

NIRB Application for Screening #125457
URI Northwest Passage Project 2019

DETAILS

Non-technical project proposal description

English: Northwest Passage Project Science Summary 2019 The Northwest Passage Project (NPP) is a US National Science Foundation funded program to investigate the changing Arctic Ocean through an expedition that will engage diverse audiences through real time interactions from sea, a high definition 2-hour documentary, and related community events. The expedition will be conducted onboard the R/V IB Oden. Undergraduate and graduate students will participate in the expedition along with scientists, historians, journalists, Nunavut students, a young Nunavut scientist, and a documentary film crew. The science activities are motivated by the overarching goal to understand how waters of the Canadian Arctic Archipelago (CAA) have changed as a consequence of the secular warming trend over the Arctic Circle. We approach this goal using an interdisciplinary ocean-based research program to explore the changes in four (4) thematic areas.

Theme 1: Water mass properties and circulation inside CAA The project will investigate the increased freshwater storage in and export from the upper Arctic Ocean due to a warming Arctic. Increased melting, river discharge, as well as changing wind patterns have led to increased freshwater accumulation in the western Arctic. The CAA, and particularly the Northwest Passage, is one of the principle conduits for freshwater transport from the Arctic Ocean to the North Atlantic, however, there are uncertainties in the magnitude of transport and water properties. The currents in the CAA will be studied with a Lowered Acoustic Doppler Current Profiler (LADCP) data, and a CTD. NPP will conduct Shore-to-shore CTD/LADCP cross-sections at 6 locations marked on the cruise track (X01 to X06). These will involve high-resolution CTD casts to resolve water mass properties along with the CTD rosette mounted LADCP.

Theme 2: Microscopic Communities in Transition As Arctic waters warm and sea ice cover decreases, the surface ocean ecosystem is changing, and species distributions and abundances may change rapidly. To examine habitats along the cruise track, zooplankton nets will be periodically towed in the upper water column ($\leq 100\text{m}$). Net contents will be catalogued. This data will be augmented by a laboratory bench-top FlowCam, which can identify and quantify 'particles' in seawater which can be sediments, phytoplankton, or zooplankton. In addition, a high frequency sonar system will observe zooplankton and fish in the water column. Combining these approaches to ecosystem studies will make the results more robust.

Theme 3: Distributions of Marine Birds in Canadian Arctic Waters Marine bird abundance and distribution can be used to monitor changes and variability in marine ecosystems. NPP will characterize the distribution and abundance of marine birds along the survey route. Associations between the marine bird community and the physical and biological properties of their marine environment will be identified and compared to past results. The cruise will use a standard non-invasive, observational method to perform seabird counts.

Theme 4: Water Column Chemistry Affecting Greenhouse Gas Fluxes The concentration and isotopic composition of methane and carbon dioxide in the Arctic Ocean and atmosphere are of great interest as both are greenhouse gases and have growing sources in the Arctic. Measuring isotopic composition of carbon dioxide can provide information about the carbon system sources and fluxes of carbon to the atmosphere. The NPP will study the concentrations and isotopes of carbon dioxide and methane by analyzing samples of the air and water with onboard laser spectroscopy instruments, as well as incubation of water to study methane consuming microbial activity.

Atmospheric gas sampling: air will be continuously analyzed for the stable isotopic ratio of hydrogen and oxygen ($2\text{H}/1\text{H}$ and $18\text{O}/16\text{O}$) of seawater and water vapor and the stable isotopic ratios (^{13}C) of CO_2 and CH_4 .

Seawater sampling: ^{13}C - CH_4 , and ^{13}C - CO_2 will be continuously sampled from the underway seawater system and from discrete bottle samples from the water column sampling. Additional analysis of the underway seawater and bottle water samples will include salinity, temperature, chlorophyll a fluorescence, colored dissolved organic matter (cDOM) fluorescence, partial pressure of carbon dioxide (pCO_2), pH, the $\delta^{18}\text{O}$ of seawater, particulate organic carbon and nitrogen (concentration and isotopic fractionation), nutrients (NO_3 , PO_4 , and $\text{Si}(\text{OH})_4$). Opportunistic sampling of floating ice will also be carried out.

