5/14/19	12:42	60	18	22.5	-0.5	15	30.0	8.2	23.5	12.45	2.075E-01	1.40E-02	6.377E-03
5/14/19	13:42	120	18.5	19	-0.4	11.6	23.2	6.3	20	13.00	1.083E-01	1.39E-02	4.575E-03
5/14/19	15:42	240	18.5	16	-0.4	8.6	17.2	4.7	17	13.50	5.625E-02	1.39E-02	3.297E-03
5/14/19	17:42	360	19	14.5	-0.3	7.2	14.4	3.9	15.5	13.75	3.819E-02	1.38E-02	2.697E-03
5/14/19	23:23	701	18	13	-0.5	5.5	11.0	3.0	14	14.00	1.997E-02	1.40E-02	1.978E-03
5/15/19	08:25	1243	16.5	12	-0.8	4.2	8.4	2.3	13	14.20	1.142E-02	1.43E-02	1.528E-03

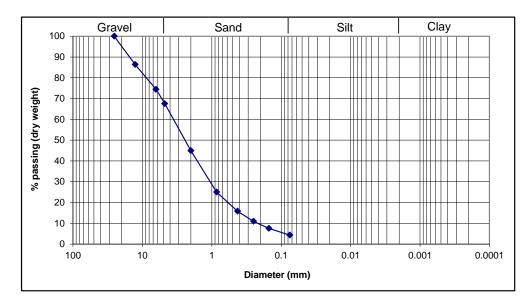
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC9-SS2-2

Depth below LNT: Bottom of 4.52 - 5.33 m

Sieve Analysis

Dry weight of sample (g) = 670.97

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	91.36	13.62	13.62	86.38
1/4"	6.35	80.24	11.96	25.57	74.43
4	4.76	46.05	6.86	32.44	67.56
10	2.00	151.83	22.63	55.07	44.93
20	0.85	134.02	19.97	75.04	24.96
40	0.425	61.57	9.18	84.22	15.78
60	0.25	32.56	4.85	89.07	10.93
100	0.15	22.76	3.39	92.46	7.54
200	0.075	21.66	3.23	95.69	4.31
pan		28.92	4.31	100.00	
		670.97			



 $D_{10} = 0.22$ $D_{30} = 1.05$ Cu = 16.36 $D_{60} = 3.6$ Cc = 1.39

USCS: SW (Well-graded sand with gravel)

 $R_{200} = 95.69$ % Gravel = 32.44 % Sand = 63.25 $R_4/R_{200} = 0.34$ % Silt & Clay = 4.31 SF = 63.25 % Clay = NA GF = 32.44 CFEM: Grave

2.44 CFEM: Gravelly Sand, trace Silt/Clay

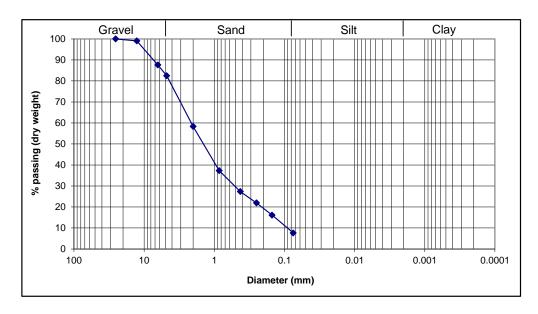
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC11-SS1

Depth below LNT: 3.85 - 4.87 m

Sieve Analysis

Dry weight of sample (g) = 307.40

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	2.89	0.94	0.94	99.06
1/4"	6.35	35.28	11.48	12.42	87.58
4	4.76	15.76	5.13	17.54	82.46
10	2.00	74.15	24.12	41.67	58.33
20	0.85	64.70	21.05	62.71	37.29
40	0.425	30.60	9.95	72.67	27.33
60	0.25	16.62	5.41	78.07	21.93
100	0.15	17.83	5.80	83.87	16.13
200	0.075	26.11	8.49	92.37	7.63
pan		23.46	7.63	100.00	
		307.40			



 $D_{10} = 0.092$

 $D_{30} = 0.51$

Cu = 22.83

 $D_{60} = 2.1$

Cc = 1.35

USCS: SP-SM (Poorly graded sand with silt and gravel) or SP-SC (Poorly graded sand with clay and gravel)

 $R_{200} = 92.37$

% Gravel = 17.54

 $R_4 = 17.54$

% Sand = 74.82

 $R_4/R_{200} = 0.19$

% Silt & Clay = 7.63

SF = 74.82

% Clay = NA

GF = 17.54

CFEM: Sand, some Gravel, trace Silt/Clay

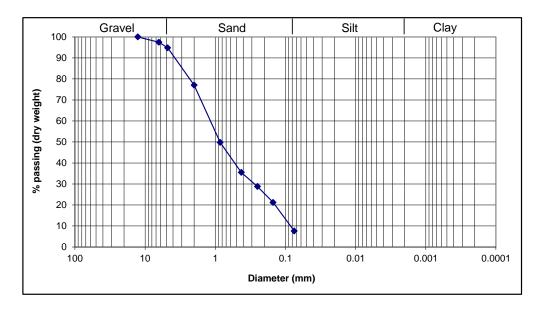
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC11-SS2

Depth below LNT: 4.87 - 5.47 m

Sieve Analysis

Dry weight of sample (g) = 195.20

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				J
1	25.4				
1/2"	12.7	0.00	0.00	0.00	100.00
1/4"	6.35	4.96	2.54	2.54	97.46
4	4.76	5.24	2.68	5.23	94.77
10	2.00	34.58	17.72	22.94	77.06
20	0.85	53.23	27.27	50.21	49.79
40	0.425	27.89	14.29	64.50	35.50
60	0.25	13.08	6.70	71.20	28.80
100	0.15	14.81	7.59	78.79	21.21
200	0.075	26.55	13.60	92.39	7.61
pan		14.86	7.61	100.00	
		195.20			



 $D_{10} = 0.084$

 $D_{30} = 0.27$

Cu = 14.29

 $D_{60} = 1.2$

Cc = 0.72

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

 $R_{200} = 92.39$

% Gravel = 5.23

 $R_4 = 5.23$

% Sand = 87.16

 $R_4/R_{200} = 0.06$

% Silt & Clay = 7.61

SF = 87.16

% Clay = NA

GF = 5.23

CFEM: Sand, trace Silt/Clay, trace Gravel

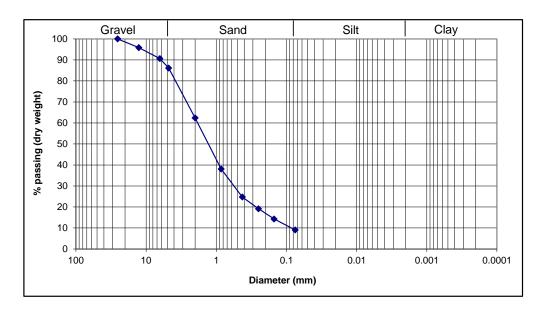
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC11-SS3

Depth below LNT: 5.47 - 6.41 m

Sieve Analysis

Dry weight of sample (g) = 406.21

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				J
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	16.85	4.15	4.15	95.85
1/4"	6.35	21.24	5.23	9.38	90.62
4	4.76	18.30	4.51	13.88	86.12
10	2.00	96.52	23.76	37.64	62.36
20	0.85	98.78	24.32	61.96	38.04
40	0.425	53.95	13.28	75.24	24.76
60	0.25	22.77	5.61	80.85	19.15
100	0.15	19.75	4.86	85.71	14.29
200	0.075	21.36	5.26	90.97	9.03
pan		36.69	9.03	100.00	
		406.21			



 $D_{10} = 0.084$ $D_{30} = 0.56$ Cu = 22.02 $D_{60} = 1.85$ Cc = 2.02

USCS: SW-SM (Well-graded sand with silt) or SW-SC (Well-graded sand with clay)

GF = 13.88 CFEM: Sand, some Gravel, trace Silt/Clay

Moisture Content (%): 19.55

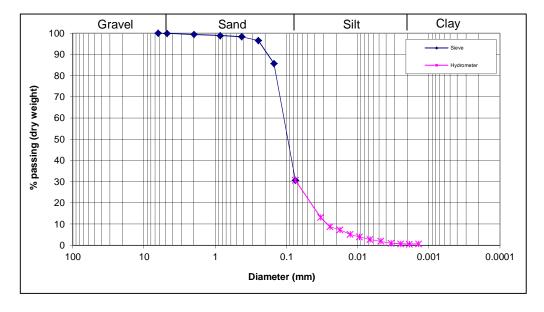
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC13-SS1-1

Depth below LNT: Top of 1.04 - 5.13 m

Sieve Analysis

Dry weight of sample (g) = 164.55

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4				
1/2"	12.7				
1/4"	6.35	0.00	0.00	0.00	100.00
4	4.76	0.14	0.09	0.09	99.91
10	2.00	0.84	0.51	0.60	99.40
20	0.85	0.85	0.52	1.11	98.89
40	0.425	0.90	0.55	1.66	98.34
60	0.25	2.92	1.77	3.43	96.57
100	0.15	17.88	10.87	14.30	85.70
200	0.075	90.61	55.07	69.36	30.64
pan		50.41	30.64	100.00	
		164.55			



 $D_{10} = 0.027$ $D_{30} = 0.074$ Cu = 4.04 $D_{60} = 0.109$ Cc = 1.86

USCS: SM (Silty sand) or SC (Clayey sand) or SC-SM (Silty clayey sand)

 $\begin{array}{lll} R_{200} = 69.36 & \text{\% Gravel} = \ 0.09 \\ R_4 = 0.09 & \text{\% Sand} = \ 69.28 \\ R_4/R_{200} = 0.00 & \text{\% Silt} = \ 30.02 \\ SF = 69.28 & \text{\% Clay} = \ 0.62 \\ GF = 0.09 & \text{CFEM: Silty Sand} \end{array}$

Moisture Content (%): 90.94

GRAIN SIZE ANALYSIS-HYDROMETER

Project No.: 3132

Location of Project: Long Pond, Manuels, NI Sample No.: 3132-PC13-SS1-1

Description of Soil : Brown, grey silt, with some fine sand Depth below LNT : Top of 1.04 - 5.13 m

Tested By: DN/ES Test Date: May 10, 2019

Hydrometer Analysis

Hydrometer Type: 152H Zero Correction: 8 Meniscus Correction: 1.0

Dispersing Agent: NaPO₄ Amount Used: 4% @ 125 ml

 G_s of Solids: 2.65 C.F. a: 1.0 (From Table 6-2)

Mass of Soil (g): 50.00 Control Sieve No.: 200 % finer than #200 from sieve analysis: 30.64

	1	2	3	5	4	6	7	8	9	10	11	12	13
Date	Time of	Elapsed	Temp.	Act. Hyd.	Temp. Corr.	Corr. Hyd.	Actual	Adjusted	Hyd. corr. for	L (cm)	L/t	K	D (mm)
	reading	Time, t(min.)	(°C)	Reading, Ra	Factor, $C_T(6-3)$	Reading, R _c	% Finer	% Finer	meniscus, R	{table 6-5}		{table 6-4}	
5/10/19	10:01	0	18	51				30.64					0.075
5/10/19	10:03	2	18	30	-0.5	21.5	43.0	13.2	31	11.20	5.600E+00	1.40E-02	3.313E-02
5/10/19	10:05	4	18	23	-0.5	14.5	29.0	8.9	24	12.40	3.100E+00	1.40E-02	2.465E-02
5/10/19	10:09	8	18	20.5	-0.5	12	24.0	7.4	21.5	12.80	1.600E+00	1.40E-02	1.771E-02
5/10/19	10:17	16	18	17	-0.5	8.5	17.0	5.2	18	13.30	8.313E-01	1.40E-02	1.276E-02
5/10/19	10:31	30	18	15	-0.5	6.5	13.0	4.0	16	13.70	4.567E-01	1.40E-02	9.461E-03
5/10/19	11:01	60	18	13	-0.5	4.5	9.0	2.8	14	14.00	2.333E-01	1.40E-02	6.763E-03
5/10/19	12:01	120	19	11.5	-0.3	3.2	6.4	2.0	12.5	14.25	1.187E-01	1.38E-02	4.755E-03
5/10/19	14:01	240	19	10	-0.3	1.7	3.4	1.0	11	14.50	6.042E-02	1.38E-02	3.392E-03
5/10/19	17:28	447	19	9.5	-0.3	1.2	2.4	0.7	10.5	14.60	3.266E-02	1.38E-02	2.494E-03
5/10/19	23:39	818	17.5	9.5	-0.6	0.9	1.8	0.6	10.5	14.60	1.785E-02	1.41E-02	1.884E-03
5/11/19	11:29	1528	16	10	-0.9	1.1	2.2	0.7	11	14.50	9.490E-03	1.44E-02	1.403E-03

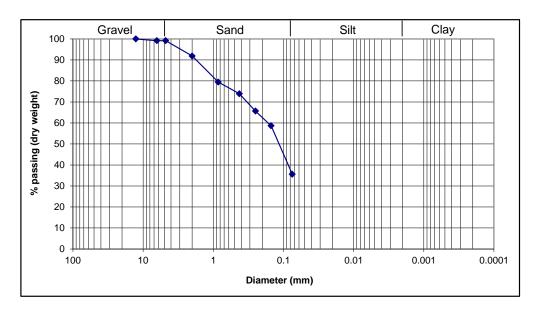
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC13-SS1-2

Depth below LNT: Bottom of 1.04 - 5.13 m

Sieve Analysis

Dry weight of sample (g) = 101.48

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4				
1/2"	12.7	0.00	0.00	0.00	100.00
1/4"	6.35	0.85	0.84	0.84	99.16
4	4.76	0.00	0.00	0.84	99.16
10	2.00	7.38	7.27	8.11	91.89
20	0.85	12.60	12.42	20.53	79.47
40	0.425	5.66	5.58	26.10	73.90
60	0.25	8.37	8.25	34.35	65.65
100	0.15	7.10	7.00	41.35	58.65
200	0.075	23.39	23.05	64.40	35.60
pan		36.13	35.60	100.00	
		101.48			



 $\begin{array}{lll} D_{10} = NA & & \\ D_{30} = NA & & Cu = NA \\ D_{60} = 0.165 & & Cc = NA \end{array}$

USCS: SM (Silty sand) or SC (Clayey sand) or SC-SM (Silty clayey sand)

GF = 0.84 CFEM: Sand and Silt/Clay

Moisture Content (%): 253.89

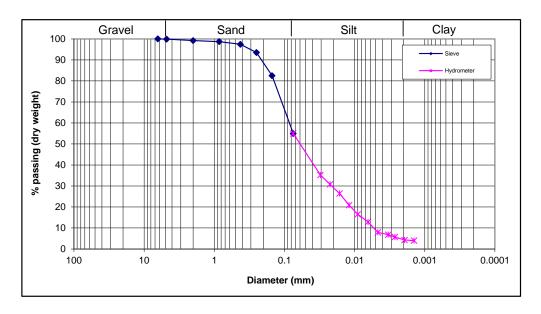
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC13-SS2

Depth below LNT: 5.13 - 7.22 m

Sieve Analysis

Dry weight of sample (g) = 133.73

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4				
1/2"	12.7				
1/4"	6.35	0.00	0.00	0.00	100.00
4	4.76	0.14	0.10	0.10	99.90
10	2.00	0.91	0.68	0.79	99.21
20	0.85	0.71	0.53	1.32	98.68
40	0.425	1.67	1.25	2.56	97.44
60	0.25	5.23	3.91	6.48	93.52
100	0.15	14.79	11.06	17.54	82.46
200	0.075	36.82	27.53	45.07	54.93
pan		73.46	54.93	100.00	
		133.73			



 $D_{10} = 0.0054$

 $D_{30} = 0.0215$ Cu = 15.93

 $D_{60} = 0.086$ Cc = 1.00

USCS: ML (Sandy Silt) or CL (Sandy lean clay) or CL-ML (Sandy silty clay)

 $R_{200} = 45.07$ % Gravel = 0.10 $R_4 = 0.10$ % Sand = 44.96

 $R_4/R_{200} = 0.00$ % Silt = 50.53 SF = 44.96 % Clay = 4.40

GF = 0.10 CFEM: Silt and Sand, trace Clay

Moisture Content (%): 218.60

GRAIN SIZE ANALYSIS-HYDROMETER

Project No.: 3132

Location of Project: Long Pond, Manuels, NI Sample No.: 3132-PC13-SS2

Description of Soil : Brown, grey, black silt Depth below LNT : 5.13 - 7.22 m

Tested By: DN/ES Test Date: May 10, 2019

Hydrometer Analysis

Hydrometer Type: 152H Zero Correction: 7.5 Meniscus Correction: 1.0

Dispersing Agent: NaPO₄ Amount Used: 4% @ 125 ml

 G_s of Solids: 2.65 C.F. a: 1.0 (From Table 6-2)

Mass of Soil (g): _____50.00 ____ Control Sieve No. : ____200 ____ % finer than #200 from sieve analysis : ____54.93

(1	2	3	5	4	6	7	8	9	10	11	12	13
Date	Time of	Elapsed	Temp.	Act. Hyd.	Temp. Corr.	Corr. Hyd.	Actual	Adjusted	Hyd. corr. for	L (cm)	L/t	K	D (mm)
	reading	Time, t(min.)	(°C)	Reading, Ra	Factor, $C_T(6-3)$	Reading, R _c	% Finer	% Finer	meniscus, R	{table 6-5}		{table 6-4}	
5/10/19	11:12	0	18	50				54.93					0.075
5/10/19	11:14	2	18	40	-0.5	32	64.0	35.2	41	9.60	4.800E+00	1.40E-02	3.067E-02
5/10/19	11:16	4	18	36	-0.5	28	56.0	30.8	37	10.20	2.550E+00	1.40E-02	2.236E-02
5/10/19	11:20	8	18	32	-0.5	24	48.0	26.4	33	10.90	1.363E+00	1.40E-02	1.634E-02
5/10/19	11:28	16	18	27	-0.5	19	38.0	20.9	28	11.70	7.313E-01	1.40E-02	1.197E-02
5/10/19	11:42	30	18	23	-0.5	15	30.0	16.5	24	12.40	4.133E-01	1.40E-02	9.001E-03
5/10/19	12:12	60	19	19.5	-0.3	11.7	23.4	12.9	20.5	12.95	2.158E-01	1.38E-02	6.411E-03
5/10/19	13:12	120	19	15	-0.3	7.2	14.4	7.9	16	13.70	1.142E-01	1.38E-02	4.663E-03
5/10/19	15:12	240	19	14	-0.3	6.2	12.4	6.8	15	13.80	5.750E-02	1.38E-02	3.309E-03
5/10/19	17:27	375	19	13	-0.3	5.2	10.4	5.7	14	14.00	3.733E-02	1.38E-02	2.666E-03
5/10/19	23:40	748	17.5	12	-0.6	3.9	7.8	4.3	13	14.20	1.898E-02	1.41E-02	1.943E-03
5/11/19	11:29	1457	16	12	-0.9	3.6	7.2	4.0	13	14.20	9.746E-03	1.44E-02	1.422E-03

