# CASE STUDY

# Remediation of Contaminated Soil and Debris from a Remote Site with Difficult Bedrock Terrain in the Canadian Arctic

# THE RADIO ISLAND EXPERIENCE

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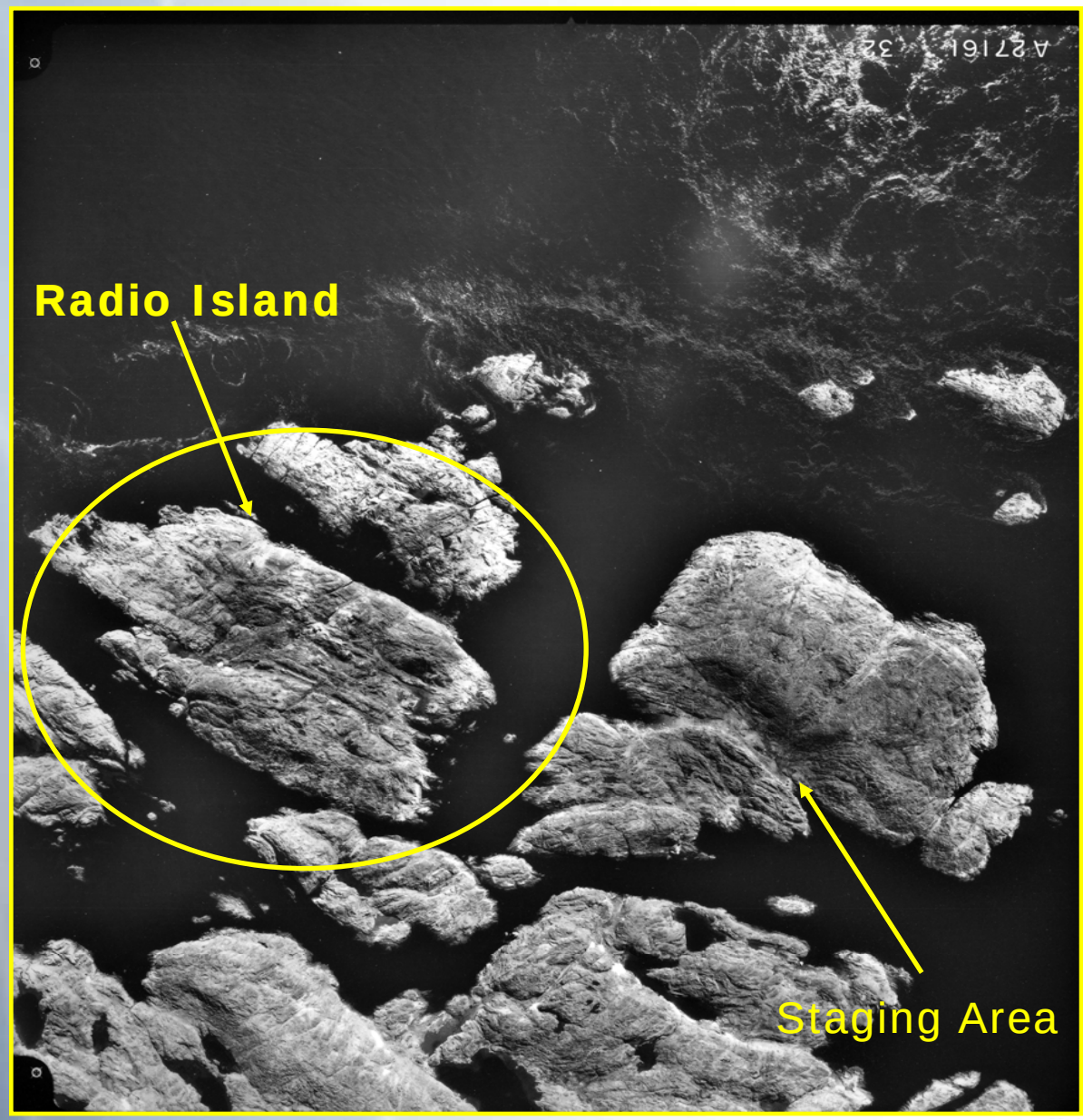
# Where is Radio Island ?