Water column profiling/sampling: Every 24 hours or 100 nautical miles, a vertical "profile" of water properties and water samples will be collected using a CTD Rosette.

Research sonar The NPP expedition is aware of concerns about the potential for scientific acoustic sources to have a behavioral impact on marine organisms, particularly marine mammals. The methodologies proposed for this expedition should minimize any potential disruption. The proposed standard procedure for the NPP 2019 expedition will be to have the hull mounted 18kHz echosounder (or potentially 38kHz or 70kHz) and the hull mounted 12kHz multibeam sonar operating when the ship is underway, except under these conditions:

- 1) Sonar operation will cease when marine mammals are detected within 500m of the ship.
- 2) The sonar will be off when within 5 km of any Nunavut community.
- 3) Due to concerns about a group of narwhals that moves between the Arctic Bay and Pond Inlet areas, the sonars will be off while in Navy Board Inlet, Eclipse Sound, and Pond Inlet. This includes turning off the CTD mounted LADCP during the hydrographic station at CTD Station 02.
- 4) Due to the potentially high concentration of marine mammals in Bellot Strait, research sonars will not be used in Bellot Strait or within 5 km of the entrance on either side.
- 5) When in restricted waters of the Price Leopold Island and Bylot Island Migratory Bird Sanctuaries or Parks Canada Waters, the sonars will be off.
- 6) If marine mammals are detected within 200m of the ship the LADCP will not be deployed.

Open Data Policy The project will disseminate scientific data and results through the NPP

[illegible]

Inuinnaqtun: Tunungani Ualiniqhianut Ikaaqqiat Havaaghat Ayuqnaqtunik Qauyihaiyut Naunaitkutait 2019Taamna Tunungani Ualiniqhianut Ikaaqqiat (Northwest Passage) Havaaghat (NPP) manighaqtitauvaktut Katitauhimayut Aviktuqhimaniit Ayuqnaqtunik Qauyihagtuliqiyinit (US National Science Foundation) qauyihariami aallannguqpalliauyuk Ukiuqtaqtumi Taryuq takuhiuqhutik katitiriyunik aallatqiingnik qunngiaqtinik hulilukaaqtunik taryuqmi qaritauyakkut, takughauttiaqtumik National Science Foundation malrungsk (2) ikaaqqiuyuk unipkaa, nunallaaqnilu hulilukaaqqiini. Takuhiuqtut umiaqqiinnahuat RVIB (Qauyihaiyut Umiangat Hikuhiutiklu) Oden-mi. Ilihaqtaarahuat ilihagtaaqhimayullu ilauniaqtut takuhiuqtunut taapkualu qauyihaiyit, ingilraaqnitani qauyihaiyit, unipkaaliuqtit, Nunavunmiutat ilihagut, inulrammiq Nunavunmiut ayuqnaqtunik qauyihaiyi, qunngialiutillu. Ayuqnaqtut qauyihagtauyughat aullaqtitauvaktut qauhittiarumaplugu

