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Challenges in the Environmental Assessment and Development of Risk-Based Corrective Actions Associated with an Abandoned Uranium Satellite Site

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SRC

The Saskatchewan Research Council (SRC) is one of Canada's leading providers of applied research, development and demonstration (RD&D) and technology commercialization. We are a Treasury Board Crown Corporation in the Province of Saskatchewan, and serve clients across Saskatchewan and the world in four main areas: Energy, Environment, Mining and Minerals, and Strategic Initiatives.

Outline

- › Background
- › Problem / Challenges
- › Approach / Solution
- › Summary
- › Next Steps



SRC Work in Northern Saskatchewan

Project CLEANS (**C**LEAnup of **A**bandoned **N**orthern **S**ites)

Initiated in 2006

Objective to transfer 37 cold war uranium sites to the Institutional Control Program

The goal of Project CLEANS is to conduct remediation activities in a manner that meets or exceeds regulatory requirements. Once the sites are cleaned up and made safe, environmental monitoring will be done to ensure remediation activities are successful.

Project CLEANs

Lorado Mill

- › Remediation completed, currently under transitional monitoring

Gunnar Mine and Mill

- › Currently under tailings remediation

35 satellite sites (mines without tailings)

- › Remediation completed at 10 sites
- › Remediation in progress at 8 sites
- › Assessment underway at 17 sites



Photo courtesy B. McIntyre

Nicholson Mine- Headframe

Background

The Road to Lorado



Lorado Mine

Abandoned uranium mine that was operational between 1956-1960 located 10 km south of Uranium City

Ore was processed at Lorado Mill

Remote

- › Air access
- › Ice road in winter



Known Potential Hazards and Environmental Concerns

- › Acid rock drainage from the waste rock pile
- › Petroleum hydrocarbon contaminated soil
- › Hazardous and non-hazardous material scattered on site
- › Gamma radiation
- › Three openings from underground
- › Surface and groundwater exceeding guidelines
- › Unstable ground
- › Flowing wells



Challenges/Problems

- › Limited field season
- › Challenging environmental conditions
- › Limited resources
- › Limited equipment
- › Costly access conditions
- › Narrow window of opportunity to plan and make decisions
- › Financial resources
- › Environmental regulations



Approach

- › Prioritize risks
- › Public Safety/Human Health
- › Restoration to reduce the environmental impacts
- › Modify traditional approaches to risk-based corrective action plans
- › Maximize value of data resources
- › Use creative resources to evaluate the issues

