Challenging ISCR PRB Approach on Industry Impacted by Chlorinated, Zinc and Cupper Bioremediation in Brazil

SGW Services
Consultoria e Engenharia Ambiental
+55 11 3217 6300 | www.sgw.com.br

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May 11th – A10

Assessment | Remediation | Audit | Licensing | Consultancy

Presentation Outline

- ✓ Conceptual Model
- ✓ Hydrogeological Model
- ✓ Fate and Flow Modeling
- ✓ PRB
- ✓ New Cupper Leakage
- ✓ Lessons Learned

Site Location

Conceptual Model

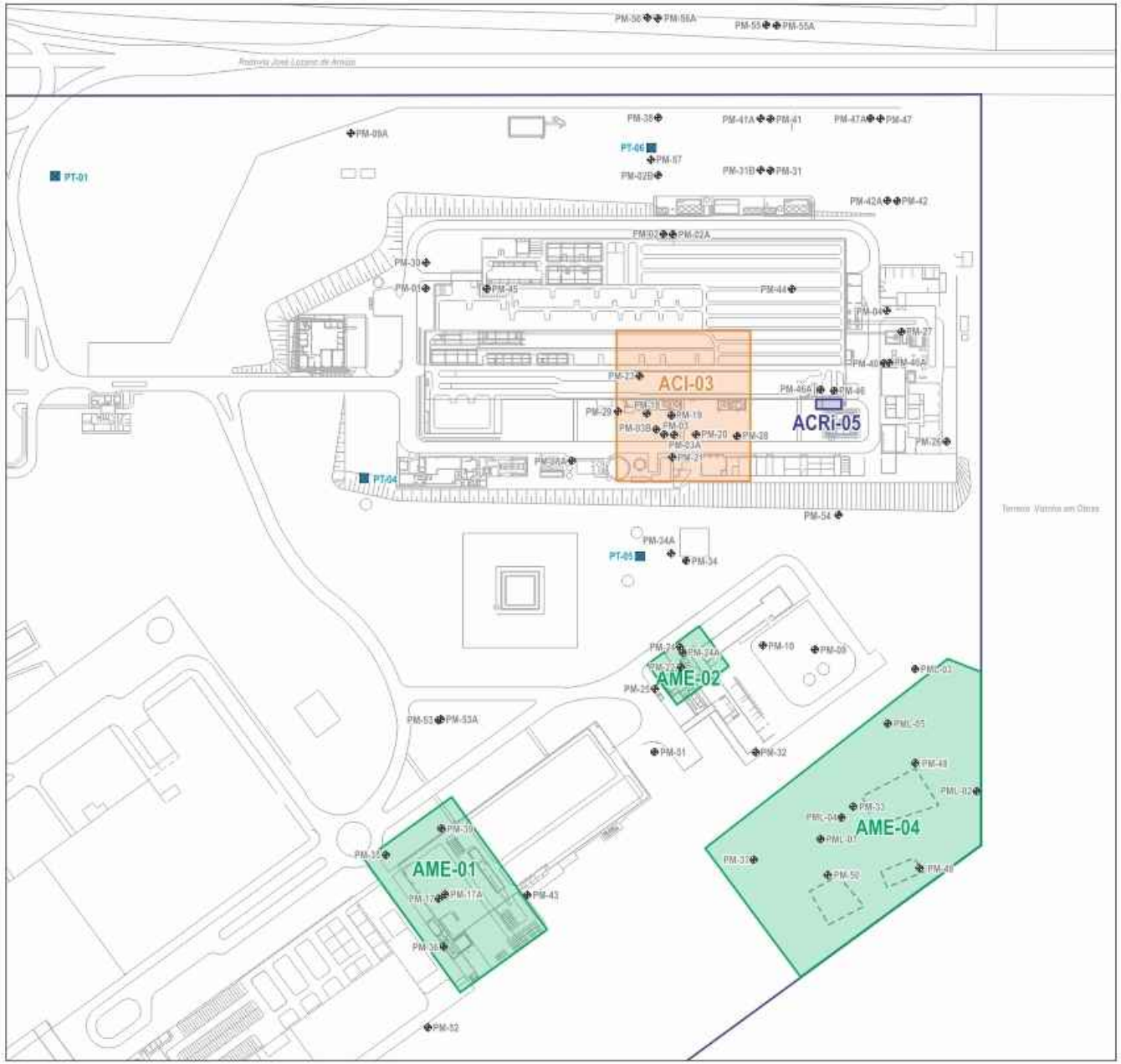
AME-01:
Chemical deplating área

AME-02:
Acid Process

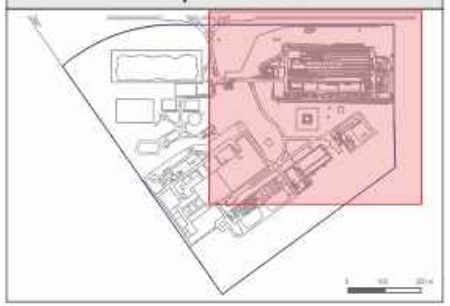
ACI-03:
Efluents Pipelines

AME-04:
Old Sludge Lagoons

ACRi-05:
Steel Wire area



Mapa Índice



Área de interesse

Área da Belgo Bekaert

Antigas lagoas de lodo

Poços de monitoramento existentes

Áreas contaminadas sob investigação

Áreas em monitoramento para encerramento

Área contaminada com risco confirmado

AME-01 Áea de decapagem química no prédio Monofio (Antiga APE-10)

AME-02 Central de ácidos (Antiga APE-12)

ACI-03 Tubulação de transporte de efluentes da latonagem para a ETE (Antiga APE-15)

