2012 Nunavut Research Licence Renewal Application: Wayne Pollard

Scientific Research #02 052 10R-M (multi-year)

Project Title: The permafrost hydrology and environmental significance of perennial springs in the Expedition Fiord area, Axel Heiberg Island

Project Leader: Wayne Pollard, McGill University,

2012 Research Team: Wayne Pollard, Chris Omelon, Melissa Ward, Alfonso Davila, Dale Andersen, Chris McKay and 1 student field assistant.

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

2012 Field sites: Sites on Axel Heiberg Island, including Expedition Fiord area (79º 25'N; 90º 45'W), Strand Fiord (79º 05'N; 90º 00'W), Whitsunday Bay (79º05'N; 87º00'W), Bunde Fiord (81º55'N ; 79º30'W) – same as previous years

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

Overview: This is an ongoing project concerned with the study of the hydrology and geomorphology of cold saline groundwater flow at several locations on Axel Heiberg Island. These springs are very unusual and provide valuable insights in to permafrost hydrology. The primary goal of this research is to understand how cold (~0ºC), saline groundwater interacts with permafrost and the high Arctic polar desert environment (ecosystem). A second goal is to assess how these springs affect the surrounding landscape. Specific aims include: (1) to determine the distribution and geographic extent of this type of groundwater system, (2) to determine the source and age of the groundwater, (3) to understand and explain landforms and processes related to the interaction between groundwater and permafrost, and (4) to describe the microbiology of springs, lakes and permafrost. Over the past few years our studies have provided new information about the limiting conditions of water and microbial life related to cold temperatures and a better understanding about landforms related to ground water. This is the only research on cold perennial springs being conducted in the high Arctic. These springs have no commercial value and our research is driven entirely by scientific questions.

Progress Report – 2010 fieldwork. Between March 25-April 10 we undertook measurements temperature and flow rate measurements for 2 groups of springs at Expedition Fiord. For the second year in a row we had problems with logistical support (PCSP) and were not able to complete most of our planned field studies, in particular we were not able to get to either Strand Fiord or Whitsunday Bay. However, I was able to collect water samples for ongoing monitoring of chemistry and environmental isotopes at Colour Peak and Gypsum Hill. I also completed annual GPS surveys of the ice and mound formations around the springs at Gypsum Hill, collected data from automatic weather stations as well as completing snow surveys (the latter are baseline data that form the core of environmental monitoring and climate change studies). These data indicate that 2010 was again a low snow year but fairly typical temperatures with a July maximum of + 10C and winter minimum of -48C. We did however experience heavy snow accumulations in April and again in late July. July snow also caused significant logistical problems. Aerial surveys of springs in other locations on Axel Heiberg Island planned for June were not possible due to logistical problems. In July we began fieldwork at a site very close to the Gypsum Hill spring that we believe is an inactive spring (old no longer flowing). This site is important because it will provide information about the geology that controls their occurrence.

2012 Proposed Research: I am again planning both late winter and summer periods of fieldwork, including: 2 weeks field beginning in early April and 2 weeks in late June, in both cases this work is based at the McGill Field Station at Expedition Fiord. The April observations are extremely important because it allows me to observe the nature and pattern of groundwater flow under cold conditions as well as allowing me to evaluate processes that occurred during the previous dark season. Field work at this time of year provides easier access to most of my study sites. My work will continue to focus on understanding the behaviour of saline groundwater under cold air temperatures and in particular the formation of surface ice deposits, frost mound structures and precipitates. I will collect water samples (~1 litre) for hydrochemical analyses that will be compared with previous year’s observations. Thee analyses document changes underground flow systems and the importance of chemistry on both physical and biological processes. These studies improve our understanding about the physical, chemical and biological processes occurring within these spring systems. Field activities will also include ground penetrating radar mapping of ice and spring deposits, snow surveys and the collection of data from several automatic weather stations. In June I will look for more active and relic spring sites that may exist on Axel and Ellesmere Islands. June field work will involve (a) measurement outflow temperatures, flow rates and chemistry of these spring systems, (b) sampling for microbial activity, (c) climate monitoring and (d) sampling and analysis of mineral precipitates. I will visit springs at Expedition, Strand and Bunde Fiords as well as Whitsunday Bay. I will collect samples from springs, lakes, surface runoff, soils and precipitation will be collected for chemical and biological analyses. I will dGPS map the location of spring outlets, flow paths and structures. I will repair and replace sensors on our network of automatic weather stations. This work will be based as the McGill field station at Expedition Fiord.

