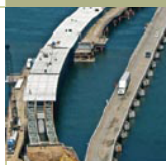
Presenter: Richard Morykot P.Eng.

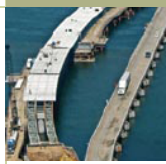
Special Acknowledgements



Public Works and Government Services Canada

- Regional Manager/Mine Water Management and Project Manager: Joe Shea P.Eng.
- Manager of Site Operations: Ronnie Kelly
- David Mayich (Retired Site Operations Manager)

CBCL Team



Discipline leads:

- Geology/Mine works: Glenn MacLeod, Geologist
- Environmental/Permitting: Lorna Campbell, P.Eng.
- Modelling: Peter Thorn, Atkins Int.
- Structural: Brad Kennedy, P.Eng
- Mechanical/Geothermal: Donnie Arsenault, P.Eng.
- Treatment Process: Aaron Baillie, P.Eng.
- Process Programming: Bill Robinson, P.Eng.
- Electrical: Mark MacNeil, CET.
- Construction Management: Robert Dickson, CET
- Civil/CBCL PM: Richard Morykot, P.Eng.

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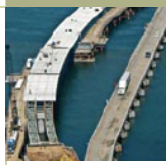
Project Location

Presentation



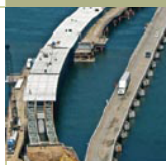
1 Brief History of Coal Mining in the Region

2 Mine Pool Evaluation and Characterization

3 Mine Water Delivery System

4 The Treatment System

Background



- Coal mining first occurred in the Sydney Coal Fields in 1685 by the French Military.
- Over the past 150 years there have been over 50 significant underground coal mines.
- These mines have left behind more than 190 million m^3 of void spaces.
- Once mining was completed and the dewatering pumps were turned off the mines began to flood.
- The quality of the water depends on the geology and mine configuration. Mine water typically has low pH, high sulphate and acidity, elevated metals, (typically iron, manganese and aluminum) and possibly other contaminates.

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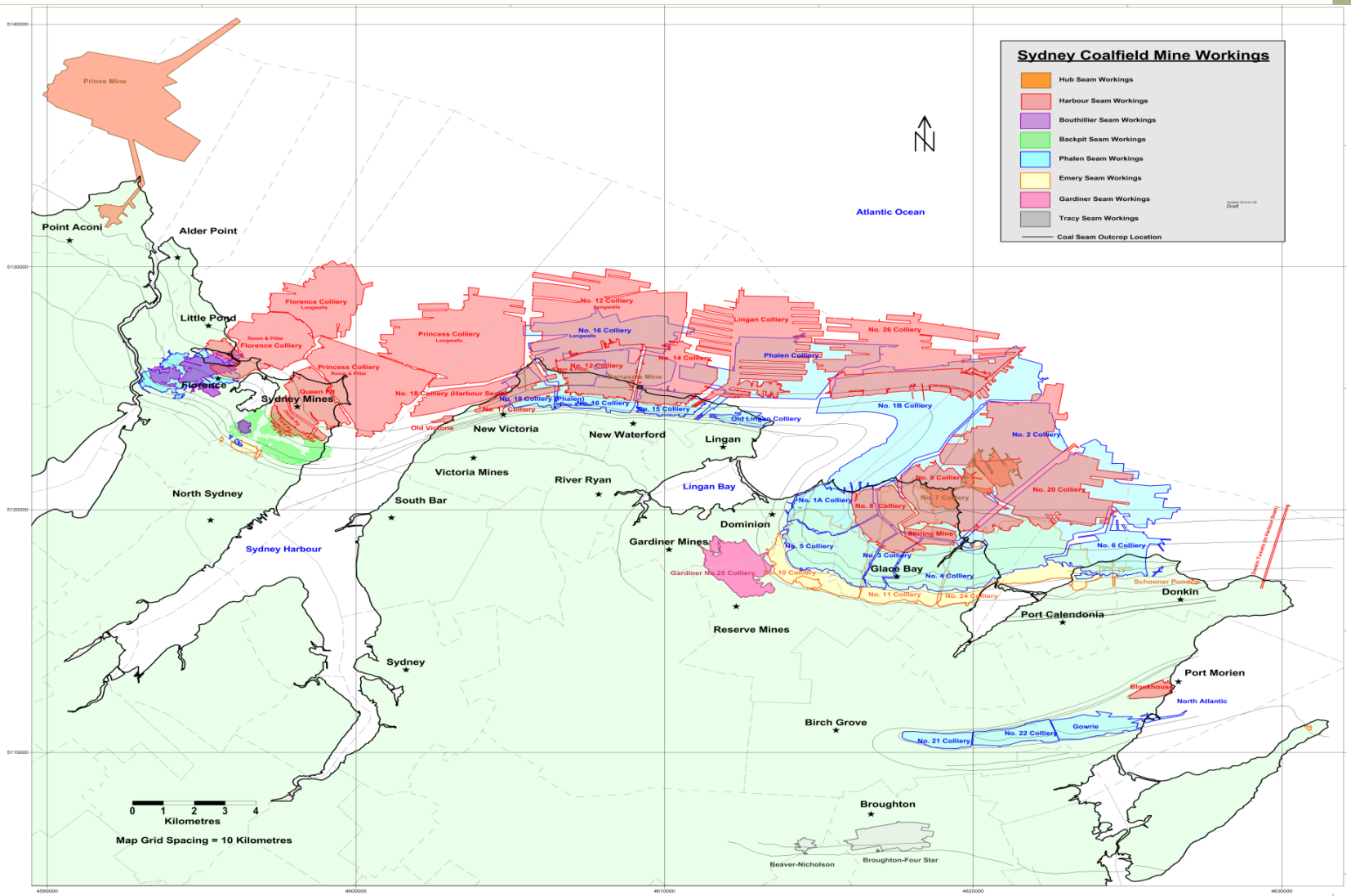
Mine Works



