Keystone Environmental

Knowledge-Driven Results

Innovative & Sustainable Approach to Barrier Wall Installation at an Active Rail Yard

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Presenter: Jason Christensen, P.Eng.

Environmental Consulting

Engineering Solutions

Assessment & Protection

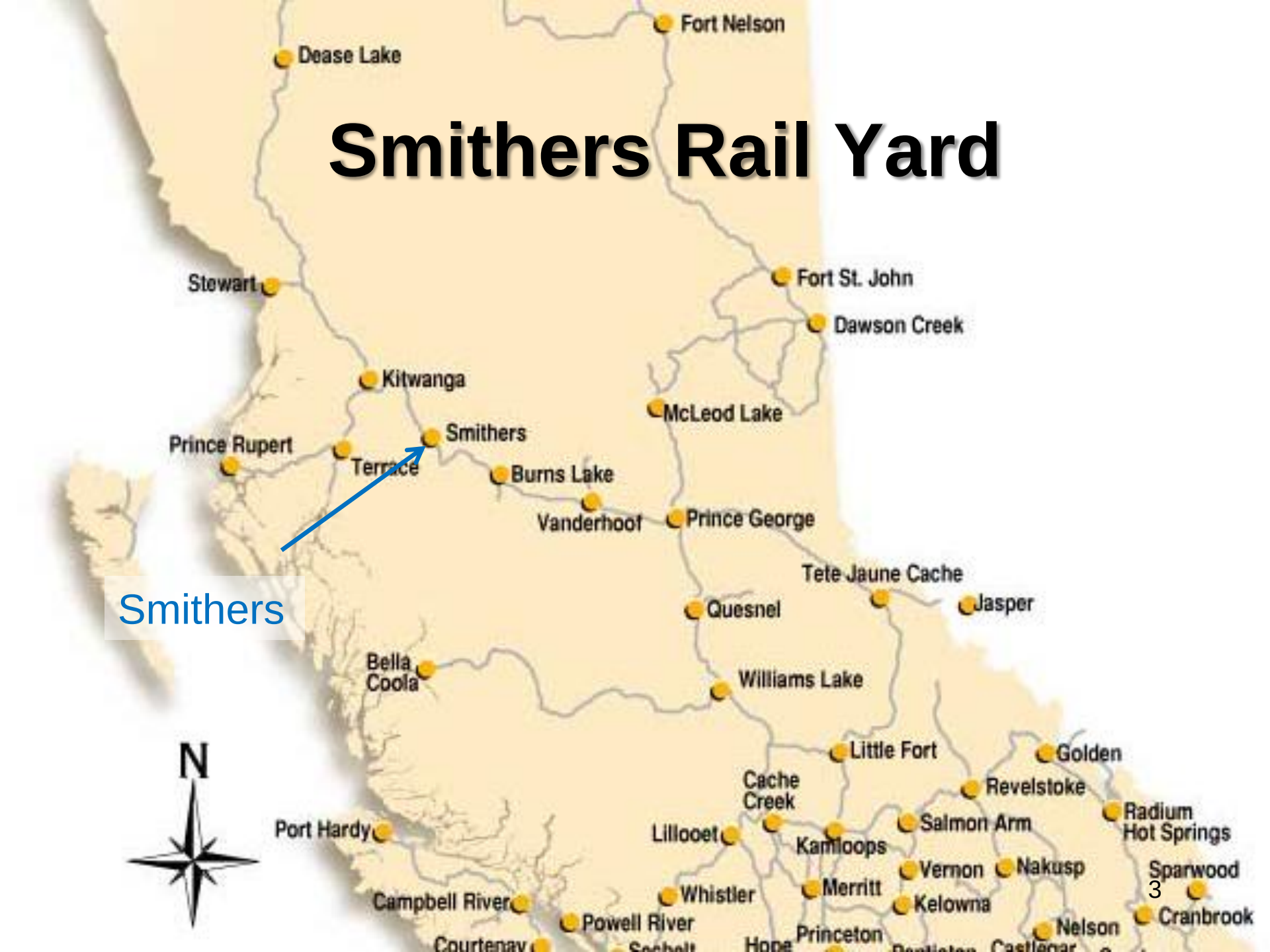
KeystoneEnviro.com

Overview

- Background
- Sustainable Remediation
- Barrier Wall Installation at Smithers Rail Yard
- Conclusions