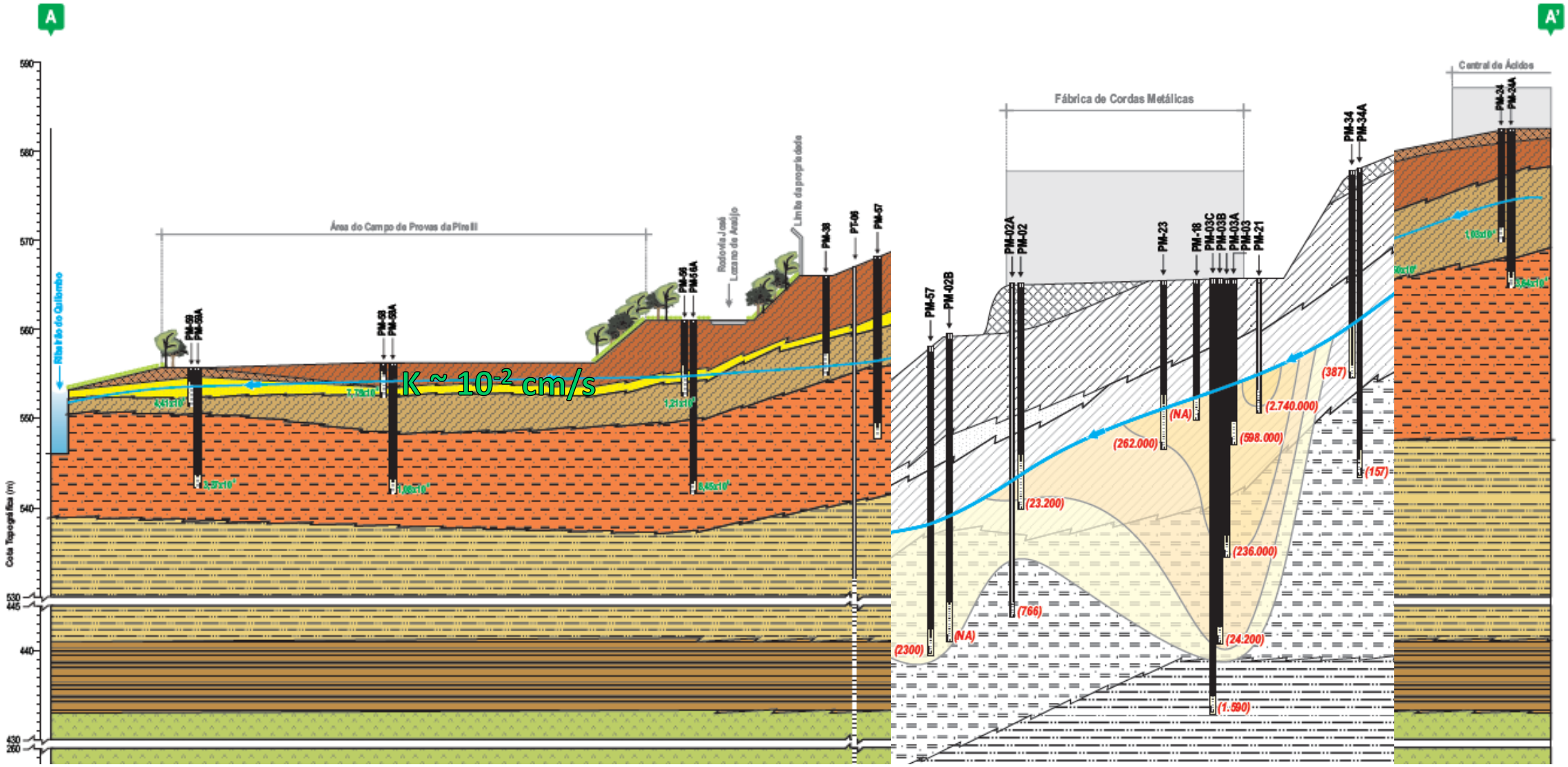
AME-04 Área das antigas lagoas de lodo

ACRi-05 Área da retifica de fieiras

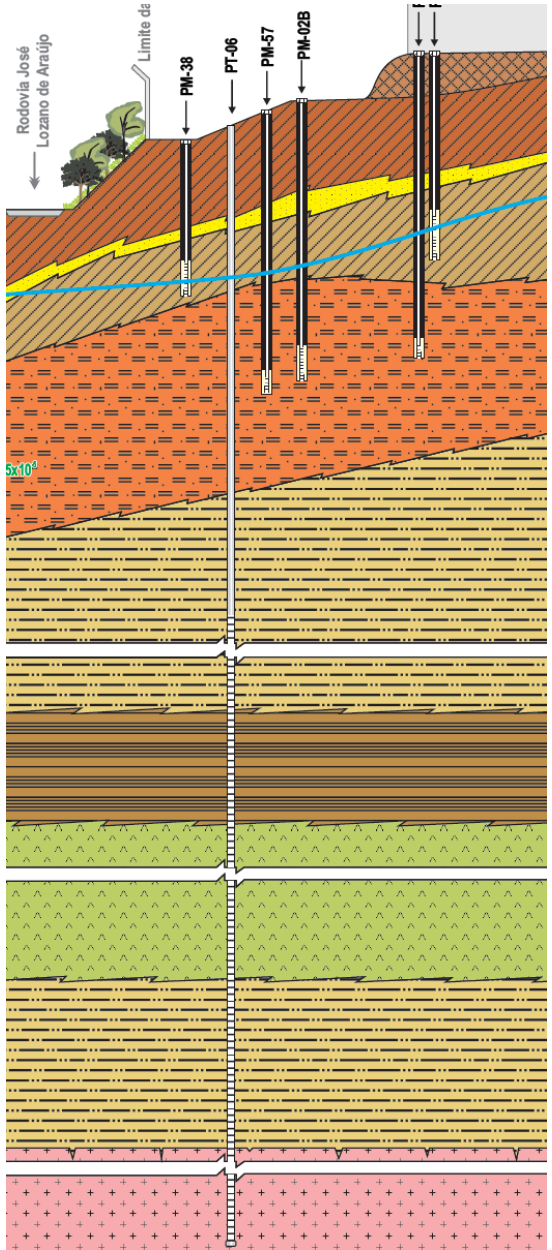
0 25 50 75 100m

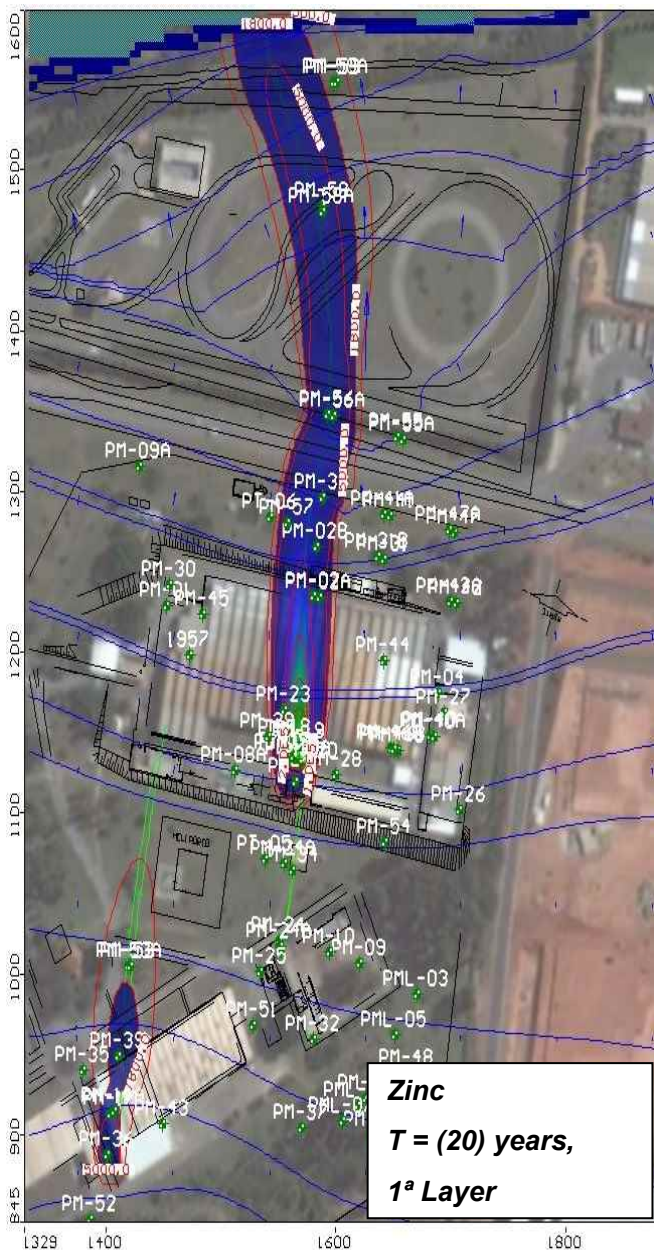
N

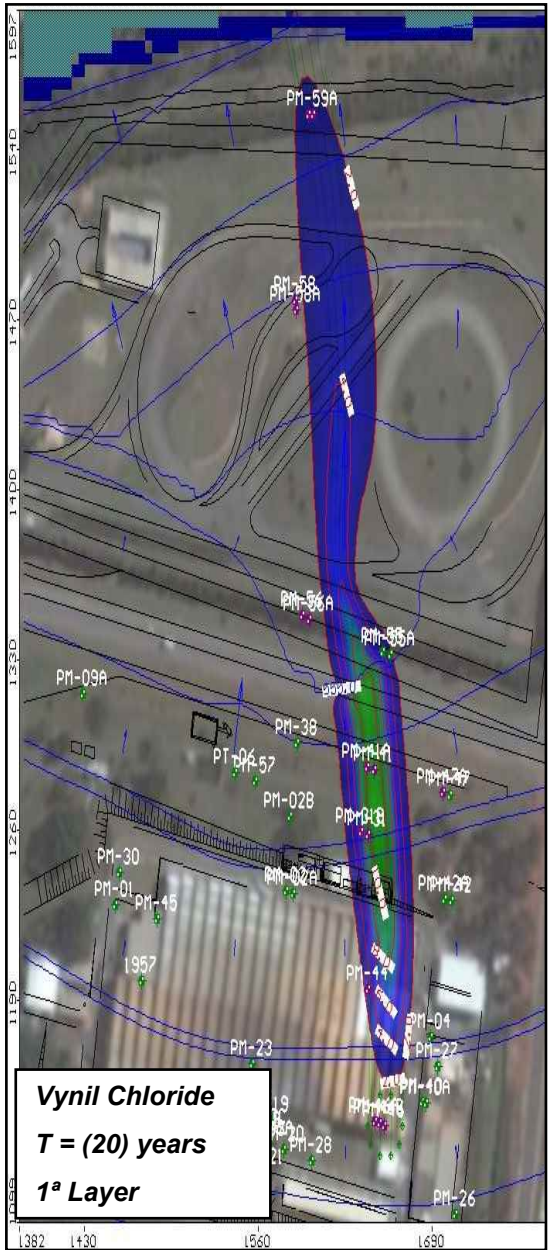
Hydrogeological Model



Risk Assessment

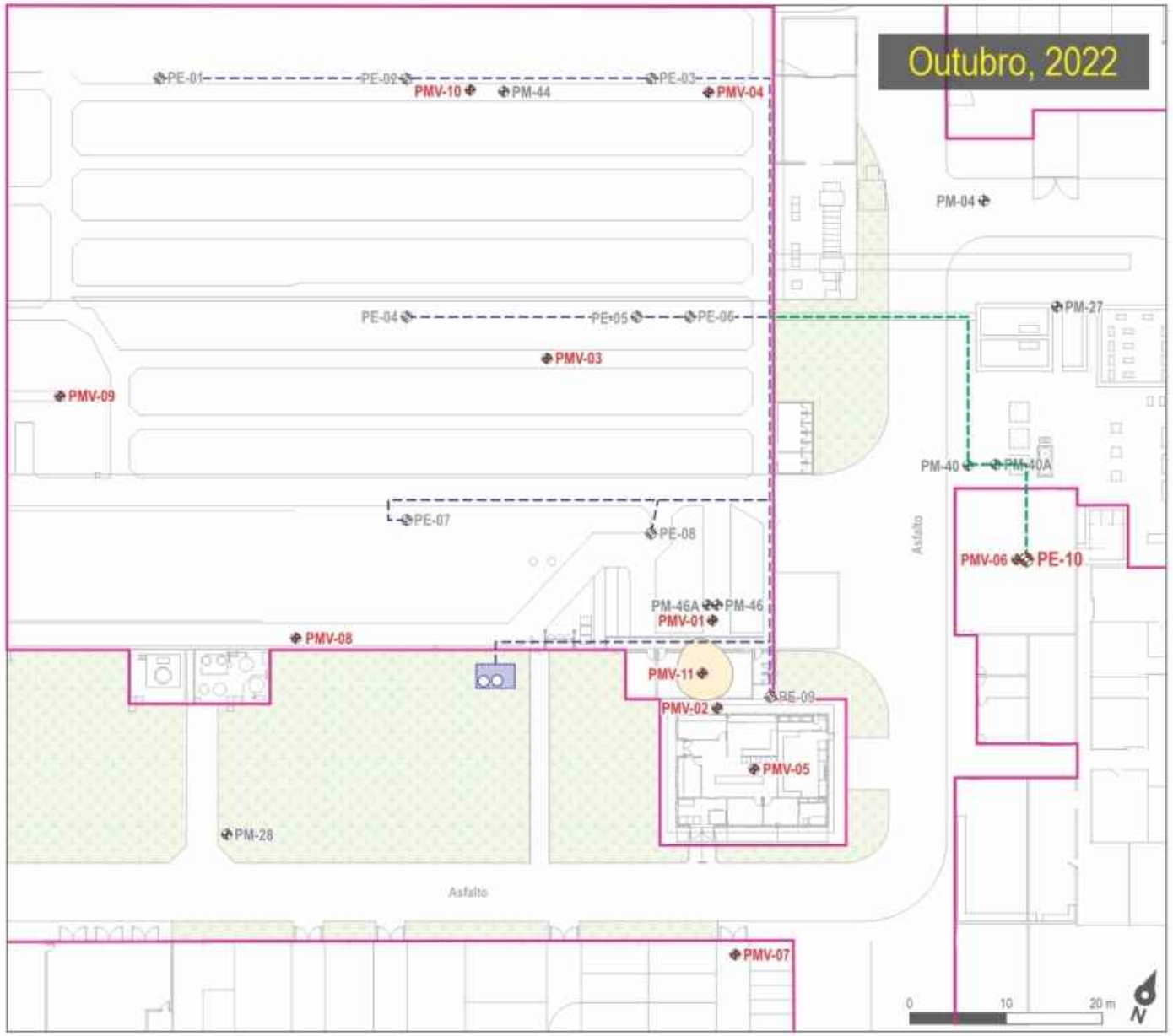


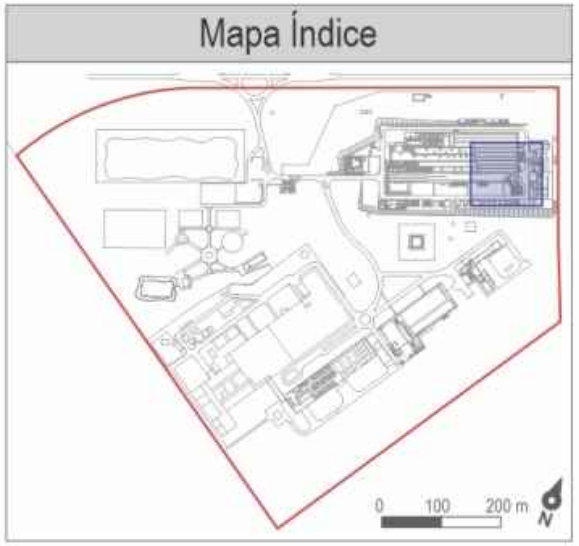




- ✓ On Site (workers)
  - ✓ GW concentrations below SSTLs
  - ✓ Subslab vapor above reference levels
- ✓ Off Site (residential):
  - ✓ Future residential ocupation
- ✓ Quilombo Stream:
  - ✓ Zinc and VC Plumes will reach the stream;
  - ✓ Concentrations above the reference levels.

