Memo

To: Paul Harper, Fisheries and Oceans Canada

From: Bryan Gale, Dillon Consulting Limited

cc: Paul Clow, Government of Nunavut

Date: August 22, 2022

Subject: Kimmirut New Sewage Lagoon – Fish Habitat Assessment

Our File: File #20-2790

Dillon Consulting Limited (Dillon) has been retained by the Government of Nunavut to assist with the planning and development of a new sewage lagoon within the municipality of Kimmirut, Nunavut (the Project). Currently, sewage from the community is discharged daily down a bank, into a natural creek/wetland system (i.e., effluent flowpath), and flows into the Arctic Ocean.

An existing pond south of the municipality is proposed to be converted into the new sewage lagoon to allow for the treatment of raw sewage. Consultation was conducted with the community of Kimmirut (i.e., with community Elders), which indicated that fish were not present within the pond and that the pond dries up and/or freezes to bottom in the winter. In discussions with Fisheries and Oceans Canada (DFO), DFO requested that fish sampling be conducted to confirm the absence of fish, and determine whether the Project may cause impacts to fish and fish habitat that would require approval under the *Fisheries Act*.

Desktop Assessment of Habitat Requirements for Potential Fish Species

The pond was assessed for both seasonal use and potential for resident populations. To determine the potential for resident populations of fish within the pond, a review of DFO's *Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, With Major Emphasis on Lake Habitat Requirements*[1] was conducted to determine:

a) Fish species with potential to occur within the pond (i.e., freshwater fish on Baffin Island); and
b) Spawning habitat requirements for those species.

A summary of the fish species with potential to occur, as well as their spawning habitat requirements, is provided in Table 1, below.

[1] Retrieved from https://publications.gc.ca/collections/collection_2007/dfo-mpo/Fs97-4-2569E.pdf

Table 1: Freshwater Fish Species on Baffin Island and their Spawning Habitat Characteristics

Fish Species	Spawning Habitat Characteristics
Burbot (*Lota lota*)	Eggs laid in sand, gravel or rubble substrates. Spawn in winter under ice.
Lake chub (*Couesius plumbeus*)	Eggs laid in rubble, cobble or gravel substrates.
Ninespine stickleback (*Pungitius pungitius*)	Nests are constructed among weeds in densely vegetated areas.
Threespine stickleback (*Gasterosteus aculeatus*)	Spawning is frequently associated with vegetated habitats, though spawning may occur in open water over sand or silt substrate.
Longnose sucker (*Catostomus catostomus*)	Adhesive eggs broadcast over gravel and sand substrates.
Arctic char (*Salvelinus alpinus*)	Cobble or gravel substrates.
Lake trout (*Salvelinus namaycush*)	Spawn primarily over cobble, rubble and large gravel substrates, interspersed with boulders in areas free of sand, silt, clay and mud.

Fish Habitat Assessment

A field-based assessment of fish habitat within the pond was conducted on July 12, 2022. Due to shallow depths and high visibility through the water, quality of habitat was easily assessed visually, as biologists walked in and around the pond. During the field assessment, observations and identification of aquatic resources and fish habitat, located in and immediately surrounding the pond, were conducted. Photos are provided at the end of this document.

Water quality was sampled at three locations within the pond using a YSI Multimeter. Water quality readings are provided in Table 2, below.

Table 2: Water Quality Results from the Unnamed Pond

Sample Location	Temperature (°C)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)	Total Dissolved Solids (g/L)
YSI #1	15.34	120	12.07	7.50
YSI #2	14.70	119	9.71	7.47
YSI #3	14.83	120	10.33	7.60

The pond is situated at the bottom of a small valley, with surrounding slopes comprised of bedrock and large boulders, with sparse ground-cover vegetation (Photos 1, 2). Water within the pond primarily consists of surface water runoff and melt within the valley, which is concentrated into a small inlet, entering the pond at on the west bank (Photos 3, 4). The inlet has a defined channel, though the channel was dry at the time of the assessment and is not anticipated to provide fish habitat nor does it connect to any other waterbodies upstream of the pond.