Keystone Environmental
Knowledge-Driven Results

Smithers Rail Yard

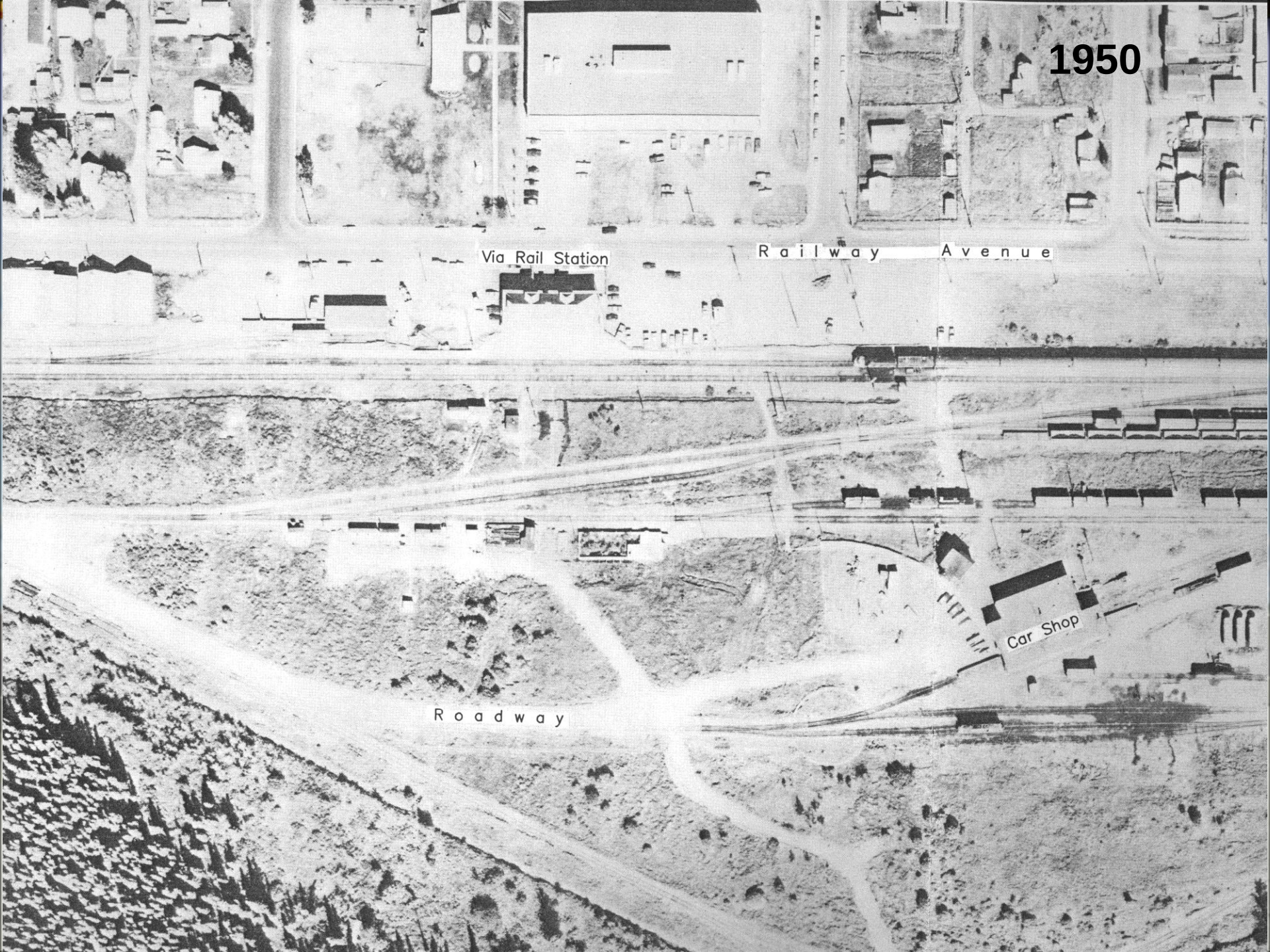


Smithers

CN Smithers Rail Yard

Background

- In operation for approximately 100 years
- Used to have multiple fueling and maintenance locations