SVE System – Emergencial Approach



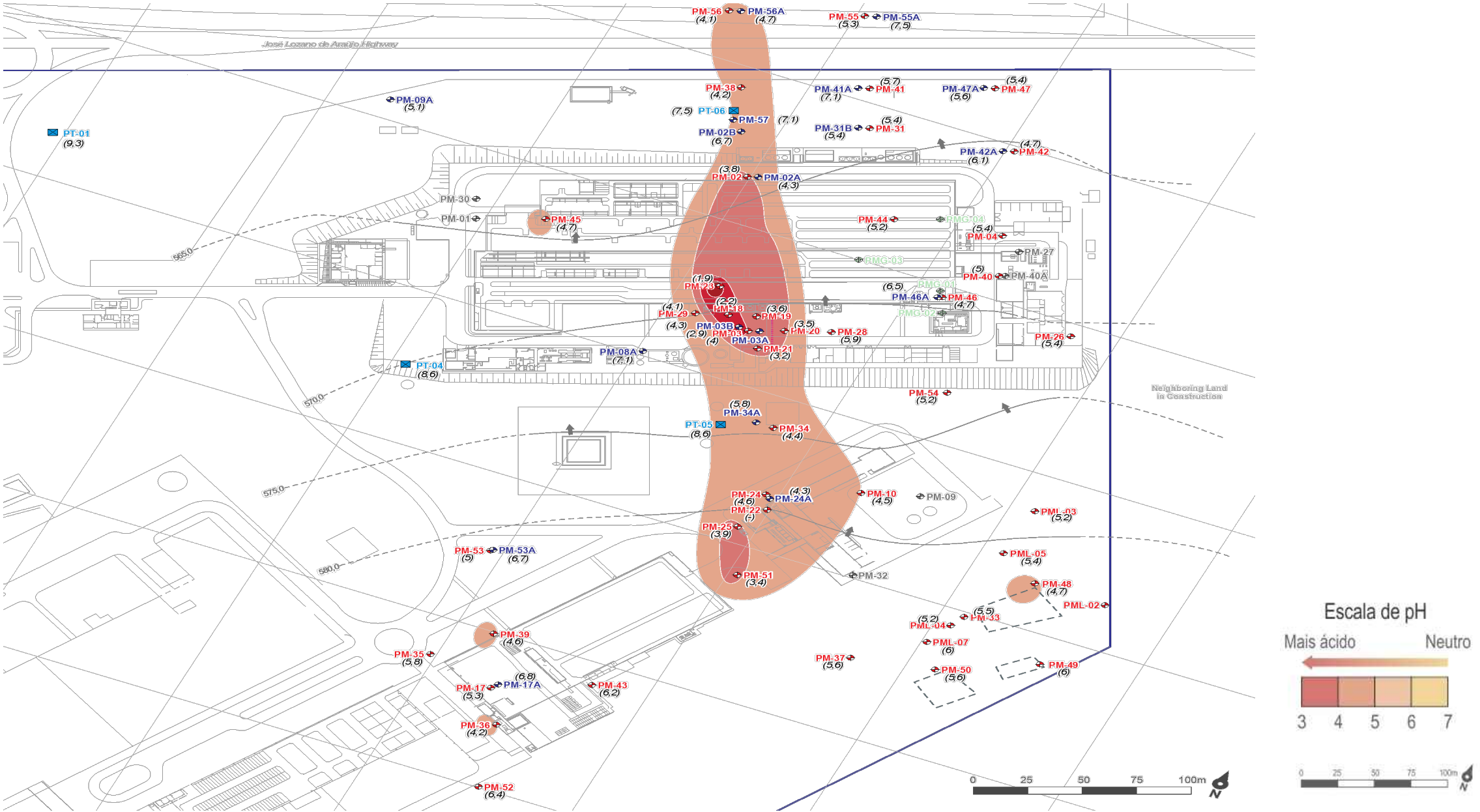


- Limite da propriedade – BMB
- Poços de monitoramento de água subterrânea
- Poços de monitoramento de vapores
- Poços de extração
- Ambientes fechados
- Gramado
- Sistema SVE
- Linhas de extração
- (280) Concentrações de Tetracloroeteno (µg/m³)

Tetracloroeteno (µg/m³)	
	< 6.000
	de 6.000 a 60.000
	de 60.000 a 600.000
	de 600.000 a 1.000.000
	> 1.000.000

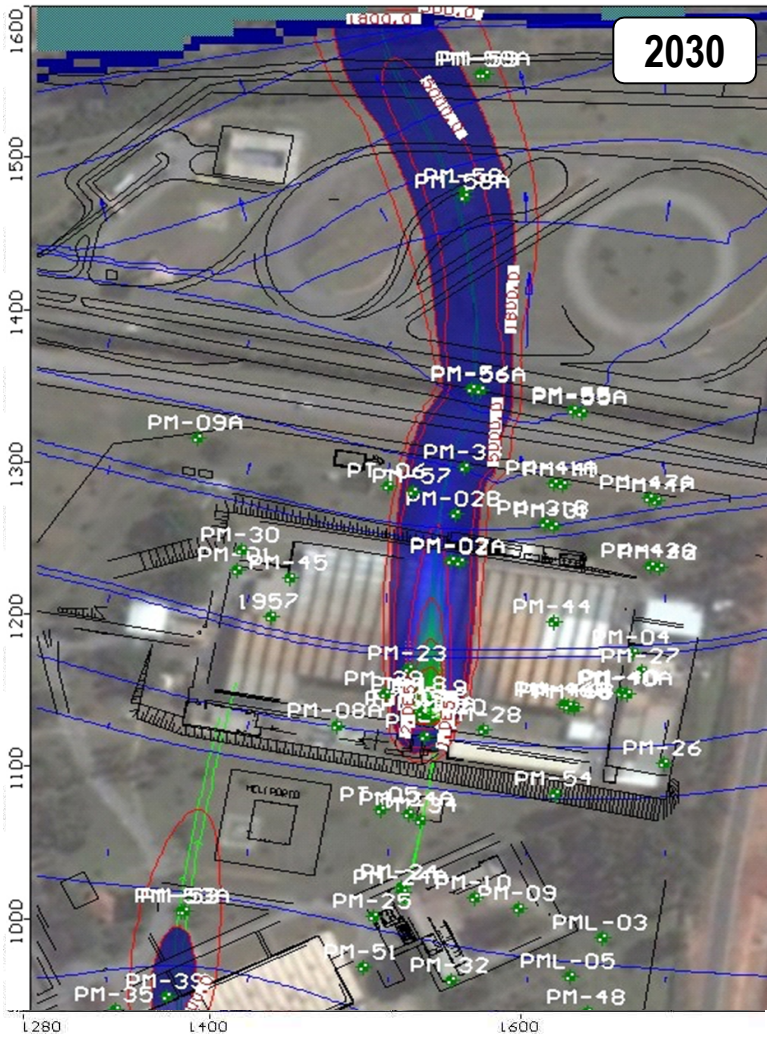
Valor de Referência: 6.000 µg/m³ (USEPA, 2020)

