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Saskatchewan Non-Uranium Abandoned Mines (NUAM) Clean-up Program

Dale Kristoff & Brent Zelensky
Saskatchewan Ministry of Environment

June 2022

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What is the NUAM Program?

- 75 known abandoned mines in northern SK.
- 42 are former uranium mines managed by Project CLEANS.
- 33 are former base or precious metals mines (aka non-uranium), managed through NUAM program.
- Six highest risk NUAM account for **~$34.6M** in provincial physical and environmental liabilities.

Flexar, 2020

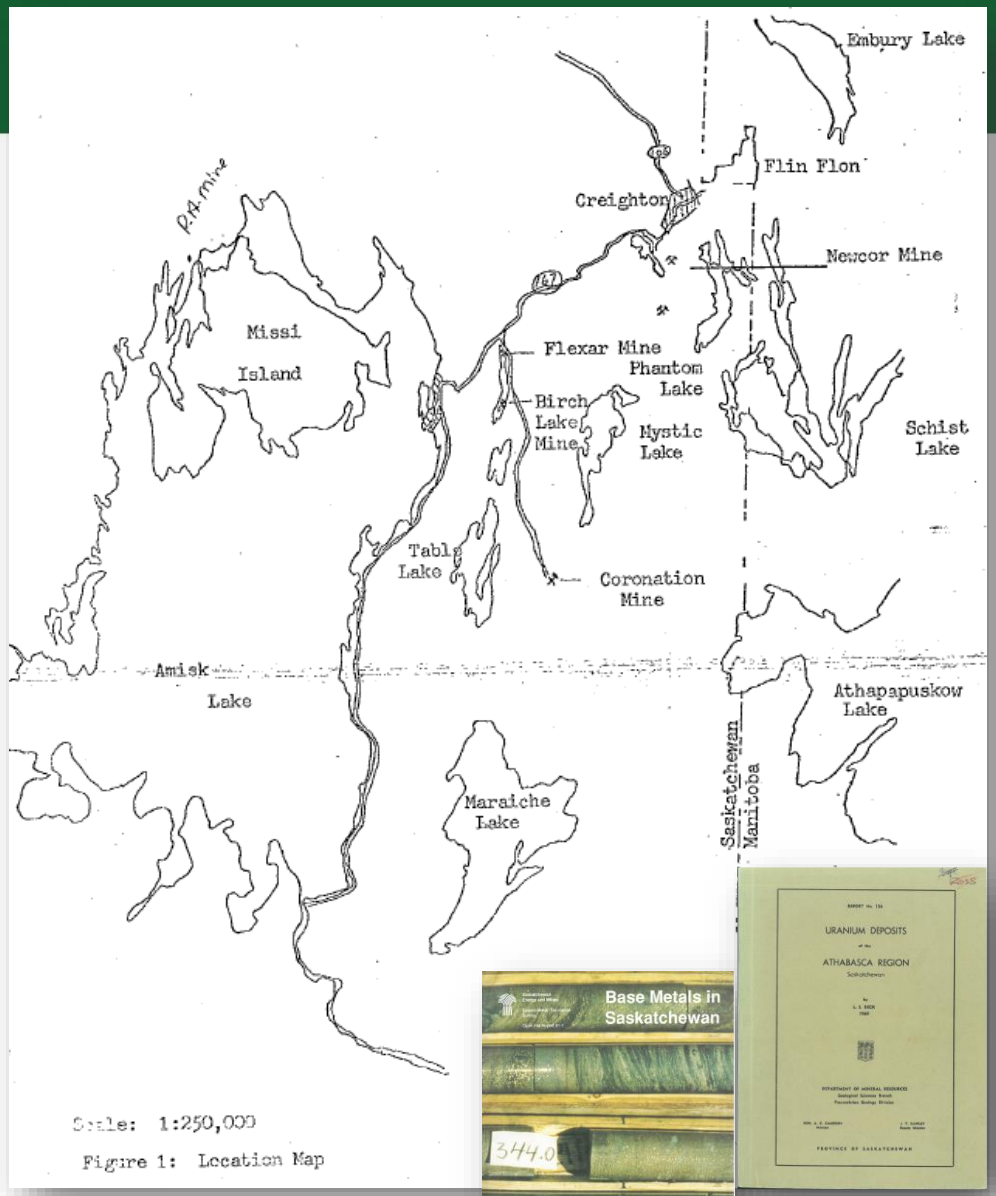
Objective

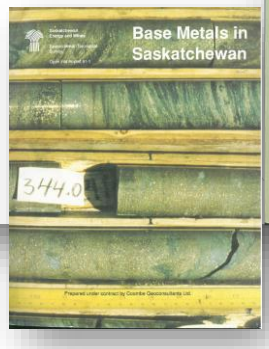
This → This

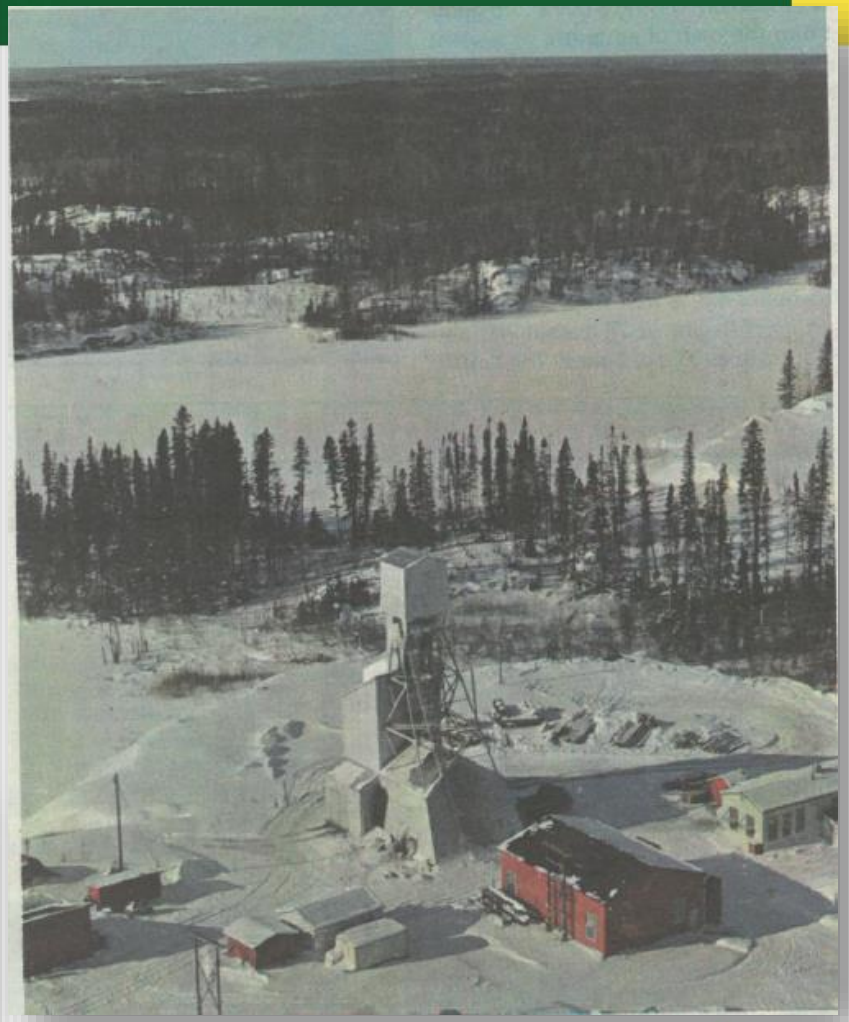
Anglo Rouyn pit and open shaft, 2020