# Background

- Radio Island is an uninhabited barren island approximately 1 km long and 0.5 km wide.
- Facility was operated and manned year around as a navigational aid and weather station from 1929 to 1961 by DOT.
- All that remained on this site after it's closure were two buildings, the remains of four others, a light beacon tower, helicopter pad and various types of waste debris scattered over the island.
- Site access is via helicopter or boat (320 km trip from Iqaluit).
- The island is situated on Canadian Shield bedrock with soil restricted to isolated pockets in gullies.

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A tyco International Ltd. Company

A BETTER TOMORROW made possible

# Remedial Action

- Site was previously assessed by RMC (1997), Earth Tech (2001), and Queens University (2005).
- Contaminants consisted of heavy metals and hydrocarbons. PCBs were not identified as being a concern.
- No suitable borrow sources available onsite for the construction of a landfill.
- In 2006, PWGSC Environmental Services developed a Remedial Action Plan for the site. The remedial method selected included the excavation of all contaminated soils and the offsite disposal of all soils and debris.
- In the spring of 2006, remedial specifications were prepared and tender documents created for the remediation of the site.
- Hazco Environmental Services was awarded the Contract to perform the remediation work under the supervision of engineers from Earth Tech Canada (Summer 2006 & 2007).

# Remedial Action

The scope of work for the remedial program included:

- Mobilization/demobilization, camp operation
- Excavation, containerization and shipment offsite of petroleum and metal impacted soils
- Collection, containerization and shipment of hazardous and non hazardous debris
- Collection and onsite incineration of all non painted/ treated wood
- Treatment of metal contaminated surface water located in five ponds on the island (ponds had been used as waste disposal areas).

# Unique Location


Rugged Terrain

# Limited areas suitable for a camp (2006 Camp Configuration)

# Limited areas suitable for a camp (2007 Camp Configuration)

# Low Tide

# High Tide – highest tide of the year

# Project Challenges

Challenges that were addressed by the contractor included:

- Safety
- Poor Weather Conditions
- Site Access
- Selection of Heavy Equipment suitable for Terrain
- Manual Labor Effort
- Polar Bear Management
- Schedule

# Poor Weather Conditions


FOG


RAIN

# High Winds!

# Site Access

- Shoreline areas are characterized by sharp cliffs that drop into the Hudson Strait.
- Very small beach area located on the north shore of the island prevented the off loading of contractors equipment and supplies.
- Only equipment that sea lift contractor was able to off load on Radio Island in 2006 was the excavator and two Bobcats.
- Closest suitable site was approximately 1 km to the northwest on adjacent island.
- Large effort to move materials between the two sites.

# Soil bags and sea cans waiting for sea lift

# Selection of Heavy Equipment

Challenges:

- Limited accessibility for heavy equipment
- Heli-portable requirement
- Needed to adapt to steep bedrock terrain
- Excavation areas were typically small narrow bedrock gully excavations partially filled with organic and mineral soils
- Soils were commonly found to be impacted to bedrock (0.3-0.75 m in depth)

# Key Equipment on Site

2006 Work Program

- 1 – Bell 212 Helicopter(1,450 kg lifting capacity)
- 1 – Takeuchi 1105 steel tracked excavator
- 1 – Kubota K-0008 mini excavator
- 2 – Bobcat 700 skid steers
- 3 – Muck Truck gas powered wheelbarrows
- 14 – Inuit Laborers

2007 Work Program

- 1 – Bell 212 Helicopter(1,450 kg lifting capacity)
- 1 – Kubota mini excavator
- 1 – Tacheuchi mini excavator
- 2 – John Deere skid steers
- 4 – Inuit Laborers

