Faro Mine Remediation Project

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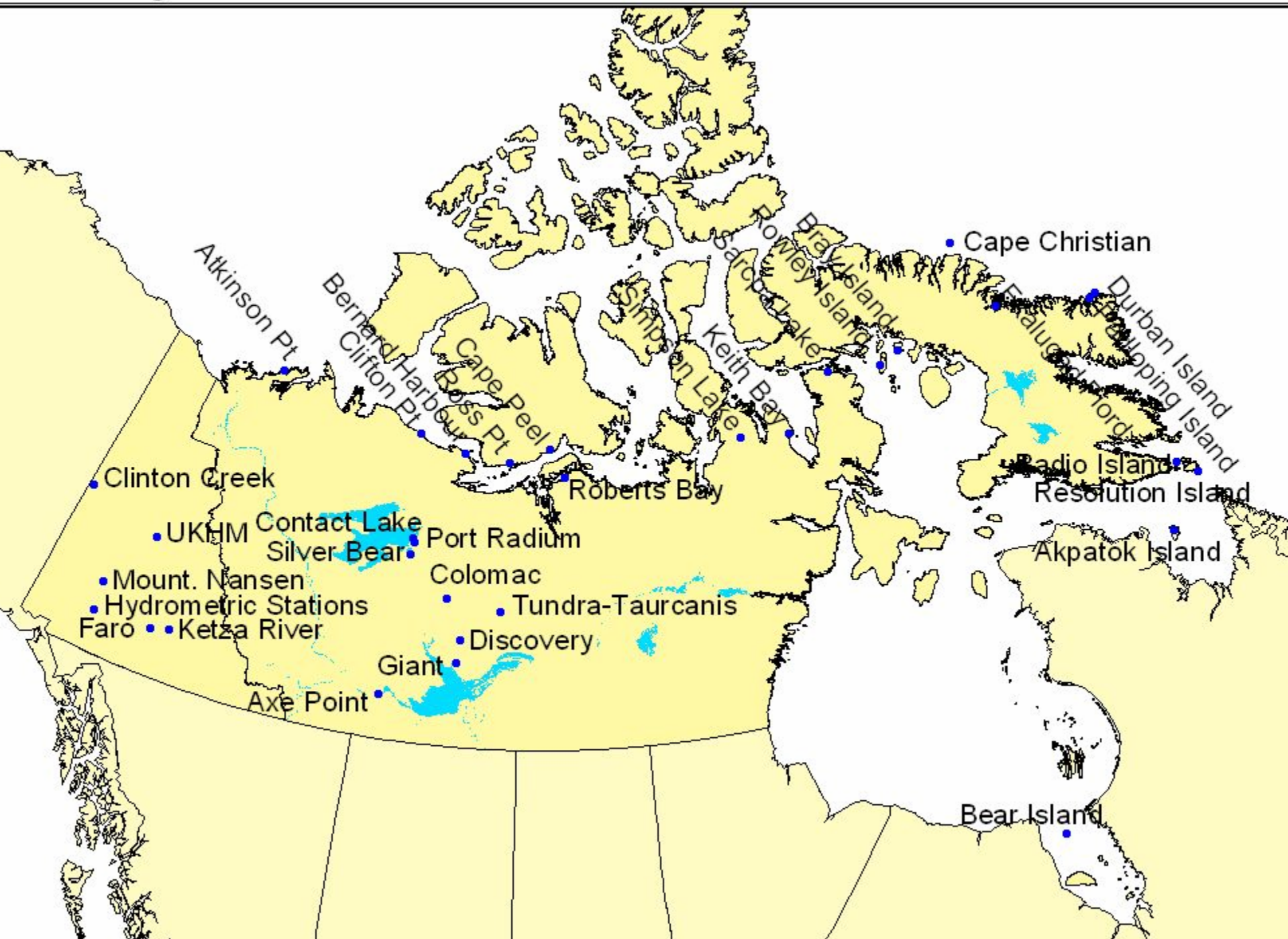
Indian & Northern Affairs Canada

Priority Sites



Current Liability Estimate

Liability: ~$997 million

Potential liability: ~$622 million

United Keno Hill Mine

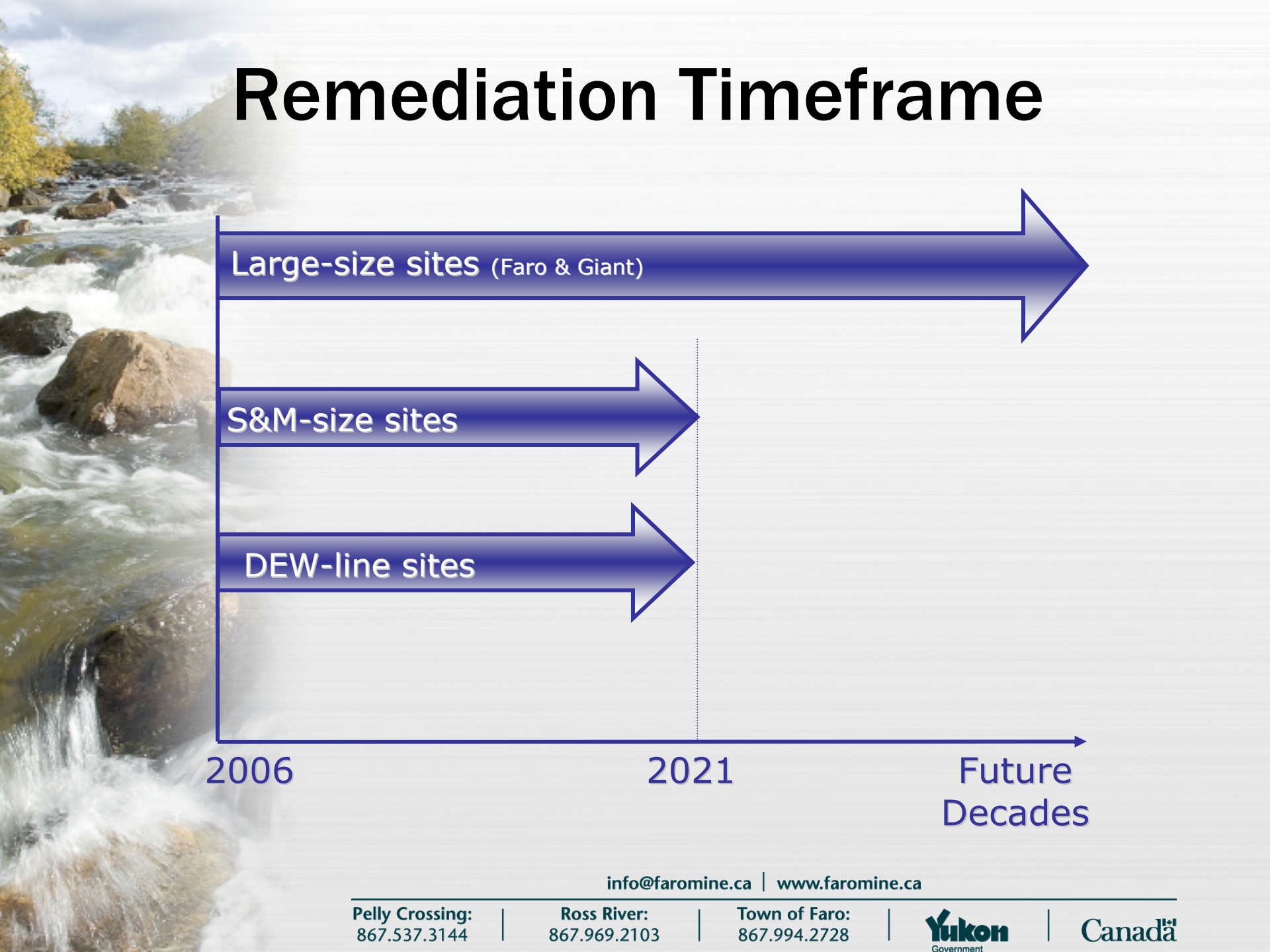
Federal Funding (FCSAP)

Speech from the Throne in Fall 2002 announced the intention to accelerate the clean up of federal contaminated sites.

Budget in February 2003 announced $175 million over two years.

A new investment of **$3.5 billion** towards the clean up of federal contaminated sites was announced in the 2004 Speech from the Throne and reaffirmed in the 2004 Budget.

Remediation Timeframe



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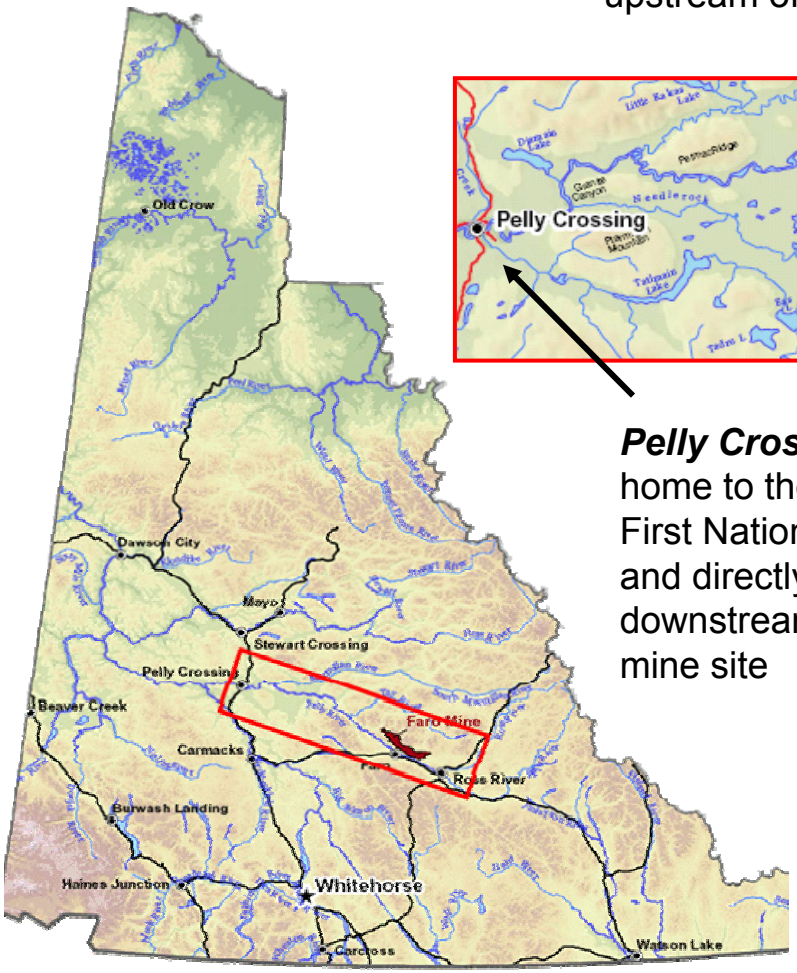
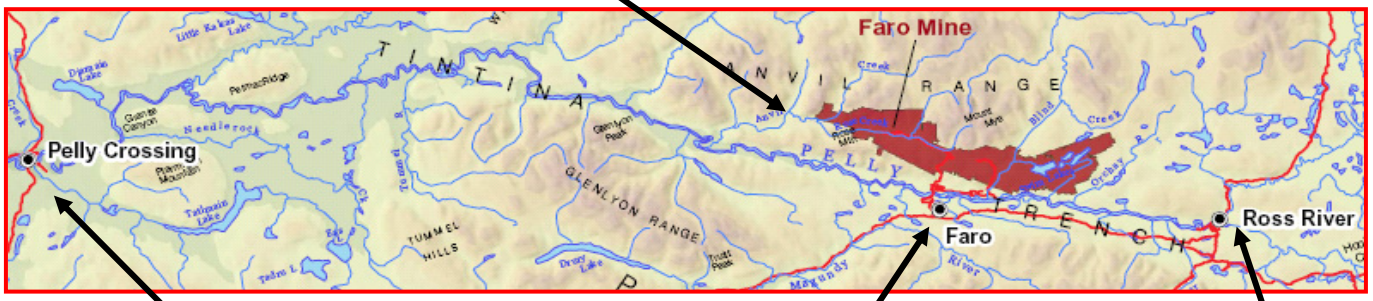
Unique Challenges in the North