Traditional Approach to Contaminated Sites

FCSAP 10-step process

Identify the Site – Step 1

Historical Review – Step 2

Initial Testing – Step 3

Classify the Site (Optional) – Step 4

Detailed Testing Program – Step 5

Reclassify the Site – Step 6

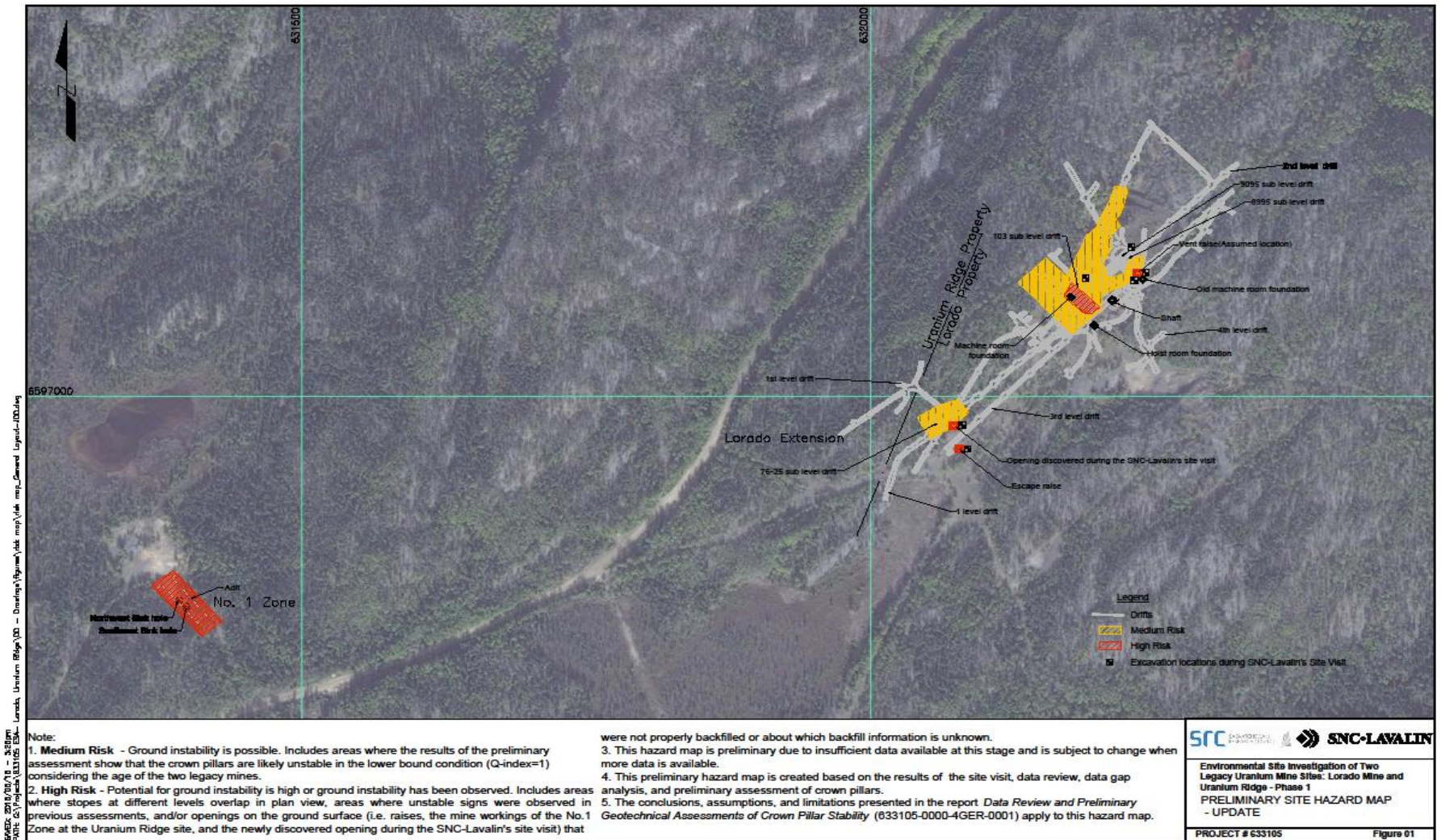
Develop Remediation Risk Management Strategy – Step 7