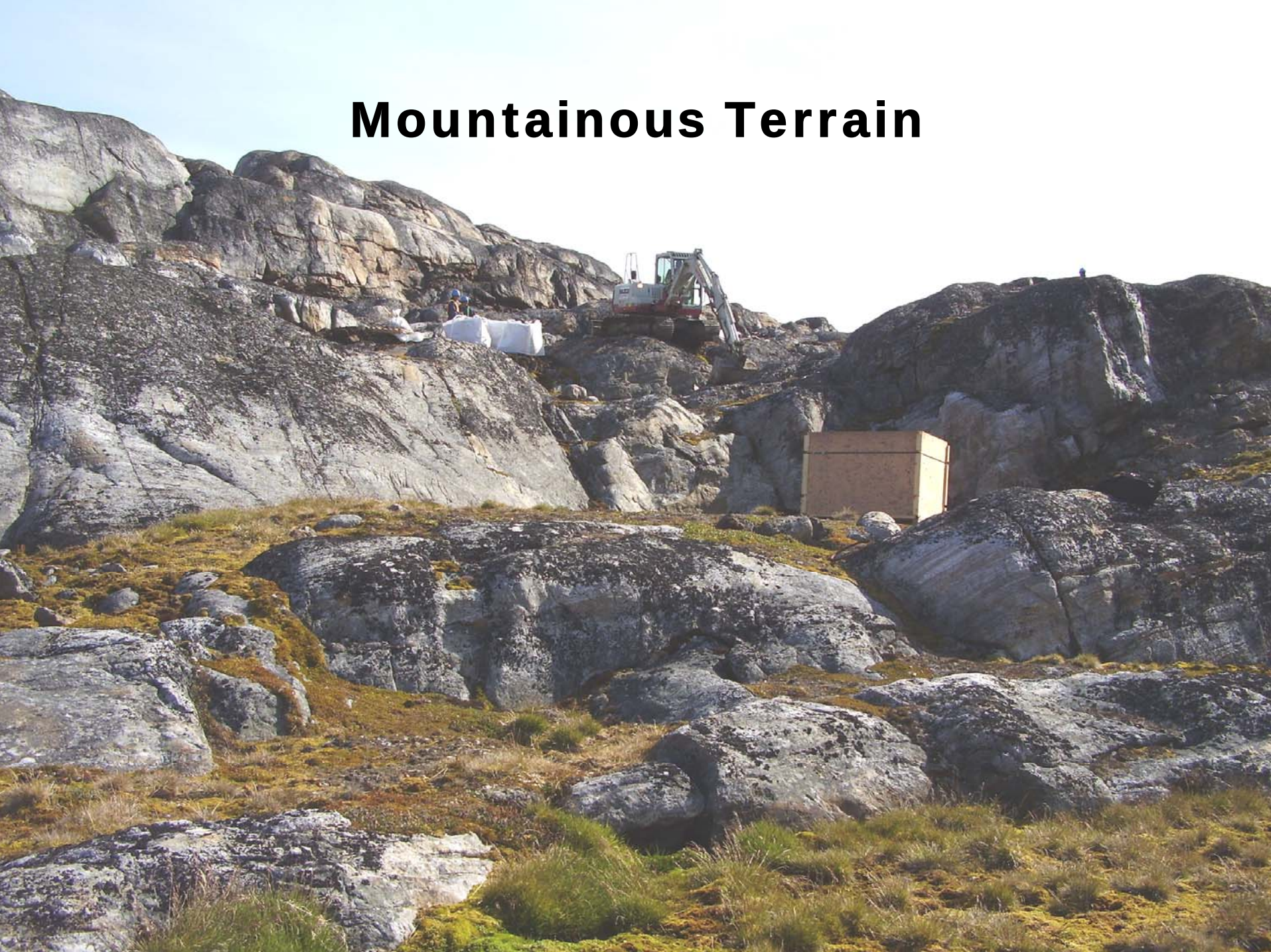
# Debris being loaded into sea cans

Mini Excavator filling soil bags at a rate of 20 – 30 $m^3$ per day (2006)