Dion Lake shaft - sealed in 2006

History of NUAM







Flexar Mine, 1970

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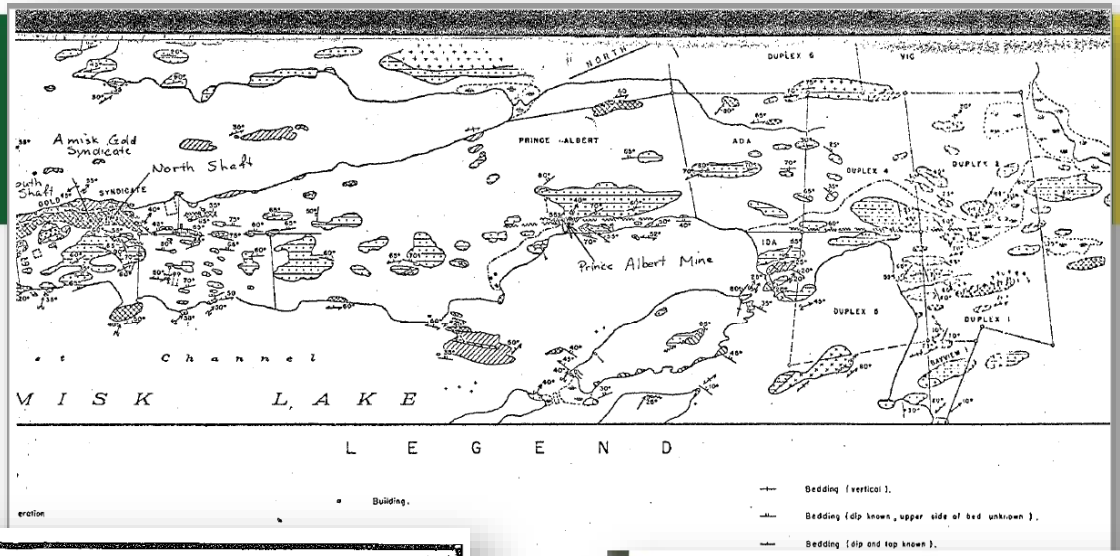
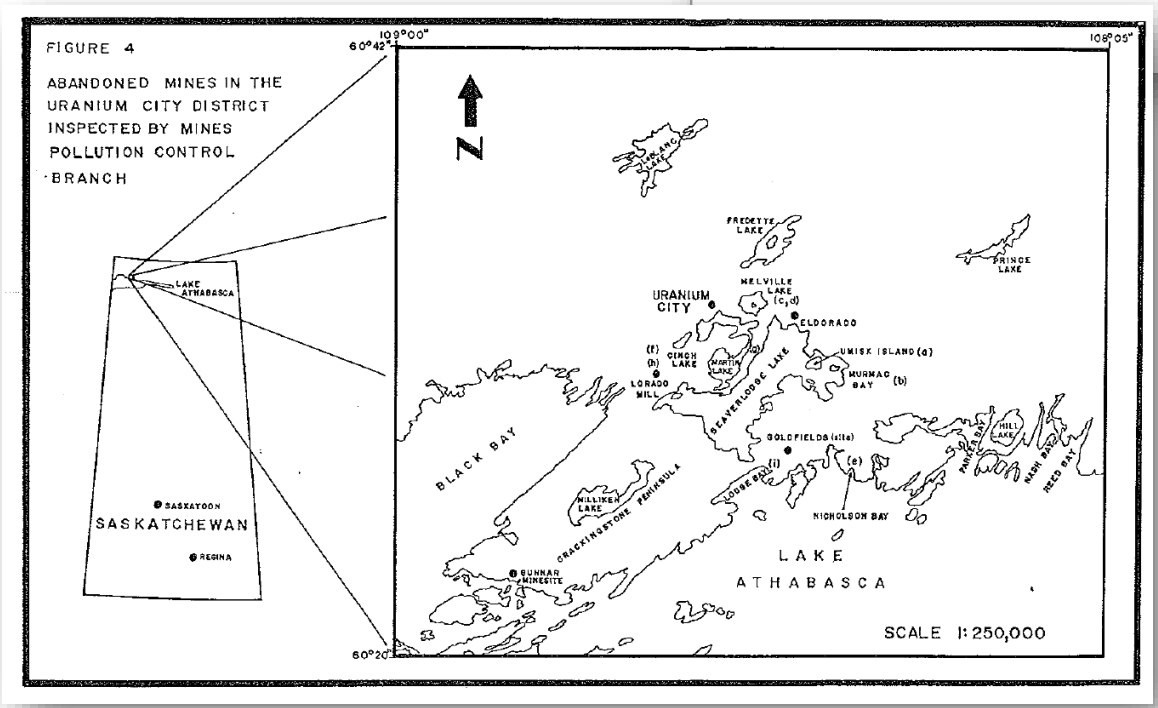
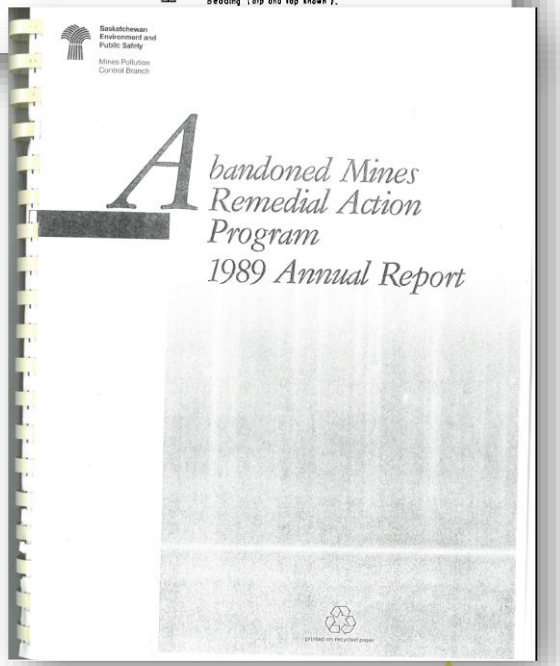
1989 Saskatchewan Environment and Public Safety, Mines Pollution Control Branch

- Abandoned Mines with Tailings
- Abandoned Mines Remedial Action Program







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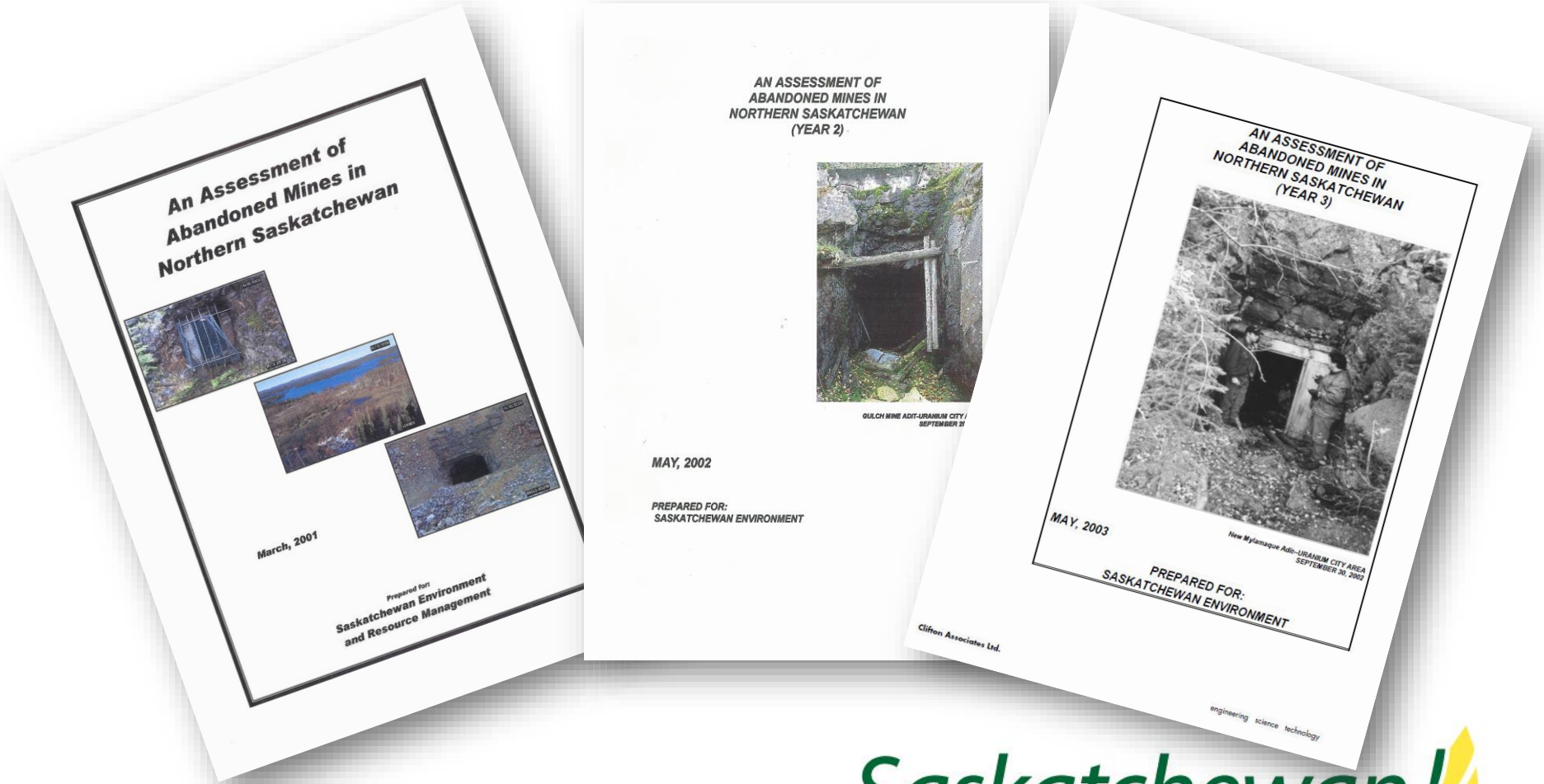
An Assessment of Abandoned Mines in Northern Saskatchewan Year 1, Year 2 and Year 3 2000, 2001, 2002 - $50,000 per year from the Centenary Fund



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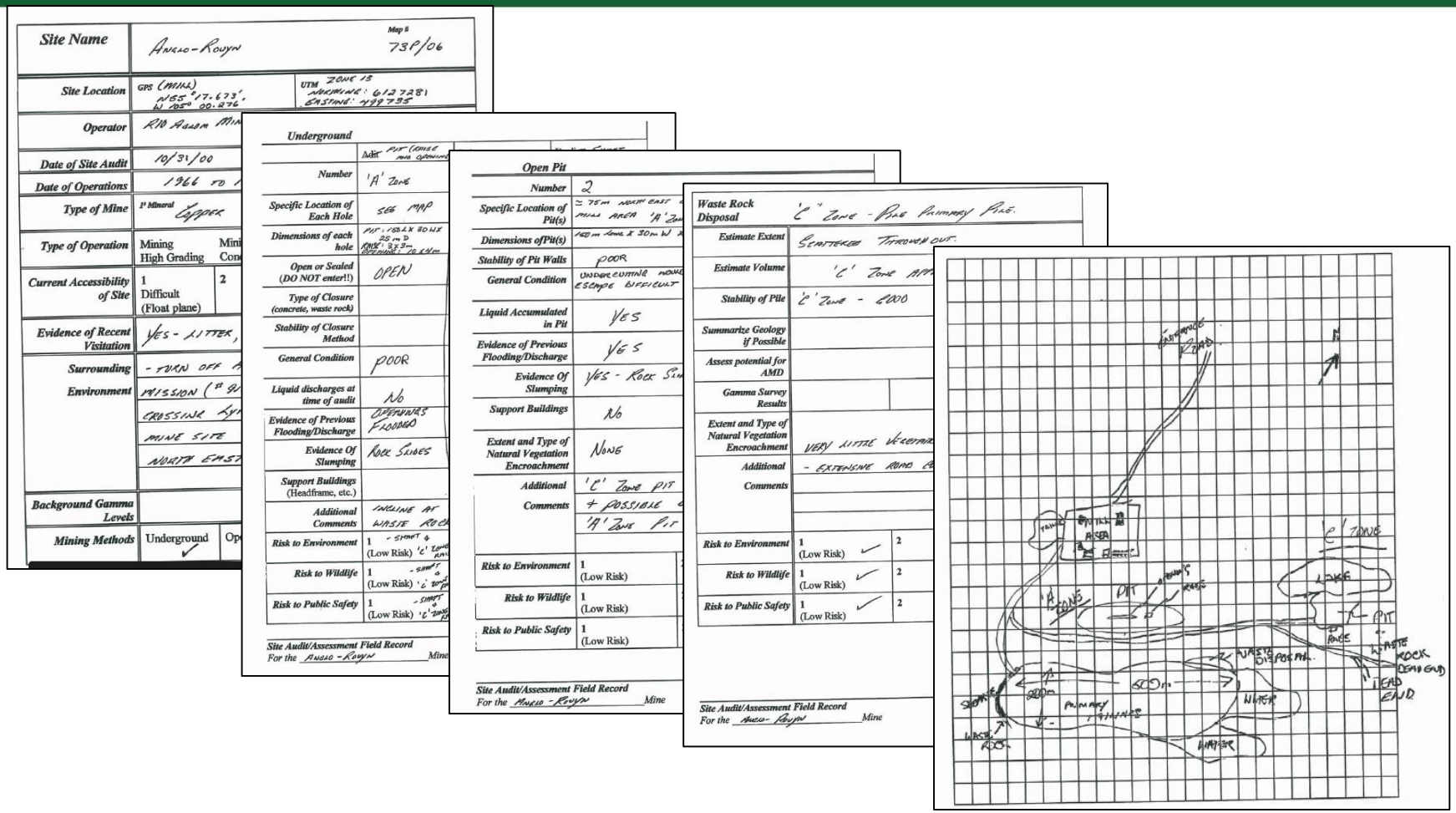

