Appendix V5-6AB

Freshwater and Marine Environmental Baseline and Fisheries Offsetting Update, November 15, 2017

TMAC RESOURCES

Memorandum

Date:	December 12, 2017
To:	Oliver Curran; TMAC Resources Inc.
From:	Geneviève Morinville; ERM Consultants Canada Ltd.
Subject:	**Summary of November 15, 2017 Meeting with DFO: Freshwater and Marine Environment Baseline and Offsetting for Madrid-Boston**

The purpose of this memorandum is to provide a summary of the meeting held on November 15, 2017 in Yellowknife, NT between Fisheries and Oceans (DFO) and TMAC (with ERM as the presenter), with attendance by members of the Kitikmeot Inuit Association (KIA).

1. MEETING SUMMARY

A two-hour meeting was organized between DFO and TMAC on November 15, 2017 in Yellowknife, NT. The purpose of the meeting was to provide an update on the 2017 baseline studies completed as part of the Madrid-Boston Project, and to discuss TMAC's approach to offsetting with regards to potential fish habitat losses should a *Fisheries Authorization* be deemed necessary as part of future *Fisheries Act (*1985) permitting processes. Presentation slides discussed during the meeting were provided in advance via email, and hard copies were made available to all attendees during the meeting. The presentation slides are provided in Appendix 1 of this memo.

Meeting attendees included:

- Angie McLellan (DFO);
- Oliver Curran (TMAC) and Alex Buchan (TMAC), and Geneviève Morinville (ERM; main presenter, phone), Kathryn Kuchapski (ERM; phone), and Greg Sharam (ERM); and
- John Roesch (KIA) and Heather Bears (KIA Consultant).

The presentation focused on the following three items:

1) Overview of Effects Assessment of Madrid-Boston on Freshwater and Marine Fish:
   - Overall background and summary of effects assessments for Freshwater Fish and Marine Fish chapters that were presented as part of the Madrid-Boston Draft Environmental Impact Assessment (DEIS);
   - Discussion of relevant DEIS technical hearing issues and commitments.

2) 2017 Field Season:
    - Approach and methods for fisheries and hydrology field studies;
    - Preliminary results on potential habitat losses relevant to fisheries offsetting for Madrid-Boston including proposed approach to fish habitat loss calculations;
    - Next steps: integration of newest water balance modelling results, fisheries, and hydrology data to calculate potential fish habitat losses associated with Madrid-Boston.

3) Fisheries Offsetting:
    - Fisheries Act: Understanding of current regulatory framework;
    - Proposed approach to freshwater and marine fisheries offsetting based on potential effects, 2017 results, and future FEIS submission.

During this meeting, ERM summarized the various field work components that were undertaken during the 2017 field season in order to address commitments specific to fisheries baseline sampling and offsetting identified during the technical review of the DEIS and Pre-hearing Conference Decision issued by the NIRB after technical meetings (NIRB 2017). ERM's approach for calculating potential habitat loss (in m^2) was presented for various streams, lakes, and Roberts Bay. Habitat loss stemming from in-water infrastructure footprints (e.g., culverts, water intakes/discharge pipelines) and from water withdrawal/water use was discussed for the freshwater environment, and habitat loss associated with a cargo dock footprint in Roberts Bay was discussed for the marine environment.

Approaches to fisheries offsetting associated with the Madrid-Boston Project proposal were presented for freshwater and marine environments. As part of the FEIS, TMAC will quantify potential habitat loss/alteration (in m^2) associated with footprint losses and water withdrawal/use effects. As part of the presentation, both local (in-kind) and off-site (out-of-kind) options for fisheries offsetting were presented, including a comparison of advantages and challenges/disadvantages associated with local and off-site options. TMAC's preference for offsetting freshwater fisheries losses is to develop an offsetting plan that considers a Cambridge Bay-based project contributing to overall objectives of the commercial Arctic Char fishery through the Integrated Fisheries Management Plan (IFMP) and/or to a subsistence fishery (e.g., Freshwater Creek). As part of the site selection process for suitable fisheries offsetting, consideration would be for identifying degraded sites that could benefit from habitat rehabilitation and/or fish passage improvements through stakeholder engagement.

TMAC and ERM discussed various potential options in and around Cambridge Bay including the removal of a barrier (culvert) on Freshwater Creek. Enhancing natural areas with reduced habitat connectivity and potential fish passage impediments and/or habitat degradation were also discussed (e.g., Freshwater Creek, Kitiga Falls). These types of activities have been shown to be beneficial in other systems, with the support and involvement of local community members.

ERM further discussed TMAC's approach for quantifying potential habitat loss/alteration (in m^2) associated with the proposed cargo dock in Roberts Bay. The assessment includes an assessment of the fisheries value associated with footprint-related habitat losses. ERM is of the opinion that

the amount of self-offsetting habitat (i.e., addition of riprap/armour rock) incorporated into the cargo dock's design will provide sufficient offsetting habitat to balance any associated losses in fisheries productivity. Therefore, no additional offsetting works would be required. However, should additional works be needed, the possibility to expand an off-site community-based project to also cover marine-related offsets, was put forward by TMAC. TMAC also shared with DFO their interest in considering complementary measures (i.e., research support) for offsetting. The off-site offsetting option in Cambridge Bay discussed during the meeting may be a suitable candidate for such complementary measures given the presence of the Canadian High Arctic Research Station (CHARS) and various ongoing research projects in and around Cambridge Bay on Arctic Char (e.g., Grenier Lake watershed).

After ERM's presentation, DFO acknowledged the importance of consultation and community support, and the offsetting principles that were presented during the presentation. Further, DFO acknowledged that TMAC's approach to calculating habitat loss followed the guidance provided in the *Fisheries Productivity Investment Policy* (DFO 2013). DFO indicated that the presentation would be provided to senior management to serve as an update on TMAC's Madrid-Boston proposal and to obtain feedback on TMAC's questions. In short, questions posed to DFO from TMAC and ERM were as follows:

- Does DFO consider the methods applied for calculating habit losses in freshwater and marine environments appropriate?
- Does DFO support the use of mitigation by design for self-offsetting habitat of the Roberts Bay Cargo Dock?
- What are DFO's expectations regarding community consultation? Is DFO willing to participate in meetings between TMAC, community members, and community organizations (e.g., Hunters and Trappers Organizations)?
- Would DFO support offsetting by complimentary measures for the Madrid-Boston Project, and if so, would the proportion of offsetting by complimentary measures be limited to 10%?
- Once freshwater and marine offset requirements are determined (separately), can offset requirements be met for both with a single offsetting plan, potentially for an anadromous species (i.e. Arctic Char)?

Next steps were discussed including future actions associated with stakeholder engagement, as well as future FEIS/NIRB regulatory timelines.

2. SUMMARY

TMAC will continue to engage with DFO and local Inuit groups to develop suitable freshwater and marine offsetting plans to address potential effects to fisheries productivity from the Madrid-Boston Project during and after the NIRB review of the FEIS. TMAC's preference is to develop an off-site, Cambridge Bay-based program to offset freshwater-related effects. In the marine environment, TMAC considers that the incorporation of riprap/armour stone within the design of the proposed cargo dock (i.e., self-offsetting) serve to offset any potential losses to fisheries productivity.

REFERENCES

1985. *Fisheries Act*, RSC, C. F-14.

DFO. 2013. Fisheries productivity investment policy: A proponent's guide to offsetting. http://www.dfo-mpo.gc.ca/pnw-ppe/offsetting-guide-compensation/index-eng.html. (accessed November 2017).

NIRB. 2017. Pre-hearing Conference Decision concerning the Phase 2 Hope Bay Belt Project (NIRB File No. 12MN001) Proposed by TMAC Resources Inc. Nunavut Impact Review Board. Cambridge Bay, NU.

APPENDIX 1 – FRESHWATER AND MARINE ENVIRONMENT BASELINE AND OFFSETTING UPDATE, NOVEMBER 15, 2017

Meeting Agenda

Meeting title:	**Pre-FEIS Meeting – Wildlife and Fish**
Meeting purpose:	• Follow-up on further data analysis requests received during the DEIS technical review. • Discuss modifications to WMMP where relevant
Meeting outcome:	Agreement on approach taken by TMAC to address technical review questions.
Date:	14 November, 2017
Location:	SRK Office - Suite 202 - 5204 50th Avenue, Yellowknife, NT, X1A 1E2
Time:	0900–1600
Notes:	Coffee, refreshments and lunch provided
Expected attendees:	TMAC: Oliver Curran, Alex Buchan ERM: Greg Sharam EDI: Michael Setterington KIA: John Rausch, Heather Bears GN: Regrets

Time Start	Topic	Notes
09:00	Welcome and Purpose of Meeting	
09:05	Overview of Technical Comments to Address	
09:15	Caribou Workshop Overview	Reflections on Inuit Input on Phase 2 Impact Assessment and WMMP before detailed discussion
09:30	Aircraft and ZOI (GN-10)	Including helicopter overflights in noise models.
09:35	Baseline enhancement (GN-15)	Seasonal ranges of caribou
09:40	Grizzly Bear (GN-14, KIA-02)	Den habitat model and mitigation
10:00	Camera (KIA-03)	Seasonal assessment of camera data.
10:20	Cumulative Effects (GN-15, NIRB-02)	Clarification of disturbances considered in effects assessment.

