2012 Nunavut Research Licence Renewal Application: Wayne Pollard

Scientific Research Licence #02 053 10R-M (multiyear)

Project Title: An investigation of the sensitivity of high Arctic permafrost to climate change

Principal investigator: Dr. Wayne Pollard, Professor, McGill University

2012 Research Team: Wayne Pollard, Michael Becker, Miles Ecclestone, Laura Thompson and 2 student field assistants from McGill

2012 Fieldwork: Planned fieldwork includes April 5-17, and June 28-July 10.

2012 Field sites: The Eureka area on the Fosheim Peninsula, Ellesmere Island (80º00'N 85º95'W), and the Expedition Fiord area, Axel Heiberg Island (79º25'N; 90º45'W).

Funding source: Natural Science and Engineering Research Council (NSERC) and ArcticNet

Introduction.
This is a long-term project that examines how climate change is affecting high Arctic permafrost conditions and high arctic landscapes. The main aims of this project are: (1) to monitor climate conditions for different landscape (e.g. tundra, mountains, coasts, wetlands ...) and assess local climate variability and how much the climate is changing, (2) to evaluate the nature and extent of ground ice in permafrost, (3) to determine the amount and rate of landscape change caused by warming and melting permafrost (thermokarst), and (4) to map these changes on a decadal scale. The information collected in this study will improve our general understanding of how climate and permafrost interact which will allow for the better prediction of future changes. Through our case studies we are providing new information about climate, permafrost, ground ice and thermokarst.

Progress Report – 2011 Fieldwork.
Last year's field program was shortened because of health reasons and limited access to logistics. For the second year in a row PCSP was unable to provide promised helicopter and twin otter support at the dates scheduled, as result we wasted a lot of time waiting for aircraft. In 2011 I was in only able to get into the field from April 1-10 and July 1-9. April fieldwork involved geophysical mapping of ground ice and ice wedges in at Expedition Fiord and Eureka, the collection of climate data and the collection of frozen sediments and ground ice for thaw sensitivity analyses. In July my fieldwork was limited to dGPS and ground penetrating radar surveys of ice wedges and massive ice deposits at Expedition Fiord on Axel Heiberg Island. Preliminary data on ice wedge subsidence indicates a potentially important area of climate change related disturbance. In this study we used different survey tools like radar and electrical profiling to assess the subsurface conditions. The impact of climate change on ice wedges documented a 10-15 cm deepening of ice wedge troughs and the development of new areas of subsidence in the past 2-3 years.

2012 Field Program.
Climate change is the most significant environmental challenge facing the North. I am beginning a new cycle of NSERC funded research which places greater emphasis on measurement of processes associated with climate change than simply detecting change. The

aim of my 2012 field program is to investigate how climate change will affect ice-rich permafrost and in particular how rates of thermokarst may change. The proposed research will be divided in to two complementary themes: (1) the analysis of the meta-stable relationship between continuous permafrost and the active layer, and (2) ice wedges as a quasi-stable complex system. A major focus of both studies is the measurement of mass and energy fluxes in the active layer and coupling between the atmosphere, active layer and permafrost. A common research design will be applied to both projects. This research will be undertaken at Expedition Fiord on Axel Heiberg Island (79º25N;90º43'W) and near Eureka on Ellesmere Island (79º59'N; 85º49'W). These sites were selected because they are representative of common ecosystems, because of their accessibility, availability of baseline data, and existing research facilities. My long term field programs at these sites provide a strong basis for comparison. I will assess the sensitivity of key permafrost systems to warming by defining the surface energy balance, and measuring mass and energy fluxes in the active layer and at the active layer permafrost interface. This study will identify critical thresholds of change and potential feedbacks. In this study we will test 4 linked hypotheses. *Hypothesis 1:* Climate change is already causing significant changes to the high arctic permafrost regime. *Hypothesis 2*: The active layer structure and ice distribution buffers permafrost systems in a self-regulating manner through complex feedbacks linked to latent heat and the thermal offset. *Hypothesis 3:* Increases in active layer depth in areas of ice-rich permafrost (and ice wedges) will be characterized by complex feedbacks associated with latent heat and convective heat fluxes from melting ground ice. And *Hypothesis 4*: Ice-rich permafrost systems have a critical threshold "tipping point" where they shift from a meta-stable quasi-static state into disequilibrium and the time it takes return to equilibrium is related to ice content. This research will look at fluxes of energy and matter at key interfaces (ground surface, base of the active layer, and the top of permafrost) and at cryostratigraphic contacts to assess potential geophysical and biogeochemical responses of different landscapes to a range of climate change scenarios. Three sets of activities are planned, but only 1) mass and energy flux measurements, and 2) ground ice mapping and analyses are related to field work. The third activity will use observations from the field as the basis for modeling future change.

Significance:

This research has made significant inroads into the understanding of permafrost in the high Arctic and in particular cold polar deserts. It is providing new insights into the origin and age of permafrost systems, rates of change and the potential vulnerability of ice cored landforms. The magnitude of warming projected for the high Arctic will have significant effects on both the ecology and geomorphology of the region. Previous research has focused mainly on the downstream consequences of warming permafrost on vegetation, and most climate models have yet to incorporate an adaptive ecosystem in response to global warming. This work will identify how changes in the active layer, soil moisture, vegetation and topography will either amplify or buffer the affects of climate change on these systems.

