ᓄᓇᕘᒥ ᐊᕙᑎᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔨᖏᑦᑎᒍᑦ ᑐᒃᓯᖅᑑᑦ ᕿᒥᕐᕈᔭᒃᓴᖅ #125500

Predicting environmental health risk from radioactivity in the Canadian Arctic

ᑐᒃᓯᖅᑑᑕᐅᔪᖅ ᖃᓄᐃᑦᑑᓂᖓ:	New
ᐱᓕᕆᐊᕆᔭᐅᔪᒪᔫᑉ ᖃᓄᐃᑦᑑᓂᖓ:	Scientific Research
ᐅᓪᓗᖓ ᑐᒃᓯᖅᑑᑎᓕᐊᖑᓂᐅᑉ:	1/15/2020 4:41:40 PM
Period of operation:	from 0001-01-01 to 0001-01-01
ᑲᔪᓯᒃᑲᐃᓯᐅᓂᐊᕿᓯᒋᔭᐅᔪᑦ:	from 0001-01-01 to 0001-01-01
ᐱᓕᕆᐊᖃᕈᒪᔪᖅ:	Dr. Lars Brinkmann Canadian Nuclear Laboratories 286 Plant Road Chalk River Ontario K0J 1J0 Canada ᐅᖄᓚᐅᑏᑦ: (000)000-0000, ᓯᑲᔪᒃᑯᑦ:

ᑐᓴᐅᒪᓂᖅᓴᖅ

ᖃᓄᐃᑦᑐᑎᒃ ᐱᓕᕆᔨᖃᑎᒌᖃᕆᔨᒋᑦᑎᒃ

ᖃᓂᒋᔭᐅᑎᑐᑦ: Project background: Radioisotopes are toxic substances that are released into the environment by industrial activities, nuclear waste upgrading and disposal, nuclear weapons tests and nuclear accidents, and are transported to the Arctic on ocean currents and the atmosphere. Radioisotopes can be very similar to substances that are important to living organisms, including water and certain nutrients. Therefore radioisotopes can accumulate to high levels in fish and plants that are consumed by humans and large animals. The recent Fukushima accident, which released radioactive contaminants into the Pacific Ocean, has demonstrated that our understanding of radiological risk assessment in complex marine systems is generally very limited. This, and prospects of increasing industrial expansion and human habitation along with dramatic effects of climate change on Arctic landscapes and Ocean environments, has renewed interest in radiological risk assessments in the Arctic. In order to fill knowledge gaps of radiological risk to humans and wildlife in the Arctic, this project focuses on the environmental fate and transfer of radioisotopes commonly released to the environment from historic weapons tests, submarine accidents, waste disposal, nuclear accidents and nuclear power reactors: cesium, strontium and hydrogen. Radioactive cesium and strontium are persistent contaminants released to the environment as a consequence of nuclear accidents and weapon tests. Cesium and strontium are known to accumulate in fish, particularly in freshwater environments. However, very little is known about the ecological fate of these radioisotopes in fishes such as migratory Arctic char, which spend time in both near-shore Ocean and freshwater habitats in the Arctic, and are an important food source for people and animals. Radioactive hydrogen, known as tritium, was historically released during the weapon tests and is also released in small quantities, albeit highly regulated and monitored, by nuclear reactors of Canadian design. It becomes part of water molecules and disperses with atmospheric water vapour. Precipitation in the form of snow and rain deposit radioactive water on the land, from where it is taken up by plants and accumulated in foliage and fruits. Models describing this process to predict radiological risks to people have been shown to underestimate the accumulation of tritium in plants considerably, and also focus primarily on agricultural products grown in temperate regions. Very little is known about tritium accumulation in wild plants of northern regions, whose fruits are an important food source for people and animals. The project will consist of two component studies at two sites in Nunavut, Kugluktuk and CFS Alert, representing the southern and high northern Arctic, respectively, and will address two central research questions: 1) What will be the risk of fish contamination from a nuclear accident in near-shore ocean food webs? 2) What will be the risk of contamination of plant life due to atmospheric releases of radioactive water from nuclear reactors? These component studies are planned as follows. Study 1: Developing a risk assessment model for Arctic charr in near-shore Arctic Ocean food webs. The Arctic Ocean study components will focus on Arctic char, as this species is an important food source for people. Char also migrate between ocean and freshwater and are therefore at higher risk to be exposed to accidental releases in both ocean and inland situations. Specific objectives of this study are: 1) To provide an analysis of the feeding ecology of arctic char to determine exposure pathways of radioactive elements cesium and strontium to char through diet and water. 2) To measure concentrations of cesium and strontium in char and their diet. 3) To develop a dynamic model by which risk from a radiological release anywhere in the Arctic Ocean can be predicted for char. To meet these objectives we are planning a sampling campaign for 2016-2017. We will seek assistance from communities with the collection of char. The samples of char we require can be derived from wastes from subsistence catches: We require and accurate measurement of live fish length and weight, and only need 1) stomach contents and internal organs, 2) skin samples, 3) the head and backbone with attached scraps of muscle tissue for our further analyses. The edible filets are not needed for our analyses and can stay with the community. For further sampling we seek to employ a local guide with boat to help with collecting marine organisms, such as crabs, shrimp and

