



IMPLEMENTATION, OPERATION AND ADAPTATION OF A LARGE-SCALE, LONG-TERM ISCO REMEDIATION PROJECT

REMTECH 2025

Annalisa Gallinari and Neil Marchand | October 17 2025



wsp Presenters



Neil Marchand, PhD PMP
Site Manager



Annalisa Gallinari, Eng.
Remediation Manager

Outline

- Site Overview
- Project Timeline
- Remediation Plan
- Site Preparation
- Injection Method, Capacity and Strategy
- Data Management
- Optimization
- Bioremediation Polishing
- New Challenges



Site Overview

70 years of industrial activity

Ore transported by train to furnace and port facilities, active from 1956 to present.

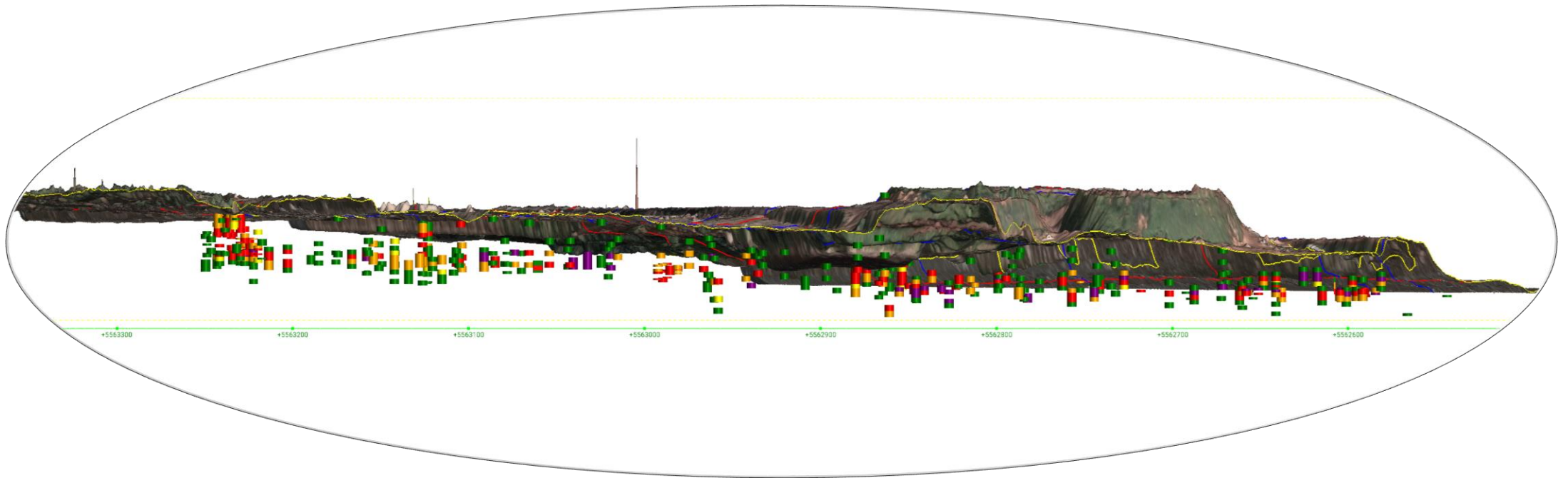
Hydrocarbon contamination

Mainly diesel, affecting soil (sandy) and groundwater.

20-year remediation plan

Currently in 7th year of operation on an area of almost 200 000 m².

Large-scale



Long-term

wsp Timeline

1990s

- First evidence of contamination

2010

- Contamination noticed in receptor
- Emergency response
- Hydraulic barrier

2013

- Pilot tests
- ISCO
- ISCD

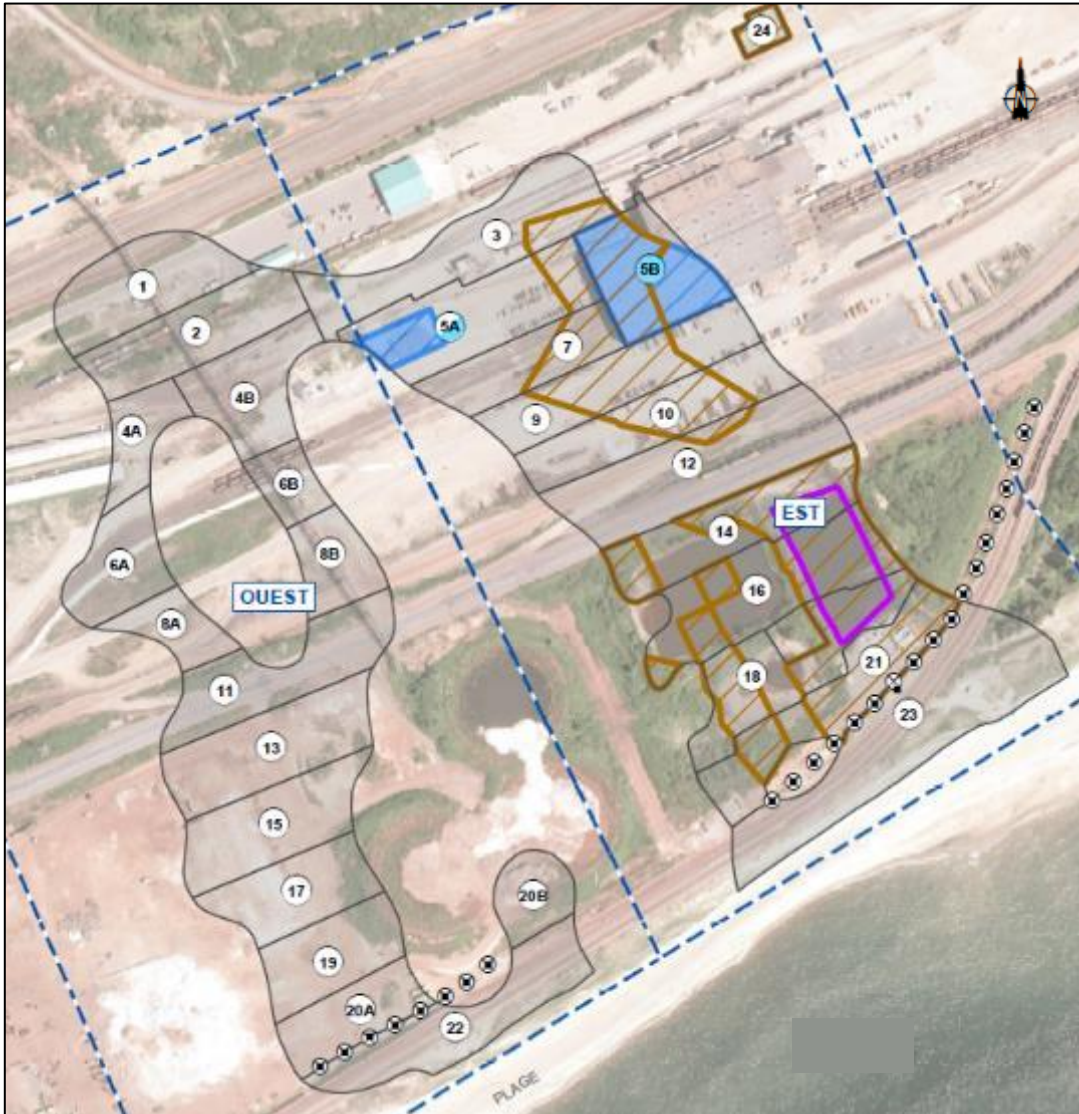
2016

- Remediation action plan development

2019

- Start of remediation work

wsp Remediation Plan



ISCO: Saturated Zone (2019 to 2038)