Implement Remediation Risk Management Strategy – Step 8

Confirmatory Sampling and Final Reporting – Step 9

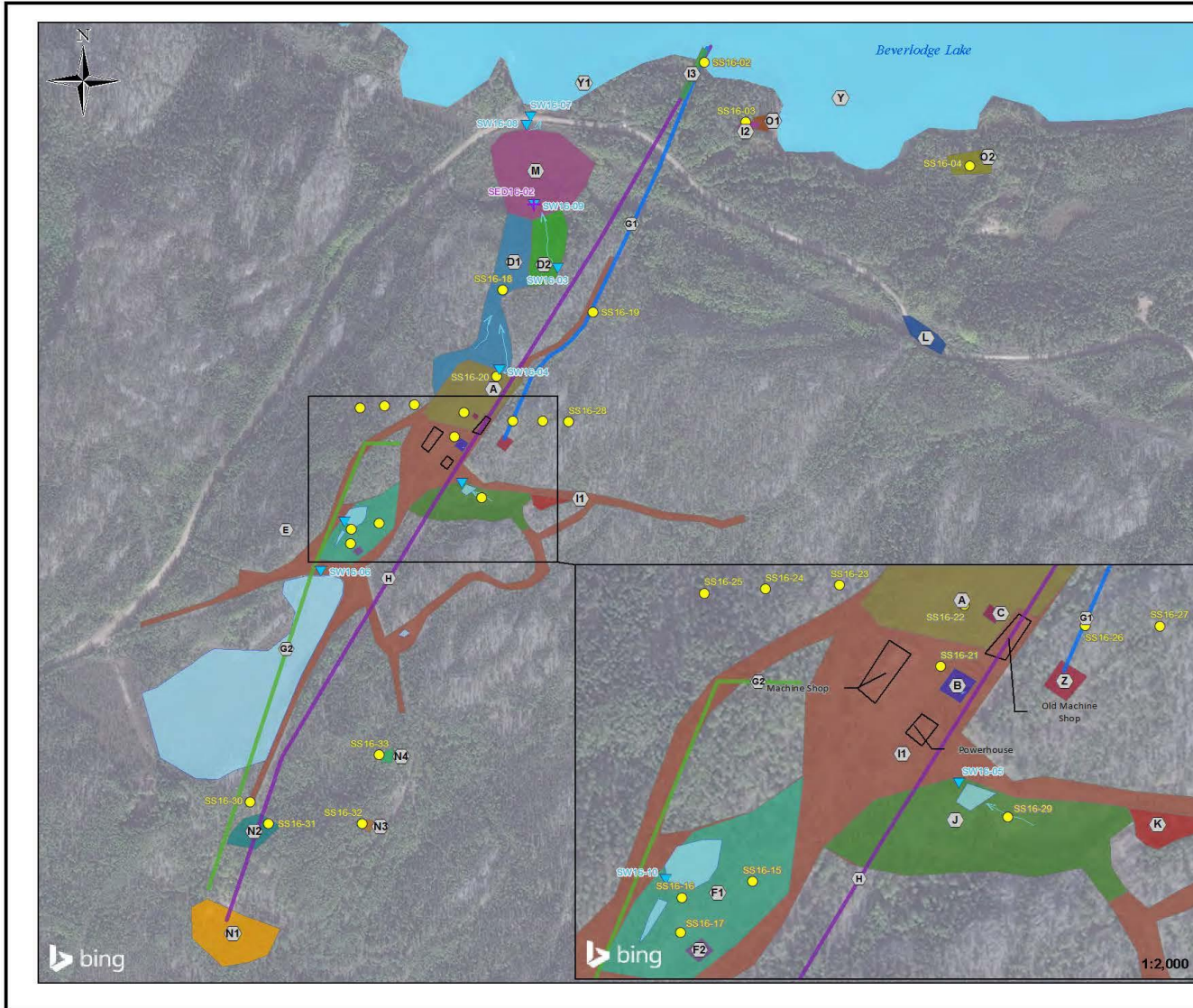
Long Term Monitoring if Required – Step 10

Geostability Study



Flowing Wells – To flow or not to flow?





DRAFT

Legend

- ✚ Sediment Sample
- Soil Sample
- ▽ Surface Water Sample
- ▭ Former Mine Buildings
- APEC G1 - Water line
- APEC G2 - Steam and Water Line
- APEC H - Powerline
- ▭ Ponded Water
- ▭ Flowing Water
- ▭ APEC A - Waste Rock
- ▭ APEC B - Lorado Shaft
- ▭ APEC C - Lorado Raise
- ▭ APEC D1 - Mine Outwash
- ▭ APEC D2 - Artesian Boreholes
- ▭ APEC F1 - Escape Raise Waste Rock
- ▭ APEC F2 - Escape Raise
- ▭ APEC I1 - Waste Rock at Former Mine Buildings and Roads
- ▭ APEC I2 - Cabin Waste Rock
- ▭ APEC I3 - Waste Rock Water Intake
- ▭ APEC J - High sulphide Zone
- ▭ APEC K - Oil Tanks
- ▭ APEC L - Garbage Disposal Area
- ▭ APEC M - Lorado Wetland
- ▭ APEC N1 - Former Camp and Cookhouse (Formerly Living Area)
- ▭ APEC N2 - Boiler House and Transformers (Formerly Living Area)
- ▭ APEC N3 - Sump with pipes and transformer (Formerly Living Area)
- ▭ APEC N4 - Garbage Disposal (Formerly Living Area)
- ▭ APEC O1 - Inactive Cabin (on BVL)
- ▭ APEC O2 - Active Cabin (on BVL)
- ▭ APEC Y - Beaverlodge Lake
- ▭ APEC Y1 - Beaverlodge Lake Sediment
- ▭ APEC Z - Former Water Tower and Drill Core

NOTES:

- Original in colour.
- Numerical scale reflects full-size print. Print scaling will distort this scale, however scale bar will remain accurate.
- Intended for illustration purposes, accuracy has not been verified for construction or navigation.