Significance: The results of this research are providing new and valuable information about the behaviour of water in cold permafrost. Together with my students and colleagues we have identified important geological characteristics related to perennial spring occurrence as well as new and unusual biological features. The results of this work have lead to partnerships with NASA who believe that these springs may help in the planning for the exploration of Mars. I am the only person in Canada doing this type of research.

2012ᒥ ᓄᓇᕗᕐᒥ ᑭᓕᓯᓂᐊᓂᕐᒧᑦ ᐱᔪᓇᐅᑎᒧᑦ ᓄᑕᐅᓕᕐᓂᒧᑦ ᑐᒃᓯᕋᐅᑎᒃ: ᕗᐃᓐ ᐹᓗᑦ

ᑭᓕᓯᓂᐊᕐᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᓂᖅ ᓇᓴᐅᑖ02 052 10R-M (ᐊᕋᒍᓄᑦ ᐊᒥᓱᓄᑦ)

ᐱᓕᕆᐊᕐᒪ ᑕᐅᔭᐅᔪᓯᐊ: ᖁᐊᖑᐃᓇᕐᑐᑦ ᑰᖃᑕᕐᑐᑦ ᐊᕙᑎᒧᓗ ᐱᒪᕆᐅᔪᑦ ᑰᖏᓇᕐᑐᑦ ᐃᒃᐱᑎᓴᓐ ᓯᒃᔭᕆᒃᑐᕐᐸᓯᒥᑐᑦ, ᐊᑯᓪ Hᐃᐴᒃ ᕿᑭᑕᖓᓂ.

ᐱᓕᕆᐊᑎᓄᑦ ᓯᕗᓕᕐᑎ: ᕗᐃᓐ ᐹᓗᑦ, ᒪᑭᐅᓪ ᓯᓚᑐᕐᓴᕐᕕᔪᐊᖓᓂᑦ,

2012ᒥ ᑭᓕᓯᓂᐊᕐᑎᐅᓂᐊᕐᑐᑦ: ᕗᐃᓐ ᐹᓗᑦ, ᑯᓇᔅ ᐅᒥᓛᓐ, ᒥᓕᓴ ᕗᐊᑦ, ᐃᐅᓪᕚᓱ ᑕᕖᓚ, ᑎᐅᓪ ᐊᓐᑐᓴᓐ, ᑯᓇᔅ ᒪᑲᐃ ᐊᒪᓗ ᐊᑕᐅᓯᖅ ᐃᓕᓂᐊᕐᑎ ᑕᐸᓂ ᐃᑲᔪᕐᑎᐅᓛᕐᑐᖅ.

2012ᒥ ᑕᐸᓂ ᐱᓕᕆᓂᐅᓛᕐᑐᖅ: ᐸᕐᓇᒃᓯᒪᔪᒧᑦ ᐊᐃᕆᓕ 5ᒥᑦ 17ᒧᑦ ᐊᒪᓗ ᔪᓂ 28ᒥᑦ ᔪᓚᐃ 10ᒧᑦ.

2012ᒥ ᐱᓕᕆᕕᒋᓛᕈᒪᔭᕗᑦ: ᐊᑯᓪ Hᐊᐃᐳᒃ ᕿᑭᑕᖓᓂ ᐊᑕᐅᓯᐅᖏᑐᕐᒥ, ᐃᓚᐅᓗᓂ ᐃᒃᐱᑎᓴᓐ ᓯᔭᕆᒃᑐᖅᐸᓯᒥ (79º 25'N; 90º 45'W), ᓯᑐᕐᖀᓐ ᓯᒃᔭᕆᒃᑐᖅ (79º 05'N; 90º 00'W), ᕗᐃᑦ ᓴᓐᑎ ᑲᖏᕐᓱᖓᓂ(79º05'N; 87º00'W), ᐸᓐᑎ ᓯᔭᕆᒃᑐᕐᒥ (81º55'N ; 79º30'W) – ᐊᐲᑐᐃᓇᖏᑦ ᐊᕋᒍᔪᕐᓂ ᓯᕗᓕᕐᓂ.

