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$\gamma_b \Delta^c \dot{\gamma} \Pi \sigma^b \quad \Lambda c_n d^{\gamma b} \gamma \sigma d n d^{\alpha L^a} \sigma^b$

Permafrost Pathways is a multi-institutional project made of scientists, international policy experts, and community stakeholders, led by Dr. Susan Natali at the Woodwell Climate Research Center. Our goal is to quantify permafrost degradation across the Arctic boreal region, and use these results to guide more realistic international climate policy. Currently, estimates of carbon emissions from permafrost regions are highly variable and thus, policymakers do not account for these emissions when setting emissions reduction targets. We intend to measure carbon exchange where data is needed most across the Arctic boreal region using a network of monitoring stations, including in Nunavut. Over the course of five years, these stations will measure carbon dioxide and methane emissions from natural permafrost ecosystems. The monitoring stations would remain in Nunavut year-round and are constructed using a structure such as a metal tri-pod, with sensors attached above and below ground. These sensors collect data about weather and environmental conditions and associated greenhouse gas exchange. Storage of the data will be managed by our organization, but all data will be openly shared to a repository at the end of each calendar year. The availability of this data will promote collaboration with other researchers. We ultimately will publish our results that identify relationships between climate change and loss of permafrost. Our project will have a relatively small impact on the lives of Nunavut residents. Our researchers will install the monitoring station in an undisturbed location that will be approved by the land owner and local organizations, and we will return annually to repair and maintain the sensors. We also plan to contract a local resident to make small adjustments to the sensors and assist with troubleshooting throughout the year. We intend to and would like to participate in a town meeting annually to share our research and answer any questions local residents may have about our local research site and larger goals. This includes meetings in Resolute, Iqaluit, and/or any other location that we may work in the future.

Permafrost Pathways est un projet multi-institutionnel composé de scientifiques, d'experts en politiques internationales et d'intervenants communautaires, dirigé par la Dre Susan Natali du Woodwell Climate Research Center. Notre objectif est de quantifier la dégradation du pergélisol dans la région boréale arctique et d'utiliser ces résultats pour orienter une politique climatique internationale plus réaliste. À l'heure actuelle, les estimations des émissions de carbone des régions de pergélisol sont très variables et, par conséquent, les décideurs ne tiennent pas compte de ces émissions lorsqu'ils fixent des objectifs de réduction des émissions. Nous avons l'intention de mesurer les échanges de carbone là où les données sont les plus nécessaires dans la région boréale de l'Arctique à l'aide d'un réseau de stations de surveillance, y compris au Nunavut. Sur une période de cinq ans, ces stations mesureront les émissions de dioxyde de carbone et de méthane des écosystèmes naturels du pergélisol. Les stations de surveillance demeureront au Nunavut toute l'année et sont construites à l'aide d'une structure telle qu'un tripod métallique, avec des capteurs fixés au-dessus et au-dessous du sol. Ces capteurs recueillent des données sur les conditions météorologiques et environnementales et les échanges de gaz à effet de serre associés. Le stockage des données sera géré par notre organisation, mais toutes les données seront partagées ouvertement dans un référentiel à la fin de chaque année civile. La disponibilité de ces données favorisera la collaboration avec d'autres chercheurs. Nous publierons en fin de compte nos résultats qui identifient les relations entre le changement climatique et la perte de pergélisol. Notre projet aura un impact relativement faible sur la vie des résidents du Nunavut. Nos chercheurs installeront la station de surveillance dans un endroit non perturbé qui sera approuvé par le propriétaire du terrain et les organisations locales, et nous reviendrons chaque année pour réparer et entretenir les capteurs. Nous prévoyons également de faire appel à un résident local pour apporter de petits ajustements aux capteurs et aider au dépannage tout au long de l'année. Nous avons l'intention et aimerions participer à une réunion de la ville chaque année pour partager nos recherches et répondre à toutes les questions que les résidents locaux pourraient avoir sur notre site de recherche local et nos objectifs plus larges. Cela comprend les réunions à Resolute, à Iqaluit et/ou à tout autre endroit où nous pourrions travailler à l'avenir.