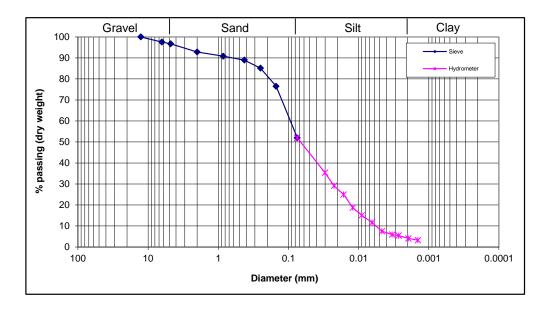
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC13-SS3-1

Depth below LNT: Top of 7.22 - 8.83 m

Sieve Analysis

Dry weight of sample (g) = 199.92

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4				
1/2"	12.7	0.00	0.00	0.00	100.00
1/4"	6.35	4.92	2.46	2.46	97.54
4	4.76	1.60	0.80	3.26	96.74
10	2.00	7.78	3.89	7.15	92.85
20	0.85	4.05	2.03	9.18	90.82
40	0.425	3.72	1.86	11.04	88.96
60	0.25	7.69	3.85	14.89	85.11
100	0.15	17.20	8.60	23.49	76.51
200	0.075	49.05	24.53	48.02	51.98
pan		103.91	51.98	100.00	
		199.92			



 $D_{10} = 0.0057$

 $D_{60} = 0.095$

 $D_{30} = 0.023$

Cu = 16.67Cc = 0.98

USCS: ML (Sandy Silt) or CL (Sandy lean clay) or CL-ML (Sandy silty clay)

 $R_{200} = 48.02$

% Gravel = 3.26

 $R_4 = 3.26$

% Sand = 44.76

 $R_4/R_{200} = 0.07$

% Silt = 47.78

SF = 44.76

% Clay = 4.20

GF = 3.26

CFEM: Silt and Sand, trace Clay, trace Gravel

Moisture Content (%): 194.40

GRAIN SIZE ANALYSIS-HYDROMETER

Project No.: 3132

Location of Project: Long Pond, Manuels, NI Sample No.: 3132-PC13-SS3-1

Description of Soil : Brown, grey, black silt Depth below LNT : Top of 7.22 - 8.83 m

Tested By: DN/ES Test Date: May 10, 2019

Hydrometer Analysis

Hydrometer Type: 152H Zero Correction: 7.5 Meniscus Correction: 1.0

Dispersing Agent: NaPO₄ Amount Used: 4% @ 125 ml

 G_s of Solids: 2.65 C.F. a: 1.0 (From Table 6-2)

Mass of Soil (g): ____50.00 ___ Control Sieve No. : ____200 ___ % finer than #200 from sieve analysis : ____51.98

	1	2	3	5	4	6	7	8	9	10	11	12	13
Date	Time of	Elapsed	Temp.	Act. Hyd.	Temp. Corr.	Corr. Hyd.	Actual	Adjusted	Hyd. corr. for	L (cm)	L/t	K	D (mm)
	reading	Time, t(min.)	(°C)	Reading, Ra	Factor, $C_T(6-3)$	Reading, R _c	% Finer	% Finer	meniscus, R	{table 6-5}		{table 6-4}	
5/10/19	11:16	0	18	49				51.98					0.075
5/10/19	11:18	2	18	42	-0.5	34	68.0	35.3	43	9.20	4.600E+00	1.40E-02	3.003E-02
5/10/19	11:20	4	18	36	-0.5	28	56.0	29.1	37	10.20	2.550E+00	1.40E-02	2.236E-02
5/10/19	11:24	8	18	32	-0.5	24	48.0	24.9	33	10.90	1.363E+00	1.40E-02	1.634E-02
5/10/19	11:32	16	18	26	-0.5	18	36.0	18.7	27	11.90	7.438E-01	1.40E-02	1.207E-02
5/10/19	11:46	30	18	22.5	-0.5	14.5	29.0	15.1	23.5	12.45	4.150E-01	1.40E-02	9.019E-03
5/10/19	12:16	60	19	19	-0.3	11.2	22.4	11.6	20	13.00	2.167E-01	1.38E-02	6.424E-03
5/10/19	13:16	120	19	15	-0.3	7.2	14.4	7.5	16	13.70	1.142E-01	1.38E-02	4.663E-03
5/10/19	15:16	240	19	13.5	-0.3	5.7	11.4	5.9	14.5	13.90	5.792E-02	1.38E-02	3.321E-03
5/10/19	17:27	371	19	13	-0.3	5.2	10.4	5.4	14	14.00	3.774E-02	1.38E-02	2.681E-03
5/10/19	23:40	744	17.5	12	-0.6	3.9	7.8	4.1	13	14.20	1.909E-02	1.41E-02	1.948E-03
5/11/19	11:30	1454	16	11.5	-0.9	3.1	6.2	3.2	12.5	14.25	9.801E-03	1.44E-02	1.426E-03

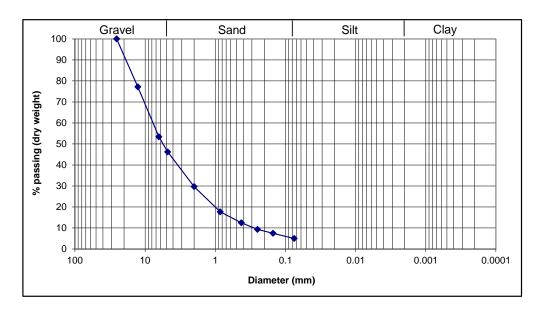
Project: 3132 - Long Pond, Manuels, NL Sample No.: 3132-PC13-SS3-2

Depth below LNT: Bottom of 7.22 - 8.83 m

Sieve Analysis

Dry weight of sample (g) = 368.82

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8				
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	84.19	22.83	22.83	77.17
1/4"	6.35	87.69	23.78	46.60	53.40
4	4.76	26.52	7.19	53.79	46.21
10	2.00	61.05	16.55	70.35	29.65
20	0.85	44.08	11.95	82.30	17.70
40	0.425	19.37	5.25	87.55	12.45
60	0.25	11.52	3.12	90.67	9.33
100	0.15	6.85	1.86	92.53	7.47
200	0.075	9.11	2.47	95.00	5.00
pan		18.44	5.00	100.00	
		368.82			



 $D_{10} = 0.28$ $D_{30} = 2.05$ Cu = 27.86 $D_{60} = 7.8$ Cc = 1.92

USCS: GW (Well-graded gravel with sand)

GF = 53.79 CFEM: Gravel and Sand, trace Silt/Clay

APPENDIX E Core Photographs



3132-BH11-SS3 Top Bottom Top Bottom Project No. Document Reference Figure E2 Split-spoon sample 3132-BH11-SS3. Full split spoon (Upper), and FFC-NL-3132-003 3132 close up of shale bedrock at appropriate locations (Lower). Scale in inches and centimeters. Location Date

Long Pond, NL

May 2019

3132-BH13-SS3 Top Bottom 11 Of = 9 Top Bottom Project No. Document Reference Figure E3 Split-spoon sample 3132-BH13-SS3. Full split spoon (Upper), and 3132 FFC-NL-3132-003 close up of shale bedrock at appropriate locations (Lower). Scale in Location Date inches. Long Pond, NL May 2019

Appendix O



Project #: 2020-033 September 10, 2020

Water Servicing:

The development is proposed to be serviced with water via a connection to the existing 200mm ductile iron water main located in Terminal Road. The new water main will be a 200mm diameter ductile iron pipe which will be installed in the site access road and continue around the new building forming a loop to promote better flow and avoid dead-ends.

It is anticipated that a 200mmØ off 200mmØ tapping sleeve and valve will be used to connect to the existing 200mm water main. This will avoid an unnecessary interruption to the existing water service to the area. In addition, main line valves will be positioned on the new water main to allow for strategic shut-offs on the site should maintenance need to be performed in the future.

Fire hydrants will be located around the site at 45m intervals to ensure proper fire protection for the new building. It is expected that the building will have an interior fire suppression system in the form of a wet sprinkler, as such, an exterior hose connection will be supplied to allow the local fire department to boost system pressures, if required. See Appendix 'A'.

System demand is estimated to be 5.87l/s which is derived based on the assumption that sanitary sewer generation rates represent 90% of water demand.

Sanitary Sewer Servicing:

The sanitary sewer system will be designed in accordance with the latest edition of the Guidelines for Design, Construction and Operation of Water and Sewerage Systems, published by the Department of Environment, NL. Calculations have been completed to determine a peak wet weather flow of 5.34l/s and also to determine the appropriate pipe sizing for the development, see Appendix 'B'.

A 200mm PVC sanitary sewer complete with concrete pre-cast manholes will convey sanitary sewer flows from the new building to Terminal Road where a sanitary sewer lift station will be installed. The lift station will convey flows via a new ductile iron force main to the nearest gravity sewer capable of receiving additional flow, which is located at the intersection of Terminal Road and Route 60. See Appendix 'A'.



Storm Sewer Servicing:

Storm water runoff for the site will primarily be conveyed to the surrounding ocean via overland flow. Care will be taken to ensure that grading around the site promotes positive drainage to the ocean. It is anticipated that there will be a depression in the grading in the area for loading/off-loading for the transport trucks. To ensure no ponding a catch basin will be located here with a short section of pipe to a headwall to discharge to the ocean. A connection for the building's roof drains will also be accommodated at this location. See Appendix 'A'

Anticipated Storm Flows From Upstream Catchment Areas:

There are two (2) river systems that convey flows into the area of Long Pond Harbour adjacent to the proposed development.

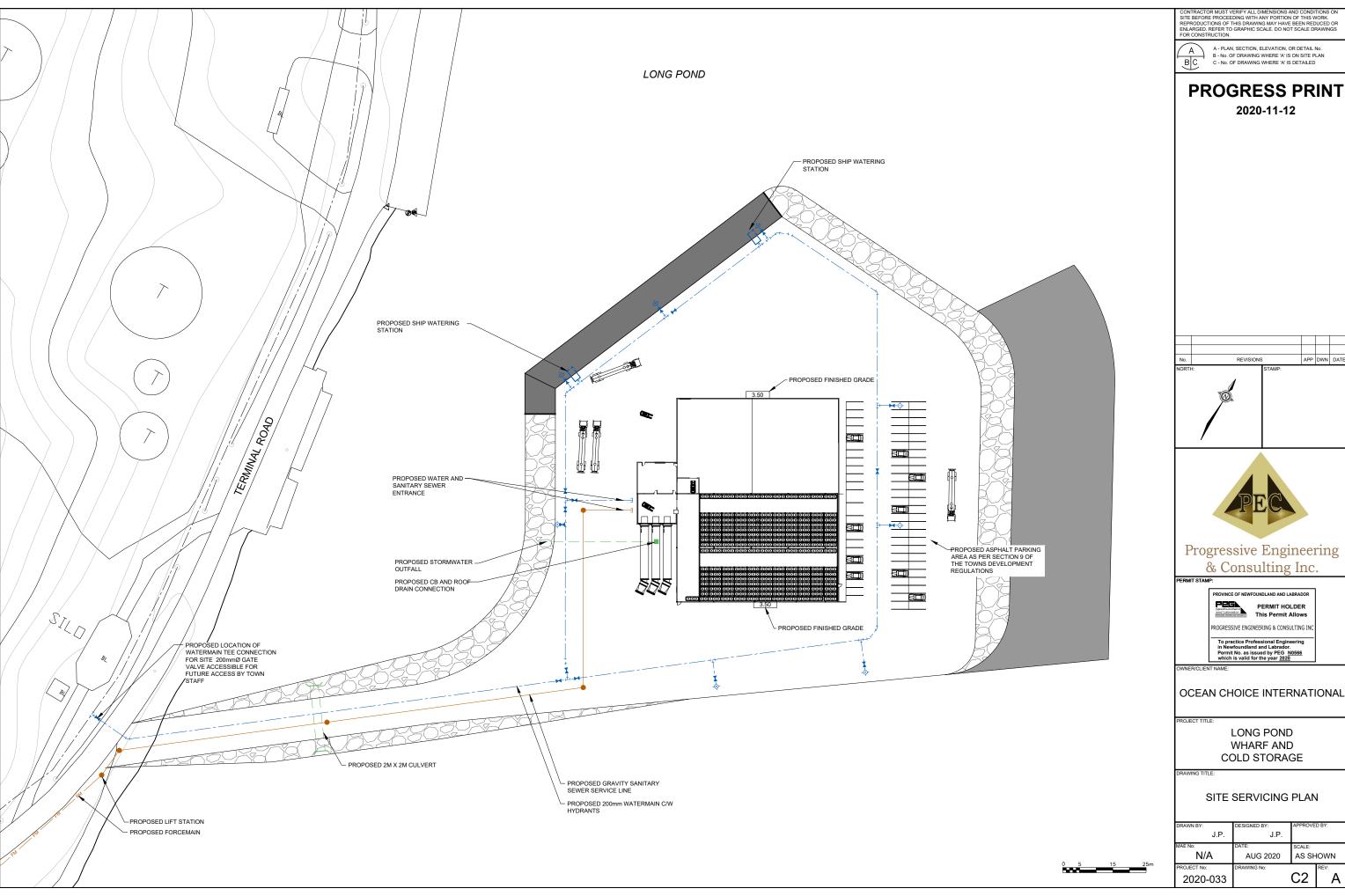
The main contribution of flows come from the Conway's Book river system. The catchment area for this system is 1105 Ha and consists primarily of forested areas with some low density development making up the remainder.

The other stream (Sobey's Stream), relative to Conway's Brook, is quite small at 32 Ha. It consists of a marshy area, adjacent to the Heritage Square Retirement Living facility, which discharges to a stream that slowly meanders the rear properties on the east side of Terminal Road before discharging into the harbour.

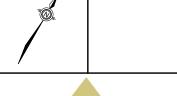
Both catchment areas were modelled using latest version of the XPSWMM software. Flow generation rates produced are based on the latest design storms provided by the City of St. John's. These storms have been created by the City to account for the effects of climate change. The results for the flows for each catchment can be found in Appendix 'C'.



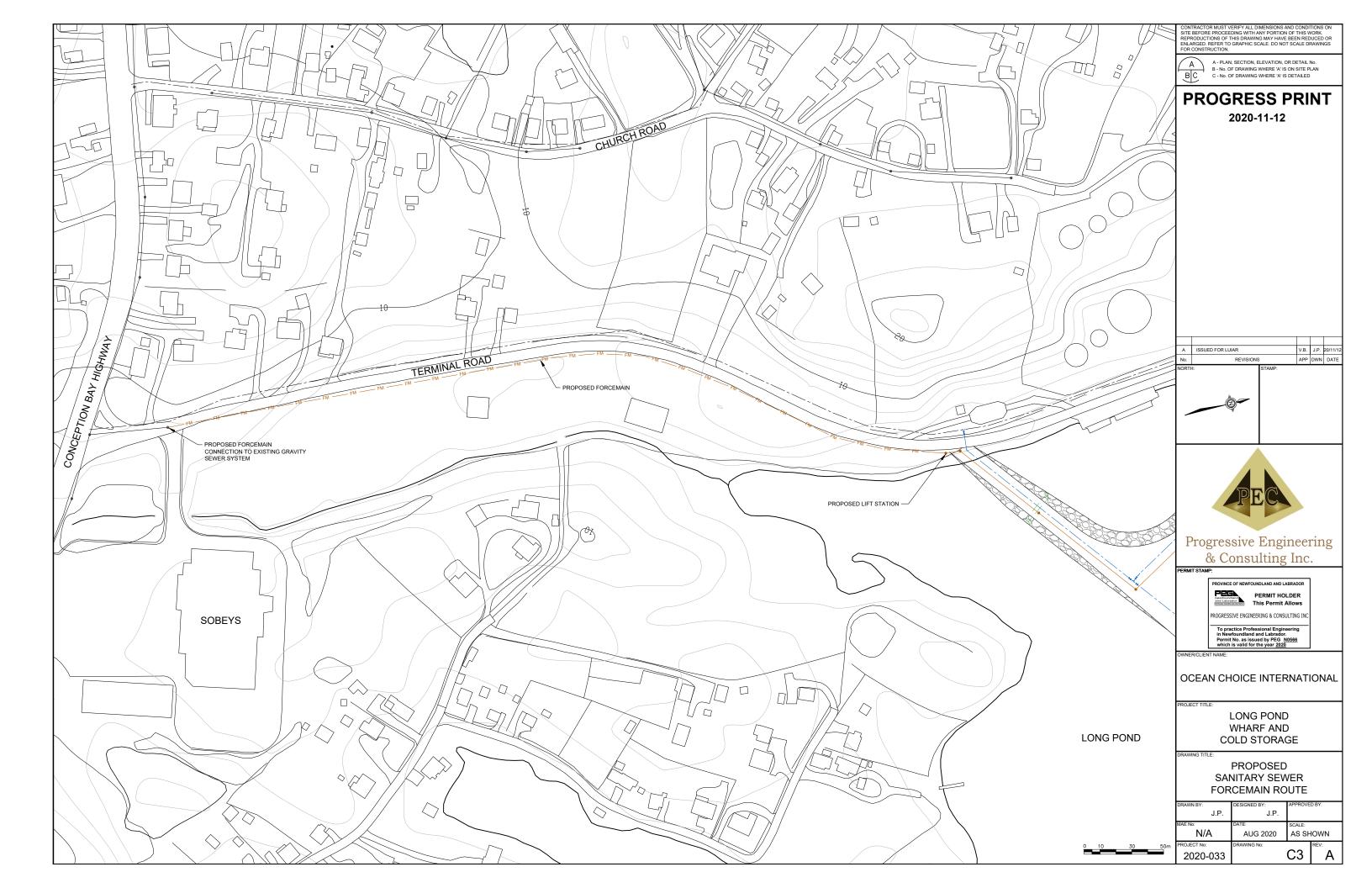
Appendix 'A'



PROGRESS PRINT



DRAWN BY:	DESIGNED BY:	APPROVE	D BY:
J.P.	J.P.		
MAE No: N/A	DATE: AUG 2020	SCALE: AS SH	IOWN
PROJECT No:	DRAWING No:		REV:
2020-033		C2	Α





Appendix 'B'



Project #: 2020-033 September 10, 2020

Calculations for Sanitary Sewer Flows and Sewer Sizing:

Types of Occupancy or Use:

1. Cold Storage Facility: 35 Employees

2. Office Building: 15,000ft² (1394m²), 50 Employees

3. Wash Down Area: 3 Garden Hoses @ 72 USGPM (272.88 l/m)

Recommended Average Flow Rates:

1. Factories (Cold Storage) = 1151/day/person (8 hour shift)

2. Office Building = $6l/day/m^2$

Average Flow Rate:

 $Q_{AVG} = (24 \text{hours/8hours x 35people x 115l/person/day}) + (1394 \text{m}^2 \text{ x 6l/day/m}^2) = 20,439 \text{l/day}$

Harmon's Peaking Factor:

 $P_f = 1 + (14/4 + P^{0.5})$ Where: P = The design contributing population in thousands

$$P_f = 1 + (14/(4+85/1000^{0.5})) = 4.26$$

Peak Dry Weather Design Flow Rate:

 $Q_{PDW} = 4.26 \times 20,439 \text{l/day} = 87,115.65 \text{ l/day}$

Assume 3 garden hoses are running simultaneously for 4 hours each day

 $Q_{PDW} = 87,115.65 \text{ l/day} + (3 \times 272.88 \text{ l/min} \times 60 \text{ min/hour} \times 24 \text{ hour/day} \times 4/24 \text{ days}) = 283,589.25 \text{ l/day}$

<u>Infiltration Allowance:</u>

 $Q_{INFIL} = 0.28 \text{ l/sec/Ha} \times 1.65 \text{ Ha} = 0.46 \text{ l/sec} = 39,744 \text{ l/day}$

 Q_{INFIL} @ Manholes = 0.4 l/sec/MH x 4 MH = 1.6 l/sec = 138,240 l/day

Peak Wet Weather Flow:

 $Q_{TOTAL} = 283,589.25 \text{ l/day} + 39,744 \text{ l/day} + 138,240 \text{ l/day} = 461,573.25 \text{ l/day} = 5.34 \text{ l/sec}$



Sanitary Sewer Pipe Size:

Assume 1% minimum on all pipes in the system

 $Q = (7.8546 \times 10^{-6} / n) D^2 R^{2/3} S^{1/2}$ Where: Q = Flow Capacity of Sewer (1/sec)

D = Inside Diameter of Pipe (mm) R = Hydraulic Radius of Pipe (mm)

S = Sewer Slope (m/m) n = Roughness Factor

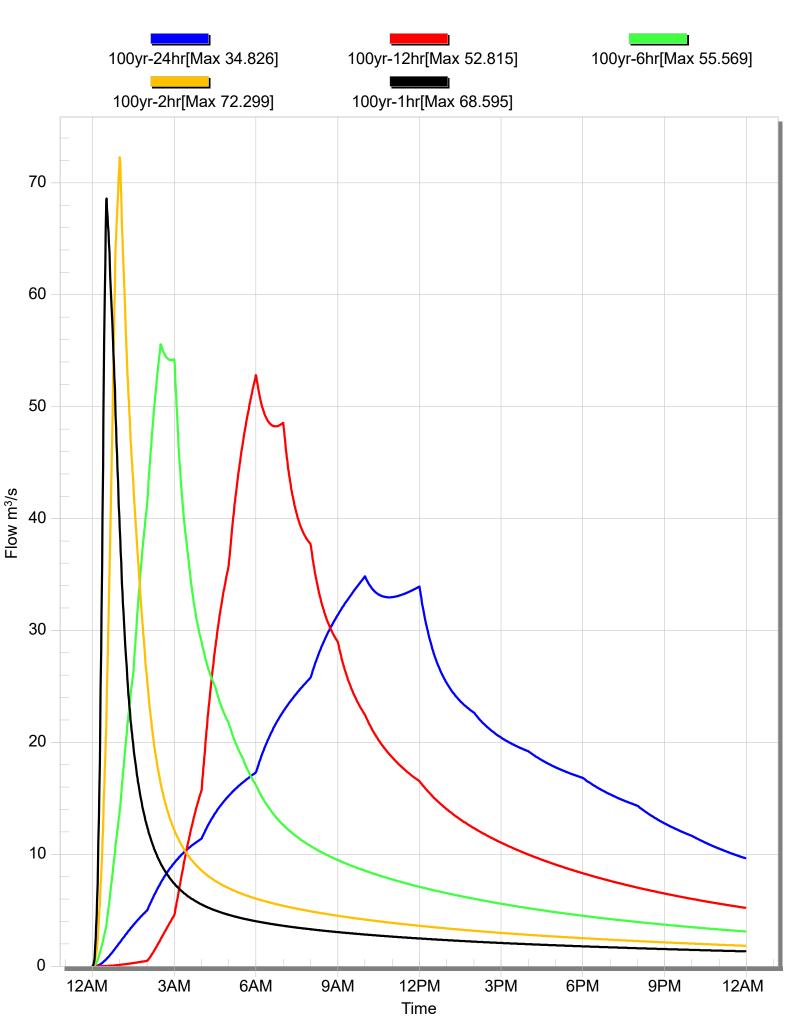
 $Q = (7.8546 \times 10^{-6} / 0.013) (200^2) (50^{2/3}) (0.01^{1/2})$ Q = 32.80 l/sec

Anticipated flow is 5.34 l/sec therefor, a 200mm diameter sewer pipe has ample capacity.

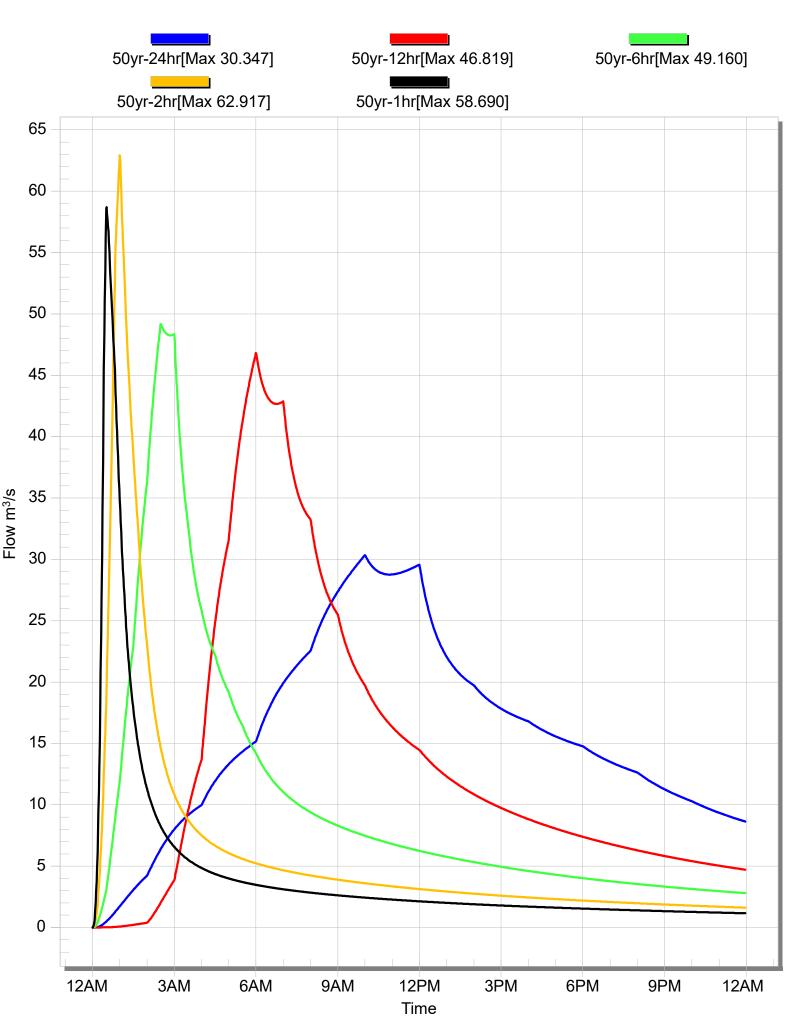


Appendix 'C'