Time Start	Topic	Notes
10:30	Encounter Rates (GN-11, 15, 16, 17)	Presentation on methods and preliminary results. Discussion on GN and KIA interpretation.
11:00	Land Use (KIA-29)	Additional land user baseline
11:30	Health (KIA-22, 23)	Inclusion in human health risk assessment
11:35	Mitigation and Monitoring (GN 12, 14, 16, 21, 22, 28; INAC-TRC 35; KIA-01, 06)	Clarification of mitigation and monitoring
12:00	**LUNCH**	**Provided by TMAC**
13:00	Raptors (GN-19, 25)	Defer to meeting with ECCC
13:10	Resilience (KIA-05)	Including discussion in FEIS
13:20	Traffic (GN-27, KIA-01)	Updated table
13:40	Wind (KIA-04)	Presentation on baseline data collected for proposed wind turbines
14:00	ZOI (GN-15, 28; KIA-08)	Using existing data to determine ZOI at Doris.
14:15	Fish (KIA-3, 12, 17, 36)	Additional fish sampling
14:30	Water Quality (KIA-46)	Baseline lake data
14:45	Updates for FEIS	Highlights key changes to FEIS from DEIS
15:00	Phase 2 Changes to WMMP	Highlight changes/enhancements/additions to WMMP to address Phase 2
15:45	Meeting Wrap-up/ Path Forward	KIA to identify remaining concerns

DRAFT

MADRID – BOSTON PROPOSAL

PHASE 2 OF THE HOPE BAY PROJECT

Freshwater and Marine Environment

Baseline and Offsetting Update - November 15, 2017

DRAFT

Agenda - DFO Workshop

- INTRODUCTIONS
- PURPOSE
- OVERVIEW OF MADRID-BOSTON
- 2017 FIELD SEASON
- FISHERIES OFFSETTING
- OPEN DISCUSSION – NEXT STEPS
- CONCLUSIONS

OVERVIEW OF MADRID-BOSTON

- Overall background and summary of effects assessment
- Discussion of relevant technical hearing issues and commitments

2017 FIELD SEASON

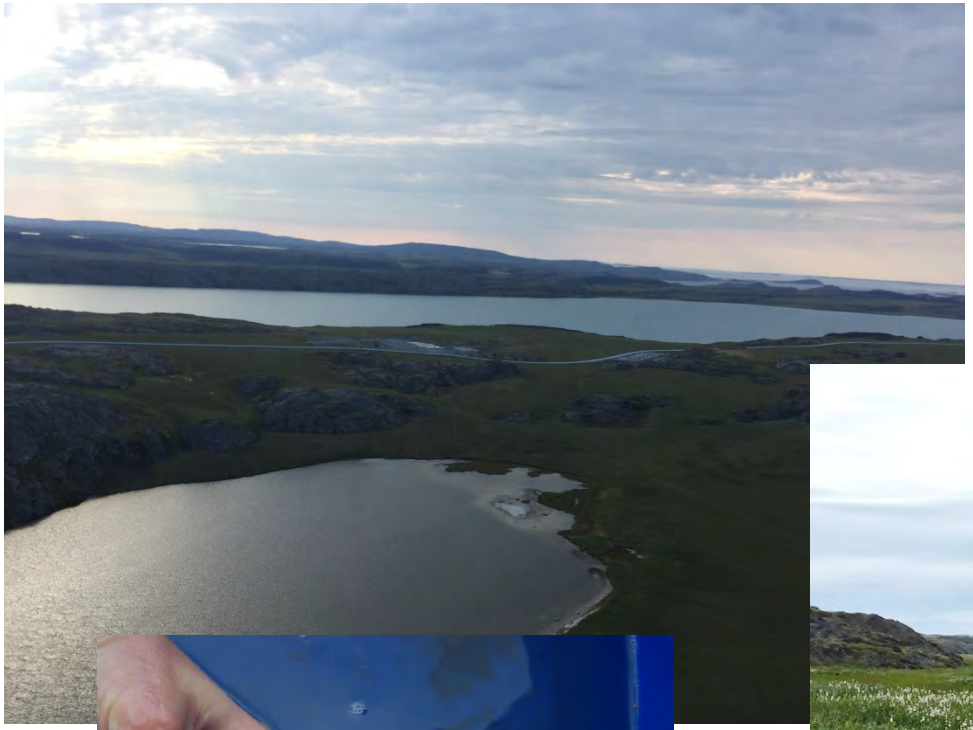
- Approach and methods – fisheries and hydrology
- Preliminary results relevant to fisheries offsetting
- Next steps – update with newest modeling results and data

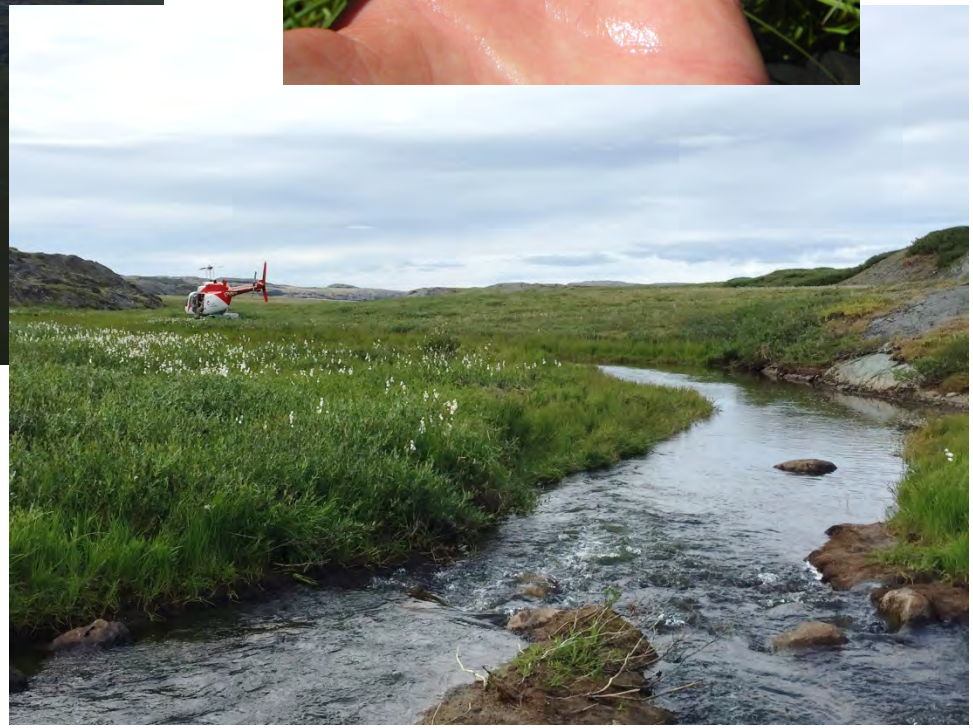
FISHERIES OFFSETTING

- Fisheries Act: Understanding of current regulatory framework
- Proposed approach to freshwater and marine fisheries offsetting based on potential effects, 2017 results and future FEIS submission

DRAFT

Freshwater





DRAFT

Our Assessment Approach

<u>Early Stages of Assessment</u>

1. Start with Traditional Knowledge
2. Identify Valued Ecosystem Components (VECs)
3. Identify Study Areas based on potential Project interactions
4. Collect baseline data from within designated Study Areas

<u>Impact Assessment Approach</u>

4. Identify Project Interactions with Freshwater and Marine Environments
5. Identify Mitigations to reduce Project Impacts
6. Model Project Interactions on water quantity and quality
7. Identify all in-water footprint losses from proposed activities and infrastructure
8. Assess potential Residual Impacts of Project on Freshwater and Marine Environments
9. Develop potential offsetting measures and monitoring approach based on assessment outcome and DFO consultation/community input

