



P.O. Box 350  
Tuktoyaktuk, NT X0E-1C0  
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## Tuktoyaktuk Community Climate Resilience Project

**Engaged members of our community contribute to our understanding and monitoring of climate change effects in order to increase our knowledge and awareness of issues, develop strategies and pro-actively implement plans to adapt or mitigate impacts.**

Tuktoyaktuk Community Corporation (TCC) submission to **INAC** for project funding under the **Indigenous Community-Based Climate Monitoring Program**  
February 16, 2018

Contact: Bill Beamish, Tuktoyaktuk Community Corporation

“There is . . . a growing consensus that local knowledge of Indigenous peoples is the solid foundation for local climate change adaptation and mitigation strategies.” – *Raygorodetsky, 2017*

"I think community-based awareness combined with community-based monitoring...is exactly what Tuktoyaktuk needs and can accomplish. In my mind there is no other community that is more affected by climate change in this country as Tuktoyaktuk...I think you are in a perfect position to capture this change in your own backyard." - *Dustin Whalen, Physical Scientist, Geological Survey Canada, personal communication, February 8, 2018*

“Inuit have for generations had very consistent and predictable weather, ice and snow conditions, Inuit have been able to extrapolate when and where they should be and what animals to hunt based on knowledge gained from many generations. Many of today’s harvesters have seen more changes in their lifetime than their forefathers have experienced in hundreds of years.” - *Darell Nasogaluak, Vice Chair, Tuktoyaktuk Community Corporation, February 13, 2018*

**Submission prepared by:** Bill Beamish and Johan Stroman in consultation with Kim C. Wilkinson

## **Executive Summary**

The Tuktoyaktuk Community Climate Resilience Project (TCCRP), with funding from Indigenous and Northern Affairs Canada will enable the community of Tuktoyaktuk to develop a locally managed program to measure, collect, record and report information about climate change and the impacts of climate change on the community and on areas that are used by the Inuvialuit for traditional activities. In addition, the program will document local issues like erosion, extreme weather and flooding events. The TCCRP will assist in connecting project leads of ongoing scientific and monitoring research programs near Tuktoyaktuk to encourage and facilitate them to share their findings with the community on a regular basis.

The Tuktoyaktuk Community Climate Resilience Project will work closely with the other Inuvialuit communities and local or regional organizations to plan and coordinate activities and to share relevant information. These groups include the Inuvialuit Regional Corporation (IRC), Inuvialuit Land Administration (ILA), Tuktoyaktuk Hunters and Trappers Committee (HTC), the Hamlet of Tuktoyaktuk, the Tuktoyaktuk Community Corporation (TCC), the Tuktoyaktuk Elders Committee (TEC), the Mangilaluk School, the Fisheries Joint Management Committee (FJMC), and the Government of Northwest Territories (GNWT).

In addition, this initiative will coordinate with the Mangilaluk School and the Junior Rangers to develop a program to educate youth about climate change, and the importance of local adaptation and mitigation efforts. The TCCRP will engaged students and Jr. Rangers with hands on activities and projects designed to measure and monitor local indicators routinely, to ensure regular structured annual data gathering required to monitor change over time. The TCCRP will involve students in research and interviews with elders and other resource users to integrate qualitative data gathering with learning and cultural transmission.

The TCCRP monitoring and community engagement budget for 2018-2019 is \$168,720 with subsequent slightly lower annual budgets for a project timeline of 3 years. As part of our start-up year the TCCRP will determine additional sources of funding through partnership and related funding to support the project beyond the ICCMP fund window.

## **Key climate indicators**

The following indicators are proposed and will be finalized (as clarified in Project Description) Ice thickness, Permafrost depth, Air Temperature, Water Temperature, Plant leaf and bloom dates, Harvest yields, Ice Forming and thaw dates, Distance from Land to Sea Ice.

Additional anecdotal historical and current day observations will be gathered reflecting recent and historical information via elders and other resource users

- *Identification of invasive plants and insects*
- *Change in Animals' and People's travel patterns on Ice*
- *Monitoring extreme weather events*
- *Monitoring traditional harvesting of animals, birds, fish, and other cultural foods*
- *Reported and observed changes on the land due to erosion, lakes, creeks or bays drying up*

### **Project lead/ funding recipient contact information**

If approved, this project will be managed and coordinated by the Tuktoyaktuk Community Corporation. The **Corporate Manager, Jocelyn Noksana**, [manager@tukcommunitycorp.com](mailto:manager@tukcommunitycorp.com) phone (867)-977-2004 will have overall responsibility to approve any expenditures and to monitor the budget. The TCC will also be responsible to audit the project budget annually. Quarterly project reports will be made to the TCC Board, the Hamlet Council and others as needed.

### **Project team and external partners**

The key staff people for this project are:

1. Bill Beamish, Consultant, Project Coordinator [wbc\\_ltd@fastmail.fm](mailto:wbc_ltd@fastmail.fm) cel (604) 989-2364
2. Johan Stroman, Consultant, School Project Coordinator, [johan@heartwoodsolutions.ca](mailto:johan@heartwoodsolutions.ca) cel (604) 989-3079
3. Chukita Gruben, TCC Board Member and Community Coordinator, [cheetaelias@gmail.com](mailto:cheetaelias@gmail.com) cel (867) 688-1217

In addition, the TCCRP will establish a local Project Steering Committee and will invite participation by representatives from the following local organizations:

1. Tuktoyaktuk Community Corporation
2. Hamlet of Tuktoyaktuk
3. Tuktoyaktuk Hunters and Trappers Committee
4. Tuktoyaktuk Elders Committee
5. Mangilaluk School (Ephraim Warren, Science Teacher and 1 student)
6. Tuktoyaktuk Jr. Rangers Program
7. Inuvialuit Land Administration – Tuktoyaktuk office
8. Inuvialuit Regional Corporation
9. Parks Canada (Pingo Park is currently monitored by Natural Resources Canada)
10. Science Mentor (Dustin Whalen, Natural Resources Canada has offered to assist)