REFERENCES:

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- BCGOV/ILMB Crown Registry and Geographic Base Branch (CRGB)

REVISIONS:

0 - AO - 2016-06-10 - Check Print -JC
 1 - AO - 2016-06-29 - DRAFT-SP

0 50 100 200 300 400
 Meters

CLIENT: SASKATCHEWAN RESEARCH COUNCIL		 SNC • LAVALIN	
PROJECT LOCATION: LORADO URANIUM RIDGE MINE, SASKATCHEWAN			
Site Plan and Areas of Potential Environmental Concern			
BY: AO	SCALE: 1:5,000	DATE: 2016/06/29	REF NO: 633105-001
CHKD: JT	Proj Coord Sys: NAD 1983 UTM Zone 12N	REV: 0	

Project Path: \SL11653\project\Saskatchewan Research Council\633105 Lorado U-Ridge\4.0 Execution\4.5 GIS and Dwg\4.5.1 GIS\Reports

Reality of Approach



Geophysical Solutions

- › Using ground LIDAR to design stainless steel caps



Before



After

Geotechnical Support for Safety/Access/Mitigate Environmental Endpoints



Capstone Collaboration with the University of Saskatchewan

In 2016, SRC proposed a project to the University of Saskatchewan Faculty of Engineering for the development of a model displaying various engineered covers at Lorado Mine

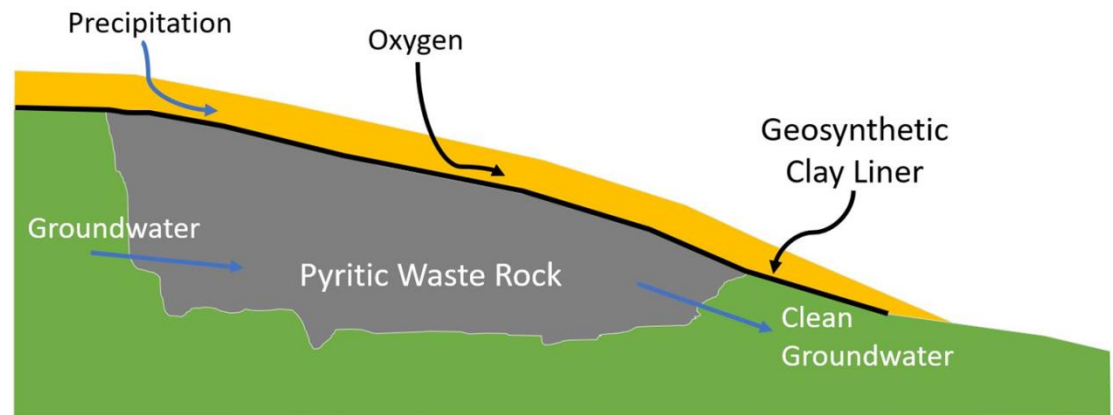
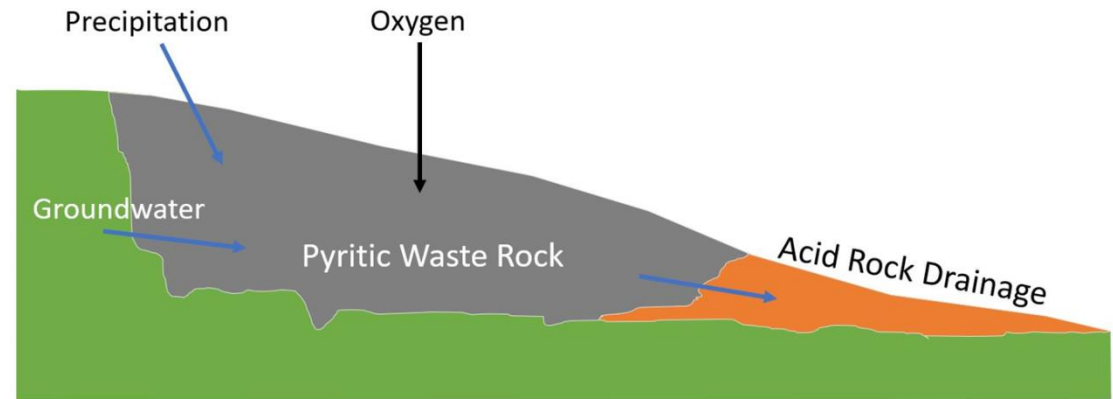
- › University accepted proposal as capstone project
- › SNC- Lavalin assisted