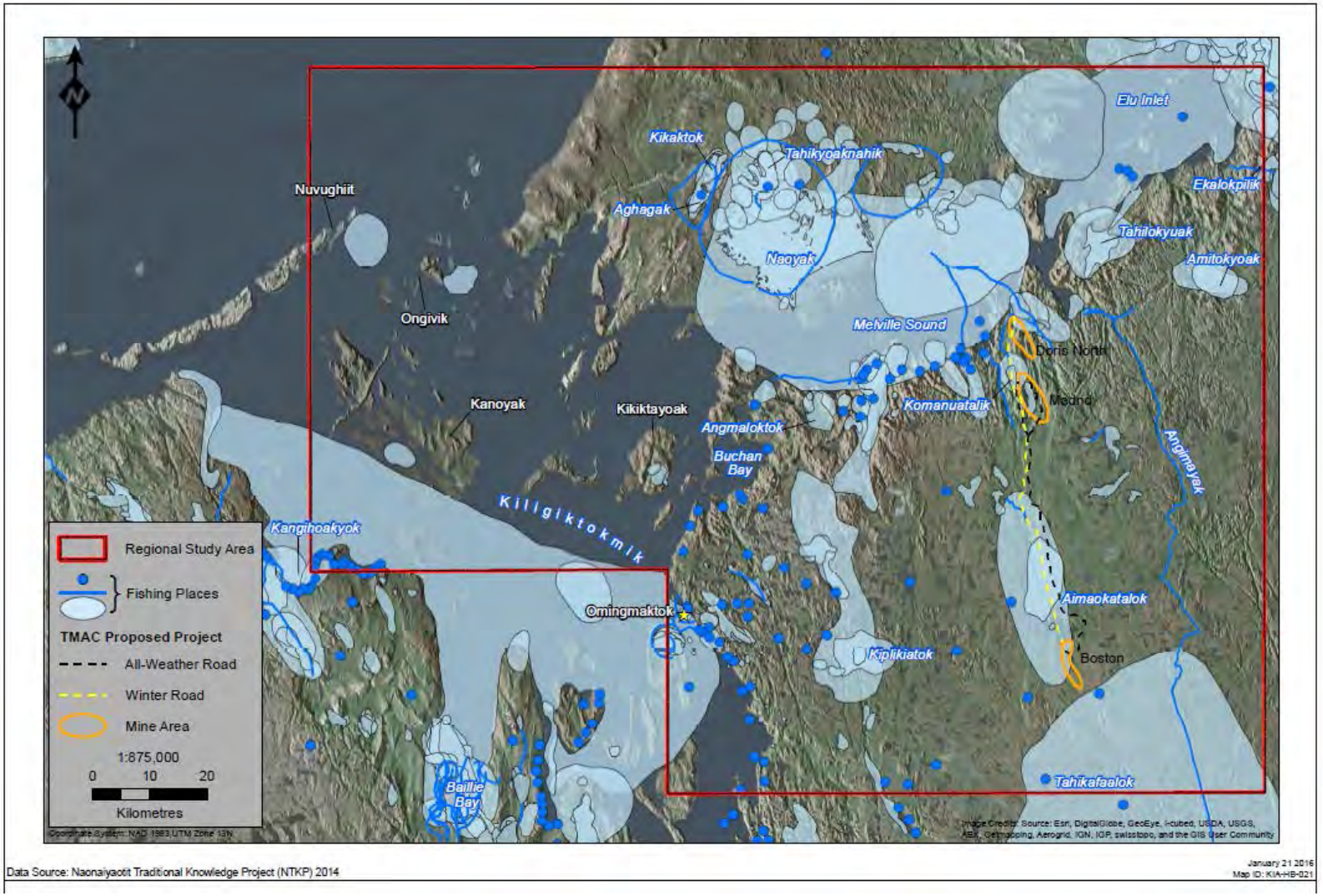
4

Inuit Engagement

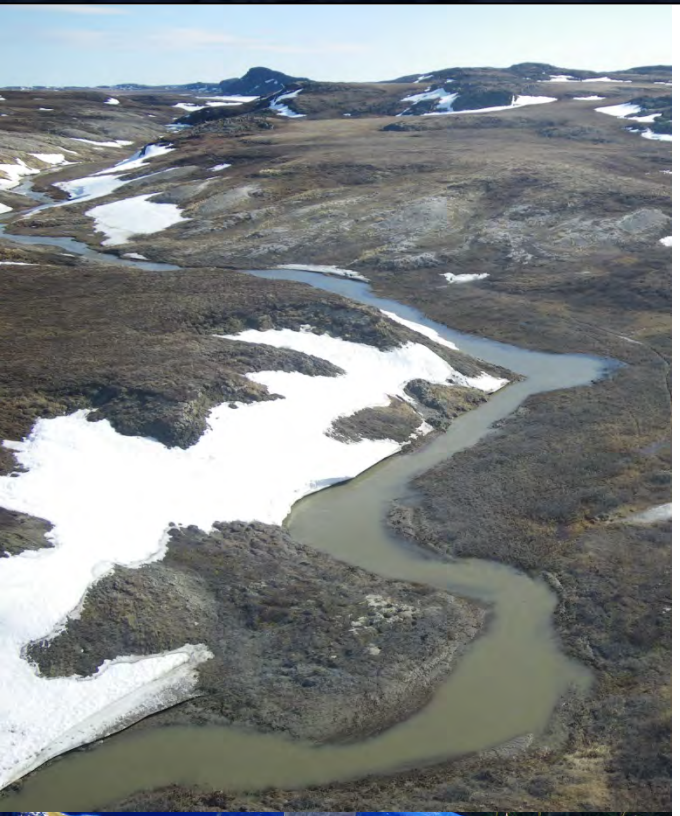
Historical and Current Inuit Comments:

- shallower lakes and lower water flows
  - frozen to streambed in winter
- mine exploration and development
- contaminant exposure through fish consumption
- potential habitat loss and approach to fisheries offsetting
- no identified drinking water sources in Project area, but water use exists

Historical Fishing Areas

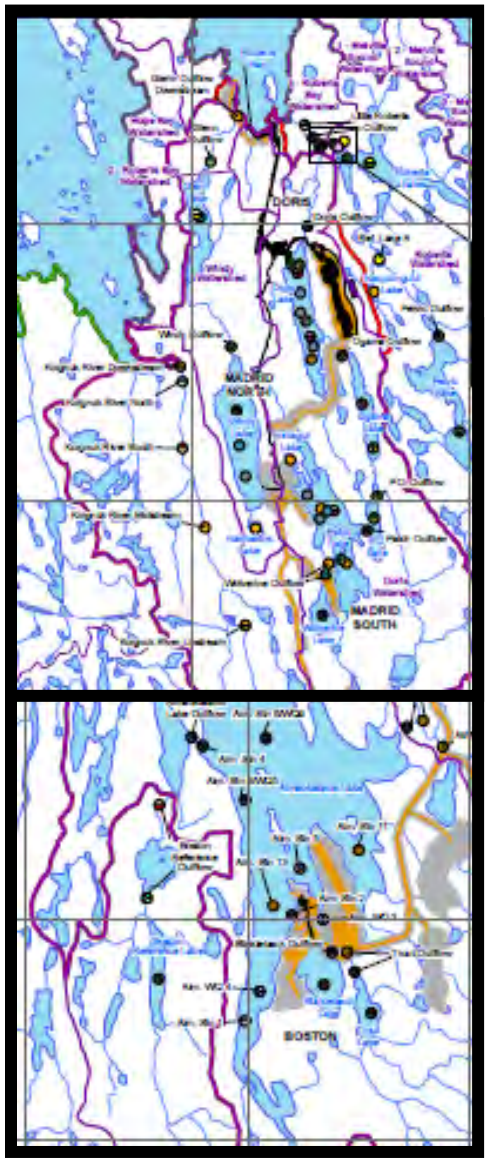


Freshwater Environment - VECs



- Valued Ecosystem Components
  - Fish community
    - Arctic Char
    - Arctic Grayling
    - Lake Trout
    - Cisco/Whitefish
  - Fish Habitat

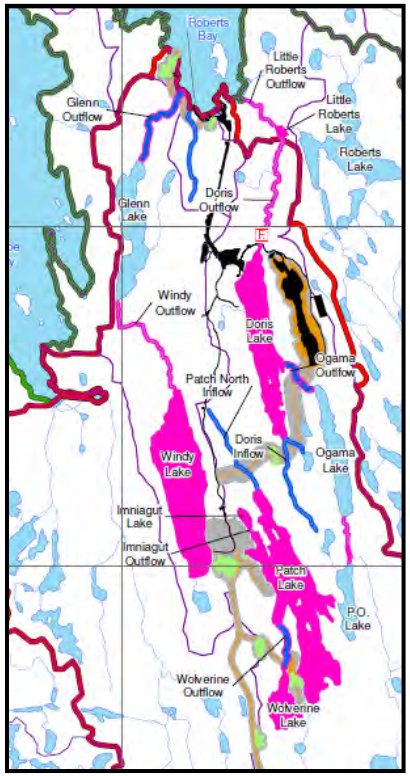
History of Baseline Collection

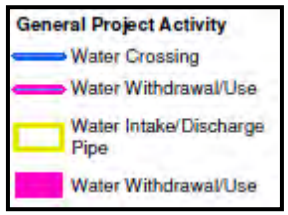


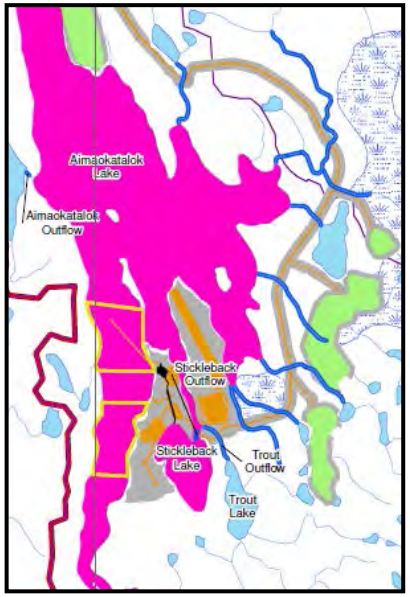
- Freshwater data has been collected in Hope Bay Belt since 1993
  - Project lakes and streams
  - Reference lakes and streams
- Freshwater lake and stream data includes:
  - Hydrology (streams) and lake levels
  - Water quality (winter and summer)
  - Sediment quality (summer)
  - Primary producers
  - Secondary producers
  - Fish and fish habitat

DRAFT

Freshwater Environment – Madrid/Boston Activities







Project Infrastructure Footprint

- Water crossings: construction of all-weather roads
- Water intakes/discharge pipes: Aimaokatalok Lake to support Boston Camp

Water withdrawal/use

- Water for domestic and industrial use drawn from Doris, Windy, and Aimaokatalok lakes
- Drawdown of water through talik to underground workings
- Modification of natural drainages through diversion of contact water and runoff

Hydrology Assessment

- Potential impacts assessed:
  - Changes to surface hydrology
    - Water withdrawal from lakes
    - Development of underground mines
    - Modification of natural drainages

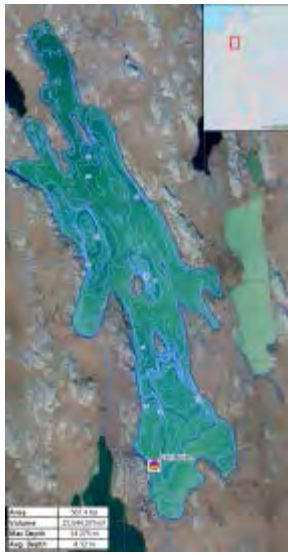
Model Inputs – Quantity

Catchments

Site Footprint

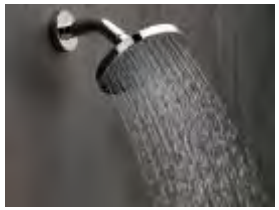
Hydrology
(Precipitation,
Evaporation,
Climate Change, and,
Runoff Coefficients)

Model

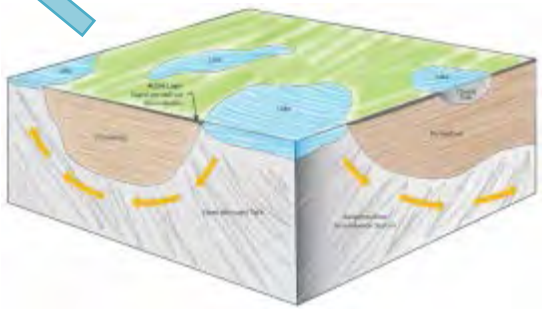


Water Storage
and Bathymetry

Mining and Milling Quantities



Water Consumption



Groundwater Inflows

Freshwater - Fisheries Assessment

- Potential impacts assessed:
  - Fish habitat loss or alteration
  - Fish mortality or changes to population abundance
    - Project infrastructure and development
    - Water withdrawal and use
    - Changes in water and sediment quality

DRAFT

Freshwater – Pathways of Effects

Streams

Pathways of Effects: Fish Habitat Loss and/or Alteration in Streams

- Project infrastructure and development: 21 water crossings
- Water withdrawal and use: 12 outflows

