PORT of vancouver | Vancouver Fraser Port Authority

June 10, 2022

Mr. Terence Hubbard
President
Impact Assessment Agency of Canada
160 Elgin Street, 22nd Floor, Place Bell
Ottawa, Ontario K1A 0H3

Dear Mr. Hubbard:

Re: Part two: Vancouver Fraser Port Authority response to draft conditions and public comment period submissions for the Roberts Bank Terminal 2 Project

The Vancouver Fraser Port Authority is pleased to provide part two of our two-part submission in response to the draft conditions and public comment period submissions posted on the Impact Assessment Agency of Canada's (IAAC) public registry for the Roberts Bank Terminal 2 Project between December 15, 2021 and March 15, 2022. Serving as a complement to our part one submission (dated April 22, 2022) and our supplementary submission in response to comments from Indigenous groups posted to the public registry after April 1, 2022 (dated May 13, 2022), this submission focuses on biofilm and western sandpipers.

To develop this response, we carefully considered and responded to the feedback provided by Indigenous groups, government agencies, non-government organizations, and members of the public during the public comment period, within the context of the federal review panel findings. In this response, we have recommended revised and additional draft conditions related to biofilm and western sandpipers. This includes a precautionary construction approach that involves a follow-up program element with adaptive management measures, as well as the creation and monitoring of biofilm habitat, to be developed in consultation with Indigenous groups. The Vancouver Fraser Port Authority's suggested revisions to the draft conditions are technically and economically feasible, and within our care and control as project proponent.

With the implementation of the measures described in our response—including mitigation considered by the review panel, additional measures proposed after the review panel report, and the additional conditions developed in consultation with Indigenous groups—we are confident that any effects from the project on biofilm and western sandpipers will be effectively mitigated.

With container trade growing faster than forecasted, globally-based supply-chain challenges that Canadians are experiencing today are a preview of made-in-Canada supply-chain problems ahead if, as a country, we don't deliver the capacity needed. Designed under our public interest mandate, Roberts Bank Terminal 2 will provide timely container capacity on Canada's West Coast, ensure greater supply chain competition, and protect Canada's trade sovereignty.

We are confident that with this submission and the full record of information available on the project—coupled with our deep experience building top-tier sustainable infrastructure—Canadians can be assured

that the project will be built in a way that aligns with our vision for the Port of Vancouver to be the world's most sustainable port.

Regards,

<Original signed by>

Cliff Stewart, P.Eng., ICD.D
Vice President, Infrastructure
Vancouver Fraser Port Authority

cc Right Honourable Justin Trudeau, Prime Minister
Hon. Chrystia Freeland, Deputy Prime Minister and Minister of Finance
Hon. Omar Alghabra, Minister of Transport Canada
Hon. Mary Ng, Minister of International Trade, Export Promotion, Small Business and Economic Development of Canada
Hon. Carla Qualtrough, Minister of Employment, Workforce Development and Disability Inclusion of Canada
Hon. Steven Guilbeault, Minister of Environment and Climate Change
Right Honourable Joyce Murray, Minister of Fisheries, Oceans, and the Canadian Coast Guard
Michael Keenan, Deputy Minister, Transport Canada
David Morrison, Deputy Minister, International Trade
Christine Hogan, Deputy Minister, Environment and Climate Change Canada
Timothy Sargent, Deputy Minister, Fisheries and Oceans Canada
Paul Halucha, Associate Deputy Minister, Environment and Climate Change Canada
Serge Bijimine, Assistant Deputy Minister, Policy, Transport Canada
Stephanie Hebert, Assistant Deputy Minister, Programs, Transport Canada
John Moffet, Assistant Deputy Minister, Environment and Climate Change Canada
Alexandra Dostal, Assistant Deputy Minister, Aquatic Ecosystems Sector
Heather McLean, Assistant Deputy Minister, Crown Indigenous Relations and Northern Affairs
Julie Mailloux, Manager, Decision Statements, Impact Assessment Agency of Canada
Analise Saely, Crown Consultation Coordinator, Impact Assessment Agency of Canada
Kim Noble, Crown Consultation Coordinator, Impact Assessment Agency of Canada
Rebecca Reid, Regional Director General, Fisheries and Oceans Canada
Brendan Mather, Project Assessment Director, Environmental Assessment Office, Government of British Columbia
Robin Silvester, President and CEO, Vancouver Fraser Port Authority
Duncan Wilson, Vice President, Environment and External Affairs, Vancouver Fraser Port Authority

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Executive Summary – Part two: Vancouver Fraser Port Authority response to draft conditions and public comment period submissions for the Roberts Bank Terminal 2 Project
Submission – Part two: Vancouver Fraser Port Authority response to draft conditions and public comment period submissions for the Roberts Bank Terminal 2 Project

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Roberts Bank Terminal 2 Project

Executive Summary - Part two: Vancouver Fraser Port Authority response to draft conditions and public comment period submissions for the Roberts Bank Terminal 2 Project

June 10, 2022

Canada

Executive summary

Background

As described in part one of the Vancouver Fraser Port Authority's (port authority) response to the draft conditions and public comment period submissions for the Roberts Bank Terminal 2 (RBT2) Project, the project is a critical investment in marine-side port infrastructure on the West Coast of Canada. RBT2 comprises a new three-berth marine container terminal, a widened causeway to accommodate additional road and rail infrastructure, and an expanded tug basin to accommodate expanded tug operations. The project is in Delta, British Columbia and proximate to Tsawwassen First Nation.

The port authority is advancing the project as part of its mandate under the *Canada Marine Act* to enable Canada's trade through the Port of Vancouver. The port authority's response to the minister of environment and climate change Canada's information request demonstrates that the project is needed to support Canada's trade ambitions and will provide much-needed capacity and direct market access for imports and exports, supporting supply chain security. The project will create tens of thousands of well-paying, family-supporting jobs during construction and operation, and will measurably support increased Canadian GDP to a degree that few projects can. The project has embedded Indigenous knowledge into its development, and will support Indigenous economic reconciliation, while enhancing the Canadian supply chain and national economic resiliency.

Purpose of the submission

In part two of its two-part submission to the Impact Assessment Agency of Canada, the port authority is providing feedback on the current federal draft conditions and responding to comments received during the public comment period on the port authority's response to the minister's information request related to biofilm and effects to migratory birds.

This submission explains the port authority's efforts to reduce the uncertainty around potential project effects to western sandpipers identified by the review panel. Additional measures, including a precautionary construction approach that addresses concern around salinity changes at Roberts Bank and the potential risk to western sandpipers, are described to support informed decision-making on the project.

Throughout the environmental assessment process, the port authority has prioritized rigorous, evidence-based environmental mitigation and habitat enhancement in consultation with Indigenous groups to ensure that Canada's trade through the Port of Vancouver occurs within a context of strong environmental protection. These efforts have included extensive study and collaboration around biofilm science and ecology, and the western sandpiper. Through the implementation of more than 20 biofilm and shorebird studies based on feedback from an expert technical advisory group and federal agencies, continued collaboration with Indigenous groups and ongoing work in the field, the port authority continues to demonstrate an ongoing commitment to this important topic.

Addressing uncertainty identified by the review panel

During the public comment period, submissions from interested parties, including Environment and Climate Change Canada, discussed the uncertainty identified by the review panel in relation to the

western sandpiper (for which biofilm is one food source). The port authority describes in this submission advancements that have been made towards addressing the key areas of uncertainty described in the federal review panel report. This includes new information on the population status of the western sandpiper, collaboration and progress toward the development of biofilm habitat, and further knowledge regarding the salinity trigger hypothesis. These efforts and the ongoing integration of Indigenous knowledge have reduced the uncertainty identified by the review panel and informed additional proposed mitigation and follow-up measures.

Enhanced measures

Based on extensive Indigenous consultation, engagement with government agencies including Environment and Climate Change Canada, and the public, the port authority has worked to avoid and reduce potential effects of the project through selection of the project location and orientation, as well as design changes and optimizations throughout the environmental assessment process.

The original terminal, widened causeway, and dredge footprint design have now been reduced by 17.9 hectares to avoid and reduce effects to Roberts Bank. Since the review panel issued their report in 2020, and as a result of additional technical analysis undertaken as part of the response to the minister's information request, the port authority has also committed to include either a breach at the terminal or along the causeway. In consultation with Indigenous groups, the port authority continues optimization of the offsetting plan, including a commitment to collaborative development of a biofilm creation project. The port authority has also developed a biofilm habitat creation guidance manual in consultation with Indigenous groups and local and international biofilm experts.

Building on work underway since early 2021, the port authority has increased its commitment to biofilm creation through continued collaboration with Indigenous groups—working closely with Tsawwassen First Nation to explore the possibility of integrating biofilm creation into the Tsawwassen Marshlands offsetting project. The port authority also continues to collaborate with Indigenous groups to identify a candidate site for an additional biofilm creation project.

Follow-up and adaptive management

The current draft potential federal conditions would require the port authority to develop and implement scientifically rigorous follow-up program elements, in consultation with Indigenous groups and agencies. The RBT2 follow-up program considered by the review panel includes elements to monitor predicted potential effects to salinity and western sandpiper prey (biofilm and invertebrates).

The port authority remains confident that the project will not have any significant adverse residual effects on western sandpipers. However, the port authority takes seriously the concerns raised regarding western sandpipers and the potential for an immediate population-level risk as described by Environment and Climate Change Canada, and we have taken this into consideration in the additional measures proposed. By applying the precautionary principle, the port authority proposes to develop and implement a precautionary construction approach, involving a follow-up program element with adaptive measures that would be developed in consultation with Indigenous groups and Environment and Climate Change Canada. In the unlikely event of an immediate project-related effect on the western sandpiper population, the port authority would implement adaptive measures, which could include removal of the portion of the marine terminal landmass constructed to date, which would effectively result in project discontinuation and deconstruction.

Additional draft conditions

Considering the information presented in this submission that addresses the remaining uncertainty identified by the review panel around the western sandpiper, and the additional mitigation and follow-up measures and initiatives proposed, the port authority is proposing revisions to the existing draft conditions and proposes new conditions to reflect these enhanced measures.

The proposed suite of conditions provide assurance to the minister that effects of the predicted changes in salinity on biofilm and consequently western sandpipers, including an immediate population-level risk to western sandpipers, would be identified, and addressed.

Conclusion

The port authority recognizes the importance of western sandpipers and has taken a precautionary approach to the environmental assessment. Building on mitigative design features implemented through the environmental assessment process, the port authority has further expanded commitments to mitigate potential effects of the project to biofilm and, as a result, to western sandpipers, which include the creation of biofilm habitat in collaboration with Indigenous groups with the integration of Indigenous knowledge, and a commitment to implement a precautionary construction approach.

Consequently, taking into account the full record of information available to the minister, including the review panel's report, the port authority's response to the minister's information request, and this submission, we believe that there is sufficient information for the minister to conclude with reasonable confidence that salinity changes due to the project are unlikely to cause a significant adverse environmental effect on western sandpipers, and that any residual uncertainty can be addressed through conditions requiring follow-up and adaptive management up to and including removal of the marine terminal landmass constructed to date, if required.

The Roberts Bank Terminal 2 Project is in Canada's national interest, can be built in an environmentally responsible manner and will provide economic benefits to Indigenous groups, local communities and businesses, and provincial and national supply chain partners. It is in the public interest for the project to proceed.

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Roberts Bank Terminal 2 Project

Part two: Vancouver Fraser Port Authority response to draft conditions and public comment period submissions for the Roberts Bank Terminal 2 Project

June 10, 2022

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1. Introduction

This submission by the Vancouver Fraser Port Authority (port authority) is part two of our two-part submission, and has been developed to address comments received on the port authority's response to the minister's information request regarding biofilm and effects to migratory birds, IR2020-4 and Appendix IR2020-4-A (CIAR #2083), and the draft conditions related to salinity, biofilm, and western sandpipers in a manner that supports decision-making on the Roberts Bank Terminal 2 Project. This submission also incorporates feedback received by the port authority during its development, including feedback from Environment and Climate Change Canada (ECCC), Tsawwassen First Nation, and Musqueam Indian Band, as appropriate.

1.1 Background information relevant to the submission

After receiving the review panel's recommendation report in March 2020, the minister of environment and climate change determined that additional information was required from the port authority before a decision is made under the *Canadian Environmental Assessment Act (CEAA), 2012* for the Roberts Bank Terminal 2 Project. The minister's request regarding biofilm and effects to migratory birds was focused on examining how new or modified project design features and mitigation measures for fish and fish habitat (considered in other parts of the request) might alter the outcomes of the geomorphological assessment of project changes in salinity and other coastal processes, including erosion and deposition, wave height, and tidal flow. The port authority provided responses to the minister's information request in IR2020-4 and Appendix IR2020-4-A, which was posted on the registry by the Impact Assessment Agency of Canada (IAAC) on September 24, 2021. IAAC opened a public comment period, from December 15, 2021 to March 15, 2022, to receive feedback on the additional information submitted by the port authority and on the potential environmental assessment conditions, which included draft conditions related to salinity, biofilm, and western sandpipers.

The port authority reviewed and considered submissions from Indigenous groups, other federal authorities, non-government organizations, and the public in developing this submission.

1.2 Overview of the submission

Following this introductory section, the submission is organized as follows:

- **Section 2. Addressing uncertainty identified by the review panel**

  This section describes the three key areas of uncertainty identified by the review panel in their report in relation to western sandpipers, and the advances towards reducing the uncertainty since the report. This includes the state of the western sandpiper population, the development of biofilm habitat, and further knowledge on the salinity trigger hypothesis (**Appendix A**). This section also describes how Indigenous knowledge and collaboration has supported the work to address uncertainty (**Appendix B**).

- **Section 3. Mitigation**

  This section describes the mitigation measures that were considered by the review panel and enhanced measures proposed by the port authority since the federal review panel report was issued (**Appendix C**), including biofilm habitat creation informed by Indigenous knowledge and collaboration.

- **Section 4. Follow-up**

  This section describes the follow-up program elements considered by the review panel and the element added since the federal review panel report, the precautionary construction approach and determining the effectiveness of proposed biofilm habitat creation.

- **Section 5. Port authority's response to IAAC's draft conditions**

  This section describes the basis for the port authority's feedback on the draft conditions proposed by IAAC. **Appendix D** presents the port authority's proposed revisions to the draft conditions and additional new conditions based on the additional mitigation and follow-up measures proposed. Where other parties have made specific suggestions for revisions to the draft potential conditions, pertaining to the salinity, biofilm, and western sandpiper effect pathway, the port authority's response to those suggestions is provided in **Appendix E**, where warranted.

- **Section 6. Conclusion**

  This section describes the conclusions related to the project effects on western sandpipers, taking into account all information available since the federal review panel report, including the mitigation and follow-up measures described in this submission.

2. Addressing uncertainty identified by the review panel

During the public comment period (December 15, 2021 to March 15, 2022), submissions were made to IAAC by several parties, including other federal agencies, provincial agencies, Indigenous groups, members of the public, and non-government organizations regarding salinity, biofilm, and western sandpiper. The port authority acknowledges and appreciates the continued participation of all parties in the environmental assessment and values the constructive input received.

In its submission on February 4, 2022 (CIAR #2212), ECCC provided a review of the port authority's responses (IR2020-4 and Appendix IR2020-4-A). ECCC states that the port authority's response to IR2020-4 was sufficiently detailed for ECCC to form a technical opinion on the information presented. ECCC indicates in their submission that the information presented does not alter their previously stated conclusion presented to the review panel that uncertainty regarding the project effects at Roberts Bank on the quality and quantity of biofilm and its associated fatty acid content remains unacceptably high.

For the federal review panel report (CIAR #2062), the review panel took into account evidence from expert witnesses called by the port authority, experts from the Government of Canada including ECCC scientists, and from other expert participants (CIAR #1637, CIAR #1947). With the benefit of that evidence, the review panel concluded that the project would result in minor changes in salinity, would have no effect on infaunal invertebrates (other prey source for western sandpipers), and would not have an adverse effect on biofilm productivity and diatom composition (CIAR #2062).

In its report, the review panel also considered:

- The state of western sandpipers: "…the context of an apparent steep population decline mandates a highly precautionary approach in relation to the Project" (CIAR #2062, p.243).

- Biofilm creation projects: "…uncertainty around the possibility that loss of productive biofilm habitat could be mitigated by the large-scale re-creation of biofilm habitat capable of supporting shorebirds, including appropriate bottom sediment characteristics and salinity conditions…" (CIAR #2062, p.243).

- The proposed salinity trigger hypothesis: "…operation of a salinity trigger at Roberts Bank as a new concept requiring further investigation" (CIAR #2062, p.151).

Based on these considerations, the review panel expressed uncertainty related to the potential project effect on western sandpipers, stating that it "…has been unable to conclude with reasonable confidence that the Project would or would not have an adverse effect on the Western Sandpiper." (CIAR #2062, p.243).

In this section, the port authority provides up-to-date information to assist in addressing the remaining uncertainty identified by the review panel. In particular, the sub-sections that follow include information about the following:

- The state of the western sandpiper population
- Advancements related to the creation/enhancement of biofilm habitat
- Evidence of the salinity trigger at Roberts Bank

The port authority also shares the ongoing integration of Indigenous knowledge and collaboration regarding biofilm initiatives. The port authority takes seriously the concerns for migrating western sandpiper populations stopping over at Roberts Bank. Accordingly, the port authority has proposed to enhance its follow-up program by incorporating a precautionary construction approach (see **Section 4.2**).

2.1 Western sandpiper population status

The review panel relied upon information provided during the public hearing about the state of the population of western sandpipers (Undertaking #31, CIAR #1887). A scientific study, published since the public hearing, estimates the current population trend of western sandpipers to be increasing (Weiser et al. 2020).[1] The authors of the study acknowledge the uncertainty associated with their analysis and recommend additional investigation. This publication lessens the uncertainty about the western sandpiper population described by the review panel.

2.2 Biofilm habitat creation

As shared in Appendix IR2020-4-A (CIAR #2083), biofilm creation is a proven effective mitigation and is being implemented in other jurisdictions (e.g., Japan). Biofilm is a common component of estuaries and has been and can be successfully created, enhanced, or restored, including at a large scale. Since the federal review panel report, the port authority has worked with local and international technical experts and sought input from Indigenous groups to identify and document existing knowledge and known

[1] Weiser, E.L., Lanctot, R.B., S.C. Brown, H. River Gates, J. Bêty, M. L. Boldenow, R.W. Brook, G.S. Brown, W.B English, S.A. Flemming, S.E. Franks, H.G. Gilchrist, M-A. Giroux, A. Johnson, S. Kendall, L.V. Kennedy, L. Koloski, E. Kwon, J-F. Lamarre, D.B. Lank, C.J. Latty, N. Lecomte, J.R. Liebezeit, R.L. McGuire, L. MacKinnon, E. Nol, D. Payer, J. Perz, J. Rausch, M. Robards, S.T. Saalfed, N.R. Senner, P.A. Smith, M. Soloviev, D. Solovlyeya, D.H. Ward, P.F. Woodward, and B.K. Sanderdock. 2020. Annual adult survival drives trends in Arctic-breeding shorebirds but knowledge gaps in other vital rates remain. The Condor: Ornithological Applications 122: 1-14.

practices for developing biofilm habitat. The port authority has compiled this technical information and international examples into a biofilm habitat creation guidance manual, as per draft condition 10.2. The methods and techniques outlined in the manual are scalable from small projects to very large sites and can guide restoration and/or creation of biofilm habitat. Indigenous feedback shared during the development of the manual include considering historical presence of biofilm alongside other factors such as the use of potential sites (past, present, and future) by Indigenous groups for cultural, spiritual, and rights-related activities.

One case study described in the manual, where intertidal biofilm habitat was successfully created, is the 320 hectare Komuke Lagoon in Japan, which is now heavily used by shorebirds.[2] In their submission to the public comment period, ECCC shares their knowledge of this site, as co-authors of a recent scientific paper describing the ecological and technical attributes of biofilm restoration to promote shorebird use (CIAR #2212, Kuwae et al. 2021).[3] In the case of this site, ECCC notes that the exchange of freshwater/seawater within the Komuke Lagoon, by installing a permanent channel connecting the freshwater dominated site with marine waters, was a key attribute to creating functional biofilm habitat and responsible for its success in increasing shorebird usage (CIAR #2212, Kuwae et al. 2021).

This information related to the proven effectiveness of biofilm habitat creation and restoration, including at larger scale, reduces the uncertainty previously identified by the review panel.

2.3 Physical conditions required under salinity trigger hypothesis

ECCC's February 4, 2022 submission raises comments about the project's potential effect on western sandpipers based on the salinity trigger hypothesis (CIAR #2212). As noted by the review panel, the salinity trigger hypothesis proposes "that a "salinity trigger" serves to induce fatty acid production in biofilm" (CIAR #2062, p.148). It is suggested that this trigger involves "large amplitude salinity oscillations within a tidal cycle (between approximately 20-25 PSU[4]) that "shock" marine-type diatoms into a lipid accumulation response" (CIAR #1947, p.4) and that these fatty acids are possibly critical to fuel western sandpiper migration (CIAR #2062). It is suggested, based on this hypothesis, that "through a compression in the range of variability of salinity experienced at Roberts Bank, the project may lead to an adverse effect on the production of PUFAs[5] by biofilm" (CIAR #2062). ECCC states that the project would result in an up to 10 PSU compression in the salinity range, which would indirectly affect the quality and quantity of biofilm. Further, they anticipate "major adverse indirect effects to the quality of up to 558 hectares of intertidal biofilm on Roberts Bank," which would "constitute an unmitigable and irreversible species-level risk to Western Sandpipers" (CIAR #2212, p.2). ECCC also emphasized that this effect would be "immediate" (CIAR #2062, p.242, CIAR #2212, p.6). The review panel identified the salinity trigger hypothesis as an area of uncertainty that requires further investigation.

[2] Shorebirds in Japan are similar to western sandpipers, as stated by ECCC in their submission (CIAR #2212).
[3] Kuwae, T., Elner, R. W., Amano, T. and M. C. Drever. 2021. Seven ecological and technical attributes for biofilm-based recovery of shorebird populations in intertidal flat ecosystems. Ecological Solutions and Evidence, 2(4), e12114. Available at https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/2688-8319.12114
[4] practical salinity units
[5] polyunsaturated fatty acids

To assist in addressing this uncertainty, the port authority analyzed measured salinity data for Roberts Bank for 2016, 2017, and 2018,[6] collected from salinity monitoring stations located in biofilm areas important to western sandpipers (CIAR #2062) (**Appendix A**), to examine existing daily salinity ranges that occur during the western sandpiper northward migration stopover period (i.e., the stopover period, April 15 to May 10, CIAR #1947) at Roberts Bank. The analysis investigated whether conditions for a salinity trigger (i.e., frequent and consistent large salinity changes over a range of 20-25 PSU) can be observed based on existing conditions at Roberts Bank during the stopover period. In addition, the port authority conducted an analysis, using available salinity model results, to investigate the predicted amount and spatial extent of the compression of the salinity range with the project during the western sandpiper stopover period (i.e., large salinity compressions over 558 hectares of biofilm) (**Appendix A**). In addition to analyses specific to the stopover period, this work also explored whether additional mitigation or follow-up measures could be applied to further reduce the uncertainty (see **Sections 3** and **4**).

The salinity of water inundating the intertidal zone at Roberts Bank is influenced by fresh water flowing from the Fraser River through Canoe Pass that mixes with marine waters from the Strait of Georgia, which rise and fall twice daily with the tide. Hence, salinity at Roberts Bank is variable over time and from location to location. At Roberts Bank, the theoretical maximum salinity range is 30 PSU—i.e.., the difference between fully saline and fresh water. However, the theoretical maximum was not observed in the field salinity data during the representative years. The existing salinity data shows that salinity oscillations (daily salinity range) at Roberts Bank are not uniform from location to location, nor are they consistent within a season or from year to year (**Appendix A**). There is no indication that large (20-25 PSU), rapid (over the course of a day) changes in salinity occur consistently or even regularly in biofilm areas important to western sandpipers during the stopover period. In fact, observed daily salinity oscillations over 20 PSU were very rare during the western sandpiper stopover period, and there were no daily oscillations over 25 PSU (**Appendix A**). In summary, based on existing salinity data collected over multiple years, there is no evidence of a consistent observable pattern of large, rapid salinity change (i.e., evidence of a salinity trigger) in the areas important to western sandpipers during the stopover period.

With the proposed project, the terminal would interact with tidal currents and would, in turn, induce a minor change in salinity, as the review panel concluded (CIAR #2062). The project influence on the salinity regime at Roberts Bank will not be consistent over the intertidal area nor constant during the western sandpiper stopover period. The day-to-day change in salinity range that would result from the marine terminal land mass would itself be variable, both in terms of the area that is affected as well as the magnitude of change in salinity range. It is predicted that every day during the western sandpiper stopover period, some productive biofilm areas would likely experience a decrease in salinity range while some areas would experience an increase (**Appendix A**), which is the same pattern of change presented at the public hearing (CIAR #1778). Most of the anticipated change in salinity range with the project is small (an increase or decrease of up to 2 PSU) (**Appendix A**). Reductions of 10 PSU or more are predicted to occur on some days during the stopover period and over limited portions of the biofilm areas important to western sandpipers (on average only 10%, 63 hectares). As noted by the review panel, the predicted salinity changes with the project will remain within natural variability experienced under existing conditions (CIAR #2062). There is no evidence that the project will result in consistent or regular compression to the existing salinity range of up to 10 PSU over areas approaching 558 hectares on any day during the western sandpiper stopover period (**Appendix A**).

[6] The long-term salinity database has been shared with various agencies, including ECCC, under a data sharing agreement that covers the period 2012 to 2019.

The information demonstrates that under the salinity trigger hypothesis, the predicted project-related changes to salinity will not result in a frequent, large reduction in the range of salinity throughout the biofilm areas at Roberts Bank where western sandpipers feed. This reduces the uncertainty identified by the review panel and ECCC.

Evaluation of available salinity data at Roberts Bank for salinity oscillations in biofilm areas important to western sandpipers during the stopover period indicate the changes to salinity due to the project are unlikely to introduce a population level risk to western sandpipers, as results indicate that the predicted project-related reduction to salinity would not occur frequently and throughout the areas at Roberts Bank where western sandpipers feed (**Appendix A**).