ᑭᓇᐅᔭᖃᑎᓯᔩᑦ: ᓱᓂᓯᒪᖏᑐᓂ ᑭᓕᓯᓂᐊᕐᑏᑦ ᐊᒪᓗ ᐊᐅᓚᓯᔩᖏᑦ ᑭᓕᓯᓂᐊᓂᒧᑦ ᑲᑎᒪᔩᖏᑦ ᑲᓇᑕᒥ

ᐱᓕᕆᐊᕆᓂᐊᕐᑕᕗᑦ: ᑕᒪᓇ ᐱᓕᕆᐊᕆᖃᑦᑕᕐᓯᒪᔭᕗᑦ ᓯᕗᓂᐊᓂ ᑲᔪᓯᓂᐊᕐᑐᑦ ᑕᕝᕙᓂ ᖃᐅᔨᓴᕐᑎᓗᑕ ᑰᒃᑐᓂᒃ ᐊᒪᓗ ᑰᒃᕕᒋᓇᐅᔭᕐᑕᖏᑦ ᓂᒃᓚᓇᕐᑐᑉ ᑕᕆᐅᖑᓗᓂ ᓄᓇᒥᑐᑦ ᑰᑦ ᐊᑕᐅᓯᐅᖏᑐᓂ ᓄᓇᖓᓂ ᐊᑯᓪ Hᐃᐴᒃ ᕿᑭᑕᖓᓂ. ᑖᒃᑯᐊ ᑰᑦ ᐱᑐᐃᓇᐅᖏᑐᑦ ᐊᒪᓗ ᐱᒪᕆᐅᔪᓂᒃ ᖃᐅᔨᑎᓯᕙᓕᐊᔪᑦ ᖁᐊᖑᐃᓇᕐᑐᑦ ᐊᐅᒃᐸᓕᐊᓂᖏᓂᒃ. ᑐᕋᒐᓗᐊᑕᕆᔭᕗᑦ ᑕᕝᕙᓂ ᑭᓕᓯᓂᐊᕈᑎᒋᔭᑎᓂ ᑐᑭᓯᔪᓇᕐᑯᓗᑕ ᖃᓄᑎᒋ ᓂᒃᓚᓱᒃᑎᒋᔪᑦ 0ᒥᒃ ᓂᒃᓚᓱᖑᓂᓕᒃ, ᑕᕆᐅᖑᓗᓂ ᓄᓇᒥ ᐃᒪᖅ ᐊᐅᒃᐸᓕᐊᑎᓯᓂᖓ ᖃᓄᐃᓕᖓᓪᒪᖔᑦ ᖁᐊᖑᐃᓇᕐᑐᓂᒃ ᐊᒪᓗ ᖁᑎᒃᑐᑉ ᐸᓂᕐᑐᓴᔭᖓᓚᑕ ᐊᕙᑎᖓᓂᒃ ᑐᑭᓯᑲᓂᖁᓗᑕ. ᐊᐃᐸᕆᔭᖓ ᑐᕋᕆᔭᑕ ᖃᓄᖅ ᑕᒪᑯᐊ ᑰᑦ ᓱᓂᖃᑦᑕᕐᒪᖔᑕ ᐊᕙᑎᖏᓂᒃ ᓄᓇᓂᒃ. ᑐᕋᒐᓗᐊᑕᕆᔭᕗᑦ ᐃᓗᓕᖃᕐᒥᔪᑦ ᐅᑯᓂᖓ (1) ᓇᓗᓇᐃᕈᒪᓗᕆᑦ ᓇᑯᑦ ᐊᒪᓗ ᓄᓇᖓᒍᑦ ᖃᓄᑎᒋ ᐅᖓᓯᒃᑎᒋᔪᕐᒧᑦ ᓄᓇᑰᖃᑦᑕᕐᒪᖔᑦ, (2) ᓇᓗᓇᐃᕈᒪᓗᒍ ᓇᑭᖓᒪᖔᑦ ᐊᒪᓗ ᖃᓄᑎᒋ ᓄᑕᐅᖏᑎᒋᒪᖔᖓ ᐃᒪᖓ ᓄᓇᒥᑐᖅ, (3) ᑐᑭᓯᔪᓇᕐᑯᓗᑕ ᐅᖃᐅᓯᕆᔪᓇᕐᓗᒍᓗ ᐊᕿᓯᒪᓂᖓ ᓄᓇᖓᑕ ᐊᒪᓗ ᖃᓄ ᑕᒪᓇ ᐊᒃᑐᐊᓂᖃᒪᖔᑦ ᓄᓇᒥᑐᕐᒥ ᐃᒪᕐᒥᒃ ᖁᐊᖑᐃᓇᕐᑐᕐᒥᓗ, ᐊᒪᓗ (4) ᑐᑭᓯᓇᓯᑎᓗᒍ ᐃᐲᖕᓄᑦ ᑕᑯᓴᐅᖏᑐᑦ ᐅᒪᔪᐃᑦ ᑰᖕᓂ, ᑕᕐᓯᓂ ᖁᐊᖑᐃᓇᕐᑐᓂᓗ. ᐊᓂᒍᕐᑐᓂ ᐊᒥᓱᖏᑐᒐᓗᐊᓂ ᐊᕋᒍᓂ ᖃᐅᔨᓴᕐᓂᓇᔭᕗᑦ ᐊᑐᐃᓇᕈᓯᓯᒪᒧᑦ ᐅᕙᑎᓄᑦ ᓄᑖᕐᓂᒃ ᑐᓴᕈᑎᓂᒃ ᖃᓄᐃᑐᕐᒥᒪᖏᑕ ᐃᓱᓕᑦᕕᓖᑦ ᐃᒪᐃᑦ ᐊᒪᓗ ᐃᓐᓄᑦ ᑕᑯᓴᐅᖏᑐᑦ ᐅᒪᔪᑦ ᓂᒃᓚᓱᒃᑐᕐᒥ ᐊᒪᓗ ᐃᑲᔪᕐᓗᓂ ᑐᑭᓯᓂᕐᓴᓇᓗᙶ ᓄᓇᐅᑉ ᐊᕿᓯᒪᓂᖓ ᐃᒪᐃᑦ ᓄᓇᒥᑐᑦ ᐱᓪᓗᒋᑦ. ᐅᓇ ᑭᓕᓯᓂᐊᕈᑎᑐᐊᕗᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᓂᓚᓱᒃᑐᕐᒥ ᑰᖏᓇᕐᑐᓂᒃ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ ᖁᑎᒃᑐᕐᒥ. ᑕᑯᐊ ᑰᑦ ᑭᓇᐅᔭᓴᐅᑎᒋᔭᖏᑕᕗᑦ ᐊᒪᓗ ᑭᓕᓯᓂᐊᕈᑎᕗᑦ ᑭᓕᓯᓂᐊᓂᒧᑦ ᐊᐱᕐᑯᑎᓂᒃ ᑭᐅᓇᓱᑐᐃᓇᕐᑐᖅ.

ᐱᓕᕆᐊᕕᓂᑕ ᐅᓂᑳᖕ - 2010 ᐱᓕᕆᕕᑎᓂ. ᐊᑯᓂᖓᓂ ᒪᐲ 25ᒧ ᐊᐃᕆᓕ 10ᐅᒧ ᐅᓇᕐᓂᓯᐅᒧᑦ ᖃᐅᔨᓴᖃᑕᓚᐅᑐᒍᑦ ᐊᒪᓗ ᑰᑐᓂᒃ ᐅᒃᑐᖃᑦᑕᕐᓗᑕ ᒪᕈᐃᓄᑦ ᑰᓄᑦ ᐃᒃᐱᑎᓴᓐ ᓯᔭᕆᒃᑐᕐᒥ. ᐊᐃᐸᖓᓂ ᐊᕋᒍᔪᕐᒥ ᑕᒪᐃᓂ ᐊᑲᐅᖏᓕᐅᕈᑎᖃᓚᐅᕋᑦ ᑕᐸᐅᖓᕐᑕᓂᒧᑦ ᐃᑲᔪᕐᑐᑕᐅᖏᓂᒧᑦ (ᑭᓕᓯᓂᐊᑐᓕᕆᔨᑯᑦ) ᐊᒪᓗ ᐱᔭᕆᕈᓇᓚᐅᖏᑕᕗᑦ ᐸᕐᓇᒃᓯᒪᔭᕗᑦ ᑕᐸᓂ ᖃᐅᔨᓴᕈᒪᔭᕗᑦ, ᐱᓗᐊᕐᑐᕐᒥ ᓯᑐᕐᖀᓐ ᓯᔭᕆᑐᒧᕈᓇᓚᐅᖏᓇᑕ ᕗᐃᑦᓴᓐᑎ ᑲᖏᕐᓱᖓᓄᓗ, ᑭᓯᐊᓂᓕ, ᐃᒪᕐᒥ ᐱᔪᓇᓚᐅᑐᖓ ᖃᐅᔨᓴᕈᑎᒃᓴᑎᓂᒃ ᖃᐅᔨᓴᕋᑎᒍᑦ ᐃᒪᕐᓗᖃᒪᖔᑦ ᐊᒪᓗ ᐊᕙᑎᒧᖓᔪᓗ ᐃᒪᕐᓗᖃᒪᖔᑦ ᑕᕐᓴᖅ ᖃᖃᒥ ᐊᒪᓗ ᑭᐸᓐ ᐱᖑᕐᒥ. ᐱᔭᕆᕈᓇᓚᐅᒥᔪᖓ ᖃᖓᑕᕐᑎᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᓗᖓ ᓯᑯᖓᓂᒃ ᖃᑎᓯᒪᔪᓗ ᓯᑯᐃᑦ ᑰᕐᐸᓯᖓᓂ ᑭᐸᓐ ᐱᖑᖓᓂ, ᓄᐊᑎᓗᑕᓗ ᓯᓚᓂᐊᕐᕕᑕ ᑐᖃᑦᑕᕐᕕᖓᓂ ᐱᔭᕆᕈᓇᓚᐅᒥᔭᕗᑦ ᐊᐳᑎᒧᑦ ᖃᐅᔨᓴᕈᑎᕗᑦ (ᑭᖑᓕᐅᔪᖅ