molluscs. Study 2: Revision of Canadian regulatory models for organic tritium in plants. The study investigating tritium accumulation by land plants will focus on perennial fruit-bearing plants, such as blueberry and cranberry, grasses and deciduous trees. These plants were chose as they represent important food sources for people and grazing and browsing animals. Specific objectives of this study are: 1) To determine the concentrations of tritium in organic tissues of the foliage and fruits of plants. 2) To examine the relationship between tritium concentrations between atmospheric water, soil water and free plant water. 3) To examine the transfer of tritium from senescent plant material to soil matter. 4) To develop an empirical model describing these processes for risk assessment purposes. Sampling for this study is planned for 2016-2017 and will encompass collection of air moisture, precipitation, surface water, soil water, soil material, fresh plant leaves, fruits and roots. Air moisture will be collected using specialized apparatus, which pumps air through a drying medium to trap water. Plant samples will include fruit-bearing woody plants and grasses. For woody plants only fruits and fresh foliage will be collected. Grasses will be collected whole, including above-ground and below-ground parts. Soil samples will be collected using a coring technique, which produces a 10cm-deep plug. Soil moisture will be initially measured with a probe and subsequently isolated quantitatively from soil core samples. The tritium concentrations will be measured in the laboratory for all materials isolated. Outlook and Deliverables: This two year project will result in a number of mathematical models and parameters for use in risk assessments for radioactive releases in the Canadian Arctic. Analyses performed to meet the project objectives will produce supporting data that is useful for future studies in wide-ranging contexts, including arctic food-web ecology, atmospheric processes and climate change. Results of this research project will be published as a series of articles in peer-reviewed scientific journals. Copies of published articles will be made available to the Nunavut government and individual communities and a presentation could be made to an appropriate group.