Stream	Crossing ID	Potential Mine-Related Effects	
		Road Crossing	Water Withdrawal and Use
Little Roberts OF			X
Doris Creek			X
Patch OF			X
Ogama IF			X
Windy OF			X
Ogama OF	C-TIA-04	X	X
Glenn OF	C-CDR-02	X	X
P.O. OF			X
Wolverine OF E			X
Imniagut OF			X
Aimaokatalok OF			X
Stickleback OF	C-MBR-20	X	X
Roberts Bay IF	C-CDR-01	X	
Patch IF	C-TIA-01	X	
Doris IF	C-TIA-02	X	
Doris IF	C-TIA-03	X	
Wolverine OF	C-MS-01	X	
Boulder Creek	C-MBR-7	X	
Boulder Creek Trib	C-MBR-8	X	
Aimaokatalok IF	C-MBR-9	X	
Aimaokatalok IF	C-MBR-10	X	
Aimaokatalok IF	C-MBR-11	X	
Aimaokatalok IF	C-MBR-12	X	
Aimaokatalok IF	C-MBR-13	X	
Aimaokatalok IF	C-MBR-14	X	
Aimaokatalok IF	C-MBR-15	X	
Aimaokatalok IF	C-MBR-16	X	
Aimaokatalok IF	C-MBR-17	X	
Aimaokatalok IF	C-MBR-18	X	
Trout OF	C-MBR-19	X	

Freshwater – Pathways of Effects

Lakes

Pathways of Effects: Fish Habitat Loss and/or Alteration

- Project infrastructure and development: Water intake in Aimaokatalok Lake
- Water withdrawal and use: 11 lakes

Lake	Potential Mine-Related Effects	
	Water Intake/Discharge Pipe	Water Withdrawal and Use
Little Roberts		X
Doris		X
Patch		X
P.O.		X
Windy		X
Ogama		X
Glenn		X
P.O. Connector		X
Wolverine		X
Imniagut		X
Aimaokatalok	X	X

DRAFT

TMAC Commitments from Technical Hearings

- DFO-3.1-2: TMAC will apply DFO's measures to avoid causing harm to fish and fish habitat, including monitoring, as necessary as it pertains to water crossing construction, operation, and decommissioning
- DFO-3.1-3:
  - TMAC commits to undertaking field studies (fish habitat, fish community and/or hydrological assessments) in spring and summer 2017 (see also Technical Comments KIA-DEIS-34, KIA-DEIS-37).
  - TMAC therefore commits to quantifying predicted habitat loss/alteration using area units (e.g., in m^2) in the FEIS submission.
- DFO-3.1-4:
  - Studies will be in waterbodies predicted to be affected by changes in water levels, based on predictions…These data will supplement existing data sets, and will help to evaluate the value of potentially lost or altered habitats…TMAC therefore commits to quantifying predicted habitat loss/alteration using area units (e.g., in m^2) in the FEIS submission.
  - TMAC will work with Fisheries and Oceans Canada's Fisheries Protection Program and local Inuit to develop a freshwater fisheries offsetting plan.
- DFO-3.2-1: TMAC will work with DFO to determine the necessary mitigation and monitoring required under the Authorization.

Methods: Water Crossing Surveys

Fish habitat and community assessments at 21 water crossings: high flow and low flow

DRAFT

Results –Water Crossing Habitat Values

Crossing ID	Habitat Value High Flow	Habitat Value Low Flow	Electrofished 2017	Fish-bearing Status	Confirmed or Predicted Stream Fish Species**	Proposed Crossing Type
C-CDR-01	Low	None	NA	Fish-bearing	NSSB	TDB
C-CDR-02	High	High	X	Fish-bearing	LKTR, ARCH, SLSC, NSSB, STFL	TDB
C-TIA-01	Low	None	NA	Assumed fish-bearing	***NSSB***	TDB
C-TIA-02	Low	None	NA	Fish-bearing	NSSB	TDB
C-TIA-03	Low	None	NA	Fish-bearing	NSSB	TDB
C-TIA-04	High	High	X	Fish-bearing	LKTR, LKWH, CISC, NSSB	TDB
C-MS-01	Low	None	NA	Likely non-fish-bearing	-	TDB
C-MBR-7	High	High	X	Fish-bearing	ARGR, NSSB	End bearing pile bridge
C-MBR-8	High	High	X	Fish-bearing	ARGR, NSSB	End bearing pile bridge
C-MBR-9	Moderate	Moderate	X	Fish-bearing	NSSB	End bearing pile bridge
C-MBR-10	None	None	NA	Non-fish-bearing	-	Culvert
C-MBR-11	Moderate	Moderate	X	Fish-bearing	NSSB	Fish-bearing culvert
C-MBR-12	High	High	-	Fish-bearing	NSSB, ARGR	End bearing pile bridge
C-MBR-13	Low	None	NA	Assumed fish-bearing	***NSSB, ARGR***	Fish-bearing culvert
C-MBR-14	None	None	NA	Non-fish-bearing	-	Fish-bearing culvert
C-MBR-15	Moderate	Moderate	X	Fish-bearing	NSSB	End bearing pile bridge
C-MBR-16	High	High	X	Fish-bearing	NSSB, ARGR	End bearing pile bridge
C-MBR-17	Low	Low	X	Fish-bearing	NSSB	Fish-bearing culvert
C-MBR-18	Low	None	NA	Likely non-fish-bearing	-	Culvert
C-MBR-19	High	Moderate	X	Fish-bearing	LKTR, ARGR, BURB, SLSC, NSSB	End bearing pile bridge
C-MBR-20	High	Moderate	X	Fish-bearing	NSSB, SLSC, ARGR	Frozen abutment bridge

***Predicted species italicized; based on habitat and/or confirmed species presence in upstream or downstream waterbodies, additional species may be present*

Results –Water Crossings

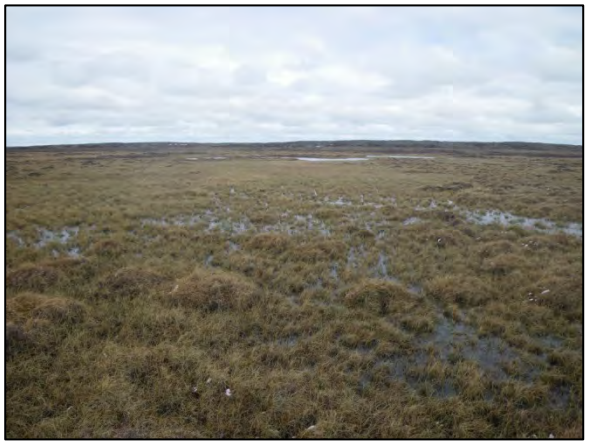
Example:

C-MBR-10 – Aimaokatalok Inflow

Habitat Value		Fish-bearing Status	Predicted Fish Species	Proposed Crossing Type
High Flow	Low Flow			
None	None	Non-fish-bearing	-	Culvert

- Habitat Value: Low
  - Non-classified drainage
  - No defined channel at high flow
  - Dry at low flow
- Potential footprint below HWM (high water mark) in fish habitat = 0 m^2

High Flow – June 11, 2017



Low Flow – July 26, 2017

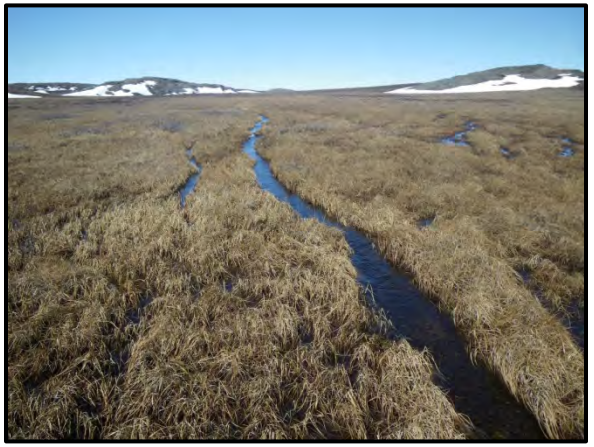
Results –Water Crossings

Example: C-TIA-01 – Patch Inflow

Habitat Value		Fish-bearing Status	Predicted Fish Species	Proposed Crossing Type
High Flow	Low Flow			
Low	None	Assumed fish-bearing	NSSB	TBD

- Habitat Value:
  - Low: seasonal habitat for non-VEC species
  - None: dry channel

High Flow – June 7, 2017



Low Flow – July 18, 2017

Results –Water Crossings

Example: C-MBR-19 – Trout Outflow

Habitat Value		Fish-bearing Status	Fish Species	Proposed Crossing Type
High Flow	Low Flow			
High	Moderate	Fish-bearing	LKTR, ARGR, BURB, SLSC, NSSB	Bridge

- Habitat Value
  - High: Spawning, rearing and/or migration habitat for multiple fish species, including VEC species
  - Moderate: seasonal passage barriers

High Flow – June 8, 2017

Low Flow – July 30, 2017

Results –Water Crossings

Example:

C-MBR-16 – Aimaokatalok Inflow

Habitat Value		Fish-bearing Status	Fish Species	Proposed Crossing Type
High Flow	Low Flow			
High	High	Fish-bearing	NSSB, ARGR	Bridge

- Habitat Value: High
  - Spawning, rearing and migration habitat for Arctic Grayling and Ninespine Stickleback
  - Potential rearing habitat for other VEC species

High Flow – June 8, 2017

Low Flow – July 26, 2017

DRAFT

Methods –Water Withdrawal and Use

- Fish community and fish habitat assessments at various waterbodies and watercourses with potential effects based on DEIS predictions
  - Imniagut OF, Patch OF, Ogama OF, Ogama IF, P.O. OF, Wolverine OF, and Stickleback OF
  - Imniagut Lake
- Hydraulic surveys in streams with greatest potential mine-related effects based on DEIS water balance model predictions

DRAFT

Methods: Hydraulic Assessment

- June: selection of locations for water level surveys
  - Ogama OF = 9
  - Ogama IF = 12
  - Patch OF = 3
- Benchmarks installed to tie water levels together and maintain a steady datum: June, July, and August
- September: full hydraulic geometry survey using total station
  - ~60 cross sections in Ogama OF and Ogama OF
  - ~20 in Patch OF
  - ~6 - 15 points surveyed per cross section
- HEC-RAS model will be developed using the September survey data, then calibrated and verified using water levels surveyed from June, July and August

Potential Habitat Loss in Streams – PRELIMINARY/IN PROGRESS

DRAFT

- Fish habitat assessments will support baseline fish habitat area calculations (i.e., stream length, average habitat unit width)
- Fish community assessments will support fish population densities
- Results of hydraulic models will support calculations of reduction in stream habitat area based on predicted reductions in flow



Results: Potential Habitat Loss in Streams – PRELIMINARY/IN PROGRESS

DRAFT

Example - Doris Creek

- Area Loss – calculated by habitat type
- Fisheries Losses – based on highest population density estimated in any sampled reach
- Other species in Doris Creek (e.g., lake trout) too few were captured to estimate population density