The following people were contacted for information or advice during the preparation of this application:

Dustin Whalen NRCAN  
Edward Wiebe, UVic  
Ephraim Warren, Mangilaluk School  
Krista Cudmore, Mangilaluk School  
Janet Elias

Darrel Nasogaluak, TCC Vice Chair  
David Atkinson, UVic

Laura Eerkes-Medrano, UVic  
Kris Boutilier

Geological Survey - Erosion Research  
School Weather Station Program  
Science Teacher  
Principal  
ILA Climate Monitor Coordinator (working with Aurora College to Develop Training Program)  
Airport Weather Monitoring  
Extreme Weather Studies (Tuk Research Program)  
Weather Studies (Tuk Research Program)  
IT Consultant

## **Project objectives**

The goal of the proposed project is to:

1. develop community-based capacity to measure and monitor climate change and its effects on Tuktoyaktuk and traditional lands around the community by working with and connecting to youth, adults and elders in gathering information – and co-ordinating events which bring all three groups together to share their findings and perspectives with the community;
2. increase the awareness and knowledge of youth and adult residents of Tuktoyaktuk on climate change and its impacts to better enable and empower local leadership to vision and proactively address climate change impacts by participating in decision making about the development and implementation of adaptation and mitigation measures;
3. empower local indigenous people, by supporting access to training on-the-land to observe, collect, record, report and share data about climate change and its impacts; and, to access the collective knowledge and wisdom of community elders and other resource users who have lived on the land and who have experienced first-hand the changes that are occurring in and around the community;
4. work with established research and scientific projects (e.g. Natural Resources Canada-NRCAN, University of Victoria, Aurora Research Institute) to ensure that western science based academic research is accessed and shared with our community in meaningful, innovative and powerful ways (in written, spoken language and visually) – alongside traditional knowledge – that informs and enable our community to develop strategies and action plans. The project strives to integrate traditional and academic scientific ways of knowing in positive and respectful ways to empower engagement and dialogue in ongoing community planning and development processes tied to climate change;
5. train and employ a core group of local people to regularly measure, report and record information as part of a community-based monitoring program that will, overtime, inform local decision making and will support development of adaptation and mitigation projects.

## **Project description**

The TCCRP will engage community stakeholders (youth, elders, community organizations) in respectful, informative, participatory and people centered dialogue, exchange and training on climate change, monitoring key indicators of change, respecting Indigenous Knowledge, and sharing this learning in ways that empower and encourage participation and support of climate change adaptation and mitigation measures that are community driven.

School and education resources will be developed using a socio-constructivist inquiry and place-based approach engaging youth on climate change topics, monitoring, and leadership. Data for this project is by necessity both quantitative and qualitative in nature. A key project outcome is to develop innovative ways to represent the information in powerful and engaging ways and to share it within and beyond the community.

Data gathering will include:

- interviewing elders and resource users on various environmental changes that they note while on the land
- monitoring quantitative indicators at sampling sites in or near to the community
- reviewing historical information via literature and interviews
- sharing information and gathering further insights at community events

The TCCRP will train workers and negotiate protocols as suggested by Dustin Whalen, NR/Can, to periodically check on equipment that has been set up in the region for data collection and monitoring specific activities approved by the IRC and other agencies (refer to e-mail from Dustin Whalen, Physical Scientist, Natural Resources Canada, August 8, 2018).

### Historical Data Gathering Methods

The TCCRP will gather a baseline set of information and specific data that reflect an as historically accurate and complete background as possible, using four proposed sources:

- a) **Literature:** study existing literature - (e.g. *1974 Report of the Berger Inquiry*, and other scientific and/or historical records from the local region. Observations would capture the date, region and observed condition to allow comparison of this information with current data in some form.
- b) **Elders:** interview local elders who can share their recollection of specific conditions in the area from 10 to 60 years in the past, using school youth and guardians. Similar to the literature, this information would be compiled in a method to ensure utility for comparison and visualization.
- c) **Other Resource Users:** interviews with other resource users in community including hunters, trappers, plant gatherers to better understand what they learned from their elders versus how things are now. The project hopes to learn how people have adapted and been resilient in the past.
- d) **Scientists:** Connect with scientists and researchers who are already conducting arctic surveys (e.g. NRCan) and incorporate data already collected but not reported at the community level, in this program.

The TCCRP may develop and apply a similar approach as the LEO Network (Alaska based reporting systems for a changing environment <https://www.leonetnetwork.org/en/docs/about/about>) or an approach such as Arctic Borderland’s community based monitoring approach (<https://www.arcticborderlands.org/>). Either would be an interesting project to undertake in concert with other Inuvialuit communities and with the ILA or IRC.

### Engaging Community in Data Collection

An important objective of the TCCRP is to enable the community to monitor and report the impacts of climate change on the community and on the areas that are used by the Inuvialuit for traditional activities on which local peoples depend like hunting caribou, geese, polar bears, belugas, fishing (coney, herring, lake trout and whitefish), plant gathering, and travelling on the land. The program will endeavour to document local issues like erosion, flooding events and extreme weather events. Huntington and Fox (2005) highlight the need for collaborative approaches as effective in identifying and addressing the challenges and opportunities posed by climate change.