- 4 phases of 5 years each (zones 1 to 24)

Bioventing: Vadose Zone

- Zone 24 (2019 - 2023)
- Locomotive shop sector (2029 - 2033)
- Settling ponds (2034 - 2039)

Hydraulic barriers

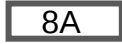
- 2011 - 2038
- Limit impact to the receptor
- Groundwater monitoring (2019-2039 - zones 1 to 24)

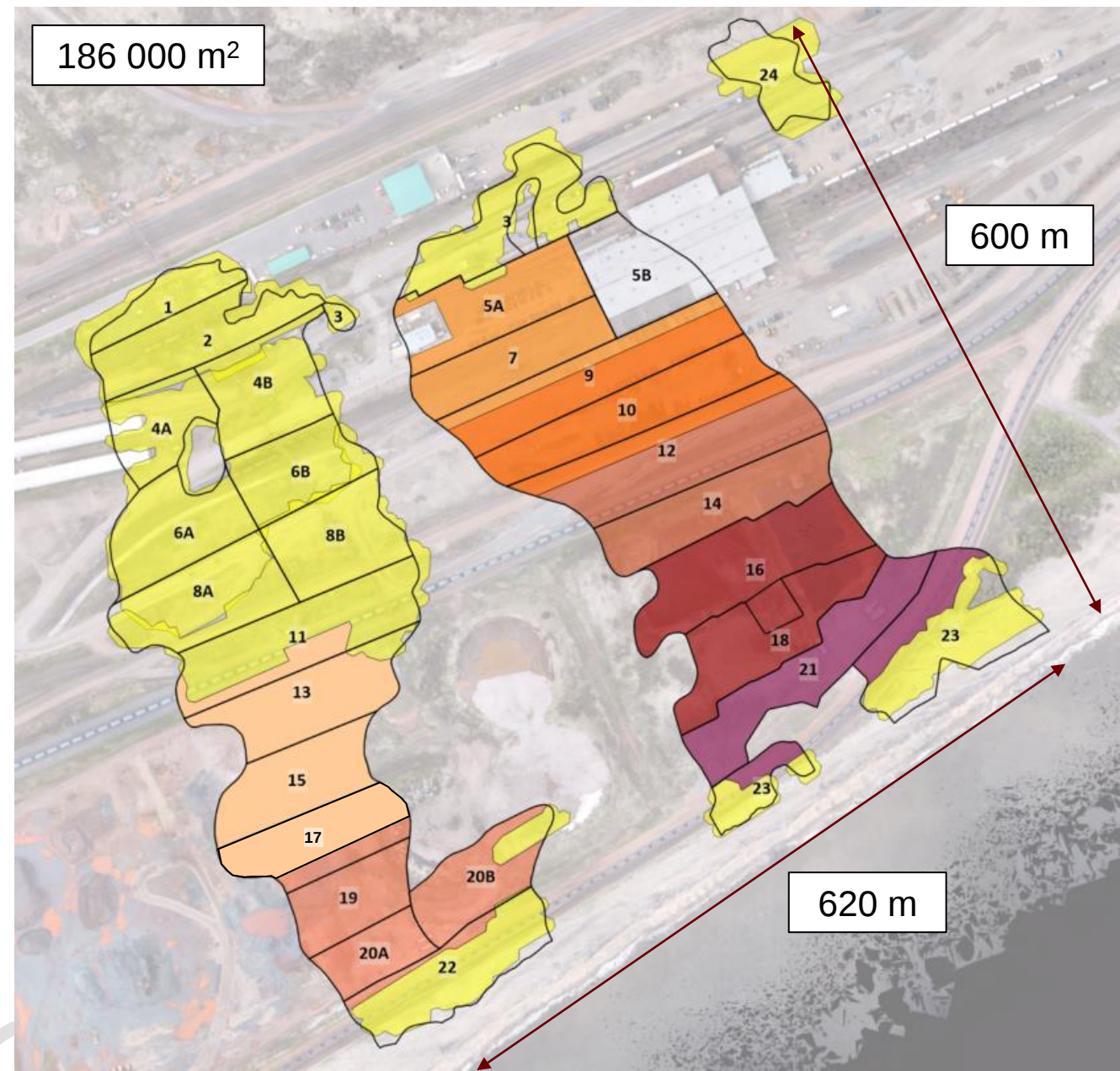
ISCD (2029 - 2033)

- Locomotive shop sector
- Heating plant sector



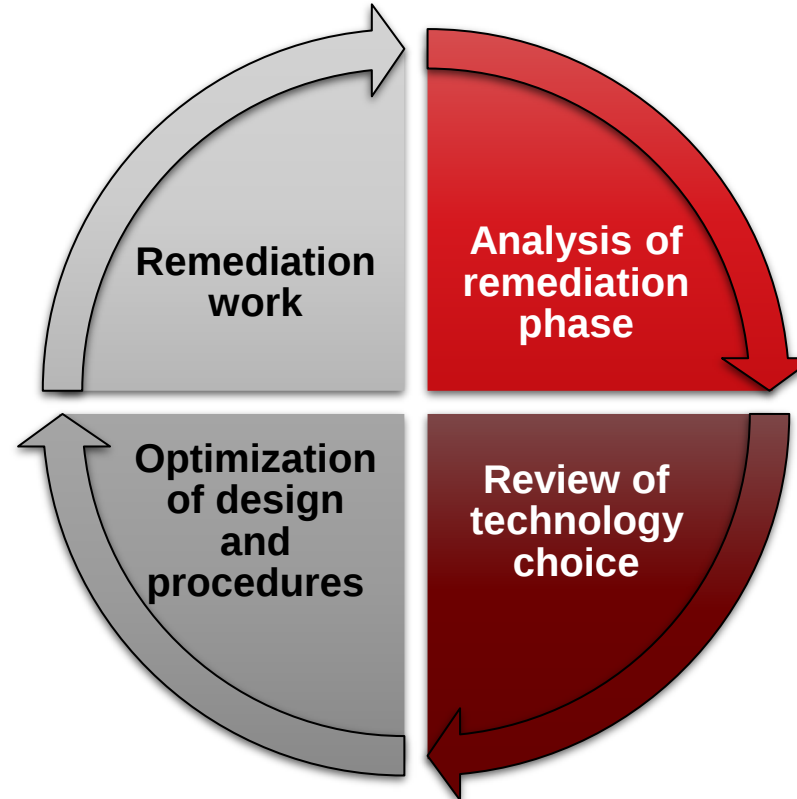
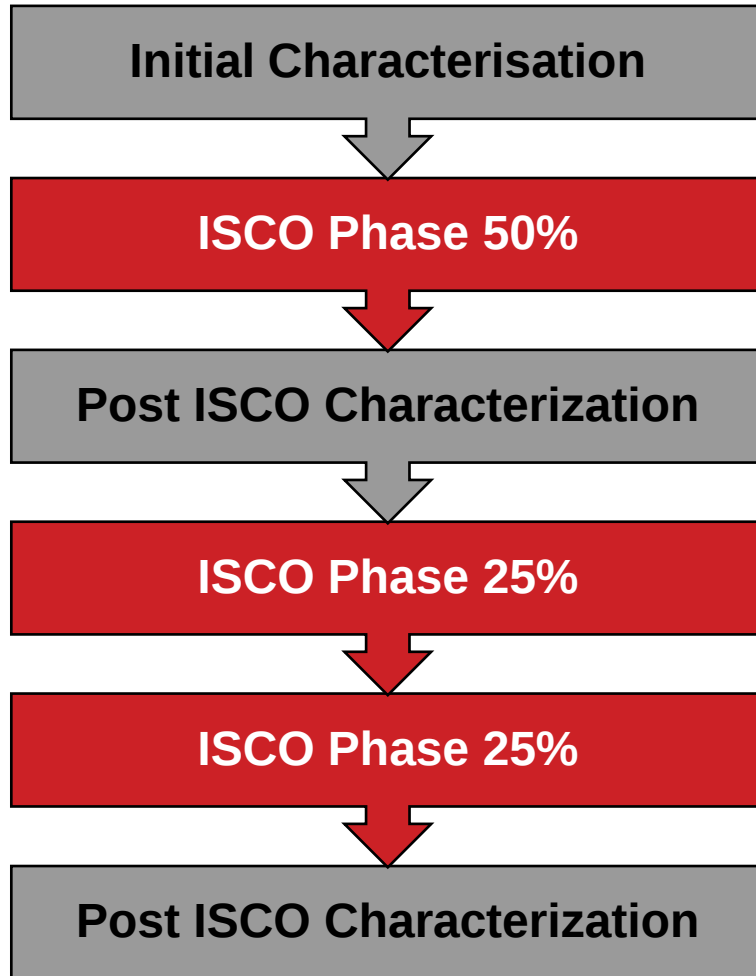
ISCO Summary 2019-2031