	Potential Area Losses (m^2)		
	July	August	September
Flow Reduction	3.5%	9.4%	20.9%
Lower Doris			
Glide	482	553	768
Pool	29	75	111
Riffle	16	18	25
Middle Doris			
Glide	63	47	50
Cascade	73	23	137
Upper Doris			
Glide	150	46	152
Cascade	42	13	79

	Fisheries Losses (August Only)			
	Juv. ARCH		NSSB	
	Density (Fish/m^2)	Loss (# Fish)	Density (Fish/m^2)	Loss (# Fish)
Lower Doris				
Glide	0.05	27.7	0.10	57.5
Pool	0.05	3.7	0.10	7.8
Riffle	0.05	0.9	0.10	1.9
Middle Doris				
Glide	0.05	2.3	0.10	4.9
Cascade	0.05	1.1	0.10	2.4
Upper Doris				
Glide	0.0	0.0	0.10	4.8
Cascade	0.0	0.0	0.10	1.4
Total		35.8		80.6

Results: Potential Habitat Loss in Streams – PRELIMINARY/IN PROGRESS

- Other streams:
  - Calculated total stream area (low flow; m^2)
  - Fish densities based on 2016 and 2017 surveys

	Total Stream Area (m^2)	Fish Density (Fish/m^2)					
		NSSB	LKTR	LKWH	WF sp.	ARGR	SLSC
Imniagut OF	120	0.02	0.00	0.00	0.00	0.00	0.00
Ogama IF	7,637	0.33	0.02	0.01	0.00	0.00	0.00
Ogama OF	13,552	0.14	0.01	0.00	0.00	0.00	0.00
Patch OF	1,810	0.31	0.00	0.00	0.07	0.00	0.00
Stickleback OF	262	0.12	0.00	0.00	0.07	0.00	0.00
Wolverine OF E	933	2.30	0.00	0.00	0.07	0.02	0.00

Potential habitat loss in streams: PRELIMINARY/IN PROGRESS

DRAFT

Stream	Fish Species	Potential Mine-Related Effect Habitat Loss (Area Units - m^2) Road Crossing*	Water Withdrawal and Use
Little Roberts OF	NSSB, LKTR, LKWH, CISC, ARCH, LSCS, BRWH		X
Doris Creek	NSSB, LKTR, LKWH, CISC, LSCS		X
Patch OF	NSSB, LKTR, LKWH, CISC, LSCS		X
Ogama IF	NSSB, LKTR, LKWH, CISC, LSCS		X
Windy OF	NSSB, LKTR, LKWH, CISC, SLSC		X
Ogama OF	NSSB, LKTR, LKWH, CISC	X	X
Glenn OF	NSSB, LKTR, LKWH, CISC, ARCH	X	X
P.O. OF	NSSB, LKTR, LKWH, CISC, LSCS		X
Wolverine OF E	NSSB, LSCS		X
Imniagut OF	NSSB		X
Aimaokatalok OF	NSSB, LKTR, LKWH, CISC, LSCS, ARGR, SLSC		X
Stickleback OF	NSSB, ARGR, SLSC	X	X
Roberts Bay IF	NSSB	X	
Patch IF	***NSSB***	X	
Doris IF	NSSB	X	
Doris IF	NSSB	X	
Wolverine OF		X	
Boulder Creek	NSSB, ARGR	X	
Boulder Creek Trib	NSSB, ARGR	X	
Aimaokatalok IF	NSSB	X	
Aimaokatalok IF		X	
Aimaokatalok IF	NSSB	X	
Aimaokatalok IF	NSSB, ARGR	X	
Aimaokatalok IF	***NSSB, ARGR***	X	
Aimaokatalok IF		X	
Aimaokatalok IF	NSSB	X	
Aimaokatalok IF	NSSB, ARGR	X	
Aimaokatalok IF	NSSB	X	
Aimaokatalok IF		X	
Trout OF	NSSB, LKTR, SLSC, BURB	X	

Results – Imniagut Lake Fish Community PRELIMINARY

DRAFT

- Gillnets
  - 11 floating and 11 sinking RISC standard gangs deployed
  - 48.25 total gang-hours of effort
  - No fish captured
- Minnow Traps
  - 22 traps for approximately 24 hours
  - 510.5 total trap-hours of effort
  - 828 Ninespine Stickleback captured
- Electrofishing
  - Shoreline electrofishing
  - 1,025 total seconds of effort
  - 20 Ninespine Stickleback captured

Results: Potential Habitat Loss in Lakes PRELIMINARY/IN PROGRESS

DRAFT

Example: Doris Lake

- Under Ice Conditions in Doris Lake (DEIS predictions, FEIS IN PROGRESS)

	Elevation (m)	2D Surface Area (m^2)	3D Surface Area (m^2)	Volume (m^3)
Baseline (no development) under ice	21.520	3,477,899	3,489,576	27,624,027
Maximum Under Ice Reduction (2031)	21.030	3,345,486	3,356,221	25,967,661
Loss		132,414	133,355	1,656,366
Percent Loss		**3.81**	**3.82**	**6.00**

<10% volume loss

- Other lakes: estimate lake volume reductions from modeled water balance outputs

DRAFT

Potential habitat loss in lakes – IN PROGRESS

Lake	Fish Species	Potential Mine-Related Effect Habitat Loss (Area Units - m^2)	
		Water Intake/ Discharge Pipe	Water Withdrawal and Use
Little Roberts	NSSB, LKTR, LKWH, CISC, ARCH, LSCS, BRWH		X
Doris	NSSB, LKTR, LKWH, CISC, LSCS		X
Patch	NSSB, LKTR, LKWH, CISC, LSCS		X
P.O.	NSSB, LKTR, LKWH, CISC, LSCS		X
Windy	NSSB, LKTR, LKWH, CISC, SLSC		X
Ogama	NSSB, LKTR, LKWH, CISC		X
Glenn	NSSB, LKTR, LKWH, CISC, ARCH		X
P.O. Connector	NSSB, LKTR, LKWH, CISC, LSCS		X
Wolverine	NSSB, LSCS		X
Imniagut	NSSB		X
Aimaokatalok	NSSB, LKTR, LKWH, CISC, LSCS, ARGR, SLSC	X	X
Stickleback	NSSB, ARGR		X

DRAFT

Freshwater – Towards an Offsetting Plan

Step 1: Characterize the residual serious harm to fish

Step 2: Select offsetting measures

Step 3: Determine the amount of offsetting required

Step 4: Establish the monitoring and reporting of conditions

Step 5: Submit plan to DFO

Freshwater – Approach to Fisheries Offsetting

Step 1: Characterize the residual harm to fish: Based on potential pathways of effects, develop and undertake focused baseline study

- Quantify potential habitat loss/alteration in m^2 (Commitment DFO 3.1-3, 3.1-4)
- Assess fisheries value of habitat potentially impacted
- Obtain a harm determination

TMAC Approach: Provide quantification (in m^2) of harm based on infrastructure footprint and proposed water use

Step 2: Consider and select offsetting measures based on anticipated losses

- Guiding principles for offsetting measures

DRAFT

Freshwater – Approach to Fisheries Offsetting

Step 3: Determine the amount of offsetting required

- Local (in-kind) versus off-site (out-of-kind) offsetting options
- Potential feasibility of offsetting projects (e.g., removal of barriers, habitat creation through shoal creation)
- Reconnaissance and subsequent baseline data collection to determine potential value of offsetting options
- Community consultation (Commitment DFO 3.1-4)

TMAC is keen to investigate off-site options for offsetting

Step 4: Establish the monitoring and reporting of conditions

- Assess offset effectiveness and describe contingency measures

Step 5: Develop Fisheries Offsetting Plan and submit to DFO along with FA Application

- Timing of letter of credit, offset credits, etc.

Fisheries Offsetting: Local vs Off-site

LOCAL ("In-kind")

- Projects within Hope Bay Belt

vs.

OFF-SITE (Out-of-kind)

- Single community-supported project in Cambridge Bay contributing to and supporting overall objectives of Arctic IFMP or subsistence-based fishery (e.g., Freshwater Creek) and supported by local community

Fisheries Offsetting : Local Options

Option 1- Enhance the Quality of Existing Juvenile Stream Rearing Habitats

- Offset potential reductions in stream habitats by constructing more productive habitat types (i.e., riffles and cascades) in less productive areas (poor quality glides).

Option 2 – Improve access to the upper reaches of Stream E09

- Fish access to Stream E09, including existing habitat enhancement pools for rearing juvenile Arctic Char, is limited by a steep section of creek upstream of Roberts Lake.

Option 3 – Increase the abundance of spawning and juvenile rearing habitats in lakes

- Add habitat features that provide cover for juvenile fish as they migrate between critical habitat areas (improves productivity by reducing predation pressure by Lake Trout)

Fisheries Offsetting: Off-site Options

Single project in Cambridge Bay contributing to and supporting overall objectives of Arctic IFMP and/or subsistence fisheries

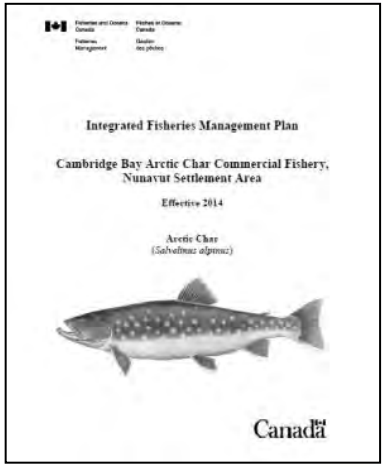


Figure 2 : Map of Cambridge Bay area showing current commercial fishing locations.
The Paliryuak (Surrey), Halokvik (Thirty-Mile), Palik (Lauchlan), Ekalluktok (Ekalluk) and Jayko (Jayco) rivers are commercially fished for anadromous (searun) Arctic Char.