Group	Data Gathering Role(s)	Related Program Role
School Youth and Jr. Rangers	Monitoring Ice conditions and other indicators by training use of equipment and to gather and record accurate measurements over time	Learning about climate change adaptation and sharing their ideas through community events
Guardians - Ranger leaders	Observing, measuring and monitoring values in sensitive and high value areas (e.g. Husky Lake) and other particular aspects; gathering information a range of open sources and data; checking or maintaining monitoring equipment for other projects	Developing leadership/ community voice, capacity and vision for Tuktoyaktuk into the future
Elders	Providing traditional knowledge and observations; observing and monitoring particular aspects (to be determined)	Sharing anecdotal historical information on climate impacts, and their thoughts about climate change and the future, resilience strategies in the face of change.
Other Resource Users (via	Measuring and monitoring specific areas of interest like infrastructure impacts (HoT),	Share historical and current data and observations about impacts

community stakeholders like HTC, FJMC, Hamlet of Tuktoyaktuk)	wildlife (HTC) and fisheries (FJMC); observing changes on the land (HTC and others)	
Scientists <sup>1</sup>	Measuring and monitoring specific aspects of climate change (in collaboration with groups like Aurora Research Institute)	Share historical and current data
Recreational users (hunters, fishers)	Reporting observations about seasonal changes noted while participating in activities on the land and ice like fishing, hunting, camping or travelling in the region; a program to measure ice thickness by fishers may be introduced.	Users of the land are the best sources to identify what is changing from year to year and where changes like erosion or dry lakes-creeks are discovered.

### Data and Findings Sharing

Sharing the historical, current and projected future impacts of climate change is a key outcome of this project. There are two aspects to this: how the TCCRP supports convening events that include youth, adults and elders, and how data is shared to engage others. The TCCRP sees evolving ways of doing this which reflect collaborative approach that inspires community participants to share their findings, their stories with the larger community and capturing these perspectives in powerful ways that engage the community, school youth, and visitors to Tuktoyaktuk and the surrounding ISR lands. Raising community awareness about the impacts of increased use of local resources, water, sewer, diesel fuel alongside mitigation actions that individuals and the community can do is an essential aspect to sharing the knowledge of change.

The TCCRP will use graphs and charts to summarize quantitative data as well as maps, and digital/3D representations with video where possible. The TCCRP also envision use of quotes, anecdotes, stories and Inuvialuit art integrated in ways to capture and empower local communities, visitors and others who come in contact with this project.

Students will be supported to help conduct ethnographic interviews with elders and other resource users as a means for the project to gather qualitative climate monitoring information in an integrated multi-aged approach with assistance from other community stakeholders.

Qualitative data will be gathered using anecdotal information from interviews with elders and other resource users. The types of information TCCRP will seek out specifically relate to noted changes over time (in the past 10 to 60 years, as well as in current seasons):

- *Identification of invasive plants and insects*
- *Change in Animals' travel patterns on Ice*
- *Change in People's travel patterns on ice*
- *Monitoring extreme weather events*
- *Monitoring traditional harvesting of animals, birds, fish, and other cultural foods*
- *Reported and observed changes on the land due to erosion, lakes, creeks or bays drying up*

One proposed quantitative measure would be recording the leaf and bloom dates and yields for edible or other-use plants (roots) by establishing a series of plots. Climate monitoring for quantitative parameters will establish

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<sup>1</sup> currently engaged in measuring and monitoring projects for other agencies and government departments

study plots in and adjacent to Tuktoyaktuk using established methodologies for measuring these key parameters in the following sampling areas:

Indicators	Parameters	Site 1	Site 2	Site 3	Methodology/Rationale
Ice thickness	Meters (0.0000 m)	Tuktoyaktuk Harbour	Husky Lakes	West side of North Point outside Tuktoyaktuk harbour	Propose training fishermen, providing tools and GPS for location(s) to gather information over a wide range of plots. Wadhams (1997) notes risk of fixed location measurement
Permafrost depth	Active layer depth	Tuktoyaktuk Area	Husky Lakes	Peninsula	CALM Active Layer Protocol <a href="http://bit.ly/2EvbPXY">http://bit.ly/2EvbPXY</a>
Air Temperature	Degrees Celsius (00.0 C)	Tuktoyaktuk Airport	Husky Lakes	Peninsula	Direct measurements with weather station thermometers
Water Turbidity	NTU or FNRU	Tuktoyaktuk Harbour	Husky Lakes	Peninsula	<a href="#">EPA Method 180.1 or ISO 7027</a> (see e-mail from Dustin Whalen)
Plant leaf and bloom dates	Date (month-day-year)	Tuktoyaktuk Area	Husky Lakes	Peninsula	Established plots for recording, Plant species will include aqpiq (cloudberries), cranberries and others to be determined
Edible plant yields	% fruit set	Tuktoyaktuk Area	Husky Lakes	Peninsula	Using one of two methods outlined to quantify crop <a href="http://bit.ly/2oa6RJ9">http://bit.ly/2oa6RJ9</a>
Ice forming and thaw dates	Date (month-day-year)	Tuktoyaktuk Harbour	Husky Lakes	Peninsula	Direct observation
Distance from Land to Sea Ice	Km (0.000)	Tuktoyaktuk Harbour	-	Peninsula	Proposed: distance to open water as measured regularly through the winter season from a set of key points

The TCCRP recognizes that the specific indicators and specifics may change prior to the start of project monitoring. The TCCRP will meet with all community stakeholders (school, elders, local organizations listed above, Ila and IRC) in Tuktoyaktuk as soon as the grant for this program is announced to thoroughly review and discuss our program objectives, establish the steering committee and implementation process. TCCRP will select final indicators, parameters, sampling locations and sampling frequencies early in the start-up year. These will be reviewed annually in consultation with the Steering Committee including scientists already quantifying climate change parameters locally to ensure they meet the project's long-term objectives and adhere to project. This continuity will ensure the information gathered can contribute to scientific data. This will be done in communication with key partners and other scientists already quantifying climate change parameters locally. This includes finalizing sampling locations in the Hamlet, adjacent commissioner and Inuvialuit Settlement Region (ISR) areas.