ᐅᐃᐦᑎᑐᑦ: Not Available

ᐃᓄᒃᑎᑐᑦ: Not Available

Inuinnaqtun: Not Available

Personnel

Personnel on site: 3

Days on site: 28

Total Person days: 84

Operations Phase: from 2016-06-24 to 2017-12-24

ᐱᓕᕆᐊᕆᔭᐅᓂᐊᖅᑐᑦ

ᓇᒥ	ᖃᓄᐃᑦᑑᒥᑦ ᐱᓕᕆᐊᖃᕐᓂᐊᖅᐸ	ᑭᒃᑯᑦ ᓄᓇᖁᑖᓂ	ᑐᓴᐅᒪᔭᒃᓴᑦ ᓄᓇᐅᑉ ᖃᓄᖅ ᐊᑐᖓᐅᓚᐅᖅᓯᒪᔭᕆᐊᖕᖓᓂᒃ	ᐃᑦᓴᕐᓂᑕᖅᑲᕐᕕᐅᕙᓚᐅᖅᐸ ᐃᓄᒡᓄᑦ ᓇᔪᖅᑕᐅᖃᑦᑕᕐᓂᑰᕙᓗ ᑕᐃᑦᓯᒪᓂᑐᖃᐅᓕᖅᑐᖅ	ᖃᓂᖕᓂᖅᐹᖅ ᓄᓇᓕᒥᔭᐅᔪᖅ ᐊᒻᒪᓗ ᓴᐳᒻᒥᒃᓰᕕᐅᕙᓗ ᓯᓇᓄᑦ
Study area around Kugluktuk	Researching	Marine	Unknown	Unknown	Kugluktutk
Study area around Alert	Researching	Crown	Unknown	Unknown	CFB Alert
Study area around Kugluktuk	Researching	Commissioners	Community of Kugluktuk	Unknown	Withing Community of Kugluktuk and out to Kugluk Territorial Park.

ᓄᓇᓕᐅᑉ ᐃᓚᐅᖃᑕᐅᓂᖓ ᓄᓇᓖᓪᓗ ᐊᕕᒃᑐᖅᓯᒪᐅᕐᓂᖓᓄᑦ ᐃᑲᔪᑕᐅᔪᓐᓇᖅᑐᑦ

ᓄᓇᓕᒋᔭᖅ	ᐊᑏᑦ	ᑲᑐᔾᔨᐊᖅᑎᒌᒋᔭᖅ	ᖃᖓᒍ ᑐᓴᖅᑎᑕᐅᓚᐅᕆᐊᖕᒋᓐᓂᒃ
Information is not available			

ᓚᐃᓴᓐᓰᑦ ᐱᒍᓐᓇᐅᑏ ᐊᖏᖅᑕᐅᓯᒪᔪᑦ

ᓇᒦᒥᐊᖕᒥᓐᓂᒃ ᐱᓕᕆᐊᕆᕝᕕᐅᓂᐊᖅᑐᑦ ᑎᑎᕋᕐᓗᒋᑦ:

Kitikmeot
North Baffin

ᓚᐃᓴᓐᓰᑦ ᐱᒍᓐᓇᐅᑏ ᐊᖏᖅᑕᐅᓯᒪᔪᑦ

ᒐᕙᒪᒋᔭᐅᔫᑉ ᐊᕕᒃᑐᖅᓯᒪᐅᕐᓂᖓᓐᓂ ᒪᓕᒐᕐᓅᖓᔪᓂᒃ ᐱᕐᑯᔭᕐᓅᖓᔪᓂᒡᓗ ᑲᒪᔩᑦ ᐱᔪᓐᓇᐅᑎᑖᕈᑎᓂᒃ ᓚᐃᓴᓐᓯᓄᓪᓗ ᑲᔪᓯᒃᑲᐃᔩᑦ	ᖃᓄᐃᑦᑐᓪᓚᓇᐅᕙ ᓚᐃᓴᓐᓯᑖᕈᑕᐅᔪᖅ ᐱᔪᓐᓇᐅᑎᑖᕈᑕᐅᔪᖅ ᐊᖏᖅᑕᐅᔪᕐᓘᓐᓃᑦ	ᒫᓐᓇ ᖃᓄᐃᓕᖓᕙ	ᐅᓪᓗᒥ ᑐᓂᔭᖅ/ ᑐᒃᓯᖅᑑᑕᐅᓚᐅᖅᓯᒪᔪᖅ	ᑭᒡᓕᖃᕐᕕᖓ
ᑲᓇᑕᒥ ᐃᖃᓗᓕᕆᔩᑦ ᑕᕆᐅᓕᕆᔩᓪᓗ	Scientific Research Licence	Not Yet Applied		
ᓄᓇᕗᒥ ᖃᐅᔨᓴᖅᑐᓕᕆᔨᒃᑯᑦ	Scientific Research Licence	Not Yet Applied		