1950
Via Rail Station
Railway Avenue
Car Shop
Roadway

CN Smithers Rail Yard

Background

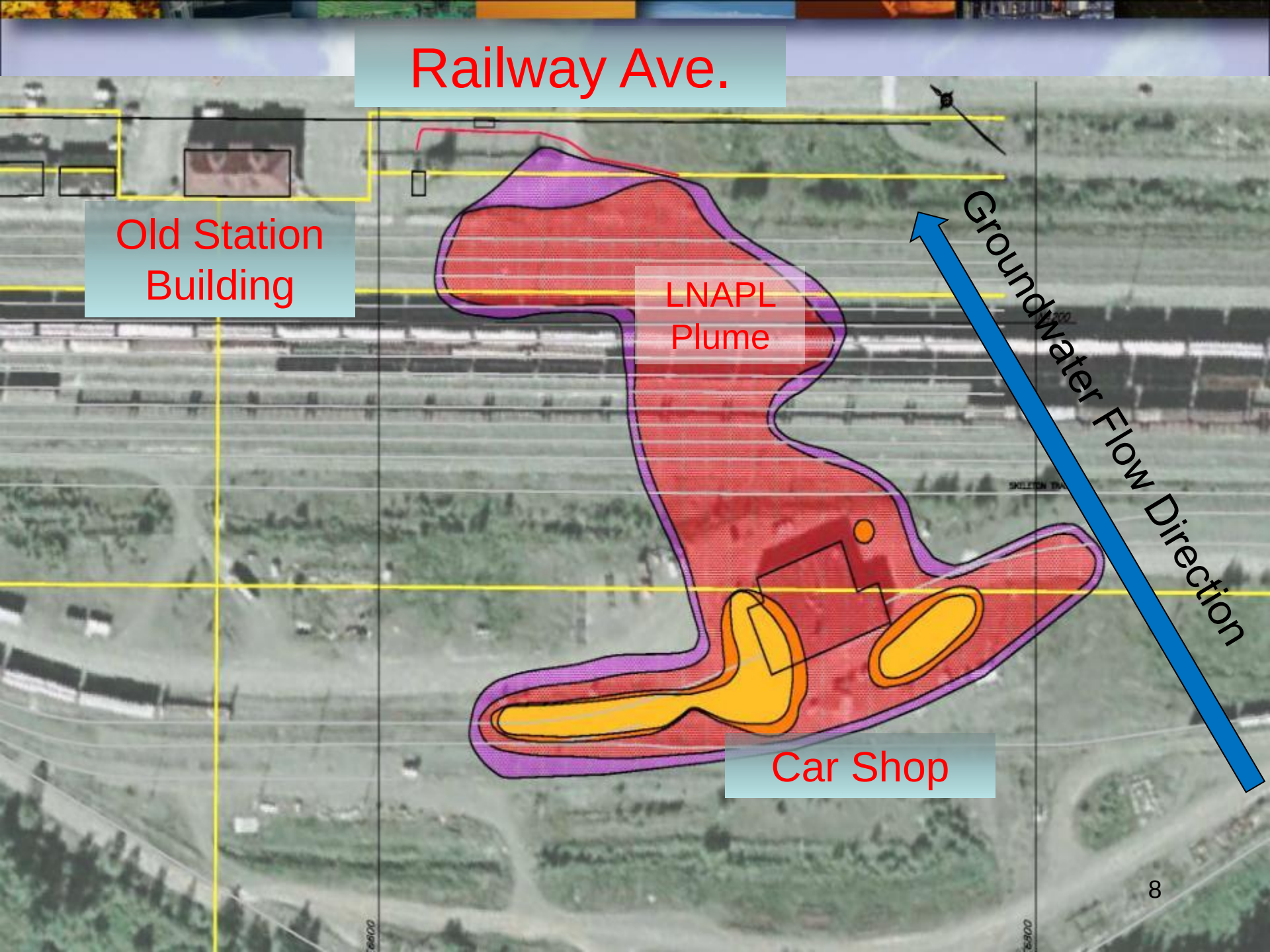
- Large LNAPL (diesel) plume
- Soil layers consist of 2-3 ft of gravel fill, a layer of clay and sand aquifer below clay

Depth (ft)	Depth (m)	Symbol	Soil / Sediment Description
			Ground Surface
0	0		***FILL*** Grey crushed rock and medium to coarse grained sand, very dense, moist, and no odours or staining observed.
3	1		***Sandy CLAY (CL)*** Grey fine grained sandy CLAY with trace silt, stiff, wet, medium plasticity, and no odours or staining observerd.
5	2		***Silty SAND (SM)*** Brown silty medium to fine grained SAND, moderately dense, saturated, strong petroleum hydrocarbon-like odour observed.