We are exploring the potential for the installation and ongoing monitoring and maintenance of a weather station at the Mangilaluk School in Tuktoyaktuk, possibly in collaboration with the University of Victoria (refer to Appendices - e-mail from Edward Wiebe Feb 15 18) in the second year of the program.

A reference map of the region is included below.



*Reference Map showing Tuktoyaktuk and surrounding area (Blue circle)*

### Arctic Edge Communities Conference – Year 2

The TCCRP will support an **Arctic Edge Communities Conference** in Tuktoyaktuk in Fall 2019 to bring together the 6 Inuvialuit communities to share and discuss the TCCRP community-based monitoring program and experiences, and to share adaptation and mitigation priorities for our communities. We see this as an opportunity to learn together through knowledge sharing and support similar project work in adjacent communities. The TCCRP recognizes the need to explicitly apply leading and recommended best practices in managing, convening and communicating projects and related information in indigenous communities (Wilkinson et al., 2007). Huntington and Fox (2005) identify the urgency of supporting and involving indigenous peoples in the processes because for many communities the impacts of poverty, housing and cultural preservation alongside the daily and seasonal demands of a traditional lifestyle may preclude the level of engagement necessary to ensure strong local leadership and local insights inform the decision-making processes and priorities of adapting to and mitigating climate change impacts. This proposal upholds the need to draw on both scientific and traditional knowledge as the need to “double understand” (Randall Tetlich, Vuntut Gwitch’in leader from Old Crow, Yukon Territory – quoted in Huntington and Fox (2005)).

### **Indigenous youth engagement**

The TCCRP was designed with the understanding that monitoring climate indicators in our community together with learning and sharing these understandings is essential.

The TCCRP will engage school students and youth and provide opportunity for them to participate in:

- quantitative data gathering on the land with training to operate and monitor equipment; and,
- interviews with elders and other resource users, and sharing the findings with community members alongside the climate change education provided in conjunction with the Mangiluk School. We have consulted with the current science teacher and principal who both support this project.

A key outcome the TCCRP seeks to support is having youth and children receive the message directly from elders of how the Inuvialuit peoples have adapted and been resilient in the face of hardship and change in the past.

Working in concert with the ILA and Aurora College, the TCCRP proposes to train and employ up to four (4) youth in part time leadership roles for the Guardian program. They will support development and participate in the program and take part in meetings to share progress and exchange information and ideas on approaches and solutions with other community members. They will play a direct role in visioning ways to share and relay the data to community effectively.

### **Indigenous Knowledge component**

Ethnographic interviews with adults and other resource users will be a key aspect of the project along with guiding students and school staff on the basics of climate change science, local impacts and means to adapt and mitigate these through individual and community leadership. By engaging youth and school students directly in interviews, in sharing their perspectives and participating in gatherings the TCCRP will support intergenerational knowledge transfer between youth – elders and other resource users – as well as through community dialogues.

While all data will be managed as outlined below, a particular effort will be made at the outset to relay the need to distinguish knowledge and teachings that are considered sacred so that appropriate Inuvialuit processes are acknowledged and respected. This may mean some knowledge shared is not captured for analysis and reporting and where information is permitted to be gathered but not shared, it will be retained in the same manner as personal information under PIPEDA legislation. **Data management system**

TCC recognizes the needs to ensure PIPEDA legislation is met and proposes to use an online tool offered via AeroFS (<https://www.aerofs.com/>) to support use of a team server for core staff and consultants supporting this project. We are exploring options to either host a team server locally or renting via Amazon Web Services (AWS EC2) using their Canadian Server Region based in Montreal to address Canadian Data Sovereignty issues and possibly use AWS EC2 as a second server to unburden the network link back to TCC's local site for high speed access for remote team members. This will be resolved to satisfy INAC and any PIPEDA requirements in this project.

### Resource Person:

Jenn Parrott, Research Manager, Inuvialuit Regional Corporation 867-777-7000 /  
[jparrott@inuvialuit.com](mailto:jparrott@inuvialuit.com)

## APPENDICES

### Appendix A. Letter of Resolution – Tuktoyaktuk Community Corporation (TCC)



P.O. Box 350  
Tuktoyaktuk, NT X0E-1C0  
Phone: (867) 977-2004  
Fax: (867) 977-2504  
Email: [manager@tukcommunitycorp.com](mailto:manager@tukcommunitycorp.com)

February 13, 2018

To: Whom it may concern,

The Tuktoyaktuk Community Corporation held a Regular Board Meeting on January 25, 2018 during which time the following resolution was made:

MOTION#021/2018 was made to apply for \$150,000.00 for the Indigenous Community Based Climate Monitoring Program.

MOVE: Peter Nogasak

SECOND: Chukita Gruben

MOTION CARRIED.

If you require any additional information, please do not hesitate to contact the undersigned.

Respectfully,



Jocelyn Noksana  
Corporate Manager  
Tuktoyaktuk Community Corporation

Appendix B. Letter of Support – Hamlet of Tuktoyaktuk (HoT)



P.O. BOX 120  
TUKTOYAKTUK, NT X0E 1C0

TEL#: 867-977-2286  
FAX#: 867-977-2110

Thursday, February 08, 2018

Bill Beamish  
Tuktoyaktuk Community Corporation  
PO BOX 350  
Tuktoyaktuk, NT X0E1C0

**Re: Tuktoyaktuk Climate Monitoring Program**

Dear Mr. Beamish,

The Hamlet Council of Tuktoyaktuk fully supports your proposed Erosion and Climate Change Adaptation and Mitigation Project and application to the Indigenous Community Based Climate Monitoring Program for funding.

