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***For the Reconsideration Process of
Agnico Eagle Mines Limited's "Meliadine
Extension" Project Proposal
Bëgha nayeti há ëdiri Aginco Eagle Mines
Limited "Meliadine Extension" Bëgha
Hok'ats'ëde Detł'ısı***

Prepared for the Nunavut Impact Review Board
September 2023

Canada

Outline

- Mandate
- Relevant Acts and Scope of Review
- Technical Review and Recommendations
 - Groundwater Quantity
 - Permafrost
 - Mine Waste Management



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 - Nıh Tu T'anēt'ē
 - Nıh Hoʔtēn ı́aghē nēnē k'ēyaghē
 - Nıh yorıldēdhı Asıı Ađel Boghēdı





Mandate

- Natural Resources Canada is a federal department responsible for ensuring the country's natural resources are developed sustainably, competitively and inclusively.
- Natural Resources Canada is a science-based department, with nearly half of its employees being scientists, engineers or technicians.
- Natural Resources Canada scientists are conducting research on permafrost, groundwater, mine waste characterisation and management as well as environmental dispersal and effects associated with acid rock drainage and/or metal leaching.
- Natural Resources Canada also provides scientific support to organizations that advance knowledge in mine waste management, including in areas such as prevention and control of acid rock drainage and metal leaching, disposal technologies, mine water treatment.





Ēdırı Bēgharı

- Canada Nih Hots'ı Asië k'ëyaghë hots'ı k'olde bēts'ën norēltth'ı nih hots'ı asië bēt'orēdhı há, t'ahı hētië yorēlısı ēla bētorē?a há.
- Canada Nih Hots'ı Asië science-bēgharı t'ahı ēyır ēghēdalanası, t'ahı ēghēdalan nahië scientist, engineer huto tsatsanē bēnı hılı bası ēghēdalana.
- Canada Nih Hots'ı Asië hētië dōya scientist hadat'ı ho?tēn gha yēdareldēn, nih tu tth'ı, nih yeridēdhı asië āldedhı boghēdı ēyı hēł nih bası t'at'u asië bēredısı ēyı chu acid tthe tth'ı bēt'a t'ahune hası tıtl'ıl chú/tsatsanē tıtl'ilē.
- Canada Nih Hots'ı Asië scientific denē ēts'ēdanı nih naghēldēdhı asië āldedhı bası, ēsone ch'a acid tthe boghēdı hēł bēt'a t'ahune hası tıtl'ıl chú tsatsanē tıtl'ilē, t'at'u āldedh hası, tu boghēdı tth'ı bēł.



Relevant Acts and Scope of Review

- Regulator for the *Explosives Act*:
 - Provision of licenses for the storage and manufacture of explosives
- Scientific Analysis Provided:
 - Groundwater Quantity/flow (hydrogeology)
 - Permafrost
 - Mine Waste Management



Ēḷk'ēsı Bēgha Dēt'ıs chu Nēnēt'ı há

- Ērit'ıs Bēgharı *Asiē Ētēḷk'ēdhı Ts'ı Ērit'ıs*:
 - Ērit'ıs bēgharı asiē senıye chu Asiē Ētēḷk'ēdhı hodle bası

- T'ahı asiē hēnırıısı tth'ı bēgharı:
 - Nıh Tu T'anēt'ē/hēt'ēḷ (hydrogeology)
 - Nıh Hoʔtēn ḷaghē nēnē k'ēyaghē
 - Nıh yorıldēdhı Asıı Aḍel Boghēdı



Technical Review: Groundwater Quantity

- Hydrogeological data are collected to characterize subsurface properties and groundwater conditions in order to develop an understanding of groundwater flow and interactions with surface waters.
- Groundwater models are used to help quantify and assess current groundwater conditions and predict those expected to develop as a result of mining and closure activities.
- Groundwater data and knowledge are essential for assessing impacts on groundwater quantity and quality, and groundwater interactions with surface waters.

Specific Issues Considered:

- Complexity of vertical groundwater flow through taliks and their monitoring
- Assessment of tailings and waste rock disposal in exhausted pits
- Assessment of closure and post-closure phases
- Effect of saline water storage in B7
- Groundwater flow basin near the Discovery underground mine
- Inclusion of grouting in hydrogeology model and groundwater inflow estimates



Nënët'ı T'ahı Yenirıñısı: Nih Tu T'anëlt'ë

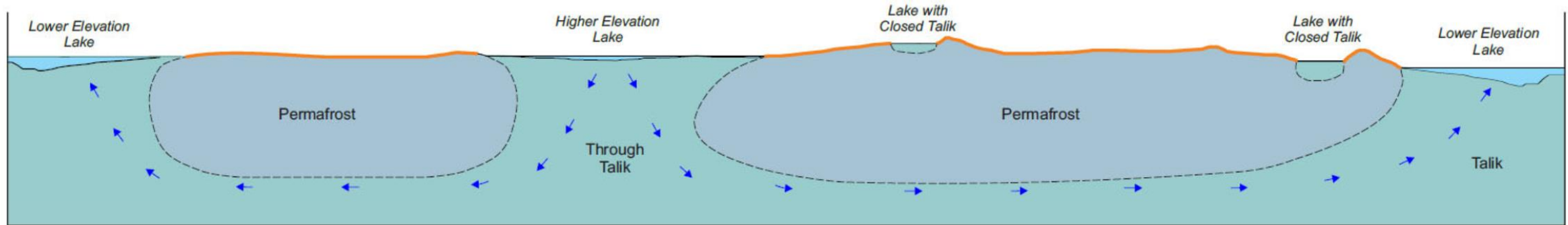
- Hydrogeological bëgha k'oja há asië bëts'eldën ëdirı nih k'ë tu t'at'ësi ëyi bëgharı bënërdı há t'at'u nih hots'ı tu hëtl'ëlsı ëyi chı tu nih daghë ëla t'at'u hëtl'ël bënërdı há.
- Nih hots'ı tu boghëdı ts'ı asië bët'orë?a tu t'anëlt'ë chı nët'ı ëltth'ı bası há ëdirı nih hots'ı tu t'at'ësi há ëyi chı t'ane hası bëgharı nih gha dëldhı bëgharı bëdarëti bası.
- Nih hots'ı tu bëgha k'oja há asië bëts'eldëni, ëyi hëtië bët'orë?a bëgharı asië nët'ı há nih hots'ı tu t'anëlt'ë chı t'at'ësi tth'ı, ëyi chı tu nih daghë ëla t'at'u hëtl'ël bënërdı há.