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Inuinnaqtun: Nunap qiqumaninganik Apqutit amihunik havagviuyut havaaq hanayauhmayuq naunaiyaiyiniq, hilaqyuami pitquhiqmi ayugitunik, nunagiyaumilu ilaayut, hiviliquhqtayut Dr. Susan Natali-mit Woodwell Hilap Ilituqhaivikmi Havakviuyumi. Tikinahuarutivut naunaiyagianganik qiqumanirit mamitirnirmun avatiini Ukiuqtaqtumi nunaini, uvalu atuqlugit hapkua qanuginiit maligahat itquumayut nunaqyuami hilap maliruagahait. Tadjja, itqungniarutit puyuit anianiit hapkunanga nunap qiqumaninganin aviktungniinin akhut aalakiigutiqagtut uvalu, maliguagahat pidjutiqangitut hapkununga puyuit humi hiamitiqnikkut ikikliyuumiqlugit turaarutit. Naunaiyarniaqtugut alqunngup puyuanut himmautingit talvani nampangit ihariagiyaayut tamainni Ukiuqtaqtumi boreal aviktuqhimaninnga aturhuni havaqatigiikniqmik munariniqmut, unalu Nunavunmi. Talimani ukiuni, hapkua havagviit aktilaarniaqtait puyuit dioxidemik uvalu puyuit puyuit nunap qiqumaninganin avatingit. Munarinikkut havagviit aulahimaniaqtun Nunavunmi ukiuq tamaat piliuqtaulutiklu aturlutik tunngavimik imaatun havigalikmik pinghunik, inuk ingutaarnirnik ilaliutihimajun qulaani ataanilu nunami. Hapkuat mihingnautit katitiqhivaktut naunaitkutikhanik hilatigut imaalu avatimut qanurinniinnik imaalu pidjutiqaqtunik puyuum anariaqtuqtilaangit himmautingit. Tutquumaviit naunaipkutit munariyauniaqtut timiuyumit, kihiani tamaita naunaipkutit akmaumaniaqtut ilitariyaufaariagani ihulinigani atuni tatqiqhiunmi ukiumi. Piinariaqaqinnga una nampalik atuliqtitauniaqtuq havaqatigiikniq aadlanut ihivriuqtiuyunut. Titiraffaarniaqtavut qanurilivut tikuaqhiyut inuuqatiriigutinin ukua hilap aalaguqniganik ahiuniganiklu nunap qiqumaninganik. Havaavut mikiyumik hulaqutiqaqniaqtut inuuhiinun Nunavunmi inuit. Ihivriuqtiyut iliurarniaqtait munarivikhangit ihuangittumik nayuganganik angiqtauniaqtuq uumannga nunannga nanminiaqtuq unalu nunamikni timiqutigiyayut, utiffaarniaqtugutlu ukiuq tamaat ihuarhigiami pihimagiamilu mihiknarninngit. Upalungaiyaqtugutlu katulaakkut nunamingni inungnun ihuaqhaiyaangini mihingnautinun uvalu ikayuqlutik ayuqhautinik atuqtilugu ukiuq. Ilaupkarumajugut ilaajumaplutalu nunamingni katimapkaidjutikhanik ukiuq tamaat uqautigilugit qaujihaidjutikhat imaalu kiulugit apiqqutikhat nunamingni nunaqaqtut nunamingni qaujihainikkut najugainnik imaalu angitqijaniq tikinnahuaqtakhainnik. Una ilaayuq katimadjutit Qausuittungmi, Iqalungni, uvalu/uvaluuniin aalat nayugait tapkua havangniaqtuqut hivuniptingni.

## Post-Closure Phase: from to

$$\Lambda \subset \mathbb{N} \triangleleft \mathbb{N} \xrightarrow{\sigma} \mathbb{N}^{\mathbb{N}} \supset \mathbb{C}$$

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Resolute Monitoring Station (primary)	Equipment installation	Commissioners	Currently designated as GN airport parcel, otherwise appears untouched. Melissa Lafrenière at Queens University has visited the site and reported that it looked natural and suitable for our needs. History otherwise unknown.	Unknown	2.5km to YRB runway, 0.5km to Crystal City structures.
Resolute Monitoring Station (alternative)	Equipment installation	Municipal	Unknown	Unknown	1km south of nearest Resolute residential area
Pond Inlet Monitoring Station (primary)	Equipment installation	Municipal	Un-surveyed municipal land, otherwise unknown.	Unknown	1.2km to shooting range, 1.8km to YIO runway
Pond Inlet Monitoring Station (alternative)	Equipment installation	Municipal	Un-surveyed municipal land, otherwise unknown.	Unknown	0.7km from nearest municipal road
Resolute Monitoring Station (primary)	Scientific/International Polar Year Research	Commissioners	Currently designated as GN airport parcel, otherwise appears untouched. Melissa Lafrenière at Queens University has visited the site and reported that it looked natural and suitable for our needs. History otherwise unknown.	Unknown	2.5km to YRB runway, 0.5km to Crystal City structures.
Resolute Monitoring Station (alternative)	Scientific/International Polar Year Research	Municipal	Unknown	Unknown	1km south of nearest Resolute residential area
Pond Inlet Monitoring Station (primary)	Scientific/International Polar Year Research	Municipal	Un-surveyed municipal land, otherwise unknown.	Unknown	1.2km to shooting range, 1.8km to YIO runway
Pond Inlet Monitoring Station (alternative)	Scientific/International Polar Year Research	Municipal	Un-surveyed municipal land, otherwise unknown.	Unknown	0.7km from nearest municipal road