- Remote sites
  - Mobilization challenges
  - Winter road and air access
- Short field season
- Permafrost
  - Use in construction
  - Climate change implications
- Wildlife
  - Sensitive areas
  - Traditional land use
  - Health & safety (bear attacks)
- Labour & Construction Costs
  - Competing for resources
  - Winter roads

Faro Mine Complex: General Location

Faro Mine – operational from 1969 to 1998; located in the traditional territory of the Ross River Dena Council, and upstream of the community of Pelly Crossing



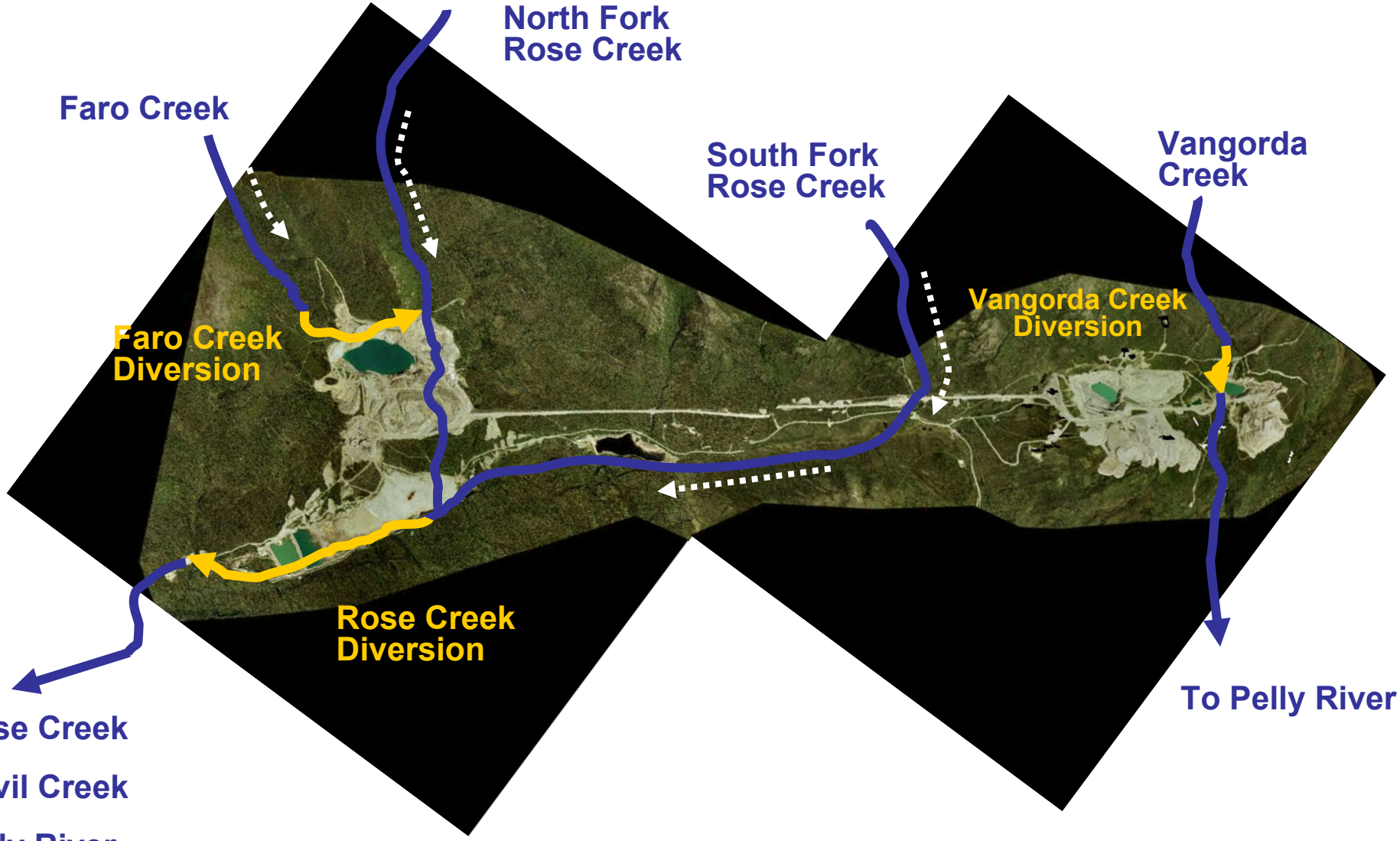


Pelly Crossing
home to the Selkirk First Nation (SFN) and directly downstream of the mine site

Town of Faro
established to service the Faro Mine in 1969, now home to 400 people

Ross River
home to the Ross River Dena Council (RRDC), part of the Kaska Nation

Faro Mine Complex: Site Overview



Faro Mine Complex:
History (1969 – 1998)

1969 Faro Mine opens & Town of Faro established

1970s Largest lead/zinc mine in Canada • 15% of world's Pb/Zn output • population of Faro reaches 2000 by early 1980's.

1982 First of numerous shutdowns • population of Faro drops to 97 by mid-1980's.

1998 Reclamation bond in place approx. $14 million • after 29 years of intermittent operations, last owner placed into receivership • care and maintenance carried out by receiver

