February 4, 2022

Roberts Bank Terminal 2 Project
Environment and Climate Change Canada (ECCC) Review of Information Request 2020-4: Biofilm and Effects to Migratory Birds, and Appendix IR2020-4-A

Summary

On August 24, 2020, the Minister responsible for the *Canadian Environmental Assessment Act*, 2012, the Minister of Environment and Climate Change Canada (the Minister) requested the Vancouver Fraser Port Authority (VFPA or the Proponent) provide additional information regarding potential mitigating measures that would avoid or reduce effects to fish and fish habitat during construction and operations of the Roberts Bank Terminal 2 Project (the Project). The Proponent was also asked to describe any technically feasible Project design options that could be considered to reduce these effects of the Project in consideration of fish and fish habitat mitigation measures. The Minister requested that in respect of any on-site design changes, the Proponent also undertakes a geomorphological assessment including predictions for salinity. In response, the Proponent described potential on-site design optimizations that could reduce effects by reducing the Project's footprint by 14.4 ha, and described potential breach locations at the east end of the terminal and three locations along the causeway. The Proponent characterized the predicted hydrological and salinity regimes to be similar to predictions for the original Project design. The Proponent's response to information requested for biofilm and migratory birds is outlined in Information Request (IR) 2020-4: Biofilm and Effects to Migratory Birds (IR2020-4), and in Appendix IR2020-4 (IR2020-4-A).

Environment and Climate Change Canada (ECCC) has reviewed the Proponent's response to the information request and advises that we believe the Proponent has responded to IR-2020-4 in sufficient detail for ECCC to form a technical assessment on the information presented. ECCC also agrees with the Proponent's conclusion that on-site design changes as presented by the Proponent to reduce effects to fish and fish habitat would result in hydrological and salinity regimes similar to the original Project.

In their response to IR2020-4 the Proponent indicates that their environmental impact statement conclusion that salinity changes resulting from the project will not adversely affect biofilm and migratory birds, including shorebirds, remains unchanged. The Proponent also sustains that their environmental impact statement conclusion continues to be supported by evidence showing that biofilm at Roberts Bank thrives and is abundant under variable salinity conditions. The Panel Report (15:3:3) stated that the protected status of the Western Sandpiper under the *Migratory Birds Convention Act, 1994*, in the context of an ongoing population decline, mandates a highly precautionary approach to the proposed RBT2 Project. In the Panel Hearings as reflected in the Panel Report (Shorebirds, 15:3:3), ECCC's assessment was that the Project would present a high risk of reducing the quality and quantity of marine and estuarine type biofilm with high fatty acid content upon which certain species of migratory birds rely on as their primary food source during key part of their life cycle. **Upon review of IR2020-4 and IR2020-4-A, ECCC's opinion on the Project's effects to biofilm and migratory shorebirds remains unchanged.** ECCC's opinion remains that effects of the Project, as designed, will likely be unmitigable and irreversible, resulting in an increased risk to the population viability of the Western Sandpiper species, in particular.

In their response to IR2020-4 the Proponent undertook geomorphological assessment for 2 on-site design change scenarios. Scenario 1 was a reduction of the project footprint of 14.4 ha which consisted in a

reduction of the marine terminal footprint by 10.3 ha and the widened causeway by 4.1 ha. Scenario 2 included the potential project footprint reduction in Scenario 1, plus causeway breach location 3 (as described in IR2020-2.2). The Proponent considered a third scenario which consisted of a potential project footprint reduction of 14.4 ha, plus a marine terminal breach. The Proponent did not model this scenario directly explaining that the assessment for Scenario 3 is based on the results of modelling for Scenarios 1 and 2 that are representative of the anticipated changes to waves, currents, and the seabed, and assessed changes in salinity based on known coastal processes. The Proponent concludes that with the predictions of very subtle to no change in geomorphological conditions (including salinity) resulting from the reduced project footprint reduction and potential breach locations, compared to the EIS project reference concept design, the conclusions of the EIS effects assessments for biofilm and migratory shorebirds (notably western sandpiper, *Calidris mauri*) remain unchanged.