-  ISCO completed (2019-2024)
-  ISCO (2025) - completed
-  ISCO (2026)
-  ISCO (2027)
-  ISCO (2028)
-  ISCO (2029)
-  ISCO (2030)
-  ISCO (2031)
-  Remediation Zone

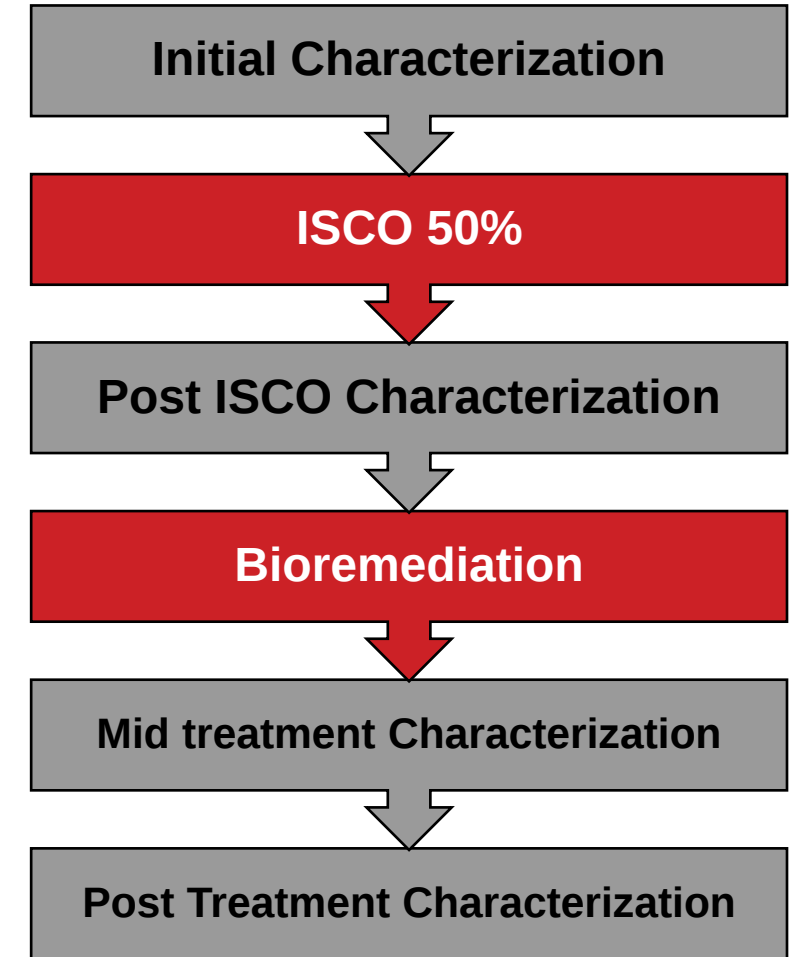


Project cycle

Remediation Plan Strategy



Current Strategy

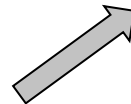
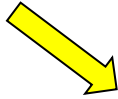