qanuq immat Kanatam Kiklianit Qikiqtautainit (CAA) aallannguqtut uqquuhivalliyumi Ukiuqtaqtum Kiklianit. Inirahuaqpaktavut havaaghat atuqhugit qauhimayut amihunik taryumiutanik qauyihautinik takuhiuqlugit aallannguqhimayut hitamanit (4) havaaghanit. Unipkaa 1: Imautit iluliillu harvaqviallu iluani Kanatam Kiklianit Qikiqtautait (CAA) Havaaghanit qauyihainahuat imarikpaallirnia talvani hanguviallu qulvahikpaanit Ukiuqtaqtum Taryuanit uqquuhivalliyumi Ukiuqtaqtumi. Mahakpalliyuq, kuugaq harvaqtuq, anurilu aallannguqtaqtuq imarighivalliutiyuq ualiniqhianit Ukiuqtaqtuq. CAA-t, taamnalluaq Tunungani Ualiniqhianut Ikaaqvial, harvaqviuvaktuq imariktumik Ukiuqtaqtum Taryuanit talvunga Tununganut Atlantic-mut, kihimi, naluyauyuq qanuq harvaqpaktuq imariqtuq hakugingnianiklu immap. Harvaqtut talvani Kanatam Kiklianit Qikiqtautainut (CAA) qauyihagtaunahuat atuqlutik Nipikittunik Paqittitjutinik (LADCP) naunaitkutanik, taaffuminngalu CTD-nik (Hakugingnianik, Niklamanianik, Itinianiklu) Tunungani Ualiniqhianut Ikaaqvial Havaaghaanit qauyihainahuat Hinaanit-Hinaanut CTD-nik/LADCP-niklu quulliriiktunik 6-iuyunit nayugaqnit titiraqhimayut umitjam ikaaqvighaanit (X01-X06). Taimaa nakuuniqhanik-ingilrutituqhutik CTD-nik iqqaqhaqpangniat ima qauyihaglugu CTD-nut naktitaqtuq LADCP-kut. Unipkaa 2: Iiyikkut takunnaittut Imaqmiutat Nuutpalliyut Ukiuqtaqtumi taryuq uunnakpalliyumi hikulu aughiqpalliyumi, taryumi qaanganiittut aallannguqpalliyut, taryumiutallu anngutighat naatjuhiit aallannguqpangniaqtut. Ihivriuriamik nayugaqnik ikaaqvianit, kingungnut kuvyait qakugunnguraangat kaliyauvangniat taryum qaangani uunatqiyamit imaqmit (ikkatqiyaanik 100 meters-nit). Kuvyaninngaaqtut titiraqtaunahuat. Naunaitkutanut ilauniaqtut qauyihagvium ighivautap-qaanganunngalaanik piksaliutit FlowCam, ilittuqhilaqtumik kitittilaqtumiklu 'hunavalungnik' taryumit taimaa katiqhuqhimayunik natianit, nauyunik, kingungniklu. Ahiagullu, qauyihautituqlutiklu qunngiaqpagahuaqtait taapkua kinguit iqaluillu imaqmit. Katittugit havaaghat taimaa uumayunik qauyihaiyut ilitturinnaqhitivalliavaktut. Unipkaa 3: Naatjuhiit Huratjat Kanatami Ukiuqtaqtumi Imautainit Huratjat naatjuhiit ingilraviillu atuqtaulaqtut munaqhiyaamik aallannguqtaqtunik taryumiutat uumayuutainit. NPP qauyihainiaqtut naatjuhiiniklu ilittuqhaqlutik huratjat ikaaqvianit. Katimaviita huratjat nayugainilu uumayuutit taryumi naunaiqtaunahuat aallannganillu qauyihagtaulutik hivuanit. Ikaaqtut atuqtaulluaqpaktunik kuinginnaittunik, qunngiarutikkut tingmiaqnik kitittivangniat. Unipkaa 4: Immap Haviqarnia ilaliutiyuq Uunnakpalliyumut Haviqarnia taapkua methane taamnalu carbon dioxide tipiit Ukiuqtaqtum Taryuani avatiinilu ihumagiyauvaktut tamangnik uunnakpalliyumit aulaviqaramik naulviqahutiklu Ukiuqtaqtumi. Qauyihaiyut haviqarnianik carbon dioxide-mik naunaiqhivigiyaulaaqtuq nauviinik aallannguqtaqtullu carbon avatipitingnit. Taamna NPP qauyihainiaqtut haviqarnianik carbon dioxide-mi methane-milu qauyihaghugu hila imaqlu ingilrutituqhutik, ima qunnavyaktumit qauyihaghaqtaat methane tipaanik uumayut nungutpalliyuktanik ilittuqhaqlutik. Avatinit tipinik qauyihaiyut: hila qauyihagtauvangniaqtuq haviqarniit ilittuqhaqlugit taapkua hydrogen oxygen-lu (2H/1H taamnalu 18O/16O) taryumit immaplu minianit haviqarniillu (13C) of CO2 taamnalu CH4. Taryuqmik qauyihaiyut: 13-CH4, taamnalu 13-CO2 qauyihagtauhimmaarahuat taryum ataanit imiqtaqhimayunillu qauyihagviat imautaanit. Ahiagullu qauyihainiaqtut taryum ataanit imiqtaqhimayuniklu taapkuninga taryuringnianik, niklamanianik, chlorophyll qaummariqtukkut, kalaliqhimayuy avuhimayut nauyut (cDOM) qaummariktumik avughamik, puplaktuqhutik qauyihaiyut carbon dioxide-mik (pCO2), pH, taimaa $\delta^{18}\text{O}$ taryuqmit, nauyut pitquhiit carbon taamnalu nitrogen (katiqhuqhimayut haviqarniillu), niqighayut (NO3, PO4, taamnalu Si(OH)4). Ayuqnaitpat qauyihavangniallu hikumik. Imautimik ilittuqhaiyut/qauyihaiyut: 24 ikaaqniit naattaraangata imaaluuniit 100-nik nautical miles-nik ikaaraangat, atpakkuuqtumik "aajjikkutaliugaqmiq" immap qanurininganianik imaalu imiqtaqlutik qauyihagtaghanik atuqhutik CTD Rosette-mik. Qauyihaitjut nipiliuqhit NPP-nit ikaarahuat ilimayut ihumaaluutaunyuk nipiliuqhitinik atuqtunik ikpingnautauyunik taryumiutanut uumayunut, kihimilluaq taryumiutanut anngutighanut. Havauhiit atuqtauniaqturiyauyut ikaaqtunit ikighihimanahuaqtaghait

