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Nunavut Water Board P.O. Box 119
Gjoa Haven, Nunavut X0B 1J0 Canada

26 February 2017

Dear Nunavut Water Board Manager of Licensing:

RE: Application for the use of water or deposit of waste without a licence

Please find attached a completed and signed application for the use of water or deposit of waste without a licence, in support of planetary analog research at Haughton Crater, Devon Island, Nunavut, in July 2017.

This document is being submitted electronically (filename: FMARS NWB Application 2017.pdf).

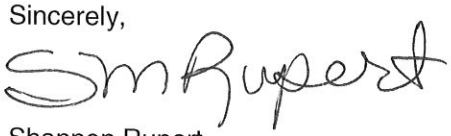
Included in this file are, in the following order:
1) This cover letter [page 1]
2) Executive summary of application (in English) [page 2]
3) Executive summary of application (in Inuktitut) [page 3]
4) Application for the use of water or deposit of waste without a licence [pages 4–14]

In addition to this application, I have submitted an application to the Wildlife Research Section, Nunavut Department of Environment for a Wildlife Research permit, a research permit application to the Nunavut Research Institute, and an application to Qikiqtani Inuit Association for Access to Inuit Owned Land.

If the application is missing information, please do not hesitate to contact me for further details.

Thank you for considering this signed application for the use of water or deposit of waste without a licence.

Sincerely,



Shannon Rupert
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EXECUTIVE SUMMARY OF WATER LICENCE APPLICATION

1 March 2017

Applicant: Shannon Rupert

Research Project Title: Planetary analog studies at the Flashline Mars Arctic Research Station.

Location of the Undertaking:
The Flashline Mars Arctic Station (75° 25.882'N, 89° 49.408'W) and surrounding area near the Haughton Crater on the northern coast of Devon Island, Nunavut.

Description of the Undertaking: We are conducting Martian planetary analog studies at the Flashline Mars Arctic Research Station on Devon Island, Nunavut in support of both a biological and geological field research programme.

Biology: A research team on a simulated mission to Mars will compare soil ecology, microbial ecosystems, lichen diversity and hypolithic cyanobacteria in two extreme environments: the deserts of southeastern Utah (research now complete) and the area near Haughton Crater on Devon Island, Nunavut.

Comparing the microbial communities of these Martian-analog sites should yield insights into the success of microbial communities in these environments and ecological and genetic factors contributing to their local abundance and fitness. Comparing these two environments using the same team and the same analytical methods will test the biological similarity of far-separated Martian analogues.

Geology: The Haughton Impact Structure has been identified as the furthest north meteor impact crater in the world. Its unique location in the Canadian arctic has exposed it various physical and weathering processes not seen on other impact structures on Earth. It has experienced several periods of glaciation throughout its history and presently hosts a number of periglacial landforms that are of particular interest to planetary geoscientists.

There are a number of locations around the crater floor that host patterned ground features that are the result of the ground swelling and contracting due to seasonal temperature changes that cause the top layer of permafrost to melt and re-freeze. Over time, this process creates patterned ground landforms, also called polygons that can provide additional insight into the nature of the permafrost in the area while also serving as an analogue for similar features that have been identified in periglacial environments on Mars.

Water use: Water will be used only for domestic purposes (drinking, cooking, washing) in our field camps.

Quantity of water involved: 6 people x 5L/person/day = 35 L/day = 0.035 m^3/day

Waste: Grey water (from cooking and washing). Sewage (human excrement; six people)

Other persons or properties affected by the undertaking: n/a

Predicted environmental impacts of the undertaking and proposed mitigation measures: None expected, as we will be using a very small volume of water, only for domestic purposes.

ᓇᐃᓈᕆᐊᖅᑕᐅᓪᓗᑎᒃ ᐃᒥᖅᑲᖅᑎᑕᐅᔪᒪᓂᕐᒧᑦ ᓚᐃᓴᑖᕈᒪᓪᓗᑎᒃ ᑐᑭᓯᐅᑎᖏᑦ ᐃᓯᒪᑕᐃᑦ

ᒫᔾᔨ 1, 2017

ᑐᑭᓴᖅᑐᖅ: ᓵᓇᓐ ᕿᐳᕐᑦ

ᖃᐅᔨᓴᐃᓂᖅᑲᕐᓗᑎᒃ ᐱᓕᕆᐊᖑᑲᐃᓐᓇᖅᑐᑉ ᑕᐃᔭᐅᓂᖓ: ᐊᑦᔨᒌᒃᓚᒃᑰᓂᖅᑲᕐᓂᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᖅ ᒫᓐ ᐅᑭᐅᖅᑕᖅᑐᒥ ᖃᐅᔨᓴᕐᕕᒻᒥ ᐱᓕᕆᐊᖑᔪᓄᑦ ᐃᑎᕈᓐᓇᐅᑎᑦ.

ᓇᓂ ᐱᓕᕆᓂᖅᑲᕐᓂᐊᕐᓂᖓᑦ:
ᒫᓐ ᐅᑭᐅᖅᑕᖅᑐᒥ ᖃᐅᔨᓴᕐᕕᖓᑦ (75° 25.882'N, 89° 49.408'W) ᓄᓇᖓ ᐊᒻᒪᓗ ᐊᕙᑎᒋᔭᖓᓂ Hᐊᐅᑕᓐ ᐃᑎᖅᓴᕐᔭᐊᖓᓂ ᑲᓇᖕᓇᖅᐸᓯᐊᑕ ᑕᓪᓗᕈᑦ ᕿᑭᖅᑕᖓᑕ ᓯᓪᔭᖓᓂ, ᓄᓇᕗᒻᒥ.