Under Scenario 1, ECCC agrees that the footprint reduction at the shoreward end of the causeway would reduce direct adverse impacts to intertidal biofilm by approximately 0.6 ha, from an anticipated direct loss of 2.5 ha in the original proposal, to 1.9 ha. However, ECCC notes that under all Scenarios (1, 2 and 3), anticipated major adverse indirect effects to the quality of up to 558 ha of intertidal biofilm on Roberts Bank would continue to occur and would not be addressed. Therefore, with or without the identified design modifications in IR2020-4, ECCC's assessment is that the Project would still result in a reduced population viability for the Western Sandpiper, and will likely constitute an unmitigable and irreversible species-level risk to Western Sandpipers.

ECCC offers the following comments on IR2020-4 in support of this conclusion:

a. The Proponent's response notes that the EIS conclusion on biofilm and migratory shorebirds is supported by the Panel Report finding that "*the Project would not result in an adverse effect on biofilm productivity or composition and diatom assemblages at Roberts Bank*" (11:2:3). While this is correct, ECCC is of the opinion that it is an incomplete description of the Panel Report's findings on biofilm. ECCC notes that the Panel also acknowledged that the ecology of biofilm and its importance in the Western Sandpiper diet are relatively recent scientific findings. According to the Panel Report (Shorebirds 15:3:3), the newness of these observations, and the still-developing scientific understanding of aspects of this issue (such as the 'salinity trigger' hypothesis), introduced considerable uncertainty for the Panel's consideration of the role of biofilm for Western Sandpiper foraging at Roberts Bank. This uncertainty left the Panel unable to conclude if the Project would have an effect on biofilm fatty acid production (*quality)* as a food resource for migrating Western Sandpipers. The panel went on to state, "*However, the panel cannot conclude with certainty about Project effects on polyunsaturated fatty acid production in biofilm, a potential critical nutritional component for western sandpiper. Due to the recent and still emerging scientific understanding of biofilm, the Panel is unable to conclude with reasonable confidence that the Project would or would not have a residual effect on western sandpiper."*

b. ECCC's advised at the Panel Hearings that predicted changes to salinity as a result of RBT2 will likely result in a reduction in the quality and quantity of marine-type diatoms in intertidal biofilm that provide essential nutrients (polyunsaturated fatty acids, PUFAs) for long-distance migration in Western Sandpipers.

Roberts Bank is a dynamic estuarine ecosystem supporting internationally significant populations of migratory shorebirds. Foraging on biofilm at Roberts Bank provides shorebirds with a rich supply of essential fatty acids at a critical juncture in their annual cycle. The best available scientific evidence to date indicates that fatty acids from biofilm are essential nutrients and primary food supply (that cannot be manufactured by the birds themselves) required for long-distance flights of shorebirds during their critical northward migration period. The Proponent's IR2020-4 characterizes the predicted hydrological regimes from alternative Project design options to be similar to the ones predicted under the original design. These design options were considered with fish and fish habitat in mind, rather than the protection of biofilm production to support migratory birds.

Predicted changes due to the Project include a change in the salinity regime at Roberts Bank, particularly in those areas of highest importance to shorebirds. IR2020-4 demonstrates that median salinity is expected to decrease over much of the area, accompanied by a reduction in the overall range of salinity in the upper intertidal by up to 10 Practical Salinity Units (PSU), thus representing nearly a third of the total variation. As described in ECCC's written submission (CEAR 1637) and in ECCC's response to Undertaking #29 (CEAR 1947), substantial evidence exists linking this variability to the production of high levels of fatty acids by diatoms, from both existing scientific literature and the Proponent's studies. ECCC has presented evidence on expected impacts of the Project on the quality and quantity of biofilm on Roberts Bank, the likely consequences of the changes on migratory shorebirds, and the improbability of being able to mitigate these effects by creating or enhancing alternative sites at an equivalent scale.

ECCC maintains its expert opinion that the predicted changes to the salinity regime as a result of the Project would likely result in a reduction in both the quality and quantity of marine-type diatoms in intertidal biofilm that provide essential nutrients (polyunsaturated fatty acids, PUFAs) needed by Western Sandpipers (*Calidris mauri*) on long-distance breeding migration. ECCC continues to advise that predicted Project-induced changes to Roberts Bank would likely constitute an unmitigable species-level risk to Western Sandpipers, and shorebirds more generally. ECCC advises that the only apparent way to be confident of avoiding the impacts on biofilm and shorebirds from these predicted geomorphological processes is for the Proponent to consider Project redesign options specifically aimed at maintaining current salinity profiles that support the production of a comparable quality and quantity of biofilm on Roberts Bank.