Drilling Management

- 400 points drilled every year
- Around 3000 points drilled since 2019



WSP Dilution and Injection

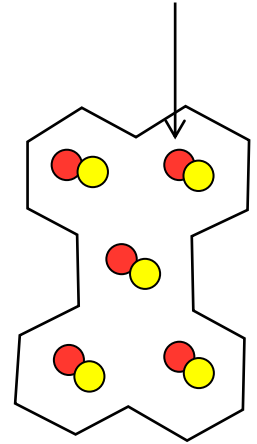


H₂O₂ 15% + sodium citrate

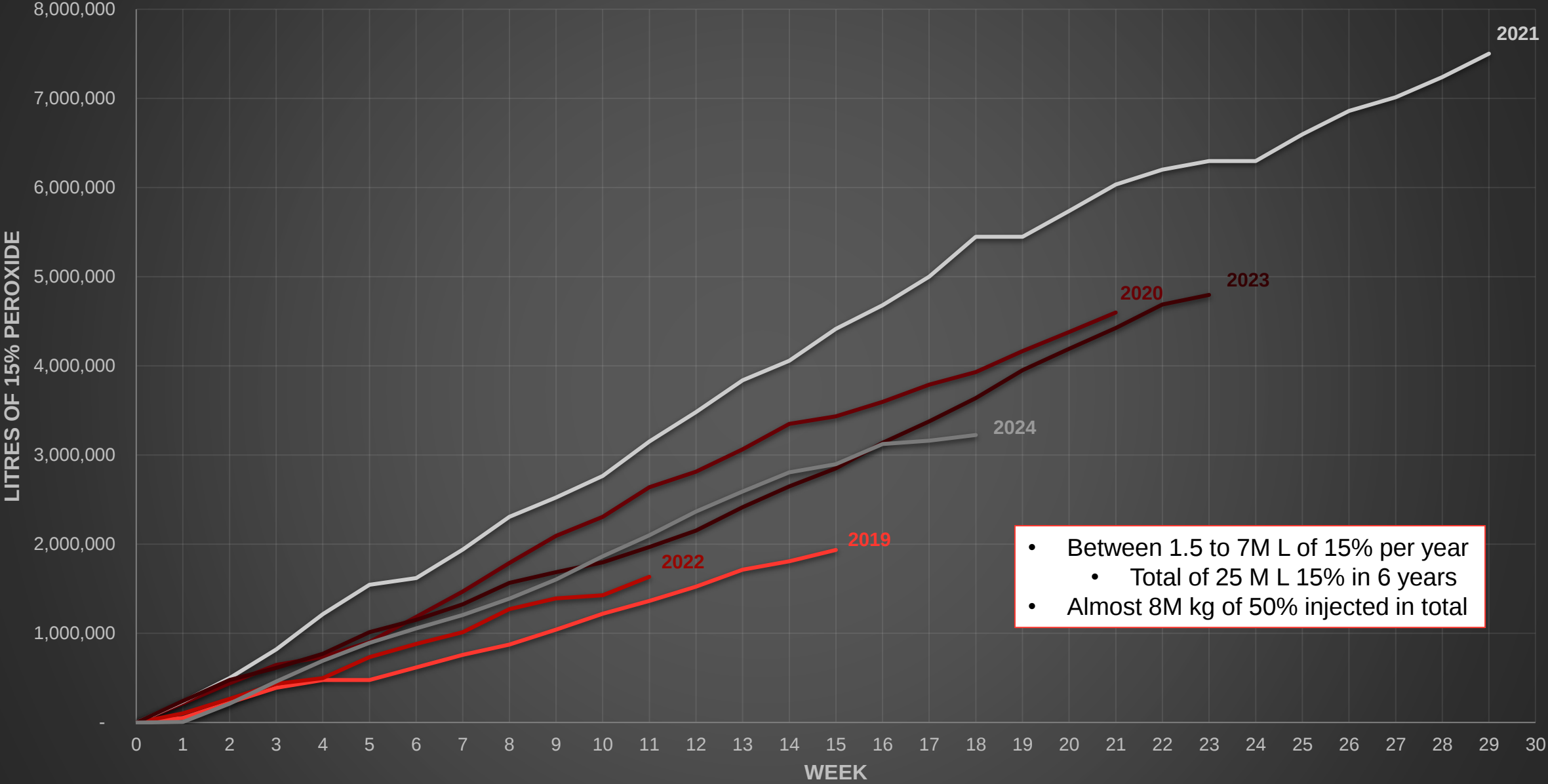


Acidified ferric sulfate

40 L/min per injection point
(Total 200 L/min)



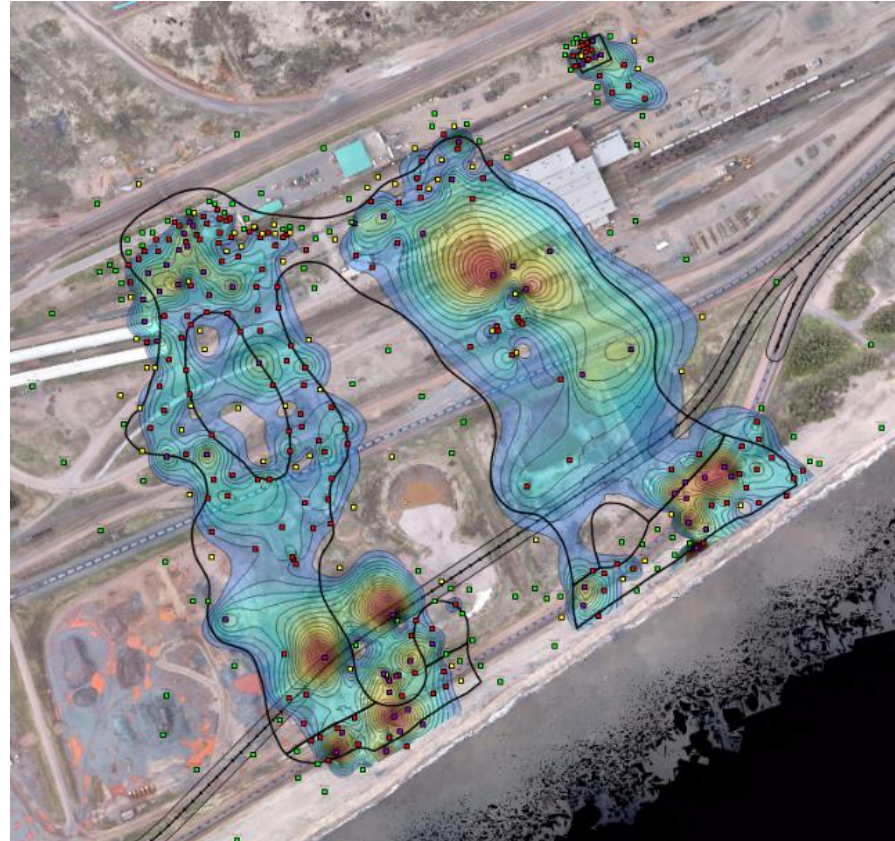
PEROXIDE INJECTED PER YEAR



- Between 1.5 to 7M L of 15% per year
 - Total of 25 M L 15% in 6 years
- Almost 8M kg of 50% injected in total

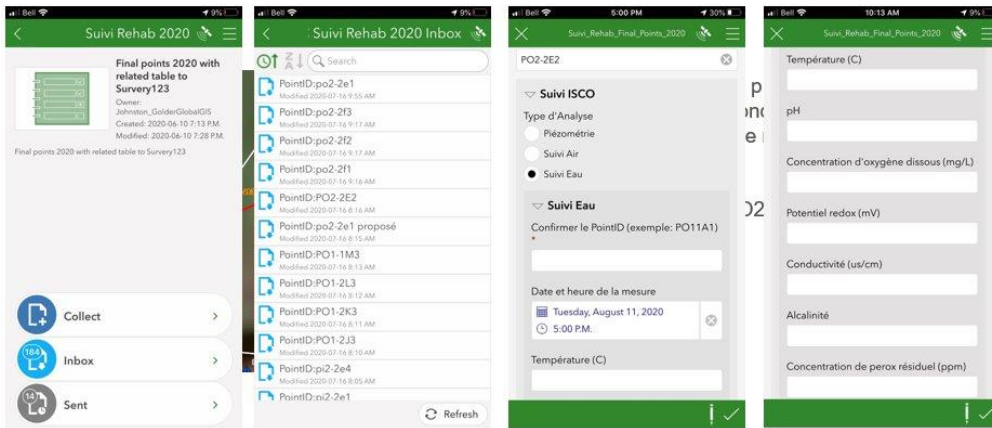
WSP Data Management

- Extent of treatment area refined each year through a pre-treatment characterization program
 - Modeled to reduce uncertainty
- Nomenclature established at the beginning of the project to include
 - Treatment zone
 - Cell (5 injection points, 3 monitoring points)
 - Phase (50-25-25%)
- Rigorous environmental monitoring framework
 - 2000 soil and water samples per year

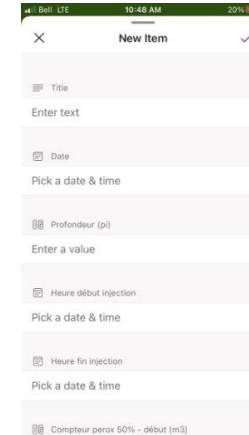


wsp Data Management

- Survey 123 for ISCO process monitoring (pH, temperature, residual peroxide, CO₂, etc.)