CN Smithers Rail Yard

Historical Management Strategy

- Monitored natural attention of dissolved phase plume
- 10 belt skimmers installed in the Car Shop area in 2001
- 3 NAPL recovery pumps installed in the Track area in 2007
- Recovery Systems recovered greater than 40,000 Litres as of 2012
- 1,000 m^3 of contaminated soil treated to concentrations less than CSR IL standards within on-Site biocell

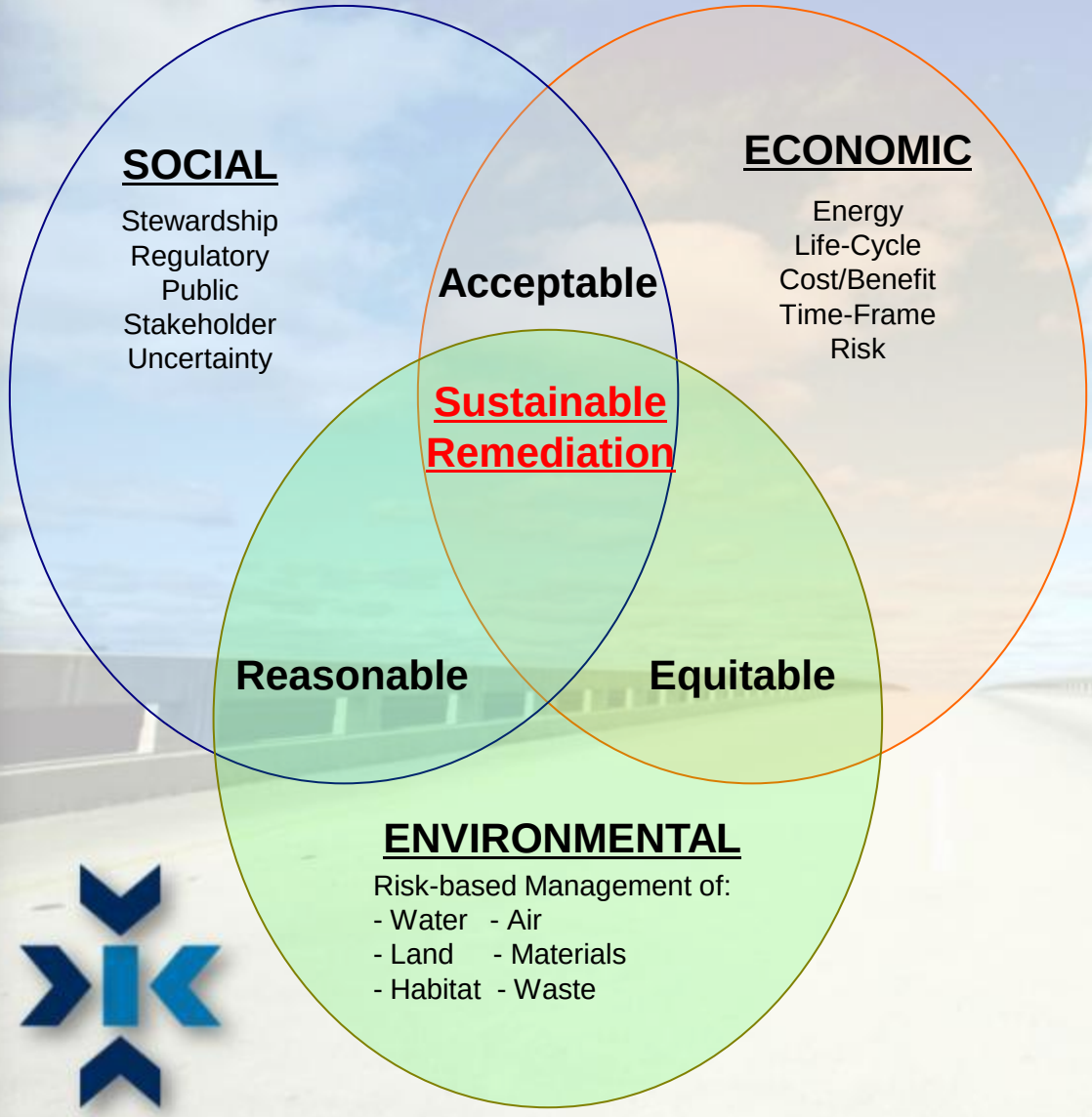

Railway Ave.
Old Station Building
LNAPL Plume
Groundwater Flow Direction
Car Shop

CN Smithers Rail Yard

Remediation Design Considerations:

- Sustainable
- Cost Effective
- Low ongoing maintenance
- Limited space available
- Multiple utilities
- Avoidance of Rail traffic disturbance
- Impacts to small community

Sustainable Remediation



SUSTAINABLE REMEDIATION – SURF CANADA, 2012

"Sustainable Remediation considers the environmental, social, economic impacts of a project to ensure an optimal outcome, while being protective of human and environmental health, both at a local level and for the larger community."