2012ᒥ ᓄᓇᕗᕐᒥ ᓕᓯᓂᐊᓂᕐᒧᑦ ᐱᔪᓇᐅᑎᒐ ᓄᑕᐅᓕᕈᒪᓗᒍ ᑐᒃᓯᕋᐅᑎᒐ: ᕗᐃᓐ ᐹᓗᑦ

ᑭᓕᓯᓂᐊᓂᕐᒧᑦ ᐱᔪᓇᐅᑎᒪ ᓇᓴᐅᑖ #02 053 10R-M (ᐊᒥᓱᓄᑦ ᐊᕋᒍᓄᑦ)

ᐱᓕᕆᐊᕆᔪᒪᔭᕋ: ᖃᐅᔨᓴᕐᓗᖓ ᓱᓂᕐᑕᐅᓴᕋᐃᓂᖓᓂᒃ ᖁᑎᒃᑑᑉ ᖁᐊᖑᐃᓇᓂᖏᑦ ᓯᓚᐅᑉ ᐊᓯᔾᔨᕐᓂᖓᓄᑦ

ᖃᐅᔨᓴᕐᑎᓗᐊᑕᖅ: ᓘᒃᑖᖅ ᕗᐃᓐ ᐹᓗᑦ, ᐃᓕᓴᐃᔨᒪᕆᒃ, ᒪᑭᐅᓪ ᓯᓚᑐᓴᕐᕕᐊᔪᐊᖓᓂ

2012ᒥ ᑭᓕᓯᓂᐊᓂᒧᑦ ᐱᓕᕆᓂᐊᕐᑐᑦ: ᕗᐃᓐ ᐹᓗᑦ, ᒪᐃᑯᓪ ᐱᑯᕐ, ᒪᐃᐅᓪᔅ ᐃᑭᓕᔅᑑᓐ, ᓗᐊᕋ ᑖᒻᓴᓐ ᐊᒪᓗ ᒪᕈᒃ ᐃᓕᓂᕐᐊᕐᑏᒃ ᑕᐸᓂ ᐃᑲᔪᕐᑎᐅᓂᐊᕐᑑᒃ ᒪᑭᐅᓪᒥᖕᖓᕐᑑᒃ

2012ᒥ ᐱᓕᕆᐊᕆᓂᐊᕐᑕᕗᑦ: ᐸᕐᓇᓯᒪᔪᒧᑦ ᑕᐸᓂ ᐱᓕᕆᔪᒪᓗᑕ ᐊᐃᕆᓕ 5ᒥᑦ 17ᒧᑦ, ᐊᒪᓗ ᔪᓂ 28ᒥᑦ ᔪᓚᐃ 10ᒧᑦ.

2012ᒥ ᐱᓕᕆᕝᕕᒋᓂᐊᕐᑕᕗᑦ: ᔪᕆᑲᐅ ᖃᓂᒋᔮᓚ ᕗᓴᐃᒻ ᓄᕗᐊᓂ (80º00'N 85º95'W), ᐊᒪᓗ ᐃᒃᐱᑎᓴᓐ ᓯᒃᔭᕆᒃᑐᕐᒥ, ᐊᑯᓪ Hᐃᐳᒃ ᕿᑭᑕᖓᓂ (79º25'N; 90º45'W).

ᑭᓇᐅᔭᖃᕐᑎᓯᔩᑦ: ᐃᓄᒃᓄᑦ ᓱᓂᑕᐅᓯᒪᖏᑐᓄ ᑭᓕᓯᓂᐊᑐᓕᕆᔨᑯᑦ ᐊᒪᓗ ᐊᐅᓚᓯᔩᑦ ᑭᓕᓯᓂᐊᓂᒧᑦ ᑲᑎᒪᔨᑯᖏᓂᑦ ᐊᒪᓗ ᐋᒃᑎᒃᓂᑦᑯᓂᑦ