Notwithstanding this demonstrated reduction in uncertainty related to salinity, the port authority takes seriously the concerns of others related to western sandpipers and thus proposes to continue to apply a precautionary approach by extending its follow-up program to include a precautionary construction approach with adaptive measures (see **Section 4.2**).

2.4 Indigenous knowledge and collaboration

The port authority has been consulting with Indigenous groups on biofilm as part of project consultation, including to inform studies, support the biofilm creation manual and contribute to the biofilm habitat creation project development. An overview of consultation specific to biofilm and western sandpipers is provided in **Appendix B**. More recently, Tsawwassen First Nation members have contributed to biofilm sampling and data collection to inform the various biofilm initiatives, in addition to 10 Indigenous groups participating in candidate site visits in the spring of 2022 to share Indigenous knowledge and provide input on site evaluation.

Musqueam Indian Band has noted that creating biofilm as it relates to other initiatives such as offsetting mudflats aligns well with the Indigenous knowledge approach of how all things are connected. Musqueam also noted that looking at names of the areas for biofilm study is important, as place names are key to informing what the area previously looked like. “Musqueam and the port authority are committed to continue ongoing work with the port authority related to biofilm and western sandpiper at Roberts Bank. Musqueam is actively collaborating with the port authority to identify, evaluate, and select a biofilm habitat creation project site. This collaboration as well as work being done on the offsetting plans, aligns with Musqueam’s stewardship vision.” (CIAR #3339).

Having participated in review of biofilm as it relates to the port authority’s research and material development, Ts’uubaa-asatx Nation noted “We wish to express our deep appreciation to the attention to detail and commitment to not only the understanding of biofilm, but also to the restoration projects in the area.” (CIAR #3543).

The expansion of knowledge regarding biofilm and Indigenous collaboration and participation associated with biofilm initiatives continues to address the areas of uncertainty identified by the review panel.

3. Mitigation

In response to feedback from agencies and input from Indigenous groups, the port authority has made many changes and improvements to the project design to reduce project footprint and impact on local areas. Below, we describe the project mitigation considered by the review panel, as well as mitigation that has been proposed since the federal review panel report was issued in March 2020. A summary of this information was provided to support engagement and is included in **Appendix C**.

3.1 Mitigation considered by the review panel

Based on extensive Indigenous consultation, government engagement, and public engagement, the port authority has worked to avoid and reduce potential effects of the project through selection of the project location and orientation, as well as design changes and optimizations.

The following avoidance and reduction measures were identified and incorporated across various phases of project planning and were considered by the review panel in their assessment of the project.

Early project planning: 2011 to 2013

- After a rigorous assessment of alternatives for the project—and based on the advice of federal agencies (including Fisheries and Oceans Canada and ECCC[7])—the port authority selected the location of the proposed marine terminal to be in deeper waters, immediately west of the existing Roberts Bank terminals and several kilometres away from sensitive intertidal habitats, and far from Indigenous and residential communities. The proposed terminal location and orientation was chosen to reduce direct loss of valued intertidal habitat that supports biofilm and shorebirds, as well as reduce the potential for tidal channel formation, the amount of dredging required, and potential noise effects on local communities.

During development of the environmental impact statement: 2013 to 2015

- **Terminal optimization:** the port authority modified the terminal design, rounding the terminal's northwest corner to decrease the extent of potential seabed scour around the west side of the terminal and incorporated sloped rocky shorelines and fish refuge habitat to increase habitat complexity

- **Causeway optimization:** the port authority reduced the causeway widening to reduce effects to marine vegetation, including biofilm, in the intertidal area

- **Tug basin optimization:** the port authority optimized the orientation and layout of the tug basin expansion to reduce marine habitat disturbance, and have plans to install a rip-rap crest protection to protect existing mudflats from tidal channel formation

Review panel phase: 2016 to 2019

- In response to feedback received from Indigenous groups and ECCC, the port authority decreased the effects of constructing the terminal by another 3.5 hectares (as documented in the project

[7] CIAR #1864 Exhibit 40 – November 2017 Summary Review of Regulatory Considerations regarding East Causeway Development.

construction update (CIAR #1210)) by reducing the size of the dredge basin and amount of dredging required, while also eliminating the need for in situ vibro-replacement activities

- The port authority reduced construction impacts (such as noise and habitat disturbance) in the intertidal zone by avoiding the use of the 33 hectare intermediate transfer pit

Biofilm habitat creation guidance manual

During the public hearing, the port authority committed to developing a biofilm habitat creation guidance manual in consultation with Indigenous groups and technical experts to support the expansion of knowledge of biofilm ecology. In developing the biofilm habitat creation guidance manual, the port authority has worked with Indigenous groups, local and international technical experts in the fields of biofilm, shorebirds, coastal engineering, and coastal geomorphology to identify and document existing knowledge and known practices for developing and enhancing biofilm habitat. The port authority also consulted with ECCC as part of its development. The manual, which is now in the final stages of development, will document existing knowledge and practices for developing biofilm habitat. As per draft condition 10.2 (with revisions suggested by the port authority in **Appendix D**), the document will be updated to reflect emerging Indigenous knowledge and science. The methods and practices documented in the manual will be applied by the port authority in biofilm habitat creation, as proposed below.

3.2 Mitigation since the review panel report

Since the review panel issued their report in 2020 and additional technical analysis was undertaken as part of the response to the minister's information request, the port authority has added the following mitigation measures:

- Reduced the total project footprint by another 14.4 hectares (to a total of 17.9 hectares), of which 4.1 hectares is along the proposed causeway avoiding intertidal habitats

- A commitment to implement a breach either at the terminal or along the causeway, pending outcomes of the feasibility study proposed in draft condition 7.1

- Continued to optimize the project's offsetting plan through consultation with Indigenous groups and agencies to further refine designs (e.g., seeking input on habitat complexing and priority species planting)

- Through ongoing consultation with Indigenous groups, the port authority committed to building a biofilm creation project to support migrating western sandpipers. Work to identify selection criteria and candidate sites was completed in 2021, and site evaluation has continued in 2022 as discussed below.

3.2.1 Biofilm habitat creation project

As described in **Section 2.2**, the port authority has been working to address the area of uncertainty identified by the review panel related to biofilm creation as mitigation for potential project effects. Since early 2021, the port authority has been actively assessing opportunities in the lower mainland of British Columbia for biofilm creation, in consultation with Indigenous groups.

The port authority is working closely with Tsawwassen First Nation to explore the opportunity to integrate biofilm creation into the Tsawwassen Marshlands offsetting project, in the inter-causeway area of Roberts Bank.

In addition, the port authority is working closely with Indigenous groups to identify a candidate site for an additional biofilm creation project through ongoing consultation, design and field studies (**Appendix B**). Indigenous groups are participating in the additional biofilm habitat creation project by providing input on the site selection criteria; participating in initial evaluations of potential biofilm creation sites and their relevance to shorebirds; engaging in employment opportunities to sample biofilm; and providing Indigenous knowledge during site visits (10 indigenous groups are participating in site visits in June 2022) and in ongoing multi-group Indigenous group workshops, led by the port authority and attended by agencies such as ECCC.

The biofilm habitat creation project will provide an opportunity to apply methods and best practices included in the biofilm habitat creation guidance manual during creation of biofilm habitat.

With the implementation of the measures described above, including mitigation considered by the review panel, additional mitigation proposed after the federal review panel report, and the final project conditions, including revisions and additions proposed by the port authority (**Appendix D**), should the project be approved, the port authority is confident that unpredicted effects from the project on biofilm and western sandpipers will be effectively mitigated.

3.3 Improved confidence and certainty

As described in **Section 2** of this submission, the review panel identified three areas of uncertainty in explaining why it was unable to conclude whether the project would result in any effect on western sandpipers: the state of the western sandpiper population, the feasibility of creating biofilm habitat, and knowledge related to the new salinity trigger hypothesis. As discussed above, additional information that serves to reduce uncertainty and increase confidence is available as follows:

- A recent scientific publication (Weiser et al. 2020) indicates that the population of western sandpiper is likely increasing
- Documentation of existing biofilm creation and enhancement sites relevant to western sandpipers in the biofilm habitat creation guidance manual
- Indigenous knowledge regarding biofilm and collaboration on biofilm initiatives
- Based on the port authority's analysis of multi-year salinity data collected at Roberts Bank, the physical conditions required under the salinity trigger hypothesis—consistent, rapid, large changes in salinity occurring over the biofilm area at Roberts Bank—are not apparent. Re-analysis of modelling results also indicates that the physical changes that would result from the project are unlikely to occur to the spatial extent that concerns ECCC.

The information in **Appendix A** confirms that there is no evidence that the project would lead to a population-level impact to western sandpipers. Accordingly, the minister can conclude with reasonable confidence that salinity changes due to the project are unlikely to result in a significant adverse effect on western sandpiper.

As is appropriate in the impact assessment process, the port authority has identified additional adaptive management measures that can be implemented to address any residual uncertainty. These are discussed below.

4. Follow-up

4.1 Follow-up program elements known by the review panel

The application of follow-up in environmental assessments is deemed important (Noble 2020)[8] and consistent with both the requirements of the *Canadian Environmental Assessment Act, 2012* and guidance issued by IAAC.

As proposed by the port authority and required by the current draft conditions, the port authority would develop and implement scientifically rigorous follow-up program elements, in consultation with Indigenous groups and agencies (including ECCC), to verify the environmental assessment predictions pertaining to western sandpipers. The follow-up program elements focus on potential changes in salinity and effects on biofilm as a result of the project. The draft conditions requiring follow-up program elements related to salinity, biofilm, and western sandpipers are summarized as follows:

- Verify predictions of project-related effects on salinity in the water column (draft condition 10.13)
- Verify effect assessment predictions on western sandpiper prey distribution and abundance (including biofilm) (draft condition 10.14)
    - Evaluate the potential effects of a compression in the range of variability of salinity experienced at Roberts Bank on polyunsaturated fatty acid production in biofilm (draft condition 10.14.4)
    - The port authority to submit the follow-up program element, including sampling and analysis methodology, for independent technical review before implementing the program (draft condition 10.14.5). The port authority also proposes for the draft condition to provide its responses on the technical review to Indigenous groups. As noted in **Appendix D**, the port authority also proposes revisions to this draft condition that would require the port authority to provide responses on the technical review to Indigenous groups.

Since the public hearing, the port authority has continued its work on biofilm, implementing a study in spring 2021 to investigate the potential to map biofilm using drone technology that could be used as a component of a follow-up monitoring program. In the spring of 2022, in addition to its long-term salinity monitoring program, the port authority sampled biofilm, sediment, and water quality at Roberts Bank and Westham Island with involvement and input from Indigenous groups and participants. The port authority also continues to record salinity levels at multiple locations across Roberts Bank. This salinity level monitoring program, initiated in 2014, is the longest known salinity monitoring program at Roberts Bank. Data from the salinity monitoring program has been shared with ECCC and other interested parties.

[8] Noble, B.F. 2020. Follow-up and monitoring of impact assessment: synthesis of knowledge and practice. Technical research report prepared for the Impact Assessment agency of Canada. Ottawa. ON. 76p. Available online at https://www.canada.ca/content/dam/iaac-acei/documents/research/Follow-up-and-Monitoring-in-Impact-Assessment-Synthesis-of-Knowledge-and-Practice-Noble-2020.pdf

4.2 Enhanced follow-up program elements since the federal review panel report

The port authority remains confident that the project will not have any significant adverse residual effects on western sandpipers. However, the port authority takes seriously the concern that project-associated salinity changes at Roberts Bank could result in an immediate population-level risk to western sandpipers. The port authority notes that, based on the hypothesis put forward by ECCC, if an effect of such magnitude and immediacy were to occur, it would be evident in the first northward migration and subsequent breeding season following initial placement of the terminal landmass. Therefore, the port authority proposes to apply the precautionary principle by developing and implementing a precautionary construction approach, involving a new follow-up program element with adaptive measures to specifically focus on verifying whether this potential adverse effect to western sandpipers is occurring. If an unforeseen immediate project-related effect on the western sandpiper population were to occur, the port authority would implement adaptive management measures, which could include removal of the portion of the terminal landmass constructed to date. This measure is also described in **Appendix C**.

The precautionary construction follow-up program element would use the existing construction sequencing of the container terminal footprint to test for indications of the hypothesized immediate population-level effect on western sandpiper. In summary:

- The proposed Roberts Bank Terminal 2 construction method (described in the Project Construction Update, Attachment B2 (CIAR #1210)) involves sequentially developing two terminal containment dykes (east and then west basins), then filling each with material to create the terminal landmass (**Figure 1**, **Figure 2**).

- The east terminal containment dyke would be completed first (**Figure 1**), by approximately March, prior to western sandpipers arriving at Roberts Bank for the first time during project construction, with dredged fill starting to be added approximately a month later.

- The port authority has determined, through analysis carried out during the preparation of this submission (described above), that the east basin containment dyke, once in place, will result in salinity changes similar in areas important to western sandpiper to those predicted for the complete project. The proposed staged approach to construction of the east basin containment dyke therefore provides an opportunity to monitor for early signals of any immediate population-level effect of the predicted change in salinity on western sandpiper in the months following completion of the east basin containment dyke, during the material time of year for western sandpipers (i.e., the first northward migration and subsequent breeding season during construction), prior to construction of the full terminal footprint (east and west basins, **Figure 2**).

- If, at that time, there are early signals of an immediate project-related population-level effect on western sandpipers, the port authority will implement adaptive management, which may include removal of the east terminal dyke constructed to that point in time, which would effectively result in project discontinuation and deconstruction.

  The port authority proposes that the follow-up program be developed with input from Indigenous groups and relevant authorities, including ECCC, and other technical experts, and that clear follow-up criteria (i.e., metrics and thresholds) be established. This is consistent with views expressed by ECCC, Tsawwassen First Nation, and Musqueam Indian Band during the development of this submission. Because this new follow-up program element would be focused specifically on verifying whether an immediate population-level effect on western sandpiper is occurring, it would be relatively narrow in scope and duration, focused on the first western sandpiper northward migration and subsequent breeding season immediately following initial construction of the east basin containment

dyke. Other follow-up program elements related to salinity, biofilm, and western sandpiper would address other aspects of this effect pathway. Further, the program would be designed to facilitate identification of a significant population-level effect, if one were to immediately occur, and determine whether any such effect is attributed to the project.

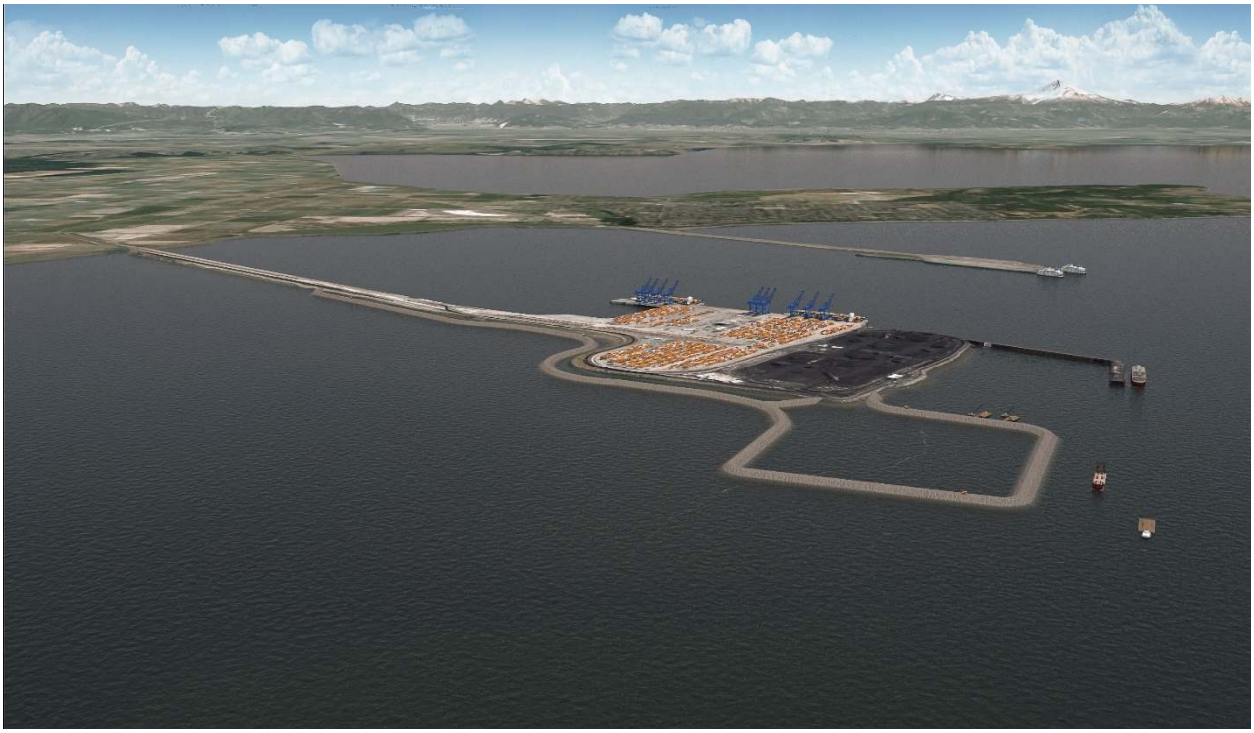

Figure 1. East containment dyke constructed: monitoring implemented at this juncture.*

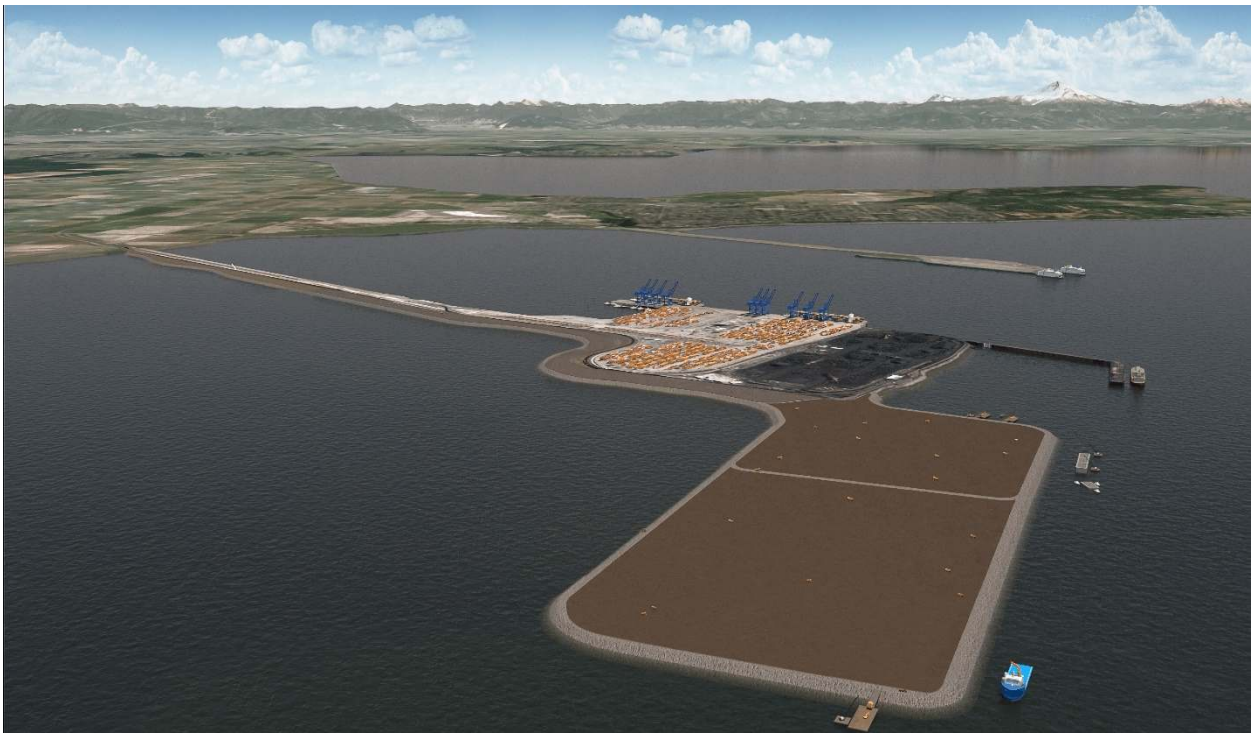

Figure 2. Full container terminal footprint (east and west basin).*

***Note:** *These graphics do not depict a causeway breach or terminal breach. The port authority has committed to implement a breach either at the terminal or along the causeway, pending outcomes of the feasibility study proposed in draft condition 7.1.*

In addition to the proposed precautionary construction follow-up program element, the port authority also proposes an additional follow-up program element to determine the effectiveness of the biofilm habitat creation project described in **Section 3.2** above.

These two new follow-up program elements, together with the follow-up program elements previously proposed and already included in the draft conditions, would serve to verify the effect predictions, including the immediate population-level effect hypothesized by ECCC and the other predicted changes to salinity and effects on biofilm and western sandpiper, and determine the effectiveness of mitigation.

5. Port authority's response to the draft conditions

Taking into account the clarification and analyses addressing the remaining uncertainty regarding the salinity, biofilm, and western sandpiper effect pathway, described in **Section 2** above, and the additional mitigation measures and follow-up program elements described in **Sections 3** and **4**, the port authority suggests revisions to the existing draft conditions and proposes additional conditions to better reflect the breadth of mitigation measures and follow-up that will be implemented to protect biofilm and western sandpiper. These suggested revisions and new conditions, together with supporting rationale, are described in **Appendix D**.

With these changes, the proposed suite of conditions provide assurance that effects of the predicted changes in salinity on biofilm and consequently western sandpiper, including an immediate population-

level risk to western sandpiper hypothesized by ECCC, would be identified and addressed. This would be done through the implementation of mitigation and an adaptive management approach, including a precautionary approach to construction of the marine terminal. In this way, the capability of the local assessment area to support western sandpiper populations will be maintained.

The key principles outlined in section 3.1 of part one of the port authority's submission (April 22, 2022, CIAR #3546) have guided the port authority's detailed feedback on the draft conditions. The port authority's feedback has also been informed by work undertaken to respond to the minister's information request; other measures proposed by the port authority; feedback received during consultation with Indigenous groups, IAAC, and other federal authorities; review of submissions by other parties on the registry; and review of the draft conditions for feasibility, clarity, and consistency, as outlined in section 3.2 of part one of the port authority's submission(April 22, 2022, CIAR #3546).

The structure of the port authority's detailed feedback on the draft conditions pertaining to the salinity, biofilm, and western sandpiper effect pathway is the same structure used in Appendix 3.2-A of part one of the port authority's submission, with one difference. All new text prepared after the submission of part one is highlighted in blue text, with suggested revisions and new conditions shown in *blue italic text* and suggested deletions shown in ~~blue strikeout text~~. Any suggested revisions and new text previously provided in part one of the port authority's submission remains shown in green text.

As much as possible, where revisions are suggested, the port authority has used language consistent with the language used elsewhere in the draft conditions and in the port authority's responses to the minister's information request.

The port authority's comments on the draft potential conditions reflect our understanding of the intent and purpose of the conditions, which has been informed by the clarifications provided by IAAC. If any comments or suggested revisions are unclear, the port authority would be pleased to provide IAAC with further clarification, if required.

6. Conclusion

The port authority recognizes the importance of western sandpipers and has taken a precautionary approach to the assessment, informed by Indigenous knowledge and consultation, and government agency and public engagement. As part of the project design, the terminal would be placed in subtidal waters away from sensitive shorebird stopover habitat. Subsequent re-designs of the project have further reduced effects to intertidal habitats. We have further expanded our commitments to mitigate potential effects to biofilm, and, as a result, to western sandpipers, which include the creation of biofilm habitat in collaboration with Indigenous groups and the integration of Indigenous knowledge. Taking a precautionary approach, we have expanded our follow-up commitments to include a commitment to implement an adaptive management approach, which may include removal of the east basin containment dyke, if there are early signals of an immediate population-level effect on western sandpipers due to the project during the first year of construction.

Further, in this submission, information has been provided with respect to each of the topics that were raised by the review panel, demonstrating the following:

- Recent population trend analysis indicates that the western sandpiper population is increasing

- Successful biofilm creation habitats, including at large scales, are feasible

- The spatial extend and magnitude of the physical changes required under the salinity trigger hypothesis are unlikely to occur

Consequently, taking into account the full record of information available to the minister in the panel's report, the port authority's response to the minister's information request, and this submission, the minister can conclude with reasonable confidence that salinity changes due to the project are unlikely to result in a significant adverse effect on western sandpipers and that any residual uncertainty can be addressed through conditions requiring follow-up and adaptive management.

Appendix A Investigation of the salinity trigger hypothesis and associated project effect predictions

Appendix A Investigation of the salinity trigger hypothesis and associated project effect predictions

Contents

Overview

In determining their conclusions on potential effects of the Roberts Bank Terminal 2 Project on western sandpipers, the review panel identified “the operation of a salinity trigger at Roberts Bank as a new concept requiring further investigation”. The salinity trigger hypothesis, presented by Environment and Climate Change Canada (ECCC) during the public hearing, was one of the primary areas of uncertainty that led the review panel to be unable to determine whether the project ‘would or would not have an adverse effect on Western Sandpiper’ (CIAR #2062, p.243).

The salinity trigger hypothesis postulates that high amplitude and rapid salinity oscillations in the order of 20-25 PSU[1] trigger diatoms in biofilm to produce polyunsaturated fatty acids (PUFA) that are thought to be important fuel for onward migration. The hypothesis assumes that there is an existing species-level (3.5 million individuals) reliance on this trigger at Roberts Bank (CIAR #1637).

Under the premise of a salinity trigger hypothesis, ECCC expresses concerns with the potential magnitude of the predicted project effects. ECCC predicts that the project could result in the compression of salinity in the range of up to 10 PSU across 558 hectares (ha) of biofilm habitat and that this compression could affect the “triggering” of fatty acid production in biofilm.

The port authority had the opportunity to review several years (2016, 2017, 2018) of measured salinity data, collected at Roberts Bank by the port authority and available to agencies, to investigate whether the conditions required under the salinity trigger hypothesis are observed under existing conditions at Roberts Bank during the western sandpiper northward migration stopover period (from 15 April to 10 May, CIAR #1947). In addition, using available salinity model results, the port authority examined the magnitude and spatial extent of the compression of the salinity range with the project during the western sandpiper stopover period. Specifically, the port authority analyzed the numerical model results to identify whether the project would result in frequent large salinity compression of up to 10 PSU over 558 ha of biofilm.