Tuktoyaktuk is witnessing first-hand the devastating effects of coastal erosion. We are currently participating in a study that will hopefully provide us a long-term solution of mitigating the future damage on the most impacted areas within the community. We are also undertaking a program to assist homeowners in the most impacted shoreline areas to relocate to more stable parcels of land.

Residents have noticed a change in the weather patterns such as more rain in the fall and warmer temperatures in winter with an increased accumulation of snow.

There is also more open water on the ocean now during winter when in the past it would be ice.

Your project proposal would provide very useful data that would assist us and other organizations in our region with long term planning and community development.

Please let me know if you require anything further.

Sincerely,

A handwritten signature in black ink, appearing to read 'Duncan Walker'.

Duncan Walker  
SAO

Appendix C. Letter of Support – Tuktoyaktuk Hunters & Trappers Committee (HTC)

*Tuktoyaktuk Hunters & Trappers Committee*



P.O. Box 286, Tuktoyaktuk, N.W.T. X0E 1C0 • Phone (867) 977-2457 • Fax (867) 977-2433

February 15, 2018

Bill Beamish  
Consultant/Project Manager  
Tuktoyaktuk Community Corporation  
Box 350  
Tuktoyaktuk, NT  
X0E-1C0

**RE: Tuktoyaktuk Climate Monitoring Program**

The Tuktoyaktuk Hunters and Trappers Committee held their regular board meeting on February 13, 2018 and are in full support of your project.

The THTC have knowledge in the climate changes with not only along the coast but with our wildlife as well. We have noticed the drastic changes in migration and the early spring thaws.

Your project with all the data that will be collected will allow us to determine what changes we may have to make in regards to the management of our quota species.

The inclusion of our youth to educate them on climate change on a year to year basis. Not only will they be educated and have the opportunity with projects and activities that measure and monitor local indicators.

If you require any additional information please contact our Resource Person, Darlene Gruben.

Sincerely,

Darlene Gruben  
Resource Person  
THTC

For

Charles A. Gruben  
President  
THTC

Appendix D. Letter of Support – Fisheries Joint Management Committee (FJMC)



February 15, 2018

**Bill Beamish**  
Tuktoyaktuk Community Corporation  
P.O. Box 350, Tuktoyaktuk NT, X0E 1C0

**Re: FJMC letter of support for Tuktoyaktuk Climate Monitoring Program**

Dear Mr. Beamish,

The Fisheries Joint Management Committee (FJMC) would like to offer support for the Tuktoyaktuk Climate Monitoring Program. The FJMC is focused on the co-management of fish and marine mammals within the Inuvialuit Settlement Region (ISR), and we see potential for this program to improve our understanding of how aquatic ecosystems and fish habitat may be impacted by climate change in the region. We are especially interested in how this program can contribute to the Inuvik Tuktoyatuk Highway monitoring initiatives that the FJMC is developing in partnership with the local Hunters and Trappers Committees (HTCs). We hope to be able to collaborate with you to learn from your program, share data, and to update you with our ongoing monitoring activities. Thank you for this opportunity to work together, it will assist in the current and future management of resources for the Inuvialuit, and involve youth and community members in the process. If there are any questions or concerns, please contact Vanessa Cunningham at the FJMC Inuvik office (867) 777-2828.

Sincerely,



Vanessa Cunningham  
On behalf of John Noksana Jr.,  
Vice-Chair, Fisheries Joint Management Committee

## Appendix E. E-Mail from Dustin Whalen, Physical Scientist, Natural Resources Canada (NRCan)

From: Whalen, Dustin (NRCan/RNCan)  
Sent: Thursday, February 8, 21:50  
Subject: Re: Tuktoyaktuk Application for Indigenous Community Based Climate Monitoring Program Grant  
To: Bill Beamish

Hi Bill,

Yes of course I remember you, thank you for the email. This is a wonderful idea. I like and have always been interested in increasing awareness of climate driven issues in the North for quite some time. You may have seen the TV spots last fall on CBC and CTV that were centered around the coastal changes issues in Tuktoyaktuk and surrounding area. These were great base level communication tools and a good introduction for the rest of the country. However, I don't think it really captured the detail that is necessary for the Tuk community to really understand the changes that they can already see. I think community-based awareness combined with community-based monitoring is a fabulous idea and is exactly what Tuktoyaktuk needs and can accomplish. In my mind there is no other community that is more affected by climate change in this country than Tuktoyaktuk, with that I think you are in a perfect position to capture this change right in your own backyard.

I would be more than happy and proud to be a part of this endeavor however you see fit. Right now, as I write this note I can think of numerous things that can be done to help monitor coastal and landscape change for and by the community. For instance, we have a time-lapse camera, and temperature cables on Tuk Island, a protocol to check those periodically would really help. I think erosion could be monitored that way through simple observations, but over time provide very useful results. I can see a community based monitoring program based on water chemistry as well? What is the effect to the water column and subsequent marine life from climate change (increased storms and erosion). Setting up a water sampling regime would provide excellent context to these changes in the water. Then simple high school chemistry techniques can be used to analysis the data in the lab (probably right at the school). Also, from a coastal hazard to community infrastructure standpoint, I think the use of drones both as a mapping tool and monitoring tool would be amazing. I wonder if you are considering new technology training as part of this monitoring program? I heard there are already initiatives a foot to make this training and experience happen in the ISR. Or how about setting up a mini observatory that measures air temperature, wind speed and direction, precipitation, and even ocean water chemistry. This is something we have done at East Whitefish (as part of the beluga whale monitoring program with DFO and FJMC). I will stop there, but have lots of ideas (from a coastal and storm surge flooding standpoint) that I think would be excellent to establish as monitoring protocols in Tuk.