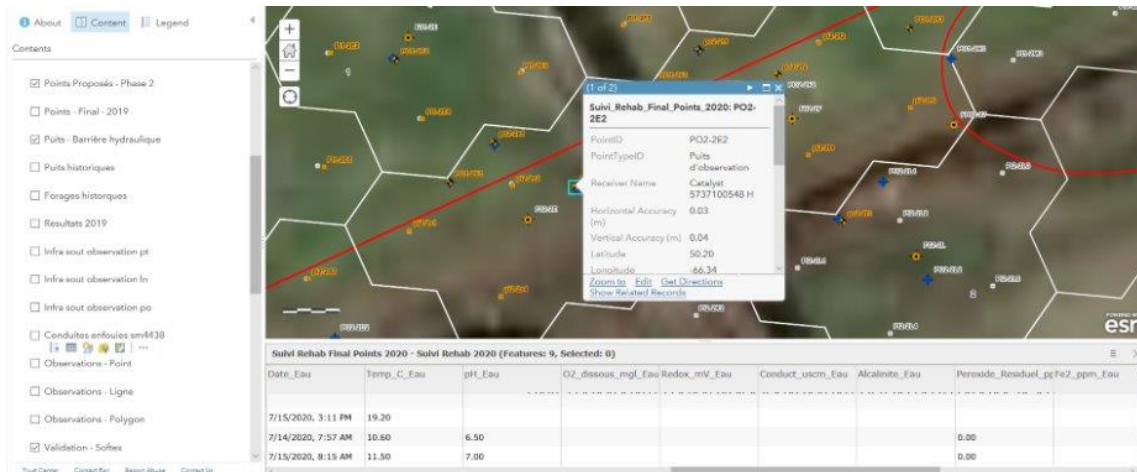


- Sharepoint lists for ISCO operational monitoring (volumes, flow rates, pressures)



# de cellule	Profondeur (pi...)	Date/Heure début...	Date/Heure Fin	Compteur Perox ...	Compteur Citrate ...	Compteur eau dé...
PI11-AC	30	5/14/2025 11:08 AM	5/14/2025 12:45 PM	1,308	0	
PI11-AA	26	5/16/2025 5:42 AM	5/16/2025 9:13 AM	1,327.51	0	9,550.02
PI11-AB	28	5/16/2025 11:20 AM	5/16/2025 12:40 PM	1,343.74	0	9,583
PI11-AB	22	5/20/2025 5:57 AM	5/20/2025 7:00 AM	1,350.48	0	9,594.63
PI11-Z	26	5/20/2025 9:37 AM	5/20/2025 12:55 PM	1,357.19	0	9,607.89
PI11-x	28	5/21/2025 5:36 AM	5/21/2025 6:33 AM	1,372.43	0	9,642.67
PI11-X	22	5/21/2025 7:45 AM	5/21/2025 9:00 AM	1,378.23	0	9,653.91

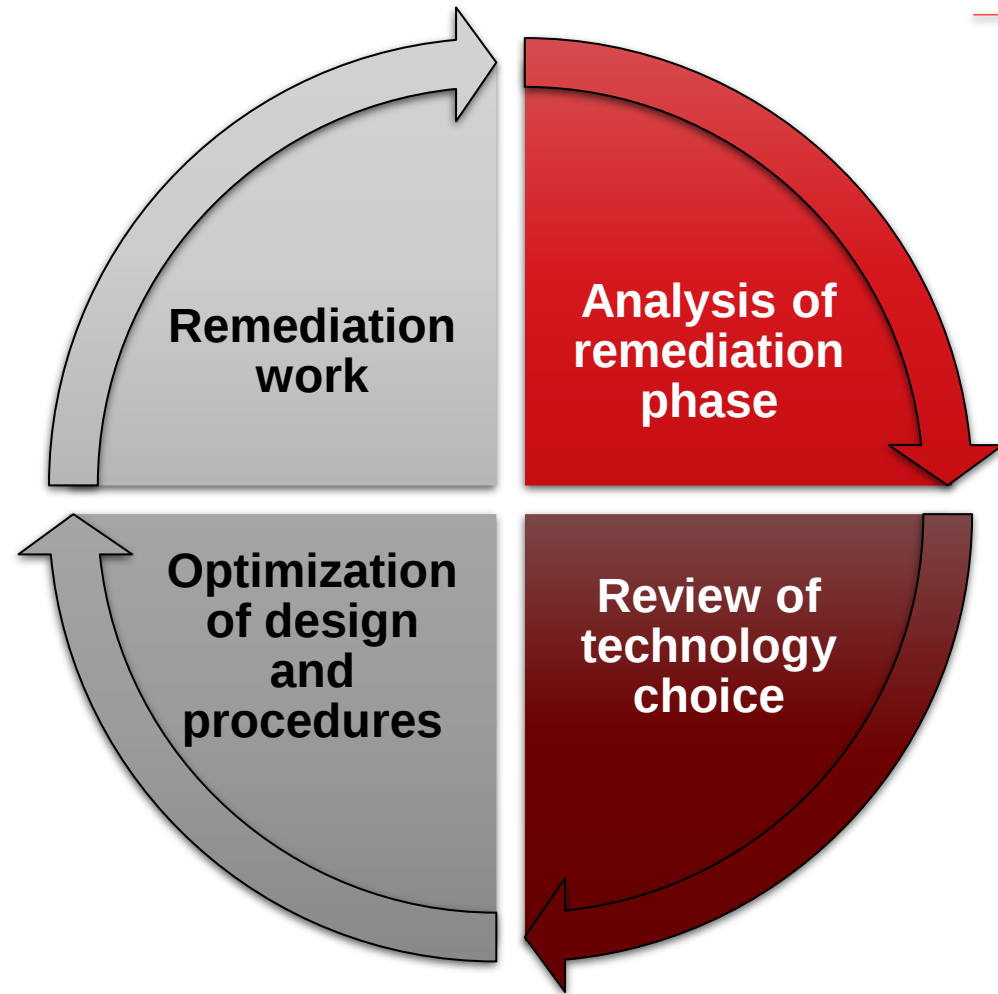
- Fieldmaps and ArcGIS Collector for georeferenced data visualization



- Access database to manage laboratory data and streamline figure production

Table	OBJECTID	typeI	Catégorie_fc	Zone	IDStation	NomPoint
dtPhase	4816	DUP	1			DUP 85
dtPiezo	4707	PO			00-1	00-1
dtPoints	4708	PO			00-14	00-14
dtPointsNotes	4709	PO			00-2	00-2
dtProjets	4710	PO			00-3	00-3
dtResultatsAnalytiques	4711	PO			00-5	00-5
dtSites	4712	PO			00-8	00-8
lienAccessEquisCas	4713	PO			00-9	00-9
lienGintdtEchantillons	4714	PO			01-01	01-01
lienParametreGroupe	4715	PO			02-02	02-02
Paste Errors	4716	PO			10	10
rtMatrices	4717	PO			11	11
rtPointType	4718	PO			14	14
	4719	PO			1A	1A
	4720	PO			20	20
	4721	PO			22	22
	4722	PO			5	5

ISCO Optimization



Drilling optimization

Updates to chemical components

Transition from 3 ISCO phases to 1 phase followed by biological polishing treatment

wsp The Injection Well Story



WSP Problem Solving Process



Problems :

Preferential pathways and product daylighting

Melting PVC



Solution

2019
Direct Push
installation of
steel rods

2019
SCH40 PVC
installed with
direct push

Solution

2020
SCH80 CPVC
installed with
auger drilling

Solution

2021
Double well
installation
Drill
modification :
4-speed head

Problems :

Slow flow rate

Preferential pathways and product daylighting

Leaky rods due to corrosion



Problem :