Typical Mine Working

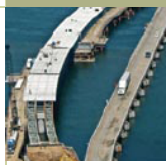
Discharge to Brook

Mine Water Discharge

Mine Water Seep

Mine Water Discharge to Ocean

Key Questions

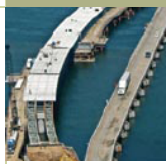


1 Where are the mine pools located and how do we get access for treatment?

2 What is the water elevation in the various mine pools and how fast is it rising?

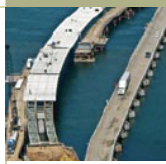
3 How will the water quality change with time? (quality highly variable)

Key Considerations



- Access to the various mine pools
- Efficient pumping system
- Land ownership
- Discharge locations (marine or freshwater)
- Location of treatment plant over shallow mine workings
- Sludge disposal
- System flexibility

Mine Pools



- **New Waterford Mine Pools**

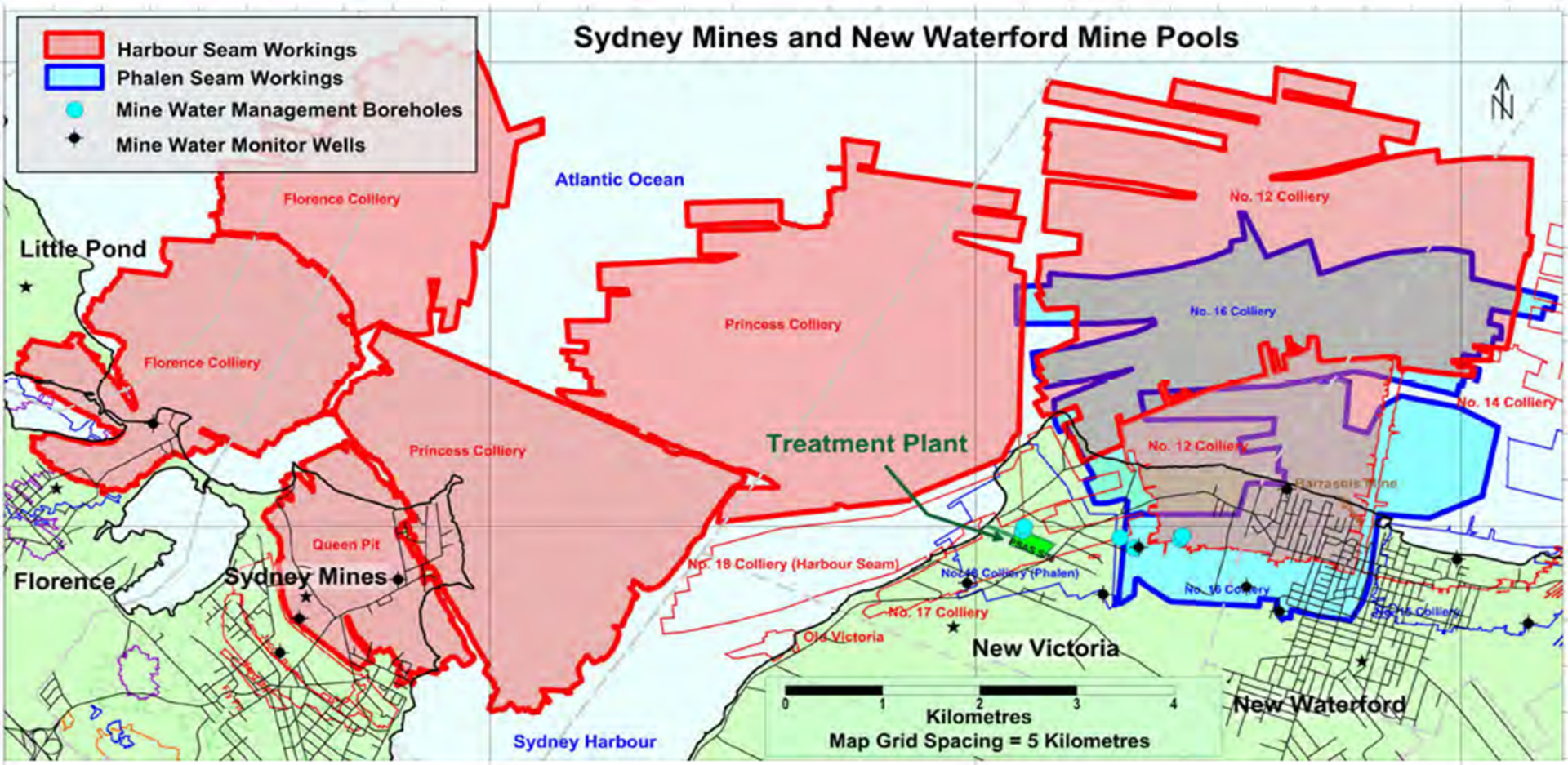
  No.12, No.14, No.16 - Actively filling

