November 7, 2019

Honorable Minister Gordon Wilson
Environmental Assessment Branch,
Nova Scotia Environment
P.O. Box 442, Halifax, Nova Scotia
B3J 2P8

RE: Northern Pulp Nova Scotia - Environmental Assessment Focus Report - Replacement Effluent Treatment Facility

Please see the following document in response to the Focus Report of Northern Pulp's Effluent Replacement Project. I am a commercial fisher and harvest lobster, rock crab, and herring from the waters directly surrounding the proposed pipe route and outfall location. I also have a background in structural engineering and have worked on various projects throughout the Maritimes assisting in both the structural design and geotechnical investigation of various structures. This submission will include a combination of site-specific observations and the effects it will have on the structural integrity of the pipe.

I have also attached my previous submission to the Environmental Assessment of Northern Pulp's Effluent Replacement Project. These submissions highlight some major concerns with the underwater portion of the proposed pipe.

Sincerely,

Colton Cameron, BScEng, Commercial fisherman

November 7, 2019

RE: Northern Pulp Nova Scotia Focus Report

In previous comments, submitted in response to Northern Pulp's Environmental Assessment, I highlighted concerns of pipe failure due to the presence of ice along the proposed pipe route. The issues raised in that submission have not been addressed by Northern Pulp in the Focus Report. The risk of damage to the marine pipe by ice is critical to determine the viability of the proposed project. TOR 2.2 requires Northern Pulp to "Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline."

My earlier paper explored two possible failure modes due to ice presence: 1) Direct impact causing a ductile failure (high amount of stress over a relatively short time), 2) Cyclical loading causing a brittle failure (stress levels lower than the mechanical strength of the material induced repeatedly over a relatively long time) (Zhang, 2005). The submission detailed the seafloor bottom as observed by fishers to be mostly sandy soft bottom. Possible problems associated with this type of bottom were highlighted including ice scour detection problems due to quick infill and non uniform stresses on the pipe. Figure 1 is a figure taken from the prior submission detailing the presence of large mounds of ice present in a large area southeast of the Caribou lighthouse (or west of Munroe's Island) along the proposed pipeline route in the winter of 2018-2019.

Figure 1: Ice southeast of Caribou lighthouse along proposed pipe route (March 4th, 2019)

Since the Minister's decision in April 2019, a geotechnical survey has been conducted by CSR GeoSurveys Limited (CSR) as part of Northern Pulp's Focus Report. The survey results describe the Caribou corridor "to be dominated by extensive areas of silty sand, sand and sand/gravel." (P.74, Appendix 2.2). In determining the trench depth of buried pipe, CSR states that the scour depth is the single most important parameter and includes that "scours in sand will experience some infill immediately due to lack of sediment cohesion." (P.95, Appendix 2.2). During the survey, if any scours had been infilled the scour measurements were taken from the top of infill (thus not truly depicting how deep the ice had actually scoured). The survey identified a total of 133 ice scours within the Caribou corridor, stating the maximum scour depth measured as 0.4 meters (scour depth minus any infill). Also found in the survey was a large area 70m x 100m (west of Munroe's Island) that indicated ice grounding to a depth of 0.7m. The ice scours found along the pipe route had measured widths ranging from 1m to 6m and lengths ranging from 2m to 260 m.

The new data obtained as part of Northern Pulp's Focus report has verified the soft sandy soil conditions and found extremely alarming rates of ice scouring directly along the proposed route. The report has also confirmed extensive ice grounding located along the shallow area in Figure 1 (Figure 2 of previous submission). Due to the predominately sandy soil along the proposed route, all of the depths of scouring obtained are subject to some degree of error, as the soil quickly infills the scouring. CSR states that all scouring was from the 2018-2019 winter, as can be expected due to quickly changing sandy bottom continuously subject to tidal and wave action. The question is how much infill had taken place from the time the ice left until the survey was completed?

Ice conditions along the proposed route during the winter of 2018-2019 were relatively average or below average with no fisheries or marine activity delayed due to ice. We do not have to look back far to find winters where fishing seasons have been delayed due the extreme ice conditions. In 2015 Lobster Fishing Area (LFA) 26A (which includes Caribou Harbour) was delayed nearly 2 weeks due to ice. Standards of practice for detecting ice scouring in shallow soft bottoms recommend that historical data be taken into account. It is also recommended that survey data be recorded at variant times, as a single data set can easily give a misrepresentation of the ice/seafloor interactions. This begs the question what would the survey have looked like directly after the ice left in 2015?