You are absolutely right, there is so much information out there and new projects happening all the time. A way to gather this, then a way to disseminate around the community in a way that makes sense to all would be great! I can only speak for myself, but even given the best intentions there is only so much time and often not all information is conveyed to all of the appropriate stakeholders, including the youth! TK in my mind and my research is an untapped but very necessary resource when dealing with changes of this magnitude, I am happy to see this part of your proposal.

What a great idea to share experiences with a classroom down south. Simple things like harbour ice thickness's active layer thicknesses, even temperature and precipitation extremes would be so neat for that BC class room to see. I know my own son (in grade 5) is blown away when I compare what we see in our backyard (in Nova Scotia) to what a typical Tuktoyaktuk backyard is like. At that age it's all about observations, and in Tuk you can not only see the change, you can hear it...as the ice breaks up early, as the cliff on Tuk island slumps off, as the waves crash over North Spit and Pokiak Spits. If the students could share these visual and audio experiences I think that would be great and serve as a way to archive environmental conditions.

The background summary is excellent, I have not heard of the watchmen programs, but sounds like a great idea. I would only add one bit to the section about historical erosion (i.e. 1974 Report of the Berger Inquiry). This is great and shows that erosion has been a problem for quite some time. However, I would add now that climate driven changes (warmer air temperatures, increased storm intensity) has accelerated the rates of erosion in Tuk and across the ISR, such that the coastal erosion happening today is greater than it has even been in recorded history.

Maybe I will stop there, but as you can see I have lots to say and passionate about Tuk and this work. I would be happy to be a part of this in any capacity.

All the best,  
Dustin

**Vancouver Island School Based Weather Station•**

**BB Question 1: A description of your school weather program and how it is typically run in a school?**

The Vancouver Island School-Based Weather Station Network began in 2005 as a science outreach effort by faculty (Andrew Weaver) and myself in the School of Earth and Ocean Sciences at UVic. We offered a weather station and related online resources to local schools for free. The schools (and school districts) were only required to help us mount the equipment on the schools and to provide power and data connections for a computer at the school. The weather station is solar powered and communicates with a receiver inside the school wirelessly so there is no need for power or data lines to be run out to the station itself. The computer in the school logs data from the receiver and relays it to our central server here at UVic. Since 2005 we have managed to install approximately 150 weather stations on Vancouver Island.

I manage and maintain the entire network which is a challenge especially since I am not allowed to spend all of my time on it. However, maintaining one station at a school is not difficult, requires few tools and little technological sophistication.

The other, very important, part of the of the project is the database and web server infrastructure. Over the years I have built this up from basic (mostly free) software tools. It is entirely custom built. The system operates on two dedicated servers here at UVic and makes use of some other resources in our department to help ensure there are redundant copies of the data and so on.

For the most part this is as far as we go in terms of interaction with the schools. As part of the project a teacher was hired to write and organize curriculum appropriate material that we offer for free to the schools involved. We also offer, again for free, the opportunity to have me visit with one or more classes of students and give a presentation about weather and climate and about the weather stations we have on the schools. I do a few of these visits every year and sometimes host a school here at UVic for a field trip.

We get little voluntary feedback from schools. I do know that some have taken ownership of their weather station and use it frequently. Others seem to forget it's there, probably as teachers and administrators change from time to time.

**BB Question 2: What equipment you are using and what the cost of it is to purchase and to maintain it annually?**

We have standardised on the Davis Vantage Pro 2 Plus weather station. This is an off-the-shelf advanced amateur weather station with a good reputation. They have a number of options available including more sophisticated devices. Here's a link.

<https://www.davisnet.com/product/wireless-vantage-pro2-plus-including-uv-solar-radiation-sensors/>

However, as Tuktoyaktuk is above the Arctic Circle the solar power option for the weather station won't be suitable all year round. In your case you will have to use the wired version. This though does allow you to try the heated rain gauge (if desired). The stations cannot measure frozen precipitation. They only measure liquid water captured in the funnel of the rain gauge.

<https://www.davisnet.com/product/cabled-vantage-pro2-plus-with-standard-radiation-shield/>

It typically costs us about \$1000 each to buy and install the stations (we have negotiated a discount with the supplier). Note that part of the work to install the station is done by the school district (providing and attaching a mast on the school for us to use for the most part). A piece of pipe attached to the roof is really all that is needed. I don't know what cost they would assign to this. Several hours of staff and equipment time at least.

In terms of maintenance we have adopted a failure first protocol. It would be better to have a regular schedule of maintenance and replacement to minimize downtime and ensure that everything is working as well as possible. However, this would require one or more full time employees and we don't have the budget for it. So, instead we simply install the stations and then ignore them until there is a need to make a repair. I try to bundle repairs into regions and visit as many sites as possible in one trip.

The stations have proven to be, on average, quite reliable. Many of them have gone years between problems that require a site visit. The stations outside and in do have backup batteries that require occasional replacement as well.

The weather stations measure the usual meteorological variables with reasonable precision for the money. The Vantage Pro 2 Plus stations measure temperature, humidity, wind speed, wind direction, air pressure, (liquid) precipitation amount, solar power (all sky insolation), and UV index.

Our project logs the data each minute.

Davis Instruments does provide tools to log and store the data, but I don't find their offerings adequate for the purposes of this project.

So, annual maintenance costs are minimal. A few hours of time per year and new parts when needed. Having said that, do not assume that this station can just be put up and forgotten. It will fail at some point.

**BB Question 3: Would UVic be interested in adding Tuktoyaktuk to your network of schools...this could be an interesting learning opportunity as according to one researcher, Dustin Whalen at NRCAN, Tuktoyaktuk is the community that is most impacted by climate change in Canada.**

I would love to include Tuktoyaktuk to our network. It would be a fantastic learning opportunity for everyone on Vancouver Island as well for your community. From my perspective it is relatively easily done. If you can organise acquiring, installing, and maintaining a station on your end I can provide the

tools we've developed on our database and website for free. I am happy to further provide my experience with respect to station siting, station maintenance and repair, and in general the use of this particular station for free as well.