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An Assessment of Abandoned Mines in Northern Saskatchewan Year 1, Year 2 and Year 3 2000, 2001, 2002 - Results

Table E-2
Year 1 - 3 Combined Scores

Ranking	Site	Year Assessed	Public Safety Score	Environmental Score	Total
1	Gunnar	2	22	28.5	50.5
2	Box	2/3	1/19	1/18	37
3	Rottenstone	2	13	23.5	36.5
4	Anglo-Rouyn	1	20.1	15	35.1
5	Coronation Mine	3	14	19.5	33.5
6	Gulch	2	19.5	11.5	31
7	Lorado Mill Site	2	10.5	18.5	29
8	Prince Albert Mine	3	16	11	27
9	Western Nuclear	1	11.1	17	28.1
10	Baska	2	15	10.5	25.5
11	Lake Cinch/Cenex	1/3	18	7	25
12	Nesbitt-Labine-Eagle Mine	1	17.5	7	24.5
13	Consolidated Nicholson	2	16.5	7	23.5
14	Amisk Syndicate Mine	3	13.5	9.5	23 (Tie)
15	Waste Disposal Area 2	1	14	9	23 (Tie)
16	Consolidated	1	13.5	9	22.5
17	Graham Mine	3	15.5	6	21.5
18	Nesbitt	2	14.1	7	21.1
19	Bearcat Showing and Prospect Shaft	3	10	10	20
20	Newcor Mine	3	12.5	7	19.5 (Tie)
21	Vista (Bootleg) Mine	3	12.5	7	19.5 (Tie)
22	Nesbitt-Labine-ABC Mine	1	12.4	7	19.4
23	Cayzor	1	15	4	19 (Tie)
24	Amisk (Beaver) Gold Mines	3	10	9	19 (Tie)
25	Laurel Lake North Gold Zone	3	10.5	8	18.5
26	Dion Lake Copper Showing and Shaft	3	13	5	18
27	Flexar Mine	3	9	8.5	17.5 (Tie)
28	Uranium Ridge	1	11.5	6	17.5 (Tie)
29	La Ronge	2	13.45	4	17.45
30	Pitch-Ore	1	11.2	6	17.2
31	Black Bay	1	13	4	17
32	Rix-Athabasca, Zone 62	1	11.7	5	16.7
33	Beaver Mine	3	8.5	8	16.5 (Tie)
34	Rix-Athabasca-Smitty Mine	1	13.5	3	16.5 (Tie)
35	Meta	1	11.4	5	16.4
36	Rix-Athabasca-Leonard Mine	1	11.3	5	16.3
37	New Mylamaque	2/3	11.1	5	16.1
38	Lorado Mine Site	1	10.6	5	15.6
39	Waverly Island	3	9	6.5	15.5 (Tie)
40	Preview Lake	2	10.5	5	15.5 (Tie)
41	St. Michaels	1	11.3	4	15.3
42	Caba	2	11.1	4	15.1
43	Don Henry	2/3	10	5	15
44	National Exploration-Keiller Adit	1	8.7	6	14.7
45	Territorial	2	10.15	4	14.15
46	Wekatch Gold Mines	3	10	4	14 (Tie)
47	Hannay (Bessie Island) Deposit	3	8.5	5.5	14 (Tie)
48	Beaverlodge-Mickey Lake	2	10.9	3	13.9
49	Sonora Deposit	3	10.5	3	13.5 (Tie)
50	Pitching Lake	2	10.5	3	13.5 (Tie)
51	National Exploration-Pat Claims	1	10	3	13 (Tie)
52	Athona	2	10	3	13 (Tie)

Table E-2 - Cont'd
Year 1 - 3 Combined Scores

Ranking	Site	Year Assessed			Total
53	CAM Option copper Showing	3	9	3.5	12.5
54	Amax Athabasca (Site 1)	1	9.4	3	12.4
55	Phantom Lake Mine	3	10	2	12 (Tie)
56	Neely Lake Mine Site	3	8	4	12 (Tie)
57	Homer Yellowknife	2	9.6	2	11.6
58	SYE/Sunset Exploration Shaft	3	10	1.5	11.5 (Tie)
59	Lucky Strike Mine	3	8.5	3	11.5 (Tie)
60	Birch Lake Mine	3	7	4	11
61	Jahala	2	7.5	3	10.5 (Tie)
62	Consolidated Beta Gamma	2	9.5	1	10.5 (Tie)
63	Henning Maloney Mine	3	8.5	2	10.5 (Tie)
64	Waste Disposal Area 1	1	5.4	5	10.4
65	Jesko	2	8.5	1	9.5
66	Nisto Mines Ltd.	1	4.4	5	9.4
67	Rix Athabasca, No. 10 Adit	1	6.4	2	8.4
68	Otonadah Lake Copper Showing and Exploration Shaft	3	7	1	8
69	Eldorado, Eagle Mine	1	5.9	2	7.9
70	Star Occurrence	3	6	1	7
71	Strike Lake	1	6.5	0	6.5
72	Amax Athabasca (Site No. 2)	1	6.3	0	6.3
73	Ace Deposit	3	4	1	5
74	Pitch-Ore	2	3.2	1	4.2
75	Amax Athabasca (Site No.3)	1/3	4	0	4
	HBMS Flux Pit	3	3.5	4	Not Ranked - Sand Pit
	Rix Athabasca	2	-	-	Not Available-Not Located
	Namew Lake	3	-	-	Site Decommissioned - Water Sample Only

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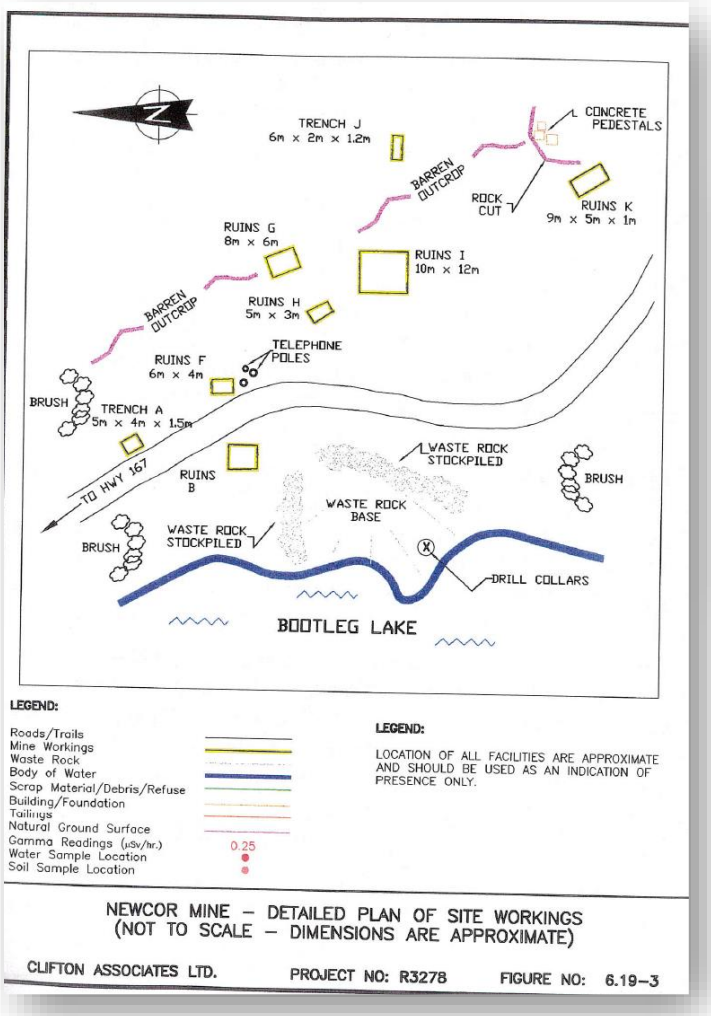