amirnautaulaagtut. Qauyihautit atuqniaqhimayait talvani NPP 2019-mi ikaaqvianit taapkua iliuraqlugit umiap natianut taapkua 18 kHz nipiliuqhitit (taimaittumikluuniit 38 kHz taimaaluuniit 70 kHz) talvanilu natianit iliurailutik amihunik qauyihautilingmik 12 kHz nipiliuqhitimik auapkailugulu ingilraliqqata, kihimi taimaitpat: 1) Nipiliuqhitinik atuqniqiaqtut paqittigumik anngutighanik ungahiaqtumik 500 m-mik umiaqmit. 2) Nipiliuqhit qaminnganahuaqtuq qanilrumiitpat 5 km-nik Nunavunmi nunallaaqmit. 3) Ihumaaluutauvaktut amihuuyut tuugaalgit qilalukkat mighaagut hanguyut Ikpiaryumi Mittimatalingmilu, nipiliuqhitit qaminnganahuat Navy Board Kangiqhuani, Eclipse Kangiqhuani, Mittimatalingmilu. Taimaalu qamitauvangniaqtuq CTD-nut iliuraqtauhimayuq LADCP-nguyuq imaqtumik qauyihavianit talvani CTD-nut Havakvianit 02.4) Amigaiqpakkamik taryumiutat anngutighat talvani Bellot Ikirahaanit, qauyihautit nipiliuqhitit atuqtaulaittut talvani Bellot Ikirahaanit imaaluuniit 5 km-nik ungahiaqtumik apuqvianit tamangnit iklugiingnit. 5) Hapummiyauhimayuniittut taryumi talvani Prince Leopold Qikiqtaani talvanilu Bylot Qikiqtaani Tingmitjat Nayugait talvanilu Pulaaqtaqtit Kanatami Imautainit, nipiliuqhitit qaminngavangniat. 6) Paqittinirumik anngutighanik 200 m-nik qanilruanit umiam taamna LADCP aullaqtitaulaittuq. Angmaumayut Naunaitkutut Maligaghait Havaaghanit qauyihainiaqtut ayuqnaqtunik naunaitkutanik qanurininganiiniklu talvuuna NPP kut qaritauyakkuurutainit. Tamangnik iniqtauhimayut qauyihavimayut tutquumaniaqtut talvani Ayuqnaqtunik Qauyihavtuliqiyinit-ikayuqhimayainik Ukiuqtaqtumi Naunaitkutanik Tutquumavingnit tamangniklu ihuaqtut Kanatamiutat Inuillu ayuqnaqtunik qauyihavut tutquumaviit.