Figure 2 is one of many figures in CSR's report depicting the ice gouge locations along the proposed route. The blue line shows the proposed pipeline route while the several black lines show ice gouges found by CSR's survey. The figure illustrates a portion of the pipe route where depths are as shallow as 1 meter. This figure along with many others are severally alarming when looking at the possibility of ice impact on the pipe. Considering that founded gouges have measured lengths of up to 260 meters and widths of up to 6 meters, this data is not something to take lightly. If there is any amount of error in forecasting the maximum depth of ice gauging there is a large possibility of ductile pipe failure due to direct impact with catastrophic repercussion to the surrounding marine environment.

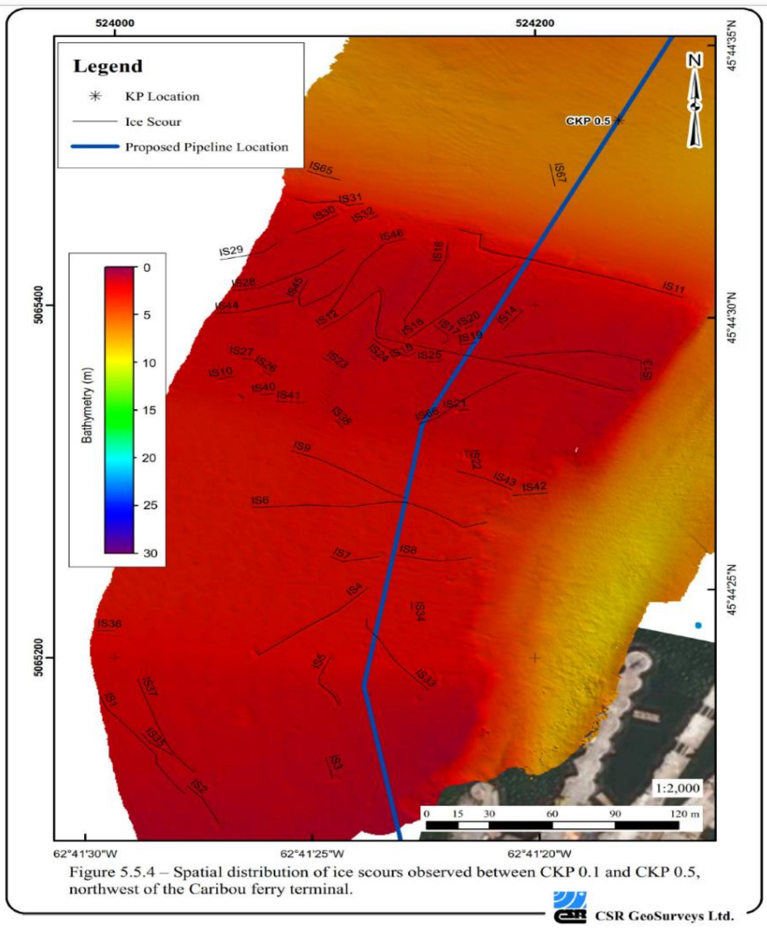

Figure 2: Ice Gouging along a small section of the Proposed Route (P.104, Appendix 2.2)

Equally alarming as the potential for direct impact of ice on the buried pipe is the possibility of a brittle failure of the pipe under the large area found to have ice grounding. The survey found ice grounding to a depth of 0.7m over an area of 7000 square meters. To give a better understanding of the intensity of these ice forces we will do a quick calculation to estimate this section of ice groundings weight. We will use all of the smallest dimension assumptions to ensure that no one thinks we are inflating the values: Given 0.7 meters of ice embedded into the soil and choosing the shallowest depth gives 1 meter of the ice between seafloor elevation and sea level elevation, looking at Figure 1 we will conservatively estimate the mean height of ice mounds at 1m. This gives us approximately 19,000 m^3 of ice, using a density of approximately 900kg/m^3 results in over 17 million kilograms of ice or 37.6 million pounds of ice on an area 70m x 100m. Although this puts into the perspective the intense gravity forces due to ice, the lateral forces created by the ice are far more alarming. During the winter months the Northumberland Strait is filled with ice, as the tide falls each time the water level below all this tightly packed ice decreases creating even higher ice interaction forces. The weakest link in all of this being the shorelines and shallow harbours which see the brunt of these enormous lateral ice forces. This begs the question, if ice cover over a 70 meter by 100-meter sections weighs over 37.6 million pounds, how much force would all of the ice in the Northumberland Strait be able to exert laterally? Now imagine this force being constantly applied cyclical with every 12-hour tide cycle. This raises major concerns in fatigue stresses developing in the pipe over time. Even if the gouge depths do not reach the pipe depth the ice-soil interaction forces will convert to soil-pipe interaction forces continually being applied in a cyclical manner. If direct impact does not occur causing immediate ductile failure these fatigue stress could eventually lead to a brittle failure of the pipe.