SuRF SUSTAINABLE REMEDIATION FORUM

What Does This Mean for Contaminated Sites Management

- Re-use and recycle material (soil, construction)
- Implementing in-situ technologies where feasible
- Using renewable energy for system operation
- Reducing Transportation Needs
- Providing Training to Local Workers

Sustainability Tool

- Option Evaluation Tool - CN Sustainability Evaluation Tool – GoldSET© CN-SR
- Multi-Criteria Analysis Tool
  - Structured system for ranking alternatives
  - Score 0 to 100 and Weight from 1 to 3
  - Results are given by Triangular Representations

Sustainability Evaluation Metrics

Environmental	Social	Economic
• Impacts on air (including climate change) • Impacts on soil • Impacts on water • Impacts on ecology • Use of natural resources • Waste generation	• Intrusiveness • Impacts on human health and safety • Ethical and equity considerations • Impacts on neighborhoods or regions • Community involvement and satisfaction • Compliance with policy objectives and strategies	• Direct costs and benefits • Indirect costs and benefits • Employment and capital gain • Project risks • Project flexibility

CN Smithers Rail Yard

Options Considered

- Option 1: Monitored Natural Attenuation
- Option 2: Remedial excavation in the station area
- Option 3: Underground barrier wall

Option 1: Monitored Natural Attenuation

- No capital expenditure
- Low ongoing maintenance costs
- High risk for off-site migration of dissolved phase (indirect cost of liabilities)
- No disturbance to rail traffic

Option 2: Remedial Excavation

- High excavation costs
- High disposal costs
- Would be difficult in limited space
- GHG emissions from trucking and excavating
- Higher visibility in the community
- Significant impact to rail operations
- Safety risks due to presence of many utilities

Smithers Rail Yard

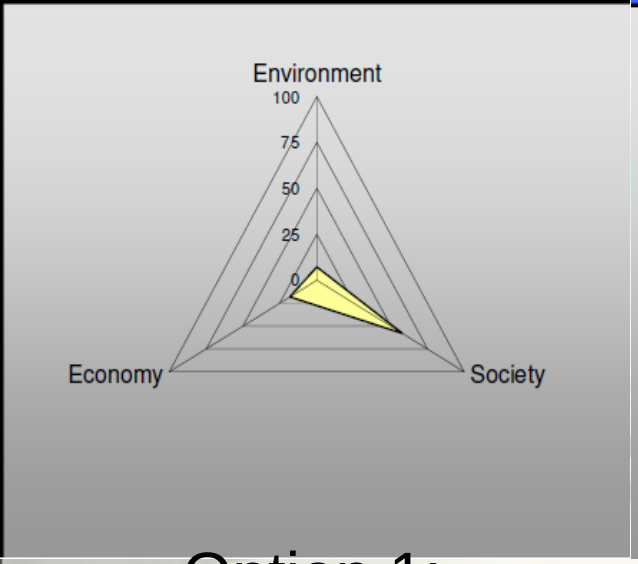
Option 3: Underground Barrier Wall

- Low relative cost
- Low ongoing maintenance
- Lower GHG than Option 2
- No disturbance to rail traffic
- Will have to deal with utilities
- Proven technique to prevent off-site migration
- High benefits to local economy

Smithers Rail Yard

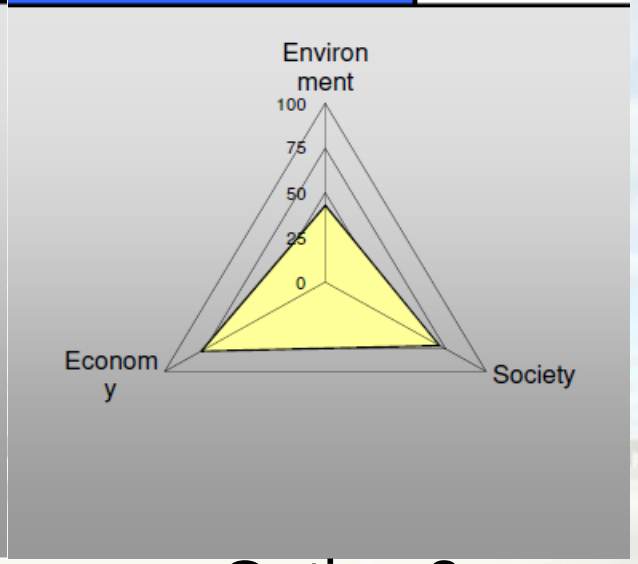
CN Sustainability Evaluation Tool for Contaminated Sites