ᐱᓕᕆᐊᖑᕝᕕᐅᓂᐊᖅᑐᓄᑦ ᓇᓗᓇᐃᔭᐅᑏᑦ: ᒫᓐᒥ ᓄᓇᒥ ᐊᑦᔨᒌᒃᓚᓐᓂᐅᔪᓂᒃ ᐱᕈᖅᑐᖅᑯᑎᐅᔪᓄᑦ ᖃᐅᔨᓴᖅᑎᐅᕙᒧᑦ ᒫᓐ ᐅᑭᐅᖅᑕᖅᑐᒥ ᖃᐅᔨᓴᕐᕕᒻᒥ ᑕᓪᓗᕈᑦ ᕿᑭᖅᑕᖓᓂ, ᓄᓇᕗᒻᒥ ᐃᑲᔪᖅᑎᒋᔭᐅᓪᓗᑕ ᐆᒪᓂᖅᑲᖅᑐᓕᕆᓂᕐᒥ ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᑕᐅᑦᑐᕆᔭᖓᓂᒃ ᖃᐅᔨᓴᐃᓂᐅᓪᓗᓂ ᐱᓕᕆᐊᖑᔪᓗᑦ. ᖃᐅᔨᓴᕐᕕᐅᔪᒧᑦ ᐅᐊᔭᕐᕕᖅᑲᕐᓂᐊᖅᑐᒧᑦ ᔫᓂ ᑕᖅᑭᖓ ᐊᑐᓕᓵᖅᑎᓪᓗᒍ ᐱᒋᐊᕐᓗᑕ ᑎᑭᓪᓗᒍ ᓯᑦᑎᐱᕆ ᑕᖅᑭᖓ ᐊᑐᓕᓵᖅᑎᓪᓗᒍ ᒪᕐᕈᓕᐊᓛᒃᑯᑦ ᖃᖓᑕᔫᒃᑯᖅᐸᒃᓗᑕ ᓵᑕᒋᔭᐅᕙᒃᑐᓂᒃ ᖃᐅᓯᐃᑦᑐᑉ ᓄᓇᓕᖓᓂᑦ, ᐊᒻᒪᓗ ᖃᐅᔨᓴᕐᕕᐅᔫᒥᓐᓂᑦᑎᓐᓂ ᐅᐊᔭᕈᑎᖅᑲᖅᐸᓐᓂᐊᖅᑐᒧᑦ Hᐋᓐᑕᓂᒃ ᐊᒻᒪᓗ ᐱᓯᖁᔭᒃᐸᓪᓗᑕ. ᐆᒪᓂᖅᑲᖅᑐᓂᒃ ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᑕᐅᑦᑐᖓᓂᒃ ᖃᐅᔨᓴᐃᓂᐅᔪᑦ ᓇᓗᓇᐃᔭᖅᑕᐅᓯᒪᓪᓗᑎᒃ ᑖᒃᑯᐊ ᐊᑖᓂ ᑕᒪᕐᒥ ᐃᓚᖅᑲᖅᑎᑕᐅᓂᐊᖅᐳᑦ ᑲᑎᖅᓯᐃᖅᑲᑦᑕᕐᓂᕐᒥ ᒥᑭᑦᑑᑎᐅᓪᓗᑎᒃ ᐅᔭᖅᑲᓂᒃ ᐊᒻᒪᓗ ᐱᕈᖅᑐᕐᑯᑎᓂᒃ ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓐᓂᕐᓂᐊᖅᑐᓂᒃ ᖃᐅᔨᓴᕐᕕᒻᒥ.

ᐆᒪᓂᖅᑲᖅᑐᓕᕆᓂᖅ: ᖃᐅᔨᓴᐃᓂᕐᒥ ᐱᓕᕆᐊᖅᑲᖅᑲᑎᒌᒃᑎᐅᔪᑦ ᒫᓐ ᓄᓇᖅᔭᐊᖓᓄᑦ ᓲᕐᓗ ᑎᓕᔭᐅᓯᒪᔾᔭᑎᖅᑲᖕᒍᐊᖅᑎᑕᐅᓪᓗᑎᒃ ᐊᑦᔨᒌᕐᓚᓐᓂᕆᔭᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᖅᑲᕐᓂᐊᖅᑐᑦ ᒪᕋᕐᓂᒃ, ᐃᔨᒧᑦ ᑕᑯᓴᐅᖕᖏᑦᑐᑎᒃ ᐆᒪᓂᖅᑲᖅᑐᖅᑯᑎᓂᒃ, ᖁᐊᔭᐅᑎᖅᑯᑏᑦ ᐊᑦᔨᒌᖕᖏᓐᓂᕆᔭᕐᖏᓂᒃ ᐊᒻᒪᓗ ᐅᔭᖅᑲᑦ ᐊᑖᓂ ᐱᕈᖅᐸᒃᑐᖅᑯᑎᐅᔪᓂᒃ ᒪᕐᕈᐃᖑᓪᓗᑎᒃ ᐊᕙᑎᒋᔭᐅᔪᓂ: ᓯᐅᕋᐃᓐᓇᖅᔭᐊᖏᓂ ᓄᓇᖏᑕ ᓯᕿᓂᖅᐸᓯᐊᓃᑦᑐᓄᑦ ᔩᑖᒥ (ᑕᒪᓐᓇ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐱᔭᓅᖅᑕᐅᓯᒪᓕᖅᑐᖅ) ᐊᒻᒪᓗ Hᐊᐅᑕᓐ ᐃᑎᖅᓴᕐᔭᐊᖓᓂ ᖃᓂᒋᔭᖓᓃᑦᑐᒥ ᑕᓪᓗᕈ ᕿᑭᖅᑕᖓᓄᑦ, ᓄᓇᕗᒻᒥ.