To summarize the results, analysis of the measured salinity data collected at Roberts Bank showed no evidence of a consistent observable pattern of large, rapid salinity change (i.e., evidence of a salinity trigger) in the areas important to western sandpipers during the stopover period. Daily salinity oscillations did not exceed 25 PSU during the western sandpiper stopover period and occurrences of a daily range in excess of 20 PSU is quite rare. In terms of project effects, analysis of model results confirms that there is no evidence that the project will result in a consistent or regular compression of the existing salinity range by up to 10 PSU over 558 ha of biofilm. The change to daily range will not be consistent in either the magnitude of the change or the direction of change (some areas will experience an increase in salinity while some areas will experience a decrease), nor is it consistent in terms of the location or amount of area that will experience a change. Of the 621 ha of biofilm available at Roberts Bank, the average area that is predicted to experience a decrease in the daily range of 10 PSU or more each day is 63 ha, or about 10% of the available biofilm habitat during the stopover period. At no time during the stopover period is 558 ha of biofilm affected by a compression of salinity of up to 10 PSU. As noted by the review panel, the predicted salinity change with the project will remain within natural variability experienced under existing conditions (CIAR #2062).

The analysis conducted by the port authority confirms that there is no evidence that the project would lead to a population-level impact to western sandpipers.

[1] Practical salinity unit.

1. Introduction

Prior to (CIAR #1637) and during the public hearing (CIAR #1947), ECCC presented to the review panel a hypothesis regarding high amplitude salinity oscillations (of 20 to 25 PSU) at Roberts Bank, during the western sandpiper northward migration stopover period, being a trigger for diatoms in biofilm to produce PUFA. This concept is referred to as the "salinity trigger hypothesis". ECCC also described to the review panel how a project induced compression in the range of salinity across biofilm habitat at Roberts Bank may lead to an adverse effect on the production of PUFA by biofilm (CIAR #2062), a food source for western sandpipers during their northward migration stopover period. ECCC states that the project would result in an up to 10 PSU compression in the salinity range, which would indirectly affect the quality and quantity of biofilm. Further, ECCC anticipates "major adverse indirect effects to the quality of up to 558 ha of intertidal biofilm on Roberts Bank" (CIAR #2212, p.2).

The objectives of this appendix are to first:

- Characterize the salinity trigger hypothesis (**Section 1.1**)
- Describe the hypothesized changes in salinity range with the project (**Section 1.2**)

and to rely on existing salinity data or available salinity model results to:

- Present existing salinity conditions at Roberts Bank and investigate for evidence of the conditions required by the salinity trigger hypothesis during the western sandpiper stopover period, based on existing salinity data (**Section 2**, with additional detail in **Annex A**)
- Examine the predicted changes in salinity range with the project (**Section 3**, with additional detail in **Annex A**).

1.1 Salinity trigger hypothesis

In its report, the review panel considered "the operation of a salinity trigger at Roberts Bank as a new concept requiring further investigation" (CIAR #2062, p.151). The salinity trigger hypothesis, presented during the public hearing, was the primary area of uncertainty that led the review panel to be unable to determine whether the project "would or would not have an adverse effect on Western Sandpiper" (CIAR #2062, p.243). The information in this appendix has the objective to address the uncertainty identified by the review panel related to the salinity trigger hypothesis.

In its report, the review panel explains that the salinity trigger hypothesis proposes "that a "salinity trigger" serves to induce fatty acid production in biofilm" (CIAR #2062, p.148). As described by the review panel, the hypothesis is that:

> "certain diatoms in biofilm would respond to the trigger by shifting from a growth phase to a stationary phase, and start producing PUFAs, which are the fatty acids ECCC considered could be critical to fuel shorebird migration" (CIAR #2062, p.148).

ECCC has provided additional context around the hypothesis, suggesting that:

> "western sandpipers are migrating through the area, and coincide with rapid, high amplitude oscillations in salinity values. Thus, a 'shock' imposed by changes in salinity 'triggers' diatoms to switch from their growth and carbohydrate production phase to the high fatty acid production phase" (CIAR #1637).

The review panel sought additional information regarding the theory during the public hearing. In its response to undertaking #29 (CIAR #1947), ECCC characterized the salinity trigger "as a lipid

accumulation response by microalgae as a response to osmotic stress ('osmotic shock')" and that this trigger involved "large amplitude salinity oscillations within a tidal cycle (between approximately 20 – 25 PSU) that "shock" marine-type diatoms into a lipid accumulation response".

In considering this hypothesis, it is important to take into account certain facts:

- If exposure to a large oscillation (range) of salinity is required for biofilm to produce PUFA available for migrating western sandpipers, then biofilm must be exposed to large salinity oscillations while or just before western sandpipers are present. Undertaking #29 (CIAR #1947) emphasized "that the major window of interest is during the western sandpiper northward migration through Roberts Bank", which was identified to be from 15 April to 10 May. Consequently, if the "salinity trigger hypothesis" influences western sandpipers while they stop over at Roberts Bank, then the change in salinity range would occur over periods and in time scales relevant to biofilm and western sandpipers.

- In the case of biofilm, undertaking #29 notes that "due to the rapid doubling times of biofilm under favorable conditions (1-2 days; Underwood 2001), a lipid accumulation response ('salinity trigger') can be expected to take place on the scale of a few days or tidal cycles" (CIAR #1947).
- In the case of western sandpipers, during the three-week northward migration stopover period at Roberts Bank, individual shorebirds stop to feed and refuel for about 1 to 4 days (Iverson et al. 1996, Warnock and Bishop 1998, Warnock et al. 2004, 2006, Franks et al. 2020).

The hypothesized salinity trigger mechanism (i.e., a large salinity range triggering high PUFA levels) would have to occur frequently over the western sandpiper northward migration stopover period at a scale of a few tidal cycles or days, as stated above. Further, the mechanism must also be occurring throughout the areas at Roberts Bank where western sandpipers feed. The review panel identified the upper intertidal of Roberts Bank as the "area of interest" for western sandpipers (Figure 11-3 in CIAR #2062). ECCC also noted that the upper intertidal corresponds with the highest western sandpiper usage (CIAR #1947). Thus, the evidence for the salinity trigger, a frequent reliable mechanism, should be currently observable under existing conditions in areas of high shorebird use (**Section 3.1.1**).

1.2 Hypothesized project effect

Under the salinity trigger hypothesis, it is hypothesized "that the Project would disrupt or remove the salinity trigger responsible for initiating fatty acid production in biofilm on Roberts Bank" (CIAR #1637). Specifically, it is hypothesized that a project-induced reduction (compression) in the overall range of salinity would affect the metabolism of the individual diatoms that are joined together as biofilm. Hence:

> "through a compression in the range of variability of salinity experienced at Roberts Bank, the project may lead to an adverse effect on the production of PUFAs by biofilm" (CIAR #2062).

In their submission to the public comment period, ECCC states that with the project, the range of salinity will be compressed by up to 10 PSU and this could affect "the quality of up to 558 ha of intertidal biofilm on Roberts Bank" which would "constitute an unmitigable and irreversible species-level risk to Western Sandpipers" (CIAR #2212).

Under the salinity trigger hypothesis, there is an existing species-level reliance by western sandpipers on biofilm at Roberts Bank, and on this physical phenomenon that initiates fatty acid production in biofilm. In considering the predicted project-related changes to salinity in the context of this hypothesis, a reduction in salinity would have to occur frequently and throughout the areas at Roberts Bank where western sandpipers feed.

2. Investigating the salinity trigger hypothesis

The salinity trigger hypothesis suggests that biofilm needs to be shocked by "large amplitude salinity oscillations within a tidal cycle (between approximately 20 – 25 PSU)" (CIAR #1947) to produce PUFA in quantities necessary to sustain the population of western sandpipers that stop over at Roberts Bank during their northward migration. This mechanism needs to:

(1) occur during the time period when western sandpipers stop over at Roberts Bank (15 April to 10 May, CIAR #1947)
(2) occur throughout all of the areas of Roberts Bank that are most important for western sandpipers foraging on biofilm[2]
(3) occur frequently (i.e., every few tidal cycles or days) and consistently throughout the stopover period.

Hence, with the data collected and available to date, the almost daily pattern should be observable under existing conditions across the upper intertidal areas at Roberts Bank during the western sandpiper stopover period each year.

2.1 Methods

The port authority relied on salinity data collected at stations located in biofilm areas important to western sandpipers (CIAR #2062), as part of its salinity monitoring program, to summarize existing salinity conditions at Roberts Bank and to examine existing daily salinity oscillations during the western sandpiper stopover period at Roberts Bank to look for evidence of a salinity trigger.

2.1.1 Salinity monitoring program

The port authority has been monitoring water column salinity at Roberts Bank since 2012. In 2016, the salinity monitoring program was expanded, and the port authority has been collecting salinity data at 5-minute intervals at a total of ten stations across the intertidal (**Figure 1**, CIAR #1379). The long-term salinity database has been shared with various agencies, including ECCC, under a data sharing agreement that covers the period of 2012 to 2019.

[2] i.e., the upper intertidal, see federal review panel report Figure 11-3; CIAR #2062, p.150.

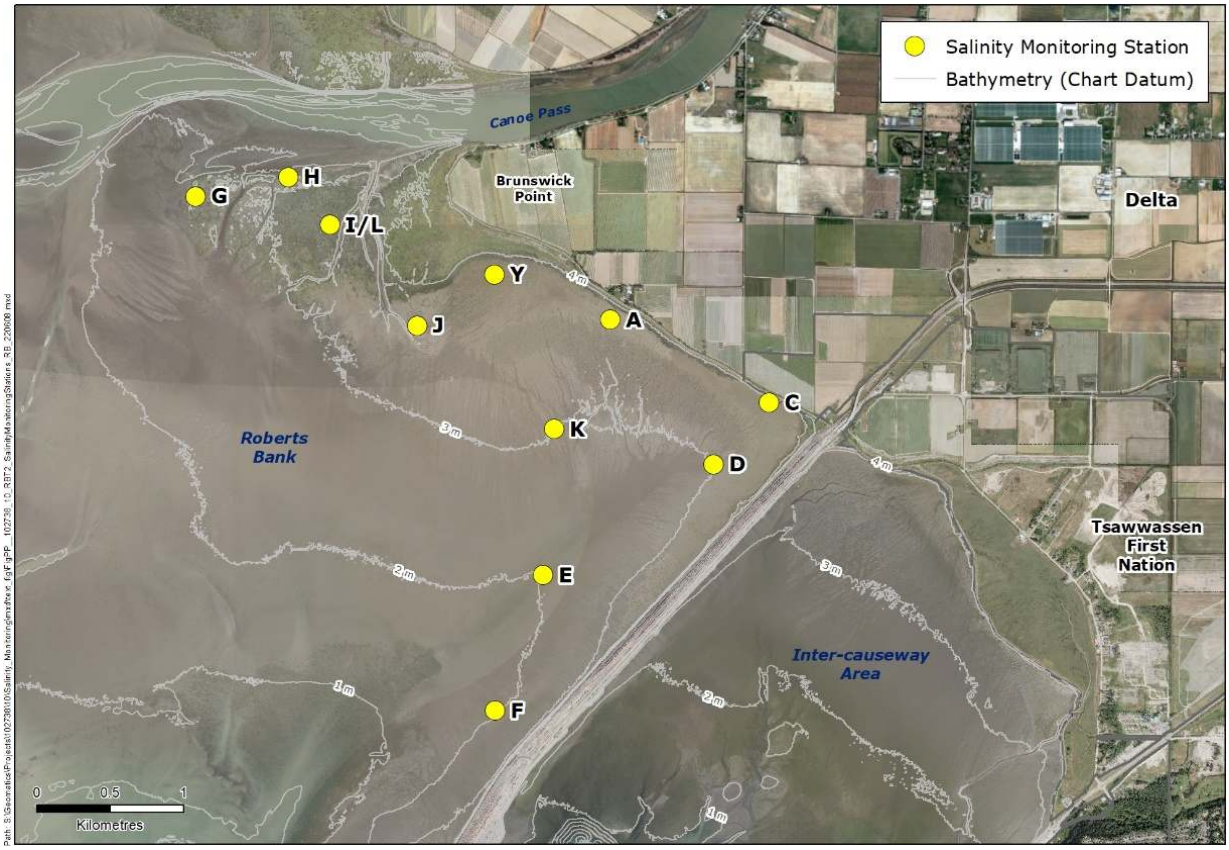

Figure 1 Salinity monitoring stations at Roberts Bank

2.1.2 Evaluating existing salinity conditions

The long-term salinity data can be used to investigate salinity patterns (including salinity range) and trends at Roberts Bank in areas important to western sandpipers. Hence, it is possible to investigate if, under existing conditions, there are frequent and consistent large salinity changes of 20-25 PSU within a tidal cycle during the western sandpiper stopover period, which are hypothesized to be required for a salinity trigger.

The recorded salinity data was examined to evaluate existing conditions at a representative suite of salinity monitoring stations across Roberts Bank, in areas of importance to western sandpipers (Figure 11-3 in CIAR #2062; **Figure 2**; Figure A-1 to A-6 in **Annex A**). As shown in **Figure 2**, stations I/L, Y, and C are located along the upper intertidal zone at varying proximity to Canoe Pass, offering a virtual transect of salinity conditions across the salinity gradient from more fresh water influenced areas close to Canoe Pass to more marine water influenced areas closer to the Roberts Bank causeway. Salinity conditions for 2016, 2017, and 2018 cover a range of Fraser River flow conditions during the western sandpiper stopover period (see Figure A-1 in **Annex A**) and coincides with previous biofilm studies conducted by the port authority (CIAR #1110, 1215, 1385).

The salinity range was calculated based on the difference between the maximum and minimum salinity value recorded over the previous diurnal tidal cycle. The port authority conducted its analysis for the period immediately prior to, during and after the western sandpiper stopover period. This “period of interest” covers the period of 10 April to 25 May.

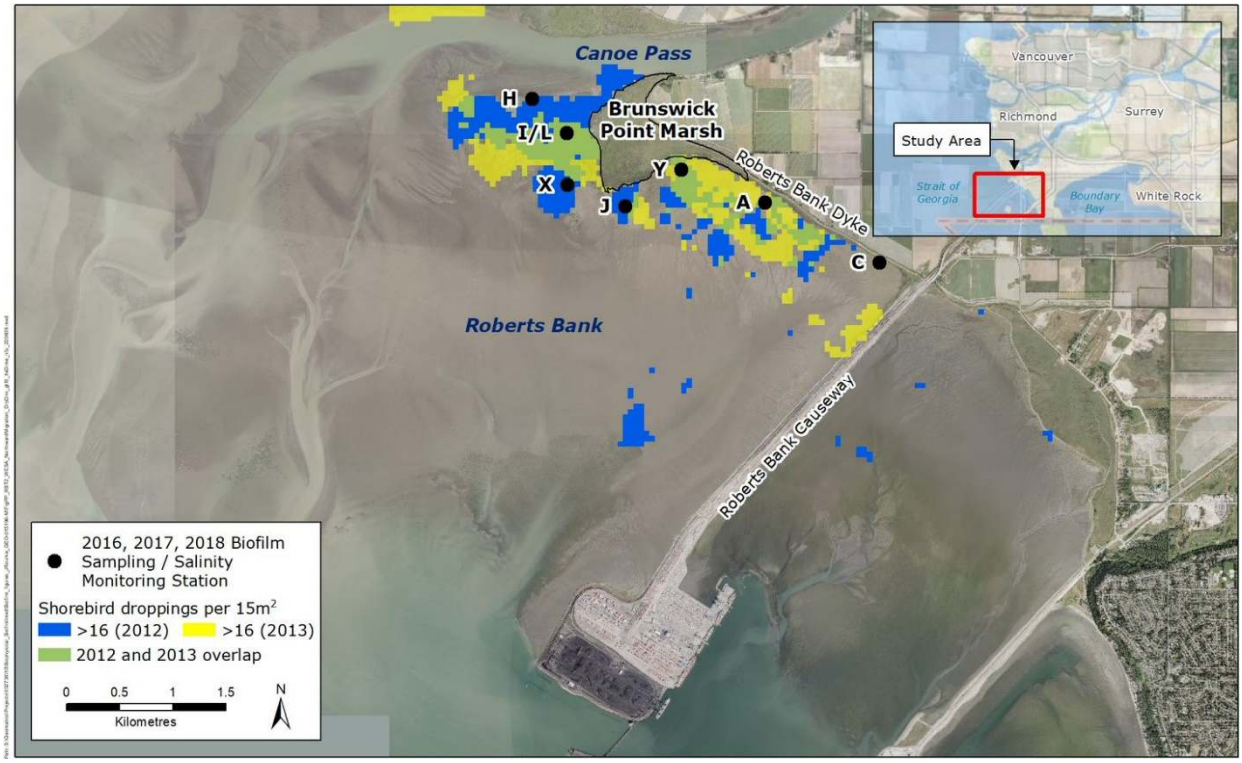

Figure 2 Areas of high western sandpiper usage of Roberts Bank during the northward migration in 2012 and 2013, based on sandpiper dropping densities, with the locations of the biofilm and salinity monitoring stations (CIAR #1110)

2.2 Results

This section describes the existing salinity conditions at Roberts Bank, including a description of the primary physical process influencing salinity conditions, followed by an examination of whether there is evidence of a salinity trigger at Roberts Bank.

2.2.1 Existing salinity conditions at Roberts Bank

Salinity at Roberts Bank is governed by two primary physical processes that interact to create the observed conditions across the tidal flats: 1) freshwater flow from the Fraser River via Canoe Pass, and 2) saline water from the Strait of Georgia. These two processes create highly variable conditions at Roberts Bank as a result of the intermixing of saline water from the Strait of Georgia driven by semi-diurnal tides that inundate and then leave exposed the tidal flats approximately twice per day and the discharge of fresh water from the Fraser River through Canoe Pass (see the salinity model video presented during the public hearing, CIAR #1778). In general, fresher conditions are more prevalent close to Canoe Pass (e.g., near Station I/L) while salinity generally increases with greater distance from the freshwater source (e.g., closer to the Roberts Bank causeway near Station C).

Fresh water flow is generally lowest in the winter and early spring when much of the Fraser River watershed receives precipitation in the form of snow and increases in the spring as temperatures rise and the snowpack begins to melt, reaching the annual flood peak during the freshet, typically in late-June to early-July (Figure A-1 in **Annex A**). The western sandpiper stopover period typically corresponds to the onset of the freshet period. During this period, Fraser River discharge is typically in transition between the

low winter flows and the rise towards the peak freshet flood. Furthermore, the range of salinity experienced at Roberts Bank in areas important to western sandpipers varies depending on the timing of the annual Fraser River flood and location relative to Canoe Pass.

Tides in the Strait of Georgia are mixed semi-diurnal, meaning that there are two highs and two lows of unequal height in a lunar day (CIAR #181). Tides vary during the lunar month in response to equilibrium between solar and lunar forces to produce spring[3] and neap[4] tides and are predictable, unlike the flows of the Fraser River. Notwithstanding the year-to-year variation in the timing of spring and neap tide cycles, there is relatively little variation in the inter-annual tidal range.

Relative elevation is also important: some areas of the tidal flats are higher than others (**Figure 1**) and so experience the effects of the tides differently. Higher areas are inundated less frequently and for shorter periods of time than areas at lower elevation, and so experience extended periods of exposure above the tide. As described in **Annex A**, all stations are observed to have varying frequency of inundation and demonstrate the variable influence of tides on salinity.

In summary, the relative influence of these physical processes (freshwater flow and tides) on water column salinity varies depending on location at Roberts Bank relative to Canoe Pass—the nearest fresh water source—and elevation on the tidal flats. It also varies seasonally in response to variations in Fraser River discharge, and in relation to variations in tides.

2.2.2 Evidence of a salinity trigger

There is no systematic or consistent pattern of frequent large salinity changes over the range of 20-25 PSU observed in the measured field data at any of the three representative salinity stations, over the three years evaluated (**Figure 3**, **Figure 4**, **Figure 5**). Patterns in salinity range that emerged can be explained by the combined influences of Fraser River discharge and tides, both of which have been demonstrated to vary year-to-year, and with varying degrees of influence across the tidal flats. Since these factors are highly variable, and in the case of Fraser River flow, highly unpredictable, it is not surprising that a consistent pattern of salinity oscillations (salinity range) is not apparent within or between sites or within or between years.

As shown in the field data, the typical range in salinity near Canoe Pass (Station I/L) is approximately 10 PSU until Fraser River discharge rises above about 4,500 m^3/s at which point it drops to nearly zero (**Figure 3** and Figure A-2, Figure A-3 and Figure A-4 in **Annex A**). At Station Y and Station C, within the upper intertidal area, the measured salinity range is quite variable, with a large proportion of the daily range measurements below 10 PSU at Station C including multi-day periods when the range is less than 5 PSU (**Figure 5**).

Daily salinity oscillations did not exceed 25 PSU during the western sandpiper stopover period and occurrences of a daily range in excess of 20 PSU is quite rare—it is observed only twice in the three representative years at Station I/L (**Figure 3**), once at Station C (**Figure 5**), and less than 25% of the days at Station Y (**Figure 4**).

In summary, based on existing salinity data collected over multiple years, there is no evidence of an existing consistent observable pattern of large, rapid salinity change (i.e., evidence of a salinity trigger) in the areas important to western sandpipers during the stopover period.

[3] Highest of high tides that occur during new and full moon phases
[4] Smaller tides that occur during the first and last quarter of the moon phase

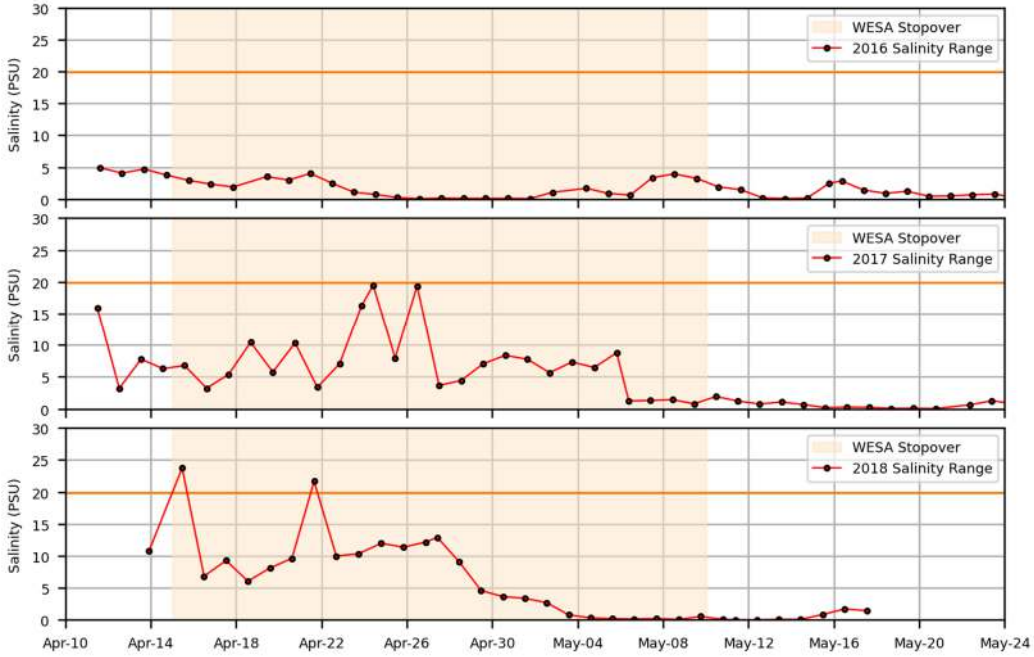

Figure 3 **Salinity range during the period of interest calculated over the previous diurnal tidal cycle at Station I/L for 2016, 2017 and 2018. Trigger range of 20 PSU highlighted by orange line**

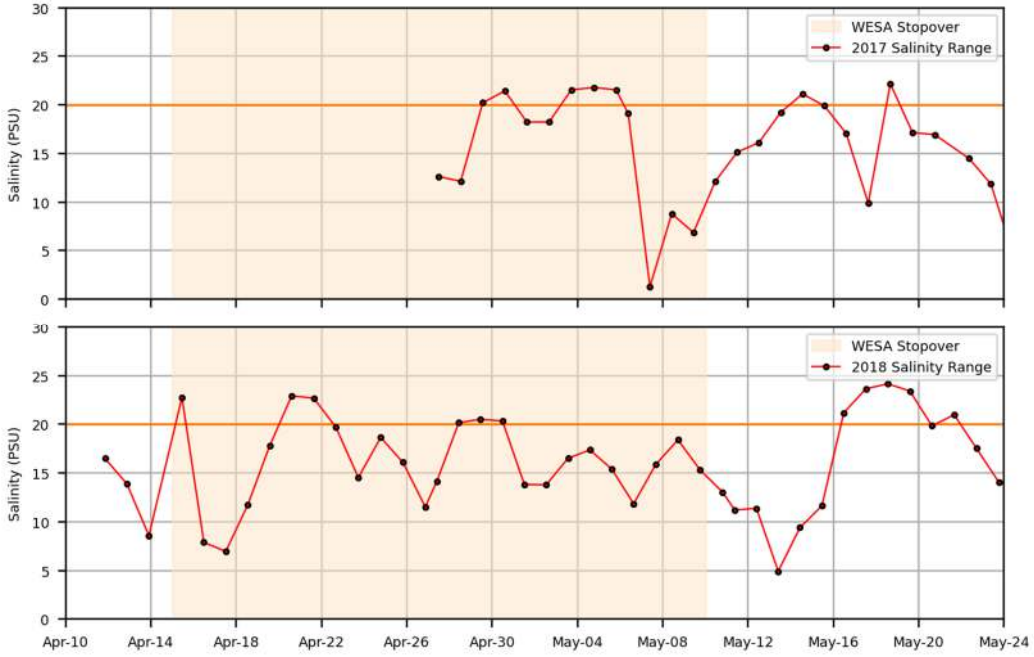

Figure 4 **Salinity range during the period of interest calculated over the previous diurnal tidal cycle at Station Y for 2017 and 2018. Trigger range of 20 PSU highlighted by orange line**

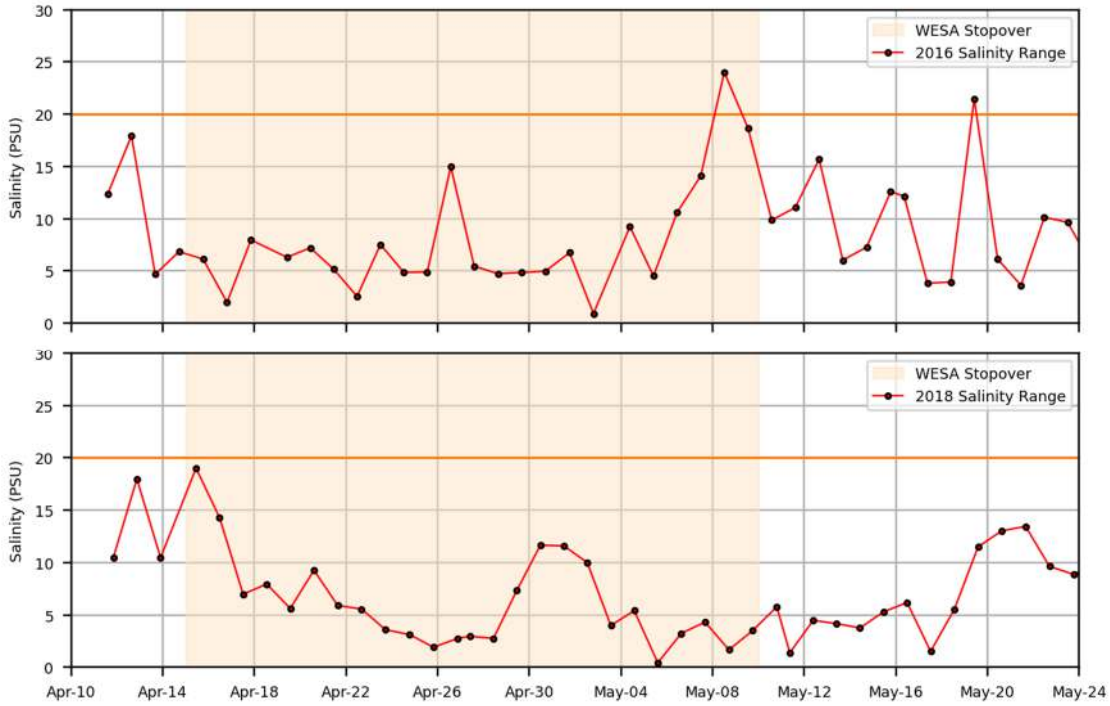

Figure 5 Salinity range during the period of interest calculated over the previous diurnal tidal cycle at Station C for 2016 and 2018. Trigger range of 20 PSU highlighted by orange line

3. Examining predicted changes with the project

As described in the environmental impact statement (EIS), the project is expected to induce a change in the salinity regime at Roberts Bank that is related to tidal currents interacting with the proposed container terminal that changes where intermixing between fresh and saline waters occurs (Appendix 9.5-A in the EIS; CIAR #181). The magnitude of this change is not consistent across all areas of Roberts Bank, nor does the change occur consistently over time during the western sandpiper stopover period. The review panel concluded that the salinity changes over Roberts Bank with the project would be minor and within the natural variability under existing conditions (CIAR #2062). As noted above, ECCC hypothesizes that the project would compress the range of salinity by up to 10 PSU which would indirectly affect the quality of up to 558 ha of intertidal biofilm.