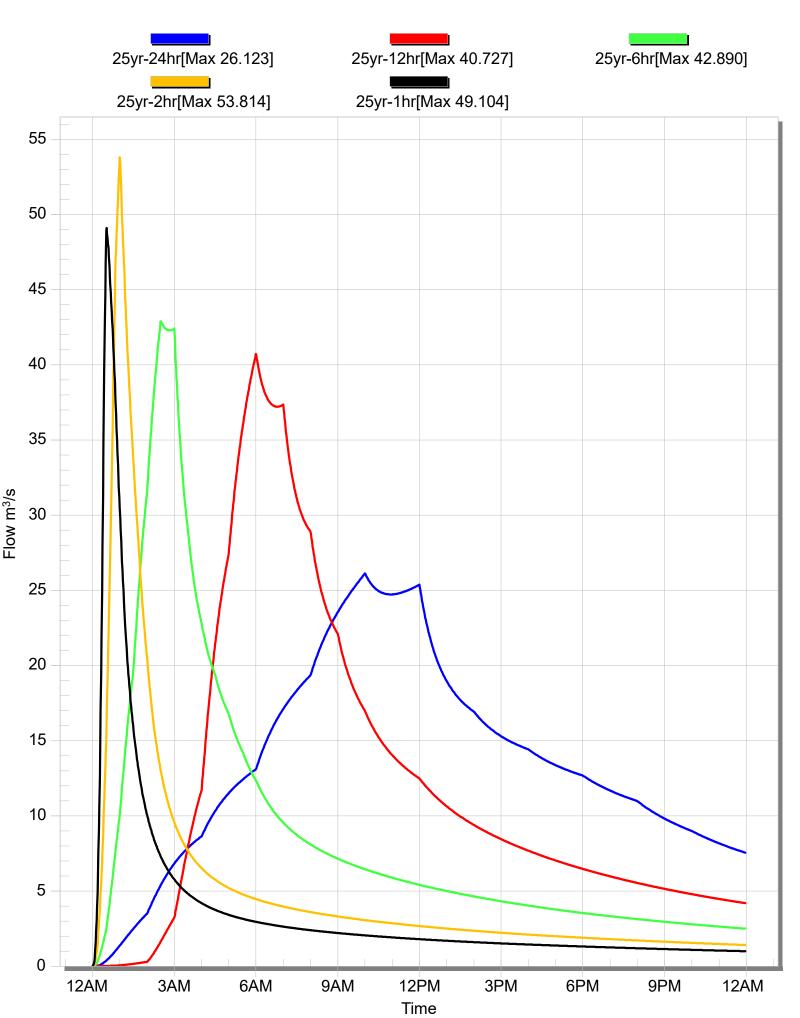
Conways Brook Catchment



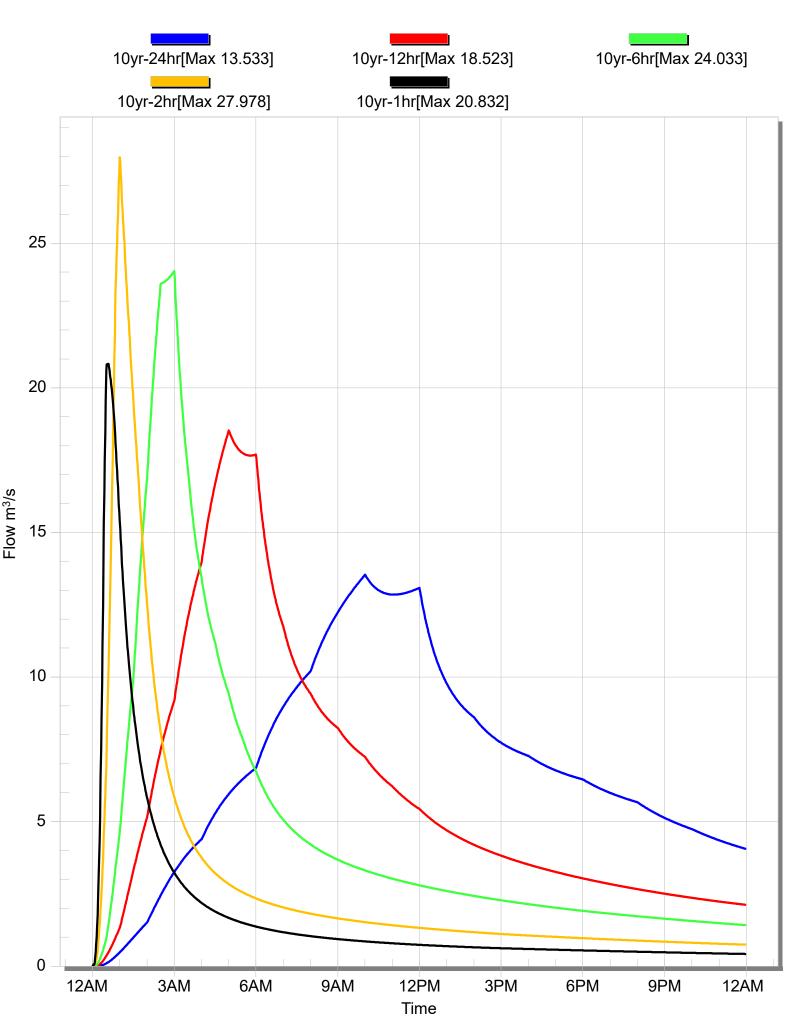
Conways Brook Catchment

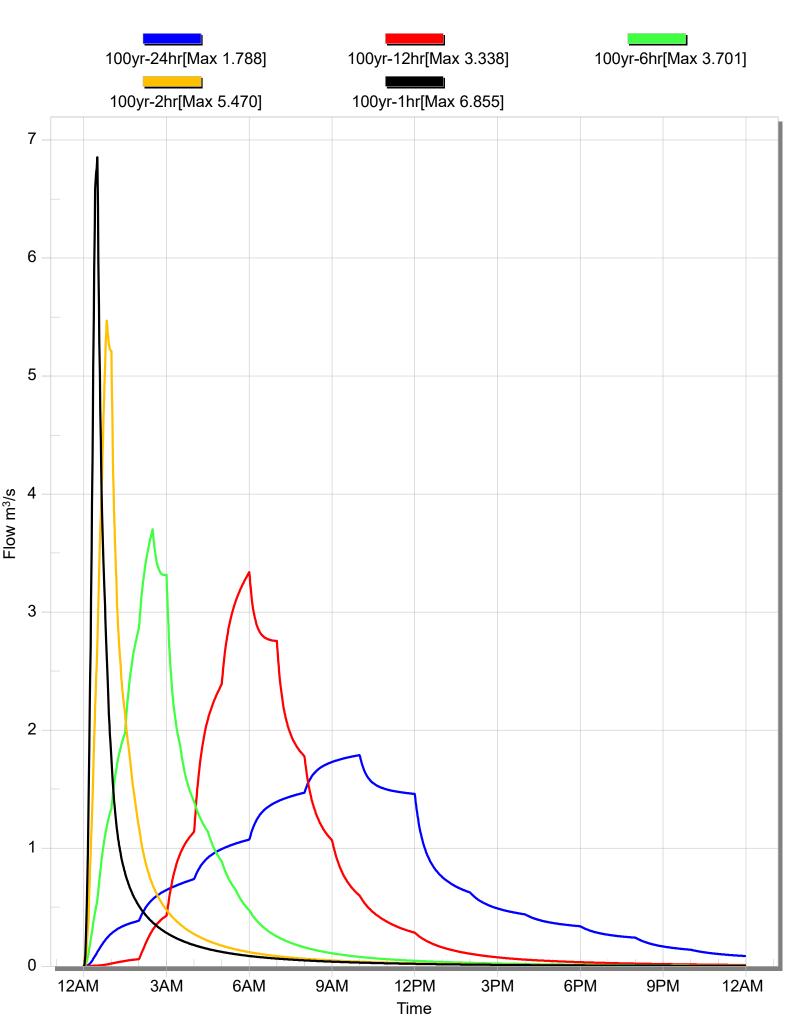


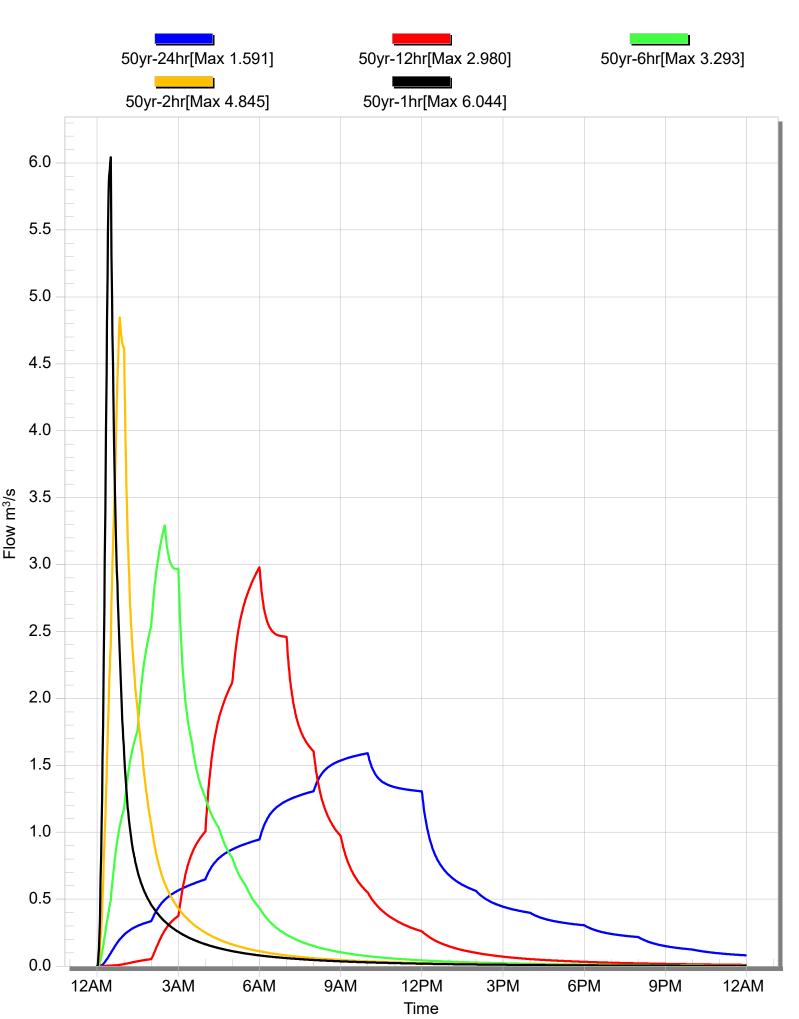
Conways Brook Catchment

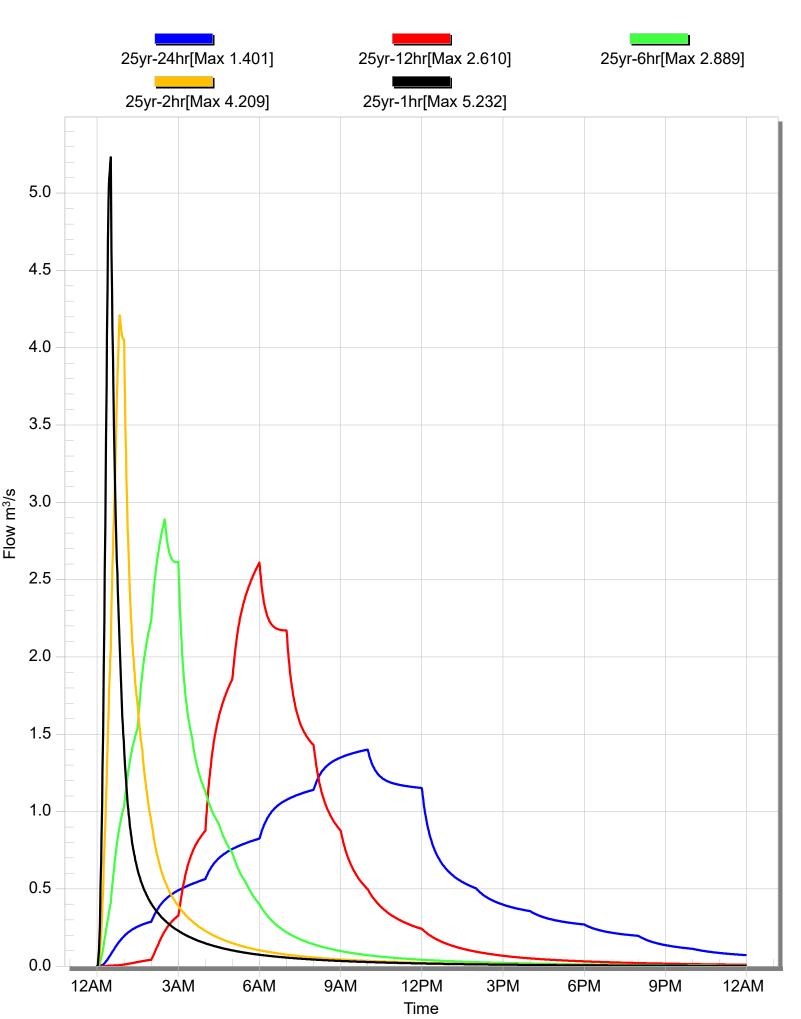


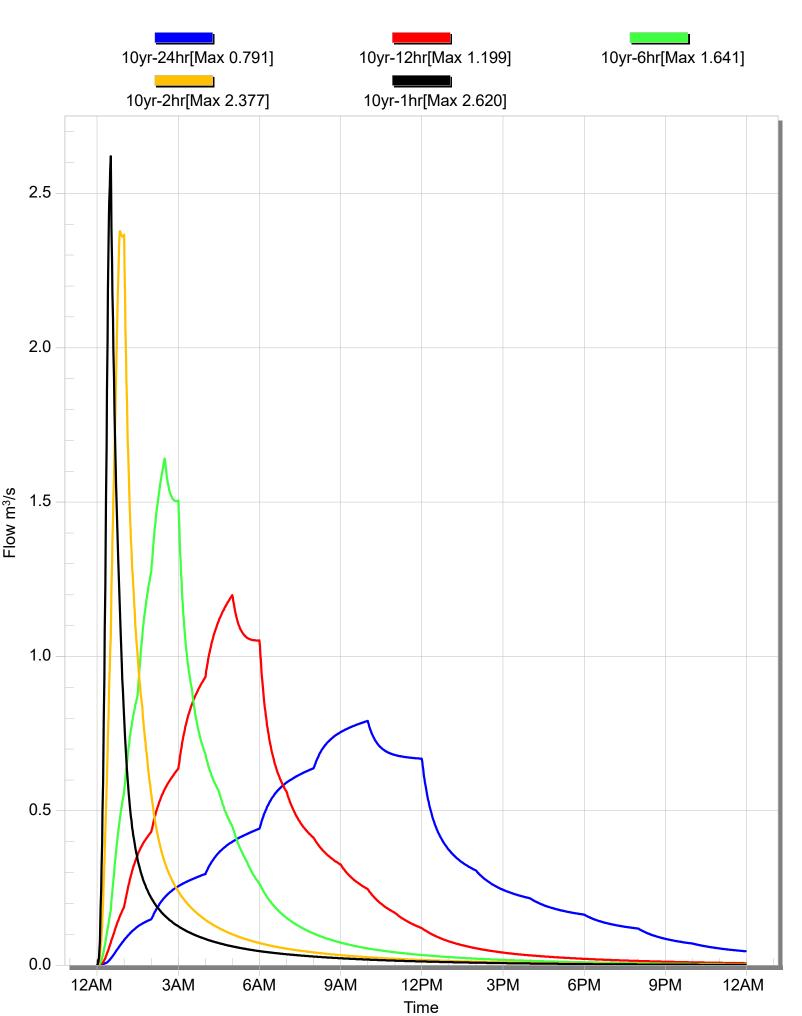
Conways Brook Catchmant











Appendix P



Gouvernement du Canada

Home > Common Project Search > Search registry > File number 2019-200018

File number 2019-200018

1 Submission language note

Please note that where appropriate, the content on this page is displayed in the language of the original submission and has not been altered.

1 Commenting period:

The commenting period is open. You have **16** day(s) left to <u>leave a comment</u> (before November 22, 2020).

Wharf, Infilling and Dredging - Long Pond, CBS, NL

Fill, Wharf, Dredging

Request details

Registry number 2438

Application Type Application for approval **②**

Date received 2020-10-20

Date notice published 2020-10-23

Province Newfoundland and Labrador

Waterway Long Pond

Work types Fill, Wharf, Dredging

Expected construction start 2020-11-23

Registry number 1866

Application Type Application for approval **@**

Date received 2020-07-09

Date notice published 2020-08-21

Province Newfoundland and Labrador

Waterway Long Pond

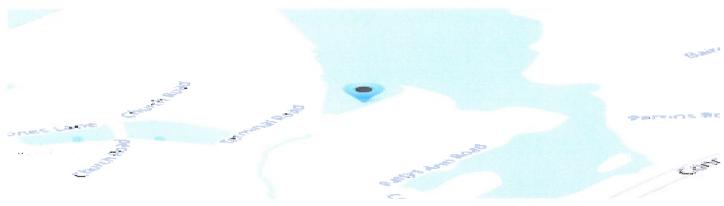
Work types Wharf, Fill

Expected construction end 2021-08-31

Latitude 47.51361

Longitude -52.97639

Status Denied



Long Pond

Documents

- UnclassifiedApplication.html
- Aerial_Port_200709 1.pdf
- Drawings.pdf

Expected construction end 2021-08-31

Latitude 47.51361

Longitude -52.97639

Status In progress



Documents

- ▶ Top View with dimensions
- ▶ Dredging Methodology
- UnclassifiedApplication.html
- wharf drawings.pdf
- ▶ 2020-033 Location Plan

1 Comments closed

The period to submit comments ended on September 20, 2020.

Wharf and Infilling - Long Pond, CBS, NL

Wharf, Fill

Request details

⚠ Third-party information liability disclaimer

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Version: 20201029.3

Appendix Q



Government of Newfoundland and Labrador Department of Municipal Affairs and Environment

File Ref No. 200.18.0246:0001

September 20, 2018

Mr. Blaine Sullivan
Ocean Choice International
1315 Topsail Rd
St. John's, NF
A1B 3N4

For:

Infilling Waterbody for Offloading and Laydown Area

At:

Long Pond, Conception Bay South

From:

Ocean Choice International

Dear Mr. Sullivan:

This application was referred to the Environmental Assessment Division and it has been determined that registration is NOT required under Section 47 of the Environmental Protection Act, SNL 2002, cE-14.2.

I understand that this project will involve the infilling of approximately 2.5 hectares of Long Pond in the municipality of Conception Bay South including a marginal wharf for the offloading or loading of ships, vehicle parking and a general laydown area.

Please be aware that this Department must be notified of any significant changes to the undertaking. All proponents are required to comply with all relevant legislation including permits and approvals from this Department and any other municipal, provincial or federal regulatory authorities.

If you have any questions regarding this matter please contact Eric Watton at (709) 729-0834, toll free at 1-800-563-6181 or email ericwatton@gov.nl.ca.

Sincerely,

Susan Squires, Ph.D.

Director

Environmental Assessment Division

c.c. Mr. Neil Hunt, AFN Engineering Inc.

Mr. Corrie Davis, Planner, Town of CBS

Mr. Jim House, Manager, Lond Pond Harbour Authority Inc.

Environment and Climate Change Canada

Environnement et Changement climatique Canada

Environmental Assessment and Marine Programs
Environmental Protection Operations Directorate - Atlantic
Environmental Stewardship Branch
6 Bruce Street
Mount Pearl NF A1N 4T3

1 May 2019

Neil Hunt AFN Engineering Inc.

Dear Mr. Hunt:

RE: Long Pond Harbour

It is understood that Ocean Choice International is considering a development in the existing Long Pond Harbour (former Transport Canada site). Project activities will involve infilling to create a new marginal wharf and parking/laydown area. It is also understood that the project may involve dredging to ensure to ensure sufficient water depth on the outside face of the wharf (possibly 1,000m³ of material, pending results of a current geotechnical program at the site).

ECCC has reviewed the information provided (e-mail correspondences on 19 March 2019) in accordance with its mandated interests and expertise stemming from its responsibilities under the *Migratory Birds Convention Act*, the *Species at Risk Act*, Section 36 of the *Fisheries Act*, and the *Canadian Environmental Protection Act*.

While it is understood that the environmental assessment (EA) for this project is not required (as per your e-mail and personal communication), ECCC offers the following guidance to support the environmental management process of the proposed project/development with respect to legislation falling under the auspices of the department.

REVIEW COMMENTS

Regulatory Requirements

Fisheries Act

The proponent should be aware of the general applicability of Section 36(3) of the Fisheries Act (http://laws-lois.justice.gc.ca/eng/acts/F-14/FullText.html) which states: "no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substances or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water". Environmental protection and mitigation measures should reflect the need to comply with Section 36(3) of the Fisheries Act. For example, measures should be taken to prevent substances such as lubricating fluids, fuels, etc. from being deposited into water frequented by fish, and drainage from construction and operational drainage must not be harmful to fish.

Migratory Birds Convention Act

Migratory birds, their eggs, nests, and young are protected under the Migratory Birds Convention Act (MBCA). Migratory birds protected by the MBCA generally include all seabirds except cormorants and pelicans, all waterfowl, all shorebirds, and most landbirds (birds with principally

terrestrial life cycles). Most of these birds are specifically named in the Environment Canada (EC) publication, *Birds Protected in Canada under the Migratory Birds Convention Act*, Canadian Wildlife Service Occasional Paper No. 1.

Under Section 6 of the Migratory Bird Regulations (MBR), it is forbidden to disturb, destroy or take a nest or egg of a migratory bird; or to be in possession of a live migratory bird, or its carcass, skin, nest or egg, except under authority of a permit. It is important to note that under the current MBR, no permits can be issued for the incidental take of migratory birds caused by development projects or other economic activities.

Furthermore, Section 5.1 of the MBCA describes prohibitions related to deposit of substances harmful to migratory birds:

- "5.1 (1) No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.
 - (2) No person or vessel shall deposit a substance or permit a substance to be deposited in any place if the substance, in combination with one or more substances, results in a substance in waters or an area frequented by migratory birds or in a place from which it may enter such waters or such an area that is harmful to migratory birds."

It is the responsibility of the proponent to ensure that activities are managed so as to ensure compliance with the MBCA and associated regulations.

Canadian Environmental Protection Act

The proponent should also be aware of the potential applicability of the Canadian Environmental Protection Act (CEPA) (https://laws-lois.justice.gc.ca/eng/acts/C-15.31/). The Canadian Environmental Protection Act enables protection of the environment, and human life and health, through the establishment of environmental quality objectives, guidelines and codes of practice, and the regulation of toxic substances, emissions and discharges from federal facilities, international air pollution, and disposal at sea.

Migratory Birds

The Canadian Wildlife Service of Environment and Climate Change Canada has reviewed the proposed Long Pond Harbour development and has the following comments.

Coastal Infrastructure

ECCC-CWS has the following recommended beneficial management practices for working on shorelines:

- Project staff should not approach concentrations of seabirds, sea ducks or shorebirds.
- Project staff should use the main navigation channels to get to and from the site; and should have well muffled vessels and machinery.
- · Project staff must avoid the discharge or oily waste into the marine environment.
- Food scraps and other garbage left on beaches and other coastal habitats can artificially enhance the populations of avian and mammalian predators of eggs and chicks of sensitive species. The proponent and their contractors should ensure that no litter (including food wastes) is left in coastal areas.
- If there is any noticeable change in seabird numbers or distribution at the location during operations, ECCC-CWS should be notified.

Fuel Leaks

The proponent must ensure that all precautions are taken by the contractors to prevent fuel leaks from equipment, and that a contingency plan in case of oil spills is prepared. Furthermore, the proponent should ensure that contractors are aware that under the MBR, "no person shall deposit or permit to be deposited oil, oil wastes or any substance harmful to migratory birds in any waters or any area frequented by migratory birds." Biodegradable alternatives to petroleum-based chainsaw bar oil and hydraulic for heavy machinery are commonly available from major manufacturers. Such biodegradable fluids should be considered for use in place of petroleum products whenever possible, as a standard for best practices. Fueling and servicing of equipment should not take place within 30 meters of environmentally sensitive areas, including shorelines and wetlands.

Provisions for wildlife response activities should be identified in the Oil Spill Prevention and Response Plan to ensure that pollution incidents affecting Wildlife are effectively and consistently mitigated. The document "Birds and Oil – CWS Response Plan Guidance" is attached and is provided to offer guidance on the development of wildlife response activities.

The following information should be included in any Oil Spill Prevention and Response Plan:

- · Mitigation measures to deter migratory birds from coming into contact with the oil.
- Mitigation measures to be undertaken if migratory birds and/or sensitive habitat becomes contaminated with the oil.
- The type and extent of monitoring that would be conducted in relation to various spill events.

Invasive Species

Measures to diminish the risk of introducing invasive species should be developed and implemented during all project phases. These measures could include:

- Cleaning and inspecting construction equipment prior to transport from elsewhere to ensure that no vegetative matter is attached to the machinery (e.g., use of pressure water hose to clean vehicles prior to transport).
- Regularly inspecting equipment prior to, during and immediately following construction in areas found to support Purple Loosestrife to ensure that vegetative matter is not transported from one construction area to another.

Dredging (General)

ECCC-CWS recommends that dredge material not be disposed of upon beaches. The proponent should be advised that old dredge spoils have been known to attract migratory birds such as Piping Plovers and other species of ground nesting birds such as terns or Killdeer.

Environment and Climate Change Canada provides the following recommendations:

- to avoid engaging in potentially destructive activities (such as disposing dredge material on beaches) during key periods in order to reduce the risk of nest destruction, i.e., avoid depositing dredge materials between the most critical period, April 15th to August 15th, to accommodate the breeding season.
- to develop and implement a management plan that includes appropriate preventive measures to minimize the risk of impacts (See "Planning ahead to reduce risks to migratory bird nests", (Website: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reducing-risk.html# 001).

It is the responsibility of the individual or company undertaking the activities to determine these measures. For guidance on how to avoid the incidental take of migratory birds nests and eggs,

please refer to the Avoidance Guidelines (Website: http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=AB36A082-1).

Onland disposal of dredge material

• Should the proponent proceed with onland disposal during the breeding or chick-rearing seasons, it should be ensured that there are no nests or fledglings of migratory birds in areas where dredged material would be deposited in order to ensure compliance with the MBCA and SARA. Presence of nests and fledglings should be determined by a professional ornithologist or a skilled birder. This person should be instructed to survey the entire area and vicinity where dredged material would be placed for evidence of breeding migratory birds. Should any birds be found to be nesting or rearing chicks in the area, ECCC-CWS should be contacted for further instructions. In such an event, it is likely that the placement of dredge material would have to be delayed until birds have naturally left the area.

Useful Reference:

Environment Canada. 2010. Harbour Maintenance Re-Dredging and Disposal at Sea of Dredged Sediments in Prince Edward Island. Canadian Wildlife Service, Environment Canada, Public Works and Government Services Canada, and Office of Greening Government Operations Charlottetown, PEI. 103p.

Light Attraction and Migratory Birds

Attraction to lights at night or in poor visibility conditions during the day may result in collision with lit structures or their support structures, or with other migratory birds. Disoriented migratory birds are prone to circling light sources and may deplete their energy reserve and either die of exhaustion or be forced to land where they are at risk of depredation.

To reduce risk of incidental take of migratory birds related to human-induced light, ECCC-CWS recommends implementation of the following beneficial management practices:

- The minimum amount of pilot warning and obstruction lighting should be used on tall structures. Warning lights should flash and should completely turn off between flashes.
- The fewest number of site-illuminating lights possible should be used in the project area. Only strobe lights should be used at night, at the lowest intensity and smallest number of flashes per minute allowable by Transport Canada.

Species at Risk

The following species at risk (as listed on Schedule 1 of the Species at Risk Act) may occur within the study area: Red Crossbill (percna subspecies, Endangered), and Olive-sided Flycatcher (Threatened). Though unlikely to be found within the project footprint, we request that the sightings be reported to ECCC-CWS.

Wetlands

Eelgrass beds contribute large amounts of nutrients to coastal and marine habitats, and eelgrass is also a very important food for migrating geese. Coastal wetlands also provide other important functions such as natural shoreline protection from wave action and erosion, as well as natural flood reduction and control. A characterization of the sea floor should be undertaken that would indicate the presence or lack thereof of eelgrass beds, which are a wetland under the Federal Policy on Wetland Conservation (FPWC).

ECCC-CWS recommends that project proponent follow the mitigation options outlined in the Federal Policy on Wetland Conservation (FPWC). The FPWC was introduced "to promote the conservation

of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future". The policy recognizes the importance of wetlands to the environment, the economy and human health, and promotes a goal of No Net Loss of Wetland Function as a result of the Government of Canada exercising a duty, function, or power in areas of Canada where wetland loss has reached critical levels. In support of this goal, the FPWC and related implementation guidance identify the importance of planning, siting and designing a project in a manner that accommodates a consideration of mitigation options in a hierarchical sequence - avoidance, minimization, and as a last resort, conservation allowances (i.e. compensation). A copy of the FPWC can be found at: http://publications.gc.ca/pub?id=9.686114&sl=0.

- General Beneficial Management Practices
 In order to promote wetland conservation ECCC-CWS recommends the following general beneficial management practices:
 - Developments on wetlands should be avoided.
 - Where development does occur in the vicinity of wetlands, a minimum vegetation buffer zone of 30 meters should be maintained around existing wetland areas.
 - Hydrologic function of the wetland should be maintained.
 - Runoff from development should be directed away from wetlands.
 - The use of a 30 meter buffer from the high water mark of any water body (1:100 year Flood Zone) in order to maintain movement corridors for migratory birds. Please see https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=8D910CAC-1#_03_1_1 for further information concerning buffer zones.
- Please note ECCC would be interested in being kept in the loop regarding DFO's comments on the destruction of eelgrass and any proposed compensation measures.

Suspension of Sediments

The disturbance of substrate during in-water activities increases sediment concentrations and turbidity in the water column. This disturbance may alter light penetration, temperature and water chemistry regimes, and may affect photosynthesis. The CCME (Canadian Council of Ministers of the Environment) Canadian Environmental Quality Guidelines (1999) recommend that, for protection of marine waters, human activities should not cause suspended solids levels to increase by more than 10% of the natural conditions expected at the time. The guidelines also recommend that no solid debris, including floating or drifting materials or settleable matter, be introduced into marine and estuarine waters.

Construction Materials

At the project planning stage, all available construction materials should be considered (e.g., untreated wood, treated wood, pre-cast concrete, corrosive-resistant steel, plastic lumber), and those materials best suited to the conditions and intended use of the structure should be selected. Analysis of the preferred construction material should include a consideration of the full life-cycle of the material (ease of use, design factors associated with the construction material, maintenance requirements, and final disposal). Environmental implications (e.g. storm and ice damage) associated with each life-cycle phase should also be considered.