ᐃᔨᒧᑦ ᑕᑯᓴᐅᖕᖏᑦᑐᖅᑯᑎᐅᔪᑦ ᑖᒃᑯᓇᓂ ᒫᓐ ᐱᕈᖅᑐᖅᑯᑎᖏᑕ ᐊᑦᔨᒌᖅᓚᒃᑰᓂᖏᓂᒃ ᖃᐅᔨᓴᕐᕕᐅᔪᓄᑦ ᐱᓕᕆᓂᖅᑲᕐᓂᖅ ᓄᓇᓂ ᐱᑦᖃᓕᕈᑎᐅᓂᐊᖅᑭᓯᕆᔭᐅᕗᑦ ᑕᑯᓴᐅᖕᖏᑦᑐᖅᑯᑎᓂᒃ ᐱᑕᖃᐅᖅᓂᖏᑦ ᐊᕙᑎᒋᔭᐅᔪᓂ ᐊᒻᒪᓗ ᐱᕈᖅᑐᖅᑯᑎᐅᔪᓄᑦ ᐆᒪᓂᖅᑲᖅᑐᓄᑦ ᐊᒻᒪᓗ ᐊᑦᔨᒌᒃᓚᒃᑐᖅᑲᕐᓂᐅᔪᓄᑦ ᐃᑲᔪᕈᑎᐅᓚᖁᔭᖅᑐᓂᒃ ᓄᓇᓚᖓᑕ ᐊᕙᑎᖓᓂ ᐱᑦᑲᐅᖅᑰᓂᖓᓄᑦ ᐊᒻᒪᓗ ᖃᓄᐃᖏᑦᑎᐊᖅᑰᓂᖏᓄᑦ ᐱᕈᖅᐸᓐᓂᕐᒥᓐᓂ. ᖃᓄᖅ ᐊᑦᔨᒌᖅᓚᖕᓂᖅᑲᕝᕕᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᖅ ᑖᒃᑯᓇᓂ ᐊᕙᑎᒋᔭᐅᔪᓂ ᐱᓕᕆᔩᖅᑲᕐᓗᑎᒃ ᑖᒃᑯᓂᖕᒐᔅᓴᐃᓐᓇᖅ ᖃᐅᔨᓴᖅᑎᐅᔪᓂᒃ ᐊᒻᒪᓗ ᖃᐅᔨᒥᐊᕈᑎᒋᕙᒃᑕᒥᓐᓂᒃ ᑖᒃᑯᓂᖕᒐᔅᓴᐃᓐᓇᖅ ᐊᑐᕐᓂᐊᕐᓂᖏᑦ ᖃᐅᔨᓴᐃᔾᔪᑎᐅᓂᐊᕐᒪᑕ ᐆᒪᓂᖅᑲᖅᑐᑦ ᐊᑦᔨᒌᒃᓚᓐᓂᖅᑲᕐᓂᖏᑕ ᐅᖓᓯᒃᑐᖅᑯᑎᒻᒪᕆᐊᓗᒃᑲᓗᐊᖅᑎᓪᓗᒋᑦ ᒫᓐᒥ ᐱᕈᖅᑐᖅᑯᑎᐅᔪᓄᑦ ᐊᑦᔨᒌᒃᓚᓐᓂᖏᓂᒃ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᓄᑦ.

ᓄᓇᑉ ᑕᐅᑦᑐᓇᔭᖕᒐ: Hᐊᐅᑕᓐ ᐊᒃᑐᖅᑕᐅᓯᒪᓂᖅᑲᖅᑐᓂ ᓇᑉᐸᖅᑎᑕᐅᓯᒪᔪᖅ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᓕᕐᒪᑦ ᑲᓇᖕᓇᖅᐸᓯᒻᒪᓇᐊᓃᑦᑑᓪᓗᓂ ᐊᓂᕐᓂᖅᑲᕐᓇᖏᑦᑐᒥᑦ ᑲᑕᒐᕐᕕᐅᓯᒪᓪᓗᓂ ᐃᑎᖅᓴᕐᔭᐊᖑᓂᖓᑕ ᓯᓚᕐᔭᐊᓕᒫᒥ. ᓇᓃᑦᑐᓂᖕᒪᑕ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖕᒪᓂ ᐊᒃᑐᖅᑕᐅᓯᒪᓂᖅᑲᓕᕐᒪᑦ ᐊᔾᔨᖕᒋᐅᖅᑐᑎᒍᑦ ᓄᓇᒥᑦ ᐊᒻᒪᓗ ᓯᓚᖕᒪᑕ ᖃᓄᐃᑦᑑᕙᓐᓂᖕᒪᓂᑦ ᐊᑦᔨᐅᖏᓐᓂᖅᑲᓗᐊᖕᖏᒪᑦ ᐊᒃᑐᖅᑕᐅᓯᒪᓂᐅᔪᓂᑦ

ᐱᑕᕐᑲᕐᕕᐅᓪᓗᑎᒃ ᓄᓇᕐᔪᐊᕐᒥ. ᑕᐃᒪᖖᒐᓂᑦ ᐃᑎᖅᓯᕐᔪᐊᖑᓕᕐᕕᐊᓂ ᐊᒥᓱᐃᖅᑕᕐᓚᒃᑐᒍ ᓱᑯᐊᓗᒻᒥᑦ ᑕᓗᔭᐅᕐᑲᑦᑕᖅᓯᒪᓂᕐᑲᕐᐸᖅ ᐊᒻᒪᓗ ᐅᓪᓗᒥᐅᓕᖅᑐᒥ ᓱᑯᐊᓗᕐᑲᓕᖅᐸᓐᓂᐅᔪᒥᑦ ᐊᒃᑐᖅᑕᐅᓯᒪᓪᓗᓂ ᕐᑯᐊᕐᑲᑦᑕᖅᓯᒪᓂᕐᑲᖅᑐᑎᒃ ᓄᓇᐃᑦ ᐊᕙᑎᖕᒐᓃᑦᑐᑦ ᐱᔾᔪᑎᒋᓪᓗᒋᑦ ᓄᓇᒥ ᐱᕈᖅᑐᕐᑯᑎᓕᕆᓂᕐᒧᑦ ᓄᓇᐅᑉ ᑕᐅᑦᑐᖕᒐᓂᒃ ᖃᐅᔨᓴᖅᑎᐅᔪᓂᑦ ᖃᐅᔨᓴᕐᕕᐅᔪᒪᑦᑐᑎᐅᓗᐊᕈᑎᒋᖕᒪᒍ.