Hëtië dëgharı Ëltth'ı Asië t'at'ësi Bëgha:

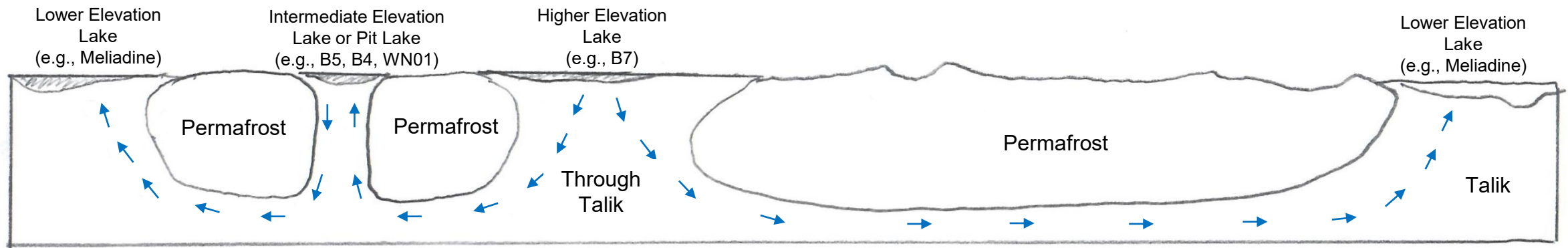
- Hëtië borënilë nih ts'ı tu t'ası hëtl'ëlsı ëdirı t'ahuk'ë ttha hots'en nih ho?tënsı hoyëho?a chı t'ahı boghëdı ts'ı asië hël
- Asië ëla hoyëho?a k'ëyaghë nılyë nët'ıë há ëyi chı the ăldedhı nih k'ëyaghë
- Bëdarëti nët'ı ëyi chı bëdarëti-bët'aghë bëgharı
- Tu dëdha hël ëltth'ı B7 k'ëyaghë boghëdı
- Nih hots'ı tu hëtl'ëli bëk'ënaltsı ts'ı asië T'ahı bulă nih yaghë nih naldëdhı k'ëyaghë
- Bëdarëlye hël hydrogeology ts'ı asië ëyi chı nih hots'ı tu dătl'ı t'anëlt'ësi honıdhën



Conceptual permafrost and groundwater flow model



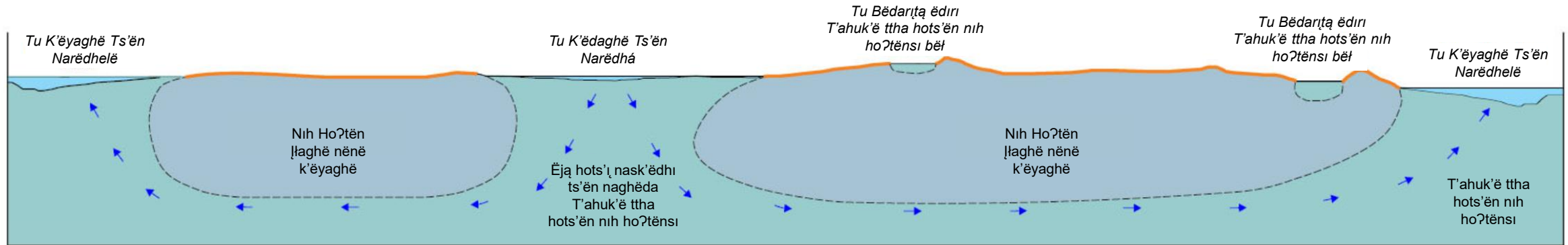
Source: Appendix G5, Summary of Hydrogeology Existing Conditions, Dec 2021



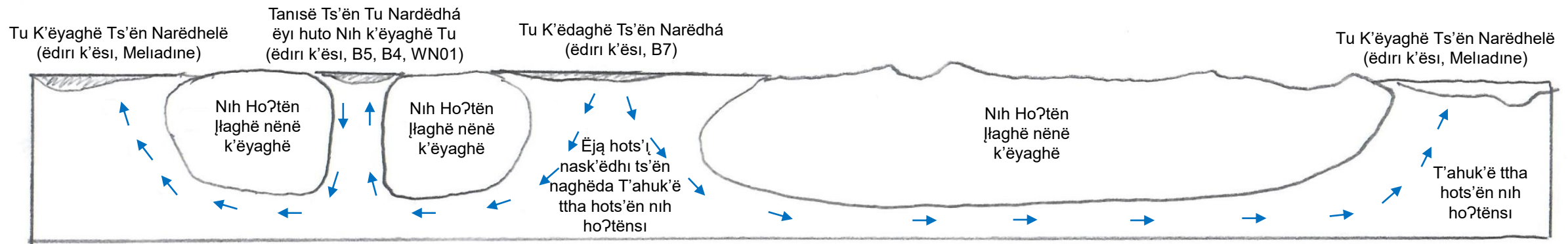
Natural Resources Canada, 2023

- Intermediate elevation lakes with through talik can receive groundwater flow from upslope lakes *and/or* provide groundwater flow to downslope lakes, with implications for in-pit disposal

T'at'u honɔdhën nih hoʔtën ɭaghë nënë k'ëyaghë chù nih tuë hëtɭ'ëɭ ts'ɭ asië



Bëgha ɛritɭ'ɩs: ɛdɩɩ bël G5, Bëgha ɛrëɭ'ɩs Hydrogeology duhɩ ɭa k'ëyaghë T'at'ësi, Dec 2021