What we provide through our project though is a real-time weather monitoring system. Using it to launch and facilitate discussions on climate and climate change is certainly one of our goals and this matches your comment above. Note though, that this project and network can't be thought of as a climate monitoring system. Measure climate takes a different standard of instrumentation, siting, and above all, time. It is certainly possible to use a weather station like those in our project to show what is happening now in Tuktoyaktuk. Information about climate and climate change from the projects that include those can be incorporated in communication about the weather being observed by one or more stations.

I hope I've addressed your questions adequately. I look forward to continuing the discussion.

Ed

## Appendix G. Background on the Tuktoyaktuk Community Climate Resilience Project (TCCRP)

### Background

On November 15, 2017, the all-season Inuvik-Tuktoyaktuk Highway was officially opened to the public. This new road will provide access to the Arctic Ocean as well as to the traditional lands of the Inuvialuit which, apart from winter access via a temporary winter ice road, have been inaccessible to the general public. In anticipation of this change a *Tuktoyaktuk Strategic Directions and Action Plan* was completed in 2017. This Plan identified the need for an Erosion and Climate Change Adaptation and Mitigation Program to be developed for the community. Tuktoyaktuk is the most northern community on mainland Canada. According to the 2016 Canada Census, it has a population of 895 people, 815 of whom are Inuvialuit.

The local government, Hamlet of Tuktoyaktuk, is concerned about the impacts of climate change which include erosion, flooding, damage to existing infrastructure, displacement of housing and other issues. In 2017 the Hamlet updated its Community Plan Bylaw and Zoning Bylaw to include provisions that restrict development and issuance of new building permits and identified areas for relocation of homes to higher elevations within the municipal boundary. Other impacts of climate change include the loss of protective islands offshore, islands that reduce storm surge damage and enable the harbour to be used for traditional activities. Also, the Government of Northwest Territories (GNWT) is coordinating a project with the Hamlet and the Inuvialuit Land Administration to investigate options for protecting exposed areas of the community from further erosion. An RFP has been issued to study this and make mitigation recommendations.

Temperature fluctuations and proximity to open water are noted changes in the environment.

In addition to changes within the community, reports of erosion and changes to the Inuvialuit Settlement Region (ISR) lands have been noted in historic documents including the *1974 Report of the Berger Inquiry* and more recently as observations by community members travelling on the land for traditional activities like hunting caribou, geese, polar bear, belugas and fishing as well as plant gathering of roots and stems.

In many indigenous communities, Guardian programs have been established to train and equip local people to observe, document and report on changes to the land and activities in sensitive areas. Guardians are also trained to work with the community and with elders to collect current and historical data, measure and document information about the impacts of climate change and to monitor local and regional strategies that are implemented to adapt to or mitigate impacts. Locally, some monitoring is done incrementally by the Tuktoyaktuk Hunters and Trappers Committee (HTC) and by the Fisheries Joint Management Committee (FJMC). However, there is no Guardian Program or organized community-based climate monitoring program in Tuktoyaktuk and little if any coordinated efforts to relay in clear and meaningful ways the findings of many scientific studies that occur within and near the community.

In October 2017 the Auditor General of Canada issued a report to the Northwest Territories Legislative Assembly on ***Climate Change in the Northwest Territories***. In this report the Auditor General cited examples of reported 'significant and widespread' climate change impacts that include: reduction of sea ice; permafrost thawing; ice forming later in the fall and thinner ice; increased variation in precipitation; and, more frequent extreme weather events. The report also noted that: ***"Responding to the impacts of climate change is a shared responsibility. It requires partnerships within and across governments; with non-governmental organizations, including industry; and with the public."*** (background #5)

The focus of the Audit was to examine if and how the GNWT is fulfilling its commitment to reduce territorial GHG emissions and to adapt to climate change impacts which ... *“is affecting wildlife, landscape, and critical infrastructure, as well as residents’ food and fuel security, their traditional economy, and their ability to get in and out of their communities.”* (#10).

While the Auditor General’s report acknowledged that the GNWT is working to develop a *Climate Change Strategic Framework* it concluded that overall *“it did not fulfill its leadership role and meet its commitments on climate change.”* (#14), and that... *“existing climate change information and analysis was not shared, and that this was a barrier to adaptation.”* (#35).

#### [INAC Indigenous Community Based Climate Monitoring Program](#)

In November 2017, Indigenous communities from across Canada participated in a symposium organized by the Centre for Indigenous Environmental Resources (CIER). The symposium was held in Winnipeg, Manitoba, and its focus was on the current state of Indigenous Based Climate Monitoring. As reported by INAC, in the background to the Indigenous Community-Based Climate Monitoring application, National Indigenous Organizations (NIOs) identified the need to:

- support Indigenous peoples in monitoring the effects of climate change in their communities
- connect Indigenous Knowledge with academic science-based climate information to better inform adaptation actions.

## Appendix H. School Engagement Plan (Draft to be discussed with the DEA and Mangilaluk School)

### TCCRP Student Climate Change Action Program

This program will support engagement of school children and youth at the local Mangilaluk School. We see integration at all grade levels with specific links across curriculum. The intent is to support teachers in engaging curriculum in an experiential, hands-on, place-based approach that is student centered, relevant, inquiry based and geared to project-based participation “on the land”. Engagement is intended to cut across curricular topics and grades (See School Based Engagement framework below for further detail).