ARD Prevention - Engineered Cover Design

Objectives:

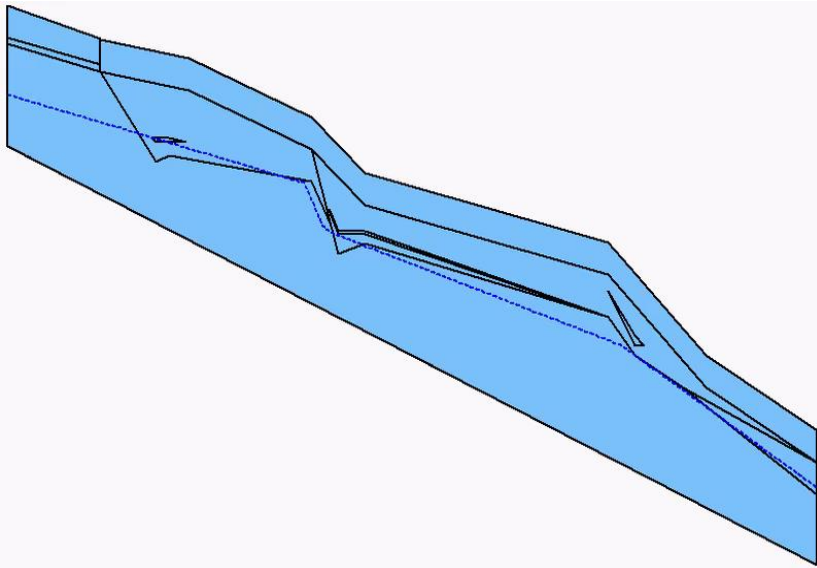
- › Prevent interaction between waste rock and oxygen
- › Regulate water in the cover
- › Support plant growth
- › Shield gamma radiation



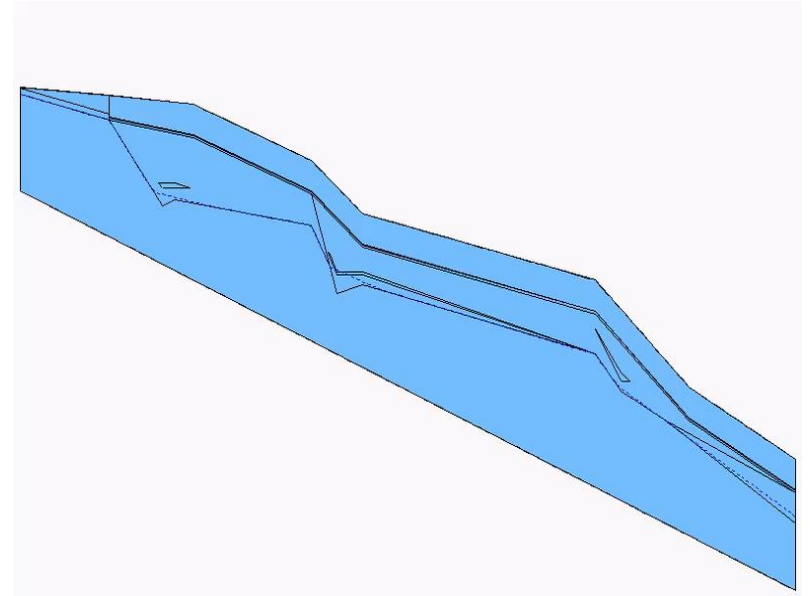
Engineering Cover Design - Numerical Modelling

- › Numerical modelling was used to evaluate engineered cover alternatives
 - › Geosynthetic Clay Liner
 - › Compacted Clay Liner
 - › Compacted Sand Bentonite
- › Geo-slope's VADOSE/W analysis
- › To simulate realistic conditions a representative climate and hydraulic flux was applied
- › Modelling results in a visualization of the ingress of oxygen through the cover system