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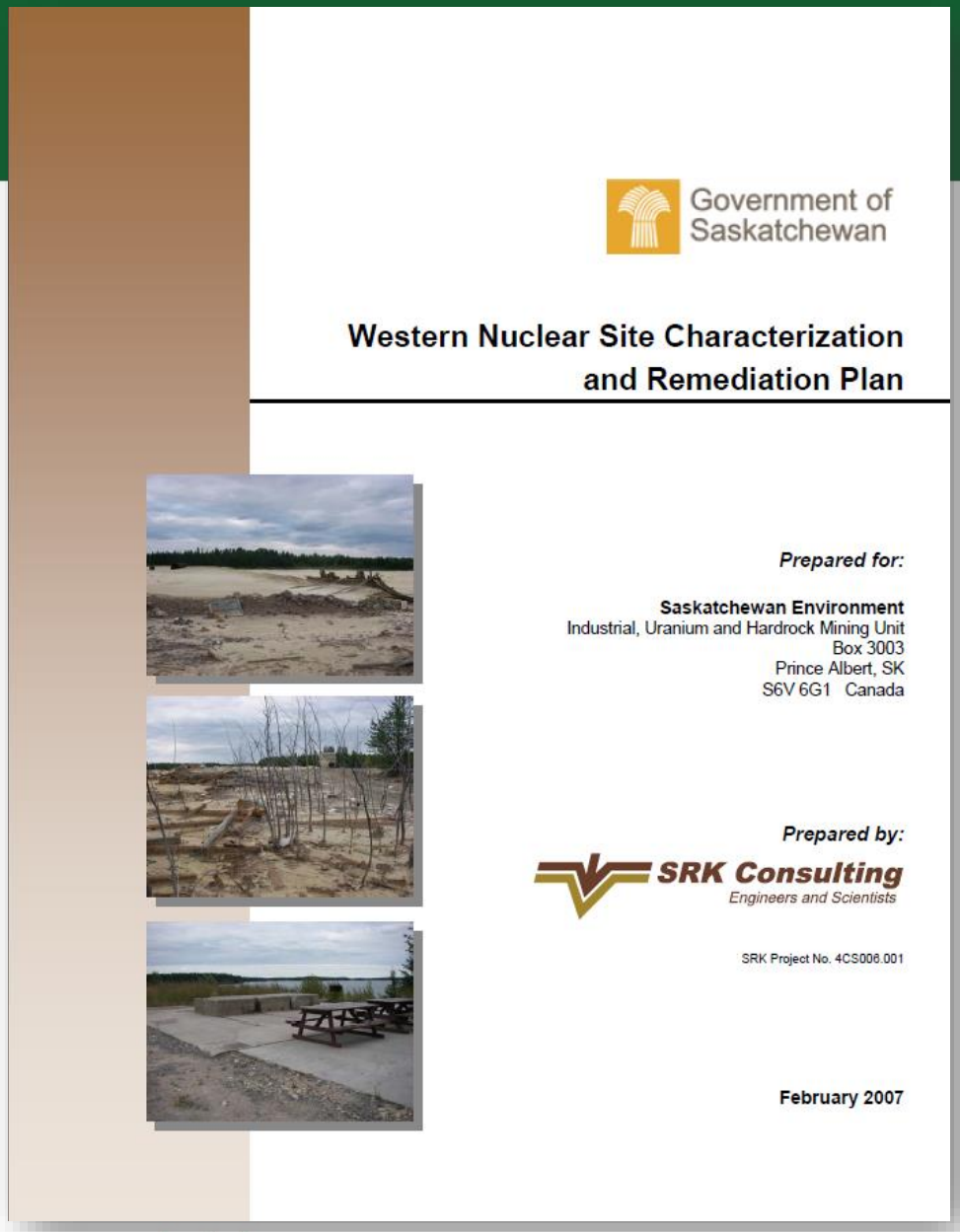
Abandoned Mines Program - 2004

- 2004-05 – 1 FTE and $40,000 to begin non-uranium abandoned mine remediation
- 2004-2005 – negotiations with the federal government concluded in an Memorandum of Agreement for the cost sharing of cleaning up Gunnar Mine and the remaining smaller uranium operated sites.
- 2004 - A responsible party was identified (Encana) for the Lorado mill, located near Uranium City.
- 2005-06 – continued development of strategy and budget proposals for Non-Uranium Abandoned Mines Program



- 2006-2007 – Western Nuclear site characterization completed
- estimated remediation cost of $1.8 million
- Concentrations of arsenic, cadmium, and lead could result in an adverse effect to site users (campers)
- Hanson Lake Recreational Site closed – remains closed

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- 2008 - Budget submission for Non-Uranium Abandoned Mines as part of the Green Strategy not approved
- 2009 – 2013 – ad hoc site safety measures taken at several sites to secure mine openings

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Site Characterization, Risk Assessment and Remediation Planning for the Newcor, Vista, Rottenstone, Anglo Rouyn, and Box Abandoned Mines, Northern Saskatchewan

Prepared for

Government of Saskatchewan

Prepared by

srk consulting

AZIMUTH

SRK Consulting (Canada) Inc.
4CG007.000
December 2013

Azimuth Consulting Group Partnership

- 2013 – site characterization of 5 abandoned mines – not Western Nuclear
- Driven by Public Sector Accounting Board (PSAB) standard PS 3260
- Governments must account for liabilities for contaminated sites
- Formal site assessment required to evaluate each site and estimate clean-up costs

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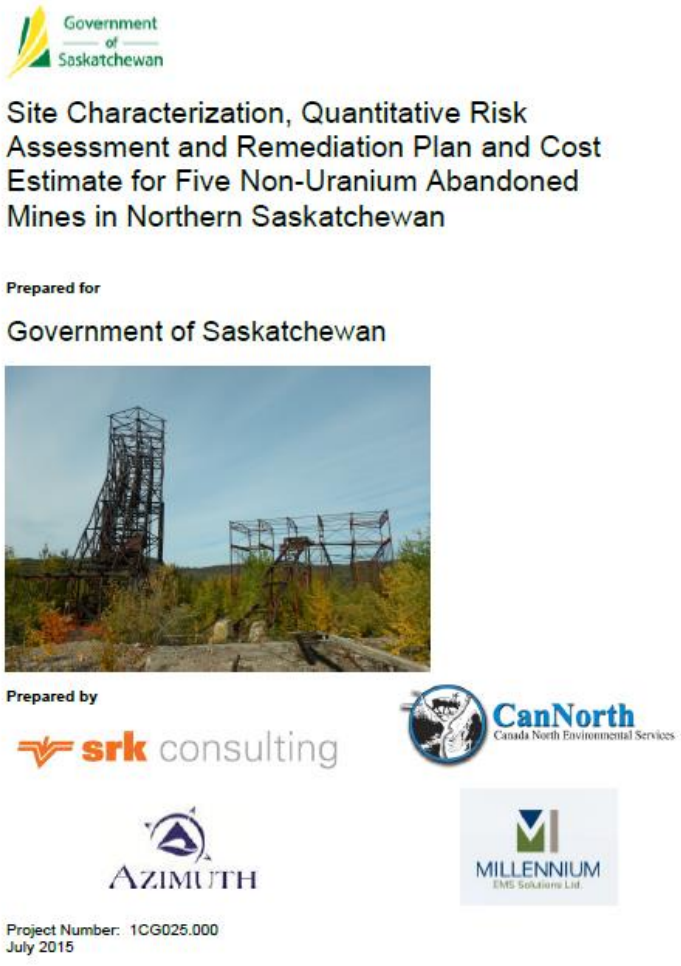

- 2014 – Additional detailed site characterization of 5 abandoned mines – not Western Nuclear
- Address data gaps identified in the 2013 program
- Quantitative human health and ecological risk assessments completed
- Greater certainty of reported environmental liabilities

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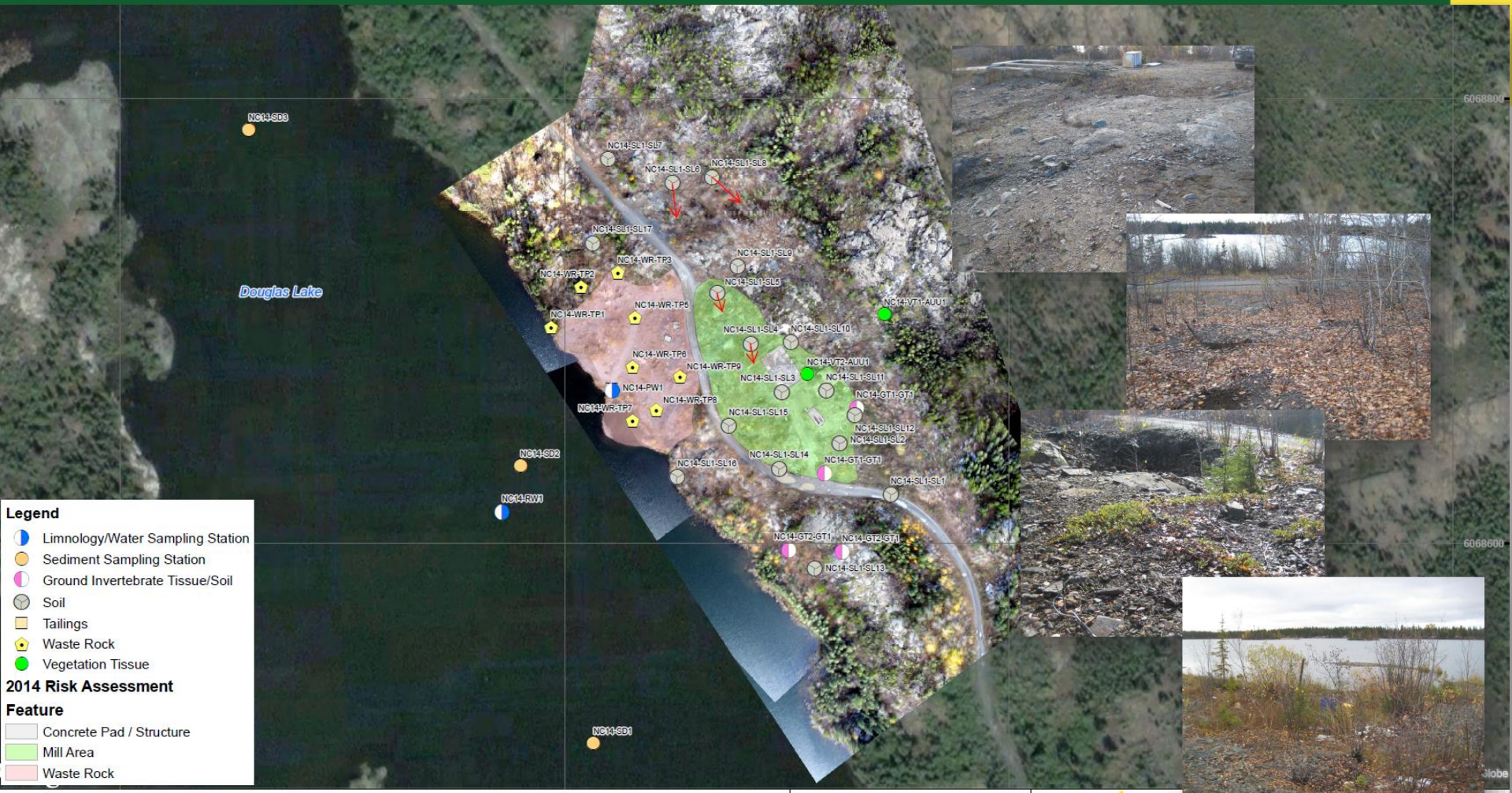

srk consulting

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Newcor Site

Job No: 1CG025.000
Filename: MOE_1CG025_000_fig_##_Newcor_site

Government of Saskatchewan
MOE Site Characterization

Date: Dec 2014
Approved:
Figure: 1

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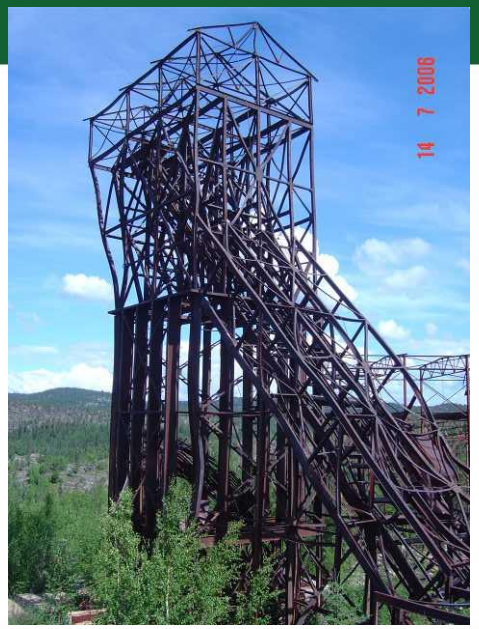
2018 Request for Proposals