  No.17, and No.18 - Collieries reached equilibrium

- **Sydney Mines Mine Pool**

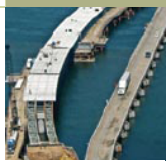
  Princess, Queen and Florence collieries began flooding in 1975 - actively filling

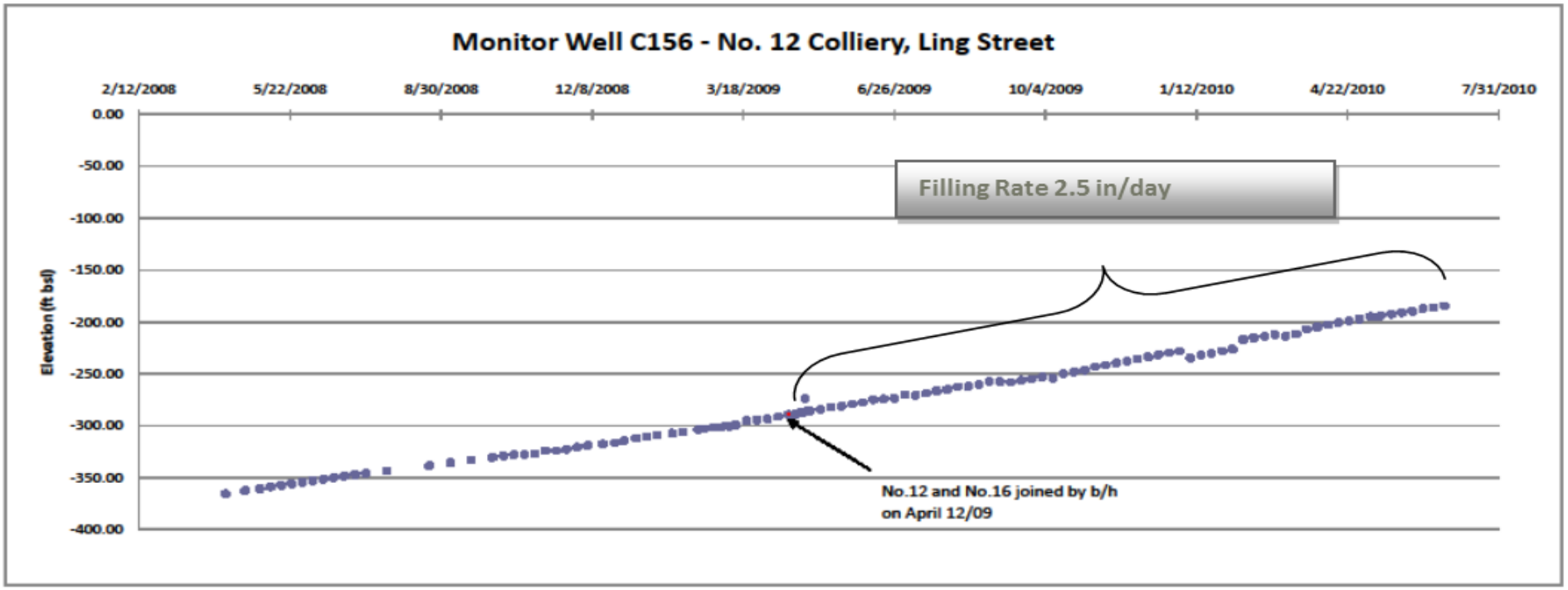
Mine Pools



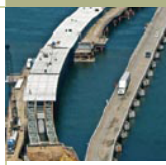
~50 km^2 with ~42 km^2 located under the Atlantic Ocean