ᑭᓱᓕᕆᓂᐊᕐᒪᖔᑕ.
ᑕᒪᓇ ᐊᑯᓂᐅᓕᕐᑐᖅ ᐱᓕᕆᐊᕆᓕᕐᑕᕗᑦ ᖃᐅᔨᓴᕐᓗᑕ ᖃᓄ ᓯᓚᐅ ᐊᓯᔾᔨᕐᓂᖓ ᓲᖕᒪᖔᑦ ᖁᑎᒃᑑᑉ ᖁᐊᖑᐃᓇᕐᑐᖏᓂᒃ ᐊᒪᓗ ᖁᑎᒃᑑᑉ ᓄᓇᖓᑕ ᐊᕿᓯᒪᓂᖓᓂᒃ. ᑐᕋᒐᓗᐊᑕᕆᔭᕗᑦ ᑕᕙᓂ ᐱᓕᕆᐊᑎᓂ ᐅᑯᐊᖑᔪᑦ: (1) ᐅᐊᓯᓗᒍ ᓄᓇᖓᑕ ᖃᓄᐃᑐᓂᖓ ᐊᕈᕆᖏᑐᓂ ᓄᓇᖏᓂ (ᓲᕐᓗ ᓄᓇᖃᐅᓂᖓ, ᖃᖃᖏᑦ, ᓯᔭᖏᑦ, ᐃᒪᓱᓚᖃᐅᕐᓂᖏᑦ ᐊᓯᖏᓗ) ᐊᒪᓗ ᖃᐅᔨᓇᓱᒃᓗᒋᑦ ᓄᓇᖓᑕ ᐊᕈᕆᔪᓂᖓ ᐊᒪᓗ ᖃᓄᑎᒥ ᓯᓚᖓ ᐊᓯᔾᔨᕐᑎᒥᒪᖔᑦ, (2) ᖃᐅᔨᓇᓱᒃᓗᒍ ᓱᓂᕐᓯᒪᖏᑐᑦ ᐊᒪᓗ ᖃᓄᑐᒥ ᐃᔪᑎᒥᒪᖔᑦ ᓄᓇᖓᑕ ᖁᐊᖑᓂᖓ, (3) ᓇᓗᓇᐃᕐᓗᒍ ᖃᓄᑎᒥᑦ ᐊᒪᓗ ᓱᑲᓂᕈᔭᖓ ᓄᓇᐅᑉ ᖃᓄᐃᓕᖓᓂᖓᑕ ᐊᓯᔾᔨᕐᓂᖓ ᓱᓂᕐᑕᐅᔪᖅ ᐅᖁᓯᕙᓕᐊᓂᕐᒧᑦ ᐊᐅᒃᐸᓕᐊᓂᖏᓄᓗᓃᑦ ᖁᐊᖑᐃᓇᕐᑐᑦ, ᐊᒪᓗ (4) ᓄᓇᖑᐊᑎᒍᑦ ᓇᓗᓇᐃᕐᓗᒥᑦ ᑕᑯᐊ ᐊᓯᔾᔨᕐᓂᐅᔪᑦ ᖁᓕᓄᑦ ᐊᕋᒍᓄᖓᓗᑎᒃ ᖃᐅᔨᓴᕈᑎᕗᑦ. ᑕᑯᐊ ᖃᐅᔨᔭᕗᑦ ᓄᐊᐸᓕᐊᔭᕗᑦ ᑕᕙᓂ ᖃᐅᔨᓴᕈᑎᑎᓂ ᐃᑲᔪᕐᓂᖃᕐᓂᐊᕐᑐᑦ ᑐᑭᓯᕙᓕᕈᓇᖅᑯᓗᑕ ᖃᓄ ᓯᓚᐅᑉ ᐊᓯᔾᔨᕐᓂᖓ ᐊᒪᓗ ᖁᐊᖑᐃᓇᕐᑐᑦ ᓱᓂᒪᖔᑕ ᑕᒪᐃᑯᑕ ᓯᕗᓂᑎᓂ ᐊᓯᔾᔨᕐᓂᐊᕐᑐᓂᒃ ᖃᐅᔨᒪᔪᑎᕆᔪᓇᓂᕐᓴᓇᓂᐊᕐᑎᒍᑦ. ᑕᕗᓇ ᖃᐅᔨᓴᕈᑎᑎᓂ ᐊᑐᐃᓇᕈᐃᕙᓕᐊᔪᒍᑦ ᓄᑖᕐᓂᒃ ᑐᓴᕈᑎᓂᒃ ᐱᔪᑎᖃᑐᓂᒃ ᓯᓚᐅ ᐊᓯᔾᔨᕐᓂᖓᓂᒃ, ᖁᐊᖑᐃᓇᕐᑐᑦ, ᒪᓂᕋᒥ ᓯᑯᐃ ᐊᒪᓗ ᓄᓇᖓᑕ ᐊᓯᔾᔨᕐᓂᖓ.