3.1 Methods

To examine the predicted change in salinity range with the project, the port authority used available salinity model results to estimate the predicted amount and spatial extent of the change in the salinity range with the project during the western sandpiper stopover period in biofilm areas at Roberts Bank. The approach is to investigate the potential for consistent large salinity compressions (up to 10 PSU) across the biofilm areas during the western sandpiper stopover period.

3.1.1 Biofilm areas at Roberts Bank

In its submission to the public comment period, ECCC notes that there is 558 ha of intertidal biofilm at Roberts Bank (CIAR #2212). The area of biofilm available to foraging western sandpipers during the stopover period is greater.

The reference to 558 ha of intertidal biofilm likely reflects the quantity of intertidal mudflat habitats[5] calculated from the 2012 and 2013 marine vegetation map (Figure 11-2 in the EIS, CIAR #181) and presented in Table IR9-05-B1 (CIAR #1360). It is estimated that there is approximately 621 ha of biofilm habitat at Roberts Bank available to foraging western sandpipers during the stopover period (**Figure 6**, **Table 1**). The estimated area includes biofilm[6] mapped in 2012 and 2013 marine vegetation map (Figure 11-2 in the EIS, CIAR #181) and biofilm habitats identified during the biofilm studies conducted from 2016 to 2018 (CIAR #1110, 1215, 1385) and during the 2012 and 2013 western sandpiper foraging study (**Figure 2**).

Biofilm areas were identified as discrete polygons to support analysis. Biofilm polygons Upper Intertidal 1 (UL1) and Canoe Pass 1 (CP1) were identified as areas where the majority of western sandpipers feed, based on the results of the foraging use study (**Figure 2**). This area also corresponds to the area identified by the review panel (Figure 11-3 in the federal review panel report, CIAR #2062). These areas represent over half (323 ha) of the biofilm areas available during the stopover period (**Figure 6**, **Table 1**).

[5] Total mudflat habitat includes the following habitat types: biofilm ≥ 5%, biofilm ≥ 5%/zostera marina ≥ 5%, and mud, as identified in Figure 11-2 of the EIS (CIAR #181)
[6] Biofilm areas correspond to the following habitat type: biofilm >=5%, as identified in Figure 11-2 of the EIS (CIAR #181).

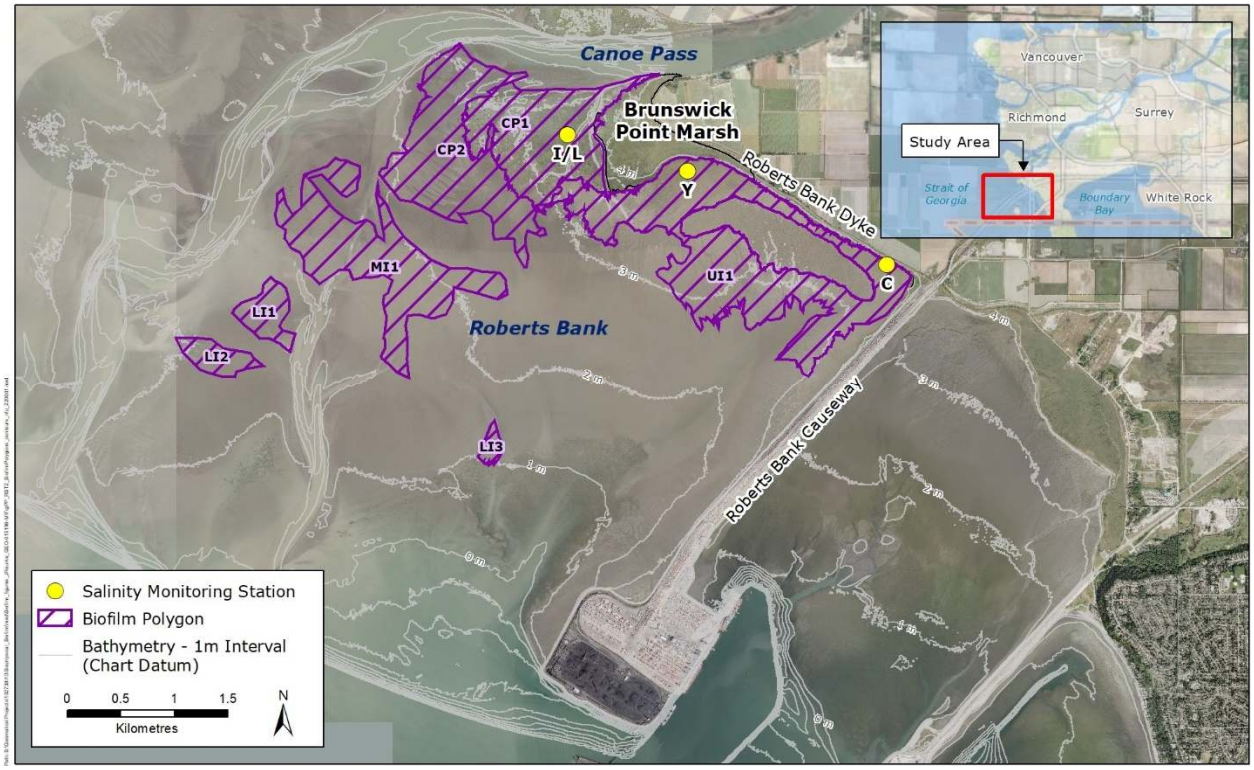

Figure 6 Biofilm areas at Roberts Bank available to foraging western sandpipers during their northward migration

Table 1 Area of individual biofilm areas (see Figure 6) available to foraging western sandpipers during their northward migration based on numerical model[7] mesh calculation.

Polygon ID	Polygon Name	Model Area (ha)
LI3	Lower Intertidal 3	5.1
LI2	Lower Intertidal 2	15.8
LI1	Lower Intertidal 1	19.9
Mi1	Mid-Intertidal 1	127.1
UI1	Upper Intertidal 1	213.6
CP1	Canoe Pass 1	109.6
CP2	Canoe Pass 2	129.5
Total		**620.6**

3.1.2 Analysis

In order to clarify the predicted project-related changes in salinity during the western sandpiper stopover period, the numerical model results for the specific stopover period were evaluated to calculate the daily

[7] The numerical model was developed for the salinity assessment for the EIS, as described in EIS Appendix 9.5-A.

range in salinity across the model domain (i.e., Roberts Bank) for both the existing condition and the with-project condition so that the project-related change to the daily salinity range could be calculated. This approach was illustrated in the salinity model video presented to the review panel during the public hearing (CIAR #1778). The magnitude of the change in salinity range was then calculated as a function of the area affected within each of the biofilm area described above in **Section 3.1.1** (**Figure 6**).

The values for daily change in salinity range were then represented spatially in 2 PSU range bins (>20, 20-18, 18-16, 16-14,…<-20) to calculate the area that would be expected to experience a change in salinity range each day at that magnitude within the biofilm areas described above in **Section 3.1.1** (**Figure 6**).

3.2 Results

The project is anticipated to change the daily range of salinity experienced at some areas of Roberts Bank (CIAR #2062). As visually demonstrated during the public hearing, the change to daily range will not be consistent in either the magnitude of the change or the direction of change (some areas will experience an increase in salinity range while some areas will experience a decrease), nor is it consistent in terms of the location or amount of area that will experience a change (CIAR #1778). As noted by the review panel, this predicted salinity change with the project will remain within the natural variability experienced under existing conditions (CIAR #2062, CIAR #1778).

There is no evidence that the project will result in a consistent or regular compression to the existing salinity range of up to 10 PSU over 558 ha (**Figure 7**). The project effect on salinity range will vary daily throughout the western sandpiper stopover period (**Figure 7**; Figure A-9 and Figure A-10 in **Annex A**). Of the 621 ha of biofilm available at Roberts Bank, the average area that is predicted to experience a decrease in the daily range of 10 PSU or more each day is 63 ha, or about 10% of the available biofilm habitat during the stopover period.

Of the total biofilm area that will experience a change in the daily salinity range, a large portion will experience an increase or decrease of a relatively small amount—up to 2 PSU. The largest magnitude changes (10 PSU or more over 100 ha of biofilm) will occur relatively infrequently within the stopover period (8 out of 26 days) and will only ever cover about one sixth of the biofilm in a given day (**Figure 7**). As noted above, the review panel stated in their report that the predicted salinity change with the project will remain within natural variability experienced under existing conditions (CIAR #2062, CIAR #1778).

The port authority also examined predicted changes with the project for the biofilm areas important to western sandpipers (**Section 3.1.1**), Upper Intertidal (UI) (Figure A-9 in **Annex A**) and Canoe Pass (CP1) (Figure A-10 in **Annex A**). Both areas will experience some decreases and some increases in salinity range over the stopover period. The Upper Intertidal biofilm area will experience more change than the Canoe Pass area as a percentage of its overall area and in the magnitude of the change. As shown in **Annex A** Figure A-9, the dominant result is a reduction in range of between 2 and 14 PSU, though both the magnitude of change and the area experiencing reduced salinity range is highly variable as a function of time, as presented to the review panel (CIAR #1778). There are several days within the stopover period when the predicted reduction would not exceed 10 PSU in any area. The daily average area within the Upper Intertidal biofilm area that is predicted to experience a decrease in the daily salinity range of 10 PSU or more is 61 ha during the stopover period, or less than one third of the Upper Intertidal biofilm area. In contrast, the predicted project-induced changes to salinity range in the Canoe Pass biofilm area are relatively small and the dominant pattern is an overall increase to the daily salinity range (Figure A-10 in **Annex A**). Specifically, on most of the days within the western sandpiper stopover period, the area of the Canoe Pass biofilm area that will experience an increased salinity range exceeds that which will

experience a decreased range. The largest area predicted to experience a decrease in salinity of 10 PSU or more within the western sandpiper stopover period on any given day is 7 ha and most of the time within this period (22 of the 26 days) there is no part of the Canoe Pass biofilm area that will experience a salinity decrease by more than 8 PSU.

Salinity Range / Date	< -20	-20 & -18	-18 & -16	-16 & -14	-14 & -12	-12 & -10	-10 & -8	-8 & -6	-6 & -4	-4 & -2	-2 & 0	0 & 2	2 & 4	4 & 6	6 & 8	8 & 10	10 & 12	12 & 14	14 & 16	16 & 18	18 & 20	> 20
10-Apr	0	0	0	0	0	0	0	0	3	56	234	290	25	8	4	0	0	0	0	0	0	0
11-Apr	0	0	0	0	0	0	0	3	45	102	175	268	27	1	0	0	0	0	0	0	0	0
12-Apr	0	0	0	0	0	0	7	20	39	83	229	223	19	0	0	0	0	0	0	0	0	0
13-Apr	0	0	0	0	0	1	8	28	69	79	146	214	69	5	0	0	0	0	0	0	0	0
14-Apr	0	0	0	0	2	4	27	49	53	85	73	193	84	40	11	1	0	0	0	0	0	0
15-Apr	0	0	0	2	20	46	35	29	29	27	99	157	79	61	36	0	0	0	0	0	0	0
16-Apr	0	0	23	39	26	20	21	23	37	43	89	74	119	67	40	0	0	0	0	0	0	0
17-Apr	0	0	0	0	6	26	48	42	32	34	49	125	88	62	31	23	19	34	2	0	0	0
18-Apr	0	0	1	12	36	56	32	23	20	25	100	139	93	55	30	0	0	0	0	0	0	0
19-Apr	0	0	1	12	36	56	32	23	20	25	99	140	93	55	30	0	0	0	0	0	0	0
20-Apr	0	0	0	7	29	50	52	37	23	36	97	128	81	53	26	1	0	0	0	0	0	0
21-Apr	0	0	0	0	29	26	41	53	36	56	161	105	71	41	2	0	0	0	0	0	0	0
22-Apr	0	0	0	2	15	21	33	57	40	35	114	128	76	62	32	8	0	0	0	0	0	0
23-Apr	0	0	0	4	15	22	36	37	37	78	116	170	78	27	0	0	0	0	0	0	0	0
24-Apr	0	0	0	0	13	23	28	78	28	68	126	173	69	13	1	0	0	0	0	0	0	0
25-Apr	0	0	0	9	24	36	27	43	36	38	72	76	82	45	47	43	42	2	0	0	0	0
26-Apr	0	0	0	9	23	35	57	32	35	35	63	169	77	60	22	1	0	0	0	0	0	0
27-Apr	1	5	13	25	45	42	20	15	33	37	57	104	45	48	64	44	22	0	0	0	0	0
28-Apr	0	4	11	30	44	38	25	16	35	47	96	83	33	32	39	31	26	21	10	0	0	0
29-Apr	4	29	40	18	20	23	30	31	47	95	105	145	23	11	0	0	0	0	0	0	0	0
30-Apr	0	1	26	17	17	17	18	23	35	45	96	135	109	57	25	1	0	0	0	0	0	0
01-May	0	0	0	2	14	20	21	25	29	32	117	80	45	57	43	44	38	32	21	1	0	0
02-May	0	4	21	23	24	29	33	35	54	85	183	83	26	16	3	2	0	0	0	0	0	0
03-May	0	8	20	40	43	28	30	21	17	14	92	193	52	18	18	13	9	5	0	0	0	0
04-May	0	0	1	10	23	29	43	33	31	36	123	171	43	42	26	7	0	0	0	0	0	0
05-May	0	0	0	0	0	8	15	40	31	44	176	206	69	28	4	0	0	0	0	0	0	0
06-May	0	0	0	0	0	1	5	29	58	71	189	174	47	40	5	3	0	0	0	0	0	0
07-May	0	0	0	0	0	0	2	27	46	96	172	180	56	37	3	2	0	0	0	0	0	0
08-May	0	0	0	0	0	0	0	4	21	105	150	233	69	28	7	4	0	0	0	0	0	0
09-May	0	0	0	0	0	0	1	10	26	49	156	268	85	19	4	2	0	0	0	0	0	0
10-May	0	0	0	0	0	1	4	9	31	62	168	237	93	15	0	0	0	0	0	0	0	0
11-May	0	0	0	1	8	20	35	57	52	43	66	182	67	40	45	5	0	0	0	0	0	0
12-May	0	6	15	17	30	43	36	46	35	35	54	166	63	47	26	0	0	0	0	0	0	0
13-May	2	10	46	28	19	19	23	33	39	37	136	174	34	21	0	0	0	0	0	0	0	0
15-May	0	13	35	42	55	56	45	52	54	77	95	65	16	13	0	0	0	0	0	0	0	0
16-May	0	3	18	25	29	32	52	54	56	68	132	94	22	16	14	6	0	0	0	0	0	0
17-May	0	1	27	48	23	23	21	25	23	22	94	161	52	38	31	8	4	8	9	4	0	0
18-May	0	0	3	17	57	44	39	34	37	51	135	139	54	12	1	0	0	0	0	0	0	0
19-May	0	0	0	0	7	27	32	37	63	73	92	151	74	60	4	0	0	0	0	0	0	0
20-May	0	0	0	1	12	27	43	66	77	86	95	174	39	0	0	0	0	0	0	0	0	0
21-May	0	0	0	0	2	9	26	40	51	69	74	213	97	39	1	0	0	0	0	0	0	0
22-May	0	0	0	1	3	9	37	48	37	42	90	235	82	35	3	0	0	0	0	0	0	0
23-May	0	0	1	12	23	32	26	41	64	101	188	121	11	0	0	0	0	0	0	0	0	0
24-May	0	0	0	0	8	20	57	38	47	114	228	93	15	0	0	0	0	0	0	0	0	0

Figure 7 Area (ha) within all biofilm polygons (621 ha) predicted to experience a change in salinity range presented in 2 PSU range bins

4. Conclusion

The salinity trigger hypothesis suggests that exposure to rapid (daily) high amplitude changes in salinity (up to 20 to 25 PSU) must occur in order to “shock” biofilm and induce the production of PUFA, which ECCC suggests could be critical to fuel shorebird migration. These large daily salinity oscillations should therefore be observed in the field measurements for the period during or just before the western sandpiper stopover period (from 15 April to 10 May). Further, ECCC suggests, based on the salinity trigger hypothesis, that the project may lead to an adverse effect on the production of PUFA by compressing the range of salinity experienced at Roberts Bank. ECCC submits that the project would result in an up to 10 PSU compression in the salinity range which would indirectly affect the quality of up to 558 ha of biofilm. At no time during the stopover period is 558 ha of biofilm affected by a compression of salinity of up to 10 PSU.

Existing salinity measurements at Roberts Bank provide no evidence of a consistent observable pattern of large, rapid salinity change (i.e., evidence of a salinity trigger) in the areas important to western sandpipers during the stopover period. Salinity measurements were collected over multiple years by the port authority at Roberts Bank and shared with various agencies, including ECCC. Data for three representative years are provided, during which a range of physical processes was experienced. The salinity monitoring stations represent areas influenced by more fresh water and more marine water influences, providing a virtual transect of salinity conditions across the salinity gradient at Roberts Bank in areas of importance to western sandpipers.

The anticipated changes to daily salinity range induced by the project will not be consistent in either the magnitude of the change or the direction of change (increase or decrease), as described during the public hearing. As noted by the review panel, the predicted salinity change with the project will remain within natural variability experienced under existing conditions. In the context of the salinity trigger hypothesis, the predicted project-related changes to salinity would have to result in a reduction in salinity, which would have to occur frequently and throughout the biofilm areas at Roberts Bank. Using the existing salinity modelling results, changes to the daily salinity range experienced within the biofilm areas were quantified for the period immediately before, during, and following the stopover period. The results show that on average, the project would be expected to reduce the salinity range by 10 PSU or more within only approximately 10% (63 ha) of the biofilm area each day during the stopover period. The results also show that many areas of the biofilm area would experience an increase in salinity range. Hence, there is no evidence that the salinity range will be compressed by up to 10 PSU or more over areas approaching 558 ha. In summary, the analysis conducted by the port authority confirms that there is no evidence that the project would lead to a population-level impact to western sandpipers.

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Annex A - Supporting information to the investigation of the salinity trigger hypothesis and associated project effects

A-1 Fraser River discharge

The Fraser River drains a 232,000 km^2 area of British Columbia (B.C.), approximately a quarter of the province. River discharge (flow), as measured at Hope, B.C., varies seasonally in response to rainfall and snowmelt. As shown in Figure A-1, discharge is generally lowest in the winter and early-spring when much of the watershed receives precipitation in the form of snow and increases in the spring as temperatures rise and the snowpack begins to melt, reaching the annual flood peak during the freshet in late-June to early-July. As with the timing and magnitude of the freshet, the onset of the freshet—when flows begin to rise—is highly dependent on regional and synoptic weather patterns and so displays large inter-annual variability. The western sandpiper northward migration stopover period often, but not always, corresponds to the onset of the freshet period (Figure A-1).

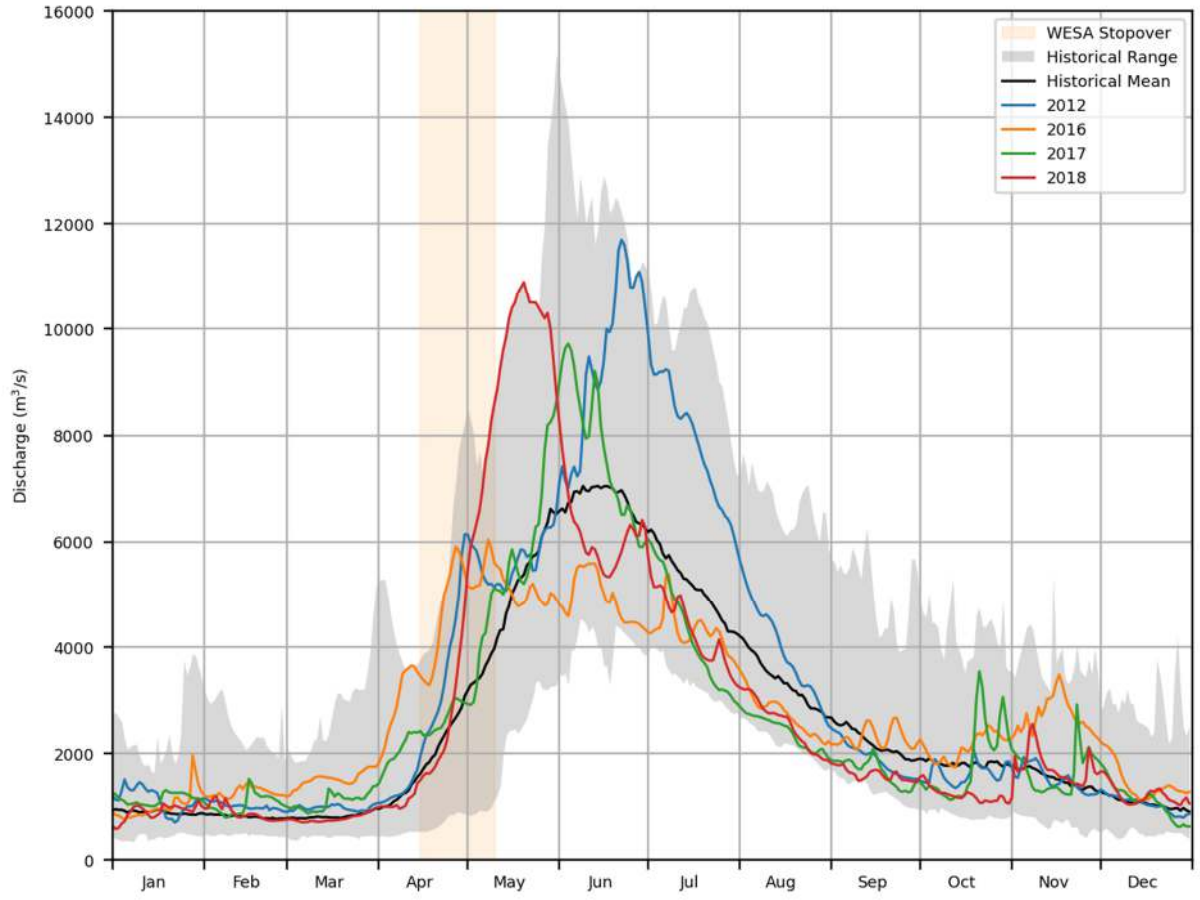

Figure A-1. Annual hydrographs of Fraser River as measured at Hope based on 105 years of data from Water Survey of Canada

A-2 Salinity monitoring stations

This section provides a description of three salinity monitoring stations and the resulting data collected for the period of interest (immediately prior to, during and after the western sandpiper stopover period; 10 April to 25 May[1]) in 2016, 2017 and 2018.