Drilling time



wsp Chemical Optimization

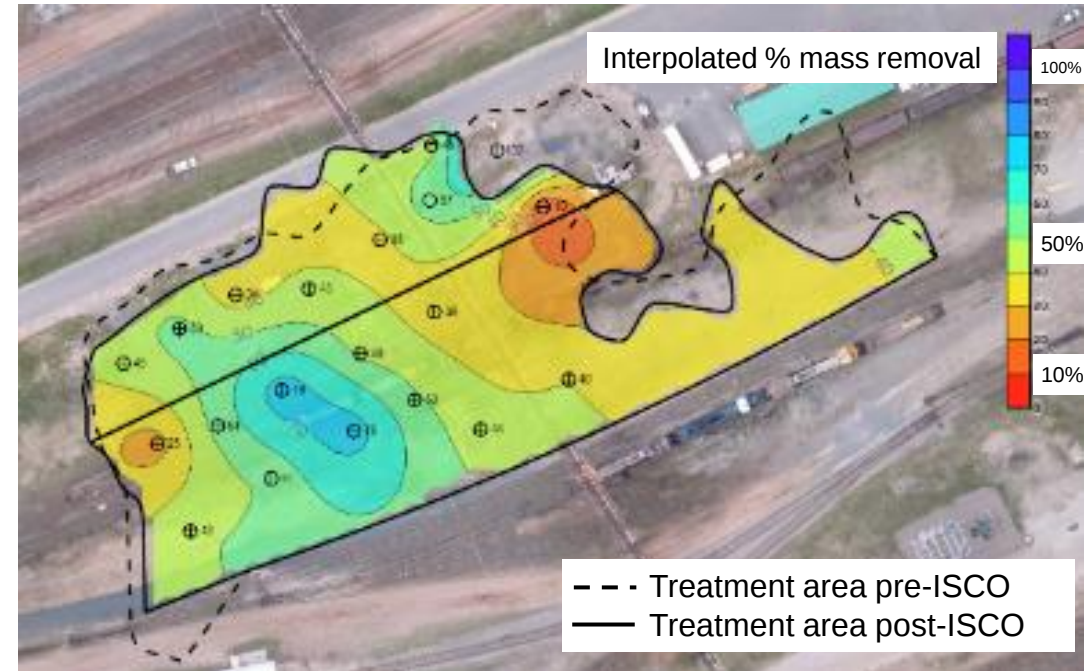
- Sodium citrate powder to liquid, then liquid concentration reduced from 40% to 30% to improve handling on site
- Acidified ferric sulfate solution modified to enhance performance (decrease pH)





Injection Strategy Change

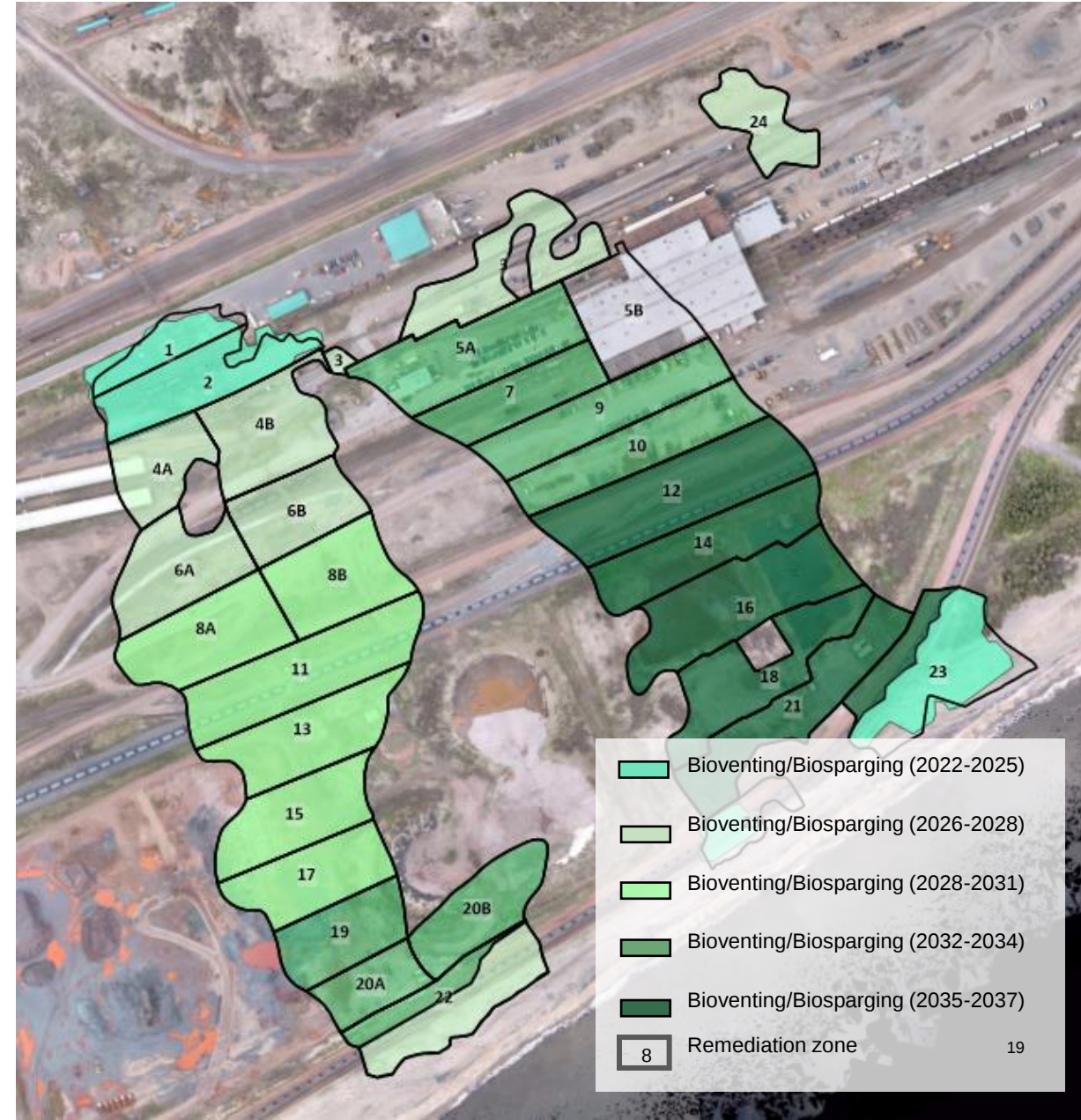
- Treatment progress is evaluated annually based on characterization data collected at different treatment phases
- Decreased mass removal after first phase of injection
- Addition of a biological polishing treatment phase