In addition, ECCC offers the following specific comments on IR2020-4 and Appendix IR2020-4-A.

Fatty acid abundance varies seasonally and in relation to salinity conditions at Roberts Bank

ECCC maintains its expert advice that predicted changes to the salinity regime as a result of RBT2 would result in a reduction in both the quality and quantity of marine-type diatoms in intertidal biofilm that provide essential nutrients needed by Western Sandpipers on long-distance breeding migration. Canham et al. (2021) analysed data from shorebird surveys conducted by ECCC from 1991 to 2019, and demonstrated that the number of shorebirds counted on Roberts Bank during their spring breeding migration has a strong negative correlation with freshwater discharge rates from the Fraser River. Freshwater discharge from the Fraser River is the main driver of salinity on Roberts Bank, and salinity has been demonstrated to have an important effect on intertidal biofilm biomass and community composition at Roberts Bank and in estuaries throughout the world (references below). Therefore, a direct link exists between estuarine conditions (specifically salinity) and the utility of Roberts Bank as a stopover site by

shorebirds. This link between estuarine conditions and fatty acid content in intertidal biofilm could be driven in several ways.

First, a change in the community composition of diatoms can influence biofilm quality. Several studies have demonstrated that the types of fatty acids present in biofilm vary with composition of algal communities (Galloway and Winder 2015, Schnurr and Allen 2015). Diatom community composition is strongly affected by salinity gradients, as shown by studies conducted at Roberts Bank by the Proponent that show strong seasonal patterns related to freshwater inputs (WorleyParsons 2015a; Hemmera et al. 2019), and at other estuaries worldwide (Underwood et al. 1998, Thornton et al. 2002, Muylaert et al. 2002, Chiu et al. 2006). Therefore, changes to the salinity regime at Roberts Bank could influence biofilm quality.

Second, an increase in the abundance of diatoms in the biofilm layer increases its fatty acid content (Schnurr et al. 2019, Schnurr et al. 2020). Studies conducted by the Proponent on Roberts Bank in 2012 and 2013 showed that biomasses of three main prey types for migrating sandpipers (biofilm, invertebrate meiofauna, invertebrate macrofauna) were positively correlated with salinity (WorleyParsons 2015b; LGL and Hemmera 2014). As such, reductions in salinity can be expected to reduce the availability of prey for foraging shorebirds.

Third, the accumulation of fatty acids by diatoms could be influenced by changes in salinity. Lipid accumulation is a generic response to changes in environmental conditions found in many species of microalgae, including diatoms. Experimental studies on laboratory cultures have demonstrated that changes in salinity can induce lipid accumulation across a wide range of microalgae, including diatoms, as reviewed in *ECCC Undertaking #29 Response: Evidence for a "salinity trigger" linking diatom production of lipids in the exponential and stationary growth phase of microalgae*. Schnurr et al. (2020) directly tested for this lipid accumulation response by examining the abundance ratios of different kinds of fatty acids in intertidal biofilm at Roberts Bank. The authors found evidence consistent with this response during spring, when environmental conditions are highly variable, coinciding with the period when Western Sandpipers aggregate on Roberts Bank in huge flocks during northward migration (100,000s of birds; Drever et al. 2014, Canham et al. 2021). In contrast, during the summer southward migration, when birds move through in smaller flocks at a slower pace (Butler et al., 1996), the ratios of different fatty acids indicate no lipid accumulation, again linking the abundance of shorebirds to fatty acid content of biofilm on the surface of intertidal mudflats.

The three identified mechanisms indicate changes to the salinity regime on Roberts Bank are likely to have complex effects on the fatty acid content of biofilm. These complex effects are supported by the Proponent's studies in 2016, 2017, and 2018 (Hemmera et al. 2019), which indicated fatty acid concentration on Roberts Bank was positively correlated with salinity, although this effect was variable from year to year. The Proponent's conclusion that biofilm quantity and quality, including levels of fatty acids, will not be affected by the Project is based on the inference that fatty acid values were consistent over a range of salinity conditions and freshet sizes. In ECCC's Written Submission to the Panel, the department identified problems with the Proponent's conclusion, which have not been addressed in IR-2020-4. Therefore, the Proponent's conclusion that salinity changes resulting from the project will not adversely affect biofilm and migratory shorebirds is inconsistent with the established ecology of biofilm and with the results of the Proponent's own studies.