ᐱᓕᕆᓯᒪᓂᕆᔭᑕ ᐅᓂᒃᑳᖓ - 2011ᒥ ᐱᓕᕆᐊᕆᓚᐅᕐᑕᕗᑦ
ᐊᕋᓂ ᑕᐸᓂ ᐱᓕᕆᐊᕆᓚᐅᑕᕗᑦ ᓇᐃᒃᓕᒋᐊᕐᑕᐅᓚᐅᕐᑐᖅ ᐱᔪᑎᒋᓗᒍ ᐊᓂᐊᕐᑐᖃᓂᖓᓄᑦ ᐊᒪᓗ ᖃᖕᒪᑕᓱᖏᓕᐅᓗᐊᒧᑦ. ᐊᐃᐸᕆᓕᕐᑕᖕᒪᓂ ᐊᕋᒍᔪᖅ ᑭᖑᓕᕐᕆᖕᓂ ᑭᓕᓯᓂᐊᑐᓕᕆᔨᑯᑦ ᖁᓕᒥᒍᓕᒥᒃ ᐊᖏᕈᑎᕆᓯᒪᔭᕐᒥᓂ ᐊᑐᕐᑎᓯᔪᓇᓚᐅᖏᑐᑦ ᒪᕈᓕᕐᒥᒃᓗ ᑕᐃᑯᓄᖓ ᐅᓪᓗᕐᓄᑦ ᐊᕿᓯᒪᔭᑎᓄᑦ, ᑕᒪᐃᓂᖓᓄ ᐅᑕᕿᑐᐃᓇᑲᑕᓚᐅᑐᒧᑦ ᖃᖕᒪᑕᓱᕐᒥᒃ. 2011ᖑᑎᓗᒍ ᑕᐸᐅᖓᕈᓇᓚᐅᑐᖕ ᑭᓯᐊᓂ ᐊᐃᕆᓕ 1ᒥᑦ 10ᒧᑦ ᐊᒪᓗ ᔪᓚᐃ 1ᒥᑦ 9ᒧᑦ. ᐊᐃᕆᓕᒥ ᐱᓕᕆᓂᕆᔭᕋ ᓄᓇᖑᐊᓄᖃᐃᓚᐅᑐᖕ ᓄᓇᖓᓂ ᓱᑯᓂᒃ ᐊᒪᓗ ᑰᒃᕕᐅᖃᑕᓂᑯᓂᒃ ᓯᑯᓂᒃ ᐃᒃᐱᑎᓴᓐ ᓯᔭᕆᒃᑐᕐᒥ ᔪᕆᑲᒥᓗ, ᓄᐊᑕᑲ ᓯᓚᐅ ᖃᓄᐃᓂᖓᑕ ᑎᑎᖃᐊᓕᐊᓱᖏᑦ ᐊᒪᓗ ᒪᕋᓂᒃ ᖁᐊᕐᓂᒃ ᓄᐊᑎᓚᐅᑐᖕ ᐊᒪᓗ ᓄᓇᒥᒃ ᓱᑯᓂᒃ ᐊᐅᓴᕋᐃᓂᖏᑦ ᖃᐅᔨᓴᕐᑎᒥᓂᐊᕐᓗᒋᑦ. ᔪᒪᐃᒥ ᑕᐸᓂ ᐱᓕᕆᓂᕆᔭᕋ ᐃᓱᓕᑕᕐᕕᖃᓚᐅᑐᖅ ᖃᖕᒪᑕᕐᑎᑕᐅᓯᒪᔪᑯᑦ ᓄᓇᖑᐊᓄᖃᐃᓗᖕ ᐊᒪᓗ ᓄᓇᖓᑦ ᐃᑭᐊᖓᒍᑦ ᖃᐅᔨᓴᕈᑎᖃᓗᖕ ᓯᑯᓂᒃ ᑰᒃᕕᐅᓂᑯᓂᒃ ᓯᑯᐋᓗᓂᒃᓗ ᐃᒃᐱᑎᓴᓐ ᓯᒃᔭᕆᒃᑐᕐᒥ ᐊᑯᓪ Hᐊᐃᐳᒃ ᕿᑭᑕᖓᓂ. ᓯᕗᓕᕐ ᑎᑎᖃᑕᐅᓯᒪᓂᑯᐃᑦ ᓯᑯᑯᑦ ᑰᒃᓂᑯᐃᑦ ᐊᐅᒃᐊᓕᐊᓂᖕ ᓇᓗᓇᐃᓯᔪᖅ ᐱᒪᕆᐊᓗᑐᐃᓇᕆᐊᖃᓂᖓᓄᑦ ᓯᓚᐅ ᐊᓯᔾᔨᕐᐸᓕᐊᓂᖓᓄᑦ ᓱᓂᕐᑕᐅᒪᓂᖓ. ᑕᕙᓂ ᖃᐅᔨᓴᕐᓗᑕ ᐊᑐᓚᐅᑐᒧᑦ ᐊᕈᕆᖏᑕᖓᓂᒃ ᕿᖑᒥᓚᕈᑎᒥᒃ ᓲᕐᓗ ᖃᐅᒪᒃᑕᔪᑯᓗᕐᑯᕈᔪᕐᒧᑦ ᐊᒪᓗ ᐅᐊᔭᒧᕐᑐᒧᑦ ᖃᐅᔨᓴᕈᑎᒥᒃ ᖁᕐᐸᓯᐊ ᖃᓄᐃᑐᓕᒪᖔᑦ. ᓱᓂᑕᐅᓯᒪᓂᖕ ᓯᓚᐅ ᐊᓯᔾᔨᕐᓯᒪᓂᖓᓄᑦ ᒡᑰᒃᕕᐅᓂᑯᐃᑦ ᑎᑎᕋᓯᒪᔭᕗᑦ 10ᒥᑦ 15ᓯᓐᑎᒦᑕᒧᑦ ᐃᑎᓂᕐᓴᐅᓕᕐᑐᑦ ᑰᒃᕕᐅᓂᑯᐃᑦ ᐊᒪᓗ ᓄᑖᕐᓂᒃ ᐊᐅᒃᕕᐅᕙᓕᐊᔪᓂ ᓴᕿᑎᓯᓗᑎᒃ ᐊᓂᒍᕐᑐᓂ ᒪᕈᓂᑦ ᐱᖓᓱᓄᑦ ᐊᕋᒍᓄᑦ.

2012ᒥ ᑕᐸᓂ ᐱᓕᕆᐊᕆᓂᐊᕐᑕᕗᑦ.