4.89			7	CF	97	×	⊕					
6.71		(GP) GRAVIER fin, un peu de sable fin à moyen, brun-gris, humide	8	CF	85		⊕×					AC
3.97			9A	CF	95		⊕		×			AC
7.63		(SP) SABLE fin, un peu de gravier fin et grossier, gris foncé, saturé	9B				⊕		×			AC
3.06			10	CF	98				⊕×			AC
8.54		(GP) GRAVIER fin, un peu de sable fin, gris, saturé	11A	CF	90				⊕×			AC
2.65		(SM) SABLE SILTEUX, traces de gravier fin, gris	11B						⊕×			AC
8.95			12	CF	100		⊕	×				AC
1.85												
9.75		FIN DU FORAGE										

wsp Integration of Bioremediation

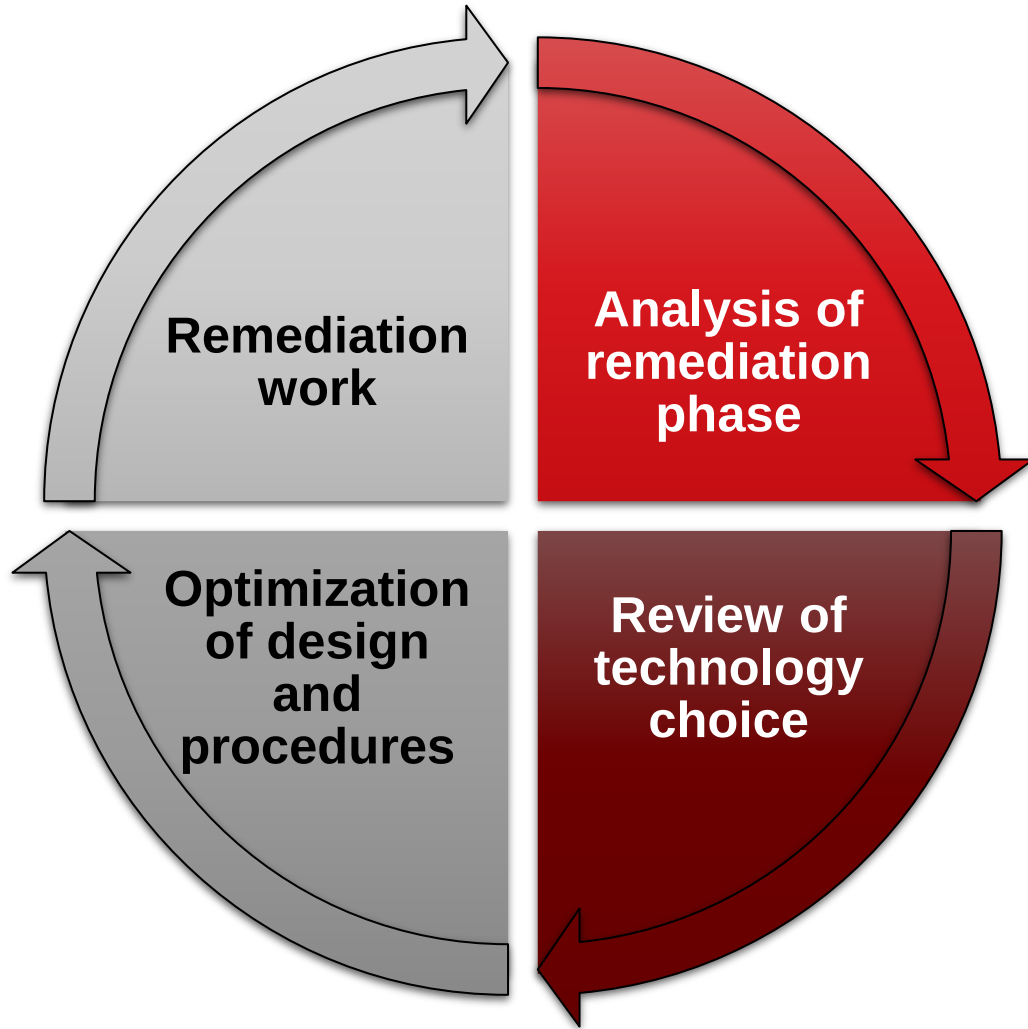
- Feasibility study underway since late 2022
 - 3 zones
 - 4 units
 - 120 double treatment well



	Bioventing/Biosparging (2022-2025)
	Bioventing/Biosparging (2026-2028)
	Bioventing/Biosparging (2028-2031)
	Bioventing/Biosparging (2032-2034)
	Bioventing/Biosparging (2035-2037)
	Remediation zone



Bioremediation Optimization



Winter operation to optimize treatment season

Nutrient injection strategy optimized

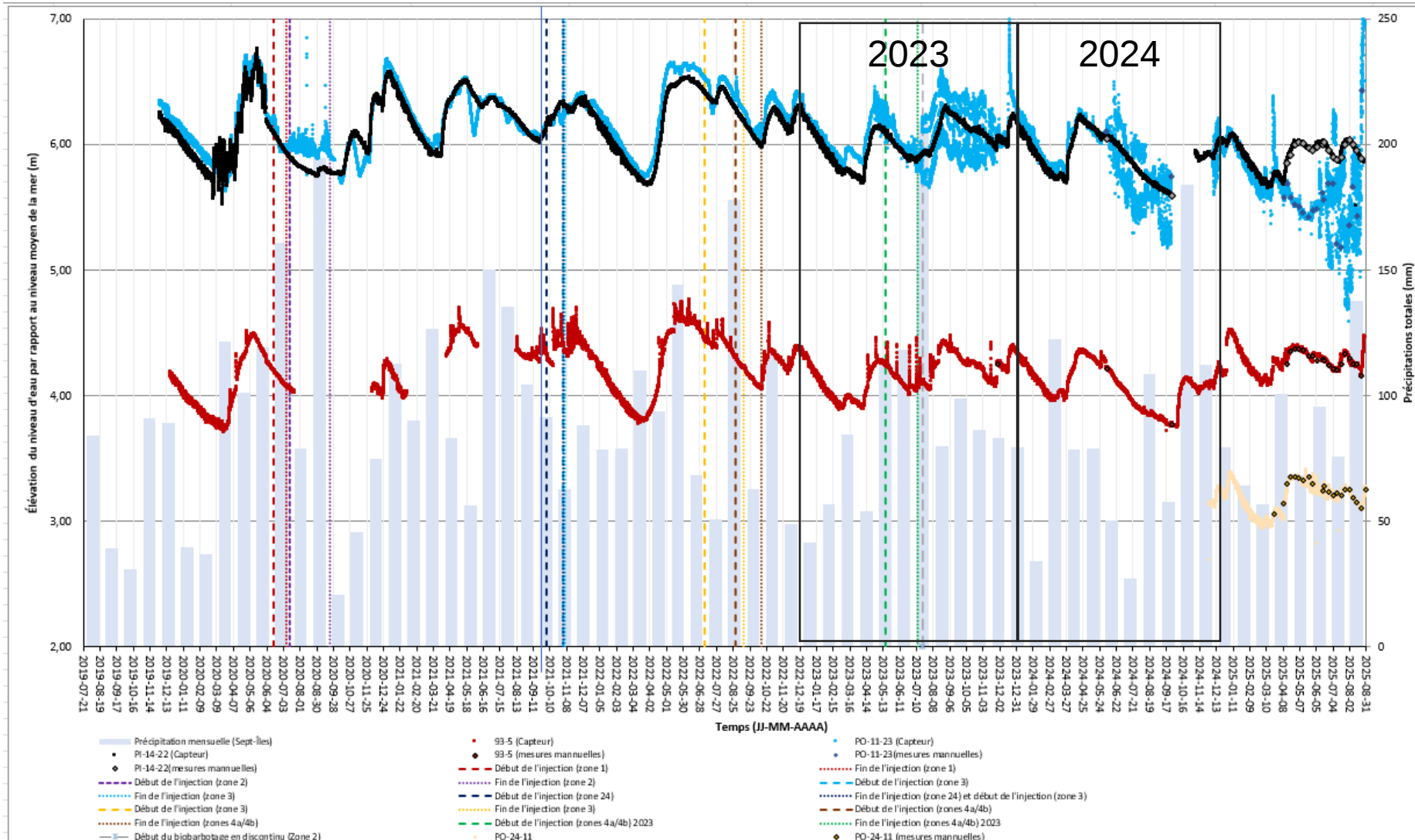
Continuous optimization throughout the year based on site conditions (cycling, flow rates)