Concrete Production

It is understood that concrete for the new fishway and associated structures (6 concrete weirs, a concrete leveling slab, water stop log, 3 concrete aprons) will be poured on-site. Discharges from project activities involving the use of concrete, cement, mortars and other Portland cement or lime-

containing construction materials may have a high pH. Work should be planned and conducted to ensure that sediments, debris, concrete, and concrete fines are not deposited, either directly or indirectly into the aquatic environment. Measures must be taken to prevent any potentially contaminated water (e.g. exposed aggregate wash-off, wet curing, equipment and truck washing) from entering the aquatic environment unless it can be confirmed that this water will not be deleterious to fish or harmful to migratory birds. Containment facilities should be provided at the site.

Effects of the Environment on the Project

Because the proposed project will be sensitive to climate and weather, particularly extreme events, mitigative procedures should be factored into the design to ensure that the risk of environmental damage is minimized. Historical data, local area knowledge and increasing ranges of weather events (e.g. Hurricane Igor) should be taken into account in determining the adequacy of the project design.

Climatological data to assess the effects of the environment on the project can be obtained at http://www.climate.weatheroffice.ec.gc.ca/. Value-added data can be obtained by consulting EC's Atlantic Climate Centre at (506) 451-6006 or by email at: climate.atlantic@ec.gc.ca.

The proponent is also encouraged to regularly consult EC's local forecast (at http://www.weatheroffice.ec.gc.ca/) so that construction-related activities can be scheduled accordingly.

Management of Hazardous Materials

Hazardous materials (e.g. fuels, lubricants, hydraulic oil) should be managed so as to minimize the risk of accidental releases. In order to ensure that a quick and effective response to a spill event is possible, spill response equipment should be readily available on-site. Response equipment, such as adsorbents and open-ended barrels for collection of cleanup debris, should be stored in an accessible location on-site.

Personnel working on the project should be knowledgeable about response procedures. The proponent should consider developing a contingency plan specific to the proposed undertaking to enable a quick and effective response to a spill event. The proponent should indicate how the contingency plans will be prepared, and response measures implemented, to reflect site-specific conditions and sensitivities. In developing a contingency plan, it is recommended that the *Emergency Preparedness and Response, CAN/CSA-Z731-03*¹, be consulted as a useful reference.

All spills or leaks of petroleum or other hazardous materials should be promptly contained, cleaned- up and reported to the 24-hour environmental emergencies reporting system (St. John's 709-772-2083; other areas 1-800-563-9089).

Other Considerations - Potential for Disposal at Sea [DAS] Permit

It is understood that the proposed project may require dredging, but details on the fate of any dredged materials have not been provided. If project activities include disposal at sea of dredged material, a permit under CEPA (Part 7 Division 3) would be required. The steps and process to be followed prior to filing a DAS permit application are available at:

¹ Canadian Standards Association (CSA). Emergency Preparedness and Response: A National Standard of Canada (CAN/CSA-Z731-03). Toronto: CSA, (R2014). https://store.csagroup.org/ccrz ProductDetails?viewState=DetailView&cartID=&sku=Z731-03&isCSRFlow=true&portalUser=&store=&cclcl=en_US

https://www.canada.ca/en/environment-climate-change/services/disposal-at-sea/permit-applicant-quide/dredged-material/applicant-guide-permit-dredged-material/chapter-3-1.html.

The proponent is advised to contact ECCC to verify applicability of Disposal at Sea provisions of CEPA (Natasha Boyd; 709-772-2161; Natasha.Boyd@canada.ca). Further information regarding the Disposal at Sea Program can be accessed at: https://www.canada.ca/en/environment-climate-change/services/disposal-at-sea.html.

I trust that this information will be of assistance in your review of this project. If you wish to discuss these comments or have further questions, please do not hesitate to contact me at 709-772-2126 or via email at jerry.pulchan@ec.gc.ca at your convenience.

Yours truly,

Jerry Pulchan

Environmental Assessment Analyst

Jeny Pulcha

Environmental Protection Operations Directorate - Atlantic

Attachment

cc: M. Hingston

August 19, 2020

Omni Marine Services Inc. 1315 Topsail Road St. John's, NL A1B 3N4



Dear Sir or Madam:

Your application **#COM-20-064** dated July 13, 2020 to construct a wharf and infill a waterbody located on **Terminal Road**, **Long Pond** has been approved under section 4.10 of the Conception Bay South Development Regulations. A permit will be issued only upon compliance with the following conditions and no construction and/or excavation will be permitted prior to the issuance of a building or construction permit.

Wharf & Infill Requirements

- 1. Receipt of approval and compliance with all requirements outlined by the Provincial Department of Municipal Affairs and Environment, Water Resources Management Division.
- 2. Receipt of approval from the Department of Fisheries and Oceans Canada.
- 3. Receipt of approval from the Federal Department of Transport Canada Navigable Water Protection Division.
- 4. Receipt of approval from the Long Pond Harbour Authority.
- 5. If approval is determined to not be required by an authority, the applicant may be required to provide the Town with written acknowledgement from the authority or written confirmation and reasoning as to why an approval is not required.
- 6. That the following be submitted to this office, prior to issuing of a building permit:
 - 6.1. A legal survey, including a property description confirming the property size, as indicated on your application
 - 6.2. A detailed site plan, prepared by a professional engineer licensed to practice in the Province of Newfoundland and Labrador. The Site Plan must incorporate all requirements outlined in condition (7) above and the following:
 - 1. Future building location, parking, access/egress provisions and any outdoor storage area and fences.
 - 2. Existing grade of site, including grade of street centerline and curb at 5m intervals along the site frontage, as well as all final grading details.
 - 3. Site servicing details for all water, sewer and storm service installations.

- 4. A detailed landscaping plan, incorporating all provisions/requirements of section 5.12.4 of the Town's Development Regulations.
- 6.3. Building permit fees and deposits for this development will be assessed as per the Town's Schedule of Rates and Fees. This assessment must be paid in full prior to the issuance of a building permit. These fees/deposits will include, but are not limited to:
 - 1. Permit fee of \$7 per \$1000 of construction value (May be waived if permit is issued in 2020).
 - A refundable construction deposit calculated at 1% of the estimated construction costs (a minimum of \$5,000 will apply). The construction deposit will be refunded upon issuance of an Occupancy Permit and confirmation that there are no outstanding deficiencies related to the development.
 - 3. A refundable landscaping deposit of \$1000.
- 7. This proposal is located within an area identified as High Hazard Vulnerability on Map 2 Environmental Overlay Map of the Municipal Plan. As per Section 5.10 of the Development Regulations, you are required to have a Land Use Impact Assessment Report (LUIAR) prepared by a suitable qualified person(s) to evaluate the level of hazard risk. The Town will draft a Terms of Reference for this report in order to initiate this process. The Town is required to advertise the draft Terms of Reference to the public and it must be considered by Council prior to a decision on its use for the LUIAR. If approved, the Terms of Reference will be released to the applicant in order to engage a consultant to prepare the LUIAR under the quidance of the Terms of Reference. Once provided to the Town, the LUIAR will be reviewed by staff and/or Council for acceptance/approval. If determined to be required by Council, a public advertising period may also be required prior to the approval/acceptance of the report. All costs associated with the LUIAR process are the responsibility of the applicant, and this process must be completed prior to the issuance of a permit.
- 8. A Business Permit for the wharf operation and cold storage plant is required prior to the operation of a business from the building. A permit fee of \$30 is required to be paid prior to the issuance of that permit. Business Tax will be assessed and payable from the date that the Business Permit is issued.

General Conditions

- If municipal water service is to be brought onto this site, a water meter is required
 to be supplied and installed at the expense of the developer in any future building
 on this property in accordance with the Conception Bay South Water Meter
 Regulations.
- 10. All certificates, approvals, documentation and any other requirements requested or identified by the Town during plan review or throughout the development process must be submitted to the Town prior to booking an occupancy permit.
- 11. This proposal and associated plans and drawings will be reviewed by the Town's Engineering Department. The applicant will be required to comply with all requests and make any modifications to the plans/drawings which are requested by the

Omni Marine Services Inc. August 19, 2020 Page 3 of 4

Town. Permits will not be issued until all necessary departments of the Town are satisfied with the proposal. Any cost and work involved in changes, modifications or alterations to the plans will be the full responsibility of the applicant.

- 12. Any water/sewer work will require that a water and sewer permit is obtained from the Town's Engineering Department. All design work and plans must be submitted and approved by the Town to commencement of any work. These plans must be completed and stamped by a professional engineer.
- 13. The construction site be maintained free of all refuse and debris resulting from the construction of this building. This material should be removed and disposed of at an approved waste disposal site.
- 14. That the parking area be constructed and finished with a hard surface and meet all standards outlined in Section 9 of the Town's Development Regulations.
- 15. The number of parking stalls provided on the entire property must meet the cumulative requirements as prescribed by Section 9 of the Town's Development Regulations.
- 16. Permits will be required for any signs that are placed/erected on this property. For more information please contact the Town's Planning and Development Department at 709-834-6500, extension 401.
- 17. The property is subject to property tax, which should be paid before a permit is issued. As well, the building will have to be assessed when completed and taxes paid from the date of completion to the end of the year. If an occupancy permit is not obtained, the tax assessment and billing will be effective from the date on which the building permit was issued.
- 18. That should ditching be required now or in the future, as a result of the development of this property in whole or in part, it is the responsibility of the builder/developer/owner. Furthermore, should any easements be required to the benefit of the Town, such easements are to be supplied to the Town at no cost to the Town.
- 19. Applicants for building and renovation permits shall be responsible for the costs associated with all modifications, installations, etc. with respect to all Town services as a result of any work carried out by the applicant as a result of the permit. This shall include but is not limited to culverts, fire hydrants, road shoulders, sidewalk removal/replacement, etc.
- 20. This development approval is valid for two years from date of issue. If a building permit is not obtained by that date, this approval is subject to renewal on or before the date of expiration. Should this approval expire, your application is subject to further review by Council.
- 21. Development of the cold storage plant or any other structures on this property will require that an additional application is submitted to the Town for consideration.

Omni Marine Services Inc. August 19, 2020 Page 4 of 4

Yours truly,

CC

22. You are hereby notified that the Approval in Principle issued on July 27, 2020 is formally revoked under the authority of Section 4.12 of the Town's Development Regulations. This approval was provided in error including the development of a cold storage plant.

Please note that you have the right to appeal the foregoing conditions. The appeal and a fee of \$200 plus HST (\$230.00 total) must be submitted to the **Secretary of the Appeal Board at the Department of Municipal and Provincial Affairs and Environment, 4th floor, Confederation Building (West Block), P.O. Box 8700, St. John's, NF, A1B 4J6 within 14 days of the day that you receive this decision. If the appeal and fee is not submitted within this time limit, your right to appeal is considered to be forfeited. You should note that any interested person also has the right to appeal the decision regarding your application within the 14 day appeal period.**

Please indicate your agreement with the foregoing conditions by signing and returning a full copy of this letter to this office within 30 days. Failure to return this letter within the specified time will result in cancellation of the application.

Please note that this approval constitutes Approval in Principle only, not approval to commence construction.

The required permits will be issued upon compliance with the foregoing conditions, receipt of a signed copy of this letter, signed copy of the Inspection Schedule and payment of the applicable permit fees.

Should you require additional information, please contact the Town's Planning and Development Department at 834-6500 ext. 401.

Daniel Barrett
Development Control Coordinator
/mb

Signature

Date

Jennifer Lake, Economic Development



P.O. Box 5667 St. John's, NL A1C 5X1

September 18, 2020

Our file Notre référence

20-HNFL-00467

Blaine Sullivan Omni Marine Services Inc. 1315 Topsail Road St. John's, NL A1B 3N4

Dear Mr. Sullivan:

<u>Subject: Marine Fish Habitat Compensation Plan (Long Pond In-Fill / Wharf Construction) – Fisheries Act Authorization</u>

Pursuant to Paragraphs 34.4(2)(b) and 35(2)(b) for the authorization for work/undertaking/activity resulting in harmful alteration, disruption or destruction of fish habitat under the *Fisheries Act*, Fisheries and Oceans Canada (DFO) authorizes the carrying on of your proposed work, undertaking or activity that results in:

- the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*; and
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*.

Description of Authorized works, undertakings or activities likely to result in the harmful alteration, disruption or destruction of fish habitat:

The works, undertakings, or activities associated with the proposed project that are likely to result in the harmful alteration, disruption or destruction of fish habitat, are:

• Construction of a 9.15m (W) x 180m (L) timber crib wharf that will be constructed on land and floated into position and rock ballasted. The wharf will



be completed with a reinforced concrete deck. Footprint for timber cribbing will measure 1650 m².

- Construction of an infill uplands area with a footprint measuring 23 550m² consisting of rock and gravel fill and topped with Class "B" and Class "A" granulars and asphalt pavement. Outer perimeter of infill will be composed of rip rap which will be sloped to provide stability.
- Construction of a connector road 90m long consisting of rock and gravel fill and topped with Class "B" and Class "A" granulars and asphalt pavement. Both sides of connector road will be composed of rip rap which will be sloped to provide stability. This roadway structure will have create a footprint of 1800m².

The authorization (20-01-001) under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* is attached.

Failure to comply with any of the terms or conditions of the attached authorization may lead to prosecution under the *Fisheries Act*.

A copy of this authorization should be kept on site while the work is in progress and upon request be provided to relevant federal or provincial officials. The authorization holder is responsible for ensuring work crews are familiar with, and able to adhere to, the conditions.

If you or anyone conducting work on your behalf have any questions please contact Roger Johnson at 746-1400 or roger.johnson@dfo-mpo.gc.ca.

Sincerely,

Jacqueline Perry

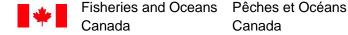
Regional Director General

Jacquel Perry

Newfoundland and Labrador Region

Fisheries and Oceans Canada





Other DFO File No.:

PATH No.: 20-HNFL-00467

2020-105-00021

Paragraphs 34.4(2)(b) and 35(2)(b) Fisheries Act Authorization

Authorization issued to

OMNI Marine Services Inc. (hereafter referred to as the "Proponent")

Attention to: Blaine Sullivan 1315 Topsail Road St. John's, NL A1B 3N4

Location of Proposed Project

Nearest community (city, town, village): Long Pond

Municipality, district, township, county: Conception Bay South Province: Newfoundland & Labrador

Name of watercourse, waterbody: Long Pond, Conception Bay South 47°30'55.87"N, 52°58'32.49"W Longitude and latitude, UTM Coordinates:

Description of Proposed Project

The proposed project of which the work, undertaking or activity authorized is a part involves:

The infill of a segment of Long Pond Harbour with an overall footprint of 27 000 m², to construct a marginal wharf and upland area to house a laydown area, parking lot and accompanying building infrastructure. An approach road will also be constructed that will connect the infill/docking area to the existing Terminal Road. Long Pond Harbour is currently maintained by the Long Pond Port Authority.

Description of Authorized works, undertakings or activities likely to result in the harmful alteration, disruption or destruction of fish habitat:

The works, undertakings, or activities associated with the proposed project described above, that are likely to result in the harmful alteration, disruption or destruction of fish habitat, are:

- Construction of a 9.15m (W) x 180m (L) timber crib wharf that will be constructed on land and floated into position and rock ballasted. The wharf will be completed with a reinforced concrete deck. Footprint for timber cribbing will measure approximately 1650 m².
- Construction of an infill uplands area with an approximate footprint of 23 550m² consisting of rock and gravel fill and topped with Class "B" and Class "A" granulars and asphalt pavement. Outer perimeter of infill will be composed of rip rap which will be sloped to provide stability.
- Construction of a connector road 90m long consisting of rock and gravel fill and topped with Class "B" and Class "A" granulars and asphalt pavement. Both sides of connector road will be composed of rip rap which will be sloped to provide stability. This roadway structure will create a footprint of approximately 1800m².



Other DFO File No.: 2020-105-00021

The authorized works, undertakings, or activities are likely to result in the following impacts to fish and fish habitat:

• Destruction of approximately 27 000m² of habitat in Long Pond Harbour including portions of intertidal and sub-tidal zones. The overall measure of this footprint is the combination of the three project elements described above which include the timber crib wharf (1650 m²), the connector road (1800m²), and the infill area (23550 m²). A large eel grass bed (an ecologically significant species (ESS)) exists within the impacted subtidal footprint and will also be destroyed as a result of this development.

Conditions of Authorization

The above described work, undertaking or activity must be carried on in accordance with the following conditions.

1. Conditions that relate to the period during which the work, undertaking or activity can be carried on

The work, undertaking or activity that is/are authorized to be carried on during the following period:

From September 01, 2020 to October 31, 2021

If the Proponent cannot complete the work, undertaking or activity during this period, Fisheries and Oceans Canada (DFO) must be notified in advance of the expiration of the above time period. An application for amendment, suspension or cancellation of the authorization should be submitted to DFO.

The periods during which other conditions of this authorization must be complied with are provided in their respective sections below.

2. Conditions that relate to measures and standards to avoid and mitigate impacts to fish and fish habitat, including impacts to aquatic species at risk, their critical habitat and/or the residences of their individuals.

- 2.1 Sediment and erosion control: Sediment and erosion control measures must be in place and shall be upgraded and maintained, such that release of sediment is avoided at the location of the authorized work, undertaking, or activity.
- 2.2 List of measures and standards to avoid and mitigate impacts to fish and fish habitat:
 - 2.2.1 Avoid introducing sediments (e.g. silts, clays and sand) into the water.
 - 2.2.2 Develop and implement an erosion and sediment control plan to avoid the introduction of sediment into any waterbody during all phases of the work, undertaking or activity
 - 2.2.3 Install effective erosion and sediment control measures prior to beginning work undertaking or activity in order to stabilize all erodible and exposed areas
 - 2.2.4 A silt curtain is to be deployed around areas of active construction
 - 2.2.5 Regularly inspect and maintain the erosion and sediment control measures and structures during all phases of the project

Other DFO File No.: 2020-105-00021

- 2.2.6 Keep the erosion and sediment control measures in place until all disturbed ground has been permanently stabilized
- 2.2.7 Remove all exposed non-biodegradable sediment control materials once site is stabilized
- 2.2.8 Use biodegradable erosion and sediment control materials whenever possible
- 2.2.9 Fill and armour stone will consist of clean, non-acid generating materials. Materials to be used are not to affect pH of water in the area.
- 2.2.10 Dispose of and stabilize all excavated material above the high water mark and ensure sediment re-entry to the watercourse is prevented.
- 2.2.11 Schedule work to avoid wet, windy and rainy periods (and heed weather advisories) that may result heavy runoff and an increase in erosion and sedimentation.
- 2.2.12 Operate machinery on land in stable, dry areas.
- 2.2.13 All equipment used in water should be cleaned, drained and dried on land before and after use for the purposes of preventing the introduction or spread of aquatic invasive/non-indigenous species.
- 2.3 Contingency measures: The proponent will work with DFO to determine appropriate contingency measures if it is determined that the measures and standards to avoid and mitigate impacts are ineffective.
- 2.4 Dates by which these measures and standards shall be implemented: Measures and standards to avoid and mitigate impacts to fish and fish habitat shall be implemented prior to the initiation of works, undertakings or activities and will remain in place during the entirety of the construction phase until all construction has been completed.

3. Conditions that relate to monitoring and reporting of measures and standards to avoid and mitigate impacts to fish and fish habitat,

- 3.1 Monitoring of avoidance and mitigation measures: The Proponent shall monitor the implementation of avoidance and mitigation measures referred to in section 2 of this authorization and report to DFO, by December 31 of the year in which the works, undertakings or activities are carried out and indicate whether the measures and standards to avoid and mitigate impacts to fish were conducted according to the conditions of this authorization. This shall be done, by:
 - 3.1.1 Demonstration of effective implementation and functioning: Providing dated photographs and inspection reports to demonstrate effective implementation and functioning of mitigation measures and standards described above to limit the impacts to fish and fish habitat to what is covered by this authorization.
 - 3.1.2 Contingency measures: Providing details of any contingency measures that were followed, to prevent impacts greater than those covered by this authorization in the event that mitigation measures did not function as described.

4. Conditions that relate to offsetting

4.1 Letter of credit: DFO may draw upon funds available to DFO as the beneficiary of the letter of credit BMTO630046OS which has been provided to DFO as part of the application for this authorization to cover the costs of implementing and maintaining the offsetting measures required to be implemented under this authorization, including the associated monitoring measures included in section 5 of this authorization, in instances where the Proponent fails to implement these required measures.

Other DFO File No.: 2020-105-00021

4.2 Scale and description of offsetting measures: OMNI Marine Services Inc. proposes as the primary offset plan to create new habitat in Conception Bay through the creation of artificial reefs near the Marine Institute's (MI) Holyrood Marine Base in Southern Arm. This will consist of deploying 43 reef balls.

The proponent and the MI have selected an area in the southern arm in Holyrood Bay near the MI Marine Base as site 1 for deployment of the reef balls. Site 1 will be located within the MI water lot. Site 2 will focus on using the layer cake designed reef ball and will focus on shallow area north of the MI Marine Base with a goal of enhancing lobster habitat in the region. This location will need to be discussed in consultation with the community.

- 4.3 The precise GPS coordinates of the individual reef ball structures in both sites will be determined once substrate type has been assessed, and will be submitted to DFO through the initial "as built" report due December 31, 2021. The offsetting measures shall be carried out in accordance with the measures set out in the Proponent's offsetting plan; Section 5.0 of the "Marine Fish Habitat Compensation Plan" dated August 12, 2020 approved by DFO and attached to this authorization. Offsetting criteria to assess the implementation and effectiveness of the offsetting measures: All fish habitat offsetting measures shall be completed by October 31, 2021 according to the criteria listed in section 5.6.2 of the document Marine Fish Habitat Compensation Plan (August 12, 2020).
- 4.4 Contingency measures: If the results of monitoring as required in section 5 indicate that the offsetting measures are not completed by the date specified in Section 4.3, and/or are not functioning, the proponent shall give written notice to DFO and shall implement the contingency measures and associated monitoring measures, as contained within the approved offsetting plan as referenced in section 4.2, and as set out in section 5 of this authorization, to ensure the implementation of the offsetting measures is completed and/or functioning as required by this authorization.
 - 4.4.1 Scale and description of contingency measures: The proponent will work with DFO to determine appropriate contingency measures should it be determined that the offsetting measures are ineffective.
 - 4.4.2 After year 3 of monitoring, the proponent will submit to DFO a comprehensive summary of the monitoring results to date and at that time DFO will determine if offsetting is functioning as designed and if it is sufficient in amount. DFO will discuss with proponent if further works are required.
 - 4.4.3 Monitoring measures to ensure offsetting contingency is completed as required:

 Proponent will be required to implement monitoring to assess the effectiveness of the contingency offsetting measures.
- 4.5 The Proponent shall not carry on any work, undertaking or activity that will adversely impact the offsetting measures.
- 4.6 The Proponent shall obtain written permission for the Proponent, DFO, and anyone authorized to act on behalf of DFO, to access lands, water sources, or water bodies that are not owned by or under the care, control, or administration of the Proponent that must be accessed in order to implement the offsetting measures in this section and the monitoring of said measures. As per section 5.4 Methodology of the "Marine Fish Habitat Compensation Plan" dated August 12, 2020
- 4.7 The Proponent shall provide the written permission to DFO prior to the commencement of the Authorized works, undertakings or activities that are likely to result in impacts to fish and fish habitat, described herein, and prior to the commencement of the implementation of the Proponent's offsetting plan referred to in condition 4.2 and dated August 12, 2020 that is to take place on lands or in water sources or water bodies not owned by or under the care, control, or administration of the Proponent.

Other DFO File No.: 2020-105-00021

4.8 Other conditions related to offsetting: The proponent proposes an additional goal of this project being the utilization of technology in partnership with the Marine Institute's Holyrood Marine Base to create an outreach program. The aim is to provide an online real time observation system utilizing underwater cameras on the reef ball site so that all that everyone from school children to researcher's can benefit. OMNI Marine Services Inc. and MI will work with technology suppliers and appropriate GOs and NGOs to establish a sustainable outreach program.

5. Conditions that relate to monitoring and reporting of implementation of offsetting measures (described in section 4):

- 5.1 Schedule(s) and criteria: The Proponent shall conduct monitoring of the implementation of offsetting measures according to the timeline and criteria below [or according to the timeline and criteria in the offsetting plan approved by DFO, referred to in section 4.2 and attached to this authorization (as per section 5.6.3 Habitat of the "Marine Fish Habitat Compensation Plan" dated August 12, 2020) and which are the following:
 - 5.1.1 List of monitoring and reporting criteria shall include but not be limited to:
 - 5.1.1.1 Individual finfish will be visually identified to species where possible (and higher taxonomic levels where necessary), species relative abundance will be quantified as numerical counts within the volume of water surveyed. Where possible, length estimates of observed animals will also be documented.
 - 5.1.1.2 Relative abundance of invertebrates on the reef complex and at the comparison site, will also be quantified using quadrats placed every 10 m along the 100m transects. These quadrat locations will be "marked" using GPS to ensure standardized locations in the subsequent years.
 - 5.1.1.3 Relative abundance (percent cover) of macro alga will also be recorded in each sample quadrat to provide ecological context for any trends in the colonization of finfish or invertebrates.
 - 5.1.1.4 Select reef balls (# to be determined) along the transect will also be monitored via photo/video comparison from time 0.1 to time 4 to determine invertebrate and macro algae colonization
 - 5.1.2 List of timelines for monitoring:

Pre-deployment survey and assessment		July 2021 (survey carried out)
Offset Monitoring	(season 1)	July 2022 (fieldwork carried out)
Offset Monitoring	(season 2)	July 2023 (fieldwork carried out)
Offset Monitoring	(season 3)	July 2024 (fieldwork carried out)
Offset Monitoring	(season 5)	July 2026 (fieldwork carried out)

5.2 List of reports to be provided to DFO: The Proponent shall report to DFO on whether the offsetting measures were conducted according to the conditions of this authorization by providing the following:

As Built/Deployment Report	December 31, 2021 (report due date)
Offset Monitoring Report (season 1)	December 31, 2022 (report due date)
Offset Monitoring Report (season 2)	December 31, 2023 (report due date)
Offset Monitoring Report (season 3)	December 31, 2024 (report due date)
Offset Monitoring Report (season 5)	December 31, 2026 (report due date)

Other DFO File No.: 2020-105-00021

5.3 Other monitoring and reporting conditions for offsetting:

5.3.1 As a key component of the yearly monitoring report the proponent shall provide a year over year comparison, as well as a cumulative comparison for all years of the monitored results including an assessment of the increase/decrease in productivity at control site, site 1 and site 2. These results to be presented in written, tabular and graphic form.

Other DFO File No.: 2020-105-00021

Authorization Limitations and Application Conditions

The Proponent is solely responsible for plans and specifications relating to this authorization and for all design, safety and workmanship aspects of all the works associated with this authorization.

The holder of this authorization is hereby authorized under the authority of Paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act.* R.S.C., 1985, c.F-14, to carry on the works, undertakings and/or activities that are likely to result in impacts to fish and fish habitat as described herein.

This authorization does not purport to release the applicant from any obligation to obtain permission from or to comply with the requirements of any other regulatory agencies.

This authorization does <u>not</u> permit the deposit of a deleterious substance in water frequented by fish. Subsection 36(3) of the *Fisheries Act* prohibits the deposit of any deleterious substances into waters frequented by fish unless authorized by regulations made by Governor in Council.

It is also your *Duty to Notify* DFO if you have caused, or are about to cause, the unauthorized death of fish by means other than fishing and/or the harmful alteration, disruption or destruction of fish habitat. Such notifications should be directed to (http://www.dfo-mpo.gc.ca/pnw-ppe/CONTACT-eng.html).

The failure to comply with any condition of this authorization constitutes an offence under Paragraph 40(3)(a) of the *Fisheries Act* and may result in charges being laid under said Act.

A copy of this authorization should be kept on site while the work is in progress and upon request be provided to relevant federal or provincial officials. The authorization holder is responsible for ensuring work crews are familiar with, and able to adhere to, the conditions.

This authorization cannot be transferred or assigned to another party. If the work(s), undertaking(s) or activity(ies) authorized to be conducted pursuant to this authorization are expected to be sold or transferred, or other circumstances arise that are expected to result in a new Proponent taking over the work(s), undertaking(s) or activity(ies), the Proponent named in this authorization shall advise DFO in advance.

Date of Issuance: September 18, 2020

Approved by: __ Jacqueline Perry/

Regional Director General

NL Region

Fisheries and Oceans Canada



Government of Newfoundland and Labrador Department of Municipal Affairs and Environment Water Resources Management Division

PERMIT TO ALTER A BODY OF WATER

Pursuant to the Water Resources Act, SNL 2002 cW-4.01, specifically Section(s) 48

Date: **SEPTEMBER 18, 2020** File No: <u>524</u>

Permit No: **ALT11335-2020**

Permit Holder: Ocean Choice International

1315 Topsail Road St. John's, NL A1B 3N4

bsullivan@oceanchoice.com

Attention: Blaine Sullivan

Re: Town of Conception Bay South - Long Pond - Marginal Wharf & Uplands Development

Permission is hereby given for: the removal of an estimated 1,000 cu-m of organic matter in addition to the infilling of approximately 150,000 cu-m of armour stone and Class A stone in Long Pond within the Town of Conception Bay South for the purpose of constructing a new marginal wharf with laydown and parking area in reference to the application received on February 28, 2019 and additional information received on August 26, 2020.

- This Permit does not release the Permit Holder from the obligation to obtain appropriate approvals from other concerned municipal, provincial and federal agencies.
- The Permit Holder must obtain the approval of the Crown Lands Administration Division if the project is being carried out on Crown Land.
- This Permit is subject to the terms and conditions indicated in Appendices A and B (attached).
- It should be noted that prior to any significant changes in the design or installation of the proposed works, or in event of changes in ownership or management of the project, an amendment to this Permit must be obtained from the Department of Municipal Affairs and Environment under Section 49 of the *Water Resources Act*.

(for) MINISTER

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

Department of Municipal Affairs and Environment

File No: <u>**524**</u>

Permit No: <u>ALT11335-2020</u>

APPENDIX A

Terms and Conditions for Permit

Dredging/Debris Removal

- 1. Dredging activity must only be carried out during periods when wind, wave and tide conditions minimize the dispersion of silt and sediment from the work site.
- 2. A water quality monitoring program is not required at this time. However, the Department reserves the right to require that the Permit Holder sample, analyse, and submit results of water quality tests, for the purpose of ensuring that the water quality is maintained within acceptable guidelines. All analyses must be undertaken by a CALA accredited laboratory.
- 3. The area to be dredged must be enclosed and isolated from the rest of the body of water through the use of a filter fabric curtain or similar method.
- 4. Dredged material must be disposed of in accordance with the regional Service NL Centre of the Department of Service NL. The Department of Service NL may require samples to be submitted for testing and analysis.

Infilling

- 5. The constructed works must be inspected regularly so that action can be taken to undertake repairs as required.
- 6. Fill material must be obtained from an approved quarry site. It must not be taken from beaches or streams, and must not be dredged from a body of water.
- 7. Infilling must not cause increased water elevation upstream or increase flow velocity downstream of the site. Reduction of the natural cross sectional area of any watercourse is not permitted.
- 8. Infilling must not disrupt the established surface drainage pattern of the area.
- 9. Before infilling, any vegetation and topsoil must be completely removed and under no circumstances shall it be used as fill material. Topsoil must be stored and reused in final landscaping of the infilled area.
- 10. The constructed works must comply with all other terms and conditions provided in the Crown Lands grant, lease, or license for occupancy.
- 11. Select heavy rocks must be placed along the toe of any infilling to provide slope stability and erosion protection.

General Alterations

- 12. Any work that must be performed below the high water mark must be carried out during a period of low water levels.
- 13. Any flowing or standing water must be diverted around work sites so that work is carried out in the dry.

- 14. Water pumped from excavations or work areas, or any runoff or effluent directed out of work sites, must have silt and turbidity removed by settling ponds, filtration, or other suitable treatment before discharging to a body of water. Effluent discharged into receiving waters must comply with the *Environmental Control Water and Sewage Regulations*, 2003.
- 15. All operations must be carried out in a manner that prevents damage to land, vegetation, and watercourses, and which prevents pollution of bodies of water.
- 16. The use of heavy equipment in streams or bodies of water is not permitted. The operation of heavy equipment must be confined to dry stable areas.
- 17. All vehicles and equipment must be clean and in good repair, free of mud and oil, or other harmful substances that could impair water quality.
- 18. During the construction of concrete components, formwork must be properly constructed to prevent any fresh concrete from entering a body of water. Dumping of concrete or washing of tools and equipment in any body of water is prohibited.
- 19. Wood preservatives such as penta, CCA or other such chemicals must not be applied to timber near a body of water. All treated wood or timber must be thoroughly dry before being brought to any work site and installed.
- 20. Any areas adversely affected by this project must be restored to a state that resembles local natural conditions. Further remedial measures to mitigate environmental impacts on water resources can and will be specified, if considered necessary in the opinion of this Department.
- 21. The bed, banks and floodplains of watercourses, or other vulnerable areas affected by this project, must be adequately protected from erosion by seeding, sodding or placing of rip-rap.
- 22. All waste materials resulting from this project must be disposed of at a site approved by the Department of Service NL.
- 23. Periodic maintenance such as painting, resurfacing, clearing of debris, or minor repairs, must be carried out without causing any physical disruption of any watercourse. Care must be taken to prevent spillage of pollutants into the water.
- 24. The owners of structures are responsible for any environmental damage resulting from dislodgement caused by wind, wave, ice action, or structural failure.
- 25. Sediment and erosion control measures must be installed before starting work. All control measures must be inspected regularly and any necessary repairs made if damage is discovered.
- 26. Fill material must be of good quality, free of fines or other substances including metals, organics, or chemicals that may be harmful to the receiving waters.
- 27. The attached Completion Report (Appendix C) for Permit No. 11335 must be completed and returned to this Department upon completion of the approved works. Pictures must be submitted along with the completion report, showing the project site prior to and after development.
- 28. This Permit is valid for two years from the date of issue. Work must be completed by that date or the application and approval procedure must be repeated.
- 29. The location of the work is highlighted on the Location Map for this Permit attached as Appendix D.
- 30. All work must be carried out within the Permit Holder's legal property boundaries.

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

Department of Municipal Affairs and Environment

File No: <u>**524**</u>

Permit No: <u>ALT11335-2020</u>

APPENDIX B

Special Terms and Conditions for Permit

- 1. The Permit Holder and its agent(s), subcontractor(s), and consultant(s) shall keep all systems and works in good condition and repair and in accordance with all laws, by-laws, directions, rules and regulations of any governmental authority. The Permit Holder or its agent(s), subcontractor(s), or consultant(s) shall immediately notify the Minister if any problem arises which may threaten the structural stability of the systems and works, endanger public safety and/or the environment or adversely affect others and/or any body of water either in or outside the said Project areas. The Permit Holder and its agent(s), subcontractor (s), and consultant(s) shall be responsible for all damages suffered by the Minister and Government resulting from any defect in the systems and works, operational deficiencies/inadequacies, or structural failure.
- 2. The Permit Holder and its agent(s), subcontractor(s), and consultant(s) shall operate the said Project and its systems and works in a manner which does not cause any water related and/or environmental problems, including but not limited to problems of erosion, deposition, flooding, and deterioration of water quality and groundwater depletion, in or outside the said Project areas. The Permit Holder and its agent(s), subcontractor(s), and consultant(s) shall be responsible for any and all damages associated with these problems caused as a result of changes, deficiencies, and inadequacies in the operational procedures by the Permit Holder or its agent(s), subcontractor(s), or consultant(s).
- 3. If the Permit Holder or its agent(s), subcontractor(s), or consultant(s) fails to perform, fulfil, or observe any of the terms and conditions, or provisions of this Permit, as determined by this Department, the Minister may, without notice, amend, modify, suspend or cancel this Permit in accordance with the *Water Resources Act*..
- 4. The Permit Holder and its agent(s), subcontractor(s), and consultant(s) indemnify and hold the Minister and Government harmless against any and all liabilities, losses, claims, demands, damages or expenses including legal expenses of any nature whatsoever whether arising in tort, contract, statute, trust or otherwise resulting directly or indirectly from granting this Permit, systems and works in or outside the said Project areas, or any act or omission of the Permit Holder or its agent(s), subcontractor(s), or consultant(s) in or outside the said Project areas, or arising out of a breach or non-performance of any of the terms and conditions, or provisions of this Permit by the Permit Holder or its agent(s), subcontractor (s), or consultant(s).
- 5. This Permit is subject to all provisions of the *Water Resources Act* and any regulations in effect either at the date of this Permit or hereafter made pursuant thereto or any other relevant legislation enacted by the Province of Newfoundland and Labrador in the future.
- 6. This Permit shall be construed and interpreted in accordance with the laws of the Province of Newfoundland and Labrador.

File No: <u>**524**</u>

Permit No: <u>ALT11335-2020</u>

cc: Neil Hunt

AFN Engineering Inc. 29 Brad Gushue Crescent St. John's, NL, A1H 0A3 nhunt@afnengineering.ca

cc: Amir Ali Khan, Ph.D., P.Eng.