Flooding Rate No. 12



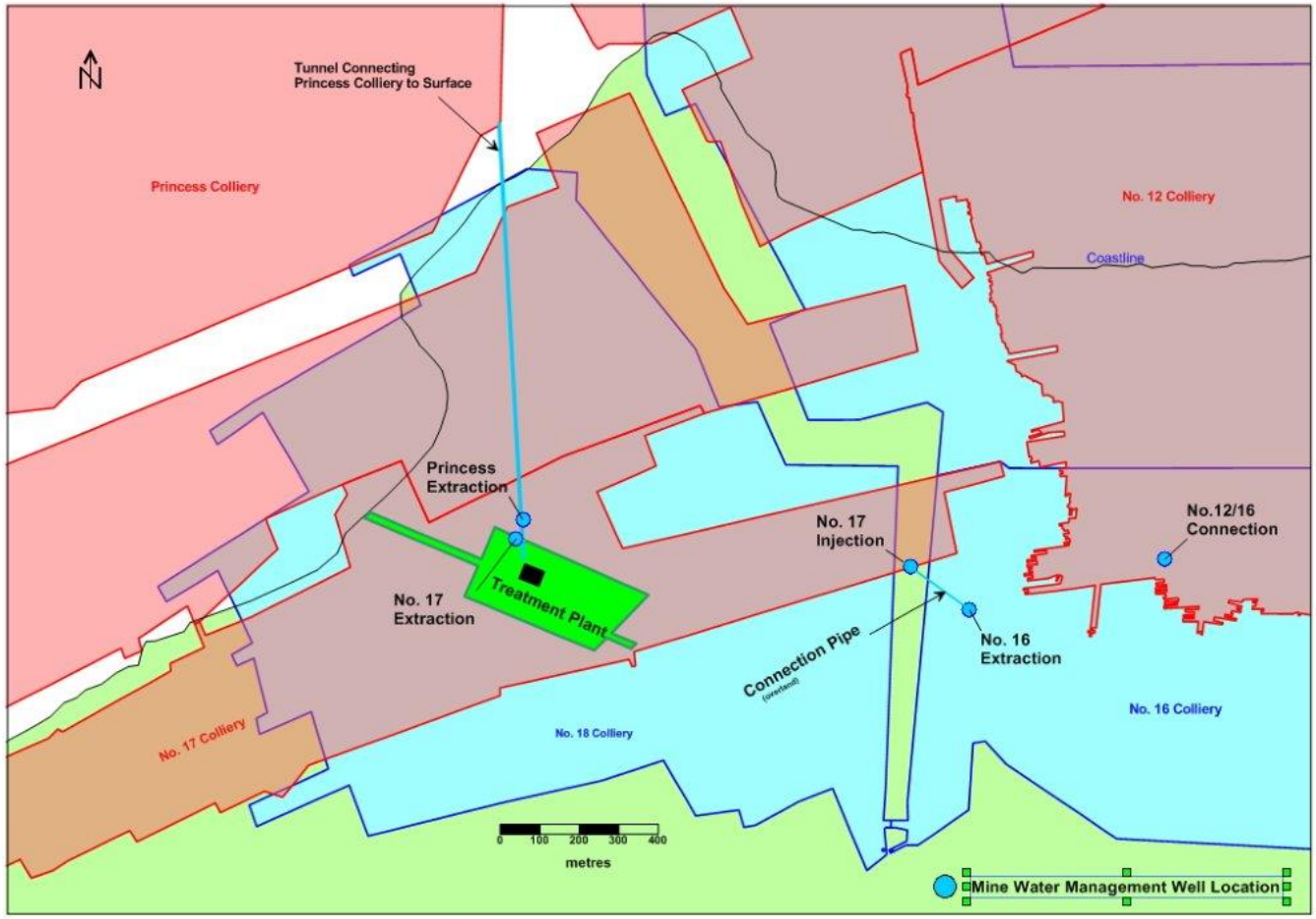


Selection of Treatment System

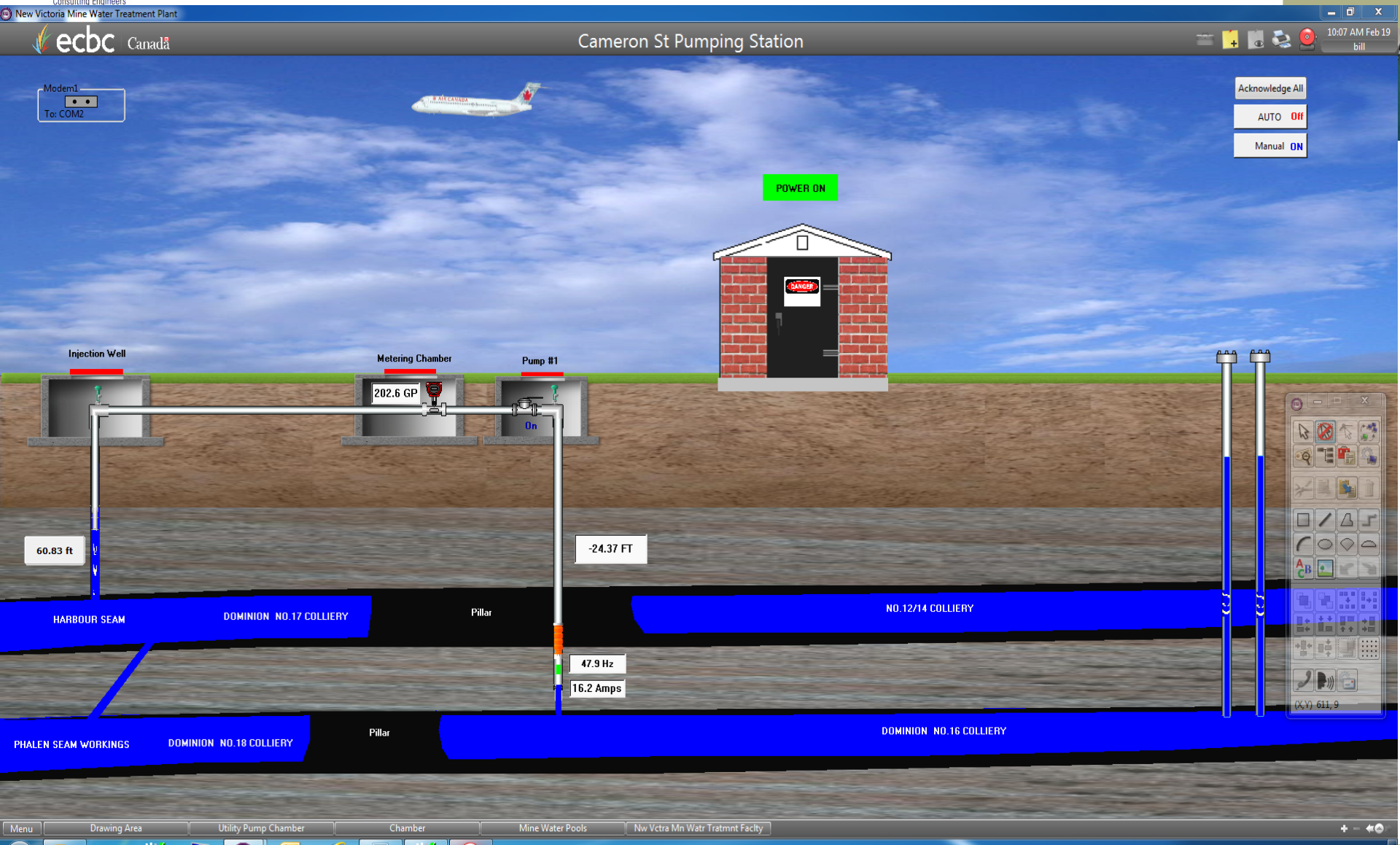


After careful consideration and debate of the issues and review of seven potential options, including multiple