**Two Mini excavators with modified buckets filling soil bags at a rate of 100 $m^3$ per day (2007)**

# Equipment needed to be Heli-portable

# Mountainous Terrain




Typical Excavation Area


Filling soil bags with large excavator (2006)
TAKEUCHI
MAZDA
TB175

# Excavation by hand in inaccessible areas

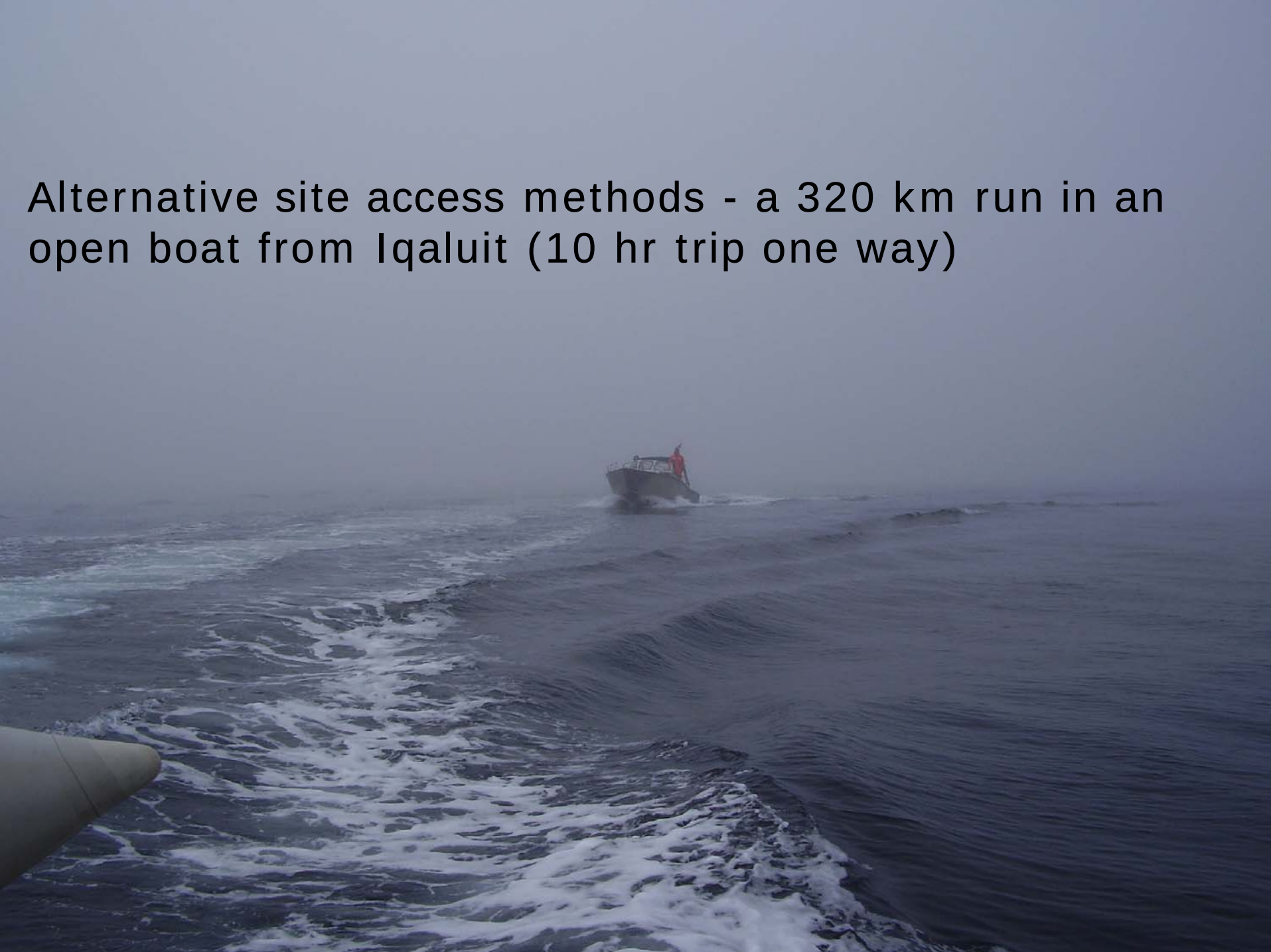
Dependence on the use of a helicopter to complete the remedial work