Manager, Water Rights, Investigations and Modelling Section Water Resources Management Division
Department of Municipal Affairs and Environment
P.O. Box 8700
4th Floor, West Block, Confederation Building
St. John's, NL A1B 4J6
akhan@gov.nl.ca

cc: Mr. Haseen Khan, P. Eng.
Director, Water Resources Management Division
Department of Environment and Climate Change
P.O. Box 8700
4th Floor, West Block, Confederation Building
St. John's, NL A1B 4J6
hkhan@gov.nl.ca

cc: Frank Norman (Eastern)
Land Management Specialist
Crown Lands Administration
Howley Building
St. John's
franknorman@gov.nl.ca

cc: Fisheries Protection Division
Ecosystem Management Branch
Fisheries and Oceans Canada
P.O. Box 5667
St. John's, NL A1C 5X1
FPP-NL@dfo-mpo.gc.ca

cc: Town of Conception Bay South
Ms. Gail Pomroy
11 Remembrance Square
P.O. Box 14040, Station Manuels
Conception Bay South, NL A1W 3J1
gpomroy@conceptionbaysouth.ca



Government of Newfoundland and Labrador Department of Municipal Affairs and Environment Water Resources Management Division

Appendix C - Completion Report

Date: SEPTEMBER 18, 2020 File No: <u>524</u> Permit No: <u>ALT11335-2020</u>

Pursuant to the Water Resources Act, SNL 2002 cW-4.01, specifically Section(s) 48

Permit Holder: Ocean Choice International

1315 Topsail Road St. John's, NL A1B 3N4

bsullivan@oceanchoice.com

Attention: Blaine Sullivan

Re: Town of Conception Bay South - Long Pond - Marginal Wharf & Uplands

Development

Permission was given for: the removal of an estimated 1,000 cu-m of organic matter in addition to the infilling of approximately 150,000 cu-m of armour stone and Class A stone in Long Pond within the Town of Conception Bay South for the purpose of constructing a new marginal wharf with laydown and parking area in reference to the application received on February 28, 2019 and additional information received on August 26, 2020.

, ,	t authorized to represent the Permit Holder) do hereby completed in accordance with the plans and
1	of Municipal Affairs and Environment and that the
·	with the terms and conditions of the Permit issued for
this project.	
Date:	Signature:

This completion report must be completed and forwarded to the following address upon completion of the approved work.

Department of Municipal Affairs and Environment Water Resources Management Division PO Box 8700 St. John's NL A1B 4J6

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR Department of Municipal Affairs and Environment

File No: <u>524</u> Permit No: <u>ALT11335-2020</u>

APPENDIX D **Location Map for Permit**





Government of Newfoundland and Labrador Department of Environment, Climate Change and Municipalities Water Resources Management Division

AMENDMENT TO PERMIT

Pursuant to the Water Resources Act, SNL 2002 cW-4.01, specifically Section(s) 49

Date: **NOVEMBER 16, 2020** File No: <u>524</u>

Permit No: <u>ALT11335-2020</u>

Amendment No: 1

Permit Holder: Ocean Choice International

1315 Topsail Road St. John's, NL A1B 3N4

Attention: Blaine Sullivan

Re: Town of Conception Bay South - Long Pond - Marginal Wharf & Uplands Development

The original Permit dated SEPTEMBER 18, 2020 is amended as follows:

the increase in dredging volume from 1000 cu-m to 6500 cu-m to be removed from the main terminal area in Long Pond in reference the email request dated October 29, 2020 and additional information received on November 16, 2020.

All other terms and conditions of the permit will remain unchanged.

All other terms and conditions of the original Permit will apply and failure to comply with the terms and conditions of this amendment and the original Permit will render this Permit null and void, place the Permit Holder and their agent(s) in violation of the *Water Resources Act* and make the Permit Holder responsible for taking any remedial measures as may be prescribed by this Department.

(for) MINISTER

File No: <u>524</u> Permit No: <u>ALT11335-2020</u> Amendment No: <u>1</u>

cc: Frank Norman (Eastern)
Land Management Specialist
Crown Lands Administration
Department of Fisheries, Forestry and Agriculture
Howley Building
St. John's
franknorman@gov.nl.ca

cc: Fisheries Protection Division
Ecosystem Management Branch
Fisheries and Oceans Canada
P.O. Box 5667
St. John's, NL A1C 5X1
FPP-NL@dfo-mpo.gc.ca

cc: Amir Ali Khan, Ph.D., P.Eng. Manager, Water Rights, Investigations and Modelling Section Water Resources Management Division Department of Environment, Climate Change and Municipalities 4th Floor, Confederation Building, West Block P.O. Box 8700, St. John's NL Canada A1B4J6 akhan@gov.nl.ca

cc: Town of Conception Bay South
Ms. Gail Pomroy
11 Remembrance Square
P.O. Box 14040, Station Manuels
Conception Bay South, NL A1W 3J1
gpomroy@conceptionbaysouth.ca

cc: Mr. Haseen Khan, P. Eng. Director, Water Resources Management Division Department of Environment and Climate Change P.O. Box 8700 4th Floor, West Block, Confederation Building St. John's, NL A1B 4J6 hkhan@gov.nl.ca

Long Pond Harbour Authority Inc.

96 Terminal Road, Conception Bay South, NL A1X 7B6

Phone: (709) 834-0027 www.portoflongpond.ca



22 September 2020

To Whom It May Concern:

Please accept this letter as our support of the project in which Ocean Choice International is proposing at the Port of Long Pond.

As part of the divestiture from the Federal Government in 2013, LPHA Inc. has been tasked with developing new business that would see revenue to support and maintain the Port of Long Pond and its infrastructure beyond the 2023 operating period.

LPHA Inc. entered into an agreement with Ocean Choice International in 2018 under terms that would ensure the continuity of established port operations, support to the recreational boating community ensuring an unimpeded flow of access, and revenue in the out years that was unanimously supported by LPHA Inc.

Ocean Choice International continues to grow as one of Newfoundland and Labrador leading exporters of fish products and has become the fabric of many communities throughout our province. With a strong pedigree of community social support and being a good business partner, LPHA Inc. is proud to cultivate a strong collective relationship going forward.

Respectfully,

LONG POND HARBOUR AUTHORITY Inc.

Margo Soucy, Vice Chair

Appendix R

LONGPOND, NL

TRANSECT SURVEY



AUGUST 31, 2018
SEA-FORCE DIVING LTD
24 Dundee Avenue, Mount Pearl, NL A1N 4R7

DATE OF INSPECTION:

August $28^{th} - 30^{th}$, 2018

LOCATION:

Proposed Backfill Site Long Pond, Newfoundland

REPORT WRITTEN BY:

Dave Pritchard, Dive Supervisor Sea-Force Diving Ltd.

DIVING CREW:

Dave Pritchard - Supervisor Jared Smith- Diver Chris O'Driscoll - Diver Tim Knight - Diver

WEATHER CONDITIONS:

Temperature: +20 °C

Wind: SW 25 - 30 km

Visibility: Sunny Tide: Weak

UNDERWATER CONDITIONS:

Temperature: +15 °C Visibility: 3 - 4 m Current: Weak

INTRODUCTION:

A diving crew was mobilized to Long Pond, Newfoundland. Sea-Force Diving performed 13 transect swims at 15m apart for proposed backfill site to determine the extent of marine life and seafloor conditions in area of transect lines. Marker buoys were laid by in approximate locations to outline area to be surveyed (Fig 1). Lines marked with 15m increments were then laid between Buoys A to B "West" and C to D "East" (Fig 2). Transect lines marked in 5 meter increments were then laid perpendicular from the west line to the east line falling on corresponding 15m marks (Fig 3).

SURVEY:

The transect lines were provided by AFN Engineering Inc. on a drawing for reference. Please refer to attached drawings for reference and see video for typical site conditions. Each transect line is presented separately for clarity:

*Note all distance measurements are in meters, diver's depth is in feet.

Location	Findings
Transect Line #1	-Diver noted the seafloor consists of soft silt and sand
Water depth 3-5ft.	largely covered with a soft marine grass and occasional kelp beds. Marine life noted included sea snails, and jelly fish.
Transect Line #2	-Diver noted the seafloor consists of soft silt and sand
Water depth 3-5ft.	largely covered with a soft marine grass and occasional
	kelp beds. Marine life noted included sea snails, and starfish.
Transect Line #3	-Diver noted the seafloor consists of soft silt and sand
Water depth 5-7ft	largely covered with a soft marine grass and occasional kelp beds. Marine life noted included sea snails, and common species of small fish.
Transect Line #4	-Diver noted the seafloor consists of soft silt and sand
Water depth 5-7ft.	largely covered with a soft marine grass and occasional kelp beds. Marine life noted included sea snails, small schools of fish and flatfish.
Transect Line #5	-Diver noted the seafloor consists of soft silt and sand
Water depth 5-8ft.	largely covered with a soft marine grass and occasional
	kelp beds. Marine life noted included sea snails, and flat fish.

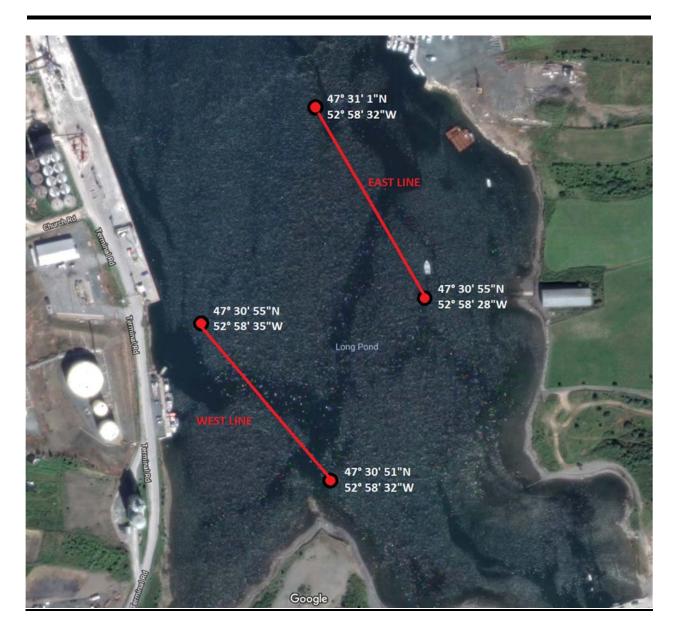
Transect Line #6 Water depth range 5-8ft.	-Diver noted the seafloor consists of soft silt and sand largely covered with a soft marine grass and occasional kelp beds. Marine life noted included sea snails, and flatfish.
Transect Line #7 Water depth 5-8ft.	-Diver noted the seafloor consists of soft silt and sand largely covered with a soft marine grass and occasional kelp beds. Marine life noted included sea snails, small crabs, a scallop and schools of small fish.
Transect Line #8 Water depth 5-8ft.	-Divers noted the seafloor consists of cobble and sand as well as soft loose silt largely covered with a soft marine grass and occasional kelp bed. Marine life noted included small common fish, small crabs, and scallops.
Transect Line #9 Water depth 5-8ft.	- Divers noted the seafloor consists of cobble and sand largely covered with soft marine grass and some kelp beds. Marine life noted included small crabs, schools of small fish.
Transect Line #10 Water depth 5-10ft.	-Diver noted the seafloor consists of soft silt and sand largely covered with a soft marine grass. Occasional large areas void of vegetation. Marine life noted included sea snails, small crabs, skate (fish), and flatfish.
Transect Line #11 Water depth 5-15ft	-Diver noted the seafloor consists of soft silt and sand with areas covered with a soft marine grass and kelp beds. Marine life noted included sea snails, lobster and small fish.
Transect Line #12 Water depth 5-15ft.	-Diver noted the seafloor consists of soft silt and cobble covered with a soft marine grass and kelp beds at shallow depths. Marine life noted included sea snails, starfish and lobster.
Transect Line #13 Water depth 5-30ft.	-Diver noted the seafloor consists of soft silt and cobble largely covered with a soft marine grass and kelp beds at shallow depths. Marine life noted included sea snails, small crabs, lobsters and scallops.

Fig 1. Marker Buoy Locations



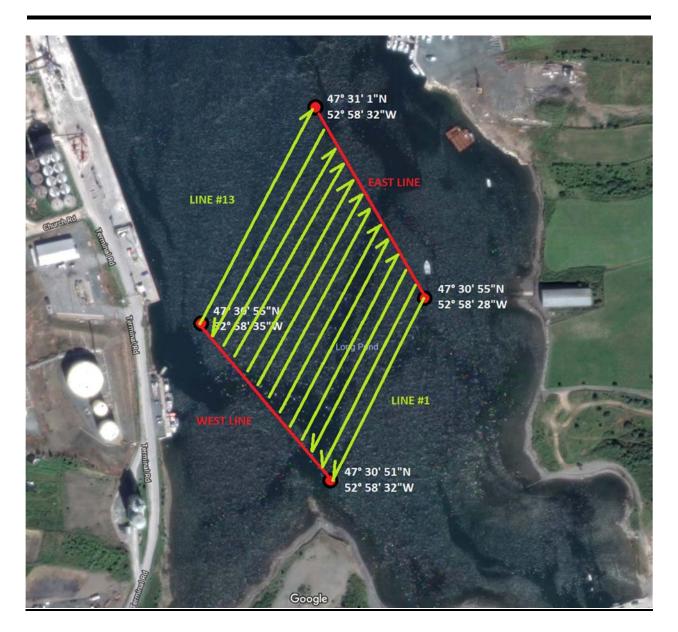
^{*}Please note locations on drawings are approximate.

Fig 2. East and West Line Locations



^{*}Please note locations on drawings are approximate.

Fig 3. Transect Line Locations and Swim Direction



^{*}Please note locations on drawings are approximate.

CONCLUSION:

If you have any questions or concerns regarding this report and survey, please contact Dave Pritchard by phone (709) 743-3539. In addition, email address supervisor@seaforcediving.com.



























Appendix S



TECHNICAL MEMORANDUM

TO: Ocean Choice International FFC-NL-3132-002

AFN Engineering

FROM: Fracflow Consultants Inc.

DATE: February 11, 2019

SUBJECT: Rock Properties and Block Sizes at the Waste Rock Slopes Trinity Resources

Mine Site, Long Pond, CBS, NL.

1.0 Background and Scope of Activities

Ocean Choice International (OCI) retained Fracflow Consultants Inc. through AFN Engineering to undertake an assessment of the rock properties of selected rock samples that were collected from the base of the waste rock slopes at the Trinity Resources mine site at 250 Minerals Road, Conception Bay South, NL. The Trinity Resources mine site and the rock block sampling locations are shown in **Figures 1a and 1b**.

The scope of work for the project included photographing the waste rock slopes at selected locations around the Trinity Resources mine site. A 2 m grid with 10 cm markings was used as a scale to provide scaled photographs at fourteen (14) sites. These photographs were then analyzed to determine rock type, colour, and aspect ratio of the rock blocks at each of those five (5) sites.

Sixteen (16) blocks (samples) of rock, approximately one cubic foot in size, were collected from four (4) of the fourteen (14) sites that were photographed. The rock samples were cored at Fracflow's office using a standard drill rig to obtain a number of NQ size cores from each block of rock. These cores were then cut to size using a diamond saw and Point Load Tests (PLTs) and Brazilian Tests (BTs) were then completed on the core samples to determine the compressive strength (from PLTs) and the indirect tensile strength (from BTs) of the three general rock types that were represented by the collected rock blocks. The field work was conducted between January 23 and 28, 2019.

This report contains all findings of the geologic site investigation. The following sections provide: (1) a description of the site and general geology of the area; (2) a summary of the procedures used to identify rock sizes and types; (3) a description of the laboratory procedures used to test core samples; (4) a detailed description of the results of the strength classification of rock types; and (5) a summary of the conclusions and recommendations.

2.0 Site Description and General Geology

The Trinity Resources site is located at 250 Minerals Road, Long Pond, Conception Bay South, NL. The regional bedrock geology in the area of Conception Bay South consists of volcanic, sedimentary and extrusive rocks that are unconformably overlain by a shallow dipping sedimentary cover sequence. The overall assemblage is part of the Manuel's Volcanic Suite which is part of the Avalon zone of the Newfoundland Appalachians (O'Brien et al., 2001). The bedrock geology of the site consists of medium- to fine-grained rhyolite which is pink/purple or grey in colour and phyllite/schistose rocks that are white, pale green, greyish or yellow in colour.

3.0 Site Investigative Procedures

At the Trinity Resources mine site, fourteen (14) locations were chosen to obtain an overall representation of the size of the rocks present at the bottom of the waste rock pile at this old mine site. A square grid measuring 2 m by 2 m was used. Measuring tapes were attached to all sides of the grid and every 10 cm interval was clearly marked. The grid was then photographed at each of the selected locations. These photographs were then used to measure the length and width of all the main rock blocks inside the grid and an aspect ratio (length versus width) of the rock blocks was determined.

Sixteen (16) rock samples were taken from the site for strength tests. The samples were logged and labeled after collection. The rock samples were divided into three obvious different rock types; grey fine grained rhyolite, pink medium grained rhyolite, and white/greenish foliated pyrophyllite.

4.0 Method for Rock Strength Classifications

First, core samples were taken from each rock sample by way of rotary diamond drilling using NQ rods and diamond impregnated bits, O.D, 75.7 mm, I.D. 47.6 mm. Acceptable cores were then labeled and cut, using a diamond rock saw, to provide a smooth exposed face and the desired lengths.

Point load testing was completed to determine the compressive strength of each of the three (3) rock types. The point load test was completed by subjecting a rock sample to an increasingly concentrated load until failure occurred by splitting the sample. The failure load was then used to calculate the compressive strength (ASTM, 2008a). The point load test consists of a loading frame, platens to hold the core sample, a hydraulic piston assembly, and a load measuring system. Fourteen (14) to sixteen (16) samples from each rock type were tested diametrally and fifteen (15) pyrophyllite samples were tested axially. The diameter of each sample was recorded and the samples were cut to a length of 1.5 times the core diameter for diametral testing and one third the core diameter for axial testing. Each sample was then loaded into the testing frame, the load measuring system was zeroed, and the load was then steadily increased until the sample failed. The peak load and failure mode were then recorded, and the sample was removed from

the frame. The Uncorrected Point Load Index (I_s), was calculated from the Point Load test data using the relationship (ASTM, 2008a),

$$I_s = P / D_e^2$$

Where:

P = load at failure:

 D_e = equivalent core diameter, D for diametral tests.

The Size Corrected Point Load Index $(I_{s(50)})$ was calculated by multiplying by a "Size Correction Factor F", obtained from the expression (ASTM, 2008a):

$$F = (D_e / 50)^{0.45}$$

The Uniaxial Compressive Strength (UCS) was then obtained from the expression:

$$UCS = K \cdot I_{s(50)}$$

Where,

K = Generalized Index to Strength Conversion Factor.

For a mean core diameter of 47.5 mm, the Generalized Index to Strength Conversion Factor (K) was 22.5 (ASTM, 2008a).

To determine the indirect tensile strength of the three (3) selected rock types, an indirect method known as the Brazilian Test was utilized. Specimen specifications for this test are; the diameter of the core must be consistent, the length must be approximately equal to the radius, and both exposed faces have to be cut smooth. Once the sample was prepared the Brazilian Test was completed as follows: the specimen was placed in two steel loading jaws and fitted with a half ball bearing to act as a load stabilizer. These loading jaws were then placed in a loading frame and force was applied diametrically to the sample until failure. Applying the load diametrically, to the axis of rotation, creates biaxial stress in the rock sample. When placed in both tension and compression, most rocks will fail in tension (Brown, 1981). This principle, along with the examination of the failure planes, allows for the determination of uniaxial tensile strength using the Brazilian Test. The indirect tensile strength can then be calculated using the following equation (ASTM, 2008b):

$$\sigma_t = 2 \cdot P / \pi \cdot t \cdot D$$

Where,

P = load at failure (N)

D = diameter of the sample (mm)

t =thickness of the sample (mm)

 σ_t = uniaxial tensile strength (MPa)

5.0 Block Sizes and Strength Data

Five (5) of the fourteen (14) locations photographed at site were chosen to show an overall representation of the size of the rocks present at the site. Sites 1, 3, 8, 12, and 13 were chosen. For each site, a length and width measurement was taken for each rock within the grid and the rock type and colour were also identified. From the length and width data, the aspect ratio of width/length was calculated. **Figure 2 to Figure 11** show the grid set up at each site as well as histograms for the length and aspect ratio results for each grid.