Faro Mine Complex: Site Components

Faro Mine Area

Components

70 million MT tailings

4 dams

1 open pit – Faro Pit

2 stream diversions

250 million MT waste rock

13km Haul Road

Vangorda Plateau

Components

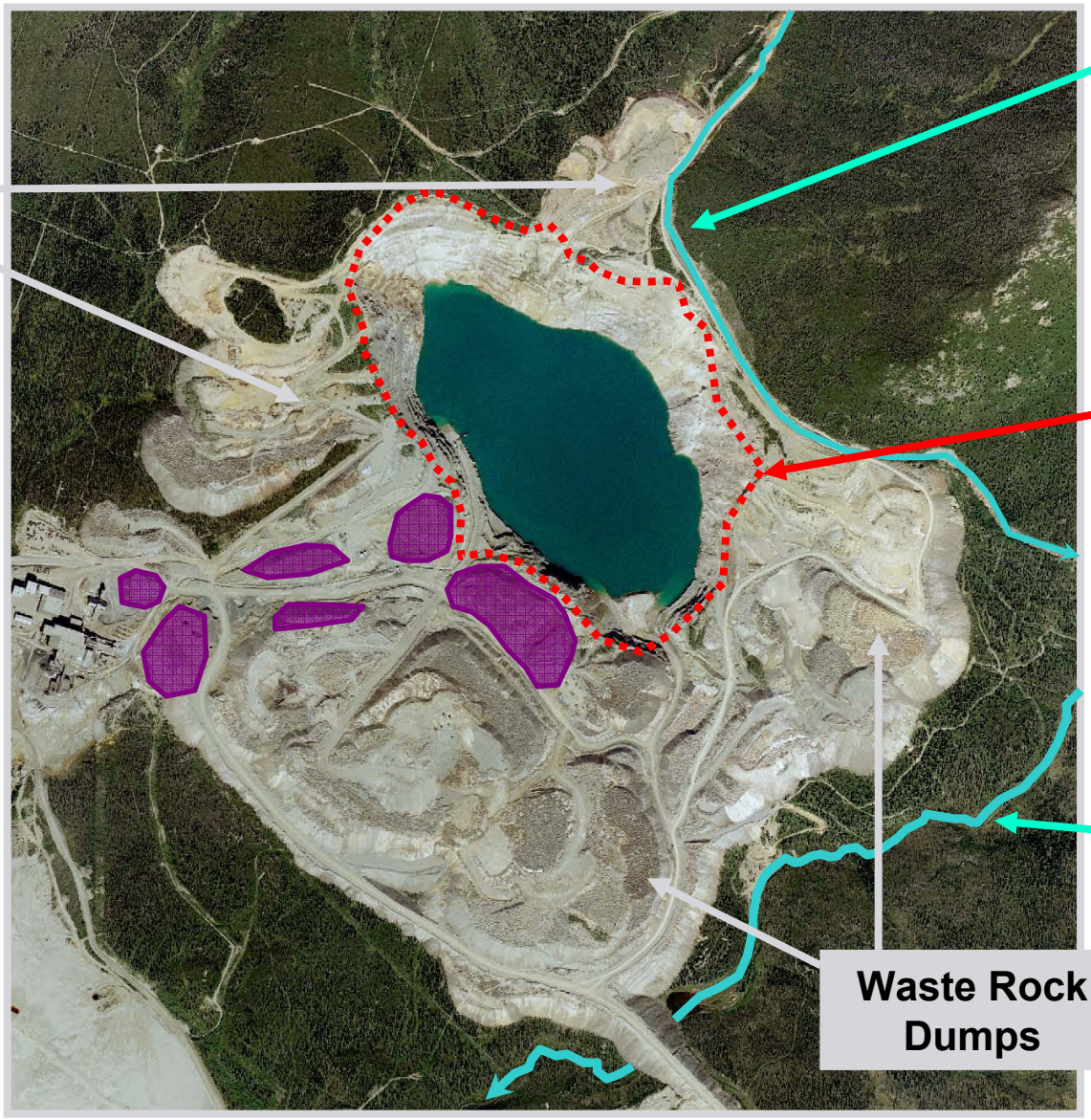
No tailings

2 open pits: Vangorda & Grum

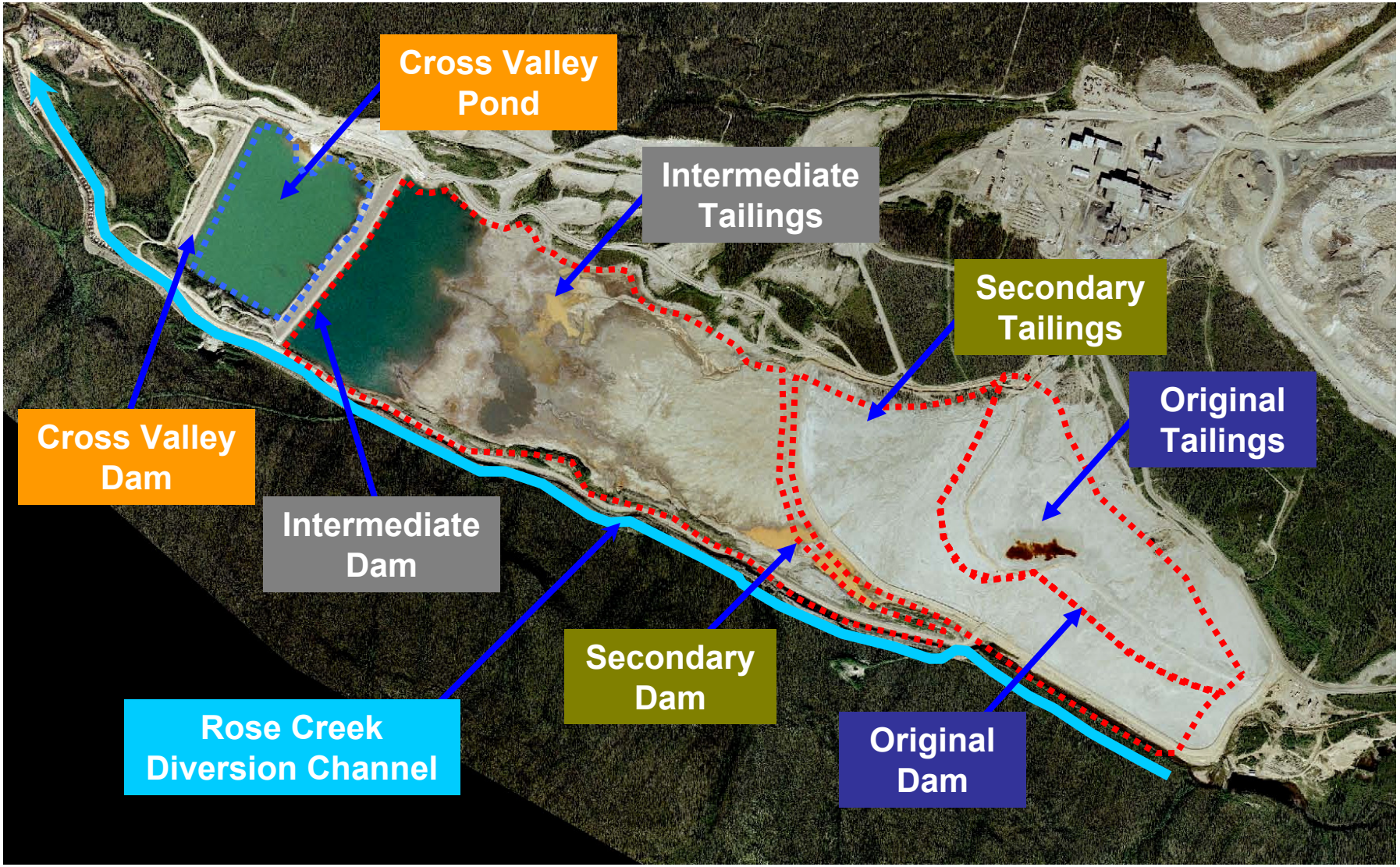
1 stream diversion

70 million MT waste rock

Faro Mine Complex: Faro Pit Components



Faro Mine Complex: Tailings Components



Faro Mine Complex: Tailings Groundwater

Faro Mine Complex:
Vangorda Plateau Components

Faro Mine Complex:
Overarching Closure Objectives

There are 5 ***objectives*** associated with a final closure and remediation plan:

1. Protect human health & safety
2. Protect, and to the extent practicable, restore the environment including land, air, water, fish and wildlife
3. Return the mine site to an acceptable state of use that reflects pre-mining land use where practicable
4. Maximize local and Yukon socio-economic benefits
5. Manage long-term site risk in a cost effective manner

Faro Mine Complex:
Present Day

Estimated liability: $ 400-800 million

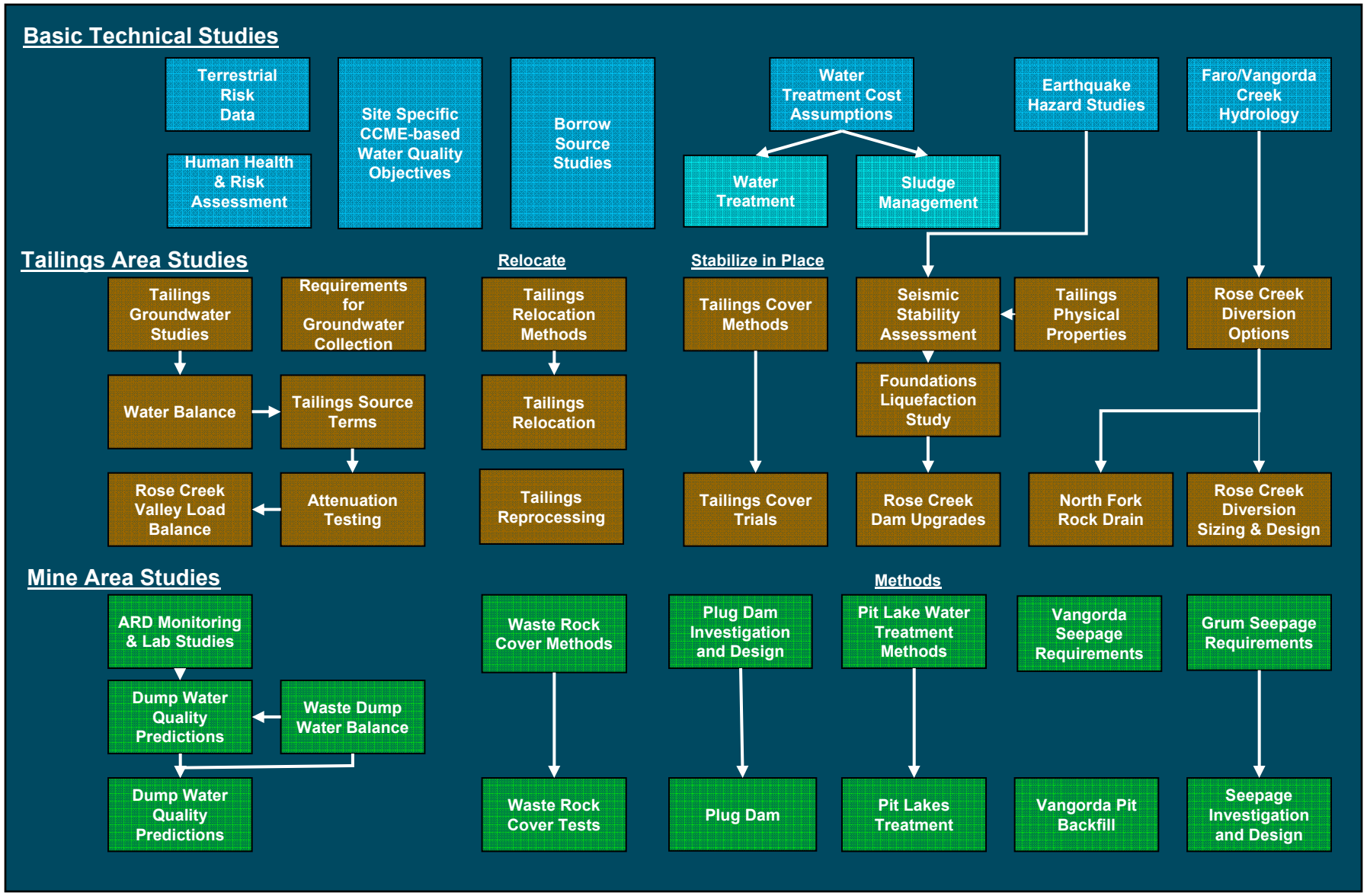
Faro Mine Site currently under the Care and Maintenance mode, implemented by Deloitte and Touche, the court appointed Interim Receiver (IR)

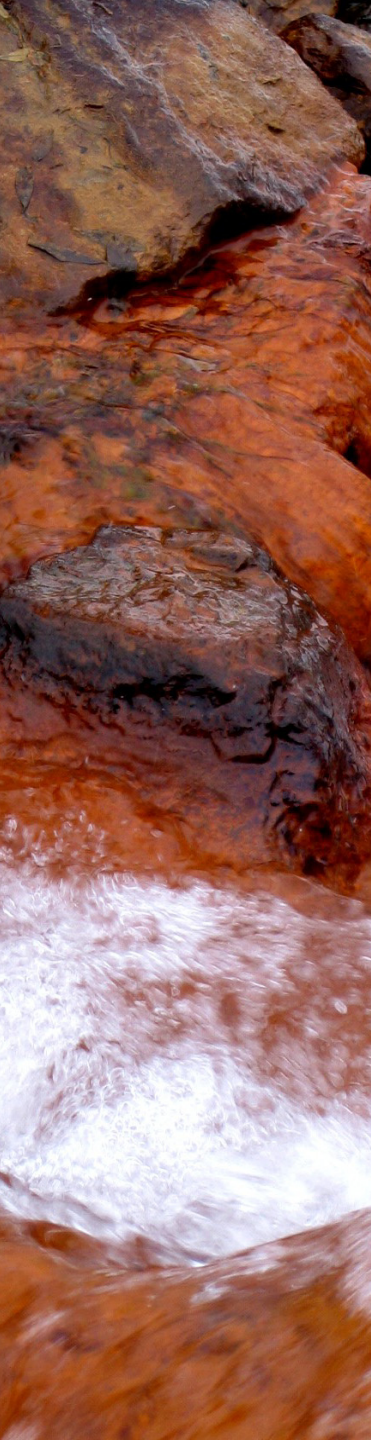
Closure plan development by 2009, submitted for initial federal approval, and Yukon regulatory review

Implementation start approx 2012 ● implementation period 10-40 years, followed by 500+ years of water treatment and other care and maintenance activities

No walk away solution – collection and treatment of contaminated water will be needed for several hundred years

Faro Mine Complex: Technical Studies 2003-06





Environmental Issues: Tailings

Acid generation & release of metals

(continue to increase 400-600 yrs)

→ **Ground & Surface Water Contamination**

(Groundwater "breakthrough" expected in 10-20 years)

Stability of dams/diversion

(Probable Maximum Flood & Maximum Credible Earthquake)

→ **Mass tailings release to aquatic environment after extreme event**

(Rose Creek, Anvil Creek, Pelly River)

Dust transport

(from tailings and mill area)

→ **Contamination of terrestrial environment**

(ongoing – currently no risk to human and ecological health)

Environmental Issues:
Waste Rock

Acid generation & release of metals → **Ground & Surface Water Contamination**

(continue to increase 400-600 yrs)

(waste rock varies in composition & potential to release metals)

Exposed Waste Rock Piles → **Direct contact by human/animals**

& future land use and aesthetics

(320 million MT in total across whole site)

(mine complex in traditional territory of Ross River Dena)

Environmental Issues:
Water Diversions

Three main stream diversions convey water around open pits and the Rose Creek Tailings impoundment

Stream diversions were designed for short-term life spans to support active mining operations

Any diversion relied upon for a final remediation plan must be upgraded to acceptable design standards; Probable Maximum Flood and Maximum Credible Earthquake

Faro Mine Complex:
Independent Peer Review Panel

Independent panel of 9 experts in aspects of Mine Remediation:

Tony Hodge	Ken Raven	Randy Knapp
Laurie Chan	Bill Price	Leslie Smith
Terry Mudder	Ken Froese	Andy Robertson

IPRP Mandate

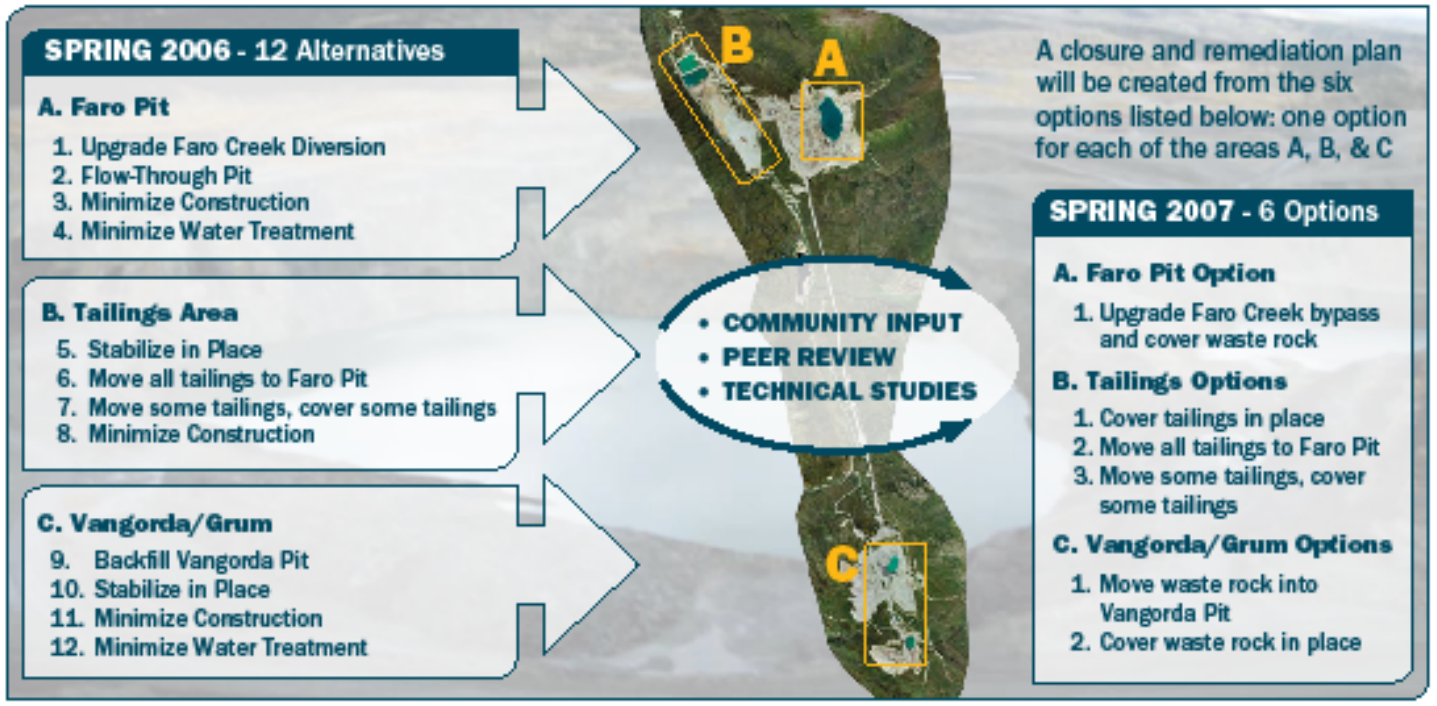
1. Has the full range of viable closure alternatives been considered?