ᐊᒥᓲᕐᓚᐅᒻᒪᑕ ᐃᑎᖅᓯᕐᔪᐊᑉ ᓇᑎᐊᓂ ᖃᓄᐃᓕᖕᒐᓕᖅᓯᒪᓂᕐᑲᕐᕕᐅᔪᑦ ᑕᐃᒪᐅᓕᕈᑎᕐᑲᖅᓯᒪᓪᓗᑎᒃ ᓄᓇᐅᑉ ᕐᑯᕝᕙᓯᒃᓯᓯᒪᓕᖅᐸᓐᓂᖕᒐᓂᑦ ᐊᒻᒪᓗ ᐅᑭᐅᖅ ᐊᑐᖅᐸᓪᓕᐊᓂᖕᒐᓂ ᓂᓪᓚᓱᓐᓂᖕᒐᑕ ᐊᓯᔾᔨᕐᑲᑦᑕᕐᓂᖕᒐᓂ ᕐᑲᓕᓇᔭᖕᒐ ᕐᑯᐊᖑᐃᓐᓇᖅᑐᑉ ᓄᓇᐅᑉ ᐊᐅᒃᐸᓪᓕᐊᕐᑲᑦᑕᖅᓯᒪᒻᒪᑦ ᐊᒻᒪᓗ ᕐᑯᐊᕈᒃᑲᓐᓂᖅᐸᒃᑐᓂ. ᑕᐃᒪᓐᓇᐃᑉᐸᓪᓕᐊᓂᖕᒐᓂ, ᑕᐃᒪᓐᐃᑉᐊᓐᓂᖕᒐ ᐱᑕᕐᑲᓕᕈᑎᐅᒻᒪᑦ ᖃᓄᐃᓕᖕᒐᓕᕐᓂᐅᔪᓄᑦ ᓄᓇᐅᑉ ᑕᐅᑦᑐᖕᒋᓂ, ᐊᒻᒪᓗ ᑕᐃᔭᐅᒻᒥᔪᑦ ᐹᓚᒃᑳᓐᓯ ᑐᑭᕐᑲᖅᑐᓂ ᒪᕐᕈᐃᓕᖕᒐᔪᑎᒎᑦ ᑕᐅᑦᑐᕐᑲᓕᖅᐸᓐᓂᐅᔪᓂᒃ ᐱᑕᕐᑲᕐᓂᖕᒐᓄᑦ ᑐᑭᓯᕝᕕᐅᓯᒪᓕᕈᓐᓇᕐᒪᑕ ᕐᑯᐊᖑᐃᓐᓇᖅᑐᑉ ᖃᓄᐃᑦᑑᓂᖕᒐᓄᑦ ᐊᕙᑎᐅᔪᒥ ᐊᒻᒪᓗ ᐊᑦᔨᕌᕐᓚᖕᓂᕐᑲᕐᕕᐅᔪᓄᑦ ᖃᓄᐃᓕᖕᒐᓐᓂᐅᔪᓄᑦ ᐃᑲᔪᕈᑎᐅᓕᕐᓗᓂ ᓇᓗᓇᐃᔭᖅᑕᐅᓯᒪᓪᓗᑎᒃ ᓱᑯᐊᓗᖕᒥᑦ ᐊᒃᑐᖅᑕᐅᓯᒪᓕᖅᐸᓐᓂᖕᒐᑕ ᐊᕙᑎᒋᔭᐅᔪᓄᑦ ᒫᖕᒥ.

ᐃᒥᕐᒥᒃ ᐊᑐᖅᐸᓐᓂᖅ: ᐃᒥᕐᒥᒃ ᐊᑐᖅᐸᓐᓂᐊᖅᑐᑦ ᑭᓯᐊᓂ ᐊᑐᖅᑕᐅᔭᓇᐊᕐᑲᖅᐸᒃᑐᓂᒃ (ᐃᒥᕐᑯᑎᒋᓗᒍ, ᓂᓇᔭᒃᓴᓕᐅᕈᑎᒋᓗᒍ, ᐅᐊᓴᐅᑎᒋᓗᒍ) ᖃᐅᔨᓴᕐᕕᒋᔭᑦᑎᓐᓂ.

ᐃᒥᐅᑉ ᐱᐅᑦᑎᐊᖅᑑᓂᖕᒐᑕ ᐱᔾᔪᑎᐅᕐᑲᑕᐅᓂᖕᒐ: 6-ᖑᔪᑦ ᐃᓄᐃᑦ x 5L/ᐊᑕᐅᓯᕐᒧᑦ ᐃᓄᒻᒧᑦ/ᕐᑲᐅᑕᒦᑦ = 35 L/ᐅᓪᓗᕐᒥ = 0.035 m^3/ᐅᓪᓗᕐᒥ

ᐊᒃᑕᑯᑦ: ᐅᐊᓴᐅᑎᐅᓯᒪᔪᖅᔭᐊᑐᖅᑕᐅᓯᒪᔪᖅ ᐃᒥᖅ (ᓂᓇᔭᔅᓴᓕᐅᕈᑎᒋᓪᓗᒍ ᐊᒻᒪᓗ ᐅᐊᓴᐅᑎᒋᓪᓗᒍ). ᐃᑎᕈᖅ (ᐃᓅᐸᐊᓇᖓ; ᐊᕐᕕᓂᓖᑦ ᐃᓄᐃᑦ)

ᐊᓯᖕᒋᑦ ᐃᓄᐃᑦ ᐅᕝᕙᓘᓐᓃᑦ ᓇᖕᒥᓂᕐᑯᑎᒋᔭᐅᔪᑦ ᐱᓕᕆᐊᒥᑦ ᐊᒃᑐᖅᑕᐅᓯᒪᓂᖕᒋᑦ: ᐱᑕᕐᑲᖖᒋᑦᑐᖅ

ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᓂᖕᒐ ᐊᕙᑎᐅᑉ ᐊᒃᑐᖅᑕᐅᓯᒪᓇᔭᕐᓂᖕᒐᑕ ᐱᓕᕆᐊᖑᔪᒥᑦ ᐊᒻᒪᓗ ᐱᓗᐊᖅᑕᐃᓕᑎᑦᑎᓯᒪᓂᐊᕐᓗᒋᑦ ᐱᓕᕆᓂᐅᓇᔭᖅᑐᑦ: ᑕᐃᒪᓐᓇᐃᑦᑐᕐᑲᕐᓂᐊᖖᒋᑦᑐᖅ, ᐱᔾᔪᑎᒋᓪᓗᒍ ᒥᑭᑦᑐᒻᒪᕆᒍᓪᓗᒥᒃ ᐃᒥᕐᒥᒃ ᐊᑐᖅᓯᒪᓂᐊᕐᕋᑦ, ᓄᓇᒥ ᓇᔪᖅᑕᑦᑎᓐᓂ ᑭᓯᐊᓂ ᐊᑐᖅᐸᓐᓂᐊᕐᓂᕚᑦ.