Stations I/L, Y and C are located along the upper intertidal zone of Roberts Bank in areas of importance to western sandpipers. The stations are located within varying proximity to Canoe Pass, offering a virtual transect of salinity conditions across the salinity gradient from more fresh water influenced areas close to Canoe Pass (station I/L) to more marine water influenced areas closer to the Roberts Bank causeway (station Y and C). The salinity time series data is provided in relation to the corresponding Fraser River discharge, tides and depth of inundation for each station (i.e., factors influencing salinity levels at Roberts Bank). The salinity time series data represents salinity values recorded every 5-minutes. Gaps in the timeseries reflect periods of time when the sensor is dry (i.e., not submerged), or when data has been screened out due to poor quality as described in NHC 2019 report (CIAR #1893[2]).

A-2.1 Salinity at Station I/L

Station I/L is located within the seasonal marsh complex extending westwards from Brunswick Point and is close to the freshwater source of Canoe Pass. It is also within the Canoe Pass 1 (CP1) biofilm area. Station I/L represents measurements of salinity at two separate locations (I and L) but because of their very close proximity (100 m) to each other, can be treated as essentially the same record. Station I was initially installed on 13 March 2016 and then moved 100 m to the west on May 31, 2017 because of the presence of a small tidal channel (thus forming station L). Station I/L sits at an elevation of 3.3 m Chart Datum (CD), which is above the mean tide of 3.1 m and so is inundated slightly less than half of the time (44%) in a typical series of tidal cycles. Given its relatively close proximity to the freshwater source of Canoe Pass, salinity at this station can be heavily influenced by fresh water, depending on flow rates in the Fraser River.

Figure A-2 shows Fraser River discharge, tide, depth of inundation, and measured salinity at Station I/L for the period of interest in 2016, while Figure A-3 and Figure A-4 show the same information for 2017 and 2018, respectively. The general trend that becomes apparent from these three years of data is that this location is dominated by freshwater inputs emanating from Canoe Pass when Fraser River discharge exceeds about 4,500 m^3/s, such that water column salinity is typically less than 3 PSU. Water column salinity is somewhat higher, and more variable, when Fraser River discharge is lower, which typically happens in the earlier part of the period of interest each year. Of the three representative years, salinity was generally highest in 2018 at a time when Fraser River discharge was at its lowest during the period of interest (Figure A-4). In 2018, salinity was generally below 15 PSU at this station, with a few notable instances of higher salinity that occurred over a single tidal cycle. In 2017, salinity was typically below 10 PSU (Figure A-3), while in 2016 salinity only once rose above 5 PSU during the period of interest (Figure A-2).

[1] Data and model results for the period 10 April to 25 May are presented to provide additional context to understand patterns of physical processes that are applicable to the western sandpiper stopover period (i.e., salinity data immediately before, during and after the western sandpiper stopover period of 15 April to 10 May).
[2] NHC (2019). Roberts Bank Salinity Model Results Verification: Comparison of 2016 & 2017 Modelled Salinity to 2016 & 2017 Measured Salinity. Report prepared by Northwest Hydraulic Consultants Ltd. for Vancouver Fraser Port Authority. 17 pp.

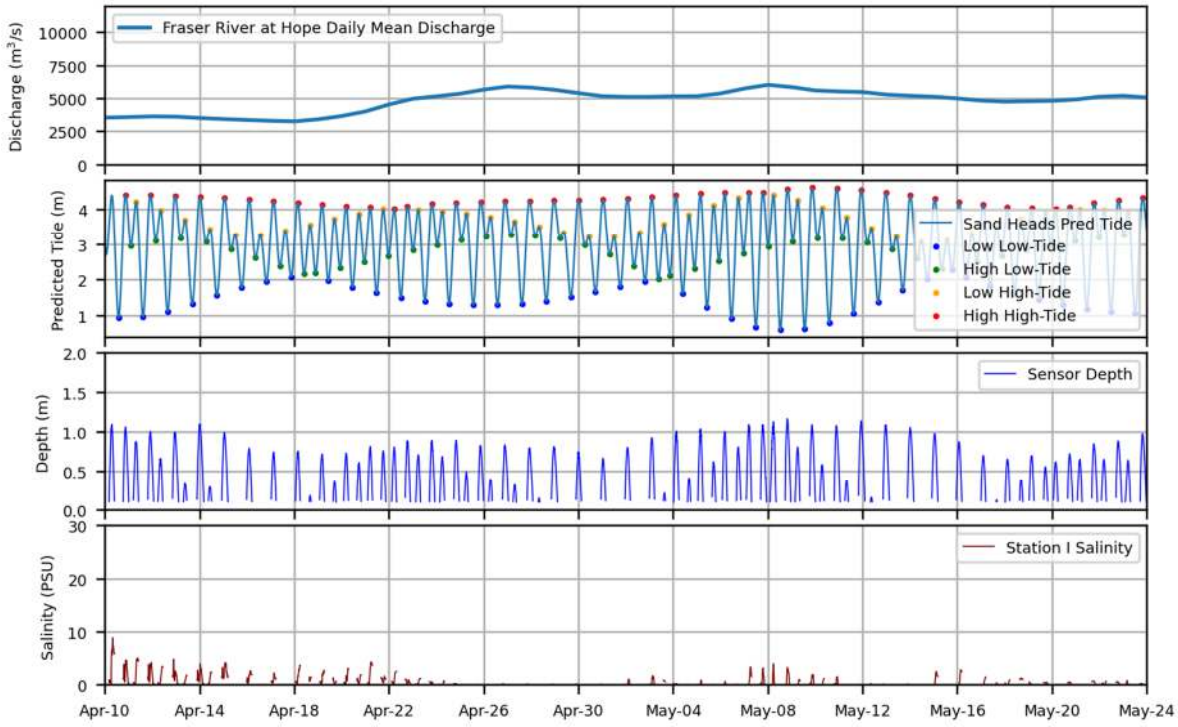

Figure A-2 Fraser River discharge (top panel), tides and depth of inundation (middle panels) and measured salinity (bottom panel) at Station I/L for the period of interest in 2016

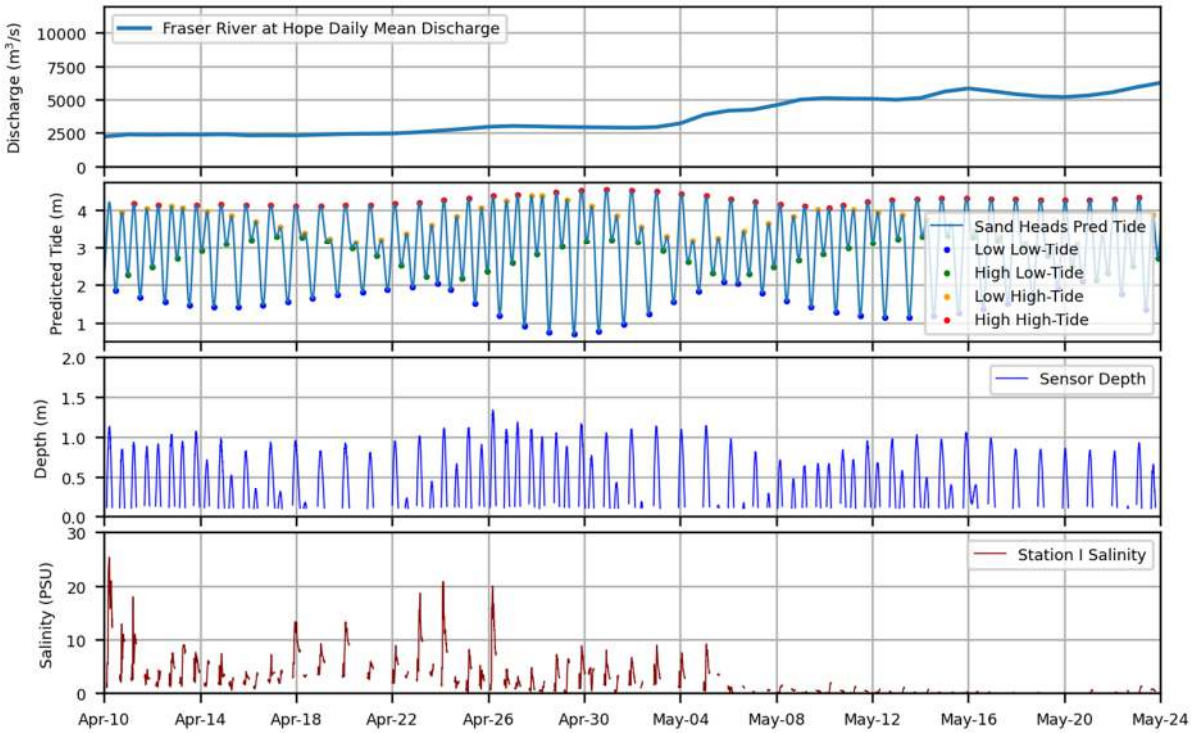

Figure A-3 Fraser River discharge (top panel), tides and depth of inundation (middle panels) and measured salinity (bottom panel) at Station I/L for the period of interest in 2017

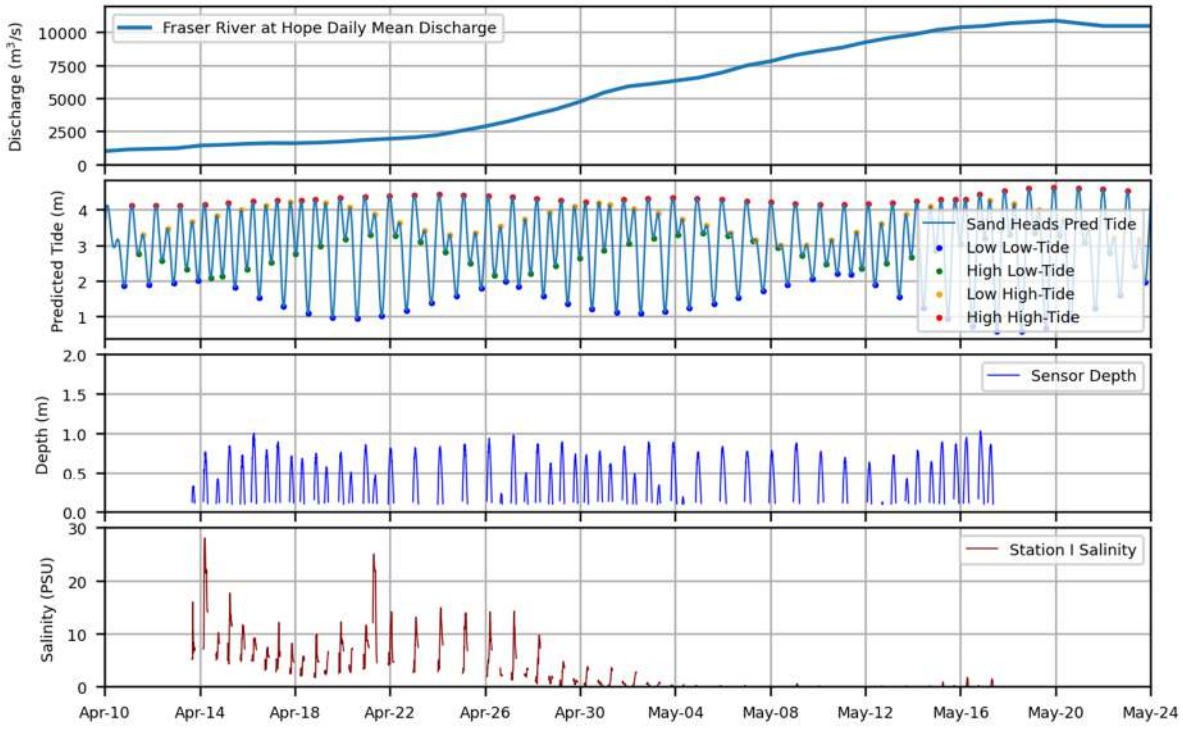

Figure A-4 Fraser River discharge (top panel), tides and depth of inundation (middle panels) and measured salinity (bottom panel) at Station I/L for the period of interest in 2018

A-2.2 Salinity at Station Y

Station Y is located on the southeast side of the marsh complex at Brunswick Point within the Upper Intertidal (UI) biofilm area. Station Y sits at an elevation of 3.6 m CD, which is 0.5 m above mean tide and as such it is inundated less frequently than Station I/L and C. The station is wetted about a quarter of the time (26%) in a typical series of tidal cycles. Given its location is approximately 2 km from Canoe Pass and separated from the main source of freshwater by the marshes of Brunswick Point, salinity at station Y is less directly influenced by freshwater discharge from the Fraser River and so the tidal signal appears more strongly in the salinity record.

Figure A-5 and Figure A-6 show Fraser River discharge, tide, depth of inundation, and measured salinity at Station Y for the period of interest in 2017 and 2018 respectively. There were no data returned at this station in 2016 and in 2017 the timeseries begins on April 26. Due to its relatively high elevation on the tidal flats, the depth of inundation at Station Y is never greater than 1 m except during particularly high spring tides. As a result, periods of more frequent inundation are quite short at this location because the lower high tides that rise to this elevation are less frequent, and there are extended periods of time lasting up to five days during which inundation occurs only once per day, which appears to exert a strong control on salinity.

The salinity variation that occurs on individual inundations is distinctly different from that observed at Station I/L and C. As shown in Figure A-5 and Figure A-6, the typical pattern is that salinity is initially low, increasing with the rising tide, and then dropping only slightly as the tide recedes. This would indicate that fresh water from Canoe Pass is initially floating as a lens over the water as the tide rises, which is carried into the upper intertidal zone at Station Y. Subsequent mixing and influx with more saline waters causes

the salinity to rise, but because the station is further from Canoe Pass than Station I/L, there is less fresh water brought into the site as the tide drops again.

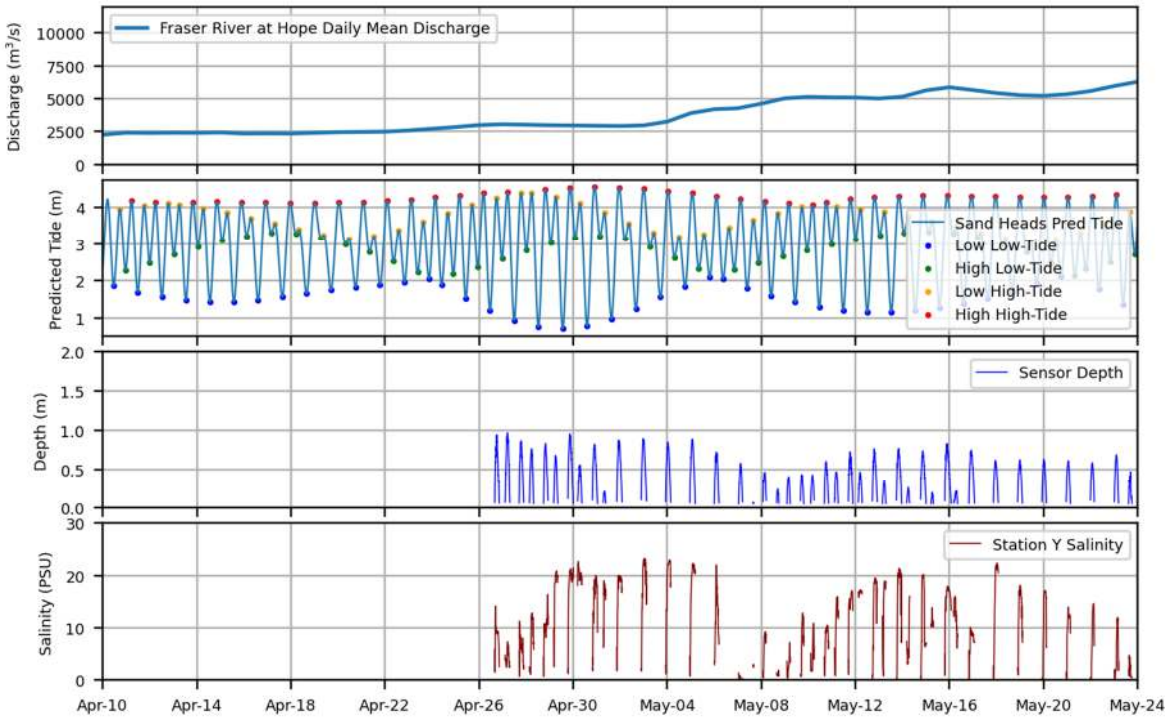

Figure A-5 Fraser River discharge (top panel), tides and depth of inundation (middle panels) and measured salinity (bottom panel) at Station Y for the period of interest in 2017 - in 2017 the timeseries at Station Y begins on 26 April

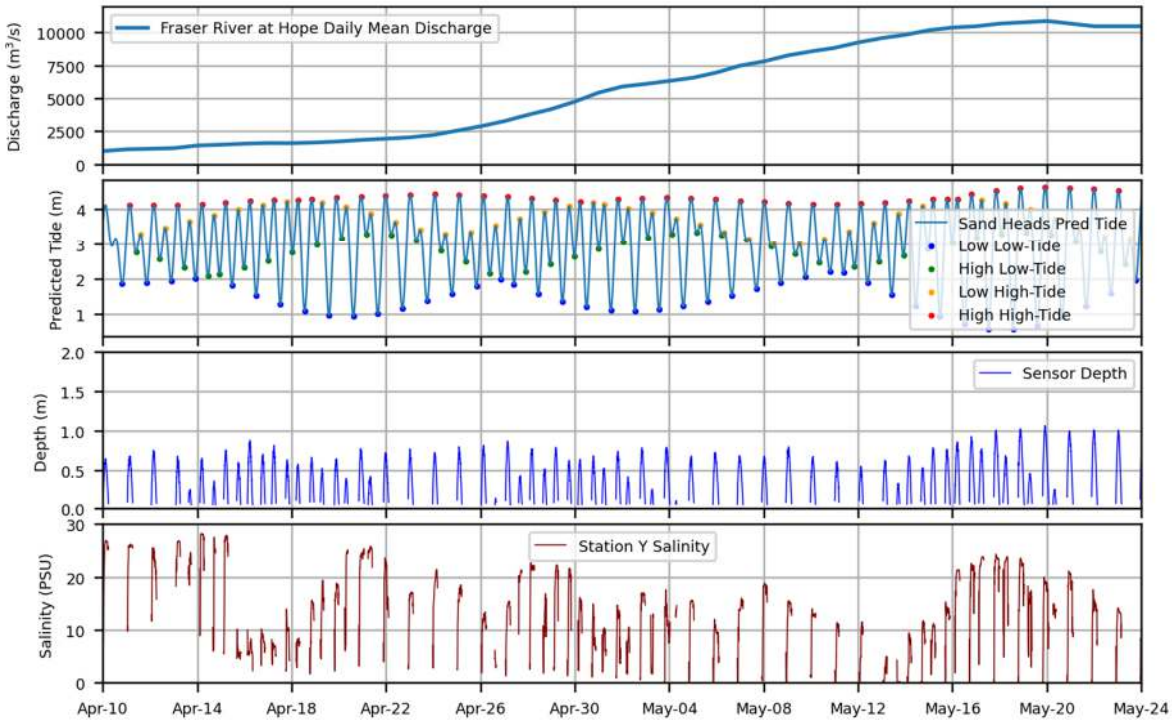

Figure A-6 Fraser River discharge (top panel), tides and depth of inundation (middle panels) and measured salinity (bottom panel) at Station Y for the period of interest in 2018

The general trend that becomes apparent from the two years of data for station Y is that salinity varies more strongly in response to spring and neap tide cycles and is less sensitive to Fraser River discharge.

A-2.3 Salinity at Station C

Station C is located at the upper intertidal area approximately 350 m west of the Roberts Bank causeway within the Upper Intertidal (UI) biofilm area. Station C sits at an elevation of 3.4 m, which is 0.3 m higher than mean tide. At this elevation the station is inundated about 40% of the time during a typical series of tidal cycles. It is quite far removed from the freshwater inputs of Canoe Pass, which is almost 4.5 km to the west but there is a small pump station nearby that periodically discharges fresh water from upland areas into the small intertidal marsh that sits in the elbow between the causeway and the upper shoreline. Timing and rates of freshwater discharge from the pump station are not known but it is assumed to be highest during periods of wet weather. As discussed in the NHC 2018 report (CIAR #1379[3]), there is some evidence that discharge from the pump station can be locally important during periods of particularly wet weather. Related to this effect, data for 2017 were not used in previous analyses and are not presented here because on close inspection the data were found to be unreliable (as described in CIAR #1893).

Figure A-7 and Figure A-8 show Fraser River discharge, tide, depth of inundation, and measured salinity at Station C for the period of interest in 2016 and 2018, respectively. Compared to the measured salinity plots for Stations I/L and Y, the trends at Station C are markedly different. It is particularly noticeable that while there is a relatively large variation in salinity over the period of interest in both years, the range over which salinity varies each day is typically quite small. Given the relatively large distance from the fresh water source at Canoe Pass, this pattern of varying water column salinity indicates a strong influence from tides.

[3] NHC (2018). Roberts Bank Salinity Model Results Verification: Comparison of 2012 Modelled Salinity to 2016 & 2017 Measured Salinity. Report prepared by Northwest Hydraulic Consultants Ltd. for Vancouver Fraser Port Authority. 17 pp.

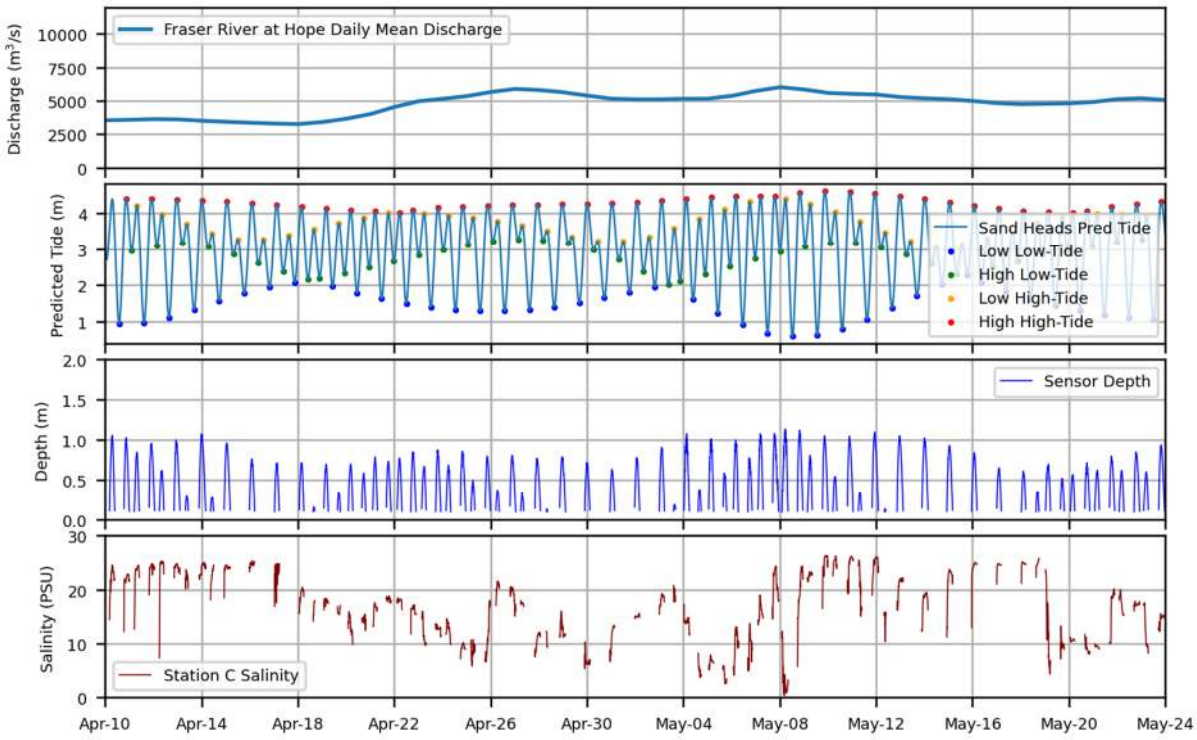

Figure A-7 Fraser River discharge (top panel), depth of inundation (middle panel) and measured salinity (bottom panel) at Station C for the period of interest in 2016

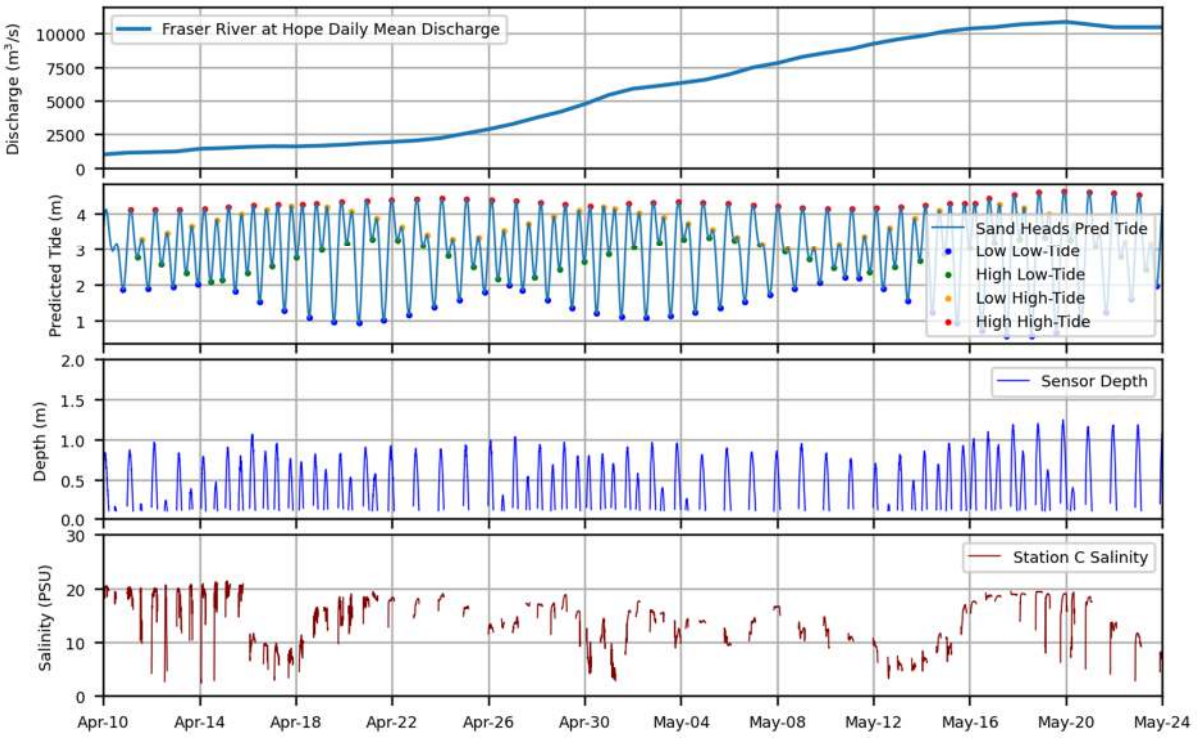

Figure A-8 Fraser River discharge (top panel), depth of inundation (middle panel) and measured salinity (bottom panel) at Station C for the period of interest in 2018

A-3 Predicted changes with the project to the salinity range

This section provides predicted changes with the project to the salinity range in two biofilm polygons within the areas of importance to western sandpipers: 1) Upper Intertidal biofilm polygon (UI1; Figure A-9); and 2) the Canoe Pass biofilm polygon (CP-1; Figure A-10). These predicted changes were calculated from the existing model results following a method described in Section 3.1 of the report.