treatment plants, the New Victoria option was selected.

Why New Victoria?



No.12/14 and 16



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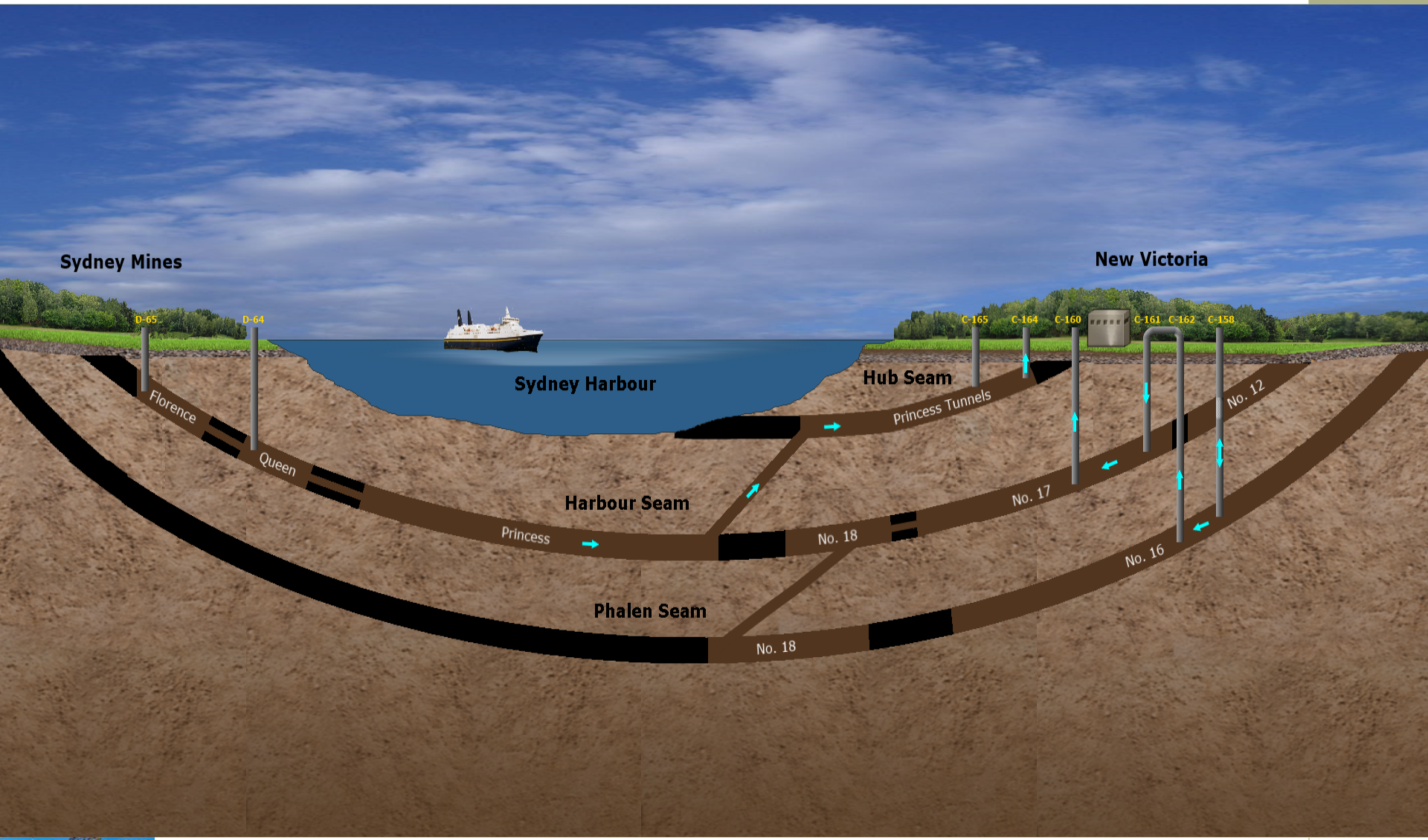
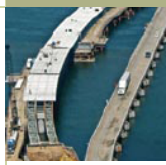
Artesian Well (no.17/18)