ᑎᑎᕋᐊᓕᐊᔪᖅ ᐊᕙᑎᐅᑉ ᐅᐊᓯᓂᖓᓂ ᓯᓚᐅᓗ ᐊᓯᔨᕐᐸᓕᐊᓂᖓᓂ ᖃᐅᔨᓴᕐᓂᕗᑦ). ᑕᑯᐊ ᓇᓗᓇᐃᓯᔪᑦ 2010ᖑᑎᓗᒍ ᐊᐳᑎᑭᑐᓚᐅᑐᖅ ᓯᓚᖓᓗ ᑕᐃᒪᐃᑐᓴᐃᓇᐅᓗᓂ ᔪᓚᐃᖑᑎᓗᒍ ᐅᖁᓛᖓ 10ᒥ ᐅᖁᓂᓕᒃ ᐊᒪᓗ ᐅᑭᐅᑯᑦ ᓂᓚᓱᖏᓛᖓ 48ᒥᒃ ᓂᒃᓚᓱᖕᓂᓕᒃ. ᑭᓯᐊᓂ ᐊᐱᔪᓛᓗᓚᐅᕐᑐᖅ ᐊᐃᕆᓕᐅᑎᓗᒍ ᓄᖑᐊᓂᓗ ᔪᓚᐃᒥ. ᔪᓚᐃᒥ ᐊᐱᓂᖓ ᓱᓂᓚᐅᑐᖅ ᑕᐸᐅᖓᕈᓇᕈᓂᕐᓗᑕ.. ᖃᖓᑕᕐᑎᑕᐅᓯᒪᔪᑯᑦ ᖃᐅᔨᓴᕈᑎᕗᑦ ᐅᐱᖔᑯᑦ ᐊᒪᓗ ᐊᓯᖏᓂ ᐊᑯᓪ Hᐃᐳᒃ ᕿᑭᑕᖓᓂ ᐸᕐᓇᓯᒪᓚᐅᑕᕗᑦ ᔪᓂᒧᑦ ᐊᔪᓇᓚᐅᑐᑦ ᖃᖓᑕᓱᖃᖏᒧᑦ. ᔪᓚᐃᒥ ᐱᒋᐊᓚᐅᑐᒍᑦ ᑕᐸᓂ ᐱᓕᕆᐊᑎᓂ ᖃᓂᒋᔭᖓᓂ ᑭᑉᓴᒻ ᐱᖒᑉ ᐅᐱᖔᑯᑦ ᐃᓱᒪᒋᔭᕗᑦ ᑰᖏᑐᕐᒥᒃ (ᓄᑕᐅᖏᑐᖅ ᑰᒍᓂᕐᑐᖅ). ᑕᐃᓇ ᓄᓇᖓ ᐱᒪᕆᐅᔪᖅ ᐱᔪᑎᒥᓗᒍ ᑐᓴᕈᑎᓂᒃ ᐱᕕᒥᔪᓇᕐᑎᒍᑦ ᓄᓇᖓ ᐱᓪᓗᒍ ᐊᐅᓚᓯᖕᒪᑦ ᖃᓄᐃᐸᓕᐊᔪᓂᒃ ᑕᐃᑲᓂ.