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kNK5 wmoEp5 vtmp5
NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYIT
OFFICE DES EAUX DU NUNAVUT

APPLICATION FOR APPROVAL FOR THE USE OF WATER OR DEPOSIT OF WASTE WITHOUT A LICENCE

Refer to the *Guide to the Approval for the Use of Water or Deposit of Waste Without a Licence* (Guide) in completing this Application.

APPLICATION NO:
(for NWB use only)

1. APPLICANT CONTACT INFORMATION (name, address)

Shannon Rupert
Mars Society
11111 W 8th Ave Ste A
Lakewood, Colorado
80215-5516
USA

Phone: **1-505-927-4927**
e-mail: srupert@marssociety.org

2. APPLICANT REPRESENTATIVE CONTACT INFORMATION if different from Block 1 (name, address)

Phone: _____
Fax: _____
e-mail: _____
(Attach authorization letter)

3. NAME OF THE OWNER OF THE LAND THAT WILL BE USED IN RELATION TO THE WATER TO BE USED OR THE WASTE TO BE DEPOSITED

Crown land

4. NAME OF PROJECT (consistent with the name of the project issued by other regulatory agencies)

Project title: **Lichens of the High Arctic; Comparative microbial ecology of extreme environments in deserts and Polar Regions conducted with Mars mission simulation techniques.**

Project location:
The Flashline Mars Arctic Station (75° 25.882'N, 89° 49.408'W) and surrounding area near the Haughton Crater on the northern coast of Devon Island, Nunavut.

Project Extents

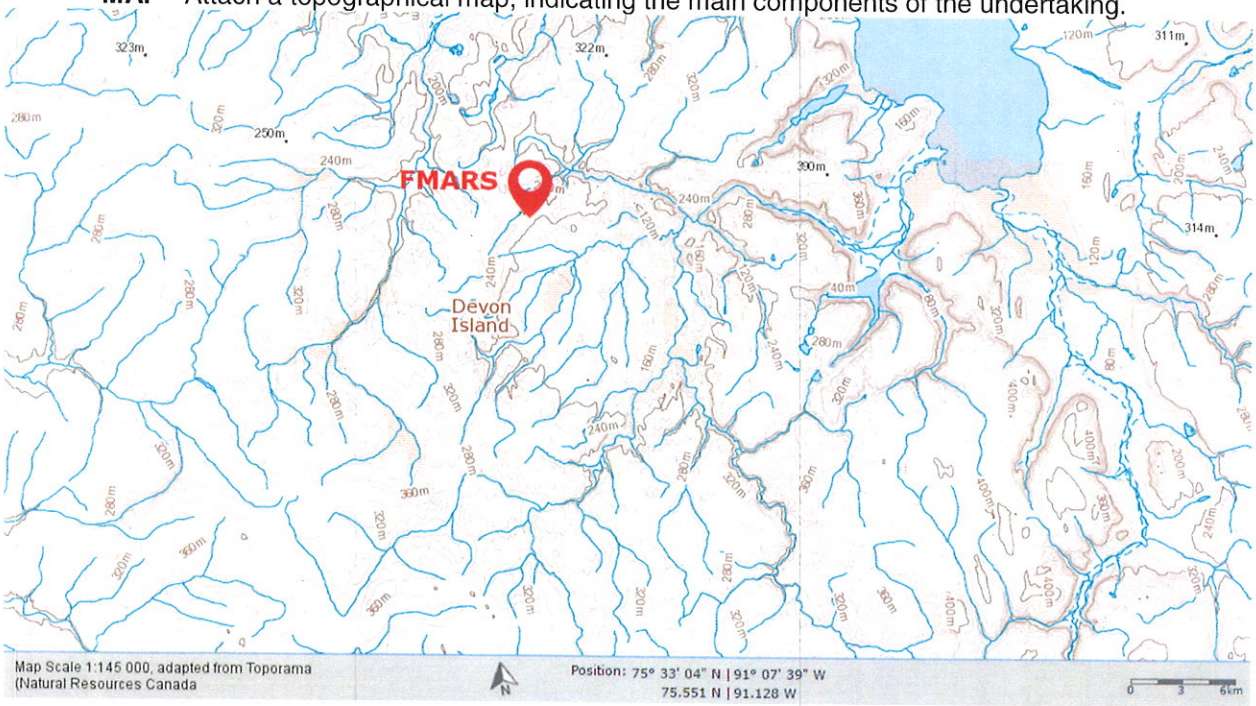
NW: Latitude: (**75°27'N**) Longitude: (**90°16'W**)
NE: Latitude: (**75°27'N**) Longitude: (**89°01'W**)

SE: Latitude: (**75°17'N**) Longitude: (**89°01'W**)
SW: Latitude: (**75°17'N**) Longitude: (**90°16'W**)

Camp Location(s):

Flashline Mars Arctic Station (75° 25.882'N, 89° 49.408'W)

MAP - Attach a topographical map, indicating the main components of the undertaking.