With no leak detection plan in place for the marine portion of the pipe, the failure could go undetected for months or years, seeping effluent in shallow waters where the receiving waters would not have the dilution characteristics necessary to dilute the effluent. Northern Pulp has not addressed the risks from ice grounding. This is a critical omission.

There is too much at stake to fast track the design process of the pipe. A full ice report including historical data and multiple surveys and site visits in winter months must be conducted to ensure the ice effects are modelled properly. Before the Minister can approve the proposed project, clear engineered documents including a leak detection plan for the marine portion of the pipe must be submitted for public review, plans should include a monitoring system with real time data. Failure to do so could lead to the catastrophic structural failure of the pipe due to direct ice impact or cyclic fatigue loadings exceeding allowable limits. Effluent prematurely released in shallow waters due to a pipe break and gone undetected would have irreversible effects on the surrounding marine ecosystems.

The Minister does not have the appropriate baseline information to determine that this project is viable, and cannot approve the project. It is recommended that the Minister call for a full federal environmental assessment. More information is required to ensure that ice presence will not cause a pipe failure, leading to catastrophic repercussions for all marine ecosystems. A real time monitoring program for the marine portion of the pipe should be included in the future design process.

Colton Cameron, BScEng, Commercial Fisherman

RE: Previous Submission Environmental Assessment

1.0 SEAFLOOR CHARACTERISTICS OF PROPOSED ROUTE

1.1 Effluent Effects Rock Crab Population

Inside Caribou harbour consists mainly of shallow soft sand and mud bottom with portions of broken hard bottom. Such seafloor characteristics create a favourable environment for the rock crab population to flourish. While harvesting rock crab throughout LFA 26A fishers have observed that this inlet presents optimal conditions for juvenile and female rock crabs. If you place traps within the harbour (south/southwest of Munros Island or directly east of the ferry terminal) the majority of the harvested catch appears to consist of small juvenile crab including a high percentage of females. As you move out of the harbour along the proposed pipe route and along the shore east and west the percentage of harvestable rock crab (a rock crab of legal size) within the catch appears to significantly increase. Traps placed further offshore in deeper waters tend to have a catch rate with the majority of the catch consisting of large harvestable crabs with very few undersized crabs. Over the years all of the above has remained consistent and local fishers have concluded that the Caribou harbour acts as a breeding ground and an optimal environment for juvenile rock crab to mature before moving to deeper waters. This raises the major concern of what effect will this effluent have on these juvenile rock crab and the rock crab population as a whole? Not to mention the chain reaction that would occur throughout other species including lobster whose diet consists of a large percentage of rock crab (Fisheries & Oceans Canada, 2013).

1.2 Effects of Site Specifics on Structural Integrity of the Pipe

The marine portion of Northern Pulps pipeline design consists of approximately 4 kilometers of 36” high density polyethylene (HDPE) pipe that will be weighted with concrete ballast and placed in a 3 m trench (providing approximately 2 m of cover to the top of pipe) and will be backfilled with armour stone (Appendix F, Northern Pulp, 2019).

The pipeline location proposed by Northern Pulp presents various challenges that must be addressed to ensure the structural integrity of the pipe. As previously stated, the bottom has been observed by fishers to consist of soft sand and mud bottom with small pockets of hard bottom. With no geotechnical investigation carried out by any of Northern Pulps consultants it is unknown how deep the soft bottom continues. This raises the concern of non-uniform settlement of the soil that will be supporting the pipe. Due to the pipe being placed in a pre-dug trench during the construction phase it is likely that the pipe will experience increased installation deflections due to the trench quickly being filled in with sand due to wave and tidal action, thus creating discrepancies between design pipe elevations and as built pipe elevations. The pipe is also likely to experience increased in-service deflections over time due to the pockets of hard bottom creating a point of solid support while large portions of soft bottom allow for settlement and pipe sag. These deflections will induce increased compressive and tensile bending stresses within the pipe wall resulting in bending strains. The design code aims to limit these strains and the geometric stability of the pipe by setting ring deflection limits of 7.5%. As deflections increase beyond this point geometric stability is eventually lost and the crown of the pipe will begin to flatten and eventually reverse leading to reverse curvature collapse of the pipe Figure 1 shows observed pipe deformation patterns that lead to failure due to increased pipe deflections (Plastic Pipe Institute, 2014).