2018 – RFP issued for multi-year cash flow estimates for the clean-up of 6 non-uranium abandoned mines



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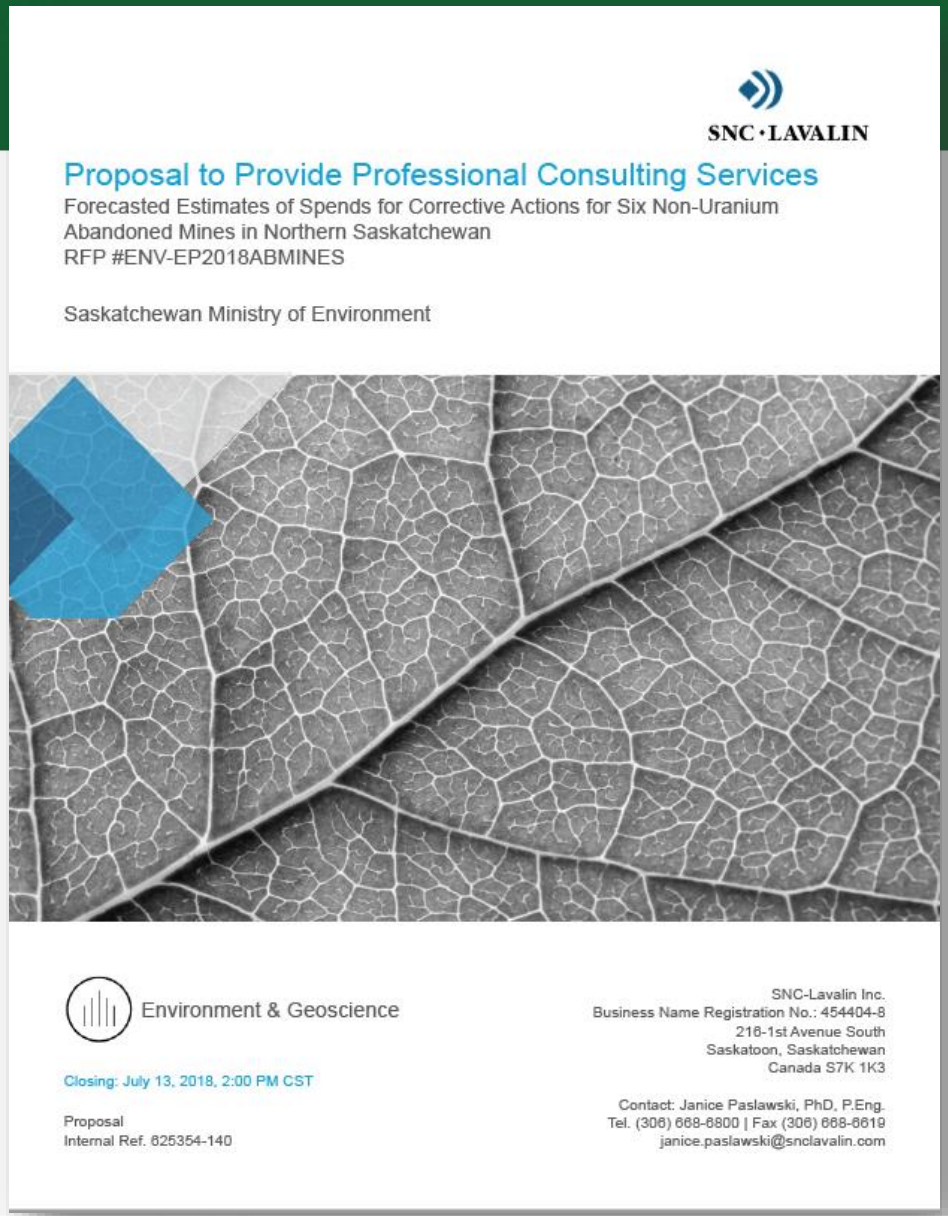
SNC-Lavalin Proposal


SNC·LAVALIN

Proposal to Provide Professional Consulting Services

Forecasted Estimates of Spends for Corrective Actions for Six Non-Uranium Abandoned Mines in Northern Saskatchewan
RFP #ENV-EP2018ABMINES

Saskatchewan Ministry of Environment

Environment & Geoscience

Closing: July 13, 2018, 2:00 PM CST

Proposal
Internal Ref. 625354-140

SNC-Lavalin Inc.
Business Name Registration No.: 454404-8
218-1st Avenue South
Saskatoon, Saskatchewan
Canada S7K 1K3

Contact: Janice Paslawski, PhD, P.Eng.
Tel. (306) 668-6800 | Fax (306) 668-6619
janice.paslawski@snclavalin.com

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Phase 1: data review, preliminary scope, remedial options evaluation, remedial action plans and cost estimate, program execution report, stakeholder presentation and plans.

Phase 1B: Supplemental Field Investigations

Phase 2: Remedial actions plans update, program execution plan update, stakeholder engagement, work package development

Phase 3: execution of remedial action plans (6 years – 1 year per site), closure, transitional phase monitoring, institutional control acceptance

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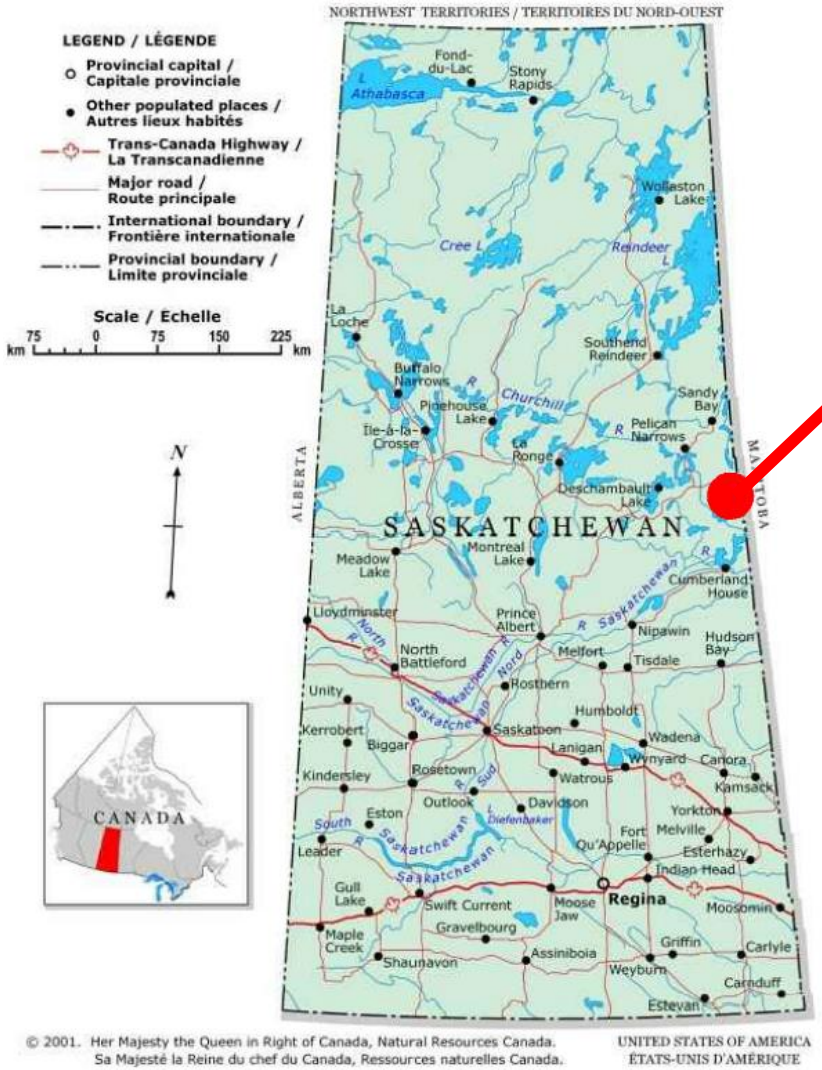
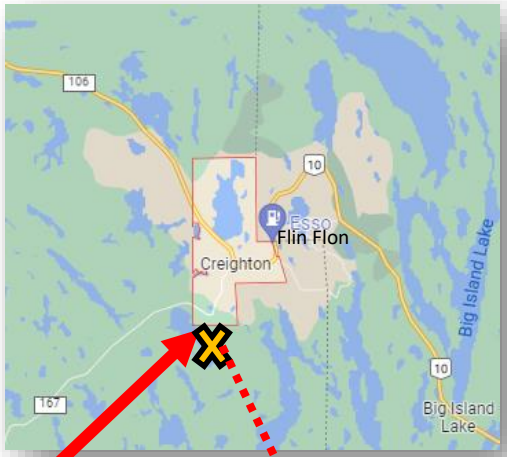
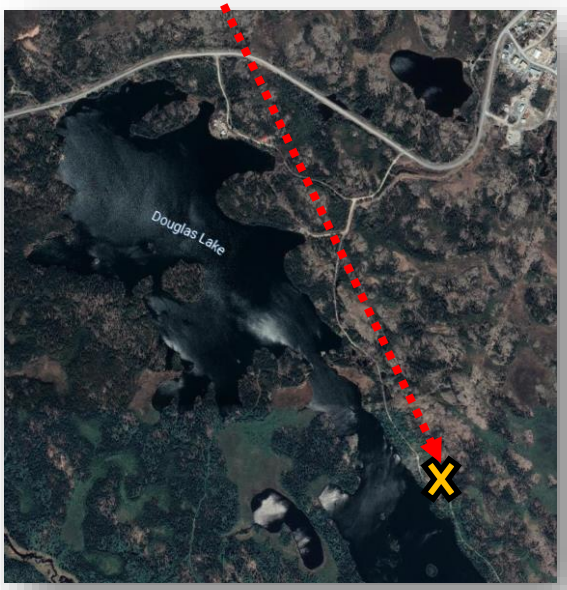
Newcor Site