2012ᒥ ᑭᓕᓯᓂᐊᕈᑎᒥᔪᒪᔭᕗᑦ: ᐸᕐᓇᑲᓂᓕᕐᒥᔪᖓ ᐅᑭᐅᑯᑦ ᐊᒪᓗ ᐊᐅᔭᑯᑦ ᑕᐃᑲᓂ ᓄᓇᖓᓂ ᐱᓕᕆᔪᒪᓗᖓ, ᐃᓚᐅᓗᑎᒃ: ᐱᓇᓱᐊᕈᓯᓂ ᒪᕈᓂᒃ ᑕᐃᑲᓂ ᐱᓕᕆᓗᖓ ᐊᐃᕆᓕᐅᑉ ᐱᒋᐊᕐᓂᖓᓂ ᔪᓂᐅᑉ ᓄᖑᐊᓂ, ᑕᒪᐃᓂ ᑕᑯᐊ ᐱᓕᕆᓂᕆᔪᒪᔭᑲ ᒪᑭᐅᓪ ᐱᓕᕆᕕᐊᑕ ᑐᖃᑕᕐᕕᖓᓂ ᐃᒃᐱᑎᓴᓐ ᓯᒃᔭᕆᒃᑐᕐᒥ. ᐊᐃᕆᓕᒥ ᐅᕈᕆᔭᕗᑦ ᐱᒪᕆᔪᐊᕐᓗᔪᑦ ᐱᔪᑎᒥᓗᒍ ᑕᑯᔪᓇᕐᑕ ᐃᓄᖕᓄᑦ ᓱᓂᕐᑕᐅᓯᒪᖏᑐᓂᒃ ᖃᓄᐃᐸᓕᐊᔪᓂᒃ ᐊᒪᓗ ᓄᓇᒥ ᐃᒪᐅᑉ ᑰᒃᓂᖓ ᓂᓚᓱᒃᑐᐊᓗᒥ ᐊᒪᓗ ᑕᒪᐃᓕᐅᑎᓗᖓ ᐱᕕᖃᑎᑕᐅᒪᒪ ᖃᐅᔨᓴᕈᓇᕐᓗᖓ ᑕᐅᕙᒃᔪᐊᕐᖑᑎᓗᒍ ᖃᓄᐃᑐᕕᓂᕐᓂᒃ. ᑕᐸᓂ ᐱᓕᕆᓂᕆᔭᕗᑦ ᐃᒪᐃᑐᓗᐊᖑᐊᕐᑎᓗᒍ ᐊᕋᓂᐅᓚᐅᑐᖅ ᐱᕕᖃᑎᓯᖃᑕᕐᒪᑦ ᖃᐅᔨᓴᕐᕕᒋᔭᕗᑦ ᑕᒪᕐᒥ ᐅᐸᒍᓇᕐᓗᒋᑦ. ᐱᓕᕆᐊᕋ ᐃᓗᓕᖃᑲᓂᕐᓂᐊᕐᒥᔪᖅ ᐃᔨᒥᓗᐊᑕᕈᒪᓗᖓ ᖃᓄᐃᑐᓂᓇᔭᕐᒥᑦ ᑕᓇᐅᖑᔪᑦ ᖃᕐᐸᓯᐊᓂ ᑰᖃᑕᕐᑐᑦ ᓂᓚᓱᒃᑐᐊᓗᑎᓗᒍ ᐊᓚ ᖁᐊᖃᑕᕐᓂᖏᑦ ᖄᐸᓯᐊᓂ ᓯᑰᑉ ᑭᓱᑕᖃᒪᖔᑕ ᐊᒪᓗ ᐊᕙᑎᖓ ᖁᐊᓂᐅᖃᑕᕐᑐᑦ ᖃᓄᐃᓕᖓᓂᖏᑦ. ᓄᐊᑎᓛᕐᑐᖓ ᐃᒪᕐᓂᒃ (ᐃᖑᓯᕐᔪᐊᒥᒃ) ᖃᐅᔨᓴᕈᑎᒃᓴᕐᓂᒃ ᐃᒪᕐᓗᖃᒪᖔᑕ ᐊᒪᓗ ᖃᐅᔨᓴᕈᑎᒥᓗᒥᑦ ᖃᓄᐃᓂᓴᐅᓕᕐᒪᖔᑕ ᓯᕗᓂᐊᓂ ᐊᕋᒍᓚᐅᑐᓂ ᑕᑯᓯᒪᔭᑎᓂᑦ. ᑕᑯᐊ ᖃᐅᔨᓴᕈᑎᒥᓯᒪᔭᑕ ᓱᓕᔪᑦ ᑎᑎᕋᓯᒪᔪᑦ ᐊᓯᔩᔪᑦ ᓄᓇᐅᑉ ᐊᑖᒍᑦ ᑰᖃᑕᕐᓂᖓᑕ ᐊᕿᓯᒪᓂᖏᒃ ᐊᒪᓗ ᐱᒪᕆᐅᓂᖓ ᐃᒪᕐᓗᖃᓂᖏᑦ ᑕᒪᐃᓂ ᑕᑯᓴᐅᔪᑯᑦ ᐃᔨᓄᑦ ᑕᑯᓴᐅᖏᑐᕐᑎᒍᑦ. ᑕᑯᐊ ᖃᐅᔨᓴᕐᓂᕆᔭᕗᑦ ᐃᑲᔪᕐᐸᓕᔪᑦ ᑐᑭᓯᐅᒪᓂᑎᓂᒃ ᐃᔨᓄ ᑕᑯᓴᐅᔪᑦ, ᐃᒪᕐᓗᖏᑦ ᐊᒪᓗ ᐃᔨᓄ ᑕᑯᓴᐅᖏᑐᑦ ᐅᒪᔪᑦ ᖃᓄᐃᖃᑕᕐᒪᖔᑕ ᑕᑯᓇᓂ ᑰᒃᓂ.