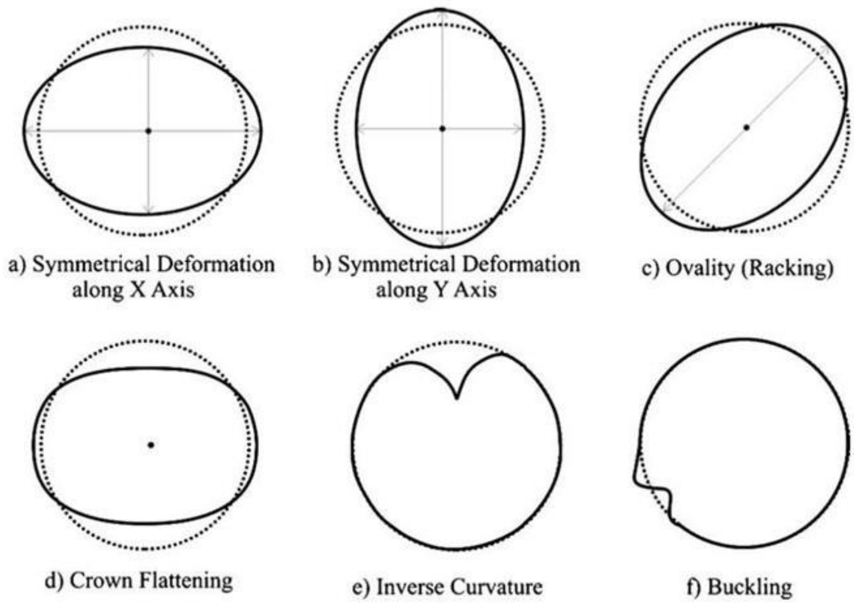

Figure 1: Observed deformations of installed HDPE pipelines (Motahari & Abolmaali, 2010)

Figure 1 is from a study published in the Journal of Transportation Engineers of the American Society of Civil Engineers (ASCE). The study included structural monitoring with video and laser surveillance of over 15,000ft (96 pipelines) of buried HDPE pipe across the USA. It was concluded that the majority of pipelines had actual deformations in excess of design code limits (Motahari & Abolmaali, 2010). This study gives great insight into the possible repercussions of not accurately modeling induced strains in buried HDPE pipes.

Due to the cyclical nature of the tidal forces and wave action these induced stresses combined with ice loads over time could present fatigue stress issues. Although HDPE pipes are extremely flexible making them well suited to bend and adhere to the seafloor, cyclical loading has the potential to cause failure if the site-specific loadings on the pipe are not properly addressed. "One of the causes for failures of HDPE pipes is fatigue which is the result of pipes being subjected to cyclic loading, such as internal pressure, weight loads or external loadings on buried pipes, which generate stress in different directions: circumferential, longitudinal and radial." (P. 600, Djebli et al., 2014). To accurately determine these site-specific loads, various data is required including accurate geotechnical site investigation with borehole results, hydrographic site surveys including bottom type/depths, potential ice scours, and site observations of ice conditions. It should be noted that none of these are present in Northern Pulp's submission.

Of all the loads the pipe will experience, ice loads present that largest risk to the structural integrity of the pipe. Potential failure of the pipe due to ice could occur from one of two mechanisms: 1) Direct impact causing a ductile failure (high amount of stress over a relatively short time), 2)

Cyclical loading causing a brittle failure (stress levels lower than the mechanical strength of the material induced repeatitly over a relatively long time) (Zhang, 2005). Brittle failure due to ice impact could occur if any of the following project tasks are neglected: complete a site survey of ice conditions, complete a hydrographic survey depicting any potential ice scours, bury pipe at an adequate distance to account for extreme ice event. Although Northern Pulp shows a pipe buried with cover of approximately 2 meters, they have not completed any of the pre-design field work required to ensure that the pipe is not at risk of failure. When determining extreme ice scouring events, it is also recommended that ice scour surveys be carried out more than once, spaced out over time to gain an accurate depiction of the ice and seafloor interaction (C-Core, 2004). Grounding models such as the one created for a tunnel project crossing the Strait of Belle Isle, Newfoundland can also be carried out to gain insight into ice activity in a given region (C-Core, 2004). The soft soil and shallow design depth of the pipe (approximately 2 meters) also poses concerns for ice and seafloor interaction. If large ice accumulation was present and gouged the seafloor to the unknown depths of the soft bottom there would be no evidence of such gouges once the ice had melted as the sand would infill the gouges within a couple tide cycles. Figure 2 and Figure 3 are a photo's taken March 4th, 2019 from the Caribou light house, the PEI ferry can be seen docked in the background.