Personnel

Personnel on site: 38

Days on site: 17

Total Person days: 646

Operations Phase: from 2019-07-16 to 2019-08-01

Activities

Location	Activity Type	Land Status	Site history	Site archaeological or paleontological value	Proximity to the nearest communities and any protected areas
Transect 01, Lancaster Sound, CTD stations 03-07	Scientific/International Polar Year Research	Marine	-	-	In Lancaster Sound, north of Bylot Island Migratory Bird Sanctuary and Sirmilik National Park, near Pond Inlet
Transect 02, Wellington Channel, CTD stations 09-11	Scientific/International Polar Year Research	Marine	-	-	Near Resolute Bay
Transect 03, Austin Channel, CTD stations 12-16	Scientific/International Polar Year Research	Marine	-	-	West of Resolute Bay
Transect 04, Melville Sound, CTD stations 17-21, location dependent on ice extent	Scientific/International Polar Year Research	Marine	-	-	West of Resolute Bay
Transect 05, Prince Regent Inlet, CTD stations 23-27	Scientific/International Polar Year Research	Marine	-	-	Southeast of Resolute Bay and West of Arctic Bay
Transect 06, Peel Sound, CTD stations 29-33	Scientific/International Polar Year Research	Marine	-	-	South of Resolute Bay
CTD station 01	Scientific/International Polar Year Research	Marine	-	-	Near Grise Fiord and Nirjutiqavvik National Wildlife Area
CTD station 02	Scientific/International Polar Year Research	Marine	-	-	Near Pond Inlet
CTD station 08	Scientific/International Polar Year Research	Marine	-	-	Near Arctic Bay
CTD station 22	Scientific/International Polar Year Research	Marine	-	-	Near Resolute Bay
CTD station 28	Scientific/International Polar Year Research	Marine	-	-	South of Resolute Bay

Community Involvement & Regional Benefits

Community	Name	Organization	Date Contacted
Pond Inlet	Hamlet Administration	Hamlet of Pond Inlet	2019-03-23
Pond Inlet	Organization Leadership	Mittimatalik Hunters and Trappers Organization	2019-03-23

Resolute Bay	Organization Leadership	Hamlet Administration	2019-03-23
Resolute Bay	Organization Leadership	Resolute Bay Hunters and Trappers Association	2019-03-23
Arctic Bay	Organization Leadership	Ikajutit Hunters and Trappers Organization	2019-03-23

Authorizations

Indicate the areas in which the project is located:

Transboundary
Kitikmeot
North Baffin

Authorizations

Regulatory Authority	Authorization Description	Current Status	Date Issued / Applied	Expiry Date
Canadian Wildlife Service	Permit to visit Prince Leopold Island Migratory Bird Sanctuary for observation and filming and to enter protected waters around the Sanctuary.	Applied, Decision Pending		
Fisheries and Oceans Canada	License to fish for scientific purposes for use of zooplankton nets.	Applied, Decision Pending		
Nunavut Research Institute	Science Research Permit	Applied, Decision Pending		
Government of Nunavut, Department of Culture, Language, Elders, and Youth	Class 1 Archaeology Tourism Permit	Applied, Decision Pending		
Qikiqtani Inuit Association	Access to Inuit Owned Land	Applied, Decision Pending		
Government of Nunavut, Department of Environment	Wildlife Observation license	Applied, Decision Pending		