Canada Nih Hots'ɩ Asië, 2023

- Tanisë Ts'ën Tu Nardëdhá ɛɭa hots'ɩ nask'ëdhɩ ts'ën naghëda t'ahuk'ë ttha hots'ën nih hoʔtënsɩ nih hots'ɩ tu bëgha nɩɭ'ɩɭ tu k'ëdaghë hots'ɩ *chu/ɛyɩ huto* nih hots'ɩ tu hanële k'ëyaghë tu ts'ën, ɛdɩɩ bël há nih-k'ëyaghë bërëdɩ há

Seepage from/to in-filled pits/pit lakes

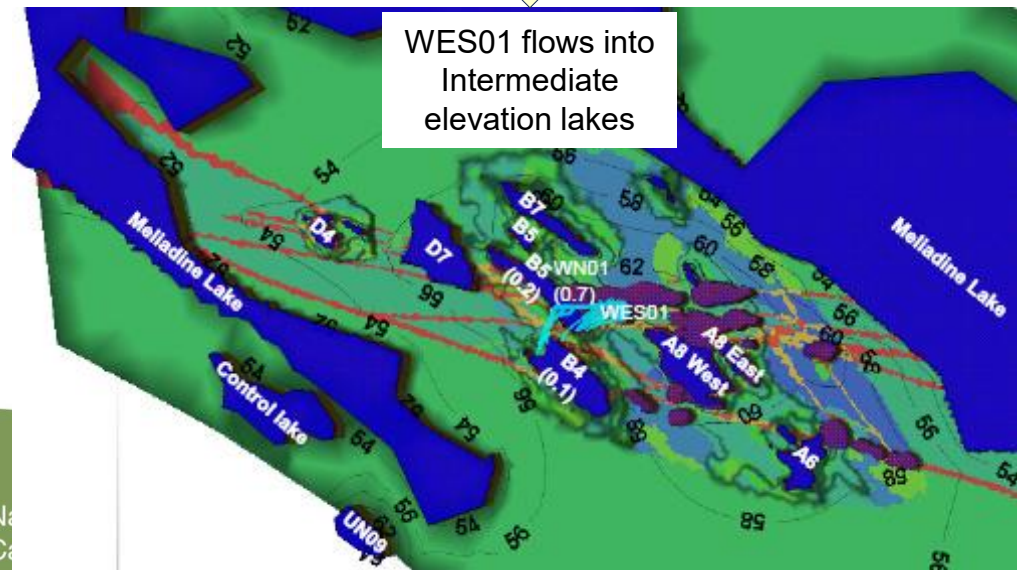
Table 2: Predict Contact Seepage Discharge from In-filled Pits to Downgradient Surface Water Lakes and Pit Lakes

| Value | Unit | WES01 | WES04 | WES05 | WN01 | PUM01 | PUM03 | DISC |
|---|---------------------|--|------------------------|----------------------|--|----------------|---|--|
| Pit Bottom Elevation | m asl | -10 | 30 | -45 | -65 | 25 | -5 | -75 |
| Backfill Material ^(a) | - | Tailings | Tailings | Tailings | Tailings | Tailings | Tailings | Waste Rock |
| Backfill Elevation ^(a) | m asl | 50 | 54 | 47 | 44 | 47 | 49 | 16 |
| Underlying Underground | - | present | not present | not present | present | present | present | present |
| Post-closure Pit Lake Elevation ^(b) | m asl | 62.5 | 63 | 63.6 | 58.3 | 58.7 | 60.3 | 67 |
| Receptor and Predicted Contact Water Flux using Numerical Groundwater Model | m ³ /day | Lake B4 – 0.1 Pit Lake WN01 – 0.7 Lake B5 – 0.2 (total contact water seepage – 1) | Meliadine Lake – 0.2 | Meliadine Lake – 4.1 | No Pit Lake Discharge. Groundwater discharges to Pit Lake. Total Discharge to Pit Lake – 93.7. | Lake B4 – 0.02 | No Pit Lake Discharge. Groundwater discharges to Pit Lake. Total Discharge to Pit Lake – 2.0. | Meliadine Lake – 0.6 Lake UN1 – 0.8 Lake CH1 – 1.0 Lake CH5 – 0.4 Lake UN3 – 0.03 (total contact water seepage 2.8) |
| Travel Time (first arrival of contact water seepage) Using Numerical Groundwater Model ^(b) | Years | Lake B4 – 450 Lake WN01 – 70 Lake B5 – 70 | Meliadine Lake – >1000 | Meliadine Lake – 275 | not applicable | Lake B4 – 650 | not applicable | Meliadine Lake – >1000 Lake UN1 – >1000 Lake CH1 – >1000 Lake CH5 – >1000 Lake UN3 – >1000 |

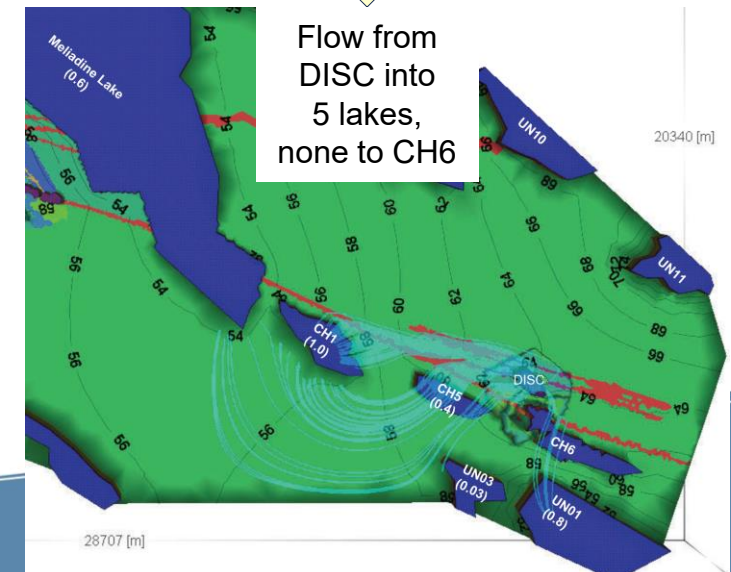
(a) From Lorax 2022.