The pond is shallow, with depths gradually increasing towards the centre of the pond. Depths range from approximately 0.1 m along the shoreline to approximately 2.0 m at the deepest point. As a result of the shallow depths and water clarity, visibility is good throughout the majority of the pond. Pond

substrate consisted primarily of organics, with an approximately 4-inch thick uniform layer of soft, unconsolidated organic material, likely consisting of partially decomposed biomass (Photo 5). Disturbing the biomass layer (e.g., walking) resulted in the mobilization of an opaque black plume of material, with gas bubbling to the pond surface (Photo 6). A strong sulfur odor was also associated with the black plume, likely methane indicating anaerobic decomposition occurring within the biomass layer. Suitable fish habitat within the pond was limited, with very little functional cover, structure or complexity in habitat. The majority of the pond consists of uniform organic substrate with sparse boulders that have potential to provide limited cover for small-bodied fish. No in-water vegetation was present and riparian vegetation consisted of low-lying shrubs, grasses, moss, and lichen. Ravens were observed flying above the valley, and no other wildlife or birds were observed within the pond or the surrounding valley. Animal bones were located throughout the riparian zone and surrounding valley, with bones from species ranging in size from small (e.g., juvenile seal) to large (e.g., caribou) observed (Photos 7, 8).

A defined outlet channel is present at the eastern bank of the pond, flowing in a northeast direction, with a bankfull width of approximately 0.3 m. (Photos 9, 10). The outlet channel was dry at the pond outlet, with surface flow starting approximately 30 m downstream of the pond (i.e., from subsurface flows). Approximately 350 m downstream of the pond, the channel outlets into the existing effluent flowpath, which is characterized by an extremely productive riparian zone and is full of other anthropogenic debris (Photo 11). While the outlet channel is defined, flow is broken up by long (approximately 50-100 m) sections, where surface flow is not present. As such, the outlet channel is not anticipated to provide suitable fish habitat, and connectivity between the pond and the effluent flowpath likely only occurs during periods of high flow.

The effluent flowpath has continuous flow, very high riparian productivity for Baffin Island (i.e., due to high nutrient load), and was full of anthropogenic debris. Due to health and safety concerns, habitat characteristics of the effluent flowpath were not collected during the field assessment.

Fish Observations and Sampling

Passive (i.e., visual observations, minnow trapping) and active (i.e., seine netting) fish sampling techniques were utilized to confirm the presence or absence of fish within the pond.

Visual Observation

Due to high visibility through the entire water column and lack of cover for fish, it was anticipated that if fish were present in the pond, they should have been able to be observed. Biologists investigated the limited areas of potential cover (i.e., boulders) for fish presence and conducted observations of the entire shoreline from the pond shoreline, and from within the pond. No fish were observed.

Minnow Trapping

Six baited minnow traps were placed within the pond, fully submerged in water ranging in depth from 0.5 m to 2.0 m. Where possible, minnow traps were placed near potential habitat cover (e.g., sparse boulders).

Traps were initially set at 10:30, and left in place while the habitat assessment and seine netting were conducted. The traps were pulled initially at 13:30. No fish were captured within the minnow traps. The six traps were again baited and reset in similar locations at 16:00 on July 12, 2022. The traps were pulled again at 9:15 on July 13, 2022. No fish were captured or observed.

Seine Netting

Using a seine net (3/16" mesh x 4' deep x 10' length), two biologists conducted 10 passes along the shoreline of the pond. Invertebrates were captured, including caddisfly (*Trichoptera* spp.) larvae, brine shrimp (*Branchiopoda* spp.) and diving beetles (*Dytiscidae* spp.) (Photo 12). No fish were captured or observed.

Conclusion

Based on the background information from the community Elders and the findings of the fish habitat assessment, the pond is unlikely to support fish. Based on the shallow depths of the pond (and information provided by the Kimmirut community Elders), the pond likely dries up in the fall or freezes to bottom during the winter. Further evidence that the pond likely freezes to bottom is provided by the indications of anaerobic respiration occurring within the substrate (sulphur odour when disturbed - possibly methane).