2. Have the technical studies characterized the alternatives in sufficient detail to allow selection of a preferred alternative?

3. Are there any concerns or deficiencies in the technical studies, such that the alternatives may be clarified or modified, as necessary.

Faro Mine Complex:
Refinement of Closure Options

Based upon Peer Review recommendations and outputs of community consultation, closure alternatives were refined into 6 closure options



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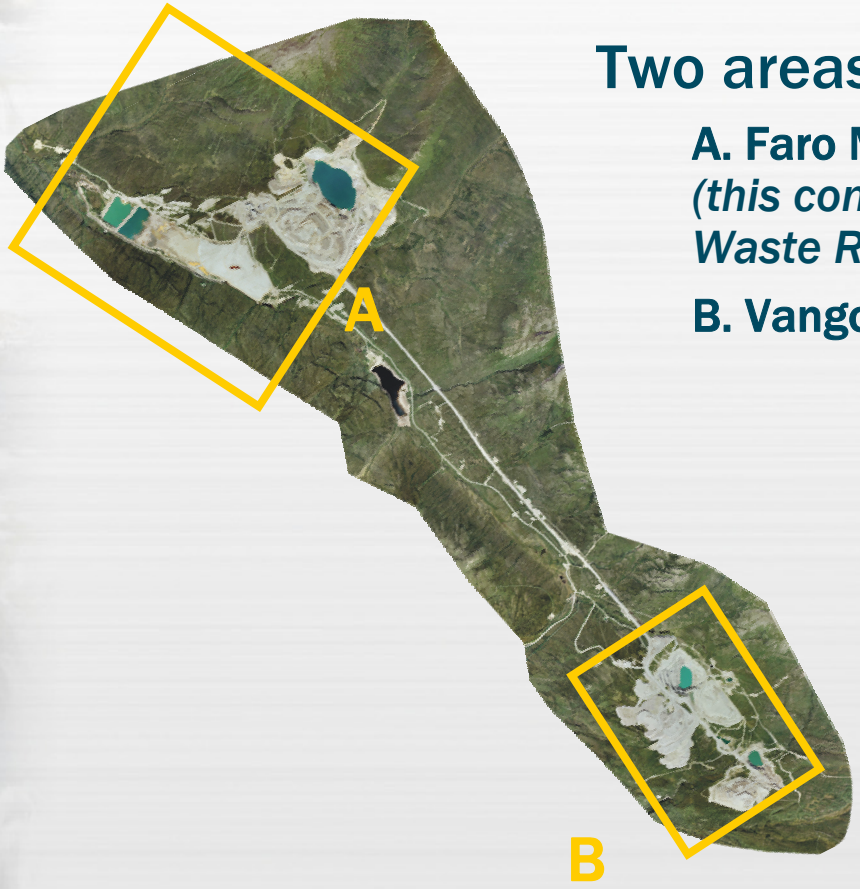
Faro Mine Complex:
Short-listed Closure Options



Two areas

A. Faro Mine Area
(this combines the Faro Pit and Waste Rock with the Tailings Area)

B. Vangorda/Grum Area

3 options for the Faro Mine Area

2 options for the Vangorda/Grum Area

5 total

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Faro Mine Complex:
Short-listed Closure Options

Combined Faro Mine Area

Move All Tailings	+	Upgrade Faro Creek Diversion and Cover/Revegetate Faro Waste Rock
or		
Cover Tailings with Soil	+	Upgrade Faro Creek Diversion and Cover/Revegetate Faro Waste Rock
or		
Move Some Tailings and Cover Some Tailings with Soil	+	Upgrade Faro Creek Diversion and Cover/Revegetate Faro Waste Rock

= 3 Combined Options

Vangorda/Grum Mine Area

Move Vangorda Waste Rock into Vangorda Pit

or

Cover Vangorda Waste Rock in Place

= 2 Options

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Faro Mine Complex:
Common Elements of Options

Any overall closure plan for the Faro Mine Complex will include some common elements:

- Resloping and covering waste rock
- Revegetation of soil covers and other areas
- Diversion of clean water around the site
- Long-term collection and treatment of contaminated water
- Long-term management of water treatment sludge
- Long-term storage of water in pits
- Long-term maintenance of remaining site facilities (diversions, covers, water collection systems, water treatment systems, dams, etc.)
- Long-term monitoring of environmental conditions (water, animals, plants, climate, etc.)

Combined Faro Mine Area Option 1

Upgrade Faro Creek diversion

Reslope, cover and revegetate Faro waste rock

Move all tailings

Estimated Jobs: 975 person years

Estimated Cost: $590 M

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Combined Faro Mine Area Option 1:
Upgrade Faro Creek Diversion / Cover Faro Waste Rock

Closure Approach

What is involved?

- Build new diversion channel for Faro Creek
- Remove North Fork Rock Drain
- Build lined channel for North Fork Rose Creek
- Waste Rock
  - Reslope and cover with soil
  - Possibly move some waste rock to Faro Pit
- Revegetate covered waste rock
- Move tailings from Emergency Tailings Area to Faro Pit or Tailings Area.
- Collect and treat contaminated water from below waste rock, Zone 2 Pit and in Faro Pit (100s of years)
- Maintain covers and channels (100s of years)
- Monitor environmental conditions and adapt to changes

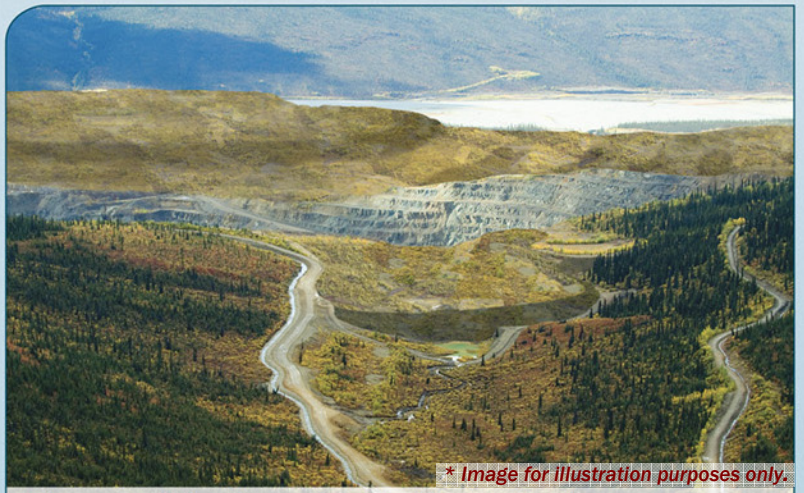
Estimated cost to build and maintain: $150M

Estimated employment: 230 person years

Each option is designed to meet technical and environmental standards.

An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vangorda/Grum Area.

Before remediation (Now)



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After remediation (approximately 40 years time)

Combined Faro Mine Area Option 1:
Move all tailings

Move All Tailings to Faro Pit

What is involved?

- Mix tailings with lime and water
- Pump tailings to Faro Pit
- Clean up remaining tailings with trucks and loaders
- Collect and treat contaminated water from under tailings (20 years?)
- Cut through dams and revegetate valley
- Construct channel for Rose Creek and put Rose Creek back in the valley when soil and water are clean
- May have to collect and treat contaminated water from mine area in Rose Creek Valley (100s of years)
- Monitor environmental conditions and adapt to changes

Estimated cost to build and maintain: $440M

Estimated employment: 745 person years

Each option is designed to meet technical and environmental standards.

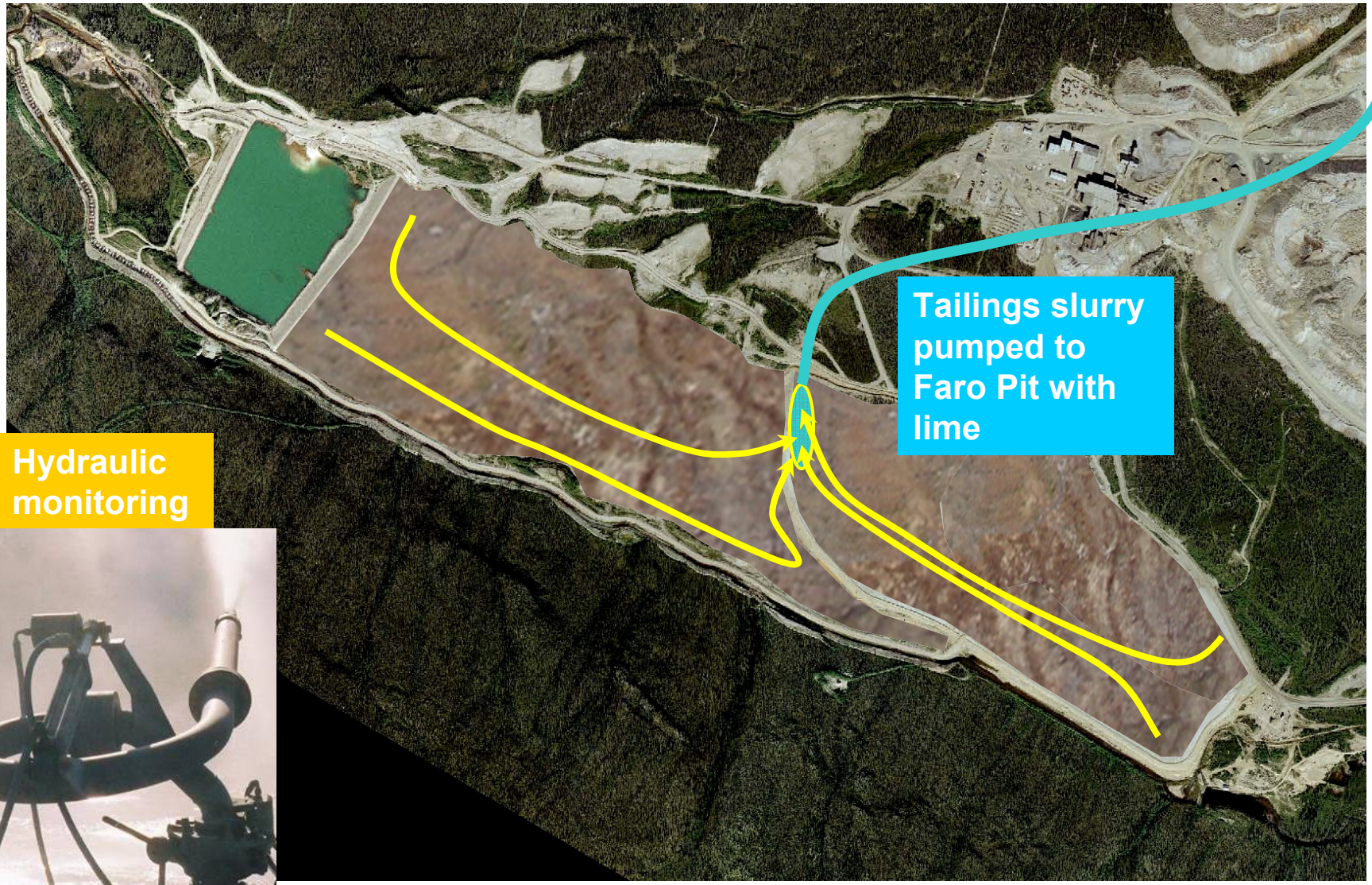
An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vangorda/Grum Area.