ENVIRONMENT	7%
SOCIETY	58%
ECONOMY	18%



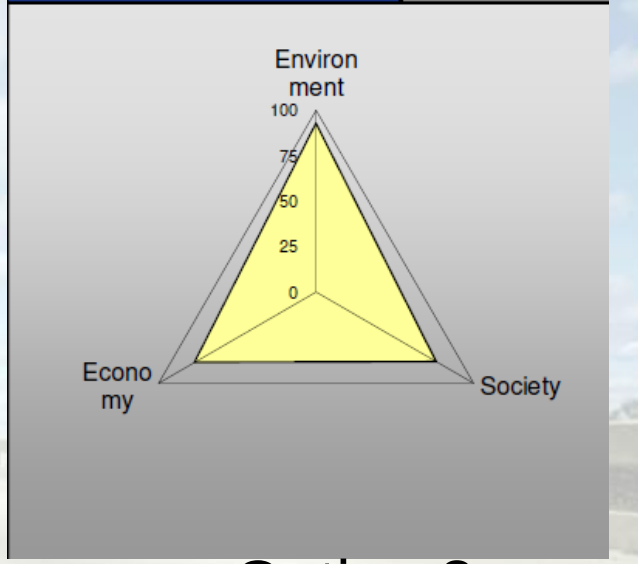
Option 1: MNA

ENVIRONMENT	43%
SOCIETY	71%
ECONOMY	77%



Option 2: Excavation

ENVIRONMENT	93%
SOCIETY	76%
ECONOMY	77%



Option 3: Barrier Wall

Barrier Wall Design

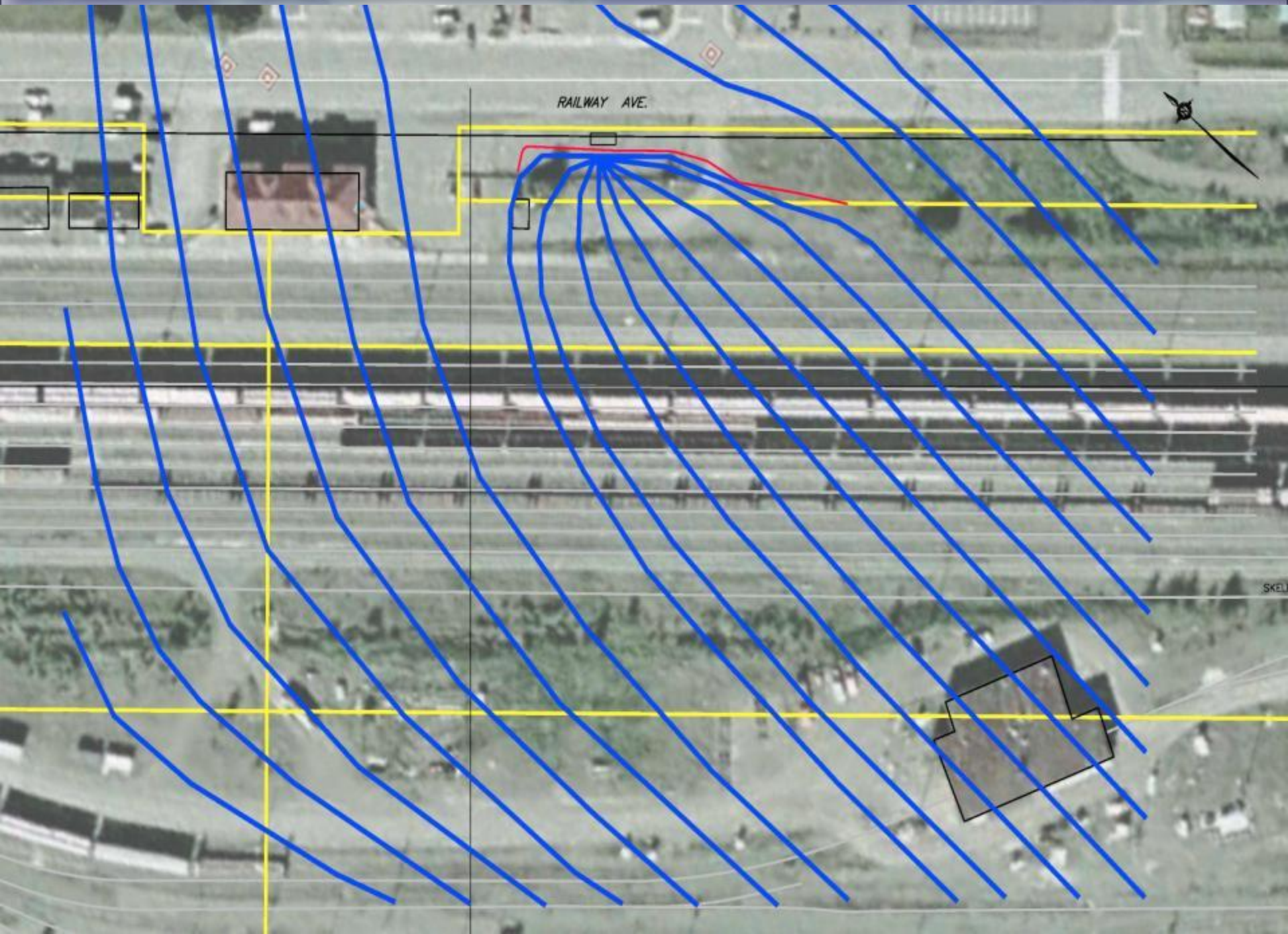
Design Preparation

- Investigation of Soil Quality at Wall Location
- Groundwater Modelling
- Mix Testing for Wall Composition
  - Composition consisted of soil/cement/bentonite with target permeability of $5x10^{-6}$ cm/s