Engineering Cover Design - Numerical Modelling

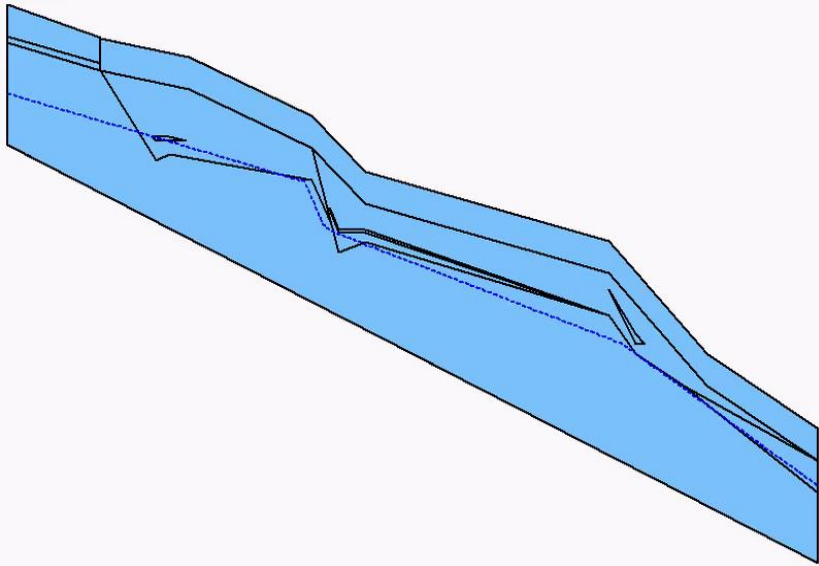


No Cover

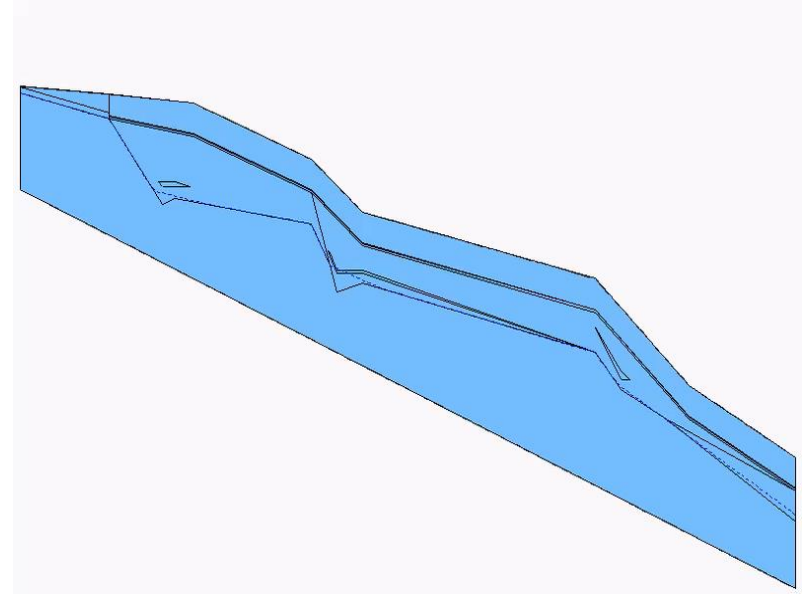


GCL Engineered Cover

Engineering Cover Design - Numerical Modelling



No Cover



GCL Engineered Cover

Summary and Next Steps

- › Limited field data
- › Limited resources
- › Requires creative solutions
- › Prioritizing needs
- › Collaborative efforts
- › Good communication

Questions / Comments

Thank you

Saskatchewan Research Council

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Values that guide us

Our values keep us anchored and on track. They speak to how we run our business, how we express ourselves as a group, and how we engage with our stakeholders and inspire their trust.

Teamwork & excellence

We're innovative, collaborative, competent and visionary.

Customer focus

Our business exists to serve and add long-term value to our customers' organizations.

Strong investor return

We seek to reward our investors' trust by delivering competitive returns.

Health & safety, security and environment

We have a responsibility to protect everyone who comes into contact with our organization and the environment we work in.

Ethics & compliance

We're committed to ethical business.

Respect

Our actions consistently demonstrate respect toward our stakeholders.