Figure 2: Ice southeast of Caribou lighthouse along proposed pipe route (March 4th, 2019)

This photo shows extensive ice directly over the proposed pipe route. Locations where water depths are as shallow as 1 meter have ice piles of 3-4-meter heights above sea level. It is not unlikely to conclude from these photos alone that potential for ice impact at a depth of 2m below seafloor bottom in a soft bottom is a very real possibility that could lead to a ductile failure resulting in the catastrophic event of premature released effluent into the Caribou harbour. Figure 3 shows more ice further north along proposed pipe route.

Figure 3: Ice east of Caribou lighthouse along proposed pipe route (March 4th, 2019)

Alex Falconer, now retired, fished the waters surrounding the proposed pipe location for 55 years. Along with other species Alex fished lobsters along the shores of Caribou Island. He recalls one winter when ice conditions were at their peak, one of his most lucrative lobster spots was completely wiped out by the ice. North of Black Point the bottom consisted of dense hard bottom with drastic elevation changes in the bottom including a large trench where lobsters could always be found. The following spring the rock bottom had been completely changed and the trench had been filled in.

Barry Sutherland, a long-time fishermen and Rob Mackay a commercial diver in the area for 25 years have also seen the power of the ice in the area. One spring Barry could not seem to get his traps boarded as they were tangled on something on the bottom. When Rob dove to retrieve them a navigational marker buoy from PEI was found drove into the rock bottom by the ice.

3.0 RECIEVEING WATER STUDY

Events that would be catastrophic to the marine ecosystems include: 1) Structural failure of the pipe causing effluent to be released prematurely of the discharge location. 2) Errors in the receiving water study including tides, water flow, mixing characteristics at discharge location, lack of consideration for climate change effects will have on mixing characteristics.

The shallow soft bottom that extends south of the Caribou lighthouse combined with Munroe's Island extruding westward creates a bottleneck effect for the water currents. This bottleneck effect is also accelerated by the water moving in from deep waters to shallow waters on a rising tide. These physical characteristics create accelerated tides and wave action, across the proposed location. These conditions combined with a prevailing north wind can cause water to swell into the harbour and hold waters in the harbour longer on a rising tide this gives the harbour very poor flushing characteristics. If there were a failure in the pipe at a location prior to the diffusers there would be no chance of meeting the dilution standards. The same could be said about the diffuser location if there is any variability in the water/mixing properties that were used in the receiving water study. Although computer modelling can give great insight into complex problems performing thousands of iterations and time steps in the matter of seconds, the results are only as good as the variables that were entered into the model. When dealing with a project with environmental consequences as catastrophic as this, each variable of tidal data, water depths, salinity, mixing characteristics etc. must be observed and calculated in a timely manner to ensure the level of confidence of the model is extremely high.

In near field portion of the receiving water study Stantec states "No historical water quality data are available for Northumberland Strait around the CH-B location. Data from the neighbouring Pictou Road (Stantec, 2017) located about 6 km southeast were used." (Stantec, 2018). While in the far field portion of the study they simply extended the boundaries of the previous model created for the previous outfall location in the original study that was completed for Pictou Harbour (Stantec, 2017). I will not attempt to touch on the technical data within the receiving waters study as I do not have the educational background to do so. I will however pose the following questions: Has adequate field investigations been carried out to ensure the results of these models are correct? Is stating there was no historical data thus we used data from our previously studied location sufficient? Should actual water sampling have been carried out at the actual location? Is this project being fast tracked? The study concludes that "The effluent discharged at the CH-B location is predicted to be dispersed and transported predominantly with offshore currents in the northwest and southeast directions. The effluent intrusion into Caribou Harbour is predicted to be minimum." (P.27 Stantec 2018). With what level of confidence can they make this statement while some data was simply pulled from the original location of Pictou Harbour? Have they modelled the bottleneck effect that all fishermen are aware of?

4.0 CONCLUSIONS & RECOMMMENDATIONS

Due to the lack of detail presented concerning site-specific data of various elements of the project, the minister must request an environmental assessment report. The report should include a geotechnical investigation, hydrographic survey and further investigations detailing ice presence. Pipe deformation issues should be addressed and a study must be conducted to ensure that direct ice impact will not occur. A detailed tidal study should be carried out to ensure that the effluent will not intrude into Caribou harbour severely effecting the marine ecosystem.

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