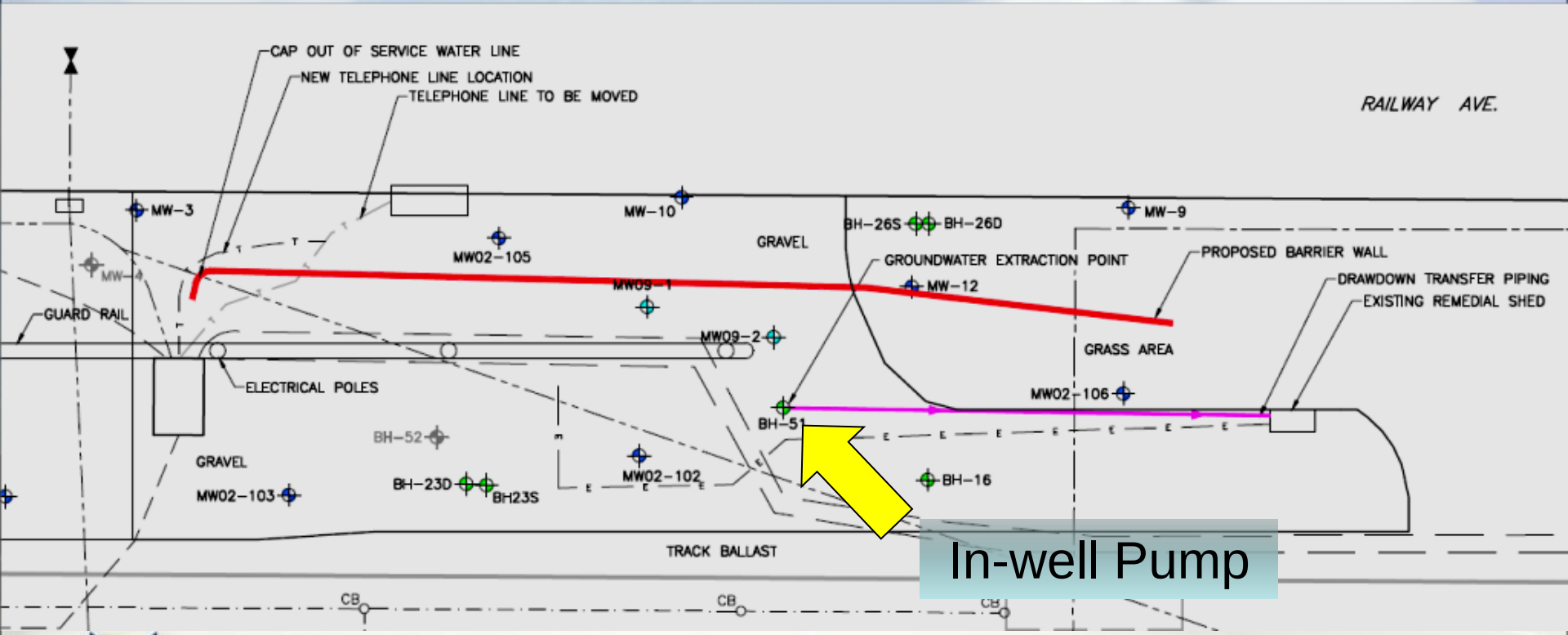
Barrier Wall Design

Groundwater Modeling

- Groundwater modeling was done to confirm the barrier wall's effect on migration pathway
- Migration pathway would be altered around and under barrier wall
- In well pump added to amplify the wall effect


RAILWAY AVE.