pH in Groundwater

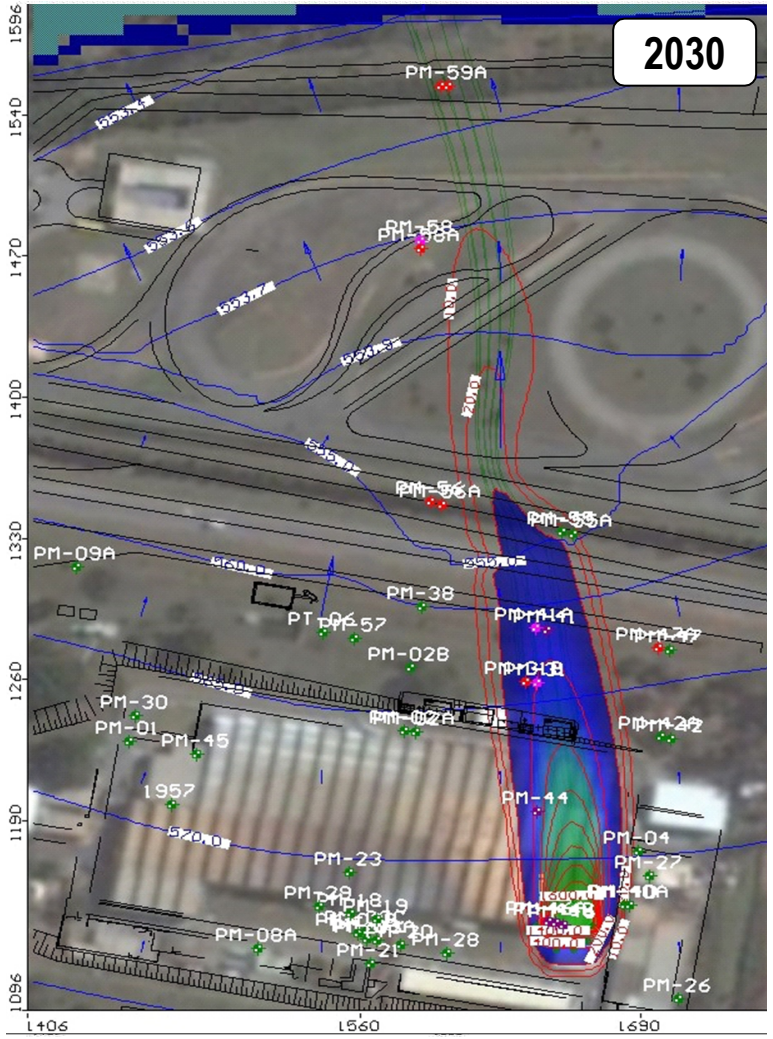


Fate and Flow Modeling – Without Any Action

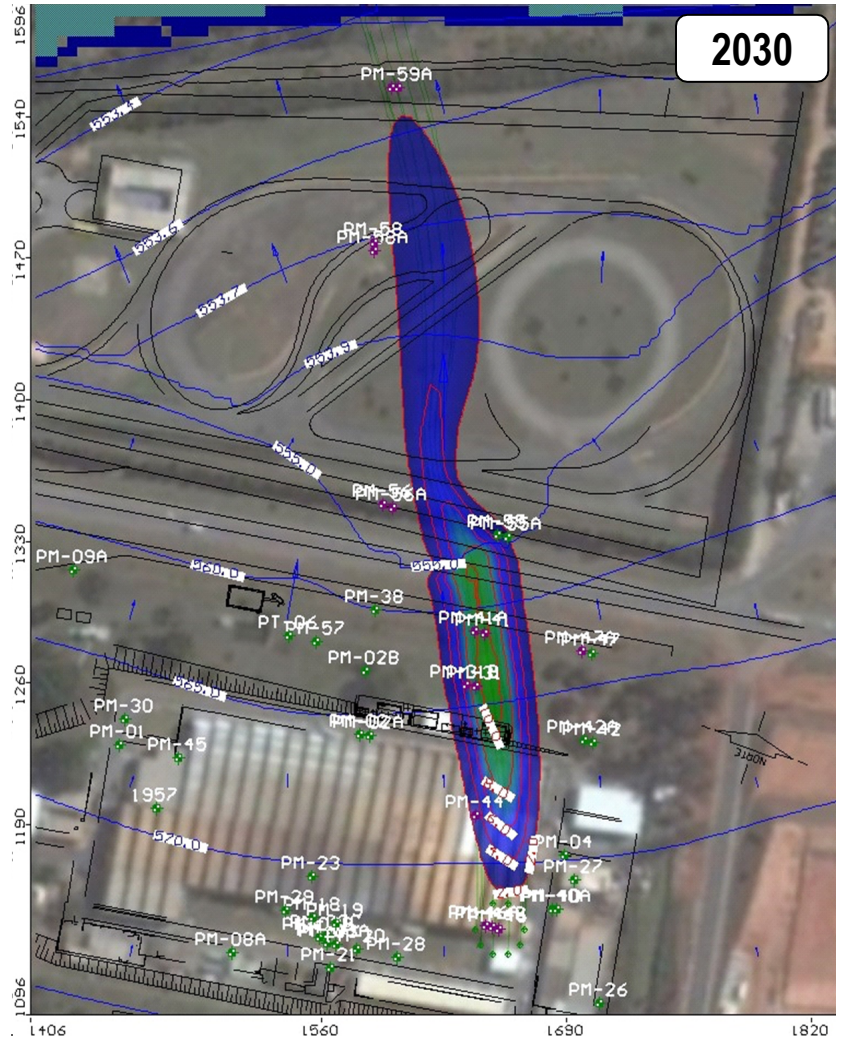
Zinco



PCE

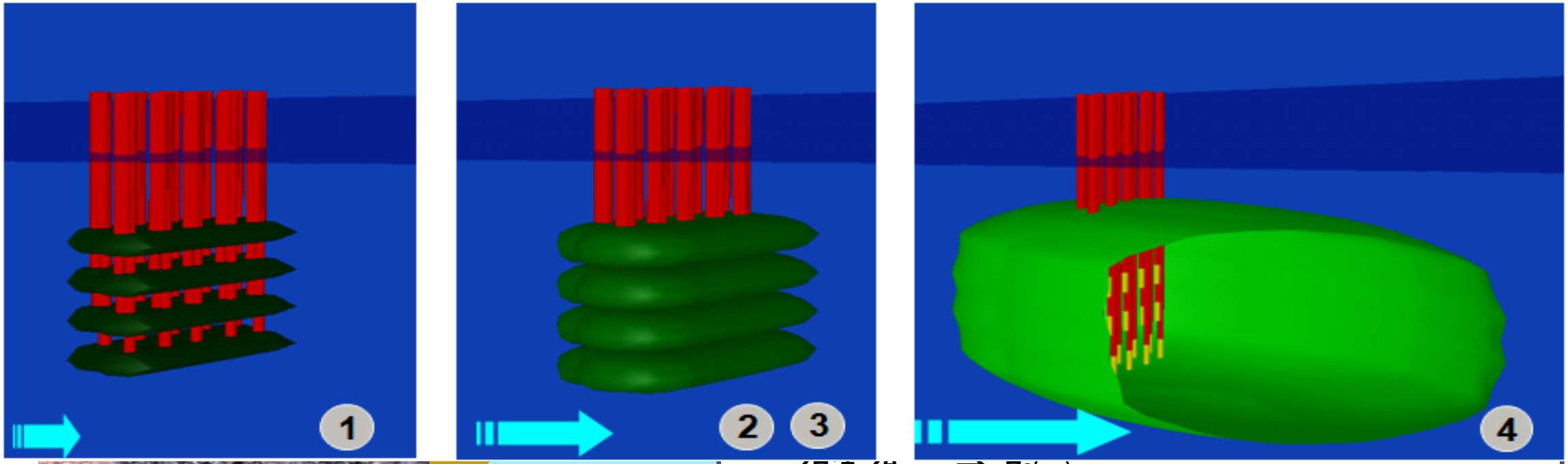


VC



ISCR

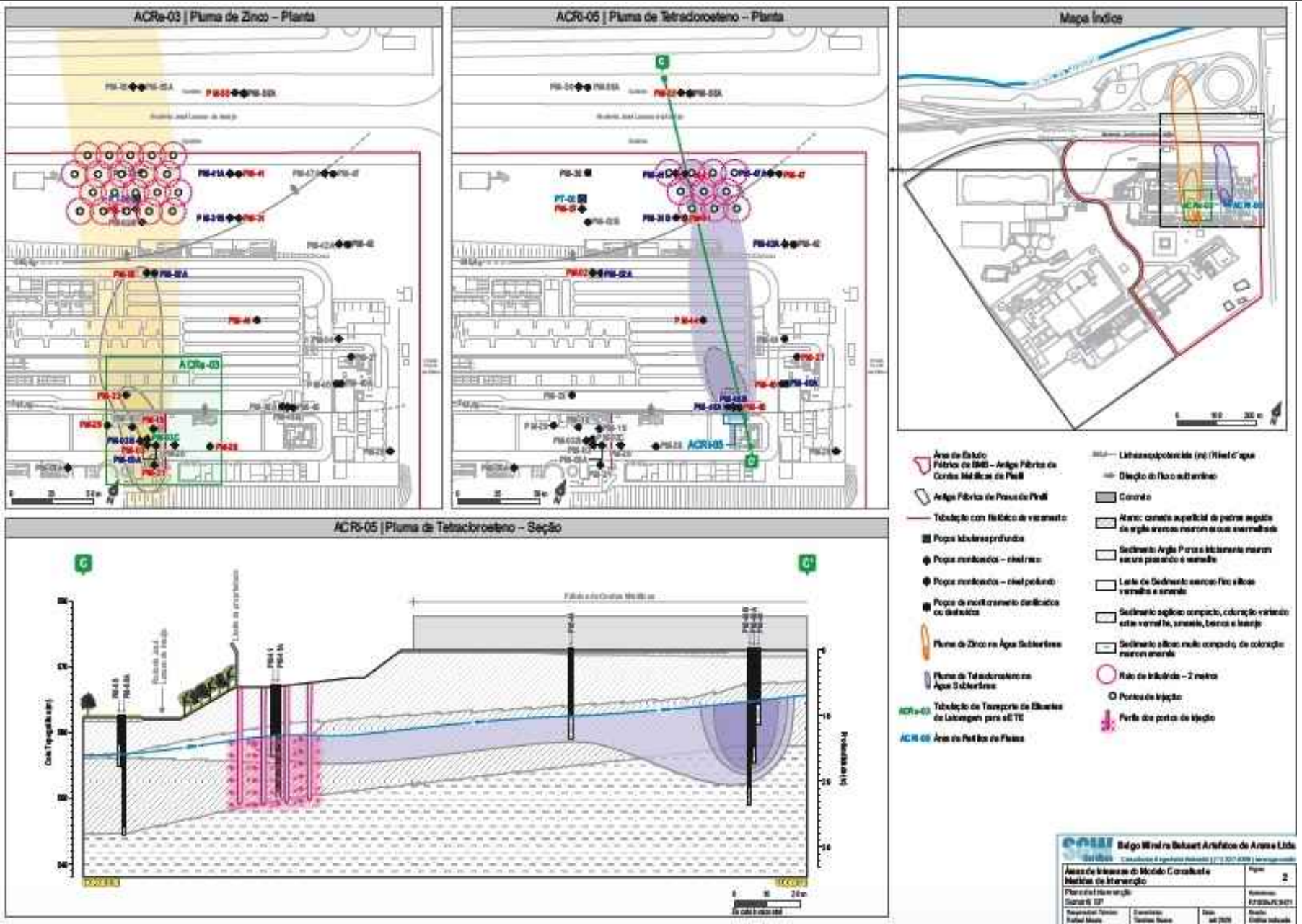
✓ **ISCR (Provect-IR and Provect-IRM):** both abiotic and biotic dechlorination