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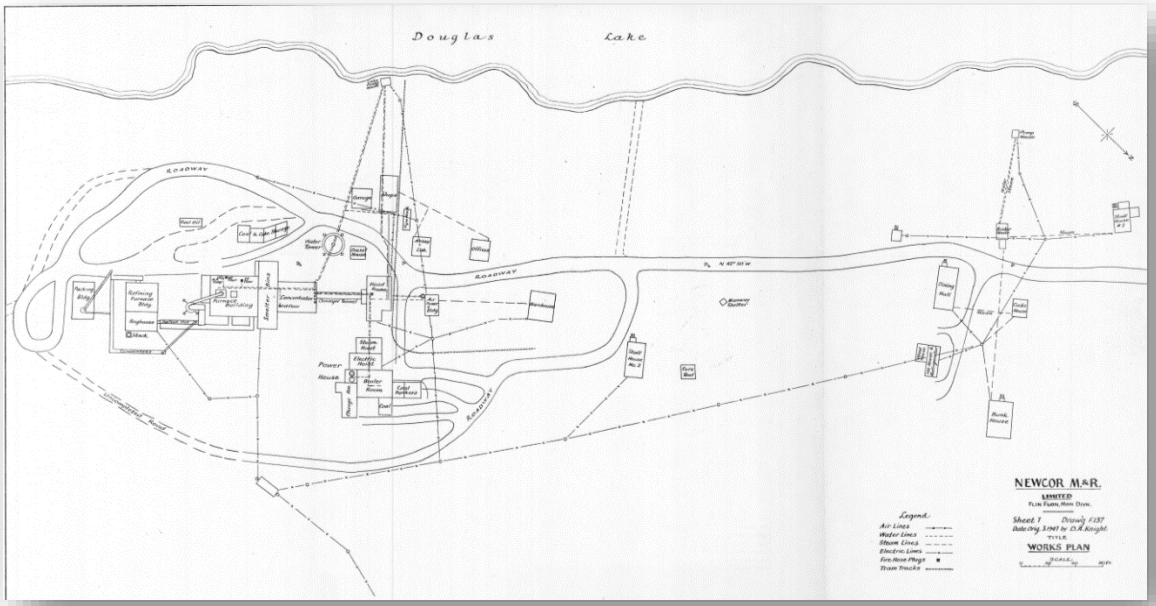
Newcor Background



- ~1.2 Ha footprint
- Operated 1943-47
- Gold-bearing sulphide ore
- Produced unknown amount of gold and arsenic
- Infrastructure included:
  - Shaft
  - Headframe
  - 200 ton/day mill
  - 125 ton/day roaster
  - Camp

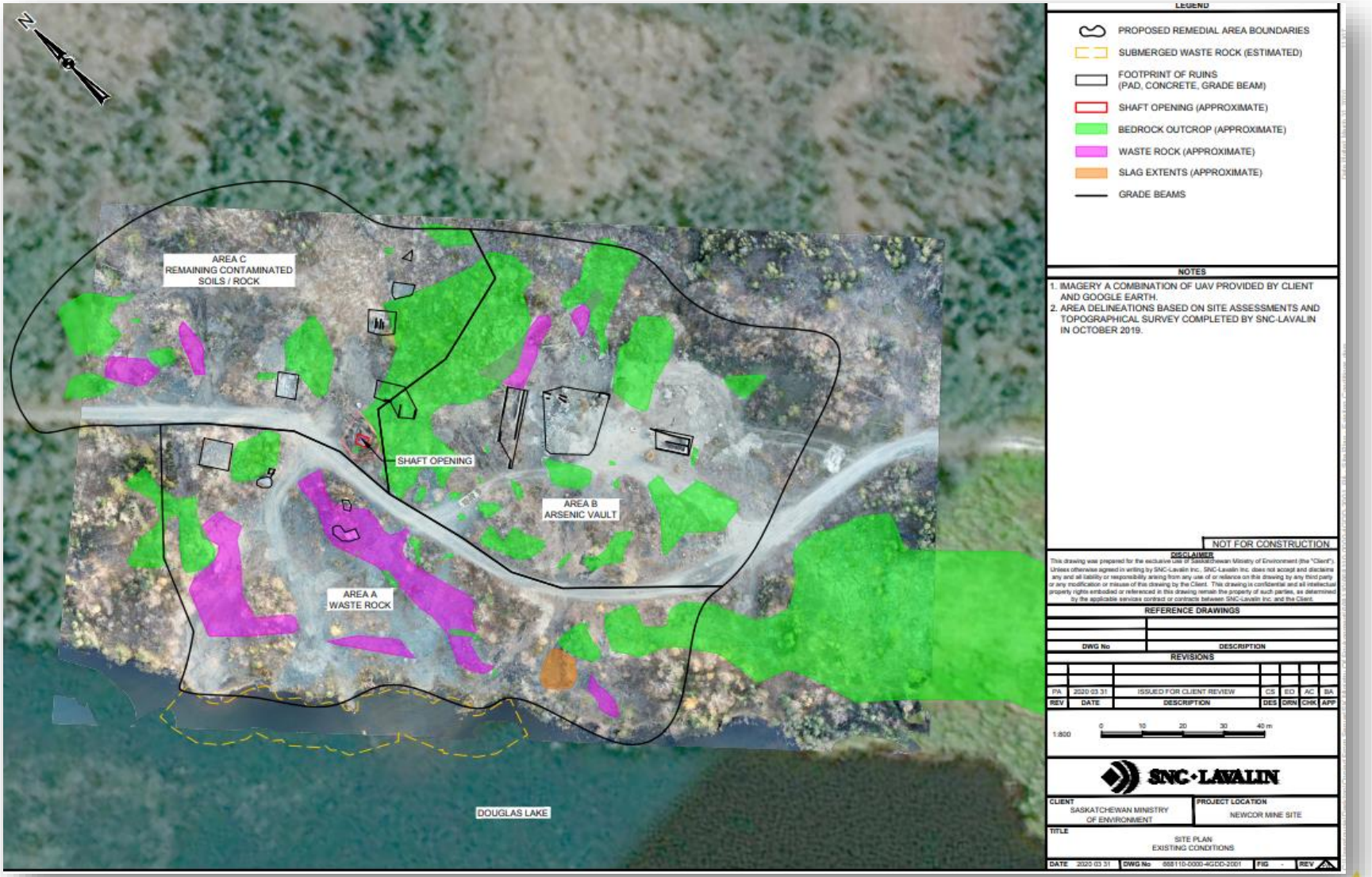
Newcor Historical Activities

- 1947 – Mine closed
- 1950 – Arsenic trioxide removal
- 1958 – Salvage operations
- 1959 – Clean up ordered and Arsenic Vault constructed
- 1962 – Second shell of concrete placed around Arsenic Vault
- 1980 – Concerns about effectiveness of vault
- 1981 – Assessment of contents of vault and clean up plan development
- 1987 – Arsenic Vault Clean Up
- 2002 – Public safety risk assessment
- 2013 – Risk Assessment and Remediation Planning
- 2015 – Site Characterization and Quantitative Human Health/Ecological Risk Assessment
- 2019 – Present – Assessment and Remediation

2019 Plan:
Newcor 60% Corrective Action Plan Development

- Highest risk site, based on proximity to Douglas Lake – drinking water source for Creighton
- $200K to develop CAP to 60% Engineering Design, including:
  - Task 1: Data Gap Compilation
  - Task 2: Supplementary Field Investigation
  - Task 3: Desktop Borrow Material Investigation
  - Task 4: Corrective Action Plan with Cost Estimate
  - Task 5: Reporting
  - Task 6: Project Management

2019 Results:
Newcor 60% Corrective Action Plan



2019 Results:
Risk Assessment Updates

APEC	Issue	Recommendation
Mine Waste Areas	-Unacceptable incremental risk for human receptors exposed to As in surface soil -Potential unacceptable risk to human ingestion of edible plants (berries)	Remediation to Tier 3 endpoints
Mine Waste on Roads	No unacceptable risks to human and ecological receptors	Remediation not recommended
Douglas Lake	-Potential unacceptable risk via recreational ingestion of surface water -No unacceptable risk via human ingestion of fish	-Remediate nearshore impacted waste rock -Do not remove submerged waste rock

2019 Results:
Newcor 60% Corrective Action Plan

Cost Estimate

- **Option 1** – 'Bare Minimum' - Store and Release cover system
- **Option 2** – 'SNC-Lavalin Preferred Option' – Geosynthetic barrier over Area A and Store and Release covers over Areas B and C
- **Option 3** - 'Highest Load Reduction' – Geosynthetic barrier cover system