$\epsilon \Delta t^{\alpha} j^c$      $\Lambda J^{\alpha} e D \dot{N}$      $d^{\alpha} r^{\beta} C D P L \downarrow^c$

$a^{\dagger}r^{\dagger}q^{\dagger}r^{\dagger}\sigma^{\dagger} \Lambda_{\sigma} r^{\dagger} q^{\dagger} \Delta \sigma^{\dagger} q^{\dagger} \gamma^{\dagger} \gamma^{\dagger} \gamma^{\dagger}$

## North Baffin

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ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ	ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ	ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ	ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ/ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ	ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ
ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ, ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ	We have submitted our application for a physical research license from the NRI, decision pending.	Applied, Decision Pending		
Hunters and Trappers Associations/Organizations	We have attempted to propose our research to the HTO boards in Pond Inlet and Resolute Bay, but have been unsuccessful in reaching them by phone or email. We are travelling to both communities in May to discuss our research in person.	Not Yet Applied		
ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ ᐱᑦᓴᐅᓄᓂᓄᓇᐃᑦ	After discussions with representatives from QIA, we determined that authorization from QIA is not necessary, as the proposed research will not be done on Inuit-owned lands	Not Yet Applied		
Government of Nunavut, Community Government & Services	We have submitted our application for a special land use permit to the Hamlet Office in Resolute Bay. The application was supplied by GN-CGS, as the unsurveyed municipal land is managed by GN	Applied, Decision Pending		
Government of Nunavut, Community Government & Services	We have submitted our application for a special land use permit to the Hamlet Office in Pond Inlet. The	Active		

	application was supplied by GN-CGS, as the unsurveyed municipal land is managed by GN. The application was approved by the Pond Inlet Hamlet Office			
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Project transportation types

Transportation Type	ᐱᓇᐱᓐ ᐱᓐᓂᐱᓐᓂᐱᓐᓂᐱᓐ	Length of Use
Air	Commercial flights from YFB-YIO for all personnel	
Land	Truck or ATV access on public roads. We will take ATVs directly to the site (across tundra) only if allowed	

Project accomodation types

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$\Pi \cap \langle D^{\perp} \rangle = \{0\}$ ,  $D^{\perp} \subseteq C$ ,  $C \subseteq D^{\perp}$ ,  $D \subseteq C^{\perp}$

ΔL<sup>9b</sup> ΔC<sup>9b</sup> CΔJL<sup>9b</sup> ΔC<sup>9b</sup>

$\mathcal{D}^c \rightarrow \mathcal{C} \dot{\mathcal{I}}^{\mathfrak{f}_b} \mathcal{A} \mathfrak{D}^{\mathfrak{f}_b} \mathcal{C} \mathcal{D} \sigma \mathcal{A}^{\mathfrak{f}_b} \mathfrak{D}^{\mathfrak{f}_b}$	$\mathfrak{f}_b \rightarrow \mathfrak{f}_b \Delta \Gamma^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \sigma \mathcal{A}^{\mathfrak{f}_b} <^c$	$\mathfrak{a} \mathcal{P}^c \Delta \Gamma^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \sigma \mathcal{A}^{\mathfrak{f}_b} <^c$
0		



$\triangleleft^b C d^c$ 
$$\Delta^b C d_C \sim \sigma \Delta^q \sigma^q$$

ᐱᑕᓕᓂᐳᓚᔭᐅᐳᐲᐲᐲᐯᑦ ᐱᑕᓕᓂᐳᓚᔭᐅᓂᐳᐳᐯᑦᓃ	ᖃᓄᐃᑦᐹᖃ ᐳᑦᑕᑎᖃ ᓴᖃᐸᐳᓂᐳᐳᐯᑦᐳᓚᔭᐅᔬᑦ	ᖃᓄᐸᓂᐳᐳᐯᑦᐳᓚᑎᖃ ᓴᖃᐸᐳᓂᐳᐳᐯᑦᐳᓚᔭᐅᔬᑦ	ᖃᓄᖃ ᐳᑦᑕᖃᑕᐅᓂᐳᐳᐯᑦᐳᓚ	ᓴᓗᒪᖃᓴᐅᐸᖃᓴᖃᓂᐳᓂᐳᐳᐯᑦᐳᓚ
Equipment installation	ᐳᑦᑕᑎᖃ ᐃᑎᐳᑕᐅᐳᐳᐯᑦᐳᓚᖃᑕ	1 standard trash bag	All waste during the installation of the sites will be collected and disposed of in municipal waste receptacles. Waste includes cardboard boxes, plastic wrap, excess lengths of wire and tubing. No waste will remain at the site.	N/A