Barrier Wall Design



Barrier Wall Design

Mix Testing

- Samples of the native material were taken during annual monitoring
- Samples mixed with bentonite, cement and water in various proportions
- Mix samples tested for permeability

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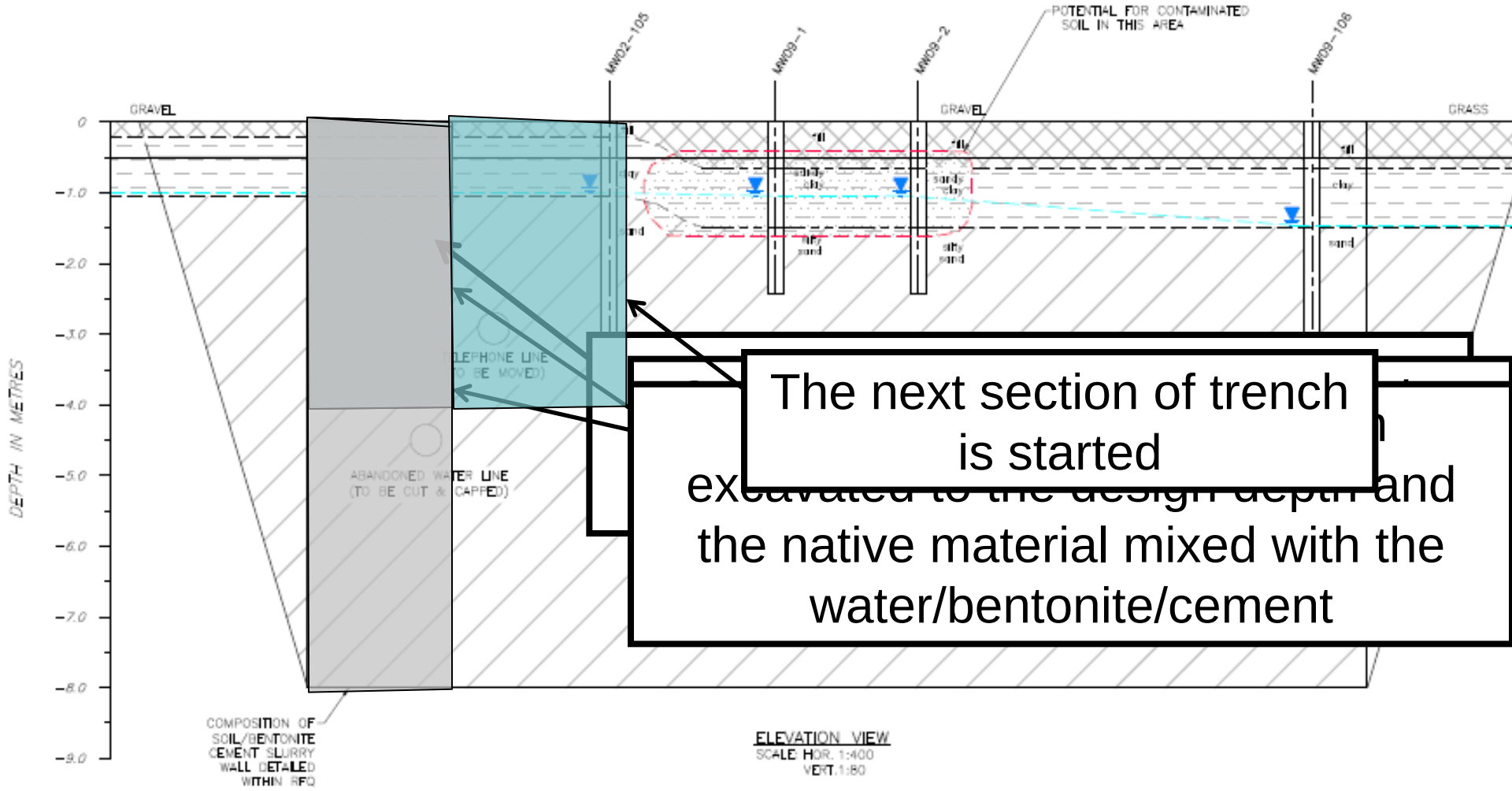
Utilities

- Telus
- Natural Gas
- Water
- CN Signals

Construction Methodology



The next section of trench is started

excavated to the design depth and the native material mixed with the water/bentonite/cement

Construction Staging Area

Construction

Project Innovations

- In-place mixing of barrier wall components
- Utility protection was designed to allow for installation around them
- Use of local contractors
- Use of local materials where possible

Smithers Rail Yard

Pump Installation

- In-well pump upgradient of barrier wall
- Conduit placed from pump to GAC unit in remediation shed

Smithers Rail Yard

Soil Disposal

- Sampled while excavating
- Clean soil reapplied to site and contaminated soil sent to on-Site biocell for treatment

Summary of Sustainability Features

ENVIRONMENTAL	SOCIAL	ECONOMIC
Low risk to off-site migration	Improves public image through addressing issue	Reliable technology with little uncertainty
Low amount of waste generation	Lower visibility than longer term excavation	

Thank you,

Questions?

Jason Christensen
jchristensen@keystoneenvironmental.ca