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File: 121415079

Attention: Terri Fraser, P.Eng.
Technical Manager
Northern Pulp Nova Scotia Corporation
PO Box 549, Station Main
New Glasgow, NS B2H 5E8

Dear Ms. Fraser,

Reference: Information Request Responses, Receiving Water Study for the Northern Pulp Effluent Treatment Plant Replacement Project, Pictou Harbour, Nova Scotia

Stantec Consulting Ltd. (Stantec) is pleased to provide the following responses for external stakeholders with regards to the effluent discharge modelling for the proposed wastewater treatment plant replacement project.

Question 1: Why ice in the harbour won't affect the dispersion of effluent and the 100-m mixing zone as it was modelled?

Quick Answer:

Effluent dispersion in winter will not be restricted by ice because of temperature and density. The receiving water report delves into ice differential. Warmer months are most challenging for dispersion; in fact, in winter dispersion will be better and faster due to cold temperatures and buoyancy. This is a result of the larger temperature difference with the ambient marine water in Northumberland Strait, leading to a larger density difference between effluent and receiving water. Furthermore, the ice cover would increase turbulence. Modelling results indicate that the plume from a diffuser with six ports reaches the surface at about 90 m from the outfall. Therefore, the impact of ice in the Northumberland Strait on the shape of the plume will be very limited as subsurface mixing is already complete.

Additional technical supporting information:

When developing the mixing model for the Receiving Water Study (RWS), Stantec recommended using a more conservative case scenario when evaluating the mixing zone in the receiving environment. As detailed below, the conditions for the more conservative case are found to occur during the summer months when the temperature and density play a lessor role in effluent mixing. In winter, mixing is effectively enhanced due to the larger difference in temperature and salinity (density) conditions. The technical discussion of this aspect is described below.

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Effluent plume dispersion involves a two-stage physical mixing process.

- The first stage is the initial mixing, which is dominated by the effluent jet discharge velocity and the differences in density between the effluent and the receiving water. The higher jet velocities exiting the diffuser creates turbulent mixing in the receiving water that persists until the turbulent momentum dissipates. Concurrently, the less dense effluent (compared to the receiving water in Northumberland Strait) is more buoyant, causing the effluent plume to rise upwards to the surface, further facilitating effluent mixing. It should be noted that as the difference in temperature increases between the effluent and the saline receiving environment, the mixing effectiveness increases as the plume is more buoyant (less dense). Warmer months therefore exhibit poorer initial mixing zone conditions.

- In the second stage of the physical mixing process, additional mixing is then facilitated by other factors in the receiving environment such as tidal currents, water levels, water quality, and freshwater inflows, as well as climactic conditions such as wind, waves and ice. The receiving water currents predominantly drive this latter stage of dispersion, causing the effluent plume to move horizontally.

Stantec applied a summertime scenario to the model as there would be poorer effluent plume mixing due to the smaller temperature differences (and thus buoyant mixing). Further, we minimized the potential effects of surface mixing by modelling and using smaller tidal ranges, warmer ambient waters, less wind-driven surface currents, and low freshwater inflows from rivers.

The receiving water conditions and the presence of ice during the winter season in Northumberland Strait are expected to be more favourable for effluent mixing and dispersion, compared to summer discharge conditions. This is a result of the larger temperature difference with the ambient marine water in Northumberland Strait, leading to a larger density difference between the effluent and receiving water and an increased effect of plume buoyancy on the mixing process. Therefore, it is expected a higher dilution will be achieved during the winter season compared to the summer season. Furthermore, the presence of ice cover would increase turbulence at the ice/water interface by providing resistance to the ambient water currents, resulting in a higher mixing and dilution.

In addition, results of the three-dimensional (3D) CORMIX modelling investigation (Stantec 2017) indicated that the plume from six ports at the Alt-D location reaches the surface at about 90 m from the diffuser where the effluent is fully mixed with ambient water (dilution ratio is 102 times) and vertical and horizontal velocities of the effluent are very small. Therefore, the impact of ice in Northumberland Strait on the shape of the plume will be very limited as subsurface mixing is already complete.

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Question 2: What happens to effluent in a "freak storm" with surge tides?

Quick Answer:

Surge tides generate turbulence and ultimately provide better and faster mixing conditions.

Additional technical supporting information:

Storm surges will beneficially increase the circulation currents (including tidal currents and surface currents) and turbulence in the receiving waters, enhancing effluent mixing within the receiving environment. With storm events, a higher dilution ratio of the effluent plume in the receiving environment is expected.

Question 3: How salinity was indirectly modelled (through density) in the report and when it will meet background salinity in the Strait?