DRAFT

Freshwater – Approach to Fisheries Offsetting

LOCAL (in-kind)

Advantages

- Direct return of fisheries productivity enhancement to impacted area = local balance of project-related effects
- Availability of baseline datasets and other site-based ongoing monitoring programs
- On-site program oversight

OFF-SITE (out-of-kind)

Advantages

- Proximity to local subsistence/commercial fishery:
  - direct return to active users
  - potential for project-ownership transfer to local community
- Ongoing community engagement and localized capacity building – training opportunities
- Responds to concerns/needs identified by local community
- Potential for project-ownership transfer to local community following implementation and suitable training
- Site accessibility via boat or road access

DRAFT

Fisheries Offsetting: Local vs Off-site

LOCAL (in-kind)

OFF-SITE (out-of-kind)

Challenges/Disadvantages

- Limited return to active users due to distance from active subsistence/commercial fishery
- Limited community engagement and localized capacity building
- Limited potential for project-ownership transfer to communities following implementation
- Site access to construction works and ongoing monitoring may be challenging (i.e., accessible only via helicopter).
- Additional consideration regarding fisheries monitoring pressure

- Direct return of fisheries productivity enhancement outside of impacted area = decrease in local fisheries productivity
- Potential limitations of availability or quality of baseline datasets
- Off-site program oversight
- Additional consideration regarding local fishing pressure

Fisheries Offsetting: Local vs Off-site

- Identify degraded areas requiring rehabilitation and/or fish passage improvements through stakeholder engagement (Technical comment DFO-3.1-4)
- Identify areas with potential for barrier removal (natural or anthropogenic): e.g., poorly-constructed culvert at Freshwater Creek near Cambridge Bay

<u>Complementary Measures:</u>

- Investments in CRA data collection and scientific research
- Up to 10% of the required amount of offsetting – how negotiable is this?

DRAFT

Barrier removal (culvert) on Freshwater Creek

DRAFT

Natural Barrier Adjustment on Freshwater Creek

DRAFT

Improving fish passage at Kitiga Falls, Cambridge Bay area?

Improving fish passage at Kitiga Falls, Cambridge Bay area ?

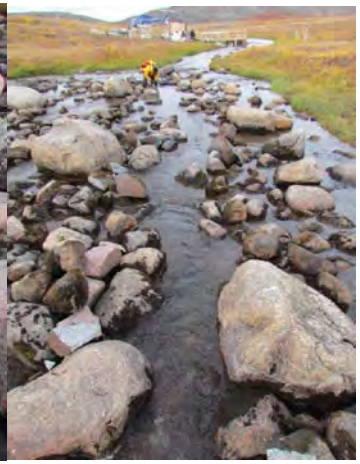
DRAFT

Kitiga Falls, from upstream

Kitiga Falls, from downstream

Freshwater – Approach to Fisheries Offsetting

- Improving fish passage by removing barriers to migration has been shown to work at other project sites:
  - Roberts Bay Outflow : demonstrated success can be replicated in other watercourses that are closer to Cambridge Bay
  - Demonstrated success that barrier removal improves fisheries productivity upstream by increasing access to fish habitat and helps to re-establish migratory populations upstream



Marine

Our Assessment Approach

Early Stages of Assessment

1. Start with Traditional Knowledge
2. Identify Valued Ecosystem Components (VECs)
3. Identify Study Areas based on potential Project interactions
4. Collect baseline data from within designated Study Areas

Impact Assessment Approach

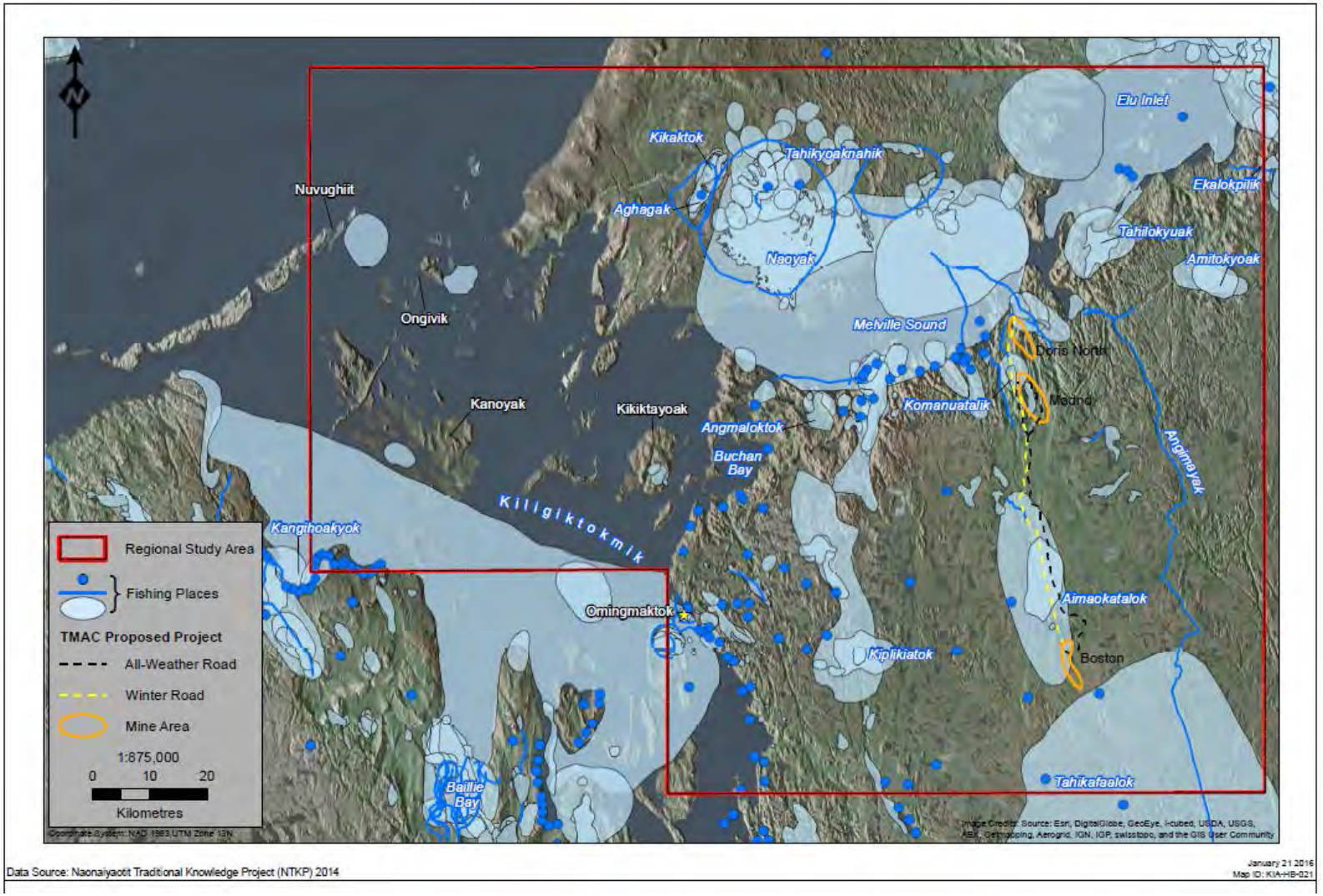
4. Identify Project Interactions with Freshwater and Marine Environments
5. Identify Mitigations to reduce Project Impacts
6. Model Project Interactions on water quantity and quality
7. Identify all in-water footprint losses from proposed activities and infrastructure
8. Assess potential Residual Impacts of Project on Marine Environment
9. Develop need for potential offsetting measures including self-offsetting by design and monitoring approach based on assessment outcome and DFO consultation/community input

Inuit Engagement

Historical and Current Inuit Comments:

- Decreasing sea level
- Thinner ice and quicker ice melting
- Contaminant exposure to through fish consumption
- Pupping and molting areas for ringed seals
- Breeding and staging areas for seabirds
- The inlets and bays near the Project area have been historically fished

Historical Fishing Areas

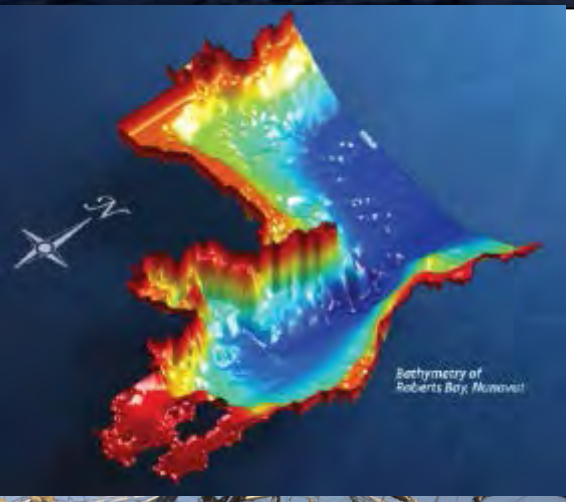


DRAFT

Marine Environment – VECs

- Valued Ecosystem Components
  - Fish Community
    - Arctic Char
    - Saffron Cod
  - Fish Habitat