Princess Return Airway

System Hydraulics



Now What is the Water Quality

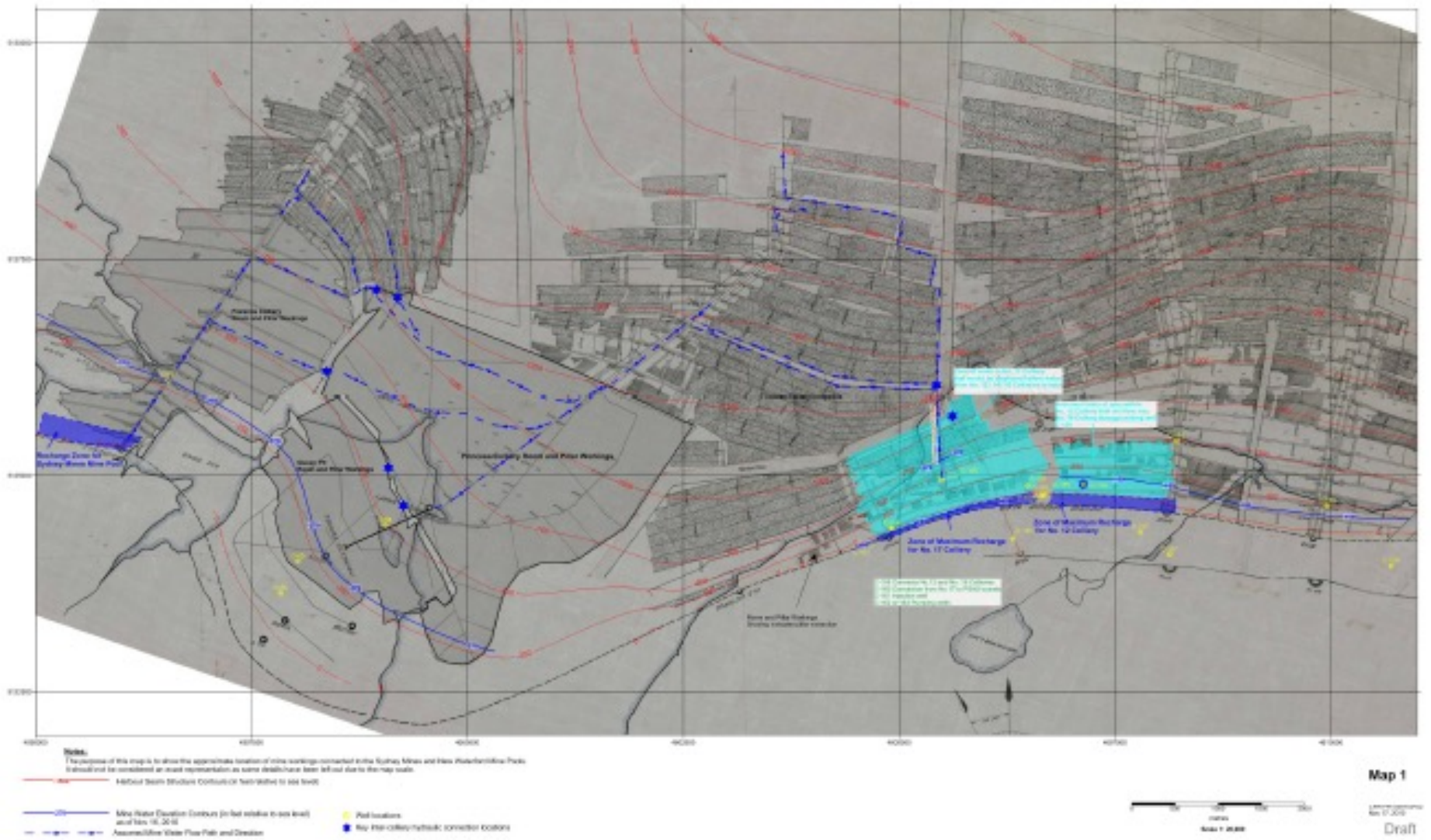


Key Chemical Parameter Summary - New Waterford Mine Pool

		C-151		C-151		C-155		C-155		C-155	
		No. 16		No. 16		No. 16		No. 16		No. 16	
Parameter	unit	Mar., 2009		Mar., 2010		Apr., 2008		Mar., 2009		Mar., 2010	
		unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered
Acidity	(mg/L)	1900		1300		1700		2000		2000	
pH	(unitless)	4.3		5.9		5.7		5.7		5.9	
Alkalinity	(mg/L as CaCO3)	ND		130		28		43		94	
Aluminum	mg/L	82	78	0.66	0.66	0.71	0.73	0.79	0.62	0.32	0.3
Total Iron	mg/L	480	450	330	330	1100	900	960	840	870	800
Iron-Ferrous	mg/L	450				820	830	850	840	810	820
Manganese	mg/L	200	170	98	97	120	110	84	72	78	75
Mercury	mg/L	0.00002	ND	<0.000013		0.00002		ND	ND	0.000014	<0.000013
Sodium	mg/L	420	400	340	370	2000	1900	1500	1300	1300	1300
Sulphate	mg/L	6800		4600		5800		6300		5400	

		C-150		C-156		C-156		C-156		C-158	