Quick Answer:

Density is the major factor governing the vertical movements of ocean waters. The density distribution is based on temperature and salinity data. Salinity will be within 2% of background five metres away from the outfall.

Additional technical supporting information:

Density is the major factor governing the vertical movements of ocean waters. When density is not measured directly (as for this site), standard industry practice allows it to be calculated based on salinity and temperature; these two parameters were obtained from previous studies (ENSR 1999, JWEL 1996) and were inputs to the model. The density distribution in the 3D CORMIX numerical model is calculated using the full United Nations Educational, Scientific and Cultural Organization (UNESCO) equation of state, which is based on user-provided temperature and salinity data.

As discussed below, salinity will be within 2% of background five metres away from the outfall. The salinity used for the effluent (expressed as Total Dissolved Solids (TDS)) was 4 g/L. Ambient salinity for the study area is approximately 27.5 g/L. Results for the effluent dilution ratios for various scenarios are presented in Table 3-4 of the RWS report (Stantec 2017). The CORMIX modelling results indicate that for the marine outfall at the Alt-D location with a six-port diffuser, the dilution ratio is 36.3 times within 5 m of the diffuser. The resulting effluent salinity in the plume 5 m from the outfall is calculated to be 26.9 g/L (i.e., ((36.3 L x 27.5 g/L) + 4 g)/ (36.3 L + 1 L)) which is 2 % less than background. This low difference in salinity will quickly reduce with increasing distance from the outfall.

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Question 4: A brief discussion regarding the data for the fisheries map [used in the RWS report].

The data used to investigate the environmental sensitivities in the study area with respect to the type of fishery species that could be present and their mapping were based on commercial, recreational, and/or Aboriginal fisheries identified in existing reports. The fisheries information in Figure 2-10 of the RWS report is based on previous environmental impact assessments conducted for Boat Harbour (JWEL 1994, 2005) and environmental effects monitoring investigations that describe resources for the area (Stantec, 2004; Ecometrix 2007, 2016). The information in these reports also relied on communications with commercial fishers, First Nations, and/or the Department of Fisheries and Oceans Canada (DFO) at that time to identify the fishery species and location of fishing grounds, which was adequate for the purposes of the RWS. More recent commercial fisheries catch data that DFO can provide are fisheries landings data in grid areas 7 km by 11 km (see attached Figure 1 further below). Fisheries data at this course scale would not be practical or useful for the purposes of the RWS. Furthermore, to comply with the relatively recent Government of Canada's privacy policy, any grid cell area containing data from less than five identified vessels, licences, or fishers are labelled as privacy-screened areas where no data can be provided. To obtain more recent fisheries information and fisheries catch effort data at an appropriate spatial scale for the relatively small dimensions of the effluent plume would require consultations with commercial fishers and the engagement of Indigenous communities. These activities were beyond the scope of the RWS investigation and likely could be a component of the environmental assessment process for the project.

CLOSING

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The information and conclusions contained in this letter are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions and recommendations presented in this letter should not be construed as legal advice.

The conclusions presented in this letter represent the best technical judgment of Stantec Consulting Ltd. based on the data obtained from the work. If any conditions become apparent that differ from our understanding of conditions as presented in this letter, we request that we be notified immediately to reassess the conclusions provided herein.

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This letter was prepared by Shelton Liu (Ph.D., P.Eng.), Igor Iskra (Ph.D., P.Eng.), reviewed by Sam Salley (M.Sc.) and independently reviewed by Michael Charles (P.Eng.).

Regards,

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Attachment: Figure 1 – 7 km by 11 km Grid Size of DFO Commercial Fisheries Landings Data for Northumberland Strait

Reference: Information Request Responses, Receiving Water Study for the Northern Pulp Effluent Treatment Plant Replacement Project, Pictou Harbour, Nova Scotia

REFERENCES

Ecomtrix. 2007. EEM Cycle 4 Interpretive Report for the Neenah Paper (Pictou Mill) Facility at New Glasgow, Nova Scotia. Report prepared for Neenah Paper Inc. (Pictou Mill).

Ecomtrix. 2016. EEM Cycle 7 Interpretive Report for the Northern Pulp Nova Scotia Corp. Facility near Pictou, Nova Scotia. Report prepared for Northern Pulp Nova Scotia Corp.

ENSR. 1999. Preliminary Effluent Diffuser Study, Kimberly-Clark Nova Scotia.

Jacques Whitford Environment Limited (JWEL). 1994. Initial Environmental Assessment of a Pipeline and Diffuser Proposal for the Boat Harbour Treatment Facility. Report prepared for the Nova Scotia Department of Supply and Services.