NTS Map Sheet No.: **58H** Map Name: **Bear Bay West**
Map Scale: **1:145 000**

Name of the Water Management Area in which the Undertaking is located. (Please see Appendix D of the Guide):
57. EASTERN DEVON ISLAND WATERSHED

5. CLASSIFICATION OF UNDERTAKING - Indicate the classification of undertaking by checking one of the following boxes.

- ☐ Industrial
- ☐ Mining
- ☐ Conservation
- ☐ Municipal
- ☐ Agricultural
- ☐ Recreational
- ☐ Power
- ✔ Other: (describe)

We will be conducting astrobiology and planetary geology research in the regions in which we plan to work (see project proposal below).

6. **DESCRIPTION OF UNDERTAKING AND EQUIPMENT USED** – Provide a brief description of the undertaking including a description of any equipment that will be used in using water or depositing waste.

Planetary analog studies at the Flashline Mars Arctic Research Station.

We are conducting Martian planetary analog studies at the Flashline Mars Arctic Research Station on Devon Island, Nunavut in support of both a biological and geological field research programme.

Biology: Comparative microbial ecology of extreme environments in deserts and Polar Regions conducted with Mars mission simulation techniques.

Summary: A research team on a simulated mission to Mars will compare soil ecology, microbial ecosystems, lichen diversity and hypolithic cyanobacteria in two extreme environments: the deserts of southeastern Utah and the area near Haughton Crater on Devon Island, Nunavut. Comparing the microbial communities of these Martian-analog sites should yield insights into the success of microbial communities in these environments and ecological and genetic factors contributing to their local abundance and fitness. Comparing these two environments using the same team and the same analytical methods will test the biological similarity of far-separated Martian analogues.

Project Rationale: Martian analog sites are locations on Earth selected as testbeds for Martian planetary exploration based on their remoteness and geological and meteorological similarities to Mars (Sokoloff et al. 2016). Microbial organisms, such as lichens and cyanobacterial hypoliths, are ecologically important in these environments due to their resistance to UV radiation and desiccation, characteristics that make them particularly interesting to astrobiologists (Sokoloff et al. 2016). Comparing the microbial communities of these Martian-analog sites, using a single team and the same techniques at both stations, should yield insights into the success of microbial communities in these environments and ecological and genetic factors contributing to their local abundance and fitness.

Lichens

Lichens are one of the best known extremophiles. Although lichens are found in temperate settings they are also present in extreme deserts and in Polar Regions. Lichens are a composite organism with a multicellular fungus (mycobiont) providing structure and environmental protection while a photosynthetic component (photobiont) provides carbon sources via photosynthesis. Many lichens can survive on atmospheric humidity only. Indeed, lichens define the lower limit of survival at low water activity (eg. Palmer and Friedmann 1990).

At MDRS and FMARS these species grow in rock and soil, and exchange photobionts with endolithic colonies of algae and biological soil crusts (Sokoloff et al. 2016). Characterizing the biodiversity and substrate ecology of lichens at Haughton Crater will provide information valuable to ongoing planetary analogue research at both Mars Society stations, and the search for these organisms is analogous to the future manned search for biomarkers on Mars. To date, 182 lichen species have been reported from the locally-rich Truelove Lowlands on Devon Island (Barrett and Thomsen 1975), 61 species have been recorded from eastern Wayne and Emery counties, Utah, and 16 species have been recorded from the vicinity of MDRS (Sokoloff et al. 2016). Further work will undoubtedly add new species records for both Mars Society stations and for the western half of Devon Island, which is underexplored for lichens.

A recent major discovery in lichen science was the identification of Cyphobasidium yeasts (unicellular fungi) as a third component (Spribille et al. 2016) in what has heretofore been assumed to be a binary

symbiosis of an alga (or cyanobacterium) and a multi-cellular fungus. The presence of this yeast is confirmed by sequencing a variety of lichen species from temperate ecosystems in Montana and in northern Europe and in herbarium specimens representing a global distribution. The discovery of this third partner opens up the question of its role in lichen survival in extreme dry and cold environments. It would be interesting to determine if the yeasts are present in the lichens in these two extreme environments. This can be determined by DNA sequencing lichens in the field using a MinIon DNA Sequencer. If this third symbiont is present, the prevalence of the yeast, and its presence or absence in different species in these extreme environments may help elucidate the ecological role of these yeast in Lichen survival.

Methods: We will undertake research in the vicinities of each site by foot, complete plant inventories of all lichens, and collect data on conservation status, ecology, distribution, and population variation as appropriate. All of these data will be useful for long-term monitoring of potential changes in species diversity in the future.

Approximately 300 specimens will be collected, photographed, and studied. Collections will be deposited at the National Herbarium of Canada (Canadian Museum of Nature), and duplicate specimens will be distributed to national and international herbaria, all contributing to the permanent scientific record documenting the distributions of Arctic lichen species in time and space. As time permits we will make occasional collections of vascular plants, algae, fungi and bryophytes.

Lichen specimens are collected from the environment by hand, using a small knife, or by using a hammer and chisel for crustose (rock-growing) specimens. These lichens are dried in the field in paper bags.

For each collection event we:

- Collect one to several individuals of a species (depending on the size of an individual, and how common the species is locally). If a species is not common, we collect only enough material to properly document its occurrence at the site. If a species is rare, we do not collect any specimens, and document its occurrence only with photographs.
- Record detailed notes on the location of the species, its local growing conditions, and other species that grow at the site. In a subset of instances we take photographs of the species growing in its natural state.

<u>Hypoliths</u>

Microbial communities dominated by cyanobacteria of the genus Chroococcidiopsis are found below the surface of translucent rocks in the most arid regions of deserts throughout the world (Cockell and Stokes, 2004; Warren-Rhodes et al., 2006, 2013; Pointing and Belnap 2012, Pointing et al., 2009). They are typically found under quartz (Nienow, 2009). They are present under suitable stones at the MDRS desert site and at the FMARS polar site.