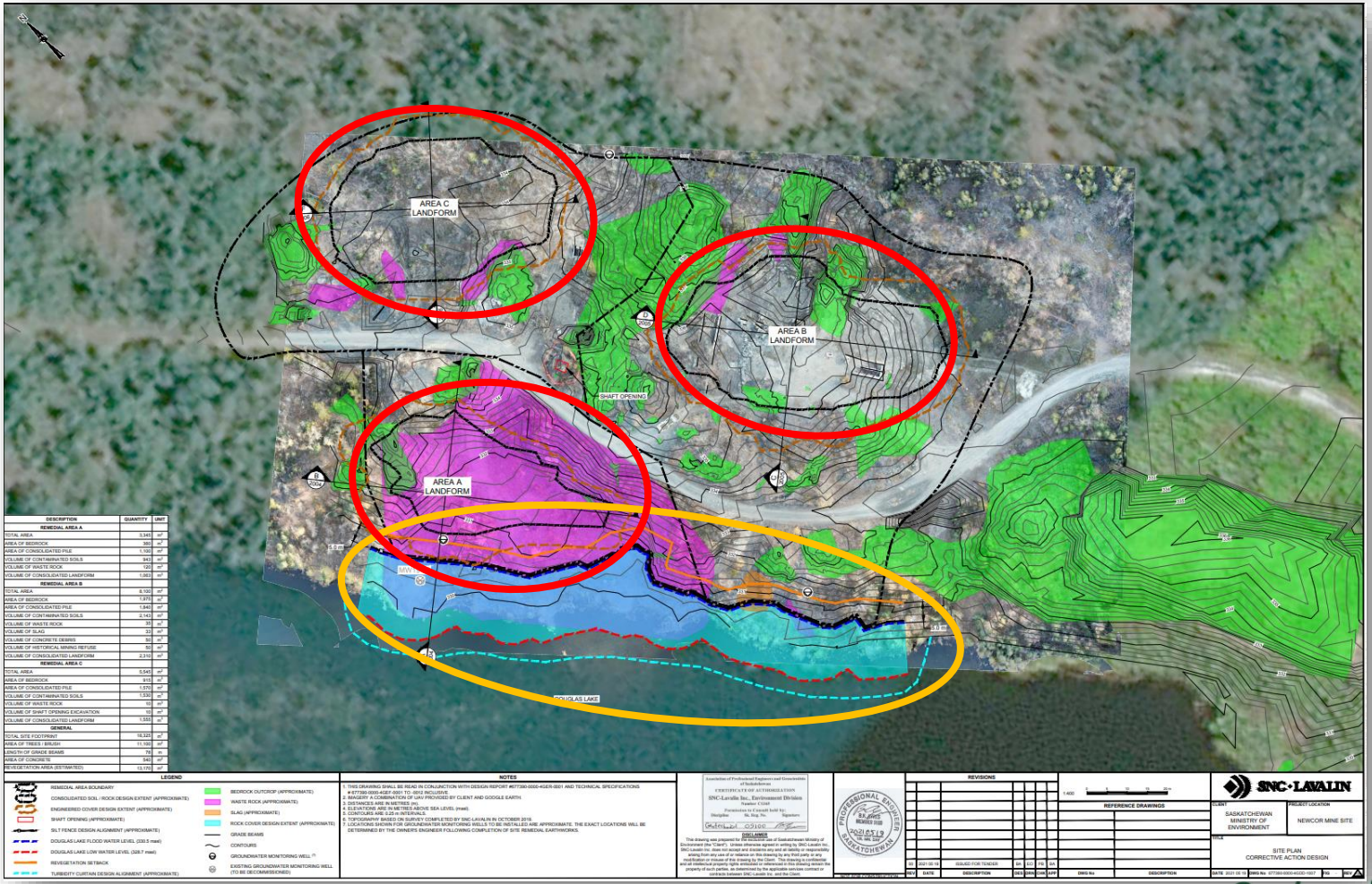
No.	Cost Element	Enviro. Option 1 (bare minimum)	Enviro. Option 2 (SNC preferred)	Enviro. Option 3 (highest load reduction)
1.0	Environmental Liability Remediation	$417,000	$487,000	$602,000
2.0	Physical Hazard Remediation	$115,000	$115,000	$115,000
3.0	Post-Remediation Maintenance	$52,000	$52,000	$52,000
4.0	Post-Remediation Monitoring	$277,000	$277,000	$277,000
	Total Estimated Liability:	**$861,000**	**$931,000**	**$1,046,000**

2020 Plan:
Newcor 100% Corrective Action Plan

- $102K to develop CAP to 100% Engineering Design, including:
  - Task 1a: On-Site Field Program
  - Task 1b: Cover Material Borrow Investigation
  - Task 2a: Finalize Remediation Design to 100% Stage
  - Task 2b: Prepare IFT Specifications and Drawings
  - Task 2c: Public Tendering Process
  - Task 2d: Project Management and Administration

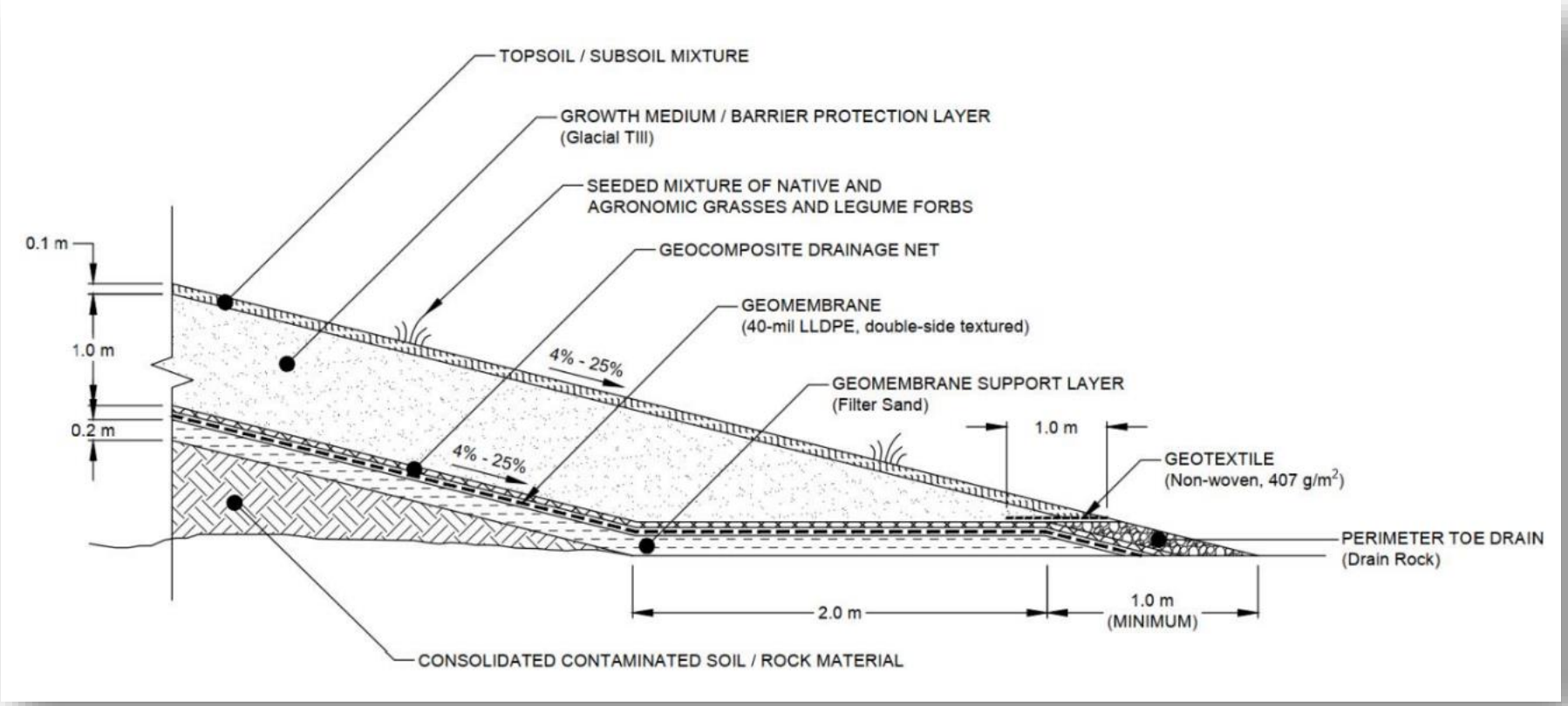
2020 Results:
Newcor 100% Corrective Action Plan

Soil Remediation



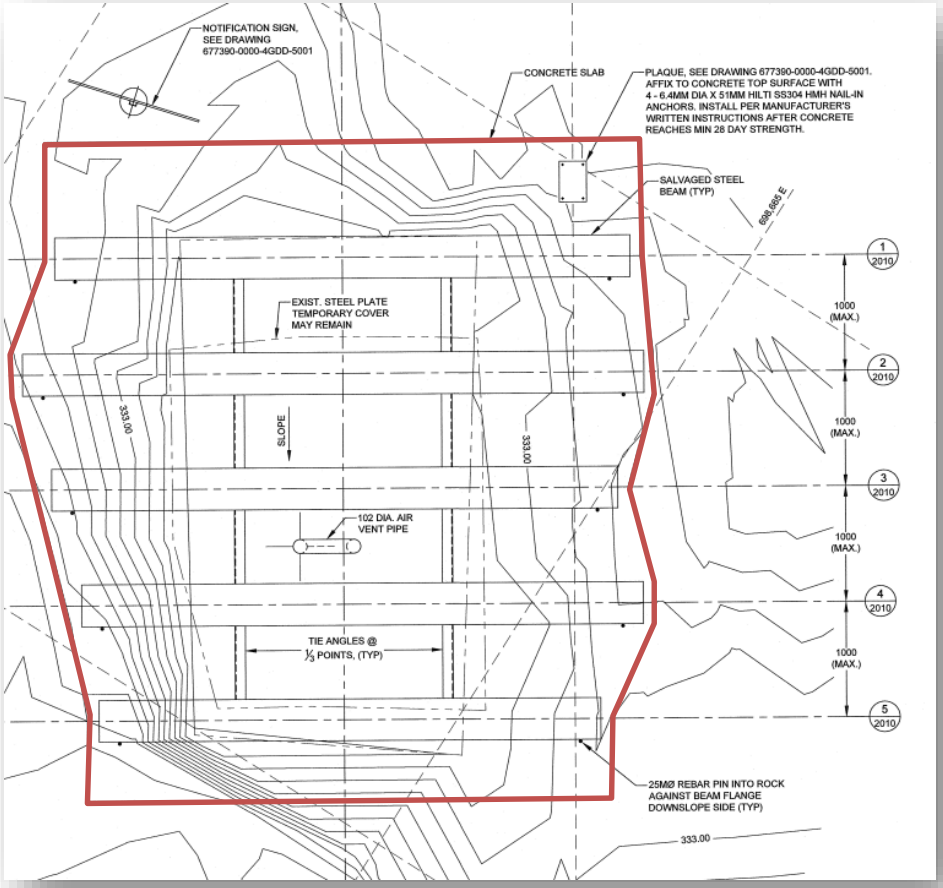
2020 Results:
Newcor 100% Corrective Action Plan