Project transportation types

Transportation Type	Proposed Use	Length of Use
Water	IB Oden	

Project accomodation types

Other,

Material Use

Equipment to be used (including drills, pumps, aircraft, vehicles, etc)

Equipment Type	Quantity	Size - Dimensions	Proposed Use
Information is not available			

Detail Fuel and Hazardous Material Use

Detail fuel material use:	Fuel Type	Number of containers	Container Capacity	Total Amount	Units	Proposed Use
16.8 molality HCl	hazardous	1	1	1	Liters	seawater processing
solution of 1% glutaraldehyde and 0.1% paraformaldehyde	hazardous	1	1.2	1.2	Liters	plakton preparation
glutaraldehyde (25%)	hazardous	1	0.5	0.5	Liters	plankton preservative
DAPI - 4',6-diamidino-2-phenylindole	hazardous	1	0.01	0.01	Liters	fluorescent dye for plankton DNA in fluorescence microscopy
Ethanol	hazardous	2	2.5	5	Liters	preservative
formaldehyde (37%)	hazardous	2	2	4	Liters	preservative

Water Consumption

Daily amount (m3)	Proposed water retrieval methods	Proposed water retrieval location
0		

Waste

Waste Management

Project Activity	Type of Waste	Projected Amount Generated	Method of Disposal	Additional treatment procedures
Scientific/International Polar Year Research	Hazardous waste	12L	All unused and waste materials will be stored in proper containers in the lab aboard the IB Oden. Chemicals will be disposed of properly when the ship reaches Thule, Greenland.	none

Environmental Impacts:

The transient nature of this expedition, and the short duration of sampling stops (4.5 hours or less at each sampling station), should result in minimal environmental impact. Because only small samples will be collected, the impacts of the actual sampling procedures will also be minimal. However, the science team does recognize that the operating frequencies of the research sonars could have an impact on the behavior of marine mammals that are in the vicinity of the ship when the sonar is active and can perceive the sound produced by sonars. To mitigate impacts from the sonar, the proposed standard procedure for the NPP 2019 expedition will be to have the hull mounted 18kHz sonar (or potentially 38kHz or 70kHz) and the hull mounted 12kHz multibeam sonar operating when the ship is underway, except under these conditions: 1) Sonar operation will cease when marine mammals are detected within 500m of the ship. 2) The sonar will be off when within 5 km of any Nunavut community. 3) Out of respect for concerns about the sonar in regard to a group of narwhals that moves between the Arctic Bay and Pond Inlet areas, the sonars will be off while in Navy Board Inlet, Eclipse Sound, and Pond Inlet. This includes turning off the CTD mounted LADCP during the hydrographic station at CTD Station 02. 4) Due to the potentially high concentration of marine mammals in Bellot Strait, research sonars will not be used in Bellot Strait or within 5 km of the entrance on either side. 5) When in restricted waters of the Price Leopold Island and Bylot Island Migratory Bird Sanctuaries or Parks Canada Waters, the sonars will be off. 6) The LADCP can be used only during CTD deployments. If marine mammals are detected within 200m of the ship the LADCP will not be deployed.