Histograms of the diametral uniaxial compressive strength results are shown in **Figure 12**. The histograms are present for all data and by group. The results show that the grey rhyolite had the highest uniaxial compressive strength with an average 156.1 megapascal (MPa). This was followed by the pink rhyolite with an average of 135.2 MPa, and the white pyrophyllite with an average of 77.1 MPa. A histogram of the results of axial compressive strength testing is shown in **Figure 13**.

Histograms of the indirect tensile strength results are shown in **Figure 14**. The histograms are presented for all data and by group. The results of the Brazilian Test indicated that the grey rhyolite had the highest indirect tensile strength with an average value of 18.7 MPa. This was followed by the pink rhyolite with an average of 14.8 MPa, and the white pyrophyllite with an average of 9.8 MPa.

The summary tables (**Tables 1 to 5**) show that there is a major difference between indirect tensile strength as well as the uniaxial compressive strength properties for the three different rock types.

6.0 Summary

Based on the data collected as part of this study, there is no indication that this rock is soluble. The rock mineralogy, an aluminum phyllosilicate, confirms that the rock is not soluble. However, on crushing, some of the fines will wash away or be subject to erosion.

The most abundant rock is the pyrophyllite based on a brief inspection of the waste rock pile slopes. Much of this rock has been exposed to the elements for the past 50 years with no obvious change in roughness to indicate any significant weathering.

The second most abundant rock is the pink rhyolite or altered rhyolite with the grey rhyolite being the least abundant. However, one would expect that much of the grey rhyolite would have been excavated first as the pit was being developed and would have been buried by subsequent waste rock disposal.

The distinct colour of the three main rock types will permit an experienced excavator operator to separate the rock on site prior to transport. Based on its strength properties, the grey rhyolite will be suitable for rip-rap. The pink/purple rhyolite, actually an altered rhyolite, would be suitable along with the grey rhyolite for crib fill. The more abundant pyrophyllite can be used as regular

rock fill within an area that is protected by rip-rap and crib structures. However, this rock, with its lower compressive strength and lower indirect tensile strength, will compact on loading. Where deformation or settlement has to be controlled, the rock should be placed in lifts and compacted on placement.

7.0 References

- ASTM, 2008a. Standard Test Method for the Determination of the Point Load Strength Index of Rock and Application to Rock Strength classifications, Designation D5731-08, ASTM International.
- ASTM, 2008b. Standard Test Method for Splitting Tensile Strength of Intact Rock Core Specimens, Designation D3967-08, ASTM International.
- Brown, E.T., 1981. Suggested Methods for Determining Tensile Strength of Rock Materials, Rock Characterization Testing & Monitoring.
- O'Brien, S.J., Dunning, G., Dube, B., O'Driscoll, C.f., Sparkes, B., Israel, S., and Ketchum, J.,2001. New Insights into the Neoproterozoic geology of the central Avalon Peninsula, Department of Mines and Energy.





Table 1 Rock identification and measurements for Site 1 (Page 1 of 2).

Site 1							
A/-	Length	Width	Assest Patie	Ro	Rock		
No.	(cm)	(cm)	Aspect Ratio	Туре	Colour	_ Partial	
1	29	21	1.38	Pyrophyllite	White	Y	
2	20	19	1.05	Pyrophyllite	Grey/White	Y	
3	43	38	1.13	Rhyolite	Grey	N	
4	41	37	1.11	Pyrophyllite	White	N	
5	17	9	1.89	Pyrophyllite	Grey/White	Y	
6	11	10	1.10	Pyrophyllite	Grey/White	Y	
7	24	9	2.67	Pyrophyllite	White	Y	
8	50	23	2.17	Pyrophyllite	Grey	N	
9	12	11	1.09	Pyrophyllite	Green/White	Υ	
10	21	17	1.24	Rhyolite	Grey	N	
11	23	8	2.88	Pyrophyllite	Greenish White	N	
12	26	8	3.25	Pyrophyllite	White	Υ	
13	14	13	1.08	Pyrophyllite	White	Υ	
14	19	13	1.46	Pyrophyllite	White	N	
15	20	18	1.11	Pyrophyllite	White	Y	
16	12	10	1.20	Rhyolite	Grey	Υ	
17	13	12	1.08	Pyrophyllite	Greenish White	N	
18	25	18	1.39	Rhyolite	Grey	Υ	
19	36	24	1.50	Pyrophyllite	Grey/White	N	
20	18	12	1.50	Pyrophyllite	Grey/White	Υ	
21	49	27	1.81	Rhyolite	Grey	N	
22	27	19	1.42	Pyrophyllite	White	Υ	
23	16	13	1.23	Pyrophyllite	White	N	
24	25	18	1.39	Rhyolite	Grey	Y	
25	19	10	1.90	Pyrophyllite	Greenish White	Y	
26	16	13	1.23	Rhyolite	Grey	N	
27	49	30	1.63	Pyrophyllite	Greenish White	N	
28	13	9	1.44	Rhyolite	Grey	Y	
29	21	13	1.62	Pyrophyllite	Grey/White	N	
30	28	18	1.56	Pyrophyllite	Grey/White	N	
31	32	28	1.14	Pyrophyllite	Grey/White	Y	
32	23	18	1.28	Pyrophyllite	White	Y	
33	43	27	1.59	Rhyolite	Dark Grey	Y	
34	45	24	1.88	Pyrophyllite	White	N	
35	21	14	1.50	Pyrophyllite	White	N	
36	30	15	2.00	Pyrophyllite	White	N	
37	40	21	1.90	Pyrophyllite	Greenish White	N	
38	20	12	1.67	Pyrophyllite	White	N	
39	31	21	1.48	Pyrophyllite	Brown/White	Y	
40	18	9	2.00	Pyrophyllite	White	Y	
41	22	12	1.83	Pyrophyllite	Greenish White	N	
42	28	19	1.47	Pyrophyllite	White	Y	
43	23	14	1.64	Pyrophyllite	Brown White	Y	
44	34	27	1.26	Pyrophyllite	White	N	
45	18	10	1.80	Rhyolite	Dark Grey	N	
46	22	13	1.69	Pyrophyllite	White	N	

Table 1 Rock identification and measurements for Site 1 (Page 2 of 2).

	Site 1							
No.	Length	Length Width	Aspect Ratio	Ro	Partial			
	(cm)	(cm)	Tioped Tiame	Туре	Colour	1		
48	17	11	1.55	Pyrophyllite	White	N		
49	44	19	2.32	Pyrophyllite	Greenish White	N		
50	16	12	1.33	Pyrophyllite	White	Υ		
51	17	11	1.55	Pyrophyllite	White	Υ		
52	31	27	1.15	Rhyolite	Dark Grey	Υ		
53	37	23	1.61	Pyrophyllite	White	Y		
54	13	12	1.08	Rhyolite	Grey/White	N		
55	29	12	2.42	Pyrophyllite	Greenish White	N		
56	40	26	1.54	Pyrophyllite	Greenish White	Υ		
57	25	9	2.78	Pyrophyllite	Grey White	Υ		
58	18	8	2.25	Rhyolite	Pink	Υ		
59	15	7	2.14	Rhyolite	Grey	Υ		
60	22	10	2.20	Rhyolite	Grey	Υ		
61	17	10	1.70	Pyrophyllite	White	Υ		
62	21	15	1.40	Pyrophyllite	Greenish White	Υ		
63	19	8	2.38	Pyrophyllite	White	Υ		
64	18	9	2.00	Pyrophyllite	White	Υ		
65	15	10	1.50	Pyrophyllite	White	Υ		

Table 2 Rock identification and measurements for Site 3.

	Site 3							
No.	Length	Width	Aspect Ratio	R	Rock			
NO.	(cm)	(cm)		Туре	Colour	- Partial		
1	50	43	1.16	Pyrophyllite	Greenish White	Y		
2	100	86	1.16	Pyrophyllite	White	Y		
3	49	20	2.45	Rhyolite	Grey	Y		
4	38	25	1.52	Rhyolite	Pink/Purple	Y		
5	83	50	1.66	Basalt	Black	Y		
6	19	5	3.80	Rhyolite	Pink	Y		
7	25	18	1.39	Pyrophyllite	Greenish White	Y		
8	8	7	1.14	Pyrophyllite	White	N		
9	30	15	2.00	Rhyolite	Grey	N		
10	10	7	1.43	Pyrophyllite	White	N		
11	25	5	5.00	Pyrophyllite	Greenish White	N		
12	10	10	1.00	Pyrophyllite	White	N		
13	80	60	1.33	Pyrophyllite	Brown/White	Y		
14	75	45	1.67	Basalt	Black	Y		
15	51	51	1.00	Pyrophyllite	Brown/White	N		
16	53	42	1.26	Pyrophyllite	White	Y		
17	58	20	2.90	Pyrophyllite	White	Y		
18	70	52	1.35	Rhyolite	Grey	Υ		
19	28	15	1.87	Rhyolite	Bluish Grey	Υ		
20	45	30	1.50	Pyrophyllite	White	Υ		
21	42	40	1.05	Pyrophyllite	White	N		
22	47	20	2.35	Rhyolite	Grey	Υ		

Table 3 Rock identification and measurements for Site 8 (Page 1 of 2).

Site 8							
No.	Length	Width	Aspect	R	Davidat		
NO.	(cm)	· I	Ratio	Туре	Colour	Partial	
1	15	5	3.00	Pyrophillite	White	Υ	
2	15	10	1.50	Rhyolite	Pink	N	
3	35	27	1.30	Pyrophillite	White	Y	
4	30	22	1.36	Rhyolite	Pink	N	
5	20	15	1.33	Pyrophillite	White	Y	
6	27	12	2.25	Rhyolite	Grey	N	
7	28	20	1.40	Rhyolite	Grey	N	
8	25	16	1.56	Rhyolite	Pink	Y	
9	19	16	1.19	Rhyolite	Grey	N	
10	28	20	1.40	Pyrophillite	Yellowish	N	
11	31	28	1.11	Pyrophillite	Greenish White	N	
12	31	10	3.10	Pyrophillite	Yellowish	N	
13	13	8	1.63	Pyrophillite	White	N	
14	23	10	2.30	Pyrophillite	White	N	
15	24	12	2.00	Rhyolite	Pink	N	
16	20	18	1.11	Pyrophillite	White	N	
17	57	39	1.46	Pyrophillite	Yellowish	N	
18	31	21	1.48	Rhyolite	Grey	Υ	
19	13	10	1.30	Pyrophillite	Yellowish	Υ	
20	17	11	1.55	Rhyolite	Pink	Y	
21	23	20	1.15	Rhyolite	Pink	N	
22	12	12	1.00	Pyrophillite	Greenish White	Υ	
23	12	11	1.09	Pyrophillite	Greenish White	Υ	
24	36	25	1.44	Rhyolite	Grey	N	
25	21	15	1.40	Pyrophillite	White	N	
26	10	10	1.00	Pyrophillite	Greenish White	N	
27	21	18	1.17	Rhyolite	Pink	N	
28	37	25	1.48	Rhyolite	Grey	N	
29	20	10	2.00	Pyrophillite	Yellowish	N	
30	35	25	1.40	Pyrophillite	Greenish White	N	
31	30	29	1.03	Pyrophillite	Greenish White	N	
32	33	30	1.10	Pyrophillite	White	N	
33	14	8	1.75	Rhyolite	Grey	Y	
34	28	18	1.56	Rhyolite	Pink	Υ	
35	30	20	1.50	Rhyolite	Pink	N	
36	26	18	1.44	Rhyolite	Grey	N	
37	20	12	1.67	Pyrophillite	White	N	
38	15	10	1.50	Pyrophillite	Yellowish	Y	
39	10	7	1.43	Pyrophillite	White	N	
40	19	10	1.90	Pyrophillite	Greenish White	N	
41	12	10	1.20	Rhyolite	Grey	Y	
42	23	15	1.53	Pyrophillite	Yellowish	Y	
43	15	10	1.50	Pyrophillite	White	Y	
44	28	20	1.40	Rhyolite	Grey	Y	
45	17	15	1.13	Pyrophillite	White	Y	
46	29	23	1.26	Pyrophillite	Yellowish	N	

Table 3 Rock identification and measurements for Site 8 (Page 2 of 2).

Site 8							
N/-	Length	Width	Aspect	Aspect Rock			
No.	(cm)	(cm)	Ratio	Туре	Colour	Partia	
47	20	20	1.00	Rhyolite	Grey	N	
48	22	10	2.20	Pyrophillite	Yellowish	N	
49	24	20	1.20	Pyrophillite	Yellowish	N	
50	15	15	1.00	Pyrophillite	Yellowish	Y	
51	38	18	2.11	Rhyolite	Grey	N	
52	29	20	1.45	Pyrophillite	Yellowish	Y	
53	55	22	2.50	Pyrophillite	White	N	
54	24	7	3.43	Pyrophillite	White	Y	
55	20	10	2.00	Rhyolite	Grey	Y	
56	20	18	1.11	Pyrophillite	Yellowish	Y	
57	50	42	1.19	Pyrophillite	Yellowish	Y	
58	27	22	1.23	Rhyolite	Grey	N	
59	50	25	2.00	Rhyolite	Pink	Y	
60	34	32	1.06	Rhyolite	Grey	N	
61	9	9	1.00	Rhyolite	Grey	Y	
62	13	12	1.08	Pyrophillite	White	Y	
63	10	10	1.00	Pyrophillite	Yellowish	Y	
64	14	7	2.00	Pyrophillite	Greenish White	Y	
65	35	27	1.30	Rhyolite	Grey	N	
66	23	11	2.09	Pyrophillite	White	N	
67	18	8	2.25	Rhyolite	Grey	Y	
68	25	15	1.67	Rhyolite	Grey	N	
69	22	15	1.47	Pyrophillite	White	N	
70	41	20	2.05	Rhyolite	Pink	N	
71	53	25	2.12	Pyrophillite	White	N	
72	25	9	2.78	Pyrophillite	White	N	
73	23	12	1.92	Pyrophillite	White	N	
74	10	10	1.00	Pyrophillite	White	N	
75	12	6	2.00	Rhyolite	Grey	N	
76	30	7	4.29	Rhyolite	Grey	Y	
77	22	20	1.10	Rhyolite	Pink	N	
78	15	14	1.07	Rhyolite	Grey	Y	
79	18	10	1.80	Rhyolite	Grey	Y	
80	30	27	1.11	Pyrophillite	White	N	
81	29	13	2.23	Pyrophillite	White	N	
82	15	12	1.25	Pyrophillite	Yellowish	N	
83	30	21	1.43	Pyrophillite	Greenish White	N	
84	32	18	1.78	Rhyolite	Pink	N	
85	30	19	1.58	Rhyolite	Grey	N	
86	21	18	1.17	Rhyolite	Grey	Y	
87	34	17	2.00	Rhyolite	Pink	Y	
88	25	13	1.92	Pyrophillite	White	N	
89	45	40	1.13	Rhyolite	Grey	Y	
90	18	17	1.06	Rhyolite	Pink	N	

Table 4 Rock identification and measurements for Site 12.

Site 12									
No.	Length (cm)	Width (cm)	Aspect Ratio	Rock		Partial			
				Туре	Colour	, ardar			
1	25	25	1.00	Pyrophyllite	White	Υ			
2	42	28	1.50	Pyrophyllite	White	N			
3	51	30	1.70	Pyrophyllite	Green/White	N			
4	49	25	1.96	Rhyolite	Grey	N			
5	67	39	1.72	Rhyolite	Grey	N			
6	20	15	1.33	Pyrophyllite	White	N			
7	57	37	1.54	Rhyolite	Grey	N			
8	32	17	1.88	Pyrophyllite	White	N			
9	30	27	1.11	Rhyolite	Pink	Υ			
10	37	15	2.47	Rhyolite	Grey	N			
11	52	18	2.89	Rhyolite	Grey	N			
12	41	15	2.73	Rhyolite	Grey	Υ			
13	36	23	1.57	Pyrophyllite	Green/White	Υ			
14	20	13	1.54	Pyrophyllite	White	N			
15	72	32	2.25	Rhyolite	Grey	Υ			
16	94	53	1.77	Rhyolite	Pink	N			
17	55	38	1.45	Pyrophyllite	White	N			
18	18	10	1.80	Rhyolite	Grey	Υ			
19	40	20	2.00	Pyrophyllite	White	N			
20	10	10	1.00	Pyrophyllite	White	N			
21	40	37	1.08	Rhyolite	Pink	Υ			
22	25	12	2.08	Rhyolite	Grey	Υ			
23	48	45	1.07	Rhyolite	Grey	N			
24	26	20	1.30	Pyrophyllite	White	N			
25	75	41	1.83	Pyrophyllite	Green/White	N			
26	32	23	1.39	Pyrophyllite	White	Υ			
27	30	26	1.15	Rhyolite	Grey	Υ			

Table 5 Rock identification and measurements for Site 13.

Site 13									
No.	Length	Width (cm)	Aspect Ratio	Rock		Partial			
	(cm)			Туре	Colour	- rartial			
1	109	50	2.18	Pyrophyllite	White	Y			
2	30	22	1.36	Pyrophyllite	White	N			
3	55	20	2.75	Pyrophyllite	White	N			
4	33	15	2.20	Rhyolite	Pink	N			
5	28	18	1.56	Rhyolite	Grey	N			
6	15	15	1.00	Pyrophyllite	White	N			
7	17	13	1.31	Pyrophyllite	Green/White	N			
8	26	10	2.60	Rhyolite	Grey	N			
9	20	12	1.67	Rhyolite	Grey	N			
10	40	27	1.48	Rhyolite	Grey	N			
11	50	47	1.06	Rhyolite	Pink	Y			
12	39	35	1.11	Rhyolite	Grey	Y			
13	20	10	2.00	Pyrophyllite	White	N			
14	65	48	1.35	Pyrophyllite	White	N			
15	100	60	1.67	Rhyolite	Grey	N			
16	50	15	3.33	Rhyolite	Grey	Y			
17	15	11	1.36	Pyrophyllite	White	N			
18	17	10	1.70	Pyrophyllite	White	N			
19	90	60	1.50	Pyrophyllite	Green/White	N			
20	50	31	1.61	Rhyolite	Grey	Υ			
21	90	45	2.00	Rhyolite	Grey	Υ			
22	20	13	1.54	N/A	N/A	Υ			
23	9	7	1.29	N/A	N/A	N			
24	15	10	1.50	N/A	N/A	N			
25	15	15	1.00	Pyrophyllite	White	N			
26	25	18	1.39	Rhyolite	Pink	N			
27	12	8	1.50	N/A	N/A	N			
28	58	30	1.93	Pyrophyllite	Green/White	Y			
29	60	34	1.76	N/A	N/A	N			
30	15	12	1.25	Pyrophyllite	Green/White	N			