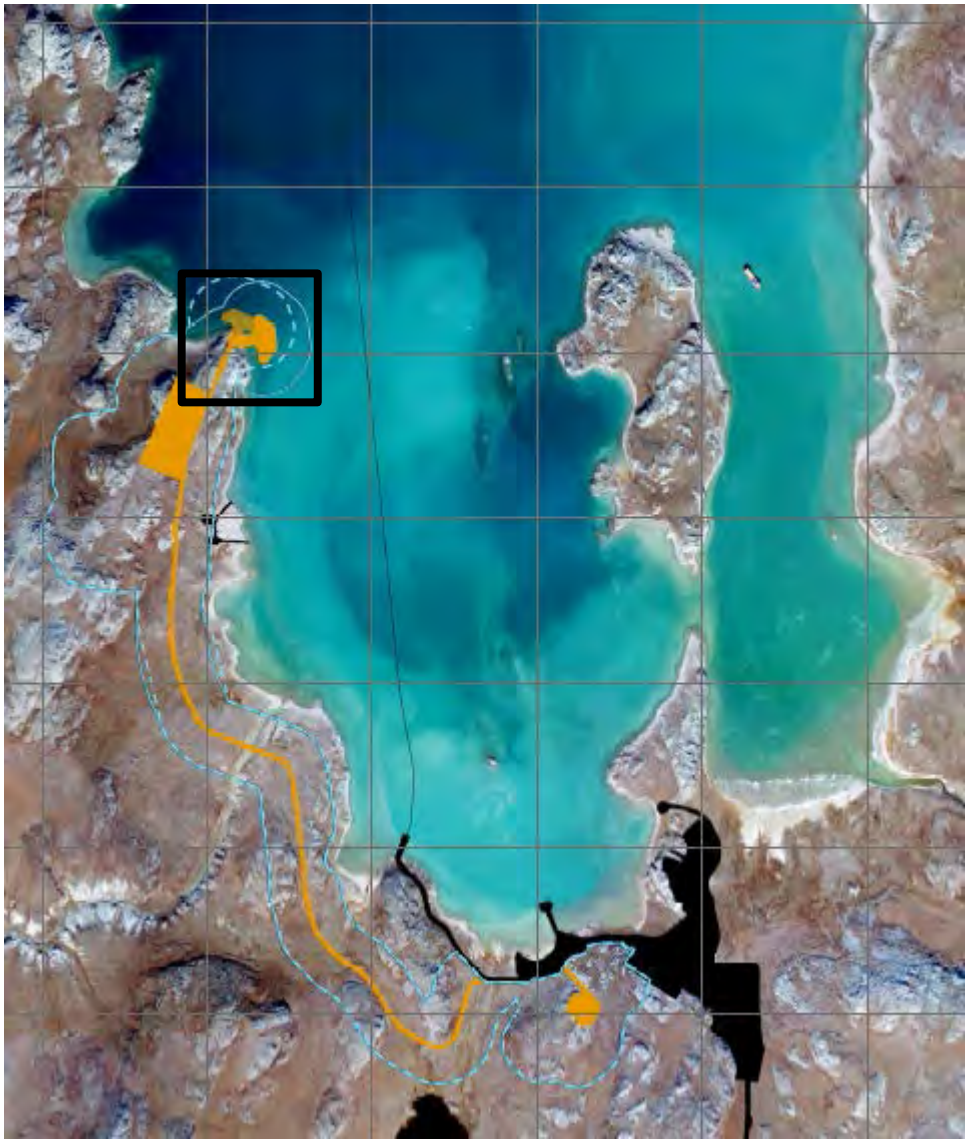
History of Marine Baseline Data Collection



- Comprehensive data collected in marine environment since 2008
  - Roberts Bay (Local Study Area)
  - Hope Bay, Ida Bay, and Melville Sound (Regional Study Area)
- Marine data includes:
  - Physical oceanography
    - (sea level, tides, profiling, and currents)
  - Circulation and effluent dispersion modelling
  - Water quality (winter and summer)
  - Sediment quality (summer)
  - Primary producers
  - Secondary producers
  - Fish and fish habitat
  - Marine mammals and seabirds

DRAFT

Marine Environment – Roberts Bay Infrastructure and Activities



- Fuel and supplies received at Roberts Bay via sealifts
- Cargo Dock proposed for safe and efficient offloading of sealifts
- Approved discharge used for Phase 2

Marine – Fisheries Assessment

- Potential impacts assessed:
  - Fish habitat loss or alteration
    - Project infrastructure footprint (Cargo Dock)
  - Fish mortality or changes to population abundance
    - Sealifts
    - Changes to water and sediment quality

DRAFT

TMAC Commitments from Technical Hearings

- DFO-3.2-2: TMAC will work with Fisheries and Oceans Canada's Fisheries Protection Program and local Inuit to develop a marine fisheries offsetting plan.

- KIA-DEIS-34: As recommended/requested by DFO in their technical comments (refer to DFO-3.1.4 and DFO-3.2.2), TMAC will work as required with DFO and KIA as required to develop a freshwater and marine fisheries offsetting plan.

- Similar TMAC commitments associated with KIA and INAC comments

DRAFT

Methods – Roberts Bay Cargo Dock

Fish Habitat Assessment

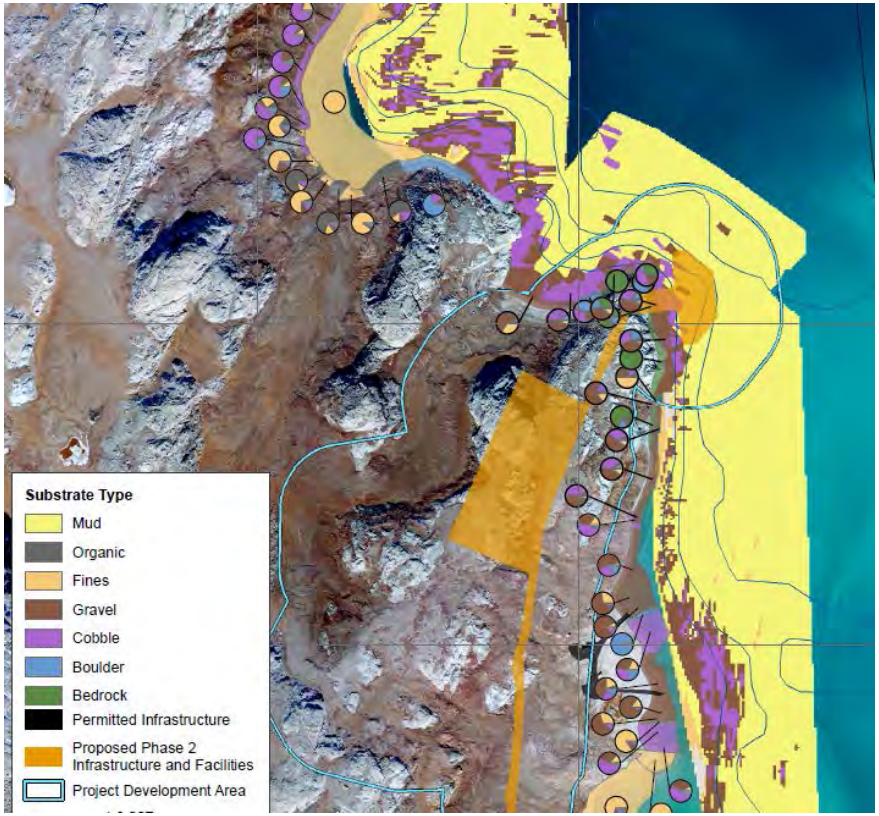
- Hydroacoustic Survey
  - Collect bathymetry and bottom type information
- Shoreline Habitat Assessment
  - Determine substrate types in littoral and tidal zones

Fish Community Assessment

- Characterize fish and macrobenthos communities
- Multiple gear types
  - Floating and sinking gillnets
  - Long lines
  - Beach seines
  - Minnow traps
  - Crab traps

Results: Fish Habitat

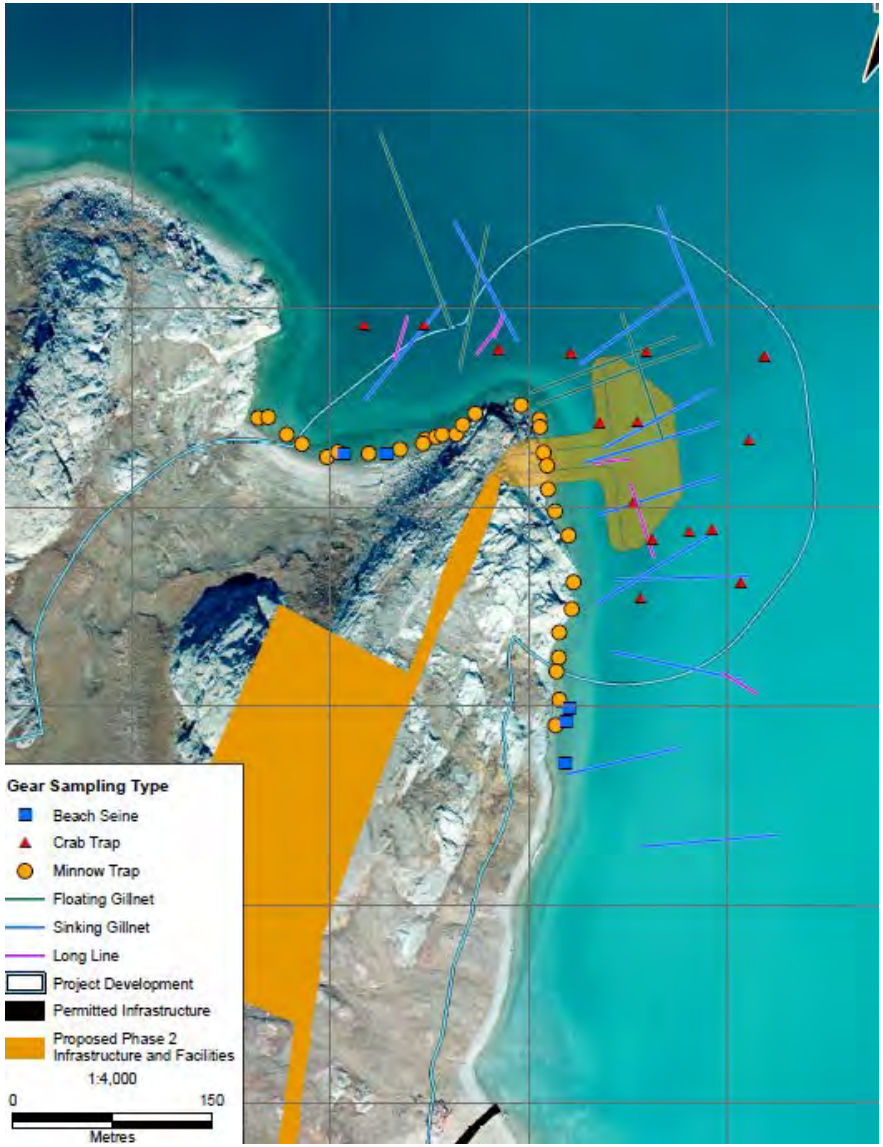
- Bathymetry
  - Measured depths from 0.8 to 32 m
  - Cargo dock located in depth < 13 m
- Bottom Type
  - 78% fines and mud
  - 9% sand and gravel
  - 13% cobble and larger rock
- Cargo Dock situated over
  - bedrock, boulder and cobble at depth < 5 m
  - Sand and gravel at depth < 10 m
  - Fines and mud in deeper areas



DRAFT

Cargo Dock Marine Fish Community
PRELIMINARY/IN PROGRESS

Species	Number of Individuals	Percent of Individuals
Fish		
Arctic char	8	9%
Fourhorn sculpin	22	24%
Greenland cod	7	8%
Inconnu	1	1%
Longhead dab	6	7%
Pacific herring	32	35%
Saffron cod	9	10%
Starry flounder	2	2%
Shorthorn sculpin	4	4%
Total	91	
Macrobenthos		
Arctic lyre crab	15	40%
Sea star	11	30%
Sea urchin	11	30%
Total	37	