In IR2020-4-A, the Proponent states that the spring fatty acid "bloom" observed in Schnurr et al. (2020) may be an artifact of the way the data were analyzed (page 8). Fatty acid values were expressed as availability per gram of sediment, and involved multiplying the fatty acid values by the percent organic content in a sample. The Supplementary Material in Schnurr et al. (2020) shows the summarized fatty acid without this multiplication, which have the same seasonal pattern as the results presented in the main text of the paper, and therefore the conclusion that highest values of fatty acid content occur in the spring does not depend on the way data were analyzed.

In IR2020-4-A, the Proponent also states that the Project would result in an increase in biofilm productivity by producing physical conditions that are more conducive to marine vegetation growth, including biofilm (page 2). Their conclusion is based on the Roberts Bank Ecosystem Productivity Model (RBEM). In its review of the RBEM, the Department of Fisheries and Oceans (DFO) indicated that this model was 'not informative with respect to understanding the potential impacts of the Project on biofilm and the Western Sandpiper' (DFO 2016). The model was run on an annual time step that was not appropriate for species abundances with a strong seasonal component, such as highly mobile Western Sandpipers, and the model did not consider the provision of essential nutrients such as fatty acids. ECCC indicated a similar concern in its submissions to the Panel, and the Review Panel's final Report (3.2.3) concurred with this advice. Consequently, results from the RBEM should not be used to predict Project effects on Western Sandpipers.

In IR2020-4-A, the Proponent further states that the shorebird foraging modeling demonstrated that biofilm in the Roberts Bank area can support over one million Western Sandpipers foraging on a single day with the Project in place (page 5). Their statement is based on an energetics approach that compares the energy (KJ/day) available in the biofilm on Roberts Bank with the demands imposed by the thousands of migrating shorebirds that pass through annually during northward migration (15 April to 15 May). The approach does not consider the provision of essential nutrients (fatty acids) for successful shorebird migration. Further, ECCC has previously raised a series of concerns with this modelling (CEAR Doc 581, ECCC's Sufficiency Review of the EIS), and which have not been addressed. ECCC therefore, does not view the conclusions based on this modelling as reliable.

Remediation options for biofilm habitat are limited

Considerable uncertainty exists around the possibility that loss of function of productive biofilm habitat could be mitigated by the large-scale re-creation of biofilm habitat capable of supporting shorebirds. Along with Japanese colleagues, ECCC recently completed an assessment of the Japanese experience in mudflat restoration (Kuwae et al. 2021). These restoration projects are small in spatial scale, and none are of the size that would be needed to mitigate the impacts from this Project, which may affect hundreds of thousands of birds at a key time in their annual cycle. Moreover, none of the restoration projects considered fatty acid content in biofilm, and therefore it is uncertain whether such an approach can be used to mitigate the predicted effects of the Project.

IR2020-4-A specifically mentions Komuke Lagoon on the east coast of Hokkaido in Japan as a case study in restoration (page 5), where biofilm feeding has been documented for Red-necked Stints (Kuwae et al. 2012), small sandpipers that share ecological similarities with the Western Sandpiper. Komuke Lagoon was naturally formed by a ridge of sand that trapped water on the landward side, and was modified to be a semi-enclosed system. The key management intervention at Komuke Lagoon was the installation of a permanent channel (Watanabe and Kuwae 2021). This channel restored the exchange of freshwater/seawater at the site, increasing shorebird usage. This result underscores the importance of

the exchange of freshwater and saltwater at shorebird stopover sites and the potential impacts that the changes in salinity regime associated with RBT2 Project would have on Western sandpipers.

Mudflat creation and offsetting remains an experimental mitigation measure for biofilm, and current best practises are untested. In IR2020-4, the Proponent has committed to continue to work with Indigenous groups, regulators, and others to i) incorporate feedback to inform the selection and advancement of technically feasible project design mitigation, and ii) implement three follow-up program elements related to verifying effect predictions with the project in place for salinity, geomorphic features and sediment erosion and deposition, and Western Sandpiper prey (including biofilm) (page 26). Considering ECCC's view that project effects on biofilm and Western Sandpipers would be unmitigable, immediate, and irreversible, ECCC suggests that an adaptive management approach would not provide an appropriate solution to remediate what ECCC continues to anticipate would be the adverse impact of the project on biofilm and western sandpipers.

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