Project transportation types

Transportation Type	ᓱᓇᒧᑦ ᐊᑐᒐᐅᓂᐊᖅᐸ	Length of Use
Air	To Kugluktuk and CFB Alert	
Water	Boat to collect marine organisms (crabs, shrimps, mollusks)	

Project accomodation types

ᓄᓇᓕᒥᔪᖅ

ᐊᑐᒐᐅᓂᐊᖅᑐᖅ

ᐱᕐᑯᑦ ᐊᖏᔪᖅ ᐊᑐᖅᑕᐅᓂᐅᕴᔪᖅ ᐃᓚᖃᓯᐅᑎᓗᒋᑦ ᐃᑰᑕᐃᑦ, ᒥᓪᓗᐊᕈᑏᑦ, ᖃᖓᑕᓲᖅ, ᓄᓇᓯᐅᑦ ᐊᓯᖏᓪᓗ

ᐊᖏᔪᖅ ᐱᕐᑯᑦ ᐊᑐᒐᐅᓂᐊᖅᑐᖅ ᖃᓄᐃᑦᑑᓂᖓ	ᖃᑦᓯᐅᕙᑦ	ᐊᖏᓂᖏᑦ - ᐳᖅᑐᓂᖏᑦ	ᓱᓇᒧᑦ ᐊᑐᒐᐅᓂᐊᖅᐸ
Scientific apparatus	1	100kg	To collect water samples from air, soil core sampling, plankton net and hand-held nets to collect marine invertebrates, beach seine.

ᑎᑎᕋᐅᓯᙵᓗᒍ ᐅᖅᓱᒃᓴᐃᑦ ᐊᑦᑕᓇᖅᑐᖅᑕᕇᓪᓗ ᐊᑐᖅᑕᐅᓂᐊᕐᓂᖏᑦ

ᓱᓇᒧᑦ ᐅᖅᓱᒃᓴᑦᒋᐊᖅ ᐊᑐᒐᐅᓂᐊᖅᐸ	ᖃᓄᐃᑦᑐᓪᓚᙵᐅᕙ ᐅᖅᓱᒃᓴᑦᒋᐊᖅ	ᖃᑦᓯᐅᕙᑦ ᐅᖅᓱᒃᓴᖃᐅᑏᑦ	ᑰᒃᓴᐅᒃ ᐃᒪᖃᖅᑎᒋᔫᓇᕐᓂᖓ	ᑲᑎᓪᓗᒍ	ᑰᒃᓴᐃᑦ ᐊᒥᓲᓂᖏᑦ	ᓱᓇᒧᑦ ᐊᑐᒐᐅᓂᐊᖅᐸ
Gasoline	fuel	3	20	60	Liters	Transportation

ᐃᒪᖅ ᐊᑐᖅᑕᐅᔾᒫᖅᑐᖅ

ᐅᓪᓗ ᑕᒫᖅ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᖅ	ᖃᓄᖅ ᐃᒥᖅᑕᖃᑦᑕᕐᓂᐊᖅᐸᑦ	ᓇᑭᑦ ᐃᒥᖅᑕᖃᑦᑕᕐᓂᐊᖅᐸᑦ
0		