(b) Travel times do not include time to develop open talik conditions below the pits. Actual travel times may be faster than predicted as a result of how the faults are incorporated in the model (see Section 3.0).

Source: WSP Technical Memo, Reference no. 22524250-972-TM-Rev1-6000, May 05, 2023



Flow into Pit Lake WN01, an in-filled pit with an intermediate elevation



Bëch'ëli ëja hots'ı/ts'ën bëyaghë-danëla nih k'ëyaghë/nih k'ëyaghë tu

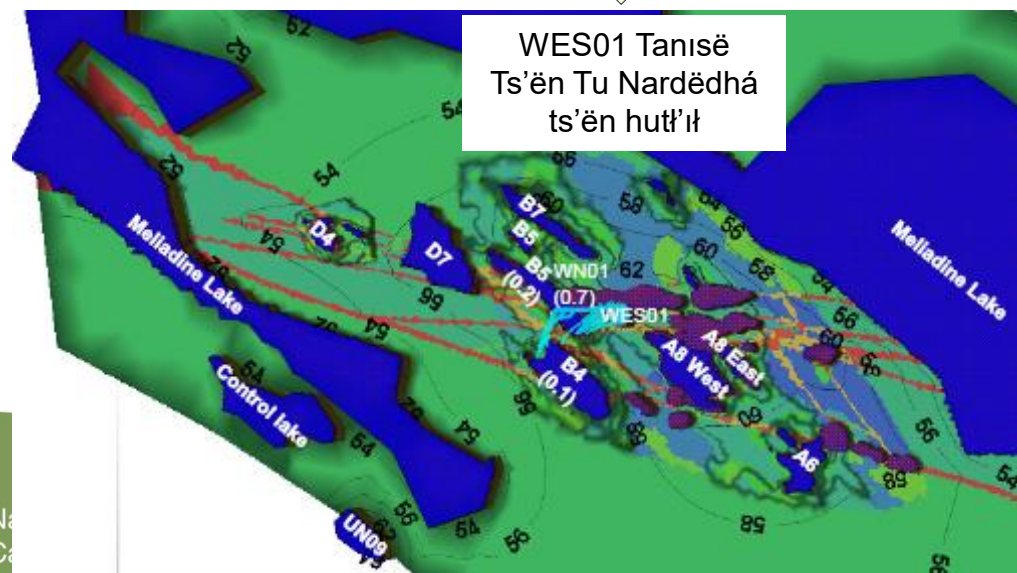
Ëja Detf'is 2: T'ahu k'ë asië noyaghë ts'ën sı, bëch'ëli huto Asië yisë-Äldedhi k'ëdaghë hots'ı nih ts'ën, Tu chu Noyaghë Nih k'ëyaghë Tu k'ë

| Hëtrë hultá | Asië yası budzëi nëchá ts'ı | WES01 | WES04 | WES05 | WN01 | PUM01 | PUM03 | DISC |
|---|-----------------------------------|---|----------------------------------|----------------------------------|---|----------------------------------|--|--|
| Nih k'ëyaghë hots'ı K'ëdaghë ts'ën | t'anittha tu chogh bëdaghë hots'ı | -10 | 30 | -45 | -65 | 25 | -5 | -75 |
| Asië bëdarëdhi Ts'ı ^(a) | - | Asië ëla hoyëho?á k'ëyaghë nilyé | Asië ëla hoyëho?á k'ëyaghë nilyé | Asië ëla hoyëho?á k'ëyaghë nilyé | Asië ëla hoyëho?á k'ëyaghë nilyé | Asië ëla hoyëho?á k'ëyaghë nilyé | Asië ëla hoyëho?á k'ëyaghë nilyé | Tthe Bët'orë?ele |
| K'ëdaghë ts'ën bëdarëdhi ^(a) | t'anittha tu chogh bëdaghë hots'ı | 50 | 54 | 47 | 44 | 47 | 49 | 16 |
| Noyaghë ts'ën huto bék'ojë | - | borët'ı | borët'ile | borët'ile | borët'ı | borët'ı | borët'ı | borët'ı |
| Hoyëho?á-bëdarët'ı Tu Nënt'ı ^(b) | t'anittha tu chogh bëdaghë hots'ı | 62.5 | 63 | 63.6 | 58.3 | 58.7 | 60.3 | 67 |
| Bék'ojá Tu Datt'ıl Nih Tu Torë?ai | m ² /dzinë | Tu B4 – 0.1 Nih k'ëyaghë Tu WN01 – 0.7 Tu B5 – 0.2 (tarelyu tu bëch'ële hël – 1) | Meliadine Tu – 0.2 | Meliadine Tu – 4.1 | Nih k'ëyaghë Tu Dodí Bëch'ëlië. Nih ts'ı tu hëtt'ıl Nih k'ëyaghë Tu hots'ı. Tu hëtt'ıl Nih k'ëyaghë Tu hots'ı – 93.7. | Tu B4 – 0.02 | Nih k'ëyaghë Tu Dodí Bëch'ëlië. Nih ts'ı tu hëtt'ıl Nih k'ëyaghë Tu hots'ı. Tu hëtt'ıl Nih k'ëyaghë Tu hots'ı – 2.0. | Meliadine Tu – 0.6 Tu UN1 – 0.8 Tu CH1 – 1.0 Tu CH5 – 0.4 Tu UN3 – 0.03 (tarelyu tu bëch'ële hël 2.8) |
| T'anittha hëtt'ële (t'atthë hots'ı tu bëch'ële ghan) Tu hoghëdi Nih hots'ı Bëghari ^(b) | Holá Nënë | Tu B4 – 450 Tu WN01 – 70 Tu B5 – 70 | Meliadine Tu – >1000 | Meliadine Tu – 275 | asië bëghá hile | Tu B4 – 650 | asië bëghá hile | Meliadine Tu – >1000 Tu UN1 – 1000 Tu CH1 – >1000 Tu CH5 – >1000 Tu UN3 – >1000 |