Additional Information

SECTION A1: Project Info

SECTION A2: Allweather Road

SECTION A3: Winter Road

SECTION B1: Project Info

SECTION B2: Exploration Activity

SECTION B3: Geosciences

SECTION B4: Drilling

SECTION B5: Stripping

SECTION B6: Underground Activity

SECTION B7: Waste Rock

SECTION B8: Stockpiles

SECTION B9: Mine Development

SECTION B10: Geology

SECTION B11: Mine

SECTION B12: Mill

SECTION C1: Pits

SECTION D1: Facility

SECTION D2: Facility Construction

SECTION D3: Facility Operation

SECTION D4: Vessel Use

SECTION E1: Offshore Survey

SECTION E2: Nearshore Survey

SECTION E3: Vessel Use

SECTION F1: Site Cleanup

SECTION G1: Well Authorization

SECTION G2: Onland Exploration

SECTION G3: Offshore Exploration

SECTION G4: Rig

SECTION H1: Vessel Use

SECTION H2: Disposal At Sea

SECTION I1: Municipal Development

Description of Existing Environment: Physical Environment

N/A

Description of Existing Environment: Biological Environment

N/A

Description of Existing Environment: Socio-economic Environment

N/A

Miscellaneous Project Information

Identification of Impacts and Proposed Mitigation Measures

The science team recognizes the potential impact on the behavior of marine mammals that are in the vicinity of the ship when the research sonars are active and can the mammals can perceive the sound produced by sonars. To mitigate impacts from the sonar, the proposed standard procedure for the NPP 2019 expedition will be to have the hull mounted 18kHz sonar (or potentially 38kHz or 70kHz) and the hull mounted 12kHz multibeam sonar operating when the ship is underway, except under these conditions: 1) Sonar operation will cease when marine mammals are detected within 500m of the ship. 2) The sonar will be off when within 5 km of any Nunavut community. 3) Out of respect for concerns about the sonar in regard to a group of narwhals that moves between the Arctic Bay and Pond Inlet areas, the sonars will be off while in Navy Board Inlet, Eclipse Sound, and Pond Inlet. This includes turning off the CTD mounted LADCP during the hydrographic station at CTD Station 02. 4) Due to the potentially high concentration of marine mammals in Bellot Strait, research sonars will not be used in Bellot Strait or within 5 km of the entrance on either side. 5) When in restricted waters of the Price Leopold Island and Bylot Island Migratory Bird Sanctuaries or Parks Canada Waters, the sonars will be off. 6) The LADCP can be used only during CTD deployments. If marine mammals are detected within 200m of the ship the LADCP will not be deployed.

Cumulative Effects

The transient nature of this expedition, and the short duration of sampling stops (4.5 hours or less at each sampling station), should result in minimal environmental impact. Because only small samples will be collected, the impacts of the actual sampling procedures will also be minimal.

Impacts

Identification of Environmental Impacts

	PHYSICAL	Designated environmental areas	Ground stability	Permafrost	Hydrology / Limnology	Water quality	Climate conditions	Eskers and other unique or fragile landscapes	Surface and bedrock geology	Sediment and soil quality	Tidal processes and bathymetry	Air quality	Noise levels	BIOLOGICAL	Vegetation	Wildlife, including habitat and migration patterns	Birds, including habitat and migration patterns	Aquatic species, incl. habitat and migration/spawning	Wildlife protected areas	SOCIO-ECONOMIC	Archaeological and cultural historic sites	Employment	Community wellness	Community infrastructure	Human health	
Construction																										
-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	
Operation																										
Scientific/International Polar Year Research		-	-	-	-	-	-	-	-	-	-	-	-	N		-	-	-	N	U		-	-	-	-	-
Decommissioning																										
-		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-

(P = Positive, N = Negative and non-mitigatable, M = Negative and mitigatable, U = Unknown)

Project Location



List of Project Geometries

- | | | |
|----|----------|---|
| 1 | polyline | Cruise track, part 1 |
| 2 | polyline | Cruise track, part 2 |
| 3 | polyline | Cruise Track, return to Thule, Greenland |
| 4 | point | Pond Inlet, shore visit |
| 5 | point | Resolute, shore visit and crew change |
| 6 | point | Transect 01, Lancaster Sound, CTD stations 03-07 |
| 7 | point | Transect 02, Wellington Channel, CTD stations 09-11 |
| 8 | point | Transect 03, Austin Channel, CTD stations 12-16 |
| 9 | point | Transect 04, Melville Sound, CTD stations 17-21, location dependent on ice extent |
| 10 | point | Transect 05, Prince Regent Inlet, CTD stations 23-27 |
| 11 | point | Transect 06, Peel Sound, CTD stations 29-33 |
| 12 | point | CTD station 01 |

13	point	CTD station 02
14	point	CTD station 08
15	point	CTD station 22
16	point	CTD station 28
17	point	Thule, Greenland, cruise beginning and end point