Responds to climate change challenges of ISCO



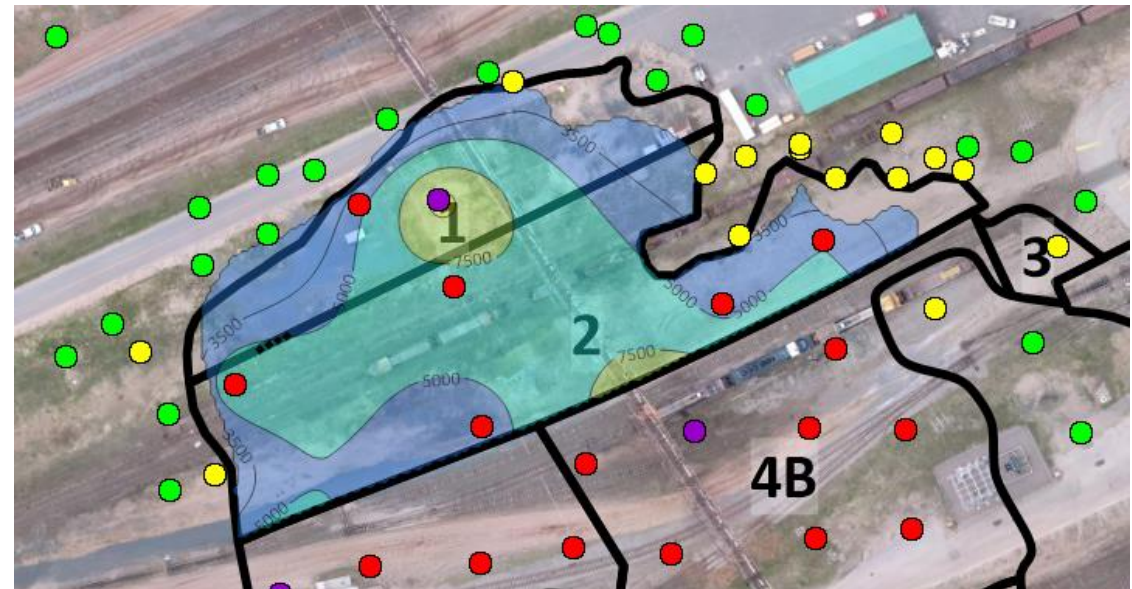
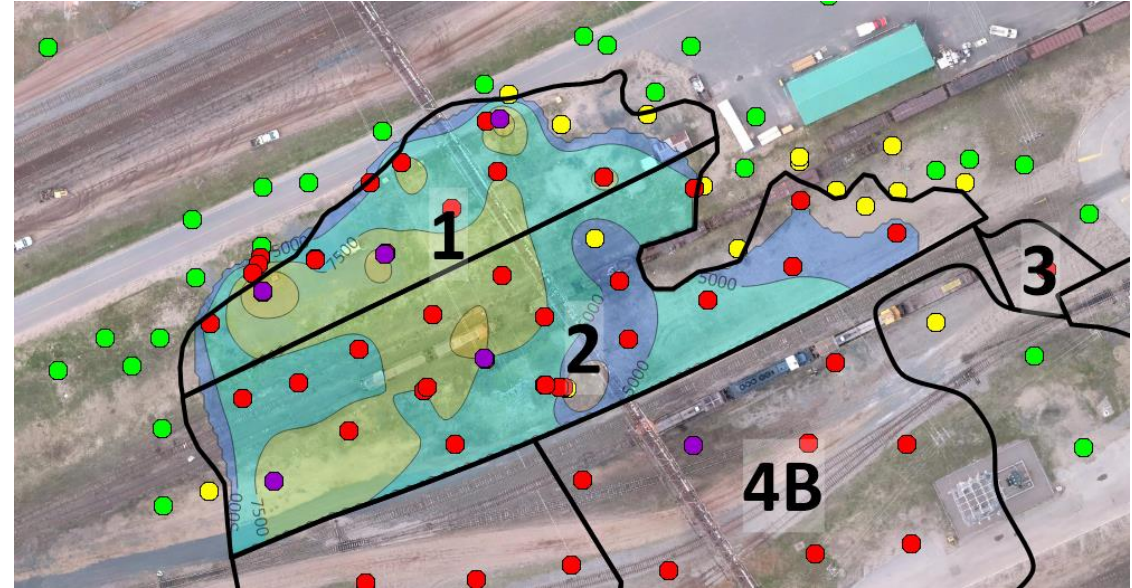
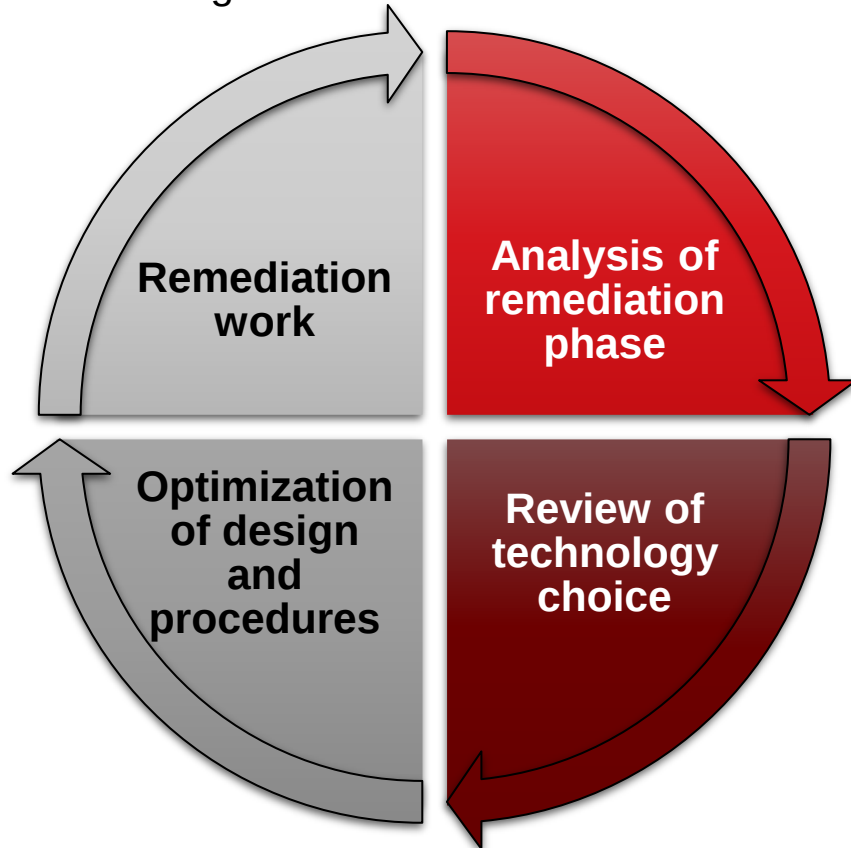
Climate Change Challenges

- Decreasing water levels making it increasingly difficult to target contamination in the water table fluctuation zone with ISCO
- Important to consider in a project over 20 years



wsp Conclusion

- Continuous improvement approach vital for long-term, large-scale projects
- Integrated, multidisciplinary, design-build team is one of the keys to success
- Future focus: Customized treatment strategy for each zone to meet targets



THANK YOU



Rite in the Rain

ALL-WEATHER

LEVEL

Nº 313