ᓯᓚᒧᑦ ᐊᓯᔨᕐᐸᓕᐊᓂᖅ ᐱᒪᓇᐅᓂᕐᐸᐅᕗᖅ ᐊᕙᑎᖓ ᐱᑐᐃᓇᐅᖏᓂᖓᓄᑦ ᐃᓄᐃᑦ ᓄᓇᖓᓂ. ᐱᒋᐊᕐᐸᓕᐊᓕᓵᕐᑐᖓ ᓄᑖᕐᒥᒃ ᑭᓇᐃᔭᖅᑎᓯᔨᒋᔭᑯᓂᑦ ᑕᒪᓇ ᐱᔪᑎᒋᓗᒍ ᐱᓕᕆᐊᕆᔭᕋ ᐱᔭᕆᐊᑐᓂᓴᐅᓂᐊᕐᑐᖅ ᐅᒃᑐᕋᐅᑎᑯᑦ ᖃᐅᔨᓴᕆᐊᖃᓂᐊᕋᑯᑦ ᓯᓚᐅᑉ ᐊᓯᔨᕐᐸᓕᐊᓂᖓ ᐅᔨᕐᓇᓂᑯᑐᐃᓇᐅᖏᑐᖅ. ᑐᕋᖓᔭᕋ 2012ᒥ ᐱᓕᕆᐊᕆᓂᐊᕐᑕᕐᓂᕙᖓ ᖃᐅᔨᓴᕈᒪᓗᖓ ᖃᓄ ᓯᓚᐅ ᐊᓯᔩᓂᕆᔭᖓ ᓱᓃᒪᖕᒋᑦ ᓯᑯᖃᒪᕆᒃᑐᕐᒥ ᓄᓇᖓᓗ ᖁᐊᖑᐃᓇᕐᑐᖅ ᐱᓗᐊᑐᕐᒥᒃ ᖃᓄ ᓱᑲᑎᒋᒪᖕᒋᑦ ᓄᓇᖓ ᐊᓯᔨᕐᐸᓕᐊᓂᖓ ᐊᐅᒃᐸᓕᐊᓂᕐᒧᑦ ᓄᓇᐅᑉ ᐊᑕᓂᑦ ᐊᓯᔨᑐᐃᓇᕆᐊᖅᑲᑦ. ᑭᓕᓯᓂᐊᕈᑎᒋᔭᒪᔭᕋ ᒪᕈᐃᓕᖅᖕᒐᓂᐊᕐᑐᖅ ᖃᐅᔨᓴᕈᑏᑳᒃ: (1) ᖃᐅᔨᓴᕐᓗᒍ ᑕᐃᒪᐃᖕᒋᓇᕐᑐᑐᖅ ᑕᐃᒪᐃᖕᒋᓇᕈᓂᑐᐃᓇᕆᐊᓕᒃ ᓄᓇᐅᑉ ᐊᑖᓂ ᖁᐊᖑᐃᓇᕐᑐᑦ ᐊᒪᓗ ᖃᖓ ᐊᐅᒃᐸᓕᐊᔪᖅ, ᐊᒪᓗ (2) ᑰᒃᕿᐅᔪᑦ ᓯᑯᐃᑦ ᖃᐅᔨᔪᐅᓚᐅᖃᕋᑎᒃ ᖃᓄᐃᑐᓯᒪᓂᖏᑦ. ᐃᓱᒪᒋᓗᐊᑕᕐᓂᐊᕐᑕᕗᑦ ᑕᒪᐃᓂ ᖃᐅᔨᓴᕈᑎᑎᓂ ᐅᒃᑐᕈᒪᓗᒋᑦ ᐃᔪᓂᖏᑦ ᐊᒪᓗ ᐊᐅᒃᐸᓕᐊᓂᖏᑦ ᑕᕙᓂ ᐊᐅᒪᖅᑕᕐᑐᓂ ᐊᒪᓗ ᖁᓖᓂᑦ ᖁᐊᖑᓂᖕᒐᓄ ᑎᑭᓗᒍ. ᑭᓕᓯᓂᐊᕈᑕᐅᓚᔾᔪᖅ ᐊᑐᑕᐃᓂᐊᕐᑐᖅ ᑕᒪᐃᓄᑦ ᑕᑯᓄᖓ ᐱᓕᕆᐊᑎᓄᑦ. ᑕᒪᓇ ᑭᓕᓯᓂᐊᕈᑎᒋᔭᕗᑦ ᑲᔪᓯᑎᓂᐊᕐᑕᕗᑦ ᐃᒃᐱᑎᓴᓐ ᓯᒃᔭᕆᒃᑐᒥ ᐊᑯᓯᓐ Hᐊᐃᕗᒃ ᕿᑭᑕᖓᓂ (79º 25'N; 90º 43'W) ᐊᒪᓗ ᖃᓂᒋᔫᓂ ᔪᕆᑲᐅᑉ ᐃᐅᓪᓴᒥᐊ ᕿᑭᑕᖓᓂ (79º 59'N; 85º 49'W). ᑕᑯᐊᒃ ᓄᓈᒃ ᓂᕈᐊᕐᓯᒪᔪᕗᑦ ᐱᔪᑎᒋᓗᒍ ᐊᕿᒋᔭᐅᒪᑎᒃ ᑕᒪᐃᓄᐸᓗ ᐊᕙᑎᐅᔪᒥᒃ, ᐅᐸᓚᓴᐅᓗᑎᒃᓗ, ᐊᑐᐃᓇᐅᓗᑎᒃᓗ ᐱᒋᐊᕐᓂᑐᖅᖕᒐᓂ ᑎᑎᕋᑕᐅᕙᓕᐊᓕᕐᓂᑯᓂᒃ, ᐊᒪᓗ ᑭᓕᓯᓂᐊᕐᕕᒃᑕᖅᑲᒪᑦ. ᐊᑯᓂ ᑕᐸᓂ ᐱᓕᕆᐊᕆᔭᕋ ᑕᑯᓇᖕᓂ ᐅᒃᐱᓇᑎᐊᕐᑐᓂᒃ ᑐᖕᓚᕝᖃᕈᒪᓗᖓ ᖃᓄᑎᒋ ᐊᓯᔨᕐᑐᖃᓂᕐᐸᑦ. ᖃᐅᔨᓵᕐᑕᑯ ᖃᓄᑎᒋ ᓱᓂᕐᑕᐅᓴᕋᐃᒪᖕᒋᑕ ᖁᐊᖑᐃᓇᕐᑐᑦ ᐱᓪᓗᐊᑕᐃ ᐅᖁᓯᕙᓕᐊᓂᖅ ᐱᔪᑎᒋᓗᒍ ᓇᒧᓇᐃᑕᐅᓚᔭᕐᑐᑦ ᖄᐸᓯᐊᑕ ᐊᐅᒃᐸᓕᐊᓂᖓᑕ, ᐊᒪᓗ ᐅᒃᑐᕋᓗᒥᓗ ᐊᖏᔪᓂᖏᑦ ᑰᖅᑕᕐᑐᓗ ᐊᐅᒪᓂᖓᓂᑐᑦ ᐊᒪᓗ ᐊᐅᒪᓂᖓᓂ ᖁᐊᖑᐃᓇᕐᑐᑦ ᖃᓄᐃᓕᖅᑕᕐᒪᖕᒋᑕ. ᑕᒪ ᖃᐅᔨᓴᕐᓂᕆᔭᕋ ᓇᓗᓇᐃᓯᓂᐊᕐᑐᖅ ᐱᒪᓇᐅᔪᑦ ᓱᓂᕐᑕᐅᓴᕋᐃᓂᖏᓂᒃ ᓯᓚᐅᑉ ᐅᖁᓯᕙᓕᐊᓂᖓᓄᑦ ᐊᓯᔨᕐᐸᓕᐊᓂᖓ ᐊᒪᓗ ᖃᓄᐃᓕᑐᐃᓇᕆᐊᖅᑲᒪᖕᒋᑕ ᖃᐅᔨᔪᑎᒋᓗᖕᒋᑦ. ᑕᐸᓂ ᖃᐅᔨᓴᕐᓂᓇᔭᕐᓂᕙᖓ ᖃᐅᔨᓴᕐᓂᐊᕐᑐᒍᑦ ᑎᓴᒪᓂ ᑕᒪᑐᒧᖓ ᐊᒃᑐᐊᔪᓂᒃ ᖃᓄᐃᓕᓖᕐᓂᐊᕋᓱᒋᓕᒪᖕᒋᑕ. *ᖃᓄᐃᓕᓖᕐᓂᐊᕋᓱᒋᔭᕗᑦ 1:* ᓯᓚᐅᑉ ᐊᓯᔨᕐᓂᖓ ᓱᓃᓯᒪᓕᕆᖅᑐᖅ ᐱᒪᓇᐅᔪᓂᒃ ᐊᓯᔩᓗᓂ ᖁᑎᒃᑑᑉ ᖁᐊᖑᐃᓇᕐᑐᖏᓂᒃ ᐃᒥᓂᒃ ᑕᐃᒪᐃᑐᓂᒃ. *ᖃᓄᐃᓕᓖᕐᓂᐊᕋᓱᒋᔭᕗᑦ 2:* ᐊᐅᒪᓂᖓᑕ ᖃᓄᐃᓕᖅᑕᕐᓂᕆᔭᖓ ᐊᒪᓗ ᓯᑰᑉ ᓯᐊᒪᖅᑕᕐᓂᖓ ᓄᖅᖃᑎᓯᖅᑕᕐᑐᖅ ᖁᐊᖑᐃᓇᑑᑦ ᖃᓄᐃᓕᖓᓂᖏᓂᒃ ᐃᒥᓂ ᐊᐅᓚᓂᑯᑦ ᐱᑐᐃᓇᐅᖏᑐᕐᑎᒍᑦ ᑕᑯᓴᐅᖏᑐᑯᑦ ᐅᓇᕐᓂᒧᑦ ᐊᒪᓗ ᐅᓇᓱᔭᖅᑕᕐᓂᖓᓄᑦ ᑕᐃᒪᐃᓚᕿᒍᓂ. *ᖃᓄᐃᓕᓖᕐᓂᐊᕋᓱᒋᔭᕗᑦ 3:* ᐊᐅᒪᓂᖓ ᐃᑎᓕᕐᐸᓕᐊᔪᖅ ᖁᐊᖑᐃᓇᕐᑐᑕᖅᓚᓂᖓ (ᐊᒪᓗ ᓂᓚᑯᑦ ᑰᓂᑯᐃᑦ) ᓇᓗᓇᕈᓂᕐᓂᐊᕐᑐᑦ ᐱᑐᐃᓇᐅᖏᑐᕐᑎᒍᑦ ᖃᓄᐃᓕᕙᓕᐊᓂᖓᒍᑦ ᑕᑯᓴᐅᖏᑐᑯᑦ ᐅᓇᕐᓂᖓᒍᑦ ᐊᒪᓗ ᐅᓇᕐᑐᑲᐃᓇᖅᑕᕐᑐᑦ ᑰᓂᑯᑦ ᐅᓇᕐᑐᒥᒃ ᑰᖅᑕᕐᑐᑦ ᐊᐅᒃᐸᓕᐊᔪᒥ ᒪᓂᕋᒥᑦ ᓯᑯᒥᑦ. ᐊᒪᓗ *ᖃᓄᐃᓕᓖᕐᓂᐊᕋᓱᒋᔭᕗᑦ 4:* ᓯᑯᓕᓖᓗᒃ ᖁᐊᖑᐃᓇᕐᑐᖅ ᖃᓄᐃᓕᖅᑕᕐᓂᕆᔭᖓ ᐱᒪᓇᐅᕗᖅ ᐃᓱᓕᑎᓯᓗᓂ "ᒥᑭᑐᑯᓗᐃᑦ ᓱᓂᕗᓇᕐᑐᓘᑐᐃᑦ" ᑕᐸᓂ ᑕᐃᒪᐃᑐᑐᖅᖃᕕᓂᕐᒥᑦ ᖃᐅᔨᔪᐅᕙᓕᐊᓕᕐᓂᒥᑦ ᐊᕿᓯᒪᑎᐊᕈᓂᕐᓂᒧᑦ ᑎᑭᓗᑎᒃ ᐊᒪᓗ ᖃᓄᐃᑐᓂᕕᓂᖓᓄᑦ ᐅᑎᖃᓯᓂᖓ ᐊᑯᓂᐅᓵᖑᓗᑎᒃ ᐊᒃᑐᐊᓂᓖᑦ ᓯᑯᒥᒃ. ᑕᒪ ᖃᐅᔨᓴᕈᒪᔪᕈ ᕿᒥᕈᓂᐊᕐᑐᒍᑦ ᑰᖑᔪᑦ ᓱᓃᔪᑦ ᐊᒪᓗ ᖃᓄᐃᑎᓯᓗᐊᖑᐊᕐᑐᑦ ᐊᓯᔨᕐᓂᕐᒥᒃ (ᒪᓂᕋᒥ ᓴᕿᔫᓂᕐᒥᑐᑦ, ᐃᓱᖓ ᐊᐅᒪᓂᖓᑕ, ᐊᒪᓗ ᖄᖓ ᖁᐊᖑᐃᓇᕐᑑᑉ) ᐊᒪᓗ ᖁᐊᑦ ᓄᓇᖓ ᓯᑯᖃᑐᑦ ᐊᒃᑐᕐᓯᖃᑕᕐᓂᖓ ᖃᐅᔨᓴᕐᓗᑎᒍᑦ ᓄᓇᖓᑕ ᖃᓄᐃᑐᓂᖓᓂᒃ ᐊᓯᔩᑐᐃᓇᕆᐊᖃᓂᖓ ᐊᒪᓗ ᐃᓴᓄ ᑕᑯᓴᐅᖏᑐᑦ ᐃᒪᕐᓗᐃᑦ ᖃᓄᐃᑲᕐᑕᓯᒪᖕᒋᑕ ᐊᐳᒥᕐᒥᑐᓂ ᓄᓇᐅᑉ ᐊᖅᑭᓯᒪᓂᖏᓂ ᑎᑭᐅᑎᓗᒍ ᓯᓚᒧᑦ ᐅᖁᓯᓂᖓᓄ ᐊᓯᔨᕐᑕᐅᕐᔪᐊᕐᑐᑦ. ᑕᑯᐊ ᐱᖕᓱᐃᓕᖅᑲᖓᔪᑦ ᐱᓕᕆᐊᕆᔪᒪᔪᕗᑦ ᐸᕐᓇᒍᑎᒋᓯᒪᔪᕗᑦ ᑭᓯᐊᓂ ᐊᑕᐅᓯᑯᐊᖅ 1) ᐊᖏᔪᖅ ᐊᒪᓗ ᐊᒪᓗ ᑰᖅᑕᕐᑐᑦ ᐅᒃᑐᕋᓗᒋᑦ, ᐊᒪᓗ 2) ᒪᓂᕋᒥᑐᑦ ᓯᑯᐃ ᓄᓇᖑᐊᑎᒍᑦ ᓇᓗᓇᐃᓗᒋᑦ ᖃᐅᔨᓴᕐᓗᒋᓗ ᖃᓄ ᐊᒃᑐᐊᓂᖅᒪᖕᒋᑕ ᑕᐸᓂ ᐱᓕᕆᐊᑎᓂ. ᐱᖕᒐᔪᖕᒋᑦ ᐱᓕᕆᐊᕆᔪᒪᔪᑕ ᐃᐳᓄᑦ ᑕᑯᓴᐅᔪᑦ ᐅᐳᕐᓇᑐᑦ ᑕᐸᓂᓂᑎᓂ ᑐᖅᑕᕐᕕᒋᓗᒋᑦ ᐃᔭᒐᓴᐅᖅᑯᓗᒋᑦ ᓯᕗᓂᑎᓂ ᐊᓯᔨᕐᓂᐅᓂᐊᕐᑐᒧᑦ.