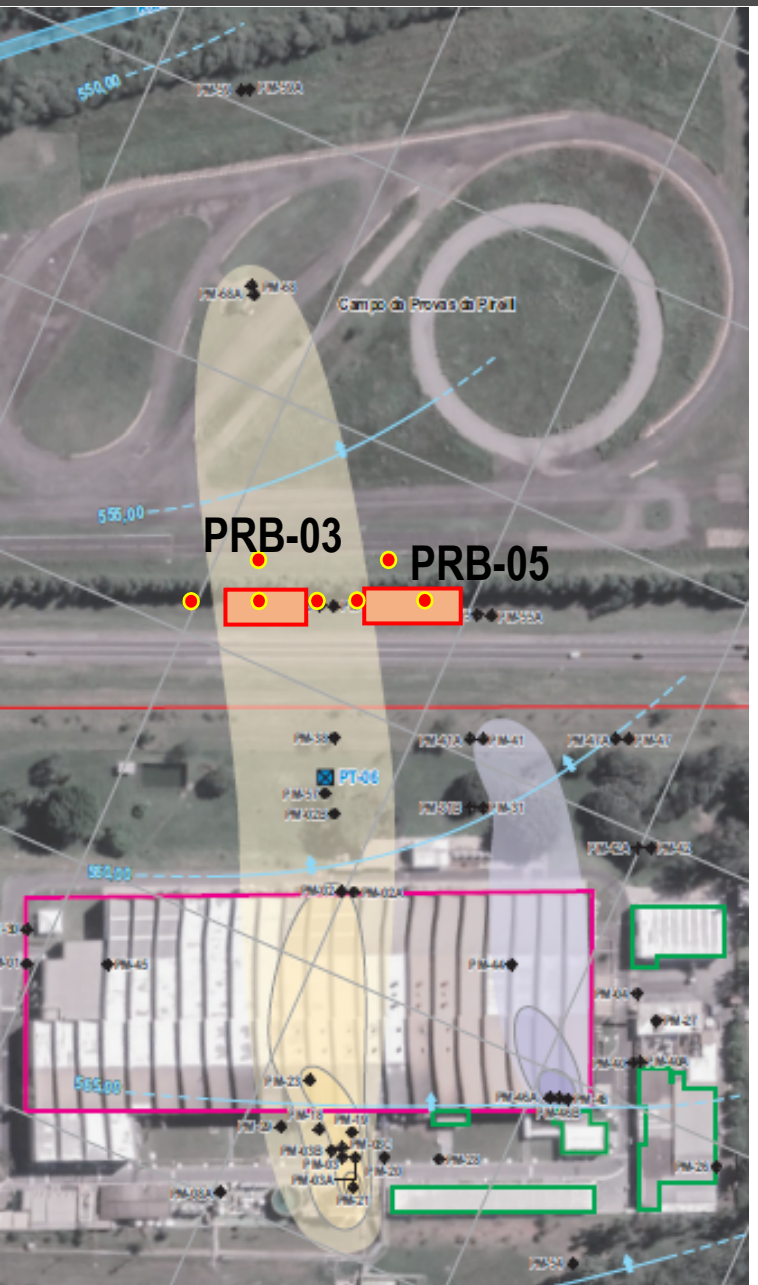
ZVI Effects	ISCR Effects	Biostimulation Effects
Beta Elimination Iron corrosion	Low ORP redox H+ diffusion	Fermatation produces VFAs and H+ Stimulation the dehalogenation

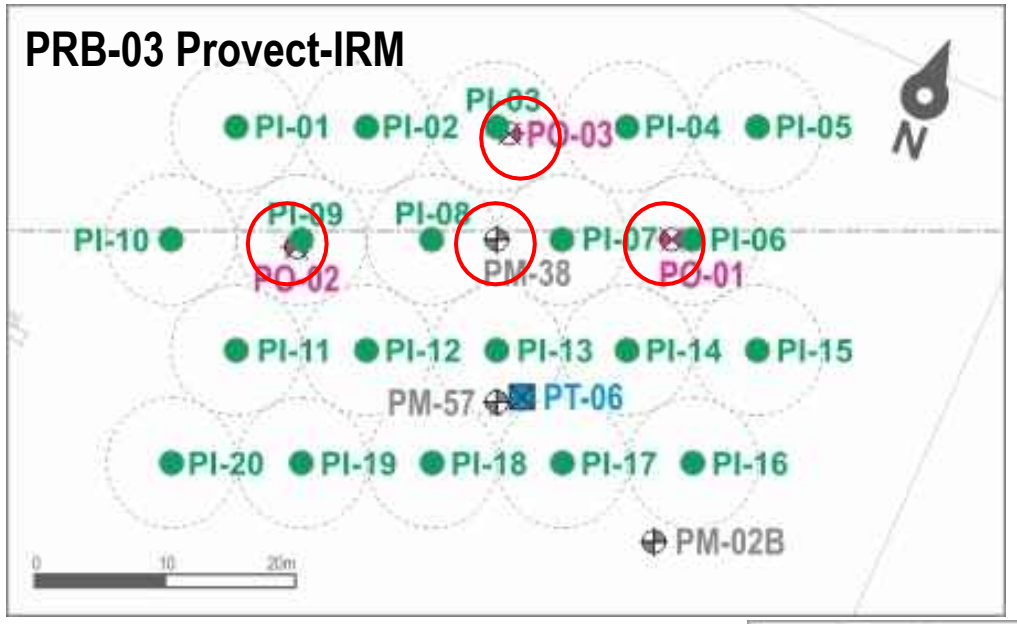
Source: Jim Mueller

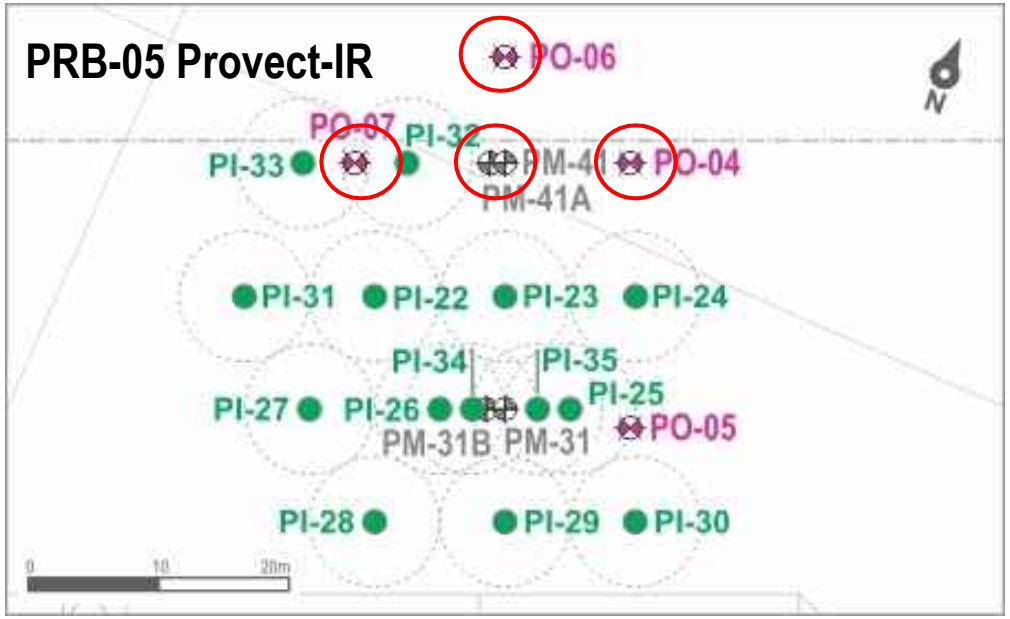
PRB Approach



ISCR PRB – PCE (Provect-IR) + Zinc (Provect-IRM)