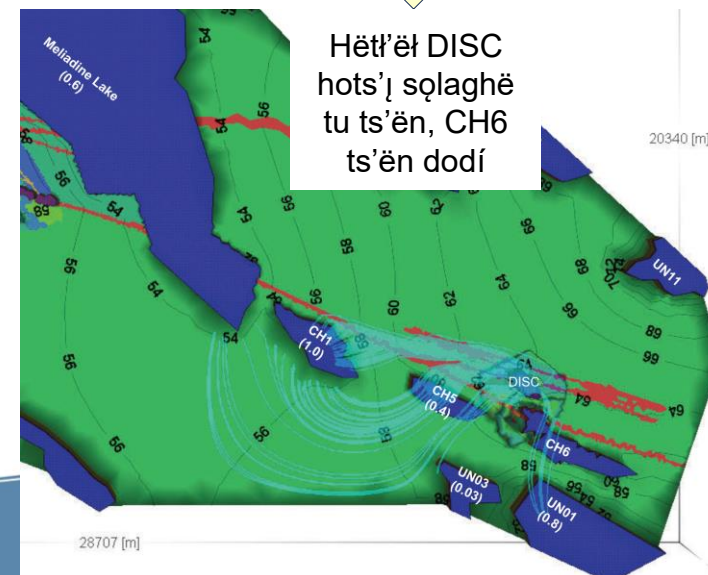
(a) Lorax 2022 hots'ı.

(b) Tanittha hëtt'ële bël hulta hile nih k'ëyaghë bëdaharët'ı há t'ahuk'e ttha hots'ën nih hoghëdi hoyëho?á bëyaghë ts'ën. T'anittha dëgharısı natf'a huto tu hoghëdi nih hots'ı bëghari (ëja detf'ısı nult 3.0).

Bëgha ërtf'ıs: WSP Tsatsanë bëni hultı ts'ı ërtf'ıs Ëdiri bëghari 22524250-972-TM-Rev1-6000, May 05, 2023



Hëtt'ëli Nih
K'ëyaghë Tu
WN01 ts'ën,
bëya-danëla nih
k'ëyaghë Tanisë
Ts'ën Tu
Nardëdhá hël



Technical Review: Permafrost

- Knowledge of permafrost is required to minimize the impacts of the project on the environment, and the impacts of the environment on the project.
- Knowledge of distribution of permafrost and unfrozen ground (talik) is essential for determining groundwater flow pathways.

Specific Issues Considered:

- Thermal modelling- To support design of Mine Waste Storage Facilities
- Ground thermal regime in the project area
- AEM response to Commitment 19 (Thermal modelling of temporary water storage in pits)
- AEM response to Commitment 42 (In-pit deposition alternative and disposal study)



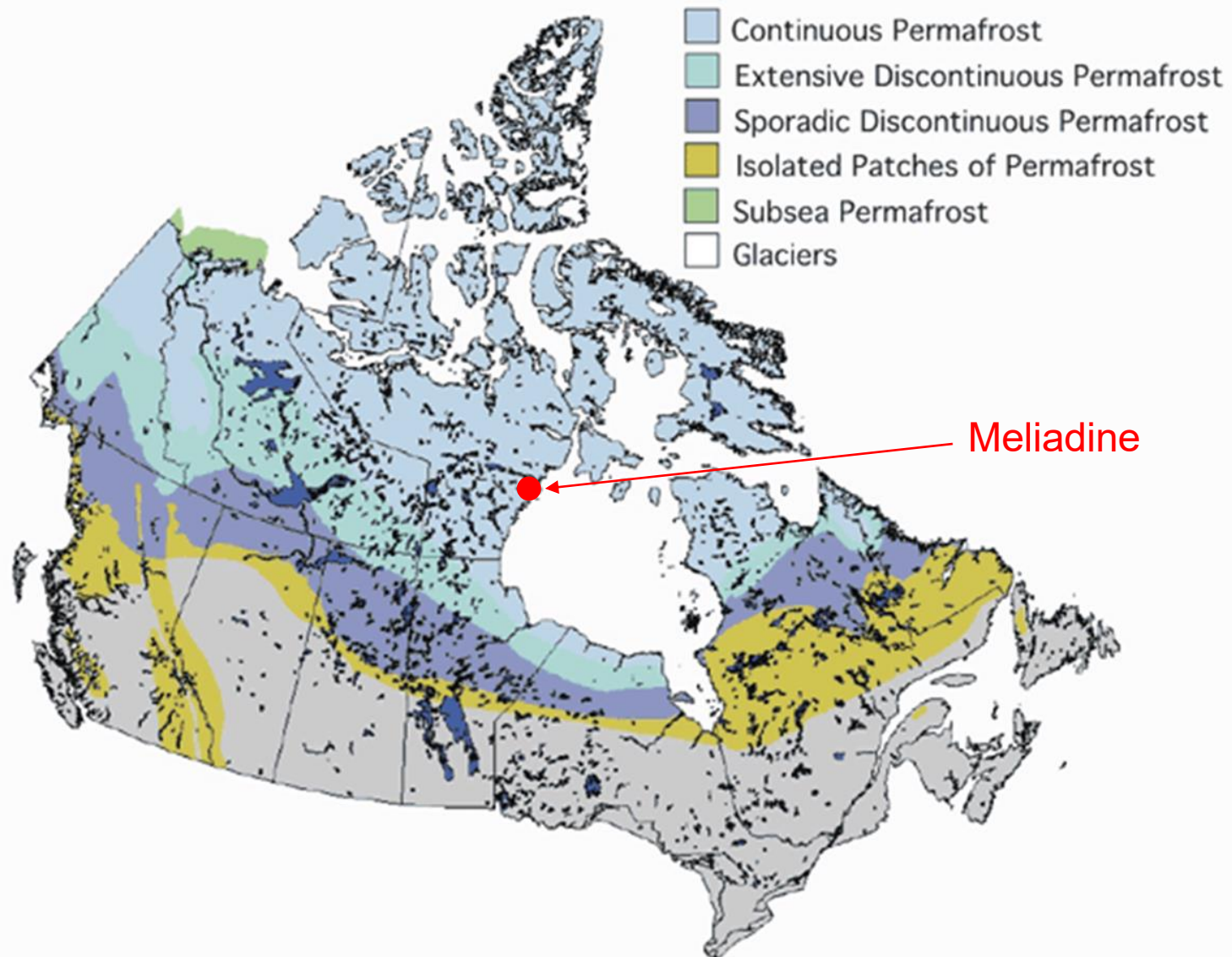
Nënët'ı T'ahı Yenirıñısı: Nih Hoʔtën ɭaghë nënë k'ëyaghë