Salinity Range / Date	< -20	-20 & -18	-18 & -16	-16 & -14	-14 & -12	-12 & -10	-10 & -8	-8 & -6	-6 & -4	-4 & -2	-2 & 0	0 & 2	2 & 4	4 & 6	6 & 8	8 & 10	10 & 12	12 & 14	14 & 16	16 & 18	18 & 20	> 20
10-Apr	0	0	0	0	0	0	0	0	3	50	132	28	0	0	0	0	0	0	0	0	0	0
11-Apr	0	0	0	0	0	0	0	2	42	87	67	16	0	0	0	0	0	0	0	0	0	0
12-Apr	0	0	0	0	0	0	7	20	35	62	70	20	0	0	0	0	0	0	0	0	0	0
13-Apr	0	0	0	0	0	1	8	28	68	65	34	9	0	0	0	0	0	0	0	0	0	0
14-Apr	0	0	0	0	2	4	27	49	46	60	19	4	3	0	0	0	0	0	0	0	0	0
15-Apr	0	0	0	2	20	46	35	29	29	24	25	3	2	0	0	0	0	0	0	0	0	0
16-Apr	0	0	23	39	26	20	20	18	22	19	27	0	0	0	0	0	0	0	0	0	0	0
17-Apr	0	0	0	0	6	26	48	41	27	28	38	0	0	0	0	0	0	0	0	0	0	0
18-Apr	0	0	1	12	36	55	31	21	17	15	22	3	0	0	0	0	0	0	0	0	0	0
19-Apr	0	0	1	12	36	55	31	21	17	15	22	3	0	0	0	0	0	0	0	0	0	0
20-Apr	0	0	0	7	29	49	50	35	17	14	13	1	0	0	0	0	0	0	0	0	0	0
21-Apr	0	0	0	0	29	26	40	53	35	15	17	0	0	0	0	0	0	0	0	0	0	0
22-Apr	0	0	0	2	15	21	33	57	37	31	16	1	0	0	0	0	0	0	0	0	0	0
23-Apr	0	0	0	4	15	22	35	36	35	46	16	4	0	0	0	0	0	0	0	0	0	0
24-Apr	0	0	0	0	13	23	28	78	28	28	12	2	0	0	0	0	0	0	0	0	0	0
25-Apr	0	0	0	9	24	36	27	43	36	26	6	2	1	1	2	1	0	0	0	0	0	0
26-Apr	0	0	0	9	23	35	57	31	30	16	10	1	0	0	0	0	0	0	0	0	0	0
27-Apr	1	5	13	25	45	42	19	14	24	15	9	1	0	0	0	0	0	0	0	0	0	0
28-Apr	0	4	11	30	44	38	25	15	17	22	8	0	0	0	0	0	0	0	0	0	0	0
29-Apr	4	29	40	18	19	17	19	13	16	27	13	0	0	0	0	0	0	0	0	0	0	0
30-Apr	0	1	26	17	17	17	18	21	22	18	43	14	0	0	0	0	0	0	0	0	0	0
01-May	0	0	0	2	14	20	21	25	29	32	71	0	0	0	0	0	0	0	0	0	0	0
02-May	0	4	20	19	18	23	22	17	16	15	52	7	0	0	0	0	0	0	0	0	0	0
03-May	0	8	20	40	41	25	25	18	10	6	9	13	0	0	0	0	0	0	0	0	0	0
04-May	0	0	1	10	23	29	43	33	31	19	11	13	0	0	0	0	0	0	0	0	0	0
05-May	0	0	0	0	0	8	15	39	30	26	49	19	13	10	3	0	0	0	0	0	0	0
06-May	0	0	0	0	0	1	5	29	54	45	18	10	8	36	5	3	0	0	0	0	0	0
07-May	0	0	0	0	0	0	2	24	41	56	22	16	15	32	3	2	0	0	0	0	0	0
08-May	0	0	0	0	0	0	0	4	19	54	40	31	32	22	7	4	0	0	0	0	0	0
09-May	0	0	0	0	0	0	1	10	26	47	38	43	34	9	4	2	0	0	0	0	0	0
10-May	0	0	0	0	0	1	4	9	31	59	60	35	12	2	0	0	0	0	0	0	0	0
11-May	0	0	0	1	8	20	35	57	52	28	10	1	0	0	0	0	0	0	0	0	0	0
12-May	0	6	15	17	30	43	33	34	17	12	6	0	0	0	0	0	0	0	0	0	0	0
13-May	2	10	46	28	19	19	19	20	23	13	14	0	0	0	0	0	0	0	0	0	0	0
15-May	0	1	9	19	21	21	22	30	21	28	30	11	0	0	0	0	0	0	0	0	0	0
16-May	0	0	12	17	19	22	27	23	22	33	38	1	0	0	0	0	0	0	0	0	0	0
17-May	0	1	27	48	22	21	19	20	14	11	26	2	0	0	0	0	0	0	0	0	0	0
18-May	0	0	3	17	56	43	36	24	13	9	14	0	0	0	0	0	0	0	0	0	0	0
19-May	0	0	0	0	7	27	32	37	54	35	17	5	0	0	0	0	0	0	0	0	0	0
20-May	0	0	0	1	12	27	42	60	25	27	17	1	1	0	0	0	0	0	0	0	0	0
21-May	0	0	0	0	2	9	26	40	51	53	21	12	0	0	0	0	0	0	0	0	0	0
22-May	0	0	0	1	3	9	37	48	37	37	28	8	7	0	0	0	0	0	0	0	0	0
23-May	0	0	1	12	23	32	26	31	39	25	19	4	2	0	0	0	0	0	0	0	0	0
24-May	0	0	0	0	8	20	57	37	33	40	15	3	0	0	0	0	0	0	0	0	0	0

Figure A-9 Area (ha) within Upper Intertidal biofilm polygon (214 ha) predicted to experience a change in salinity range presented in 2 PSU range bins

Salinity Range / Date	< -20	-20 & -18	-18 & -16	-16 & -14	-14 & -12	-12 & -10	-10 & -8	-8 & -6	-6 & -4	-4 & -2	-2 & 0	0 & 2	2 & 4	4 & 6	6 & 8	8 & 10	10 & 12	12 & 14	14 & 16	16 & 18	18 & 20	> 20
10-Apr	0	0	0	0	0	0	0	0	0	3	27	61	8	7	4	0	0	0	0	0	0	0
11-Apr	0	0	0	0	0	0	0	0	0	2	26	71	10	0	0	0	0	0	0	0	0	0
12-Apr	0	0	0	0	0	0	0	1	3	17	21	53	15	0	0	0	0	0	0	0	0	0
13-Apr	0	0	0	0	0	0	0	0	1	10	20	27	46	5	0	0	0	0	0	0	0	0
14-Apr	0	0	0	0	0	0	0	0	0	0	0	20	43	35	11	1	0	0	0	0	0	0
15-Apr	0	0	0	0	0	0	0	0	0	1	3	20	43	23	19	0	0	0	0	0	0	0
16-Apr	0	0	0	0	0	0	0	6	12	15	29	18	24	5	0	0	0	0	0	0	0	0
17-Apr	0	0	0	0	0	0	0	2	5	6	8	41	22	15	8	3	0	0	0	0	0	0
18-Apr	0	0	0	0	0	0	0	2	2	10	12	16	29	21	17	0	0	0	0	0	0	0
19-Apr	0	0	0	0	0	0	0	2	2	10	12	16	29	21	17	0	0	0	0	0	0	0
20-Apr	0	0	0	0	0	1	3	2	4	4	3	22	31	29	11	0	0	0	0	0	0	0
21-Apr	0	0	0	0	0	0	1	0	1	12	25	26	24	18	2	0	0	0	0	0	0	0
22-Apr	0	0	0	0	0	0	0	0	2	3	9	27	23	22	19	4	0	0	0	0	0	0
23-Apr	0	0	0	0	0	0	1	1	2	7	20	38	30	10	0	0	0	0	0	0	0	0
24-Apr	0	0	0	0	0	0	0	0	0	5	35	51	15	3	0	0	0	0	0	0	0	0
25-Apr	0	0	0	0	0	0	0	0	0	0	0	1	36	19	12	15	24	2	0	0	0	0
26-Apr	0	0	0	0	0	0	0	0	3	12	25	18	25	20	6	0	0	0	0	0	0	0
27-Apr	0	0	0	0	0	0	0	1	2	1	2	2	13	16	36	23	16	0	0	0	0	0
28-Apr	0	0	0	0	0	0	0	0	5	5	7	21	16	16	20	12	5	2	0	0	0	0
29-Apr	0	0	0	0	1	6	7	8	15	40	27	4	2	0	0	0	0	0	0	0	0	0
30-Apr	0	0	0	0	0	0	0	0	9	21	40	28	10	1	0	0	0	0	0	0	0	0
01-May	0	0	0	0	0	0	0	0	0	0	44	31	17	11	5	1	0	0	0	0	0	0
02-May	0	0	0	2	3	2	3	4	10	24	62	0	0	0	0	0	0	0	0	0	0	0
03-May	0	0	0	0	1	1	2	1	3	4	14	71	11	0	0	0	0	0	0	0	0	0
04-May	0	0	0	0	0	0	0	0	0	5	21	51	16	10	6	0	0	0	0	0	0	0
05-May	0	0	0	0	0	0	0	1	1	9	63	21	12	3	0	0	0	0	0	0	0	0
06-May	0	0	0	0	0	0	0	0	4	11	50	28	14	3	0	0	0	0	0	0	0	0
07-May	0	0	0	0	0	0	0	3	5	24	62	10	2	3	0	0	0	0	0	0	0	0
08-May	0	0	0	0	0	0	0	0	2	40	47	14	4	3	0	0	0	0	0	0	0	0
09-May	0	0	0	0	0	0	0	0	0	2	52	39	14	3	0	0	0	0	0	0	0	0
10-May	0	0	0	0	0	0	0	0	0	3	51	34	21	0	0	0	0	0	0	0	0	0
11-May	0	0	0	0	0	0	0	0	0	0	7	47	28	13	13	1	0	0	0	0	0	0
12-May	0	0	0	0	0	0	1	6	7	6	9	45	15	15	5	0	0	0	0	0	0	0
13-May	0	0	0	0	0	0	3	10	11	13	54	19	0	0	0	0	0	0	0	0	0	0
15-May	0	3	12	12	12	14	13	15	12	13	4	0	0	0	0	0	0	0	0	0	0	0
16-May	0	0	1	3	5	5	6	8	13	19	39	11	0	0	0	0	0	0	0	0	0	0
17-May	0	0	0	0	0	0	0	1	1	1	31	59	12	3	0	0	0	0	0	0	0	0
18-May	0	0	0	0	1	1	2	4	4	18	56	19	5	0	0	0	0	0	0	0	0	0
19-May	0	0	0	0	0	0	0	0	5	16	48	20	12	9	0	0	0	0	0	0	0	0
20-May	0	0	0	0	0	1	1	4	30	38	25	11	0	0	0	0	0	0	0	0	0	0
21-May	0	0	0	0	0	0	0	0	0	2	15	61	24	7	0	0	0	0	0	0	0	0
22-May	0	0	0	0	0	0	0	0	0	0	14	75	18	2	0	0	0	0	0	0	0	0
23-May	0	0	0	0	0	0	0	0	0	1	50	59	0	0	0	0	0	0	0	0	0	0
24-May	0	0	0	0	0	0	0	0	3	30	44	27	5	0	0	0	0	0	0	0	0	0

Figure A-10 Area (ha) within Canoe Pass biofilm polygon (110 ha) predicted to experience a change in salinity range presented in 2 PSU range bins

Appendix B Overview of Indigenous consultation on biofilm and western sandpiper

Appendix B Overview of Indigenous consultation on biofilm and western sandpiper

1. Background

Throughout the environmental assessment process, the Vancouver Fraser Port Authority (port authority) continues to be committed to meaningful Indigenous consultation guided by Indigenous knowledge, relationships, and environmental and cultural stewardship.

The port authority began its Indigenous consultation activities early in the Roberts Bank Terminal 2 (RBT2) Project planning process in 2011. The prioritization of a thorough and comprehensive ongoing consultation process with Indigenous groups through the different phases of the RBT2 environmental assessment process has resulted in significant ecological and cultural enhancements to the project, and increased benefits to Indigenous communities. The port authority's multi-phased consultation program has allowed for the integration of Indigenous knowledge throughout all phases of project development.[1]

1.1 Biofilm and western sandpiper consultation

Specifically, the port authority has been consulting with Indigenous groups on topics of interest related to biofilm and western sandpipers and has been providing ongoing opportunities for participation through one-on-one meetings, multi-group workshops, site visits, and document review, as well as employment opportunities.

To support an iterative process on the development of biofilm and western sandpiper initiatives, the port authority has held regular meetings with Indigenous groups and government agencies. Most recently in 2022, we have held one-on-one meetings and three multi-group Indigenous workshops on the topics noted below:

- February 9 – biofilm creation project, site selection criteria, evaluation matrix, and preliminary site evaluation
- April 6 – biofilm updates, 2022 sampling program, biofilm creation project and manual update
- June 1 – update on biofilm submission, biofilm field work including sampling and Indigenous group site visits (presentation slides included at end of appendix)
- July-August (dates being confirmed) – evaluate biofilm habitat creation sites through secondary criteria; review results of biofilm sampling work

Field work and follow-up opportunities have been offered to Indigenous groups during the environmental assessment. Most recently, employment opportunities were offered to 16 Indigenous groups (Roberts Bank) to support the port authority in biofilm sampling, data collection, including physical and biological parameters (e.g., site topography, surface slope, species presence, ecological values), and general land use observations to evaluate candidate biofilm habitat creation sites and proposed offsetting sites. Two members of Tsawwassen First Nation participated in the fieldwork during May and June to support several biofilm initiatives.

[1] This iterative and ongoing effort to resolve issues in partnership with Indigenous groups has been documented in Interest and Issue Tracking tables (CIAR #1360) and within responses to information requests.

2. Biofilm habitat creation guidance manual

During the public hearing for the project in May and June 2019, the port authority committed to developing a manual that describes methods and techniques to construct biofilm habitat and supports the expansion of knowledge of biofilm ecology, incorporating and reflecting in the manual Indigenous knowledge from one-on-one meetings and workshop participation.

The port authority conducted early consultation and engagement with Indigenous groups and Environment and Climate Change Canada to inform the first version of the manual. As a first step to develop the manual, the port authority held a biofilm workshop over three days in October 2019. This included a site visit to Roberts Bank as an opportunity to share local biofilm, shorebird, habitat restoration knowledge and experiences among experts and representatives of Indigenous groups.

The port authority shared a draft version of the biofilm habitat creation guidance manual with Indigenous groups and government agencies in February 2021 for review and feedback. Subsequently, in April 2021, the port authority held a biofilm focused multi-group Indigenous and government agency workshop to discuss the biofilm habitat creation guidance manual, the biofilm habitat creation project, and a biofilm technology trial (drone mapping at Roberts Bank and Westham Island). Following further consultation on the manual, and the integration of Indigenous and agency input, the port authority will be sharing the next iteration of the manual for review in summer 2022.

3. Biofilm habitat creation project

The biofilm habitat creation project involves collaborating with Indigenous groups to create additional wetland suitable for intertidal biofilm, apply techniques described in the biofilm habitat creation guidance manual, advance research on biofilm habitat creation and ecological function. Indigenous knowledge has continued to inform this project through consultation and site visits. Specifically, Indigenous groups have identified sites to be considered for biofilm habitat creation or enhancement and informed the criteria for selecting a site for biofilm habitat creation. Of the 17 sites identified, 10 sites are undergoing further evaluation to assess their potential to support biofilm, technical feasibility, and relevance to shorebirds.

To support Indigenous traditional knowledge and input in evaluating candidate biofilm habitat creation sites and proposed offsetting sites, Indigenous groups have also been invited to participate in multi-nation three-day field visits. Ten Indigenous groups will be visiting the 10 candidate biofilm sites to inform selection of a site suitable for biofilm creation and/or enhancement. Based on input from Indigenous groups, the Roberts Bank inter-causeway has been prioritized as a potential site for enhancing biofilm as part of the Tsawwassen Marshland Project. Consultation with Indigenous groups on this opportunity continues.

4. Minister of environment and climate change Canada's information request

In response to the minister's information request in August 2020, the port authority undertook extensive consultation with Indigenous groups, which included 176 one-on-one meetings and 16 multi-groups workshops on approach and content, as well as on the draft responses. Specific to IR2020-4 (CIAR #2083) regarding biofilm and effects to migratory birds, we met with Indigenous groups through one-on-one meetings and workshops, to ensure the response to the information request was reflective of Indigenous knowledge and feedback.

5. Indigenous participation in 2022 biofilm spring sampling program

Based on previous Indigenous consultation, the port authority has conducted fieldwork at 10 candidate sites for the biofilm habitat creation project. Indigenous groups have been engaged in fieldwork employment opportunities, as well as consultation site visits to biofilm habitat creation sites and proposed offsetting sites.

6. Indigenous participation within recent public comment period

The port authority has continued to consult with Indigenous groups on the Impact Assessment Agency of Canada's proposed draft conditions through 71 specific meetings on the draft conditions. Submissions from Indigenous groups included suggestions to revise or add to the draft conditions, which were responded to within the port authority submissions.

Malahat Nation submitted comments regarding biofilm related to specific draft conditions 10.2, 10.13, and 10.14 to the Impact Assessment Agency of Canada. With respect to draft condition 10.2, it was expressed that the draft condition does not go far enough in ensuring that the project will not significantly impact biofilm in the vicinity of the project, and a request was made for measurable targets for biofilm health in the area surrounding the project and a commitment to additional compensation and biofilm enhancement measure if targets are missed. With this feedback, the port authority is suggesting revisions and new conditions pertaining to biofilm to better reflect the breadth of mitigation measures and follow-up that will be implemented, in consultation with Indigenous groups, to protect biofilm.

Several groups submitted letters on the public registry to speak to consultation, and collaboration, on biofilm more broadly, including Musqueam Indian Band and Ts'uubaa-asatx Nation:

> "Musqueam and the Port Authority are committed to continuing their ongoing work related to biofilm and Western sandpiper at Roberts Bank. Musqueam is actively collaborating with the Port Authority to identify, evaluate and select a biofilm creation project site. This collaboration as well as work being done on the offsetting plan, aligns with Musqueam's stewardship vision. Musqueam is also participating in the Port Authority's process for evaluating potential biofilm habitat enhancement project sites. Currently, ten sites have passed the primary evaluation (including the inter-causeway and sturgeon bank) and are being further evaluated. Musqueam and the Port Authority remain committed to working together on priority biofilm creation projects in addition to other sites of interest.
>
> Since the Port Authority committed to developing a manual describing methods and techniques to construct biofilm habitat and support the expansion of knowledge of biofilm ecology in June 2019, Musqueam has continued to engage with the Port Authority and technical experts identifying and documenting existing knowledge and known practices for developing biofilm habitat. Musqueam remains committed to providing feedback on this process and working with the Port Authority on the development of the Biofilm Habitat Creation Guidance Manual." (CIAR #3340) – Musqueam Indian Band
>
> "We are and will continue to be very active and collaborative in the VFPA Biofilm programs. We are very excited about this project and have attended site inspections and will continue to attend site visits, Indigenous Group meetings, one-to-one meetings, etc. related to the Biofilm programs and other programs. However, we wish to express our deep appreciation to the attention to detail and commitment to not only the understanding of biofilm, but also to the restoration projects in this area." (CIAR #3543)
> – Ts'uubaa-asatx Nation

6.1 Port authority's proposed new and revised biofilm conditions

The port authority provided an overview of the proposed measures to protect biofilm and western sandpipers through one-on-one meetings and at a multi-group workshop on June 1, 2022 (see presentation below). Several revisions were made to the proposed conditions based on input received from Tsawwassen First Nation and Musqueam Indian Band, including the following:

- A new sub-condition related to the application of the biofilm habitat creation guidance manual
- Additional rationale and language regarding the determination of population-level effect and follow-up program duration
- Expanded rationale to highlight where the proposed approach is consistent with the views expressed by Indigenous groups

The port authority will continue to consult with Indigenous groups on the development of the proposed measures to ensure Indigenous knowledge is reflected in the follow-up program and adaptive management measures, and to facilitate ongoing employment and follow-up opportunities for Indigenous groups.

Consultation material presented June 1, 2022

Project updates: biofilm submission

- Impact Assessment Agency of Canada's public comment period on the Project has concluded
- On April 22, 2022, we shared part one of our submission in response to IAAC's invitation to comment on the draft conditions and submissions by other parties, including Indigenous groups, and to support decision-making
  - Our submission and executive summary also shared with Indigenous groups on April 26, 2022
  - Supplementary submission in response to Indigenous groups comments made after preparation of our main submission was shared with IAAC on Friday, May 13, 2022
- In mid June we will provide the remainder of our response, focusing on biofilm and western sandpiper

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Project updates: biofilm submission

- Submission will include:
  - Response to comments on biofilm and western sandpiper in the submissions of Indigenous groups and other parties
  - Feedback on the draft conditions related to biofilm and western sandpiper
- Feedback on conditions reflects
  - Formalizing prior commitment (IR4) to advance the creation of biofilm habitat
  - Ongoing development of the Follow-up Program (FUP), reflecting high interest and feedback on biofilm
  - Enhanced FUP monitoring and adaptive management

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Project updates: biofilm studies

- 2022 Biofilm Sampling (April – June 2022)
  - Support the implementation of project commitments related to biofilm and western sandpiper
  - Indigenous knowledge and data will support project work including the biofilm habitat creation manual, the biofilm habitat creation project, and ongoing offsetting sites

- Over the last eight weeks (April 8-9, April 16-17, April 21-23, April 28-29, May 6-7, May 13-14, May 19-20, May 26-27), 17 biofilm sampling days occurred at Brunswick Point and Westham Island
  - Indigenous participation from TFN
- Sampling to continue until early June, including additional sampling at potential biofilm creation and offsetting sites

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Project updates: biofilm habitat creation & offsetting

- Biofilm habitat creation & offsetting projects (May – June 2022)
  - Site visits to incorporate Indigenous knowledge and input to evaluate potential biofilm habitat creation, and inform and further develop offsetting projects
  - Technical site visits – biofilm sampling and data collection
  - Multi-nation site visits to potential biofilm creation and offsetting sites
    - June 10 – Sturgeon Bank, Main Arm Site 3, Steveston Island South
    - June 16 - North Arm Jetty, Iona Beach 2, North Arm Log Lagoon, North Arm McDonald Park
    - June 17 – Semiahmoo Bay Little Campbell River, Roberts Bank inter-causeway, Tilbury Island

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Appendix C Overview of measures proposed since the federal review panel report

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Briefing note

Roberts Bank Terminal 2: biofilm and western sandpipers

Key takeaways

(1) As a federal agency, the Vancouver Fraser Port Authority is dedicated to rigorous, evidence-based environmental mitigation and habitat enhancement, to ensure that Canada's trade through the Port of Vancouver occurs within a context of strong environmental protection
(2) In response to feedback from agencies and input from Indigenous groups, the port authority has made many changes and improvements to the project design to reduce project footprint and impact on the local areas
(3) In part two of its two-part submission, the port authority will soon respond to comments received during the public comment period, provide feedback, and recommend additional conditions related to biofilm and western sandpipers, including a follow-up program with adaptive management measures, as outlined below

Proposed new measures to protect western sandpipers and biofilm

Precautionary construction approach

As part of its two-part submission to the Impact Assessment Agency of Canada, the port authority is providing feedback on the current federal draft conditions. This includes recommended enhancements to the draft conditions, as well as new substantial proposed conditions, including a precautionary construction with a backstop approach—an adaptive management measure to be implemented if follow-up program monitoring demonstrates the need—that addresses ECCC's stated concern that project-associated salinity changes at Roberts Bank could result in an immediate population-level risk to western sandpipers.

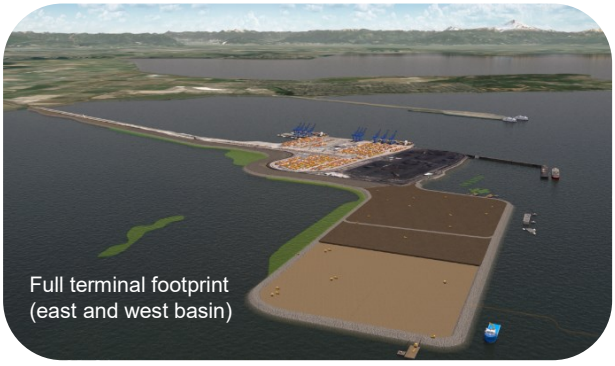
The proposed Roberts Bank Terminal 2 construction method involves sequentially developing two terminal containment dykes (east and west basins), then filling each with material to create the terminal landmass. The east terminal containment dyke would be completed first, with dredged fill starting to be added approximately a month later.

The precautionary construction with backstop approach would involve monitoring for evidence of early signals of an immediate population level effect on western sandpipers in the months following completion of the east terminal containment dyke during western sandpiper northward migration. The port authority proposes that the monitoring program be developed with input from Indigenous groups and key regulators, including ECCC, and that clear criteria be established.

The staged approach to construction of the east basin containment dyke of the marine terminal provides an opportunity to monitor for any immediate effect of the predicted change in salinity during the material time of year for western sandpipers (i.e., northward migration and subsequent breeding), prior to construction of the full terminal footprint (east and west basins).