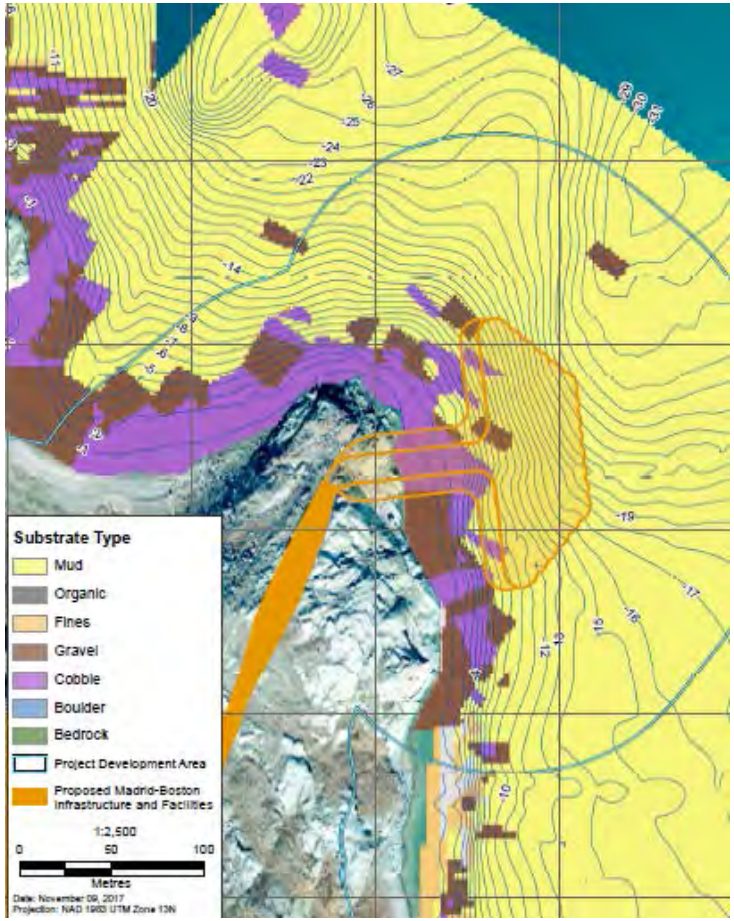


Cargo Dock Substrate Types PRELIMINARY/IN PROGRESS

DRAFT

Footprint losses dominated by fines

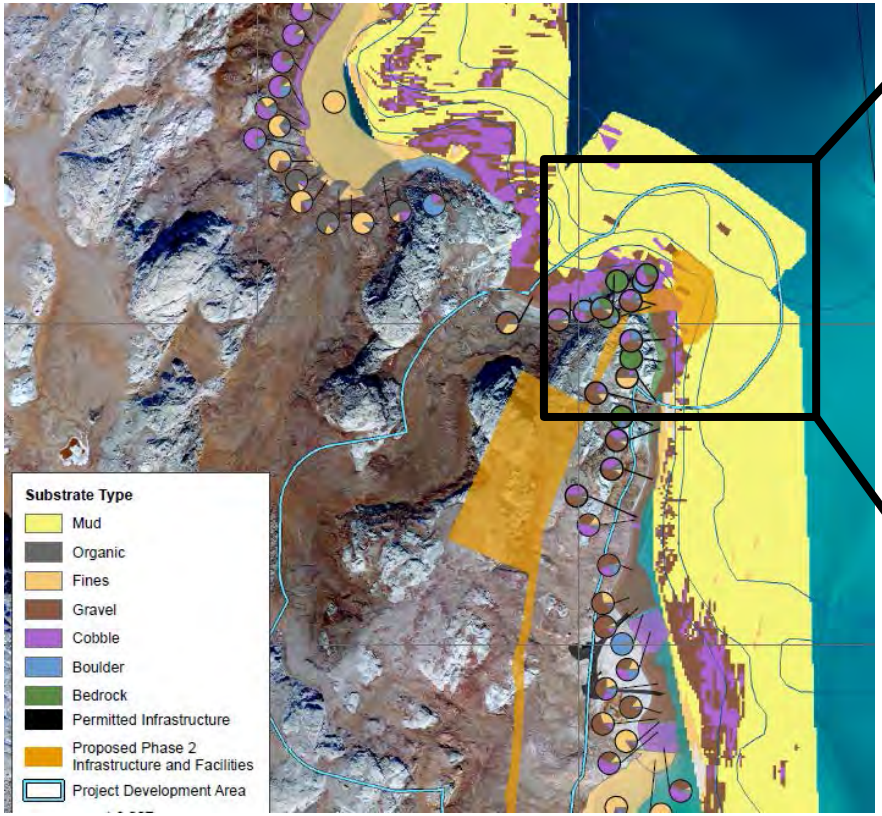
Depth	Substrate			
	Cobble and Larger Rocks	Sand and Gravel	Fines/Mud	Grand Total
Intertidal (0-0.5m)	192.47	15.11	0.00	207.57
Upper Sub-Tidal (0.5-3m)	719.66	13.93	0.00	733.59
Lower Sub-Tidal (3-15m)	816.93	337.90	3538.30	4693.13
Moderate Sub-Tidal (15-25m)	0.40	0.00	3155.38	3155.78
Deep Sub-Tidal > 25m	0.00	0.00	0.00	0.00
Grand Total	**1729.46**	**366.94**	**6693.67**	**8790.07**

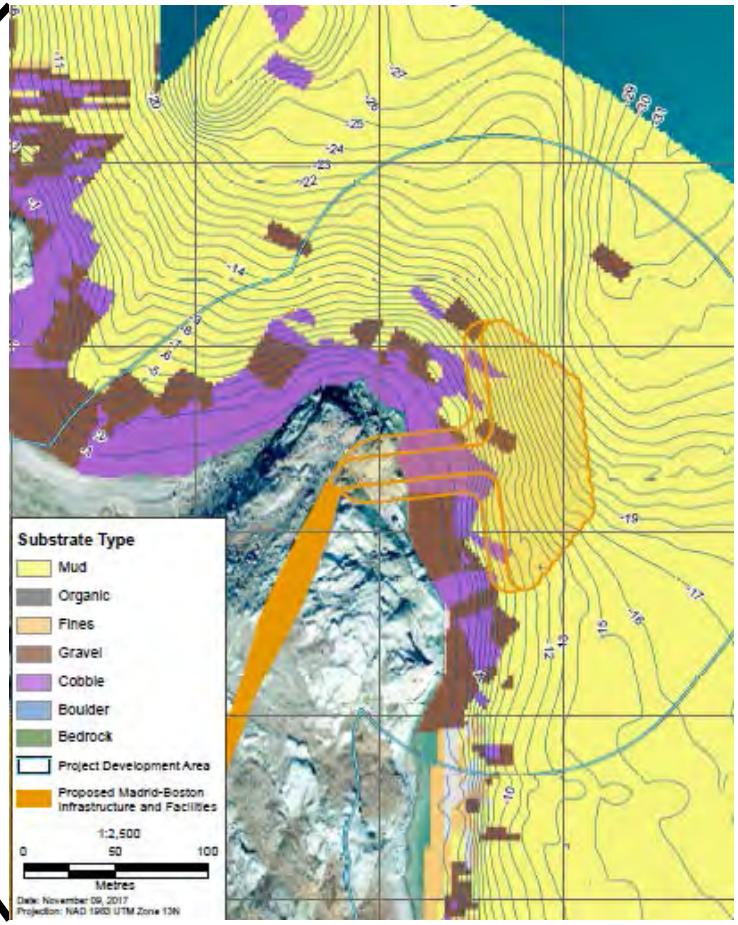


DRAFT

Cargo Dock Habitat Losses and Gains
PRELIMINARY/IN PROGRESS

In-water seabed footprint area <u>lost</u> (2-D) = 8,790 m^2 (0.88 ha)





In-water habitat area <u>created</u> (2-D) = In-water habitat area <u>created</u> (2-D) = ~ 1,000 m^2 through rip rap below HW

DRAFT

Marine – Towards an Offsetting Plan

Step 1: Characterize the residual serious harm to fish

Step 2: Select offsetting measures

Step 3: Determine the amount of offsetting required

Step 4: Establish the monitoring and reporting of conditions

Step 5: Submit plan to DFO

DRAFT

Marine– Approach to Fisheries Offsetting

Step 1: Characterize the residual harm to fish: Based on potential pathways of effects, develop and undertake focused baseline study

- Quantifying potential habitat loss/alteration in m^2 (Commitment DFO3.2-2) based on pathways of effects (in-water footprint losses)
  - fish community and fish habitat surveys
- Assess fisheries value of habitat potentially impacted
- Obtain a harm determination based on residual effects to fisheries productivity

TMAC APPROACH: cargo dock's design will self-offset to the extent possible

Step 2: Consider and select offsetting measures based on anticipated losses

- Guiding principles for offsetting measures

Marine – Approach to Fisheries Offsetting

Step 3: Determine the amount of fisheries offsetting required

- Confirm amount of self-offsetting by design: Cargo dock will be constructed to maximize self-offsetting potential
- Precedent in showing that more structurally complex and limiting substrates will be beneficial (through construction of compensation shoals in Roberts Bay)

Step 4: Establish the monitoring and reporting of conditions

- Develop Monitoring Plan to confirm that new habitat is functioning as intended

Step 5: Develop Fisheries Offsetting Plan and submit to DFO along with FA Application

- Timing of submission, letter of credit, offset credits, etc.

OPEN DISCUSSION

- TMAC's preference for offsetting = off-site project located in Cambridge Bay to be determined through stakeholder consultation
- Cargo dock design to be considered as self-offsetting habitat
- DFO expectations regarding community consultation-based on technical hearing commitments
- TMAC is interested in complementary measures (research support)

Next Steps

Conceptual plan will be provided in FEIS. Further discussions post-NIRB certificate.

- Freshwater: Off-site preference for offsetting : Cambridge Bay-based project contributing to overall objectives of Arctic IFMP and/or subsistence fisheries (e.g., Freshwater Creek)

- Marine: Self-offsetting habitat created by design of cargo dock – no need for additional habitat offset