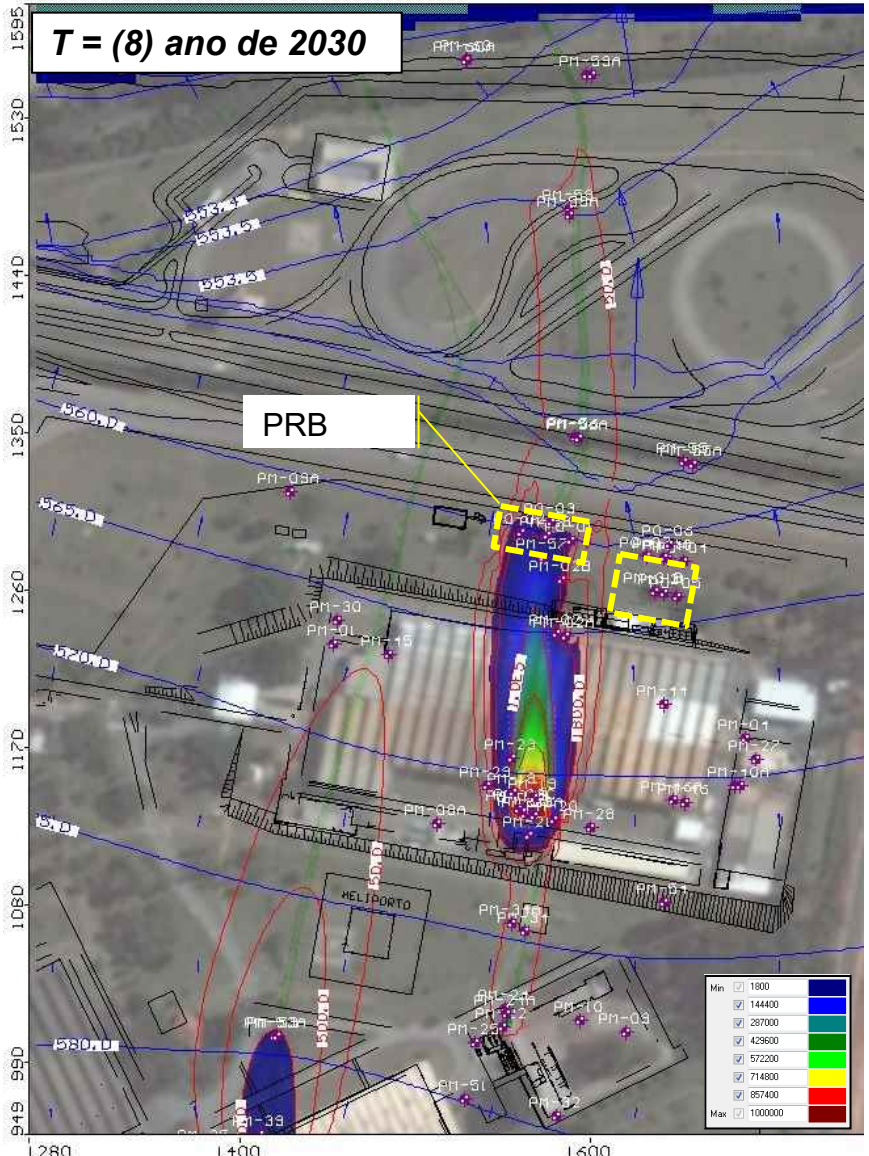




PRB
PO

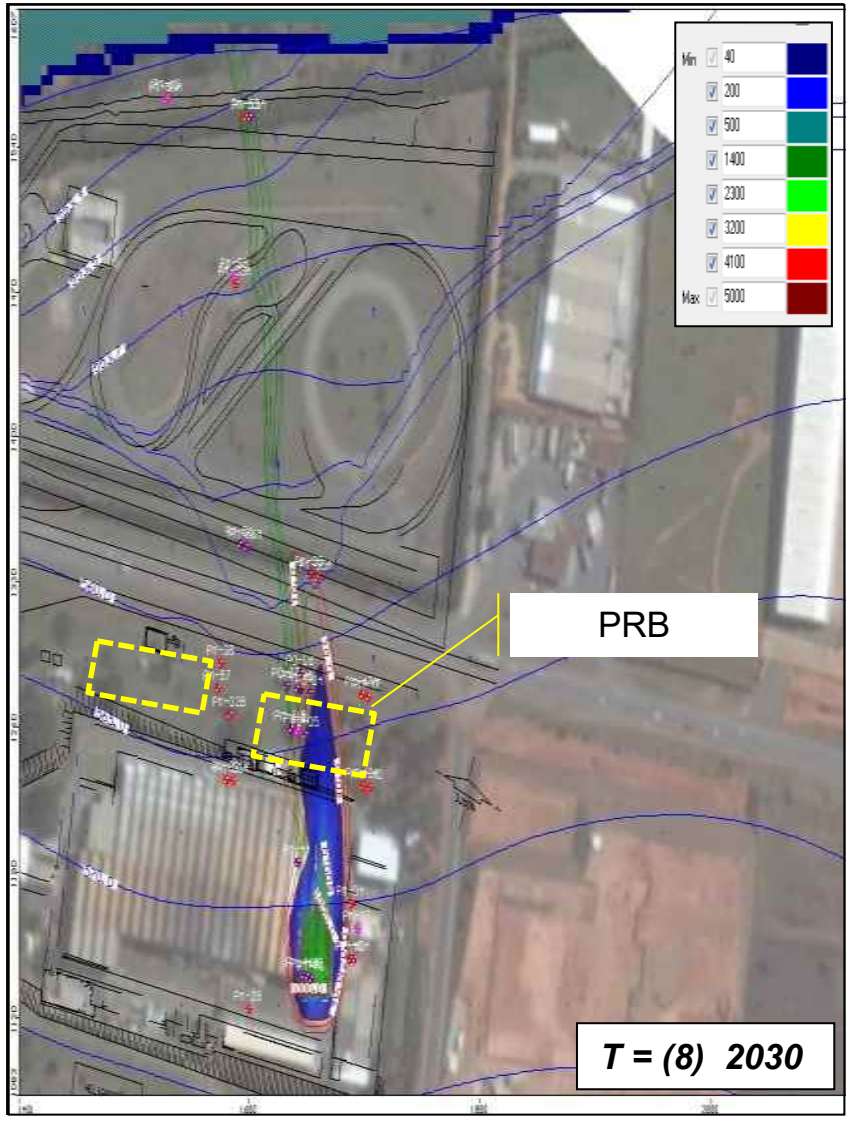
Fate and Flow Modeling With PRB - ZINC

Zinco

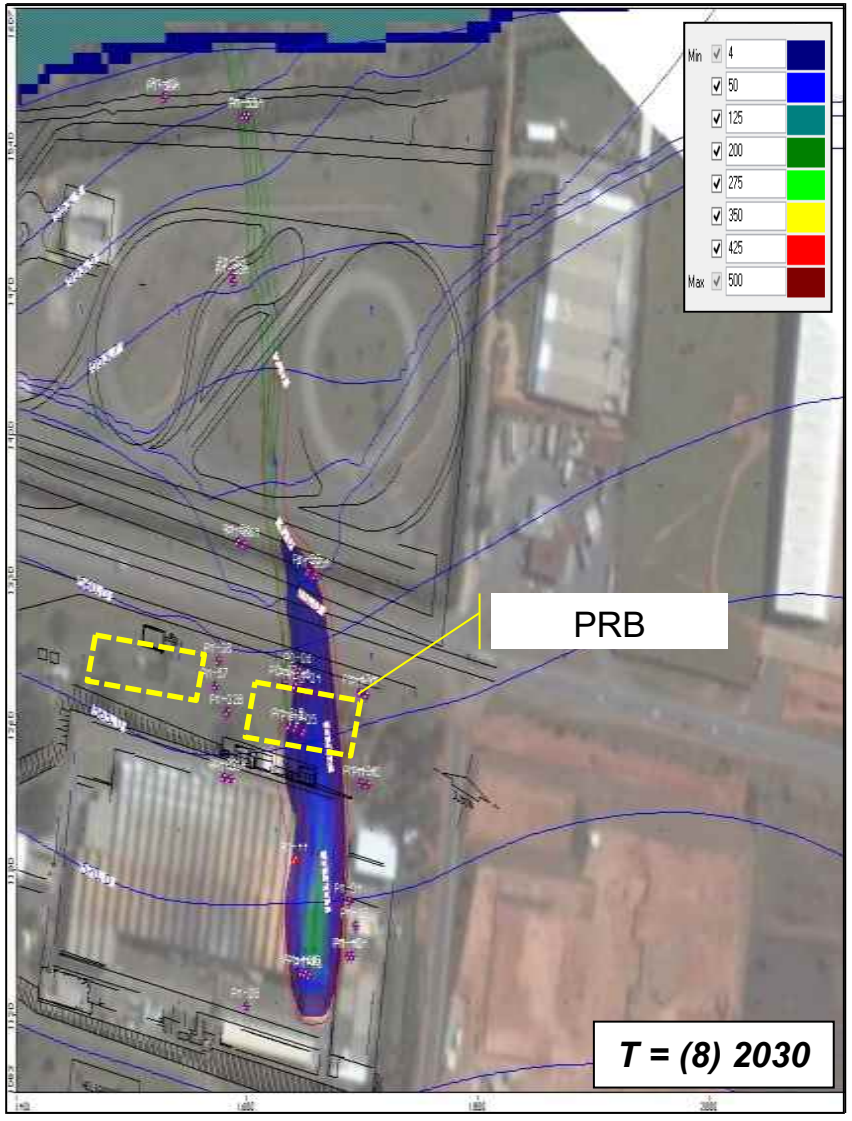


Fate and Flow Modeling With PRB - CHLORINATED

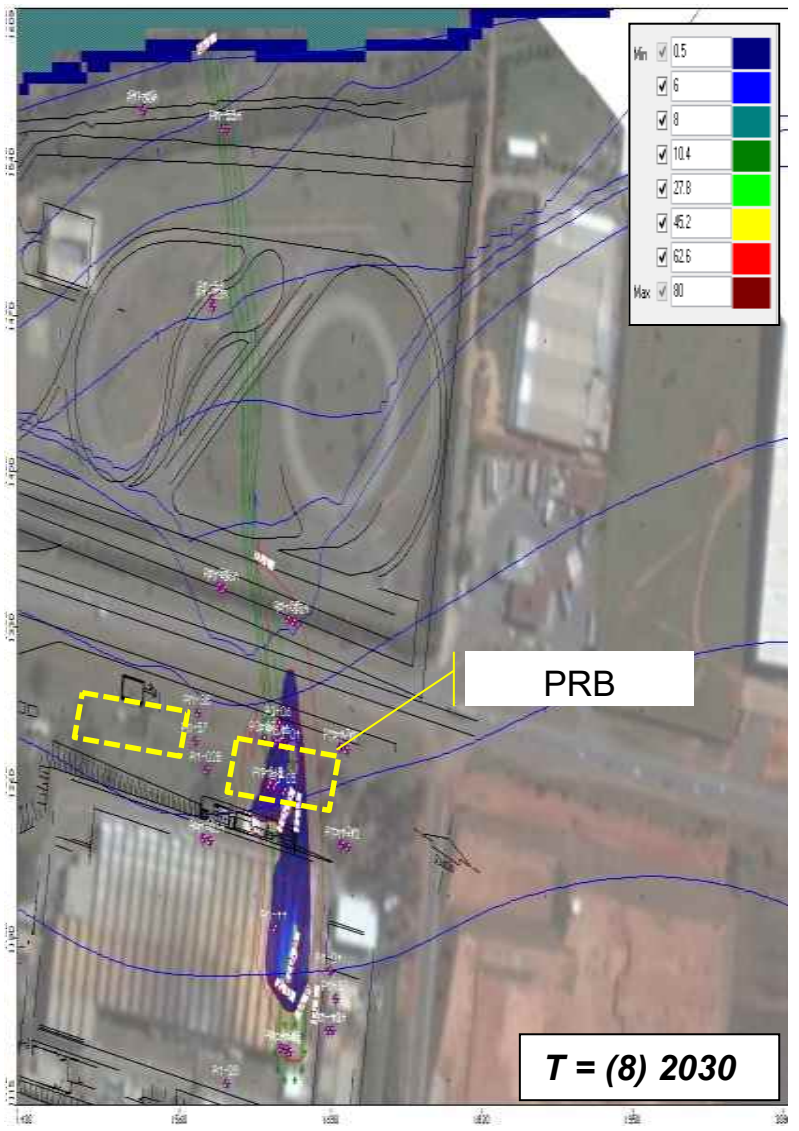
PCE



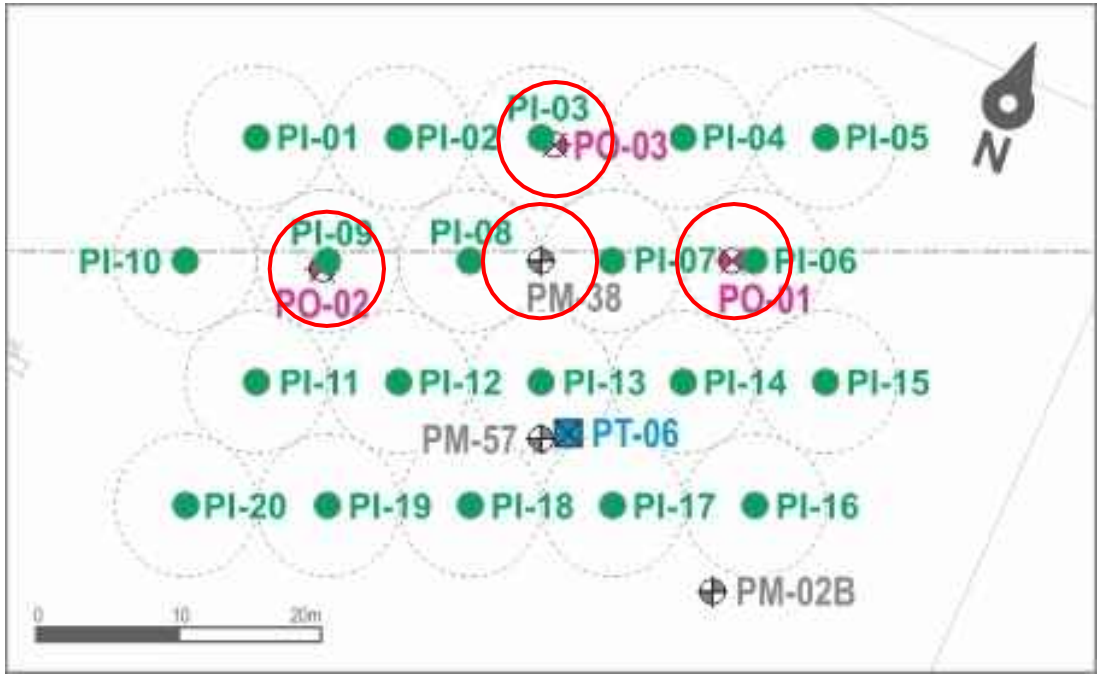
TCE



VC

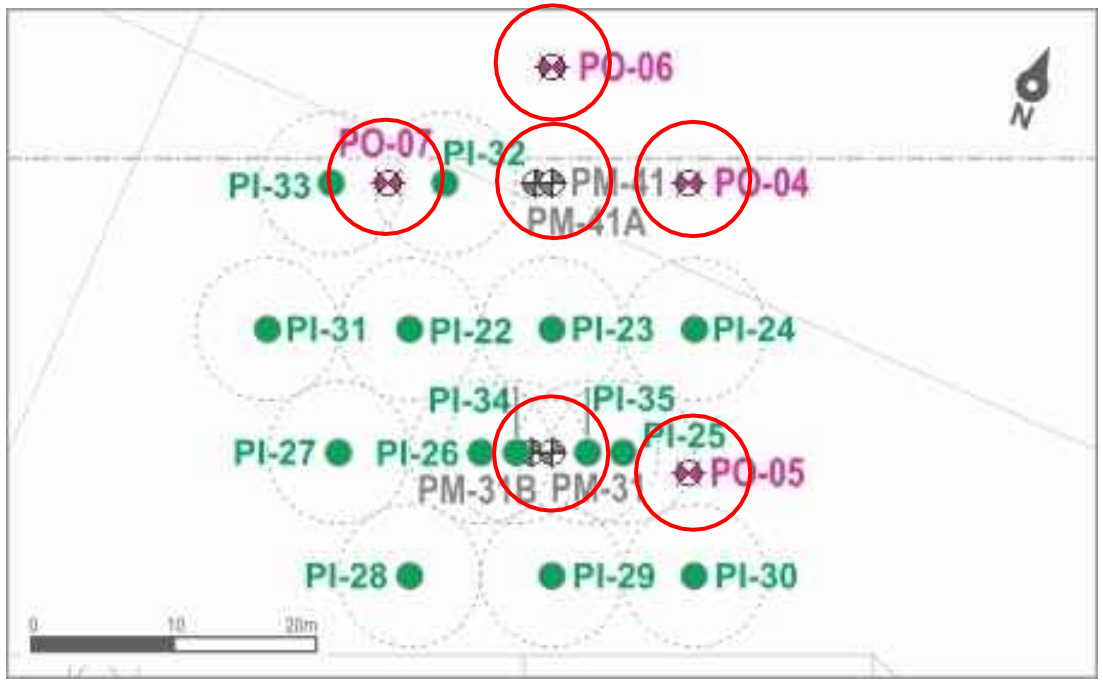


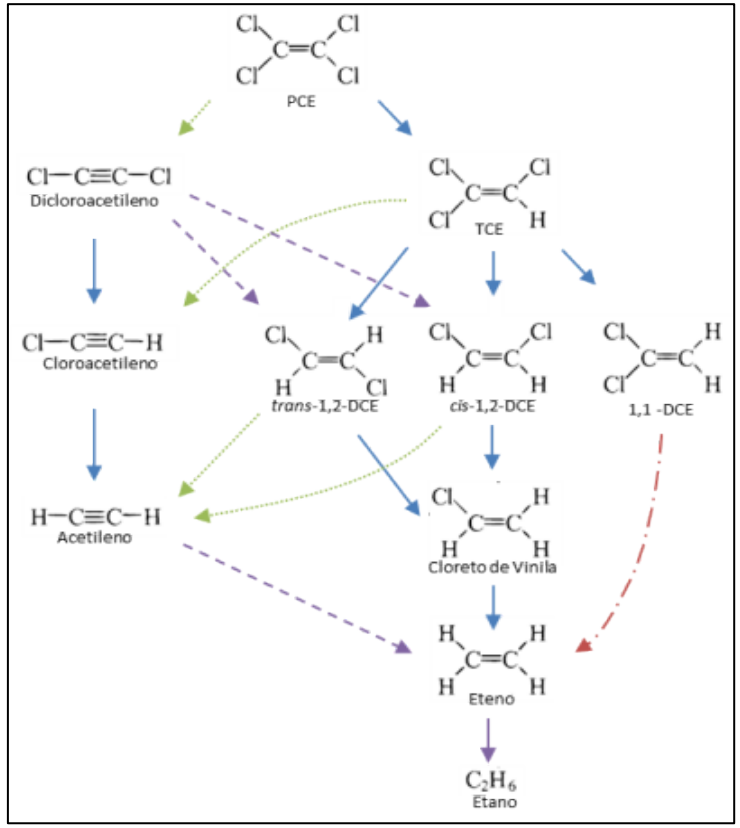
Performance Results – PRB03 Zinc Plume



Inorgânicos Totais (µg/L)	PM-38			PO-01		PO-02		PO-03		Valores de Referência
	abr-21	mai-21	set-21	abr-21	set-21	abr-21	set-21	abr-21	set-21	