Fish habitat potential within the pond is low to nil. Based on the spawning requirements for fish with the potential to occur on Baffin Island (see Table 1), the pond does not provide suitable spawning habitat for any of the listed fish species. Rearing habitat is poor, as fish habitat cover and complexity is functionally non-existent. There is a potential food source in the invertebrates captured via seine netting. Migration habitat is seasonal at best through the outlet channel, with the pond isolated throughout most of the year. The pond also likely does not provide overwintering habitat, as the pond likely freezes to bottom, with any potential water remaining likely becoming anoxic.

The pond is isolated for the majority of the year, with connectivity to the effluent flowpath likely only potentially occurring during spring melt. While it is possible that fish could migrate upstream to the pond during times with surface flow connectivity, fish are likely to become isolated in the pond due to the short-term connectivity. The pond is considered to be low quality, only seasonally available fish habitat due to the likelihood of freezing or drying up and lacking a sufficient surficial connection to fish habitat either within the ocean or any adjacent waterbodies. Fish were not found within the pond and are highly unlikely to ever be present. Should any fish species migrate to the site during high flow, the lack of habitat would indicate that they would not be likely to survive and are likely to be predated upon by bird species, due to the lack of habitat cover.

Site Photos

Photo 1: Facing southeast. The unnamed pond and surrounding valley. July 12, 2022.

Photo 2: Facing northwest. Close-up of pond depth, riparian zone. July 12, 2022.

Photo 3: Facing south. Dry inlet channel. July 12, 2022.

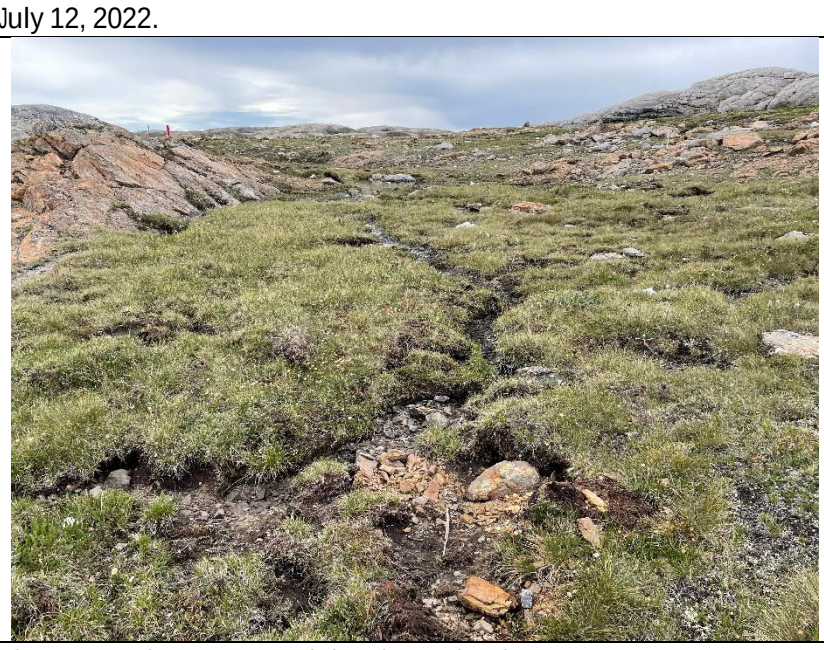

Photo 4: Facing west. Dry inlet channel. July 12, 2022.

Photo 5: Substrate of the unnamed pond. July 12, 2022.

Photo 6: Black plume and gas bubbles with strong sulphur odor. July 12, 2022.

Photo 7: Partial mandible of a small mammal, potentially a juvenile harbour seal (*Phoca vitulina*) based on morphology. July 12, 2022.

Photo 8: Partial caribou (*Rangifer tarandus groenlandicus*) skull and antlers. July 12, 2022.

Photo 9: Facing west. Dry portion of the outlet channel. July 12, 2022.

Photo 10: Facing northeast. Wetted portion of the outlet channel. July 12, 2022.

Photo 11: Facing north. Effluent flowpath and debris from landfill. July 13, 2022.

Photo 12: Invertebrates captured via seine netting. July 12, 2022.