ᐊᑲᑕᔪᑦ

ᐊᑲᑕᔪᓪᓗᓂᐊᕐᓂᖅ

ᐱᓕᓇᐊᓇᔨᐅᔾᔨᒪᔾᔪᒍᑦ ᐱᓕᓇᐊᓇᔨᐅᓂᐊᖅᑐᖅ	ᖃᓄᐅᐃᑦᑐᖅ ᐊᑲᑕᔪᖅ	ᖃᓄᐅᑎᒋ ᐊᑲᑕᔪᑦ ᓴᖅᑭᐊᓂᐊᖅᑐᓇᔨᐅᕐᑦ	ᖃᓄᐅᖅ ᐊᑲᑕᖅᑕᐅᓂᐊᖅᐸ	ᓴᓗᒪᖅᓴᐅᑎᑲᓴᑲᖏᓂᐅᓂᐊᖅᑐᑦ
Berm	ᐊᑲᑕᔪᑦ ᐃᔪᐊᓪᑕᑕᐅᔾᔨᓐᓇᖅᑐᑦ	5kg	Regular municipal disposal	None
Berm	ᐃᒪᐃᑦ ᐊᑐᖅᑕᐅᔨᓭᖅᓯᒪᔾᔪᑦ	1000kg	Regular municipal infrastructure	none
Berm	ᖃᔪᖅᑕᓪᓗᓂᖅ	100kg	regular municipal infrastructure	none

ᐊᓵᑎᒥᐅᑕᓂᕐᑐᑦ ᐊᑲᑐᖅᑕᑕᐅᓯᒪᔾᔪᑦ

This project does not use hazardous chemical. No environmental impacts are expected from the project.