Jacques Whitford Environment Limited (JWEL), 1996. First cycle EEM aquatic environmental effects monitoring program Boat Harbour waste water treatment facility. Report to Environment Canada on behalf of the Nova Scotia Department of Supply and Services, 65 p. appendices A - I.

Jacques Whitford Environment Limited (JWEL). 2005. Re-introduction of Tidal Influence to Boat Harbour, Pictou County, Nova Scotia.

Stantec Consulting Ltd. (Stantec). 2017. Preliminary Receiving Water Study for Northern Pulp Effluent Treatment Plant Replacement, Pictou Harbour, Nova Scotia. Final Report prepared for KSH Solutions Inc. August 11, 2017.

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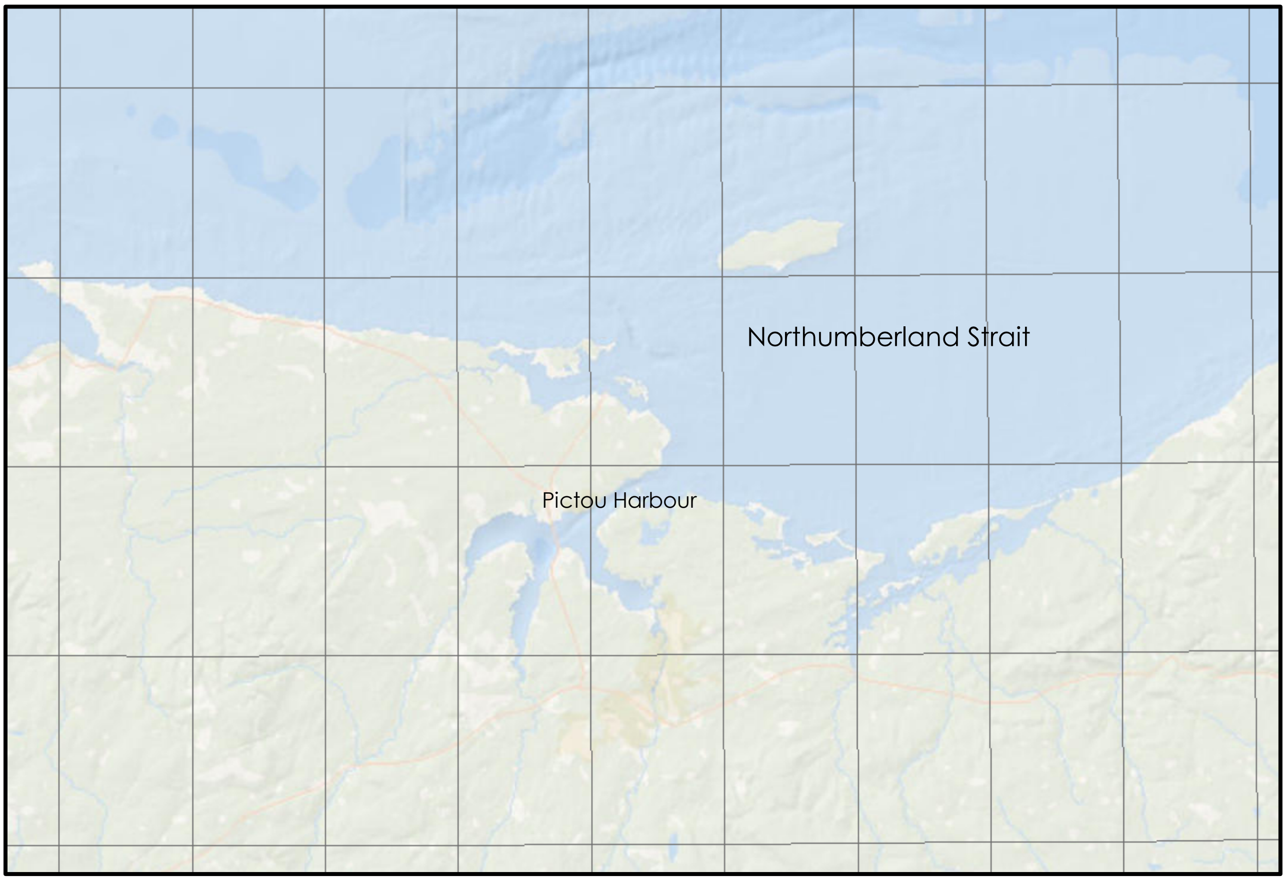

Figure 1 - 7 km by 11 km Grid Size of DFO Commercial Fisheries Landings Data for Northumberland Strait