# Large helipad existed at the site

# Helicopter moving supplies

# Helicopter lifting large / heavy objects

# Grounded during periods of fog


Alternative site access methods - a 320 km run in an open boat from Iqaluit (10 hr trip one way)

# Polar Bear Control

# Polar Bear Control Measures

- Radio Island is a known Polar Bear Denning Area
- Polar Bear Management Plan was developed
- 5 wildlife monitors with guns, two way radios, and bear bangers provided 24 hour, 7 day per week surveillance
- 2 m high, 10,000 volt electrical fence surrounded the camp
- 10 bear sightings were reported over the 6 week period in 2006, only two sightings in 2007


10,000 volt electrified fence surrounding camp


Our Friends the Bears!


Smile for the Camera

# Engineer’s Best Friend!

# Water Treatment Program

Ponds used for waste disposal, as a result, waters were impacted with cadmium, copper, lead and zinc

# Pond full of debris to be de-watered and treated

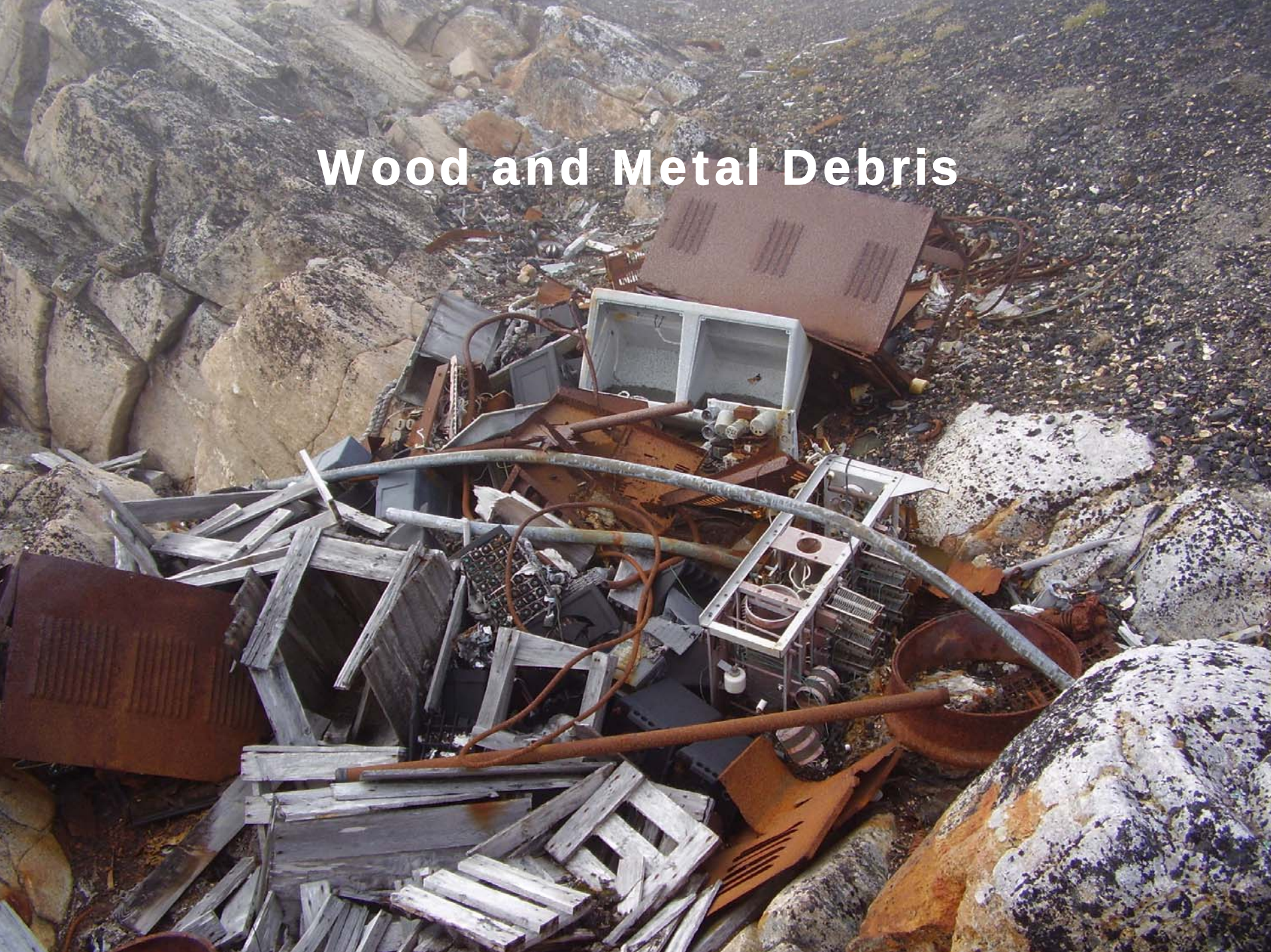
# Water Treatment


Portable water treatment plant consisting of filters and drums of alumnino-silicate

# Hazardous Materials and Non-Hazardous Debris Handling

# Collection of Site Debris (2006)

- Waste debris collection was completed by hand in 2006 with a team of 14 local labourers.
- In total 143 $m^3$ of non-hazardous debris, 53 $m^3$ of wood debris, and 20 $m^3$ of hazardous materials were recovered in 2006.
- 10 seacans of hazardous/regulated wastes were recovered (asbestos containing materials, batteries, lead paint, lead wrapped cable) and non-hazardous debris were shipped to Montreal for disposal .


Wood and Metal Debris


Scattered debris in a bedrock gully


Battery Dump


Non-Hazardous Debris Dump