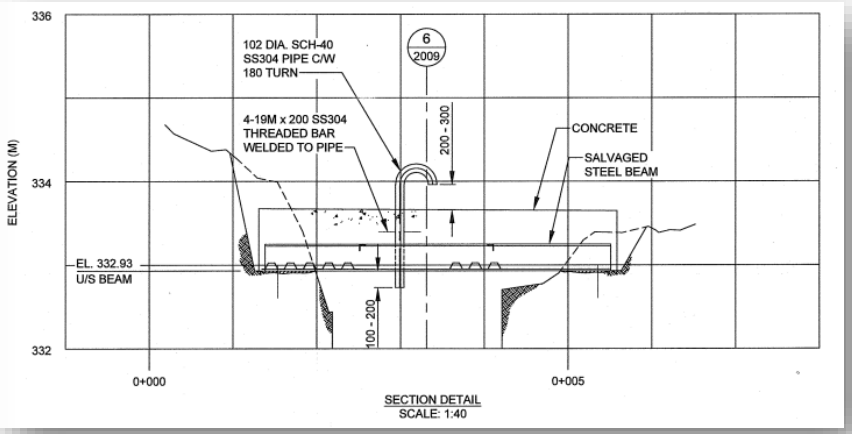
Engineered Cover Design



2020 Results:
Newcor 100% Corrective Action Plan

Mine Shaft Cover





2021 Newcor Remediation

Clearing and Grubbing

2021 Newcor Remediation

Shaft Cover Prep

2021 Newcor Remediation

Shaft Cover Prep

2021 Newcor Remediation

Shaft Cover Forms and Reinforcement

2021 Newcor Remediation

Shaft Cover Concrete Pour

2021 Newcor Remediation

Shaft Cover Concrete Heating and Hoarding

2021 Newcor Remediation

Permanent Concrete Shaft Cover

2021 Newcor Remediation

Grade Beam and Slab Demolition

2021 Newcor Remediation

Turbidity Curtain in Douglas Lake

2021 Newcor Remediation

Rip Rap over Submerged Waste Rock and Shoreline

2021 Newcor Remediation

Contaminated Soil Excavation into Landforms

2021 Newcor Remediation

Filter Sand on Landform A

2021 Newcor Remediation

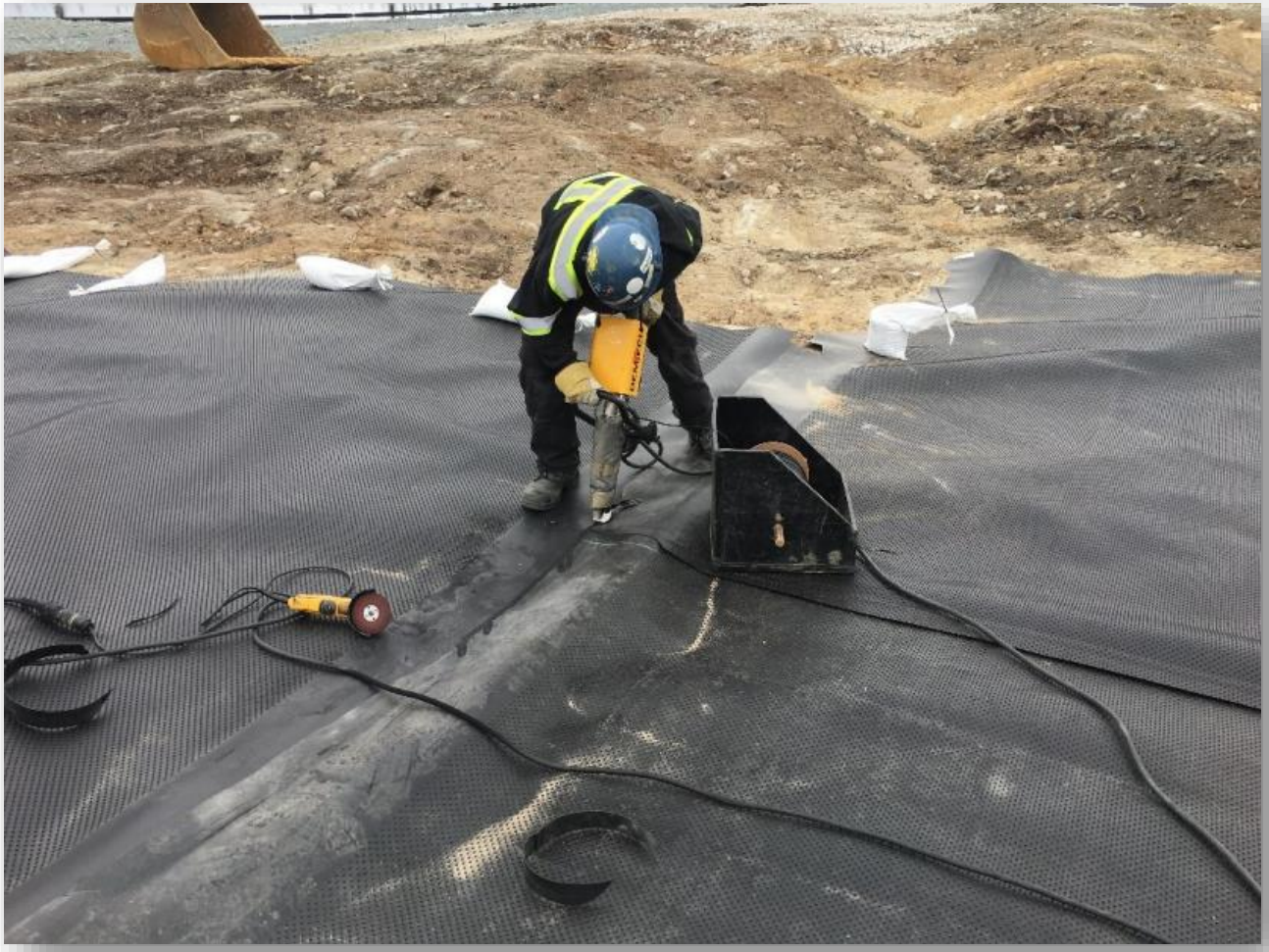
UAV Image of Filter Sand, Road Work, and Shoreline Cover

2021 Newcor Remediation

Placing Geomembrane on Landform A

2021 Newcor Remediation

Welding Geomembrane Seams



2021 Newcor Remediation

Drainage Net over Geomembrane on Landform B

2021 Newcor Remediation

UAV Image of Cover System Installation

2021 Newcor Remediation

Till Growth Medium Placement

2021 Newcor Remediation

Toe Drain on Landform C

2021 Newcor Remediation

Road Reconstruction

2021 Newcor Remediation

Topsoil Placement and Seeding on Landform A

2021 Newcor Remediation

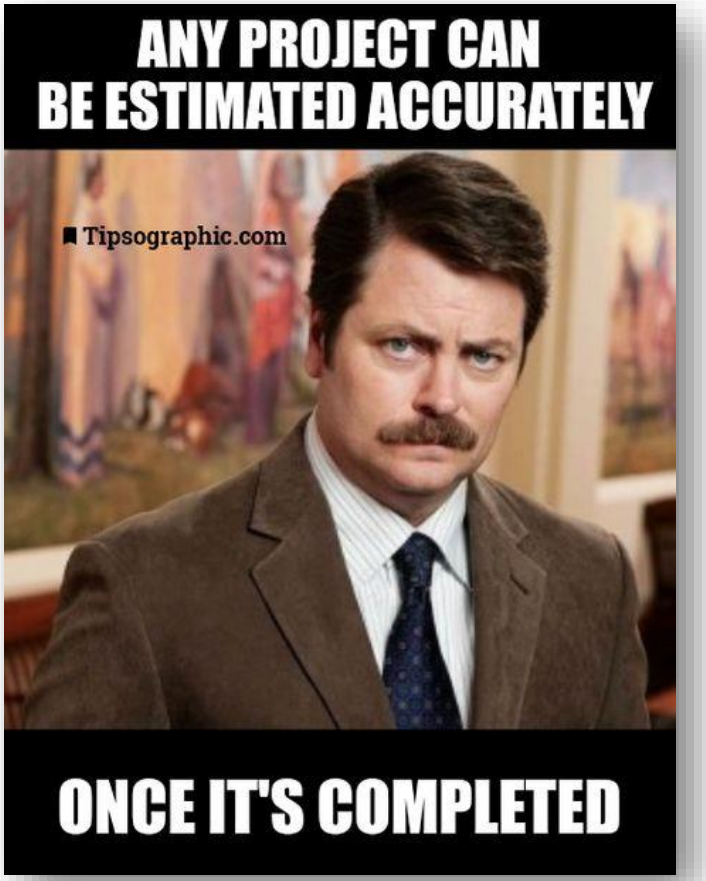
Monitoring Well Installation

2021 Newcor Remediation

Signage

Challenges

- Short timelines from 100% CAP Design to Execution
- Short construction season
- Budget constraints
- Construction deficiencies
- Invoicing
- Health and Safety



Next Steps for NUAM Program

- Post-remediation maintenance and monitoring at Newcor starting 2022
- 100% CAP design for Western Nuclear in 2022
- 2022-2024 – 60% CAPs for Anglo Rouyn, Rottenstone, and Box
- 2023-2025 – 100% CAPs for Vista, Anglo-Rouyn, Rottenstone, and Box
- Address the physical hazards at each site (structures, pits, shafts, foundations, etc)
- Based on the outcome of the revised corrective action plans and cost estimates – develop budget submissions for the execution of the corrective action plans at each site.
- Finalize and execute CAPs as budgets approved for Western Nuclear, Vista, Anglo Rouyn, Rottenstone, and Box Mine.

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