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

ᐃᓐᓇ ᐊᕐᑎᐅᑦ ᖃᓄᐃᑦᑐᓕᕆᔨᓂᖅ: ᓄᓇᑦ ᖃᓄᐃᑦᑐᓂᖅ

ᐃᓐᓇ ᐊᕐᑎᐅᑦ ᖃᓄᐃᑦᑐᓕᕆᔨᓂᖅ: ᐅᒪᔪᖅᑕᖃᖅᓂᖅ

ᐃᓐᓇ ᐊᕐᑎᐅᑦ ᖃᓄᐃᑦᑐᓕᕆᔨᓂᖅ: ᐃᓄᓕᕆᓂᕐᒧᖅᓱᑦ-ᐱᕐᓕᐊᔪᓕᕆᓂᕐᒧᖅᓱᑦ

Miscellaneous Project Information

ᓄᓕᓄᐃᖅᑕᐅᓂᖅᑎᑦ ᐊᒃᑐᖅᑕᐅᔨᒪᔪᑦ ᖃᓄᐃᑦᑐᓂᖅᑎᑦ ᕿᓕᐅᒥᒃᔪᓂᖅᑕᐅᓂᐊᖏᓂᖅᑎᓪᓗ

Cumulative Effects

Impacts

ᓄᓇᓕᐃᖅᑕᐅᓂᖅᐸᑦ ᐊᕐᕌᒍᑎᐅᑕᓱᑦᑐᑦ ᐊᖏᑐᖅᑕᐅᓯᒪᔪᑦ

	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
ᓴᓇᓂᖅ																									
-		-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-
ᐅᔨᖃᑦᑕᕐᓂᖅ																									
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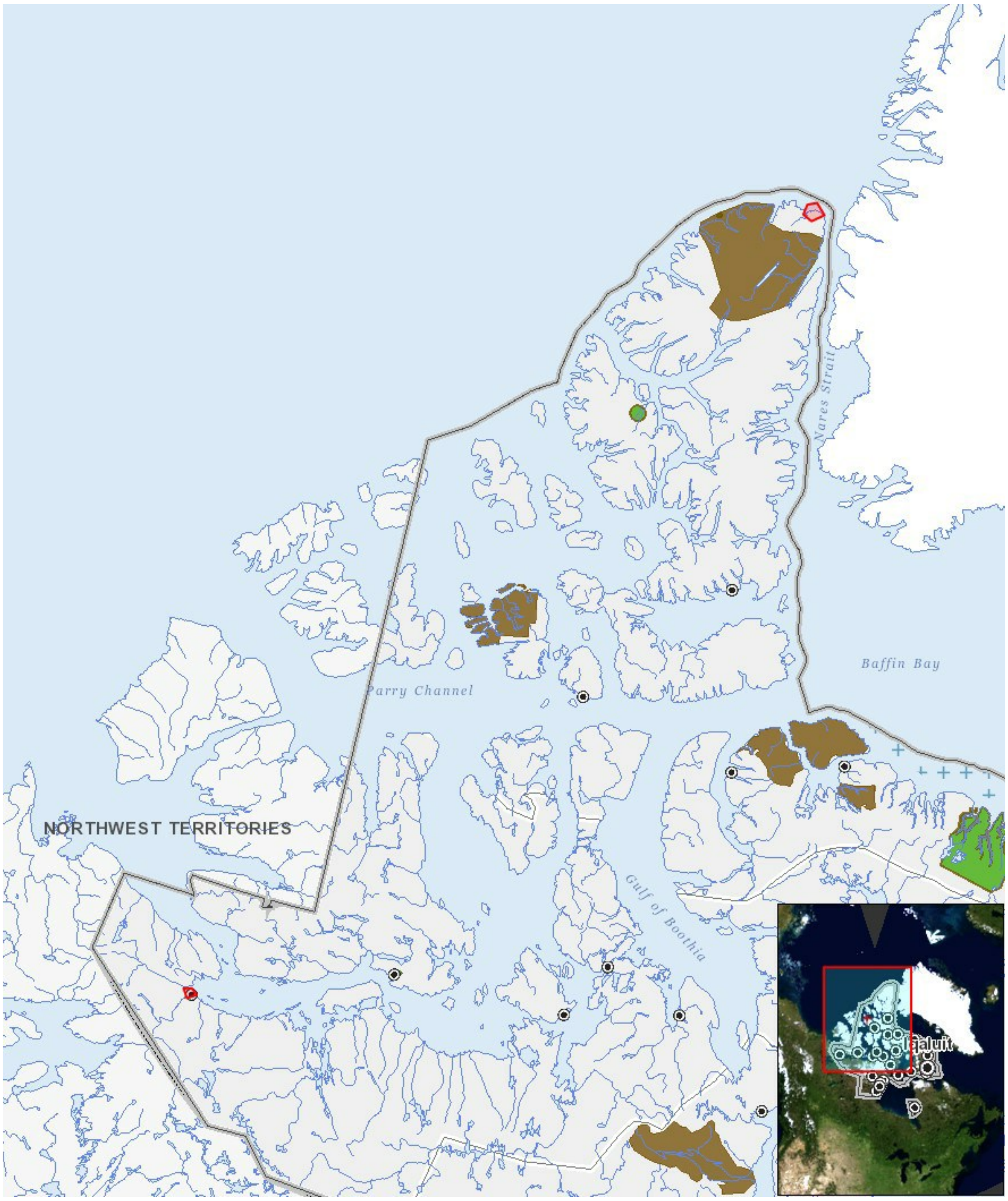
ᐃᑐᑦᑎᓗᓂᖅ																									
-		-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-

(P = ᐊᖏᐅᓀᒥᔪᓐᓇᖅᑐᑦ, N = ᐊᖏᐅᖅᑭᔪᑎᑕᐅᔪᓐᓇᖅᑐᑦ ᕿᓚᐅᒥᔪᔨᓂᖅᑐᑕᐅᔪᓐᓇᖅᑭᑦᑐᓪᓗ, M = ᐊᖏᐅᖅᑭᔪᑎᑕᐅᔪᓐᓇᖅᑐᑦ ᕿᓚᐅᒥᔪᔨᓂᖅᑐᑕᐅᔪᓐᓇᖅᑐᓪᓗ, U = ᖃᐅᐅᔾᓚᓐᓇᖅᑭᑦᑐᖅ)

ᓇᒦᒻᒪᖕᒑᖅ ᐱᓕᕆᐊᕆᔭᐅᔪᖅ



List of Project Geometries

1	polygon	Study area around Kugluktuk
2	polygon	Study area around Alert