**Paint on Buildings contained 115,000 ppm lead – needed to be removed**


Main house with lead paint removed


Seacans full of debris and haz-waste

# The use of soil bags for collecting and transporting contaminated soil


Excavation down to bedrock
HAZCO


Excavation down to bedrock inside building foundations


Soil bags at one of the excavation areas

# Radio Island Project Summary

- 143 $m^3$ of non-hazardous debris (2006)
- 53 $m^3$ of wood debris (2006)
- 20 $m^3$ of hazardous materials (2006)
- 1038 $m^3$ of contaminated soil (2006)
- 738 $m^3$ of contaminated soil (2007)
- 411,000 L of treated water (2006)
- 169,000 L of treated water (2007)

# Lessons Learned

- Invest the time and effort to properly assess and evaluate contaminated areas.
- Requirement for remediation contractor to have thorough understanding of site constraints in order to properly select heavy equipment.
- Don’t underestimate the effects of weather when projects are close to marine environments or on isolated islands, build contingency into schedules.
- Identify alternate modes of transportation in case the primary means are not available.
- Be prepared to handle and address unforeseen events (i.e. changes in weather, environmental spills, labor issues, and breaks in the supply chain).
- Understand site constraints when selecting heavy equipment for the project.

# Closure

- The 2006 Program included the removal of 60% of the contaminated soil as well as all of the hazardous and non-hazardous waste/debris.
- The 2007 Program was completed more effectively using the knowledge gained from working on this rugged and remote location in 2006.
- Earth Tech, PWGSC, INAC, and Hazco worked together to solve logistical and technical challenges resulting in a successful project.

# QUESTIONS ?