Before remediation (Now)

** Image for illustration purposes only.*

After remediation (approximately 40 years time)

Combined Faro Mine Area Option 1:
Moving Tailings



Hydraulic monitoring

Combined Faro Mine Area Option 1:
Clean Up of Valley

1. Use trucks and excavators to clean up contaminated material left behind

2. Collect and treat water until valley is clean (10 to 20 years)

3. Cut through dams and the diversion and return Rose Creek to the valley

Combined Faro Mine Area Option 2

Upgrade Faro Creek diversion

Reslope, cover and revegetate Faro waste rock

Cover tailings with soil

Estimated Jobs: 566 person years

Estimated Cost: $410 M

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Combined Faro Mine Area Option 2:
Cover tailings with soil

Cover Tailings with Soil

What is involved?

- Remove Cross-Valley Dam or change/upgrade it for emergency water storage
- Stabilize Second Dam
- Regrade tailings and cover with waste rock and soil
- Revegetate covered tailings and other areas
- Build/upgrade diversions, channels and spillways to deal with floods
- Collect and treat contaminated water from valley (100s of years)
- Maintain covers, channels and dams (100s of years)
- Monitor environmental conditions and adapt to changes

Estimated cost to build and maintain: $260M

Estimated employment: 336 person years

Each option is designed to meet technical and environmental standards.

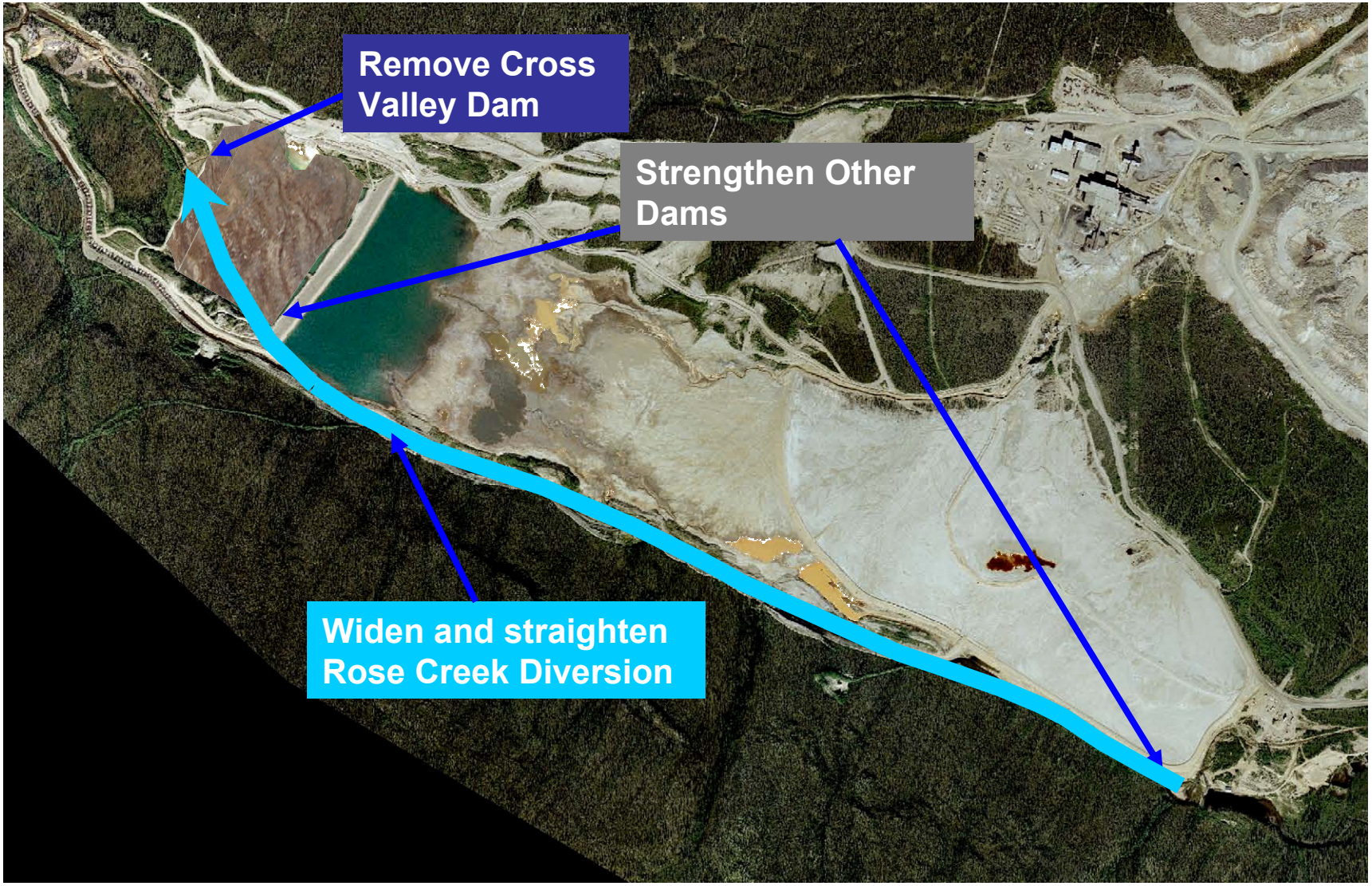
An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vangorda/Grum Area.

Before remediation (Now)

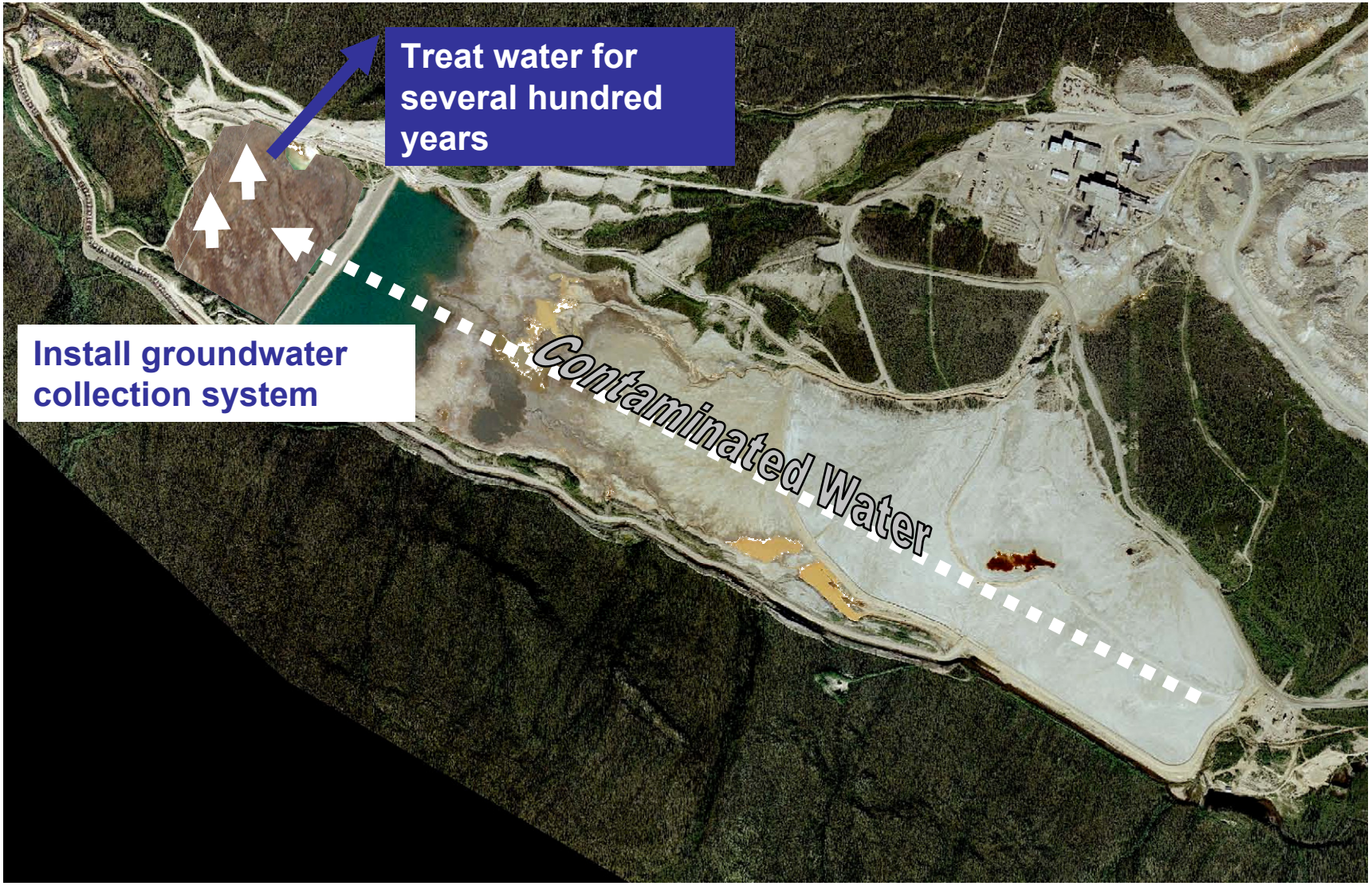
** Image for illustration purposes only.*

After remediation (approximately 40 years time)