- Nih Hoʔtën ɭaghë nënë k'ëyaghë bëgha k'oja horët'ı edırı k'arëʔu há nih bası, ëyi chú nih t'anodhi hası t'ahı bası eghëdaladası.
- Nih Hoʔtën ɭaghë nënë k'ëyaghë bëgha k'oja t'at'u narıt'ı hası ëyi chú t'ahı nih hoʔtën hılësi (T'ahuk'ë ttha hots'ën nih hoʔtënsı) bëgharı nih ts'ı tu t'ats'ën hët'ëlsı bék'oja há.

Hëtië dëgharı Ėłth'ı Asië t'at'ësi Bëgha:

- Hodhël Ts'ı Asië – Nih yorıldedhi Asië Ałdedhi Kqë t'at'u hodle há
- Nih hodhël bëgharı t'ahuk'ë bëgha eghëdaladası
- AEM Commitment 19 ts'ën yaghıtı (Hodhël Ts'ı Asië tha hots'ën hılë tu k'onië nih ghaldedhi k'ëyaghë)
- AEM Commitment 42 ts'ën yaghıtı (Bëyë-nih gha ghaldedhi k'ëyaghë bəthëni ałdedhi chú bëgha bets'eldën)



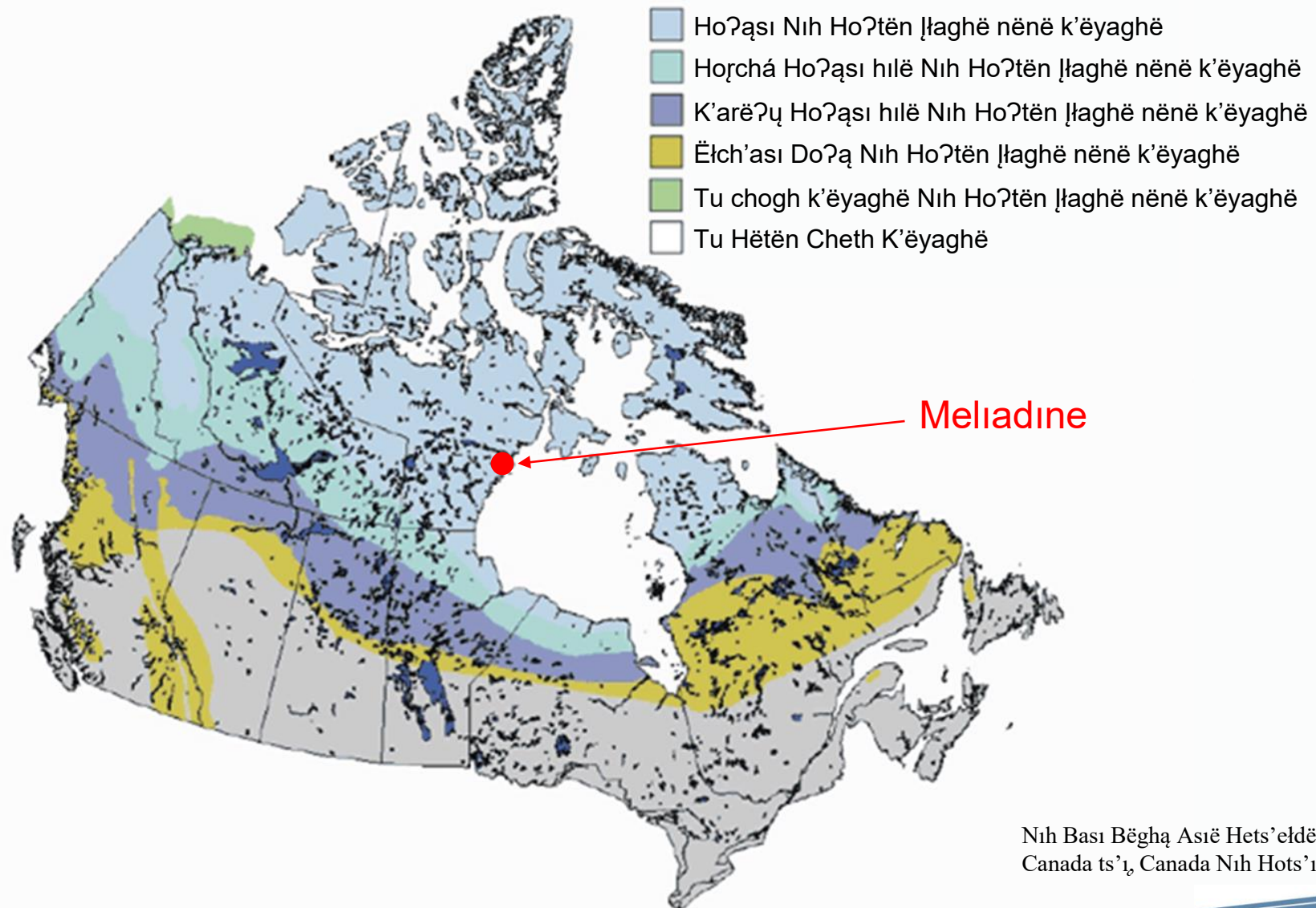


Geologic Survey of Canada,
Natural Resources Canada

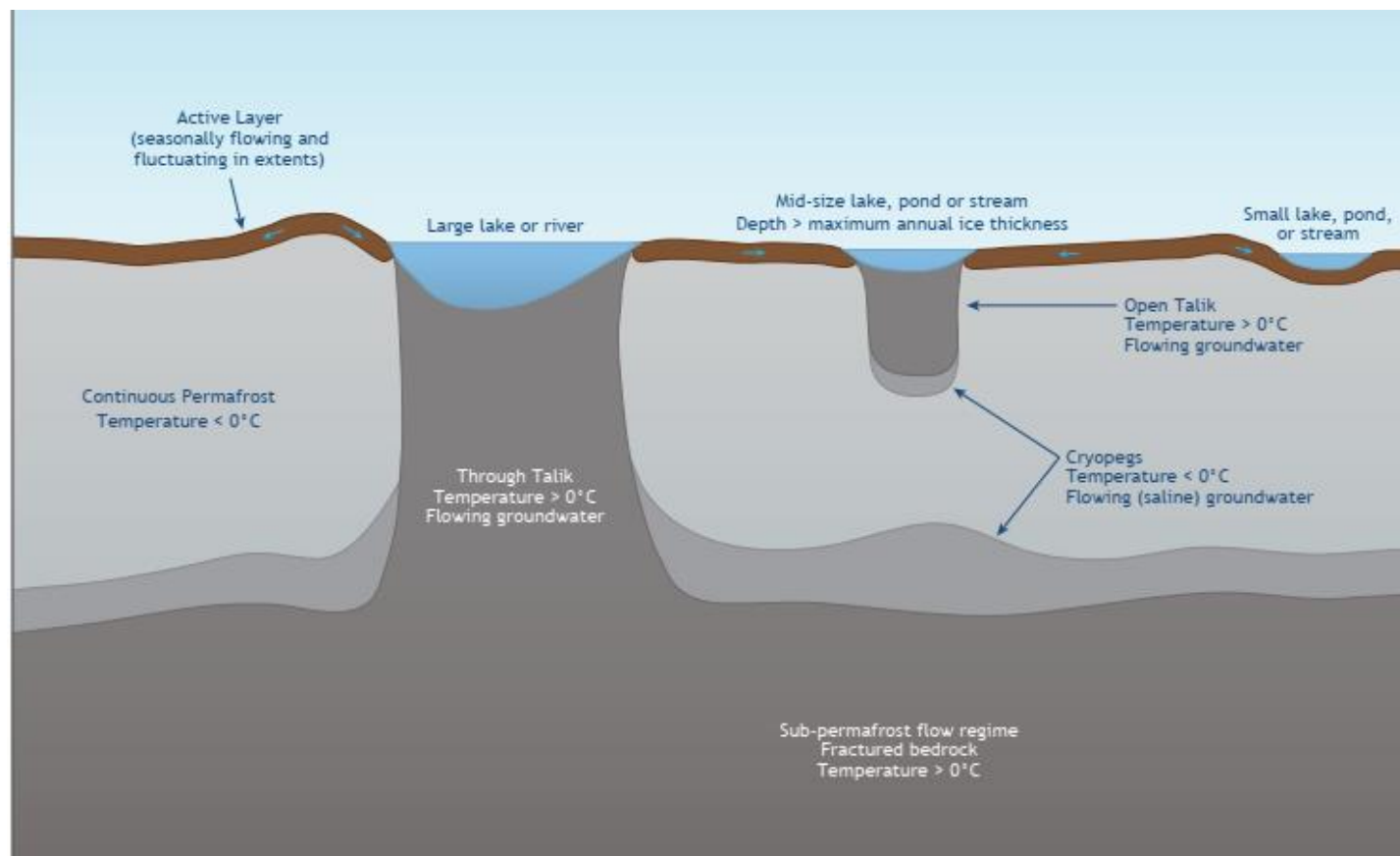


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Permafrost



Source – Rescan, Sabina Gold Final Environmental Impact Statement submission to Nunavut Impact Review Board, 2017

- Although permafrost is continuous at Meliadine, unfrozen ground (talik) can exist beneath lakes.
- Through taliks beneath large deep lakes or pits provide unfrozen groundwater flow pathways between these lakes and pits, and also with mine workings below the continuous permafrost.



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Technical Review: Mine Waste Management

- Representative characterization of mine waste is essential to identify adequate management methods to limit the impacts to the receiving environment.
- Some mine waste presents acid rock drainage and arsenic leaching potential. Therefore, Natural Resources Canada recommends on-going laboratory and field characterization of mine waste.
- This characterization should be used to validate site water quality predictions and the proponent should adapt its mine waste management strategy accordingly.