ᐱᓕᕆᐊᕗᑦ ᑕᐸᓂ ᐃᓗᓕᖃᑲᓂᕐᓂᐊᕐᒥᔪᖅ ᓄᓇᐅᑉ ᐃᑭᐊᖑᑦ ᖃᐅᒪᑕᔪᖑᐊᒧᖃᐃᓂᕐᒥᒃ ᓂᓚᖕᓂᒃ ᐊᒪᓗ ᑰᖕᓂᒃ, ᐊᐳᑏᑦ ᕿᖑᒥᓚᖃᑕᕐᓯᒪᔭᕗᑦ ᐊᒪᓗ ᓄᐊᓯᒪᔭᕗᑦ ᑎᑎᕋᓯᒪᔭᑦ ᐃᒥᓂ ᑎᑎᕋᐸᓕᐊᔪᓂᑦ ᓯᓚᓂᐊᕐᕕᓂᑦ ᐱᓗᑕ. ᔪᓂᐅᑎᓗᒍ ᕿᓂᑲᓂᓛᕐᑐᖓ ᑰᒃᑐᓂᒃ ᐊᒪᓗ ᑰᑐᖅᕕᓂᕐᓂᒃ ᐊᒃᓪᒥ ᐊᒪᓗ ᐃᐅᓪᔅᒥᐊ ᕿᑭᑕᖓᓂ ᐱᑕᖃᑐᐃᓇᕆᐊᖃᒪᑦ .ᔪᓂᒥ ᑕᐸᓂ ᐱᓕᕆᓂᕗᑦ ᐃᓗᓕᖃᓂᐊᕐᑐᖅ (ᐃ) ᐅᒃᑐᖅᓗᒥᑦ ᑯᑉ ᐅᓇᕐᓂᖏᑦ, ᖃᓄᑎᒥ ᑰᒃᑎᒥᒪᖔᑕ ᐊᒪᓗ ᐃᒪᕐᓗᖃᒪᖔᑕ ᑕᑯᐊ ᑰᑦ, (ᐱ) ᖃᐅᔨᓴᕈᑎᓂᒃ ᐱᓪᓗᑕ ᐃᔨᓄ ᑕᑯᓴᐅᖏᑐᓂᒃ ᖃᓄᐃᓕᕙᓕᐊᒪᖔᑕ, (ᑎ) ᓯᓚᐅᑉ ᐊᓯᔨᕐᐸᓕᐊᓂᖓᑕ ᐅᐊᓯᓗᒍ ᐊᒪᓗ (ᑭ) ᖃᐅᔨᓴᕈᑎᓂ ᐱᓪᓗᑕ ᖃᓄᐃᒪᖔᑕᓗ ᑎᑎᕋᓗᒥᑦ ᓴᕕᕋᔭᒃᓴᕈᔪᓂᒃ ᐱᑕᖃᒪᖔᑕ. ᐅᐸᓛᕐᑕᑲ ᑯᑦ ᐃᒃᐱᑎᓴᓐᒥ, ᓯᑐᕐᓃᒻ ᐊᒪᓗ ᐸᓐᑎ ᓯᔭᓇᒃᑐᕐᒥ ᐊᒪᓗᑕᐅᖅ ᕗᐃᑦᓴᓐᑎ ᑲᖏᓯᖕ. ᖃᐅᔨᓴᕈᑎᓴᓂ ᓄᐊᑎᓛᕐᑐᖓ ᑰᒃᓂᑦ, ᑕᓯᕐᓂᑦ, ᖄᐸᓯᐊᓂ ᑰᑯᓗᓂᑦ, ᓄᓇᔭᖓᓂᑦ ᐊᒪᓗ ᒪᖁᓂᑯᕕᕐᓂᓂᒃ ᓄᐊᑎᓗᖓ ᖃᐅᔨᓴᕐᓗᕐᒥᑦ ᐃᒪᕐᓗᖃᕐᓂᖓᑕ ᐃᔨᓄᓗ ᑕᑯᓴᐅᖏᑐᓂᒃ ᐅᒪᔭᖃᓚᓚᑦ. ᐊᕿᓯᐃᓂᐊᕐᑐᖅ ᐊᒪᓗ ᐊᓯᔨᕐᑐᓛᕆᓗᕐ ᖃᐅᔨᓴᕈᐲᑦ ᓯᓚᓂᐊᕐᐱᑎᒥᔭᕗᑦ ᑐᕐᑕᕐᕕᑎᓂ ᓯᓚᓂᐊᕐᓂᒧᑦ. ᑕᒪᓇ ᐱᓕᕆᐊᔪᕗᑦ ᑐᖓᕕᖃᓂᐊᕐᑐᖅ ᒪᑭᐅᑉ ᐱᓕᕆᕕᖓᑕ ᑐᕐᑕᕐᕕᐊᓂ ᐃᒃᐱᑎᓴᓐ ᓯᔭᓇᒃᑐᕐᒥ.