Nível d'Água (m)	*8,64*	*8,21*	*8,43*	*8,51*	*8,01*	*8,50*	*7,86*	*7,35*	*7,61*	
pH	*5,8*	*6,6*	*8,3*	*4,3*	*6,5*	*3,3*	*7,4*	*5,5*	*6,8*	
ORP (mV)	*148,0*	*-282,4*	*-264,5*	*375,0*	*-189,4*	*392,0*	*-362,2*	*184,0*	*-115,0*	
Bário	135	135	270,7	< 10,0	68,6	< 10,0	72,96	153	62,22	700 (1)
Boro	< 200	265	242	< 200	425,9	< 200	502,9	< 200	343,7	2400 (1)
Cobalto	19,7	15,7	<5	29,6	60,7	7,82	<5	20	<5	70 (1)
Cobre	< 30,0	< 30,0	<30	285	<30	1090	<30	31,3	<30	2000 (1)
Níquel	< 10,0	< 10,0	<10	12,7	21,28	< 10,0	<10	< 10,0	<10	70 (1)
Zinco	2170	< 50,0	<50	6990	<50	8080	<50	2830	<50	1800 (1)

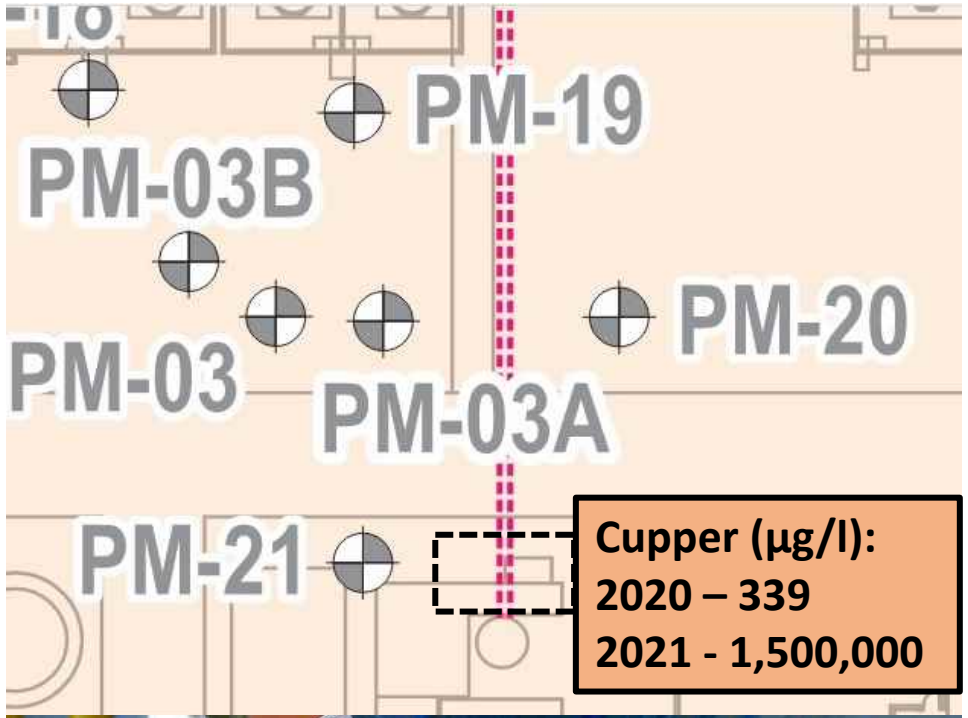
Performance Results – PRB03 Chlorinated Plume