If, at that time, there are early signals of an immediate population-level effect on western sandpipers, the port authority will implement a range of adaptive management measures, which may include removal of

the east terminal dyke constructed to that point in time, which would effectively result in project discontinuation and deconstruction.



This graphic does not depict a causeway breach or terminal breach. We have committed to a breach at the terminal, and we are studying the feasibility of an alternative breach along the causeway.

Indigenous knowledge and collaboration

Since 2011, the port authority has consulted with 46 Indigenous groups, as directed by the Impact Assessment Agency of Canada. This has allowed for the integration of Indigenous knowledge throughout all phases of project development. Indigenous knowledge has been used in the biofilm creation manual and offsetting and biofilm habitat creation site selection and will continue to be used in site monitoring. Some specific examples include the following:

- Musqueam noted that creating biofilm as it relates to other initiatives such as offsetting mudflats marries well with Indigenous knowledge approach of how all things are connected. Musqueam also noted that looking at names of the areas for biofilm study is important, as place names are key in informing what the area previously looked like.
- Tsawwassen First Nation noted that some of channels coming off the mouth of the river at Canoe Pass will vacillate back and forth over time and will have an effect on biofilm. As this is not a deep area of water, with silt coming in and out, biofilm needs to be considered within this dynamic environment.

The port authority is collaborating with Tsawwassen First Nation on the Tsawwassen Marshland Offsetting Project, which is considering opportunities to include a biofilm habitat creation component in the intercauseway area as a holistic approach to ecological stewardship

Existing commitments to protect western sandpipers and biofilm

The port authority has been studying biofilm and western sandpipers for more than 10 years, scoping studies and field programs with input from ECCC, biofilm and western sandpiper experts, Indigenous groups, and Indigenous knowledge holders. Based on federal government engagement and Indigenous group consultation, the port authority has worked to avoid and reduce potential effects of the project through project location, design changes, and optimizations to avoid and reduce potential effects from the project.

Project design elements

- The terminal will be located in deep waters, several kilometers away from sensitive intertidal habitats that support biofilm and shorebirds, and far from Indigenous and residential communities

- The original terminal, causeway, and dredge footprint design have now been reduced by 17.9 hectares to avoid and reduce effects to Roberts Bank
- The tug basin layout design has been adjusted to reduce marine habitat disturbance and protect existing mudflats
- We have committed to further project modifications to include either a breach at the terminal or along the causeway

Enhancing science and knowledge

The port authority has continued work on biofilm in consultation with Indigenous groups and agencies. This includes:

- Carrying out more than 20 biofilm and shorebird studies, including conducting an additional three years of biofilm studies after the environmental impact statement submission
- Establishing a biofilm and shorebirds technical advisory group with involvement from local and international shorebird and biofilm experts to inform the design of baseline studies
- Meetings with ECCC to present and discuss baseline study designs and results prior to submitting the environmental impact statement
- Implementing a study in spring 2021 to investigate the potential to map biofilm using drone technology

Follow-up program and mitigation

The port authority is committed to implementing follow-up programs in consultation with ECCC and Indigenous groups to verify effect assessment predictions on western sandpiper prey distribution and abundance (including biofilm), and predictions of project related effects on salinity in the water column.

Biofilm habitat creation project and guidance manual

Since early 2021, the port authority has been actively assessing local opportunities in the Fraser River Estuary in consultation with Indigenous groups. The port authority is committed to advancing the feasibility assessment of an intertidal biofilm habitat creation project that would support western sandpipers. Indigenous groups are participating in the port authority's biofilm habitat creation project by providing input on the site selection criteria; participating in initial evaluations of potential biofilm creation sites and their relevance to shorebirds; employment opportunities to sample biofilm; and gathering Indigenous knowledge during site visits (11 indigenous groups are participating in site visits in June) and in multi-group Indigenous group workshops with agencies such as ECCC.

In consultation with and input from Indigenous group and technical experts, the port authority is developing a biofilm habitat creation guidance manual to support the expansion of knowledge and biofilm ecology. The manual, which is now in the final stages of development, will identify and document existing knowledge and practices for developing biofilm habitat. The methods and techniques outlined in the manual are scalable from small projects to large sites and can guide both restoration and creation of biofilm habitat.

Appendix D Port authority feedback on draft conditions related to biofilm and western sandpiper

Appendix D Port authority feedback on draft conditions related to biofilm and western sandpiper

Roberts Bank Terminal 2 public comment period draft conditions review

Condition #	Condition	Feedback / rationale Part one submission, April 22, 2022 **Part two submission, June 10, 2022**	Suggested revision *Part One submission, April 22, 2022* ***Part two submission, June 10, 2022***
2	**General conditions**		
2.13	The Proponent shall publish on the Internet the annual reports and the executive summaries referred to in conditions 2.10 and 2.12, greenhouse gas reduction plan and monitoring results referred to in conditions 3.2 and 3.3, biofilm follow-up program results referred to in conditions 10.14, the reports related to accidents and malfunctions referred to in conditions 19.6.3 and 19.6.4, the accident and malfunction communication plan referred to in condition 19.7, the schedules referred to in conditions 20.1 and 20.2, and any update or revision to the above documents, upon submission of these documents to the parties referenced in the respective conditions. The Proponent shall keep these documents publicly available for 15 years following their publication. The Proponent shall notify the Agency and Indigenous groups of the availability of these documents within two business days of their publication.	• The port authority would, through normal practice, notify all Indigenous groups as defined in draft conditions 1.22 to 1.24 (not only the "Indigenous groups" as currently defined in draft condition 1.22) of the availability of these documents. • See also comments on draft condition 1.22 in Part One of the port authority's April 22, 2022, submission (CIAR #3546). • The port authority notes that, depending on whether and how the minister chooses to alter the draft conditions pertaining to the salinity, biofilm, western sandpiper effect pathway, addressed in the port authority's feedback below, the highlighted reference in this draft condition to condition 10.14 may need to be revised.	The port authority suggests the following revision: The Proponent shall publish on the Internet the annual reports and the executive summaries referred to in conditions 2.10 and 2.12, greenhouse gas reduction plan and monitoring results referred to in conditions 3.2 and 3.3, biofilm follow-up program results referred to in conditions 10.14, the reports related to accidents and malfunctions referred to in conditions 19.6.3 and 19.6.4, the accident and malfunction communication plan referred to in condition 19.7, the schedules referred to in conditions 20.1 and 20.2, and any update or revision to the above documents, upon submission of these documents to the parties referenced in the respective conditions. The Proponent shall keep these documents publicly available for 15 years following their publication. The Proponent shall notify the Agency and Indigenous groups *(Roberts Bank)*, *Indigenous groups (marine shipping), and Indigenous groups (Fraser River)* of the availability of these documents within two business days of their publication.
10	**Avifauna**		
10.2	The Proponent shall document, prior to construction and in consultation with internationally recognized and published experts on biofilm ecology, Indigenous groups, and Environment and Climate Change Canada, methods and best practices to create biofilm habitat, including details about the production of lipids, with specific reference to fatty acids in the Fraser River estuary. The Proponent shall publish a document compiling the results of its research on its website and shall provide it to the Agency prior to construction. The Proponent shall incorporate current knowledge peer-reviewed science in the document and shall update the document at years 2, 5, and 10 following the end of construction based on emerging knowledge and science, including science developed as part of condition 10.14.	• The port authority notes that biofilm habitat creation involves other technical expertise in addition to biofilm ecology, such as coastal geomorphological processes and mudflat habitats. The condition should provide for consultation with relevant experts (where "relevant" is similar in meaning as its use in the defined term "relevant authorities"). • Tsawwassen First Nation indicated they do not have concerns with these suggested revisions, provided that the most qualified and recognized subject matter experts in the field are consulted. • The port authority notes that the term "published" is vague and not necessarily indicative of relevant expertise nor is it the sole indicator of relevant expertise. Relevant and widely recognized experts may demonstrate expertise through information produced outside of traditional publishing channels, such as reports, policy literature, working papers, white papers, plans, and so on. The term "qualified", as it is used in the defined terms "qualified individual" and "qualified professional" would be a more appropriate criterion. • The port authority understands the use of the term "research" in this condition refers to the methods and best practices specified earlier in the condition, and not other research conducted by the port authority. This should be clarified in the condition. • The port authority notes that the methods and best practices would be updated to incorporate lessons learned through the implementation of other conditions, including the creation or enhancement of biofilm habitat proposed in the new condition below. This suggested revision is consistent with feedback received from Tsawwassen First Nation during the development of this submission. • See also comments on draft condition 1.22 in Part One of the port authority's April 22, 2022, submission (CIAR #3546).	The port authority suggests the following revisions: The Proponent shall document, prior to construction and in consultation with *qualified* internationally recognized ~~and published~~ experts ~~on~~ *that are in possession of specialist or expert information or knowledge with respect to* biofilm ecology *and other relevant disciplines*, Indigenous groups *(Roberts Bank)*, and Environment and Climate Change Canada, methods and best practices to create biofilm habitat, including details about the production of lipids, with specific reference to fatty acids in the Fraser River estuary. The Proponent shall publish a document compiling the results of ~~its research~~ *this work* on its website and shall provide it to the Agency prior to construction. The Proponent shall incorporate current knowledge *and* peer-reviewed science in the document and shall update the document at years 2, 5, and 10 following the end of construction based on emerging knowledge and science, including *knowledge and* science developed ~~as part of~~ *in accordance with* condition 10.14 *and condition 10.XX* [new condition proposed below pertaining to the design and implementation of any biofilm habitat creation/enhancement].

Condition #	Condition	Feedback / rationale Part one submission, April 22, 2022 **Part two submission, June 10, 2022**	Suggested revision *Part One submission, April 22, 2022* ***Part two submission, June 10, 2022***
		• Minor revisions are suggested for clarity to correct typographical errors. • The port authority notes that, depending on whether and how the minister chooses to alter the draft conditions pertaining to the salinity, biofilm, western sandpiper effect pathway, addressed in the port authority's feedback below, the highlighted reference in this draft condition to condition 10.14 may need to be revised.	
New		• In designing and implementing any biofilm habitat creation or enhancement project, the port authority intends to apply the methods and best practices documented in the biofilm habitat creation guidance manual prepared in accordance with draft condition 10.2 (and already provided, in draft form, to ECCC and Indigenous groups for review and comment). • As noted above, lessons learned through the creation or enhancement of biofilm habitat pursuant to this proposed condition would be incorporated into the methods and best practices developed pursuant to draft condition 10.2. This suggested revision is consistent with feedback received from Tsawwassen First Nation during the development of this submission. • In addition, in the event that the methods and best practices documented in the biofilm habitat creation guidance manual cannot be applied, the port authority would document the reasons and the alternative methods and practices applied. This suggested revision is consistent with feedback received from Tsawwassen First Nation during the development of this submission.	The port authority suggests the following new condition: *10.2.1 In designing and implementing any biofilm habitat creation or enhancement, including any biofilm habitat creation or enhancement included in any wetland compensation plan developed pursuant to condition 9.2 and any biofilm habitat creation or enhancement implemented as a mitigation measure pursuant to condition 2.5.5 or 9.4.4, the Proponent shall apply the methods and best practices documented pursuant to condition 10.2.* *10.2.2 If the methods and best practices documented pursuant to condition 10.2 cannot be applied to biofilm habitat creation or enhancement undertaken by the Proponent, the Proponent shall document the reasons and the alternative methods or practices applied. The Proponent shall provide the reasons and the alternative methods or practices applied to the Agency, Indigenous groups (Roberts Bank), and Environment and Climate Change Canada.*
New		• As stated in the response to the minister's information request (Appendix IR2020-4-A, CIAR #2083), the port authority intends to implement a biofilm creation or enhancement project, should RBT2 be approved. • In recognition of the ecological importance of biofilm and the many opportunities to enhance areas available to western sandpiper and building on the intention stated in Appendix IR2020-4-A, the port authority is already exploring the implementation of a biofilm creation/enhancement project in the Lower Mainland region that would support the western sandpiper population. • As stated in Appendix IR2020-4-A and indicated within published scientific literature, biofilm is a common component of estuaries and has been and can be successfully created, including at a large scale. The ongoing evaluation is therefore focused on identifying local candidate sites and evaluating site-specific factors relevant to feasibility, such as land ownership and access, as well as potential benefit to migrating western sandpiper, and factors relevant to the likelihood of success of habitat creation and enhancement. • Work to identify selection criteria and candidate sites was completed in 2021, and site evaluation has continued in 2022. Seventeen candidate sites within the Fraser River estuary and Lower Mainland region were identified, and ten are undergoing further evaluation. The port authority is working to confirm site selection in consultation with Indigenous groups. • The port authority therefore suggests a new condition that would be consistent with its stated intention to develop and implement a biofilm habitat creation/enhancement project, while acknowledging that specifics of the biofilm creation/enhancement project (e.g., specific location, size, etc.) would be determined through consultation with Indigenous groups and ECCC.	The port authority suggests the following new condition: *10.XX The Proponent shall develop, in consultation with Indigenous groups (Roberts Bank) and Environment and Climate Change Canada, and implement prior to operation of the project, biofilm habitat creation or enhancement to support the western sandpiper population within the Lower Mainland region.*

Condition #	Condition	Feedback / rationale Part one submission, April 22, 2022 **Part two submission, June 10, 2022**	Suggested revision *Part One submission, April 22, 2022* ***Part two submission, June 10, 2022***
		• In addition, consultation with Indigenous groups continues regarding the proposed Tsawwassen Marshlands offsetting project in the inter-causeway area (described in IR2020-1.1, CIAR #2083), including the potential to include biofilm creation or enhancement. • See also comments on draft condition 1.22 in Part One of the port authority's April 22, 2022, submission (CIAR #3546). • See also new follow-up program sub-condition suggested below to determine effectiveness of created or enhanced biofilm habitat.	
10.13	The Proponent shall develop, prior to construction and in consultation with Fisheries and Oceans Canada, Environment and Climate Change Canada and Indigenous groups, a follow-up program as described in Table C15 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to salinity changes in the intertidal water column. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9. The Proponent shall share results of the follow-up program with researchers in mudflat and biofilm ecology.	• See comments on draft condition 1.22 in Part One of the port authority's April 22, 2022, submission (CIAR #3546).	The port authority suggests the following revision: The Proponent shall develop, prior to construction and in consultation with Fisheries and Oceans Canada, Environment and Climate Change Canada and Indigenous groups *(Roberts Bank)*, a follow-up program as described in Table C15 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to salinity changes in the intertidal water column. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9. The Proponent shall share results of the follow-up program with researchers in mudflat and biofilm ecology.
10.14	The Proponent shall develop, prior to construction and in consultation with Environment and Climate Change Canada and Indigenous groups, a follow-up program as described in Table C14 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to the effects of the Designated Project on the capability of the local assessment area to support Western sandpiper (*Calidris mauri*) populations due to potential alterations to distribution and abundance of biofilm and invertebrate prey. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9 and take into account past biofilm studies, most up-to-date research and best practices for sampling and analysis and developing and implementing the follow-up program. As part of the follow-up program, the Proponent shall:	• See comments on draft condition 1.22 in Part One of the port authority's April 22, 2022, submission (CIAR #3546).	The port authority suggests the following revisions: The Proponent shall develop, prior to construction and in consultation with Environment and Climate Change Canada and Indigenous groups *(Roberts Bank)*, a follow-up program as described in Table C14 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to the effects of the Designated Project on the capability of the local assessment area to support Western sandpiper (*Calidris mauri*) populations due to potential alterations to distribution and abundance of biofilm and invertebrate prey. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9 and take into account past biofilm studies, most up-to-date research and best practices for sampling and analysis and developing and implementing the follow-up program. As part of the follow-up program, the Proponent shall:
10.14.1	implement a before-after-control-impact design study using mudflats off Westham Island, or another suitable location as referenced in Table C14 of Appendix G in the Federal Review Panel Report, as the control site;	• No comment.	
10.14.2	collect, during the northern migration period of the Western sandpiper (*Calidris mauri*) prior to and throughout construction and the first three years of operation, fatty acids and carbohydrates of invertebrate prey and biofilm and chlorophyll for biofilm, and record and report as both concentration (measure per m^2) and content (measure per gram of dry sediment);	• The port authority notes that the effect of the project on biofilm (and consequently western sandpiper) hypothesized by ECCC is related to minor changes in salinity predicted to be caused by the terminal footprint. • Therefore, the timing of monitoring for the purposes of the follow-up program (i.e., to verify effect predictions) would appropriately be linked to the timing of construction of the marine terminal containment dykes (for east and west basins), particularly prior to dyke construction and following dyke completion. • The proposed duration of this follow-up program encompasses the period prior to construction, the construction phase following completion of the construction of the marine terminal containment dykes, and the initial period of operation. Given the immediacy of the potential effect on western sandpiper hypothesized by ECCC, this duration is anticipated to be sufficient to verify the environmental assessment.	The port authority suggests the following revisions: collect, during the northern migration period of the Western sandpiper (*Calidris mauri*) prior to and ~~throughout construction,~~ *following completion of the construction of the marine terminal containment dykes,* and the first three years of operation, fatty acids and carbohydrates of invertebrate prey and biofilm and chlorophyll-*a* for biofilm, and record and report as both concentration (measure per m^2) and content (measure per gram of dry sediment);

Condition #	Condition	Feedback / rationale Part one submission, April 22, 2022 **Part two submission, June 10, 2022**	Suggested revision *Part One submission, April 22, 2022* ***Part two submission, June 10, 2022***
		• The port authority notes that draft condition 2.6 would require the proponent to update the follow-up program, which could include extending the term of the follow-up program if deemed necessary. • Based on clarification provided by IAAC, the port authority understands this condition is intended to be focused on chlorophyll-a, consistent with the previous version of this draft condition.	
10.14.3	conduct total lipid and fatty acid analyses on the invertebrate prey and biofilm collected pursuant to condition 10.14.2 at a laboratory determined in consultation with Environment and Climate Change Canada;	• No comment.	
10.14.4	evaluate the potential effects of a compression in the range of variability of salinity experienced at Roberts Bank on polyunsaturated fatty acid production in biofilm; and	• No comment.	
10.14.5	submit the follow-up program, including the planned sampling and analysis methodology, before it is implemented for review and approval by an independent tripartite technical review process composed of representatives, who have knowledge or experience relative to biofilm monitoring, sampling and statistical analysis and who have been appointed by the Proponent, Environment and Climate Change Canada and other relevant authorities.	• Taking the key principles outlined in Section 3.1 of Part One of the port authority's submission (April 22, 2022, CIAR #3546) into account, the port authority notes that this condition, as drafted, would make the port authority's compliance dependent on action by a third party. • Further, as drafted, this condition would effectively delegate approval authority to individuals who have no statutory authority over the project. For these reasons, an independent technical review process may be feasible, but an independent technical approval process is not. • Alternatively, the port authority suggests that a feasible and appropriate means for expert review is a process like that used in other conditions (for example, similar to what is currently contemplated in draft conditions 2.3.3 and 2.3.4 or 18.3 and 18.4); the port authority can be required to respond to the comments by technical representatives and to report on its response to IAAC and other parties. This process would provide assurance that appropriate, objective advice from qualified, objective experts is considered and integrated as appropriate.	The port authority suggests the following revisions: submit the follow-up program, including the planned sampling and analysis methodology, before it is implemented for *technical* review ~~and approval~~ by ~~an~~ independent *experts* ~~tripartite technical review process composed of representatives,~~ who have knowledge or experience relative to biofilm monitoring, sampling, and statistical analysis and who have been appointed by the Proponent, Environment and Climate Change Canada and other relevant authorities. The port authority also suggests the following new sub-condition: *10.14.5.1 The Proponent shall undertake an impartial consideration of all views, information, and recommendations provided by the independent experts and shall provide a response in writing to the independent experts and to the Agency, Environment and Climate Change Canada, and Indigenous groups (Roberts Bank), which sets out how the views, information, and recommendations have, or have not, been integrated into the follow-up program, including a rationale for why the views, information, and recommendations have, or have not, been integrated.*
New		• In their submissions, ECCC (CIAR #2212) and other parties have suggested that the project could result in an "immediate" "species-level" risk to western sandpiper. The port authority notes that, based on the hypothesis advanced by ECCC, if an effect of such magnitude and immediacy were to occur, it would be evident during the first migration and breeding season following initial placement of the terminal landmass. The port authority therefore proposes a new follow-up program element to verify whether this potential effect is immediately evident. • The port authority notes that the proposed project construction method (described in the Project Construction Update, Attachment B2 (CIAR #1210)) involves sequentially developing two terminal containment dykes (referred to as the east and west basins) and filling each basin with material to create the terminal landmass. The east basin containment dyke would be completed first, by approximately March of the first year of construction (i.e., prior to the first period of northward migration of western sandpiper during construction). • The construction of the east basin containment dyke provides an opportunity to monitor for any immediate effects to western sandpipers from the predicted change in salinity during the material time of year for western sandpiper (i.e.,	The port authority suggests the following new conditions: *10.XX develop, in consultation with Indigenous groups (Roberts Bank), Environment and Climate Change Canada, and qualified internationally recognized experts that are in possession of specialist or expert information or knowledge with respect to biofilm ecology and other relevant disciplines, and implement prior to and during construction, a follow-up program to identify early signals of an immediate population level effect, if any, of the Designated Project on Western sandpiper (Calidris mauri). The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9. As part of the follow-up program, the Proponent shall:* *10.XX.1 identify suitable monitoring parameters;* *10.XX.2 establish, prior to construction, baseline conditions for the parameters identified pursuant to condition 10.XX.1, based on pre-construction monitoring and/or by compiling publicly available data;* *10.XX.3 monitor, in the months immediately following construction of the east basin containment dyke of the marine terminal, the parameters identified pursuant to condition 10.XX.1 and compare these against the baseline established pursuant to condition 10.XX.2;*

Condition #	Condition	Feedback / rationale Part one submission, April 22, 2022 **Part two submission, June 10, 2022**	Suggested revision *Part One submission, April 22, 2022* ***Part two submission, June 10, 2022***
		northward migration and subsequent breeding), prior to construction of the full terminal footprint (east and west basins). • If, at that time, early signals of an immediate population-level effect on western sandpiper are found, the port authority would implement adaptive management, including potentially removing the components of the east basin constructed to that point in time. • Prior to the construction phase of the project, the follow-up program would include establishment of robust multi-year baseline information for key population-related parameters to improve understanding of the range of natural variability and to facilitate the identification of a significant population-level effect, if one were to immediately occur. The follow-up program element would also include establishment of robust baseline information and on-site and control monitoring of key parameters prior to and during the period of interest to facilitate determination of whether any observed significant population-level change, if one were to immediately occur, can be attributed to the project. This proposed design is consistent with important program design details suggested by ECCC, Tsawwassen First Nation, and Musqueam Indian Band during development of this submission. • The port authority proposes that the follow-up program be developed with input from key parties including Indigenous groups and ECCC and that clear monitoring parameters (i.e., metrics and thresholds), which may include indicators of migration and breeding success (e.g., common breeding vital rates) during the breeding season immediately following construction of the east basin containment dyke, be established. This proposed consultative development of the follow-up program element is consistent with the views expressed by ECCC, Tsawwassen First Nation, and Musqueam Indian Band during the development of this submission. The port authority acknowledges and agrees that careful study design is important. • This new follow-up program element would be focused specifically on verifying whether an immediate population-level effect on western sandpiper, as hypothesized by ECCC, is occurring. As such, the monitoring program would be relatively narrow in scope and duration. Other follow-up program elements that would be required by draft conditions 10.13 and 10.14, as well as the new follow-up program element proposed by the port authority (below), would address other aspects of predicted salinity changes and consequential effects on biofilm and western sandpiper, over a longer time period.	*10.XX.4 if the monitoring referred to in 10.XX.3 indicates that a population level effect on Western sandpiper (Calidris mauri) attributable to the Designated Project is occurring or is imminent, develop and implement modified or additional mitigation measures, which may include removal of any portion of the east basin of the marine terminal or containment dyke constructed by that point in time.*
New		• As noted above, the port authority suggests a new condition to reflect its intention to develop and implement a biofilm habitat creation or enhancement project. The port authority therefore suggests the follow-up program include consideration of the effectiveness of this measure. • The port authority suggests the same parameters proposed in Table C14 of Appendix G in the federal review panel report and contemplated in draft condition 10.14.2 (i.e., fatty acids, carbohydrates, and chlorophyll-a) be used for this purpose. • The port authority also suggests the results would be shared with researchers, similar to draft condition 10.13. The consideration of lessons learned from the port authority's biofilm habitat creation and enhancement work is also contemplated in the suggested revisions to draft condition 10.2 above.	The port authority suggests the following new condition: *10.XX develop, in consultation with Indigenous groups (Roberts Bank) and Environment and Climate Change Canada, and implement a follow-up program to determine the effectiveness of the biofilm habitat created or enhanced pursuant to condition 10.XX* [new condition suggested above]*. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9. The Proponent shall share results of the follow-up program with researchers in mudflat and biofilm ecology.*

Appendix E Port authority response to comments related to biofilm and western sandpiper

Appendix E Port authority response to comments related to biofilm and western sandpiper

Roberts Bank Terminal 2 public comment period draft conditions review

#	Section	Original condition	Party commenting	Comment and suggested amendment	Port authority response
MN-3	10.2 – Avifauna	The Proponent shall document, prior to construction and in consultation with internationally recognized and published experts on biofilm ecology, Indigenous groups, and Environment and Climate Change Canada, methods and best practices to create biofilm habitat, including details about the production of lipids, with specific reference to fatty acids in the Fraser river estuary. The Proponent shall publish a document compiling the results of its research on its website and shall provide it to the Agency prior to construction. The Proponent shall incorporate current knowledge peer-reviewed science in the document and shall update the document at years 2, 5, and 10 following the end of construction based on emerging knowledge and science, including science developed as part of condition 10.14.	Malahat Nation CIAR #3501	10.2 - Condition 10.2 does not go far enough in ensuring that the RBT2 project will not significantly impact the extremely ecologically important biofilm in the vicinity of the Project. Port of Vancouver's commitment to producing reports does not provide any certainty that biofilm will be protected from harm related to project construction and operation. Malahat Nation has requested that the Port of Vancouver set measurable targets for biofilm health in the area surrounding the Project and commit to additional compensation and biofilm enhancement measures if targets are missed. As outlined in Article 29 in UNDRIP, "Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands, territories and resources."	The port authority is suggesting revisions and new conditions pertaining to biofilm to better reflect the breadth of mitigation measures and follow-up that will be implemented, in consultation with Indigenous groups, to protect biofilm; please see Appendix D of this submission. The suggested suite of conditions would work in concert with other draft conditions. In particular, draft condition 10.14 would require the port authority to develop and implement a follow-up program, consistent with draft conditions 2.5 to 2.9. Draft condition 2.5 specifies the information that must be included in the follow-up program, including, among other things, levels of environmental change relative to baseline that would require the proponent to implement modified or additional mitigation measures and the specific and measurable end points that must be achieved before the follow-up program can end. These conditions, working in combination, are anticipated to address the points raised by Malahat Nation in this comment.
MN-4	10.13 - Avifauna	The Proponent shall develop, prior to construction and in consultation with Fisheries and Oceans Canada, Environment and Climate Change Canada and Indigenous groups, a follow-up program as described in Table C15 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to salinity changes in the intertidal water column. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9. The Proponent shall share results of the follow-up program with researchers in mudflat and biofilm ecology.	Malahat Nation CIAR #3501	10.13 – Condition 10.13 references Table C15 of Appendix G of the Federal Review Panel Report which only seeks to verify effects predictions and is limited to the single parameter of salinity. This does not provide any insight into the next steps that must happen if the effects predictions are found to be incorrect. Malahat Nation has requested that the Port of Vancouver set measurable targets for allowable changes in salinity in the area surrounding the Project and commit to additional compensation and mitigation measures if targets are missed. As outlined in Article 29 in UNDRIP, "Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands, territories and resources."	The port authority notes that draft condition 10.13 would require the port authority to develop and implement a follow-up program, consistent with draft conditions 2.5 to 2.9. Draft condition 2.5, in particular, specifies the information that must be included in the follow-up program, including, among other things, levels of environmental change relative to baseline that would require the proponent to implement modified or additional mitigation measures, the mitigation measures to be implemented by the proponent if monitoring conducted as part of the follow-up program shows those levels of environmental change have been reached or exceeded, and the specific and measurable end points that must be achieved before the follow-up program can end. Further, this information must be developed in consultation with the parties specified in the condition, including Indigenous groups. The "next steps," measurable parameters, and additional mitigation measures will therefore be determined through the consultative development of the follow-up program.
MN-5	10.14 - Avifauna	The Proponent shall develop, prior to construction and in consultation with Environment and Climate Change Canada and Indigenous groups, a follow-up program as described in Table C14 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to the	Malahat Nation CIAR #3501	10.14 – Condition 10.14 references table C14 of Appendix G of the Federal Review Panel Report which only seeks to verify effects predictions and is limited in its focus to the density and biomass of biofilm and invertebrates. This does not provide any insight into the next steps that must happen if the effects predictions	Please see response to MN-4 above; the same response applies here.