ᐱᒪᕆᐅᓂᖓ: ᑕᑯᐊ ᖃᐅᔨᔭᕗᑦ ᑕᐊᖓ ᑭᓕᓯᓂᐊᕈᑎᒥᔭᑎᓂᑦ ᐊᑐᐃᓇᕈᑎᓯᔪᑦ ᓄᑖᕐᓂᒃ ᐊᒪᓗ ᐱᒪᕆᐅᔪᓂᒃ ᑐᓴᕈᑎᓂᒃ ᐱᔪᑎᖃᑐᓂᒃ ᖃᓄᐃᑎᓂᓇᔭᕐᒥ ᐃᒪᐃᑦ ᓂᓚᓱᒃᑐᒥ ᓄᓇᖓᑕ ᖁᐊᖑᐃᓇᓂᕐᓗᓂ. ᑲᑎᓗᒥᑦ ᐃᓚᓂᐊᑎᑲᓗ ᐊᒪᓗ ᐃᖃᓇᐃᔭᖅᑎᑲ ᓇᓗᓇᐃᓯᒪᔭᕗᑦ ᐱᒪᕆᐅᓂᖓ ᓄᓇᖓᑕ ᖃᓄᐃᓕᕙᓕᐊᓂᖓ ᐱᔪᑎᓕᒃ ᑰᖏᓇᕐᑐᑦ ᐊᒪᓗ ᓄᑖᑦ ᐊᒪᓗ ᐱᑐᐃᓇᐅᖏᑐᑦ ᐅᒪᔪᐃᑦ ᐃᔨᓄ ᑕᑯᓴᐅᖏᑐᑦ ᖃᓄᐃᑐᓂᖏᑦ. ᑕᑯᐊ ᖃᐅᔨᔭᖁᕗᑦ ᐱᓕᕆᐊᑎᓂ ᐃᑲᔪᕐᓯᒪᔪᑦ ᐃᓚᐅᓚᕐᓗᑎᒃ ᑭᓇᐅᔭᖅᑎᓯᐳᒥᔭᕗᑦ ᑕᑯᐊᓗ ᐅᒃᐱᕈᓱᒃᑐᑦ ᑕᑯᐊ ᑰᑦ ᐃᑲᔪᑐᐃᓇᓇᐊᓛᑦ ᐸᓇᒍᑎᒥᒃ ᐃᖏᕋᕕᒥᓕᔭᕐᑕᖏᓄᑦ ᓯᖑᕆᒧᑦ. ᐅᕙᖓᑐᐊᕐᓯᐊᖅ ᐃᓄᑐᔪᖓ ᑲᓇᑕᒥ ᐃᒪᐃᑐᒃᓴᔭᕐᒥᒃ ᑭᓕᓯᓂᐊᕈᑎᖃᓗᖓ.