It is known that Chroococcidiopsis is tolerant of radiation, long periods of desiccation, and limited water availability (Billi et al. 2000) and this has made them of particular interest to astrobiology (Billi et al. 2011). In this study we propose to compare the sequences between Chroococcidiopsis from the temperate desert site at MDRS with FMARS polar site to determine there are any common genes that form part of the tool-box used by organisms to survive in extreme environments. We hypothesize that genetic analysis will show that cyanobacteria of the genus Chroococcidiopsis which are found below the surface of translucent rocks at the MDRS desert site and the FMARS polar site share comment genes that enable their survival in extreme environments.

Methods: photosynthetic hypoliths (algae and cyanobacteria that grow on the underside of rocks) are of particular interest to astrobiologists due to the extreme environments they inhabit. We will collect rocks with hypolith colonization from sites around the operational area of the Flashline Mars Arctic Research station and record the following accompanying data:

1. Precise coordinates of where sample was collected.
2. A habitat description for each sample location
3. Rock type
4. Soil type where rock was found.
5. % colonization of each site
6. Colonization measurement of each rock
7. Soil moisture, and pH, and EC

In addition we will take field photographs of each specimen as required. The samples will be returned to the lab at the Flashline Mars Arctic Research Station where selected samples will be DNA sequenced using a portable minION DNA sequencer.

Geology: Patterned Ground Research

The Haughton Impact Structure has been identified as the furthest north meteor impact crater in the world. Its unique location in the Canadian arctic has exposed it various physical and weathering processes not seen on other impact structures on Earth. It has experienced several periods of glaciation throughout its history and presently hosts a number of periglacial landforms that are of particular interest to planetary geoscientists.

There are a number of locations around the crater floor that host patterned ground features that are the result of the ground swelling and contracting due to seasonal temperature changes that cause the top layer of permafrost to melt and re-freeze. Over time, this process creates patterned ground landforms, also called polygons, which can provide additional insight into the nature of the permafrost in the area while also serving as an analogue for similar features that have been identified in periglacial environments on Mars.

The proposed scope of patterned ground research to be conducted over the summer months of 2017 will include three distinct phases as outlined below.

Phase 1 will involve site characterization activities including but not limited to: measuring individual patterned ground features using surveying equipment and GPS units, aerial photography using a line-of-sight ground-operated drone, and the placement of temporary markers or flags to identify points of interest that will be removed and packed out at the conclusion of field activities.

Phase 2 will involve the installation of several temperature and moisture dataloggers to measure subsurface conditions in selected patterned ground features. These dataloggers are about 1 cm wide by 2 cm long and will be installed to the permafrost/soil contact, not expected to exceed 1 meter below ground surface. They will be installed to this depth using a battery-operated handheld drill with an auger-bit attachment. The dataloggers will be connected to a cable running to the surface and identified using a pin-flag and left in the ground over a period of approximately 80 days to record subsurface conditions over that period of time. At the conclusion of field activities, the dataloggers will be retrieved and their holes back filled, returning surface conditions to those observed at the time of arrival.

Phase 3 involves collecting confirmation grab samples at the time of datalogger retrieval to understand the ambient physical conditions they were situated in over the monitoring period. Additional grab surface samples will also be collected as a part of Phase 3 to support observations made as a part of Phases 1 and 2 as needed. Each collected sample volume is expected to fit inside of a standard-sized sandwich bag

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7. **SCHEDULE** – Applicants are advised that approvals without a licence are issued for a one year term.

Proposed Start Date: 1**June 2017** (Month/Year)

Proposed Completion Date: **1 September 2017** (Month/Year)

8. **TYPE OF USE OF WATER WITHOUT A LICENCE PROPOSED -** Check the box that applies to the type of water use proposed. If none of the water uses listed below applies to the proposed water use, an application for a water licence will be required. See the NWB's *Guide 4 – Completing and Submitting a Water Licence Application for a New Licence*.

☐ For an undertaking other than a Power undertaking and for a use of water related to the construction of a structure across a watercourse that is less than 5 metres wide at the ordinary high water mark at the point of construction.

☐ For an undertaking other than a Power undertaking and for a use of water related to the training of an intermittent watercourse.

☐ For an undertaking other than a Power undertaking and for a use of water related to the training of a watercourse that involves the infilling of the watercourse, if the watercourse

has no inflow or outflow and a surface area of less than 0.5 hectares.

☐ For an undertaking other than a Power undertaking and for a use of water related to the training of a watercourse that involves removal or placement of less than 100 m^3 of material.

☐ For an undertaking other than a Power undertaking and for a use of water related to the construction of a temporary structure in a watercourse for the purpose of flood control.

☐ For an undertaking other than a Power undertaking and for any use of water related to the storage of 2,500 m3 or less.

☒ For an undertaking other than a Power undertaking and for any use of water less than 50 m^3 per day.

9. QUANTITY AND QUALITY OF WATER INVOLVED - For each type of water use indicated in Block 9, provide the source of water, the estimated quantity to be used in cubic metres per day, and the periods during which water will be extracted.

Type of Water Use indicated in Block 9	**Name of water source**	**Estimated quantity of water to be used in cubic metres per day**	**Periods during which water will be extracted**
For an undertaking other than a Power undertaking and for any use of water less than 50 m3 per day.	Unnamed streams or lakes in study region	0.035 m^3/day	1 June – 1 September 2017

10. TYPE OF DEPOSIT OF WASTE PROPOSED - Check the box that applies to the type of deposit of waste proposed. If none of the deposits of waste listed below apply to the proposed deposit of waste, an application for a water licence will be required. See the NWB's *Guide 4 – Completing and Submitting a Water Licence Application for a New Licence*.

☐ For an Industrial undertaking, for an activity related to hydrostatic testing or cleaning of storage tanks and pipelines, and for any deposit of waste resulting from hydrostatic testing or cleaning of unused storage tanks or pipelines.

☐ For an Industrial undertaking, for an activity related to quarrying and gravel washing, and for any deposit of waste that is not deposited to surface water and that results from quarrying or gravel washing above the ordinary high water mark.

☐ For a Mining undertaking, for an activity related to exploratory work, any deposit of sewage to a sump.

☐ For a Power undertaking, any deposit of sewage to a sump.