		No. 14		No. 12/14		No. 12/14		No. 12/14		No. 12/14 & No.16	
Parameter	unit	Mar., 2010		Apr., 2008		Mar., 2009		Mar., 2010		Mar., 2010	
		unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered
Acidity	(mg/L)	1700		5100		6400		7100		2200	
pH	(unitless)	3.8		5.4		5.6		4.5		5.8	
Alkalinity	(mg/L as CaCO3)	<1		54		85		<1		100	
Aluminum	mg/L	130	140	2.9	0.43	1.9	1.9	86	86	0.35	0.4
Total Iron	mg/L	210	220	2700	2600	3300	3300	3900	3700	920	910
Iron-Ferrous	mg/L	250	240	2900	3100	3200		3600		940	
Manganese	mg/L	34	37	280	270	340	340	450	420	95	93
Mercury	mg/L	0.00007	0.00003	0.00001	<0.00001	0.00002		0.000023		<0.000013	
Sodium	mg/L	45	49	1200	1200	1300	1200	1300	1300	1300	1300
Sulphate	mg/L	2600		13000		15000		15000		6800	

Mine Plan Water Modeling



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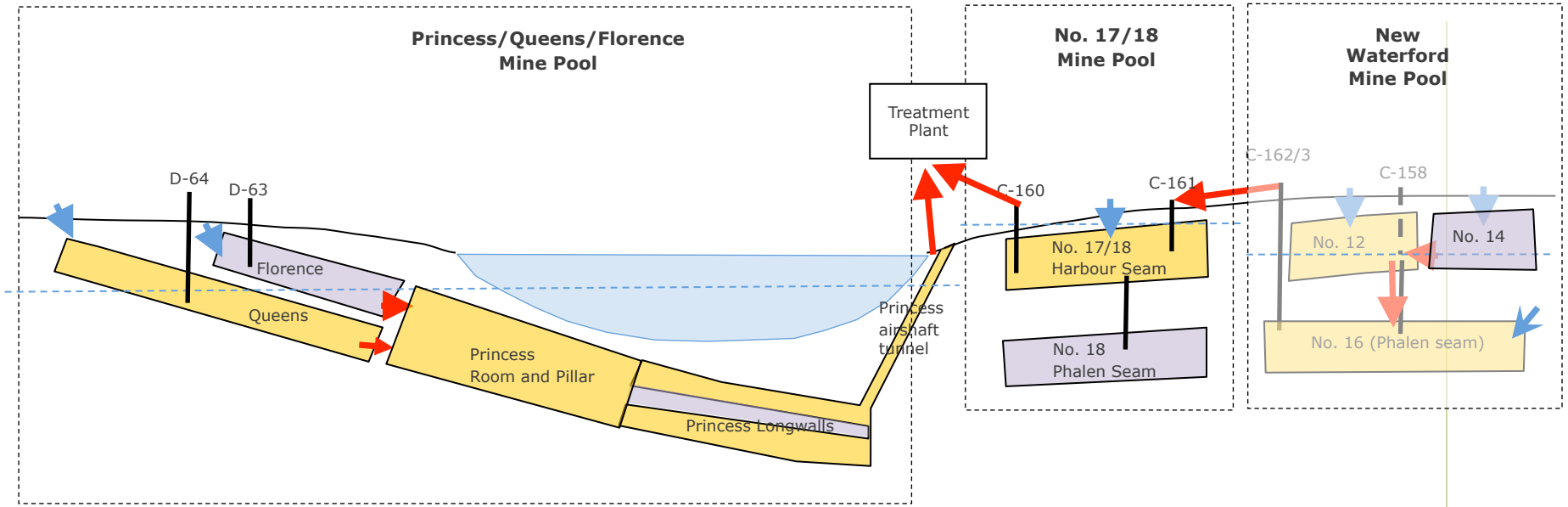
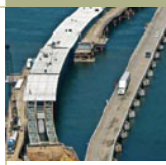
Conceptual Schematic Pathways Mine Water Interactions