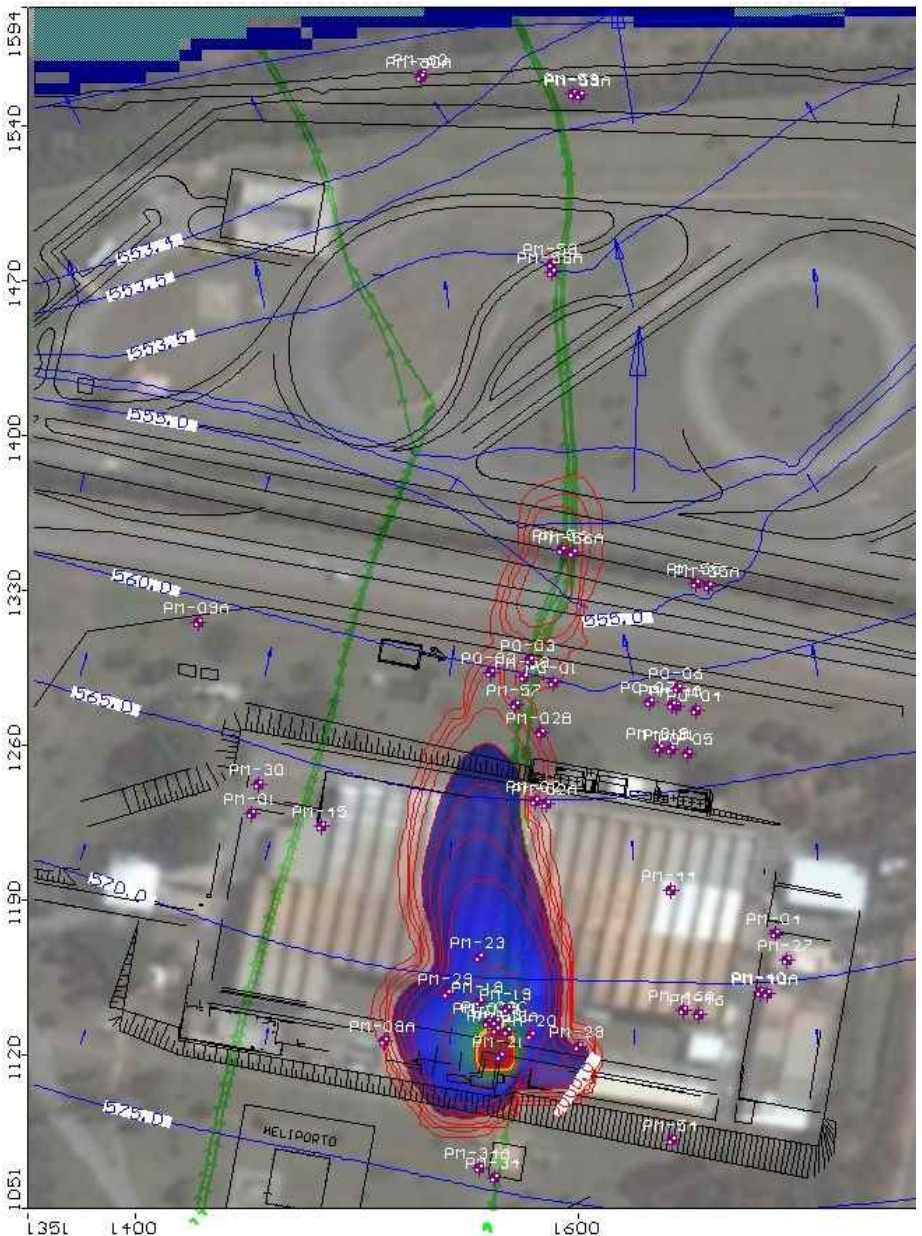


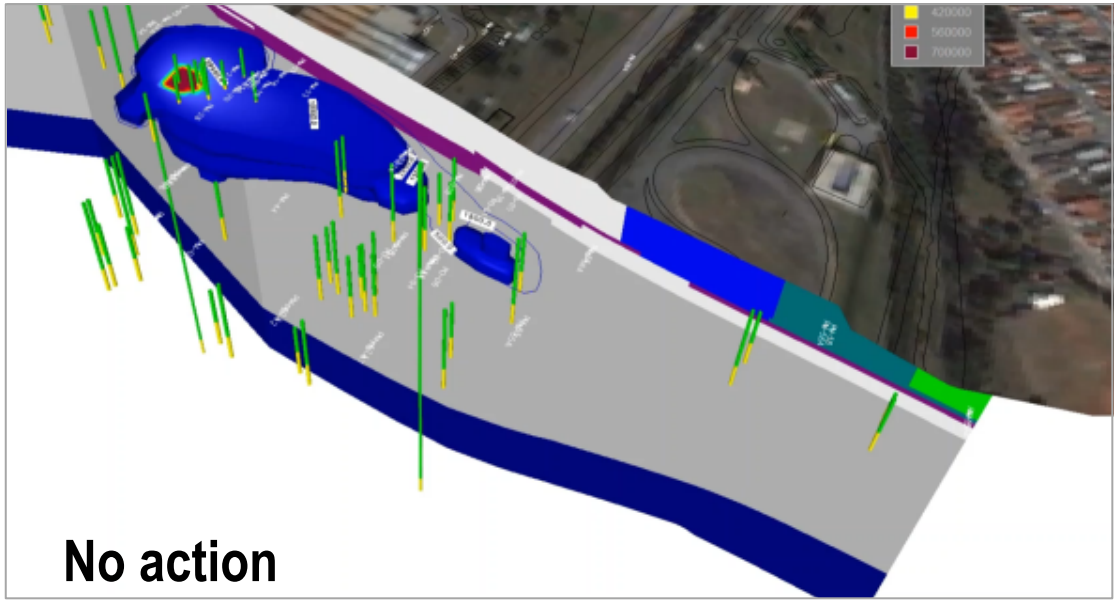
VOC (µg/L)	PM-31		PM-41		PO-04		PO-05		PO-06		PO-07		Valores de Referência	Campo de Provas da Pirelli (ambiente fechado, ocupação residencial)
	abr-21	set-21	abr-21	set-21	jun-21	set-21	jun-21	set-21	jun-21	set-21	jun-21	set-21		
Nível d'Água (m)	*9,40*	*10,10*	*8,09*	*9,24*	*9,03*	*9,30*	*9,88*	*10,03*	*7,48*	*7,93*	*9,17*	*9,72*		
pH	*5,6*	*6,5*	*4,9*	*6,0*	*6,2*	*7,0*	*5,9*	*6,0*	*5,9*	*5,9*	*5,8*	*6,2*		
ORP (mV)	*104,0*	*-195,4*	*237,0*	*-60,8*	*170,8*	*-42,5*	*109,7*	*-23,5*	*192,1*	*-127,6*	*373,0*	*-164,8*		
Tetracloroeteno	225	< 2	27	75,8	5	< 2	44	41,3	14	< 2	123	< 2	40 (1)	669
Tricloroeteno	69	< 2	< 5	< 2	< 5	< 2	< 5	< 2	< 5	< 2	17	< 2	20 (1)	41
cis-1,2-dicloroeteno	114	306,4	< 5	< 5	< 5	< 5	5	< 5	< 5	< 5	61	305,6	50 (1)	ND
Cloreto de Vinila	4	12,9	< 2	< 0,3	< 2	< 0,3	< 2	< 0,3	< 2	< 0,3	< 2	9,29	2 (1)	93

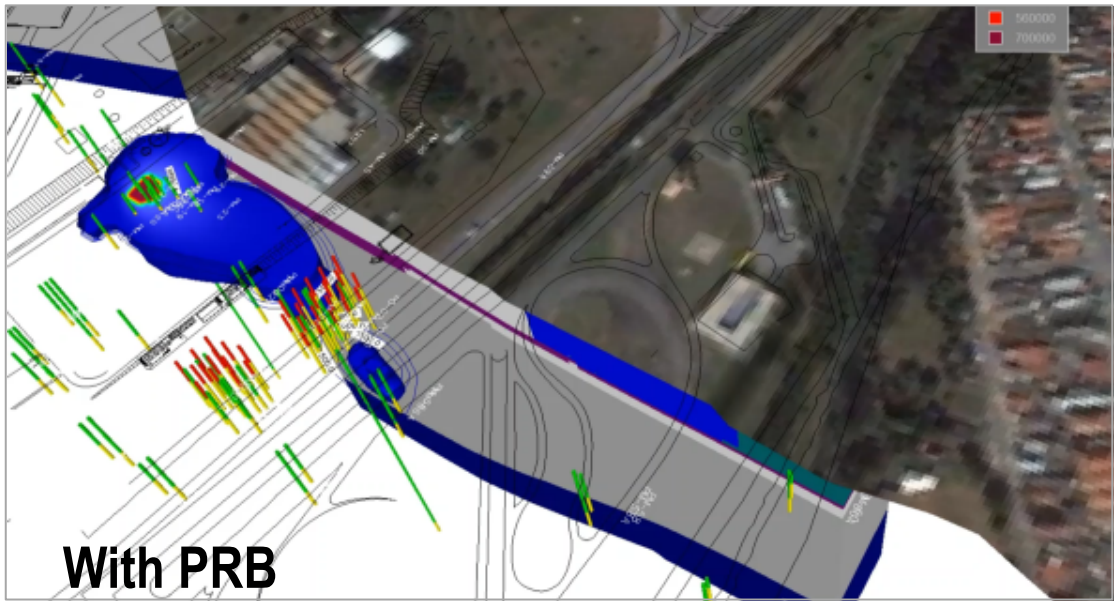
New Leakage (2021) – WWTP Area – Cupper



Fate and Flow Modelling – Cupper







Next Steps / Lessons Learned

Next Steps:

Keep monitoring and updating the fate and flow model and biogeochemical data

PRB was not designed for the new situation, need to be re-installed in the future

Full scale is being designed at this moment

Lessons Learned:

Hydrogeological and Fate and Flow modeling were the key for the effective actions

Cupper plume, even in very high concentrations, was not enough to affect the reactive zone formed by Provect-IR and Provect-IRM

Thanks!

Sidney Aluani

saluani@sgw.com.br

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