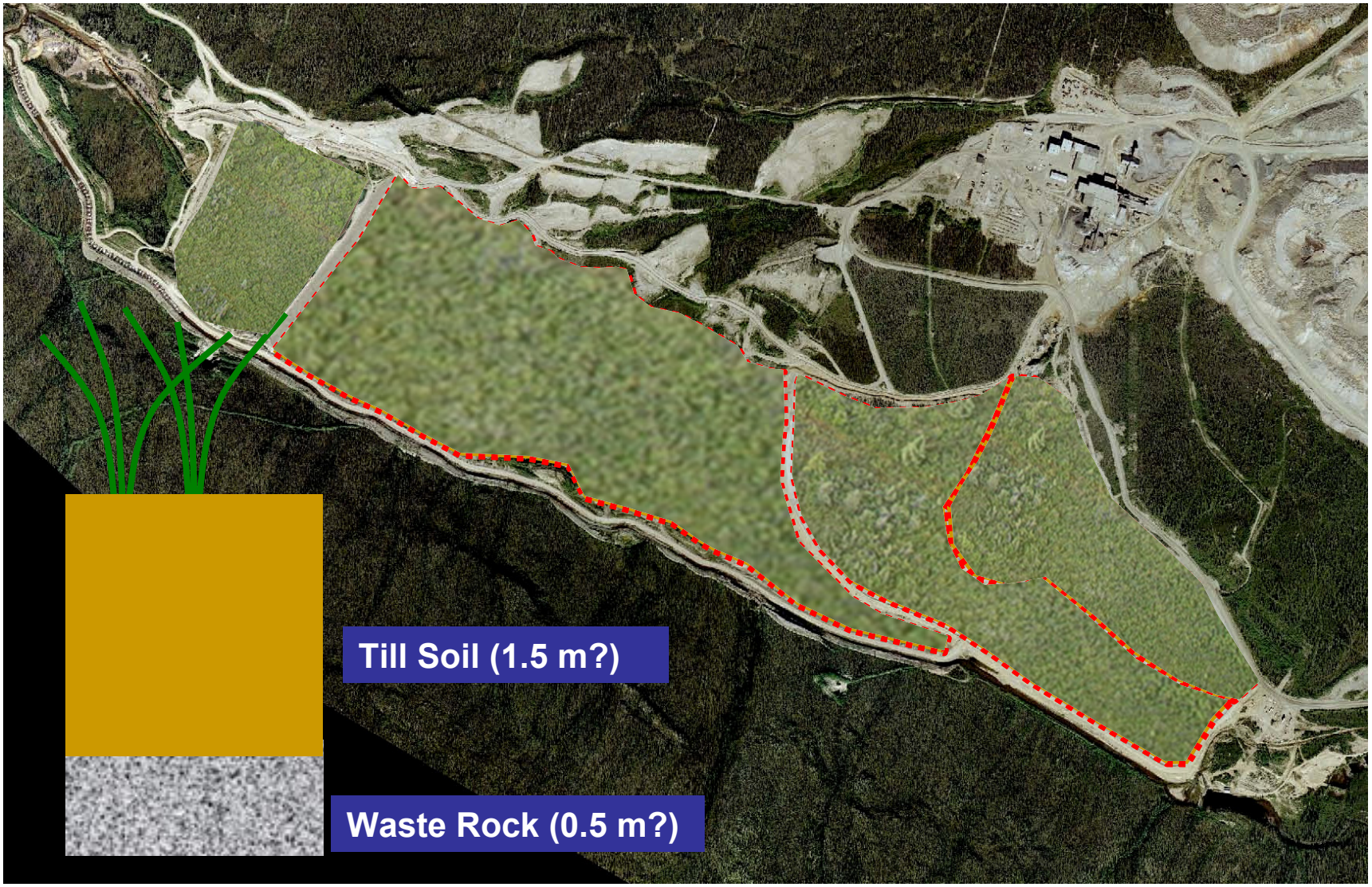
Combined Faro Mine Area Option 2:
Cover tailings with soil



Combined Faro Mine Area Option 2:
Cover tailings with soil



Combined Faro Mine Area Option 2:
Cover tailings with soil



Combined Faro Mine Area Option 3

Upgrade Faro Creek diversion

Reslope, cover and revegetate Faro waste rock

Move some tailings and cover some tailings with soil

Estimated Jobs: 782 person years

Estimated Cost: $490 M

Combined Faro Mine Area Option 3:
Move some tailings and cover some tailings with soil

Move Some Tailings and Cover Some Tailings

What is involved?

- Remove Cross-Valley Dam or change/upgrade it for emergency water storage
- Stabilize Second Dam
- Mix Intermediate Tailings with lime/water and pump to Faro Pit
- Clean up remaining Intermediate Tailings with trucks and loaders
- Regrade Original and Second Tailings and cover with waste rock and soil
- Revegetate covered tailings and valley area
- Upgrade diversion channel for upper part of Rose Creek
- Construct channel for lower part of Rose Creek and return the creek to the valley when soil and water are clean
- Collect and treat contaminated water (100s of years)
- Maintain covers, channels and dams (100s of years)
- Monitor environmental conditions and adapt to changes

Estimated cost to build and maintain: $340M

Estimated employment: 552 person years

Each option is designed to meet technical and environmental standards.

An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vangorda/Grum Area.

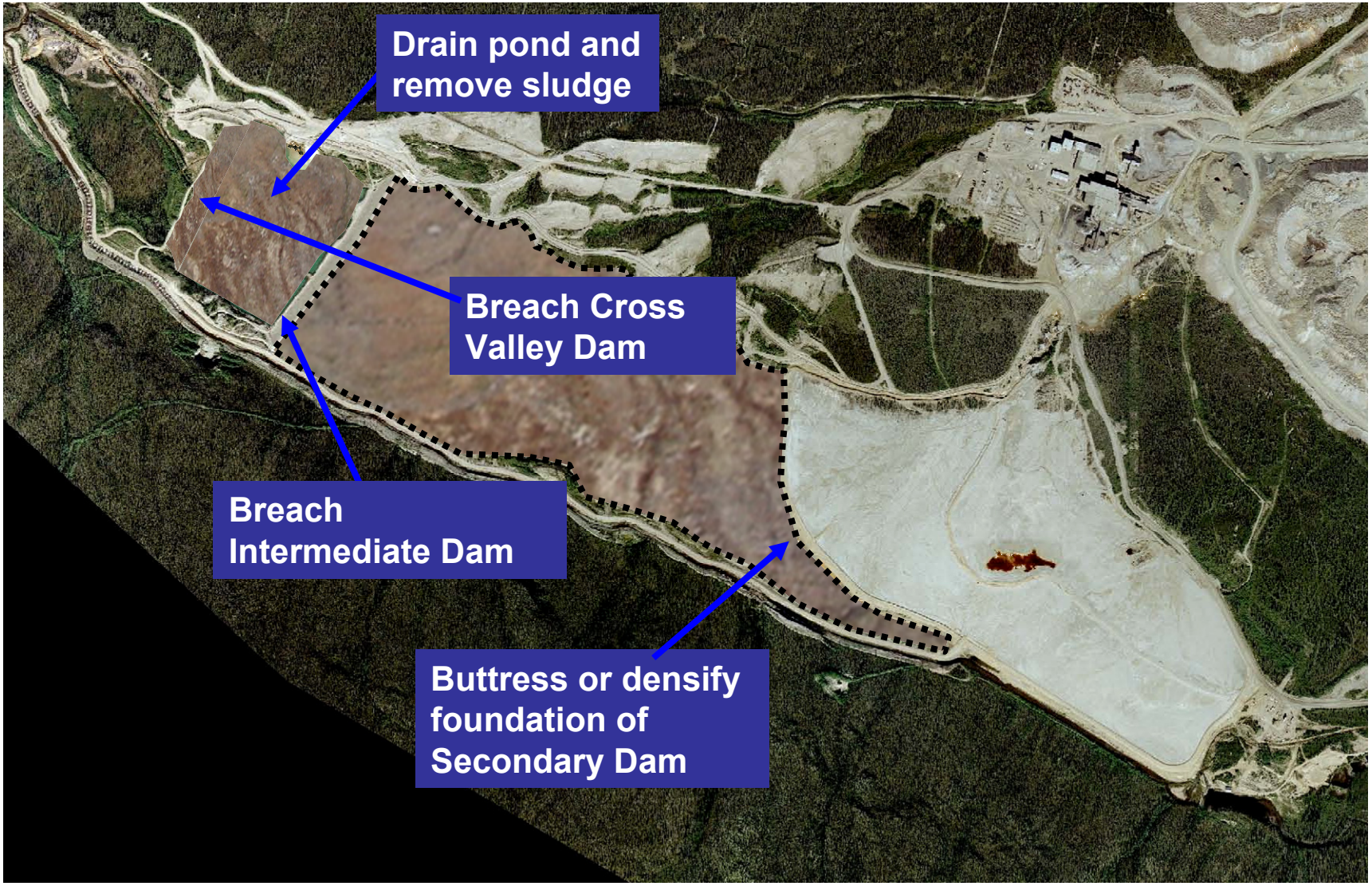
Before remediation (Now)

** Image for illustration purposes only.*

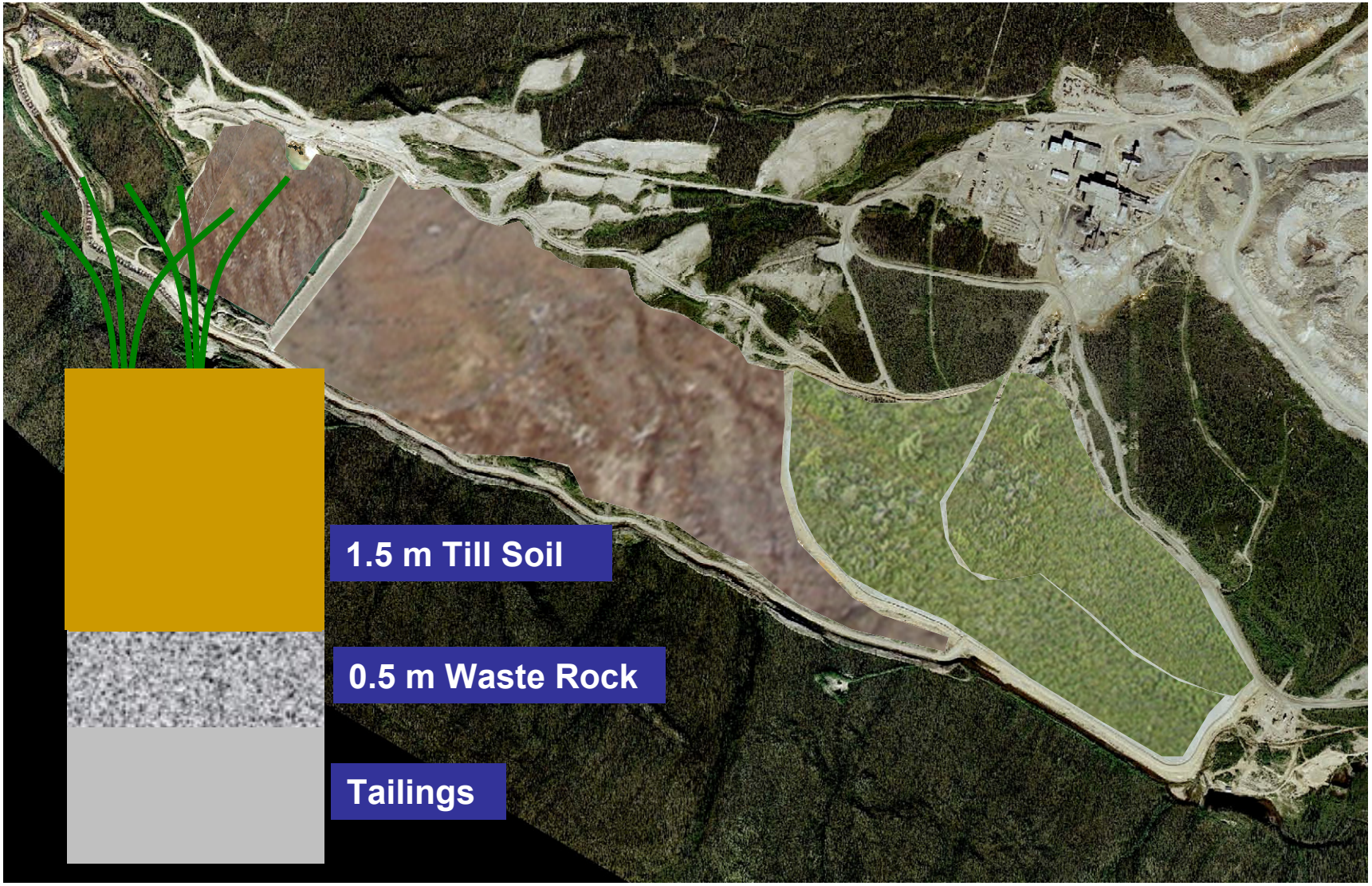
After remediation (approximately 40 years time)

Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil

Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil



Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil



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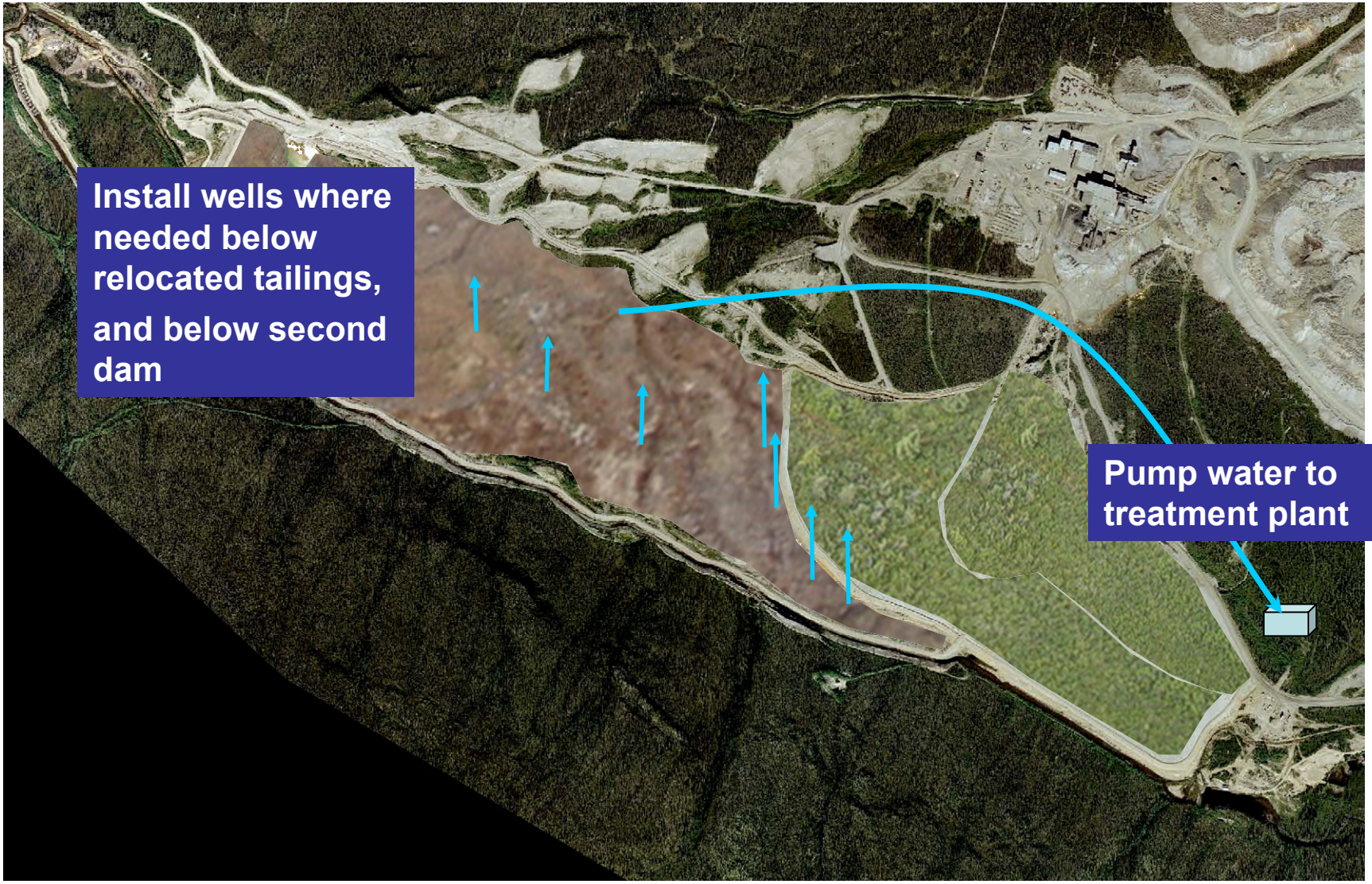

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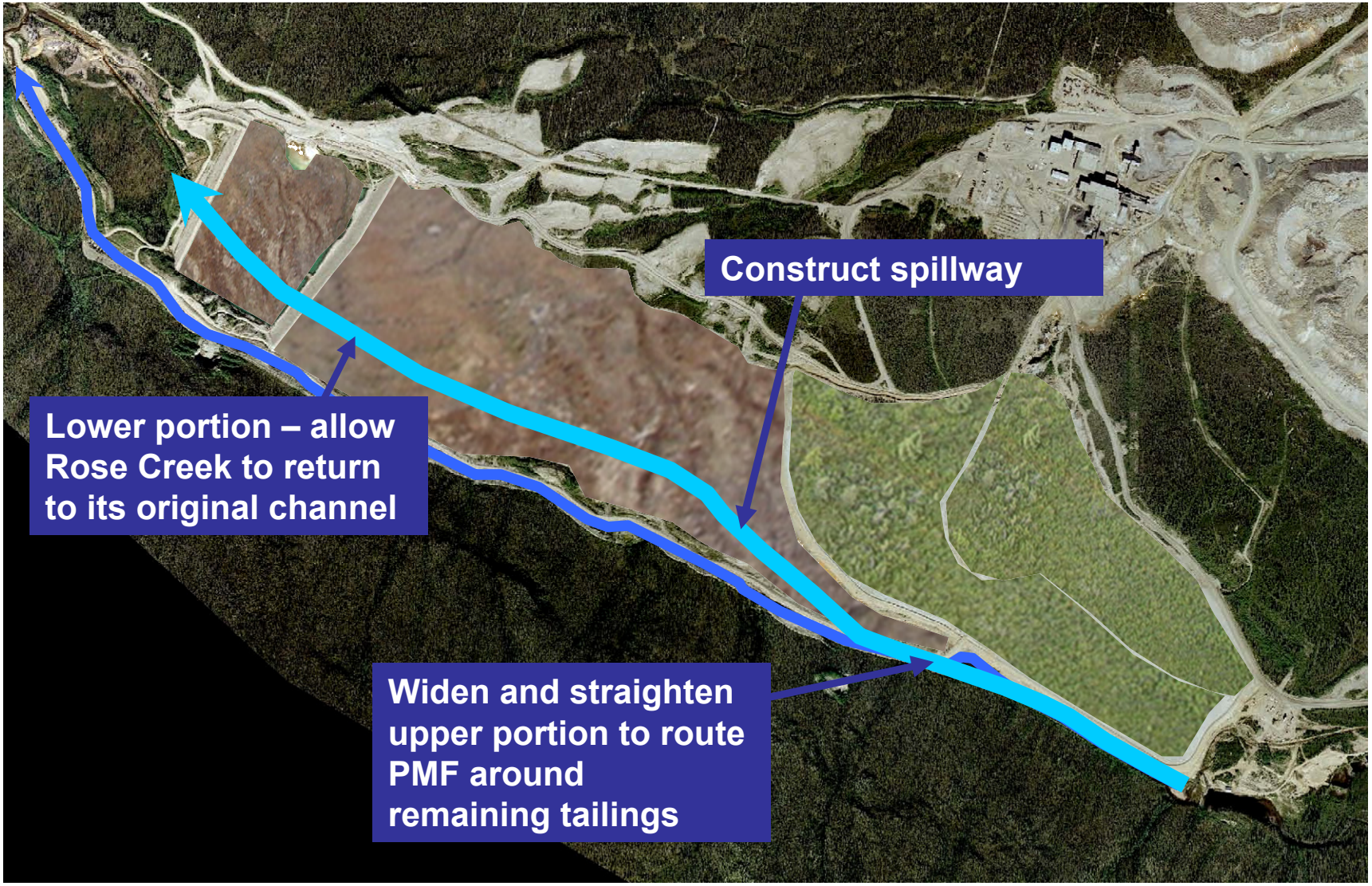


Selection of Preferred Option

Multi-variable Assessment

- Structured method to compare remediation options to project objectives
- Proven method used for complex decision making applications:
  - Nuclear Waste Management long-term disposal assessment
  - Other mine closure projects; ex. Ekati Mine, Red Dog
- Useful for multi-stakeholder assessments where consensus is desired

Selection of Preferred Option

Multi-variable Analysis

- Established Assessment Team with representation by 2FN and advisors, technical advisor, IPRP, YG and INAC
- Hired MVA/decision analysis experts used in NWMO disposal options analysis
- Significant reports going into process:
  - Draft alternatives report
  - IPRP report and comments by expert departments
  - Implementation approach
  - Risk assessment of options

Selection of Preferred Option

How did we go about it?

Major Steps in assessment were:

1. Converted each project objective into measurable sub-objectives. They are:
   1. environment
   2. public health and safety
   3. worker health and safety
   4. traditional land use
   5. local land-use
   6. local socio-economic
   7. Yukon socio-economic
   8. cost
2. Worked through factors that influence the sub-objectives
3. For each sub-objective short term (40 years) and long-term (500-1000 years) were considered
4. Developed technical notes describing the performance of each alternative for each sub-objective for both short and long-terms scenarios

Selection of Preferred Option

How did we go about it?

Major Steps in assessment were (Cont'd):

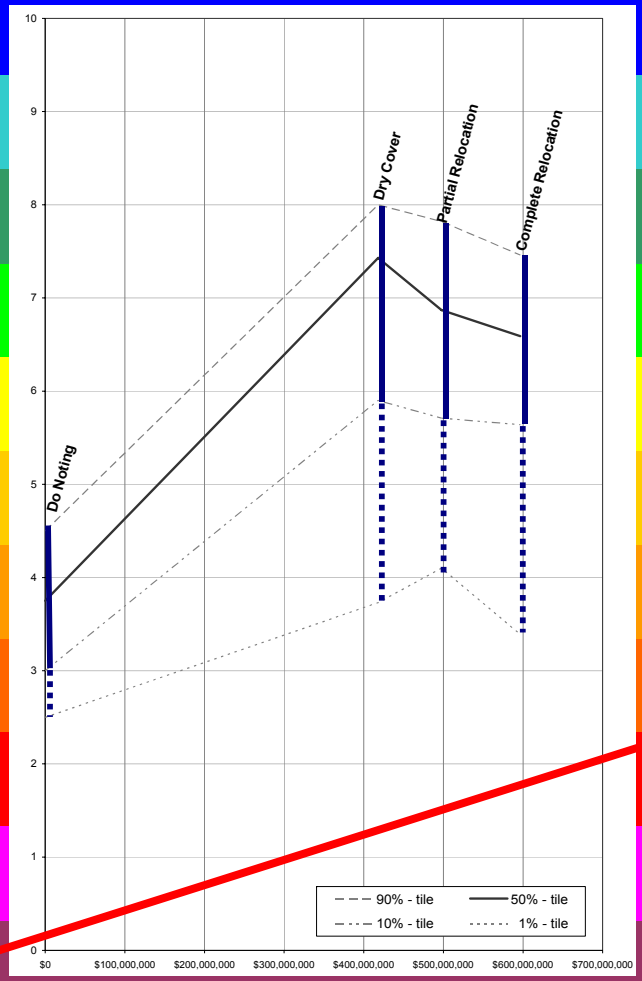
5. Conducted assessment by individually assigning scores from 0-10 for the expected performance of each option to meet sub-objectives
6. Assigned individual weightings for each sub-objective (relative importance of each objective)
7. Produced bar charts of results
8. Conducted sensitivity analysis to determine the influence of weightings on the results