ᐱᒪᓇᐅᓂᖓ:

ᑕᒪᓇ ᑭᓕᓯᓂᐊᕈᑎᒋᔭᕗᑦ ᓴᕿᑎᓯᔪᖅ ᐱᒪᓇᐅᔪᓂᒃ ᐊᖁᓯᐅᓂᕐᓂᒃ ᑐᑭᓯᐅᒪᓂᕐᒥᒃ ᖁᐊᖑᐃᓇᕐᑐᑦ ᐱᓪᓗᒋᑦ ᖁᑎᒃᑐᒥ ᐊᒪᓗ ᐱᓗᐊᑐᒥ ᖁᑎᑐᒥᐅᑦ ᐸᓂᕐᓂᖕᒐᓂᑐᓂᒃ. ᐊᑐᐃᓇᕈᑎᓯᐊᖅ ᓄᑖᕐᓂᒃ ᖃᐅᔨᒪᓂᕐᓂᒃ ᖃᓄᐃᑐᓚᑖᖑᓂᕕᓂᖏᓂᒃ ᐊᒪᓗ ᖃᓄᑐᒋ ᓄᑕᐅᖕᒋᒪᖕᒋᑕ ᑕᒪᑯᐊ ᖁᐊᖑᐃᓇᕐᑐᑦ ᖃᓄᐃᓕᓱᖑᒪᖕᒋᑦ, ᖃᓄᓗ ᓱᑲᑎᒋᒪᖕᒋᑦ ᐊᓯᔨᕐᐊᓕᐊᓂᖓ ᐊᒪᓗ ᐊᑕᕐᓇᑐᑐᐃᓇᕆᐊᖃᓂᖓ ᓯᑯᒥᒃ ᑐᖅᑕᕐᕕᓖᑦ ᓄᓇᐃᑦ ᐊᕿᓯᒪᓂᖏᑦ. ᐊᖏᔪᓂᖓ ᐅᖁᓯᕙᓕᐊᓂᒧᑦ ᖁᑎᒃᑑᑉ ᖃᓄᐃᑐᓚᖃᓯᒪᔪᐅᓂᖓ ᓱᓂᕗᓕᑑᓗᓂᐊᕐᑐᑦ ᑕᒪᐃᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᖃᑕᑦ ᐅᒪᔪᑦ ᐊᒪᓗ ᓄᓇᐃᑦ ᖃᓄᐃᓕᓇᖅᓯᓂᖏᓂᒃ ᑕᐸᓂᕐᐸᓯᒃ. ᓯᕗᓂᐊᓂ ᑭᓕᓯᓂᐊᓂᖅ ᐃᐳᒥᑐᐊᑕᓚᐅᑐᖅ ᑭᖑᓂᐊᒍ ᖃᓄᐃᓕᓕᔪᖅᑐᓂᒃ ᐊᐅᒃᐸᓕᐊᓂᖏᑦ ᖁᐊᖑᐃᓇᕐᑐᑦ ᐃᓱᒪᒋᓗᒋᑦ ᓯᓚᐅᑉ ᐅᖁᓯᕙᓕᐊᓂᖓ ᐱᓪᓗᒍ. ᑕᒪ ᐱᓕᕆᐊᕆᔭᕗᑦ ᓇᓗᓇᐃᕐᓯᔪᖅ ᖃᓄ ᑕᒪ ᐊᓯᔨᕐᐊᓕᐊᓂᖓ ᐊᐅᒃᐸᓕᐊᔫᑉ, ᓄᓇᔭᖕᒪᑕ ᒪᓴᐅᓂᖓ, ᐱᕈᑐᐃ ᐊᒪᓗ ᖁᑎᓂᕐᒥᑦ ᐊᑎᓯᕙᓕᐊᓂᕐᒧᑦ ᐊᖏᓕᕙᓕᐊᓂᐊᕐᑐᖅ

ᐅᕙᓗᓃᑦ ᓱᓂᕐᑕᐅᒐᔭᕐᑐᐊᓗᓂ ᐱᓗᐊᑎᓯᖕᒋᓂᓴᐅᑐᐃᓇᕆᐊᓕᒃ ᓯᓚᐅᑉ ᐊᓯᔨᕐᐸᓕᐊᓂᖕᒐᓄ ᑕᒪᑯᐊ ᐱᓪᓗᒋᑦ.