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		effects of the Designated Project on the capability of the local assessment area to support Western sandpiper (*Calidris mauri*) populations due to potential alterations to distribution and abundance of biofilm and invertebrate prey. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9 and take into account past biofilm studies, most up-to-date research and best practices for sampling and analysis and developing and implementing the follow-up program. As part of the follow-up program, the Proponent shall:		are found to be incorrect. Malahat Nation has requested that the Port of Vancouver set measurable targets for allowable changes in the density and biomass of biofilm and invertebrates in the area surrounding the Project and commit to additional compensation and biofilm and invertebrate enhancement measures if targets are missed. As outlined in Article 29 in UNDRIP, “Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands, territories and resources.”	
BC-17	N/A	N/A	Birds Canada CIAR #3133	2.9 That prior to approval the Vancouver Port Authority be instructed to re-design Roberts Bank Terminal 2 project to avoid changing the salinity regime on Roberts Bank.	As summarized in Section 3 of this submission, the design of the project currently reflected in the Designated Project Description and the draft conditions already integrates design and re-design considerations to avoid and reduce the potential effect of the project on intertidal habitats, including biofilm habitat, and fish. These design features include locating the terminal in deep water, reducing the footprint of both the marine terminal and the widened causeway, and adding a fish passage breach. As noted by the review panel, the changes in salinity that would be caused by the physical footprint of the terminal are minor and would remain within natural variability experienced under existing conditions (CIAR #2062). As described in Section 2 and Appendix A of this submission, the predicted changes in salinity are highly variable spatially and temporally, resulting in both increases and decreases of salinity range across the area used by western sandpiper during their northward migration. Further, the port authority has suggested a new condition to reflect a precautionary approach to construction of the marine terminal, which would involve follow-up to detect any early signals of an immediate population-level effect of the project on western sandpipers and trigger adaptive management measures, which may include removal of the east basin containment dyke of the marine terminal, if any such effect is identified. Further re-design of the project is not warranted.
BC-18	N/A	10.2 The Proponent shall document, prior to construction and in consultation with internationally recognized and published experts on biofilm ecology, Indigenous groups, and Environment and Climate Change Canada, methods and best practices to create biofilm habitat, including details about the production of lipids, with specific reference to fatty acids in the Fraser river estuary. The Proponent shall publish a document compiling the results of its research on its website and shall provide it to the Agency prior to construction. The Proponent shall	Birds Canada CIAR #3133	2.10 That prior to approval the Vancouver Port Authority be required to post to the Environmental Assessment portal for public review and comment the Biofilm Habitat Creation Guidelines Manual.	The biofilm habitat creation guidance manual has been drafted with input from Indigenous groups and technical specialists with expertise in biofilm ecology, habitat creation, and related disciplines. The first version of the manual has been shared with Indigenous groups and Environment and Climate Change Canada (ECCC) for review. Indigenous knowledge and perspectives are being integrated into the manual, as well as additional technical feedback. The manual will be published prior to the commencement of construction of the project. The port

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		incorporate current knowledge peer-reviewed science in the document and shall update the document at years 2, 5, and 10 following the end of construction based on emerging knowledge and science, including science developed as part of condition 10.14.			authority has suggested revisions and new conditions to ensure that biofilm habitat creation and enhancement carried out by the port authority in relation to the project applies the methods and best practices outlined in the manual in addition to ongoing Indigenous input and traditional knowledge.
BC-19	N/A	N/A	Birds Canada CIAR #3133	2.11 That within the Draft Conditions the Port of Vancouver be required to identify where on the Fraser Delta it intends to create approximately 1120 hectares of biofilm habitat capable of meeting the polyunsaturated fatty acid production and other requirements of foraging shorebirds.	The predicted changes in salinity due to the project are similar to the observed natural variability in the dynamic Fraser River estuary, which has continued to support biofilm and western sandpipers, even following the development of existing port terminal and causeway infrastructure. The Roberts Bank area is expected to continue to be capable of meeting the polyunsaturated fatty acid and other requirements of foraging shorebirds with the project in place. Nevertheless, as stated in Appendix IR2020-4-A (CIAR #2083), the port authority intends to implement a biofilm habitat creation or enhancement project, should RBT2 be approved. Please see Appendix D of this submission for further detail on the port authority's suggested new condition to reflect this intention. As with other measures and follow-up program elements, the details of the biofilm habitat creation/enhancement project would be determined in consultation with Indigenous groups and ECCC and would consider the methods and best practices developed pursuant to draft condition 10.2.
BC-20	N/A	N/A	Birds Canada CIAR #3133	2.12 That prior to approval the Port of Vancouver implement a biofilm habitat creation pilot project on the Fraser River delta and demonstrate through 3 years of monitoring successful use of biofilm habitat by migrating and overwintering shorebirds.	As stated in Appendix IR2020-4-A (CIAR #2083), the port authority intends to implement a biofilm habitat creation or enhancement project, should RBT2 be approved. Please see Appendix D of this submission for further detail on the port authority's suggested new condition to reflect this intention. As with other measures and follow-up program elements, the details of the biofilm habitat creation/enhancement project would be determined in consultation with Indigenous groups and ECCC and would apply the methods and best practices outlined in the biofilm manual referred to in draft condition 10.2. Consultation regarding biofilm habitat creation and enhancement is ongoing with Indigenous groups; as noted in Appendix D of this submission, the port authority is working to confirm site selection in consultation with Indigenous groups this summer. In addition, consultation continues with Indigenous groups regarding the proposed Tsawwassen Marshlands offsetting project in the inter-causeway area (described in IR2020-1.1, CIAR #2083), including the potential to include biofilm habitat creation/enhancement. As it will be part of a larger offsetting project, the schedule for that biofilm component will be determined as part of the

#	Section	Original condition	Party commenting	Comment and suggested amendment	Port authority response
					development of the offsetting project and directly with Tsawwassen First Nation. As stated in Appendix IR2020-4-A (CIAR #2083), biofilm is a common component of estuaries and has been and can be successfully created, including at a large scale. The ongoing evaluation is therefore focused on identifying local candidate sites and evaluating site-specific factors relevant to feasibility, such as land ownership and access and offsetting site interactions, as well as potential benefit to western sandpiper, taking Indigenous knowledge into account. The site selection work is ongoing and is anticipated to be completed prior to commencement of project construction.
BC-21	10.14.1 – Avifauna	implement a before-after-control-impact design study using mudflats off Westham Island, or another suitable location as referenced in Table C14 of Appendix G in the Federal Review Panel Report, as the control site;	Birds Canada CIAR #3133	2.13 That under Draft Condition 10.14.1 regarding the design of a before-after-control-impact study of impacts on Western Sandpiper that study design be extended to include migratory shorebird stopover sites remote from the Fraser River delta such as the Copper River Delta and Tofino Mudflats to ensure impacts on shorebird condition of shifting stopover sites are accounted for in the adaptive management program.	The follow-up program element referenced in Table C14 of Appendix G in the review panel report (CIAR #2062) and associated with this draft condition is related to 'Western Sandpiper Prey Effects Prediction'. In short, the objective of this follow-up program element is to verify that abundance and density of prey (biofilm and marine invertebrates) at Roberts Bank will remain similar with the project. Westham Island is an appropriate control site as it is influenced by similar environmental factors and conditions (e.g., Fraser River, weather, etc.). The Copper River delta and Tofino mudflats are not exposed to similar conditions and thus would not be appropriate control sites for this follow-up program element. As outlined in Appendix D of this submission, the port authority has suggested a new condition to reflect the proposed precautionary approach to construction of the marine terminal, which would involve follow-up to detect any early signals of an immediate population-level effect of the project on western sandpiper. The parameters involved in such follow-up may include data collection at other stopover sites (e.g., Copper River delta) and/or numbers and vital rates of western sandpiper arriving at known breeding grounds (i.e., in Alaska). The port authority proposes that the follow-up program be developed with input from key parties, including Indigenous groups, ECCC, and technical experts.
BC-22	10.14 – Avifauna	The Proponent shall develop, prior to construction and in consultation with Environment and Climate Change Canada and Indigenous groups, a follow-up program as described in Table C14 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to the effects of the Designated Project on the capability of the local assessment area to support Western sandpiper (*Calidris mauri*) populations due to potential alterations to distribution and abundance of biofilm	Birds Canada CIAR #3133	2.14 That Draft Condition 10.14 be modified to require the Port of Vancouver contribute $50,000 a year in funding to third party migratory shorebird monitoring enabling monitoring of potential impacts at sites remote from the Fraser River Delta.	Please see response to BC-21 above; that response applies here as well. The port authority notes that under CEAA 2012 and the *Impact Assessment Act*, it is not appropriate to impose direct financial requirements in conditions.

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		and invertebrate prey. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9 and take into account past biofilm studies, most up-to-date research and best practices for sampling and analysis and developing and implementing the follow-up program. As part of the follow-up program, the Proponent shall:			
BC-23	10.14 – Avifauna	The Proponent shall develop, prior to construction and in consultation with Environment and Climate Change Canada and Indigenous groups, a follow-up program as described in Table C14 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to the effects of the Designated Project on the capability of the local assessment area to support Western sandpiper (*Calidris mauri*) populations due to potential alterations to distribution and abundance of biofilm and invertebrate prey. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9 and take into account past biofilm studies, most up-to-date research and best practices for sampling and analysis and developing and implementing the follow-up program. As part of the follow-up program, the Proponent shall:	Birds Canada CIAR #3133	2.16 That Draft Condition 10.14 be modified to include research on the impact of likely changes in lipid fatty acid production on other shorebirds beside Western Sandpiper utilizing the delta.	As explained in Section 15.2.1 of the environmental impact statement (CIAR #181), western sandpipers were selected as a representative species for the shorebirds sub-component of coastal birds for the purposes of environmental assessment. Table 15-1 of the environmental impact statement outlined the rationale for the selection of western sandpipers as a representative species, as follows: • Recommended by the Technical Advisory Group as good indicators of change • Potential to be directly and indirectly affected by the project • Roberts Bank is important for migrating and overwintering shorebirds • Conservative estimates of 500,000 western sandpipers use the Roberts Bank annually during migration • Good historical data on distribution and abundance • Species is protected under the *Migratory Birds Convention Act* As stated in the response to information request package 5 from the review panel (CIAR #934), "[r]epresentative species are also considered in terms of the biological and ecological similarities they share with other species within the sub-component, and for potential similarities in how the Project may interact with and affect them. In some cases, biological attributes may differ within a sub-component grouping, but their interactions with the Project and mechanisms contributing to potential effects from the Project are considered to be analogous. As a result, the port authority selected representative species for each sub-component for which sufficient information is known, in order to provide an assessment that considers all potential interactions and Project-related effects." "Moreover, in selecting representative species, or in some cases species groups, consideration was given to species of specific importance to regulatory agencies, Aboriginal groups, and the public, as identified by community knowledge and Aboriginal traditional knowledge, and during consultation and engagement, and assessment planning. This approach was taken as it would be impractical to characterise existing conditions and assess effects on every

#	Section	Original condition	Party commenting	Comment and suggested amendment	Port authority response
					species that may frequent the Roberts Bank area. In this way, the use of VCs, sub-components, or representative species improves the effectiveness and efficiency of assessment by focusing on the key Project interactions." For these reasons, the port authority considers that further assessment of potential effects of the project on other shorebirds is not warranted.
BC-24			Birds Canada CIAR #3133	2.17 That a Draft Condition be included requiring the Port of Vancouver to engage relevant government, Indigenous Peoples and Communities and the public about enhancing protection of the mudflats of Brunswick Point through the creation of an Ecological Reserve, or other effective designation, intended to protect the ecological role of the mudflats as a foraging habitat for shorebirds and a likely site of lipid fatty acid production for other species yet identified.	As per the key principles outlined in Section 3.1 of Part One of the port authority's submission (April 22, 2022, CIAR #3546), the conditions must pertain to the effects of the project; the project is not predicted to result in an effect on Brunswick Point. The port authority notes that Brunswick Point is located within a provincially designated Roberts Bank Wildlife Management Area with the purpose to manage critical habitat for fish, waterfowl, shorebirds, raptors and other species.[1] Further, it is not federal land or real property within the jurisdiction of or administered by the port authority and the creation of an Ecological Reserve or other land use designation for that site is not within the care and control of the port authority. However, as noted in response to BC-20 above, consultation regarding biofilm habitat creation and enhancement is ongoing with Indigenous groups; as noted in Appendix B of this submission, the port authority is working to confirm site selection in consultation with Indigenous groups this summer. Once a site has been selected, the port authority will work with Indigenous groups and ECCC to develop a plan for the biofilm habitat creation or enhancement.
BC-27			Birds Canada CIAR #3133	3.3 A condition be added requiring the Port of Vancouver monitoring climate related changes in timing linked to anticipated changes in Environmental Flow Regimes[2] within the Fraser River and other sources of freshwater input to the Fraser River Delta and adjust mitigation efforts appropriately.	As per the key principles outlined in Section 3.1 of Part One of the port authority's submission (April 22, 2022, CIAR #3546), the conditions must pertain to the effects of the project; climate-related changes would not be caused by the project, and the conditions should not require the proponent to monitor such changes. The port authority notes that the design and implementation of biofilm habitat creation or enhancement, as described in response to BC-20 above, will take into account relevant design factors such as climate-related changes that could affect long-term habitat stability.
BC-34			Birds Canada CIAR #3133	5.3 That the Port of Vancouver contribute to the Western Hemisphere Shorebird Reserve Network to	The port authority notes that draft condition 10.14 would require a follow-up program to be developed in

[1] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-habitats/conservation-lands/wma/wmas-list/roberts-bank#:~:text=Purpose%3A%20Management%20of%20critical%20habitat,%2C%20raptors%2C%20and%20other%20species.
[2] Canham, R., Flemming, S. A., Hope, D. D., & Drever, M. C. (2021). Sandpipers go with the flow: Correlations between estuarine conditions and shorebird abundance at an important stopover on the Pacific Flyway. Ecology and evolution, 11(6), 2828–2841. https://doi.org/10.1002/ece3.7240

#	Section	Original condition	Party commenting	Comment and suggested amendment	Port authority response
				develop a panel of independent internationally recognized shorebird experts to develop a population model for Western Sandpiper that identifies a level of abundance and recruitment trends that need to be maintain in any determination of effective mitigation.	consultation with specified parties and in accordance with conditions 2.5 to 2.9. In particular, pursuant to draft condition 2.5.4, the levels of environmental change relative to baseline that are caused by the project and that would require the proponent to implement modified or additional mitigation measures would be determined through the consultative development of the follow-up program. Further, draft condition 2.5.6 would require the follow-up program to identify the specific and measurable end points that must be achieved before the follow-up program can end, including end points that indicate that the mitigation measures are effective. These, too, would be determined through the consultative development of the follow-up program. Draft condition 10.14.5, with revisions suggested by the port authority, would further require the port authority to seek technical review of the follow-up program from independent experts with relevant expertise. A panel is not required to carry out the consultative development of the follow-up program. Please also refer to Appendix D of this submission for a description of the extensive revisions and new conditions pertaining to biofilm and western sandpiper suggested by the port authority to better reflect the breadth of mitigation measures and follow-up that will be implemented to protect biofilm.
BC-35	10.14 - Avifauna	The Proponent shall develop, prior to construction and in consultation with Environment and Climate Change Canada and Indigenous groups, a follow-up program as described in Table C14 of Appendix G in the Federal Review Panel Report to verify the accuracy of the environmental assessment as it pertains to the effects of the Designated Project on the capability of the local assessment area to support Western sandpiper (*Calidris mauri*) populations due to potential alterations to distribution and abundance of biofilm and invertebrate prey. The Proponent shall implement the follow-up program in accordance with conditions 2.5 to 2.9 and take into account past biofilm studies, most up-to-date research and best practices for sampling and analysis and developing and implementing the follow-up program. As part of the follow-up program, the Proponent shall:	Birds Canada CIAR #3133	5.4 That as part of Draft Condition 10.14 a phased approach to construction of the Roberts Bank Terminal 2 project be implemented requiring cessation and removal of the RBT2 infrastructure should species level declines of Western Sandpipers or other shorebirds be observed.	The port authority has suggested a new condition to reflect a precautionary approach to construction of the marine terminal, which would be developed in consultation with Indigenous groups, ECCC, and technical experts. This new condition would involve follow-up to detect any early signals of an immediate population-level effect of the project on western sandpiper and trigger adaptive management, which may include removal of the east basin containment dyke of the marine terminal, if any such effect is identified. Please see Appendix D of this submission for more detail.
BC-36	N/A			5.5 That a Draft Condition be included requiring Port of Vancouver contribute $xx per year funding to coastal climate adaption efforts on the Fraser River Delta that have the potential to create additional foraging habitat for shorebirds.	See response to BC-27 above regarding climate-related changes. In addition, the port authority notes that under CEAA 2012 and the *Impact Assessment Act*, it is not appropriate to impose direct financial requirements in conditions. As stated in Appendix IR2020-4-A (CIAR #2083), the port authority intends to implement a biofilm habitat

#	Section	Original condition	Party commenting	Comment and suggested amendment	Port authority response
					creation or enhancement project, should RBT2 be approved. Please see Appendix D of this submission for further detail on the port authority's suggested new condition to reflect this intention. In addition, consultation continues with Indigenous groups regarding the proposed Tsawwassen Marshlands offsetting project in the inter-causeway area (described in IR2020-1.1, CIAR #2083), including the potential to include biofilm creation or enhancement. The proposed biofilm habitat creation or enhancement will support foraging habitat for shorebirds in the Fraser River estuary. Please see response to BC-20 for more detail.
BC-37	N/A			5.6 That the Port of Vancouver contribute $50,000 a year in funding to and collaborate with third party researchers within the Migratory Shorebird Project to enable monitoring the population levels of shorebirds along the Pacific Flyway.	The port authority notes that under CEAA 2012 and the *Impact Assessment Act*, it is not appropriate to impose direct financial requirements in conditions. As per the key principles outlined in Section 3.1 of Part One of the port authority's submission (April 22, 2022, CIAR #3546), the conditions must pertain to the effects of the project; population level effects on shorebirds along the Pacific Flyway may be caused by many other factors other than the project. To focus on the potential effects of the project, the port authority has suggested a new condition to reflect the proposed precautionary approach to construction of the marine terminal, which would involve follow-up to detect any early signals of an immediate population-level effect of the project on western sandpiper. The parameters involved in such monitoring may include numbers and vital rates of western sandpiper arriving at known breeding grounds. The port authority proposes that the follow-up program be developed with input from key parties, including Indigenous groups, ECCC, and technical experts. Please see Appendix D of this submission for more detail.
BC-38	N/A			5.7 That prior to final approval of the proposed Roberts Bank Terminal 2 Project the Port of Vancouver construct and monitor for 3 years pilot 1120 hectares of shorebird foraging habitat at other sites along the Fraser River Delta that is expected to persist through anticipate sea-level rise.	Please see responses to BC-19, BC-20, and BC-27 above.
BC-39	2.13 – Information Sharing	The Proponent shall publish on the Internet the annual reports and the executive summaries referred to in conditions 2.10 and 2.12, greenhouse gas reduction plan and monitoring results referred to in conditions 3.2 and 3.3, biofilm follow-up program results referred to in conditions 10.14, the reports related to accidents		6.1 Draft Condition 2.13 be altered to a requirement for the Port of Vancouver to notify countries and indigenous peoples along the Pacific Flyway that Canada is considering approving a project that will compromise their sovereign integrity by reducing shared migratory bird populations. The required	There is no factual nor legal basis upon which Canada could suggest that it will breach the sovereignty of any other country through approval of the project. In any event, the proposed revision is unnecessary. Publication of the specified information in accordance

#	Section	Original condition	Party commenting	Comment and suggested amendment	Port authority response
		and malfunctions referred to in conditions 19.6.3 and 19.6.4, the accident and malfunction communication plan referred to in condition 19.7, the schedules referred to in conditions 20.1 and 20.2, and any update or revision to the above documents, upon submission of these documents to the parties referenced in the respective conditions. The Proponent shall keep these documents publicly available for 15 years following their publication. The Proponent shall notify the Agency and Indigenous groups of the availability of these documents within two business days of their publication		reporting within 2.13 should be extended to those impacted countries and indigenous communities	with the proposed condition will provide access to the information by interested parties.
GCCS-1	10.1 & 10.2 - Avifauna	10.1 – The Proponent shall carry out the Designated Project in a manner that protects migratory birds and avoids injuring, killing or disturbing migratory birds, destroying or disturbing their nests or eggs, or taking them. In this regard, the Proponent shall take into account Environment and Climate Change Canada's *Avoidance Guidelines* to reduce the risk to migratory birds. The Proponent's actions when carrying out the Designated Project shall be in compliance with the *Migratory Birds Convention Act, 1994,* the *Migratory Birds Regulations* and with the *Species at Risk Act*. 10.2 - The Proponent shall document, prior to construction and in consultation with internationally recognized and published experts on biofilm ecology, Indigenous groups, and Environment and Climate Change Canada, methods and best practices to create biofilm habitat, including details about the production of lipids, with specific reference to fatty acids in the Fraser river estuary. The Proponent shall publish a document compiling the results of its research on its website and shall provide it to the Agency prior to construction. The Proponent shall incorporate current knowledge peer-reviewed science in the document and shall update the document at years 2, 5, and 10 following the end of construction based on emerging knowledge and science, including science developed as part of condition 10.14.	Garden City Conservation Society CIAR #3338	If the federal ECCC Minister and Cabinet approve RBT2, there will be pre-set conditions. In the 48 pages of potential RBT2 *conditions,* only the above two conditions are re Western Sandpipers. They are also the only hint "the unmitigable species-level risk to Western Sandpipers" exists: • 10.1, a condition that the Proponent follow Canadian law (already the law) • 10.2, a condition to publish, on a VFPA website, current research about biofilm habitat, etc. In contrast, robust conditions in this matter would require measured achievement of a set of standards. In other words, they would require proven steps and demonstrated results. Together they would end the serious unmitigable species-level risk to Western Sandpipers. For example, they might require, prior to approval, (a) completion of a working prototype of the set of methods and (b) a bond of a sufficient amount to ensure the set of methods get implemented well. Or VFPA could redesign so the habitat isn't lost, as ECCC has suggested for 18 years. The weak "potential conditions" re Western Sandpipers epitomize the RBT2 farce. It is still possible to get beyond that, but time is short.	As described in the main body of this submission, the change in salinity predicted to result from the project is not considered likely to result in a significant adverse environmental effect on western sandpipers. Nevertheless, as described above (see responses to BC-19, BC-20, BC-21), the port authority has suggested extensive revisions and new conditions (outlined in Appendix D of this submission) pertaining to biofilm to better reflect the breadth of mitigation measures and follow-up that will be implemented to protect biofilm. These include more specific conditions pertaining to biofilm habitat creation methods and best practices and a requirement to create or enhance biofilm habitat. Further, as noted above in the response to BC-34, the consultative development of the follow-up program in accordance with conditions 2.5 to 2.9 would include determination of measurable parameters, levels of environmental change, and end points, as well as further adaptive management measures that may be implemented if required. As noted earlier, the proposed mitigation measures and follow-up program would be developed through a consultative process that is already ongoing and is expected to be completed prior to the commencement of project construction. Please also see the response to BC-17 regarding re-design.