Faro Mine & Tailings

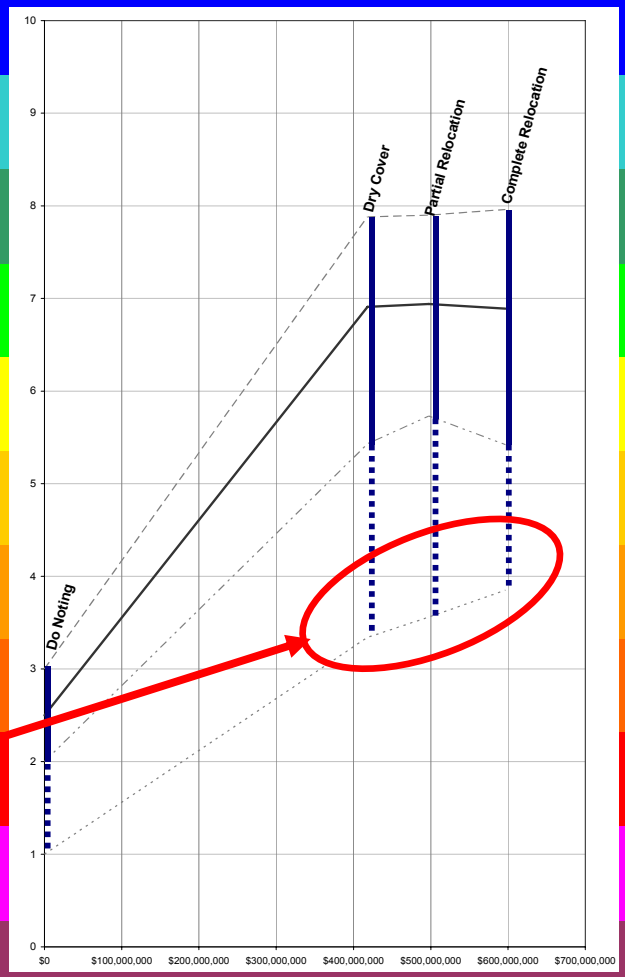
Environmental Scores

Score	
10	Ideal performance. No adverse impact to any aspect of the environment, including aesthetics. Thealternative fully restores and protects all water, land, air, fish and wildlife to conditions that are equal to or exceed that which existed prior to the mine. Comprehensive monitoring provides assurance.
9	Very good performance. Impacts are insignificant. No violations to environmental standards will occur. Although some minimal aesthetic affects may remain, the alternative fully restores and protects all highvalue resources. Cleanup and monitoring is best-practice.
8	Good performance. Some minor, localized, temporary impacts to environmental resources. Any violations to standards are minor; exceedences will self-correct within the year. Monitoring is adequate to allow problems to be identified and addressed in a timely fashion.
7	Fair performance. Some exceedences of applicable standards and/or localized, short-term impacts to environmental resources will occur. Effects on plants, fish, and wildlife will be mild and self-correcting within about 3 years.
6	Mediocre performance. There will be a few serious violations of applicable environmental standards. Effects on environmental resources will be significant, but localized and correctable. Regional abundance of the important species will not be seriously affected. Self-correcting in about 10 years.
5	Poor performance. Significant violations and significant problems. There will be serious but correctable damage to some highly valued ecosystem components. Regional abundance of some important species will be affected, and adverse effects will not persist for more than a generation.
4	Very poor performance. Serious problems. Moderate-scale, long-term, ecosystem damage. Regional abundance of important species impacted over multiple generations. Not entirely correctable.
3	Bad performance. Very serious, moderate-scale problems with irreversible (permanent) damage to some of the most highly-valued ecosystem components. Between scores of 2 and 4.
2	Very bad performance. Major problems. Permanent, large-scale, ecosystem damage. Regional loss of some key resources.
1	Terrible performance. Critical problem. Loss of some ecosystem functions. Between scores of 0 and 2.
0	Abominable performance. An environmental disaster. Permanent, large-scale loss of many key species and irreparable damage to ecosystem function.

Short Term



Long Term



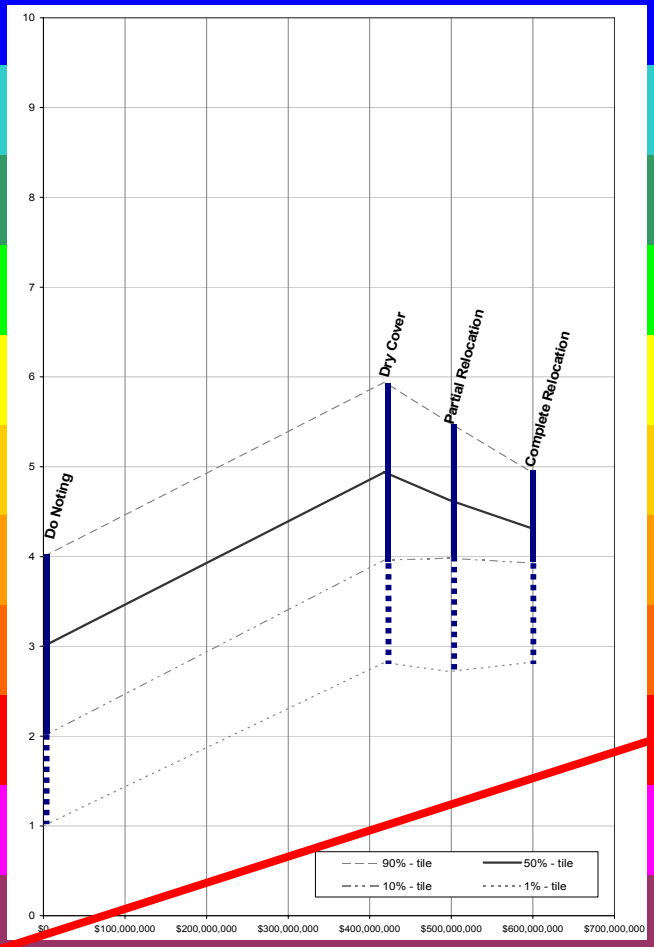
These are the improvements in long term environmental risk. Note that the differences are not that great, there are risks in all cases. Also note that Complete Relocation option, which has the lowest long term risk, actually scores poorest in the short term.

Faro Mine & Tailings

Traditional Land Use Scores

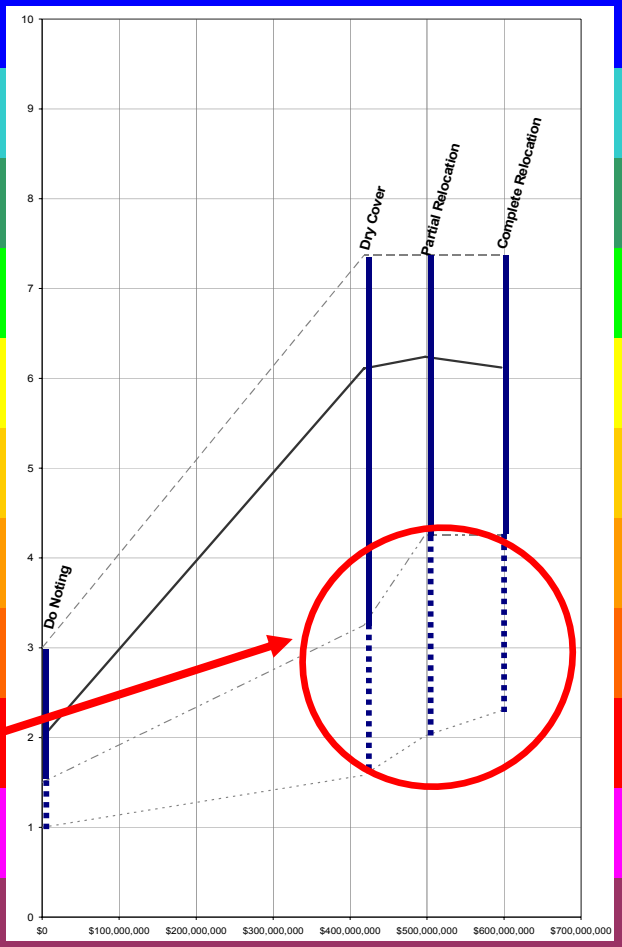
Score	
10	Ideal performance. No adverse impact to traditional land use. Site fully restored to natural state.
9	Very good performance. Some remaining aesthetic affects, but only insignificant and impacts on traditional land use. Necessary aquatic resources fully restored. Site allows hunting, trapping trails, trap lines essentially as existed prior to mine. Unimpeded access available at traditional trails.
8	Good performance. Some minor, localized impacts to traditional land use. Few people are effected and for only a limited amount of time.
7	Fair performance. Some moderate, highly localized, short-term limitations to traditional land use. Affects utilization of some, but not all traditional resources.
6	Mediocre performance. Some significant limitations over a small area on traditional land use remain. Between 5 and 7
5	Poor performance. Significant problems (e.g., reduction in habitat productivity) limit but do not eliminate uses essential for tradition. The impact is over a moderately sized area. Between scores of 4 and 6.
4	Very poor performance. Serious problems result in significant and persistent limitations on traditional land use over a relatively large area. Affects usage of many important traditional resources. Seriously adversely affects traditions for some peoples.
3	Bad performance. Very serious problems. Impacts large area. Between scores of 2 and 4.
2	Very bad performance. Major problems. Key traditional resources lost. Permanent and major limitations on traditional land use over a very large area. Affects usage of nearly all important traditional resources for many people. Traditions lost for many peoples.
1	Terrible performance. Critical problem. Between scores of 0 and 2.
0	Abominable performance. An disaster for traditional land use. Permanent loss of traditional land use opportunities over an extensive area and for nearly all people resulting in irreparable break with traditions.

Short Term



NPV Total Cost

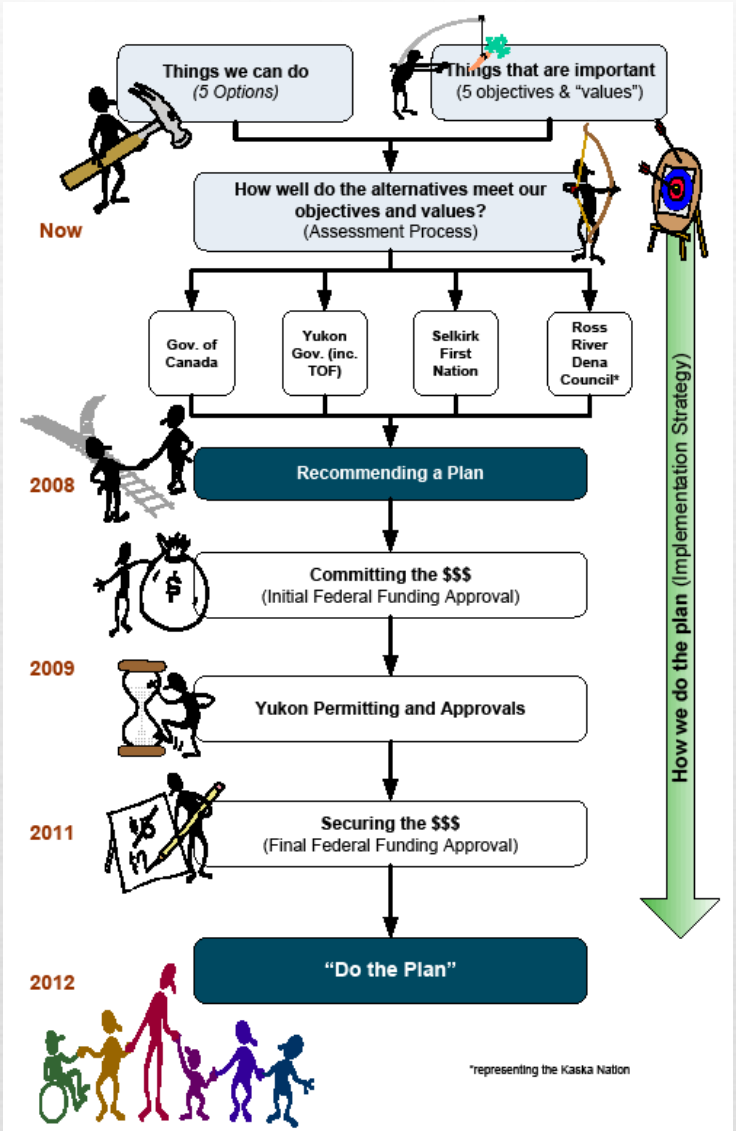
Long Term



NPV Total Cost

For traditional land use, the relocation options clearly offer lower long-term risks. But, again, all options have significant risks. Also, again, Complete Relocation option scores poorest in the short term.

Next Steps: Roadmap to Remediation



- The communities and governments are now conducting their own assessment processes.
- Information from these processes will be used by the project Oversight Committee to arrive at a **final closure and remediation plan** to recommend to the federal government for initial funding approval.

Questions?

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