☐

For an Agricultural undertaking, any deposit of sewage to a sump.

☐ For a Recreation undertaking, any deposit of sewage to a sump.

☒ For any Other type of undertaking not listed above, other than Municipal, any deposit of sewage to a sump.

11. QUANTITY AND QUALITY OF WASTE INVOLVED – For each type of waste indicated in Block 11, describe the quantity in cubic metres/day, measures to avoid or mitigate adverse impacts, and periods of deposition.

Type of Waste indicated in Block 11	Quantity to be deposited in cubic metres per day	Measures to avoid or mitigate any adverse impacts	Periods during which waste will be deposited
For any Other type of undertaking not listed above, other than Municipal, any deposit of sewage to a sump. (Greywater)	0.035 m^3/day	Will dump grey water at least 50 m from water sources	1 June – 1 September 2017
For any Other type of undertaking not listed above, other than Municipal, any deposit of sewage to a sump. (Sewage)	Minimal (six people)	We plan on incinerating solid waste and disposing liquid waste far from freshwater sources.	1 June – 1 September 2017

12. SIGNATURE

I, Shannon Rupert (print name), certify that the information given on this form is, to the best of my knowledge, correct and complete.

✔ Yes ☐ No

OR

I, _____ (print name), as an authorized representative of the Applicant, _____, certify that the information given on this form is, to the best of my knowledge, correct and complete.

✔ Yes ☐ No

I certify that the Nunavut Planning Commission's land use planning requirements under Article 11 of the Nunavut Land Claims Agreement have been met.

✔ Yes ☐ No

I certify that the Nunavut Impact Review Board's development impact review requirements under Article 12 of the NLCA have been met.

✔ Yes ☐ No

I certify that the proposed water use is of a type set out in column 2 of Schedule 2 of the Regulations that is further specified by column 3, in respect of an undertaking set out in column 1. See list in Block 9.

✔ Yes ☐ NA ☐ No

I certify that the proposed deposit of waste is an activity that is set out and then further specified in columns 2 and 3 of Schedule 3 of the Regulations, in respect of an undertaking that is set out in column 1 of Schedule 3. See list in Block 11.

✔ Yes ☐ NA ☐ No

I certify that the proposed water use or deposit of waste will not substantially affect the quality, quantity or flow of the watercourse whose waters are used.

✔ Yes ☐ No

I certify that the proposed water use or deposit of waste will not substantially affect the quality, quantity or flow of waters flowing through Inuit Owned Lands.

✔ Yes ☐ No

I certify that the proposed water use or deposit of waste will not affect the use of waters by a person who would be entitled to compensation under sections 58 or 60 of the *Nunavut Waters Nunavut Surface Rights Tribunal Act* (Act) if their use of these waters were to be adversely affected by an applicant for a licence.

✔ Yes ☐ No

I certify that a licence is not required for another use of water, or deposit of waste in respect of the proposed undertaking.

✔ Yes ☐ No

I have read and agree to comply with the following conditions outlined in sections 4(3), 5(4), 5(5) and 6 of the *Nunavut Waters Regulations*:

1. In the case of an applicant who has a mineral right and who intends to use waters or deposit waste in relation to that right, the applicant shall respect the priority conferred on Inuit by section 62 of the *Act* as if that applicant had a licence for the use or deposit.

2. Measures must be taken prior to using water to minimize any alteration to the bed or banks of a watercourse whose waters are to be used, and the measures shall be maintained during the operation of the undertaking.

3. No waste is to be deposited to surface water or within 31 metres of the ordinary high water mark of any body of water.

4. The waste shall not contain more than 15 milligrams per litre of petroleum or petroleum product and must not have a visible hydrocarbon sheen.

5. Prior to the closure or abandonment of the undertaking or end of the period authorized for the use of water or deposit of waste without a licence, whichever occurs first, the site shall be restored — to the extent practicable — to the state in which it was before the water was used or the waste was deposited.[a]

6. An applicant who is authorized under the Regulations to use waters or deposit waste without a licence shall:
   a. maintain accurate and detailed books and records of:
      i. the quantity of water, in cubic metres, used each day,
      ii. the quantity, in cubic metres, of waste deposited each day,

iii. the type of waste deposited each day,
iv. where the waste is deposited,
v. the concentration of the substance, or substances, in the deposited solid or liquid that has the effect of making the deposit waste,
vi. the methodology used to calculate or determine the information referred to in items (i) to (iv), and
vii. the measures that were taken to avoid or mitigate any adverse impacts of the deposit of waste.

b. keep the books and records on the site of the undertaking during the period of its operation and make them available during that period to an inspector on request;

c. submit to the Board a report containing a summary description and supporting photographs of the restoration of the site of the undertaking within 30 days after the earliest of (i) the day on which the undertaking is closed or abandoned, and (ii) the last day of the period authorized for the use or deposit without a licence;[b] and

d. keep the books and records for two years after submitting the report describing the restoration of the site of the undertaking.

Notes:

a) A site need not be restored prior to the end of the period authorized for the water use or deposit of waste without a licence, as required by Item 5, if the Board issues a licence for the use of water or deposit of waste on that site prior to the end of that period.

b) An applicant need not submit the report referred to in Item 6 (c), to the Board if the applicant obtains the Board's approval for a use of water or deposit of waste without a licence, or a licence for a use of water or deposit of waste, on the same site within thirty (30) days after the last day of the period authorized for the use or deposit.

✔ Yes ☐ No

I understand that any approval granted by the Board for the use of water or deposit of waste without a licence will be authorized for a period of one year after the day on which the Board approves the Application. The use or deposit is not authorized until the Board approves the Application and it is only valid as long as the applicant is in compliance with the conditions set out in the declaration above.

✔ Yes ☐ No

I understand that if I have answered "No" to any of the above statements a water licence is required from the Nunavut Water Board prior to the use of water or deposit of waste.

✔ Yes ☐ No

Shannon Rupert	Principal Investigator	S M Rupert	1 March 2017
Name (Print)	Title (Print)	Signature	Date