$$4^{\circ} 07' 20'' \text{C} \quad 4^{\circ} 07' 20'' \text{C}$$

We anticipate that our project will not have any detrimental environmental impacts. During the installation phase, we will access the site to install research equipment, and this will involve carrying heavy batteries across the tundra from the road. We will do everything possible to keep the path short and use existing paths when present. Additionally, we will dig small holes to install sensors, but we will refill those holes and leave them otherwise undisturbed. During operation, the tower will be surrounded by wooden boardwalks to keep our feet above the delicate tundra. We will only visit the site as needed for maintenance, repairs, and cleaning. One pump will produce a small amount of noise during operation, but this noise will not be audible from more than 100m away.

## **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

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The existing environment where the study will be taking place is a natural tundra landscape in both Pond Inlet and Resolute Bay. These areas are represented by continuous permafrost with an active layer of < 1m. The soil is a granular till. Some trails already exist for community use.

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The existing biological environments in both Pond Inlet and Resolute Bay are a natural high Arctic tundra ecosystem with some minor human disturbance. The local watersheds consist of three primary vegetation communities; wet sedge, mesic tundra, and dry tundra. Minor disturbances within the watersheds include ATV and walking trails that have been formed through community access usage.

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This research will be conducted within the municipal boundaries of both Pond Inlet and Resolute Bay. Local community members and youth will be hired and trained in research techniques, instrument maintenance, and data analysis.

## Miscellaneous Project Information

We are attempting to involve the local community as closely as possible, by asking for their input in site locations as well as providing employment opportunities. We would also like to use our existing infrastructure to support other research that is important to the community.

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Our project will have minimal negative impacts on the physical, biological or socioeconomic environment. These consist only of physical access across natural tundra, and minimal noise from equipment. It will have however a positive impact on the employment opportunities in Pond Inlet and Resolute Bay. The project will also have a positive impact on the general advancement of knowledge of the area, which is beneficial for all of Nunavut.

## Cumulative Effects

Continuous access to the sites over the timeframe of the project may have cumulative effects on the tundra, this will be mitigated by constructing a boardwalk to protect the vegetation and permafrost.

## Impacts

$\mathbb{C} \rightarrow \mathbb{C} \Delta^{\mathfrak{b}} \mathbb{C} \rightarrow \sigma^{\mathfrak{a}} \mathfrak{r}^{\mathfrak{c}} \quad \mathbb{A} \mathbb{C} \cap \Gamma \rightarrow \mathbb{C} \mathfrak{c}^{\mathfrak{c}} \mathbb{C} \quad \mathbb{A}^{\mathfrak{b}} \mathbb{C} \Delta^{\mathfrak{b}} \mathbb{C} \rightarrow \mathbb{L} \mathbb{L}^{\mathfrak{c}}$

[illegible]
$$(P = \langle 46\text{d}\bar{6}\text{p}\bar{0}\text{N}\bar{4}^{\text{e}}\bar{6}^{\text{b}}\bar{0}^{\text{c}} \rangle, N = \langle 46\text{d}^{\text{b}}\text{r}^{\text{b}}\bar{4}\text{C}\bar{D}\bar{4}^{\text{e}}\bar{6}^{\text{b}}\bar{0}^{\text{c}} \rangle \langle \bar{4}\bar{6}\text{D}\bar{7}^{\text{b}}\bar{4}\bar{r}^{\text{b}}\bar{0}^{\text{b}}\bar{6}^{\text{b}}\text{C}\bar{D}\bar{4}^{\text{e}}\bar{6}^{\text{b}}\bar{0}^{\text{c}} \rangle^{\text{c}}, M = \langle 46\text{d}^{\text{b}}\text{r}^{\text{b}}\bar{4}\text{C}\bar{D}\bar{4}^{\text{e}}\bar{6}^{\text{b}}\bar{0}^{\text{c}} \rangle \langle \bar{4}\bar{6}\text{D}\bar{7}^{\text{b}}\bar{4}\bar{r}^{\text{b}}\bar{0}^{\text{b}}\bar{6}^{\text{b}}\text{C}\bar{D}\bar{4}^{\text{e}}\bar{6}^{\text{b}}\bar{0}^{\text{c}} \rangle^{\text{c}}, U = \langle 6\text{b}\bar{D}\bar{7}\bar{L}^{\text{e}}\bar{6}^{\text{b}}\bar{0}^{\text{c}}\bar{0}^{\text{b}} \rangle)$$

1	point	Resolute Monitoring Station (primary)
2	point	Pond Inlet Monitoring Station (primary)
3	point	Resolute Monitoring Station (alternative)
4	point	Pond Inlet Monitoring Station (alternative)