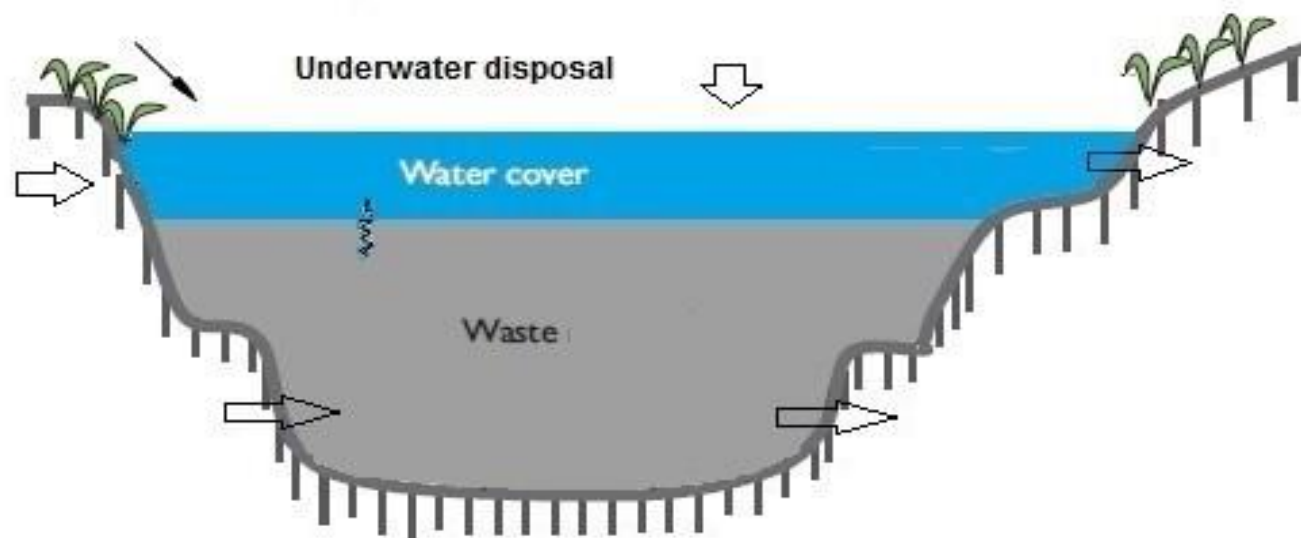


Nënët'ı T'ahı Yenirıñısı: Nih yorıldëdhi Ası Ađel Boghëdı

- Nih ghałdëdhi asië ałdedhhi hëtië t'at'u halye hası, boghëdı hël t'at'u nih bët'a k'arë?u besdołe ch'a.
- Nahië nih ghałdëdhi asië ałdedhi acid tthe hatı'ıl k'ë chı arsenic bëch'ëlı huto há. Eyi?a Canada Nih Hots'ı Asië hadıy hok'ëtı'a-bëgha eghëlada t'at'u nët'ı hël eyı chı t'ahı asië ałdedhi t'at'ësi gharı há.
- T'ahı asië ałdedhi t'at'ësi gharı há bët'orë?a walı tu t'at'ësi há, eyı?a nih ghałdedhi asië ałdedhi boghëdısı t'ane honıdhësi ëłtth'ı boghëdı há.



Mine Waste Management: In-pit Disposal



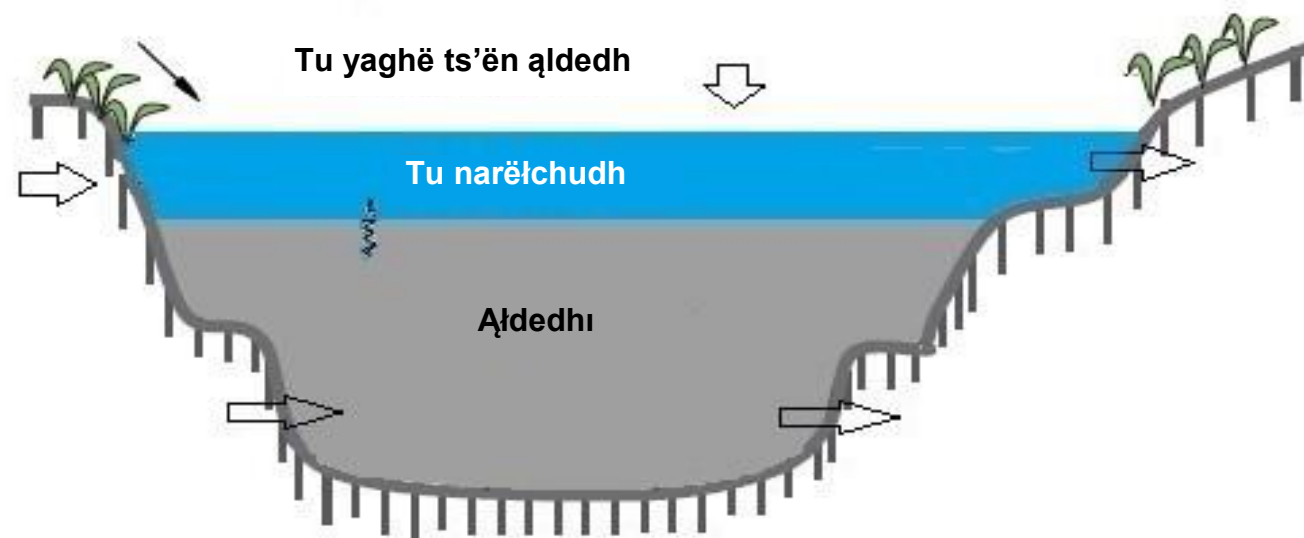
- In-pit disposal under the water table reduces/eliminates:
 - acid rock drainage and metal leaching;
 - groundwater contamination if appropriately designed; and
 - maintenance of above ground dam structures.
- Natural Resources Canada recommends that acid rock drainage and arsenic leaching mine waste be placed in exhausted open pits to the extent practicable as recommended by Mine Environment Neutral Drainage (MEND) 2.36.1 and 2.36.1b

Source: Pit disposal concept (adapted from Mine Environment Neutral Drainage (MEND) report 2.36.1 "Review of in-pit disposal practices for the prevention of acid mine drainage – Case studies",) from [Subaqueous in-pit disposal – Mine Closure \(gtk.fi\)](#)



Nih yorildëdhi Ası Ađel Boghëdı:

Nih k'ëyaghë – yisë Ađdedh



- Nih k'ëyaghë – yisë ađdedh tu yaghë hots'ı k'arë?u/bëdı halyé:
 - acid tthe hat'ıl k'ë chü tsatsanë bëch'ëli;
 - nih tu nëzülë ëłth'ı halya de; ëyı chü
 - nih k'ëdaghë tu bëdarıla boghëdı.
- Canada Nih Hots'ı Asië bëgharı ëdırı acid tthe hat'ıl k'ë chü arsenic bëch'ëli nih ghalëdëdhi asië ađdedhi ëja nılye há nih k'ëyaghë ëdırı MEND 2.36.1 chü 2.36.1b ërit'is bëgharı há.

Bëgha ërit'is: Nih k'ëyaghë t'ahonıdhënsı (MEND ërit'is hots'ı yılchú 2.36.1 “Ërit'is nënet'ı nih k'ëyaghë – yisë asië ađdedhi t'at'u haldhënsı ëdırı acid nih ghalëdëdhi hëtt'ëli – Ërit'is bets'eldëni”) [ëja hots'ı Tu yaghë ts'ën nih k'ëyaghë – yisë Nih ghalëdëdhi Bëdarëti \(gtk.fi\)](#)



Questions?



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Orëlkr?