Specific content and approaches would be developed in collaboration with teachers and administration at Mangilaluk School, using NWT Aboriginal foundation documents Dene Kede and Inuuqatigiit documents. Essential to this work is an approach is to use the existing educational frameworks that integrate Scientific Literacy with the knowledge, skills and attitudes of both Indigenous and Western science. We see strong fits with explicitly using the four primary steps of experiential learning which include Experiential learning, concrete experiences, reflective observation, and abstract conceptualization.

The program for schools is intended to support climate change education, leadership and applied sciences to support student Science Technology Engineering and Math (STEM) learning and skills – we recognize the critical need to motivate student participation not only through science itself but ensuring a focus on what Keith Elliott (2012) refers to as hands-on learning that has personal meaning and gives students “a measure of autonomy and challenge”.

We envision student engagement in learning about:

- i. basic science behind climate change including human activity causes
- ii. powerful stories of change, leadership, resilience and solutions being led by youth and indigenous people globally
- iii. practical actions at home and in community – in class contests
- iv. sharing their insights and learning through community events and use of different media

### *School Program Work Plan Draft*

1. Develop Specific Program Objectives, Annual Goals and Program Scope, Criteria
2. Identify highest value course and curriculum fits
3. Define communications model and engagement approaches to ensure good program uptake

Include this approach language into documents and framework

Invitation for communications lead to support Kick-off and/or Fall conference event

4. Draft Program Framework and proposed map of activities for 2018-2019
5. Draft engagement milestones for 2018-2019

Contact	Date	Location
Introductory meeting with teachers and admin	June 2018	Tuktoyaktuk
Program Resource Development update	August 2018	Online
Coordinate Program kickoff at school	Sept 2018	Online
Program Launch with teachers and admin	October 2018	Tuktoyaktuk
Program Review (first semester)	December 2018	Online

Program check-in/ update	January 2019	Tuktoyaktuk
Program check-in/ update	February 2019	Online
Program check-in/ update – coordinate upcoming event	March 2019	Online
Program Event and check-in with teachers and admin	April 2019	Tuktoyaktuk
Assessment and next development stage meeting	June 2019	Tuktoyaktuk

6. Identify key related resources
7. Draft Program materials and supporting documents
  - Grade specific curriculum links
  - Links to related online resources
  - Print/Online Resources
    - Program overview document
    - Program specific approaches by grade level
    - Grade specific activities for students/teachers
    - Data gathering methods and resources
    - Assessment rubrics
  - Program reflection and feedback form
7. Review Materials and ensure key criteria are identified and resources in place
8. Provide oversight and support for teachers and admin
9. Support Event in community and help co-ordinate resources and added value content
10. Resource and Program review and revision cycle

*Draft School Based Engagement Framework by grade*

Grade Levels	Participation	Course Focus
K to 3	<ul style="list-style-type: none"> <li>• Students learn about program through presentations by Guardian/ Gr. 8 to 12 students</li> <li>• Students create art to reflect program outcomes</li> <li>• Students learn about climate change actions they can take with a focus on positive</li> </ul>	Arts Education Science Language Math
4 to 8	<ul style="list-style-type: none"> <li>• Students learn about program through presentation by Guardian/Gr. 8 to 12 students</li> <li>• Students write about/ create art-visual graphics about program outcomes</li> <li>• Students explore and respond to data collected and presented</li> <li>• Students learn about climate change solutions and specific actions they can take at home and in their community</li> </ul>	Science Math English Language Literacy with Information and Communications Technology Northern Studies Social Studies
9 to 12	<p>Students participate similarly to Grade 4 to 8 students            Students engage directly in monitoring studies near the community            Students apply Math and Science through Experiential Science 10-20  <i>The program will explore the possibilities of creating a Career and Technology Services Unit or specialization course to support students in gaining skills and support College or University degree studies specializing in areas related to this Program – Community and Cultural study; Northern Studies; Climate Change science; Ecosystem studies; Engineering; and Renewable Energy</i></p>	<b>Science, Experiential Science 10-20, Math</b> English Language, Literacy Information and Communications, Technology, Northern Studies, Social Studies



## Bibliography

Community of Tuktoyaktuk, The Wildlife Management Advisory Council (NWT) and The Joint Secretariat (2008). Tuktoyaktuk Community Conservation Plan, April

Environment and Climate Change Canada (2017). Pan-Canadian Framework on Clean Growth and Climate Change – Canada’s plan to address climate change and grow the economy, 86pp.

Huntington, H., and Fox, S. (2005). The changing arctic: Indigenous perspectives, p.61-98, in: Arctic Climate Impact Assessment - Scientific Report, ACIA, 1046 pp.

<http://www.acia.uaf.edu/pages/scientific.html>

Parmesan, C. (2006). Ecological and evolutionary responses to recent climate change. *Annual Review of Ecology, Evolution, and Systematics* 37: 637-669.

Peers, M.J.L. (2017). Predicting the fitness effects of climate change on Snowshoe Hares, *InfoNorth, Arctic*, **70(4)**: p.430-434.

Raygorodetsky, Gleb. (2017). *The Archipelago of Hope – Wisdom and Resilience from the Edge of Climate Change*, Pegasus books, NY

Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F., et al. 2004. Extinction risks from climate change. *Nature* 427(6970): 145-148.

<https://doi.org/10.1038/nature02121>

Wilkinson, Kim C., Susan G., and Burch, William R. (2007). *Other Voices, Other Ways, Better Practices. Bridging Local and Professional Environmental Knowledge*. Yale F&ES Publication Series, 14, p.58

<http://environment.research.yale.edu/publication-series/documents/downloads/a-g/FES-Report-14.pdf>

Wadhams (1997). Ice thickness in the Arctic Ocean: The statistical reliability of experimental data. *J. Geophysical Research*, Vol. 102 (No. C13): 27,951-27,959