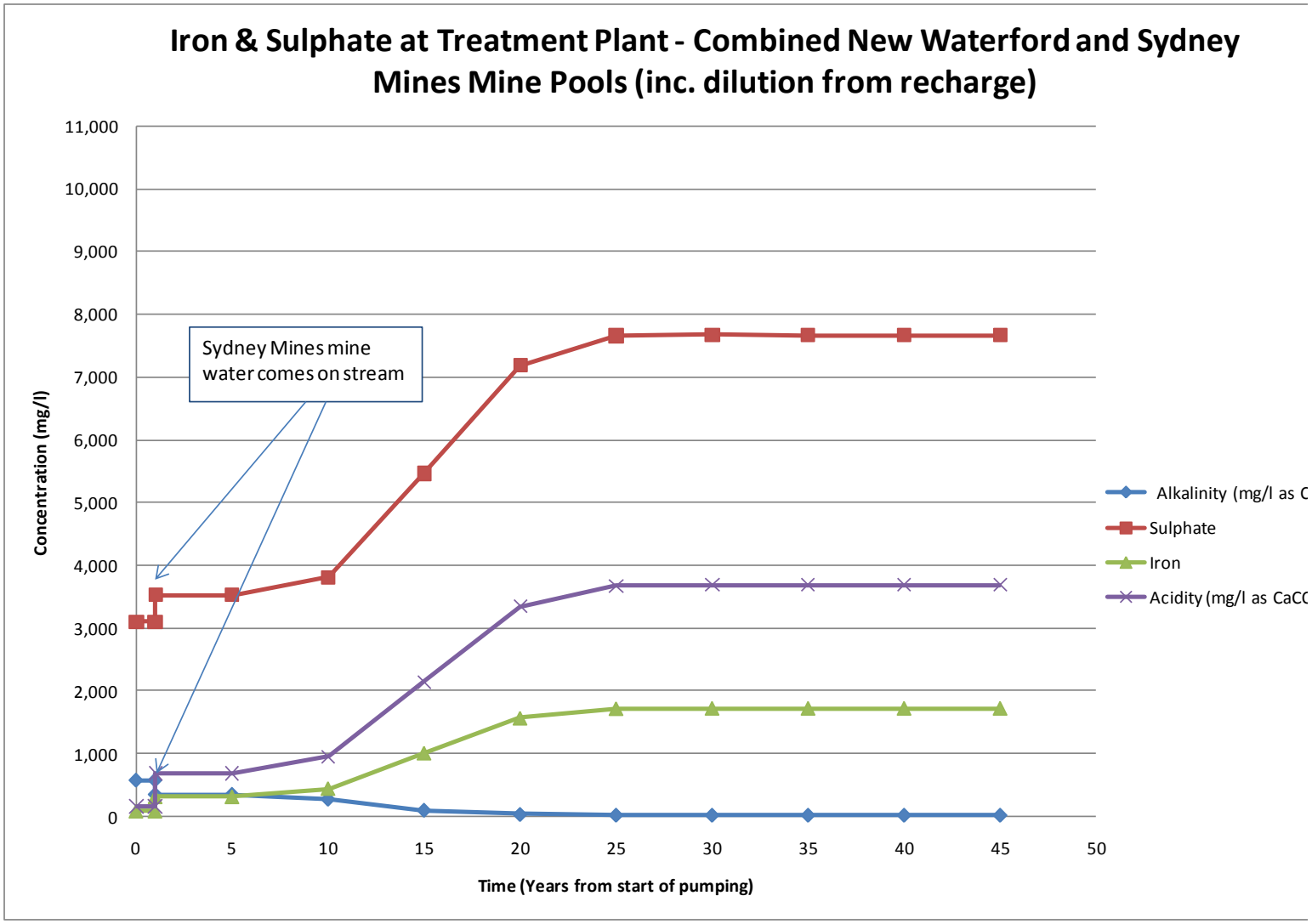


Key

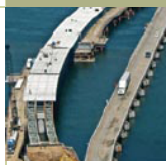
- Mine pools where waters will mix
- Mine pools drawn from only
- Principal recharge to workings
- Mine water linkages
- Water levels in mine pools (indicative only)
- Borehole/Well or linking Shaft

Modelling Results



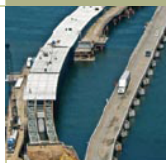


High Density Sludge Treatment System



- Mine Water Delivery System
- Aeration Cascade
- Mechanical Aeration Tank/PH Adjustment
- Seed Tank
- Polymer System
- Clarifier
- Drum Filter
- **Geothermal System**

Finishing



- Final Polishing through a settling pond and wetland before discharge to Atlantic Ocean
- Sludge placed in containment area

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Treatment Plant

Mine Water Delivery System

Aeration Cascade

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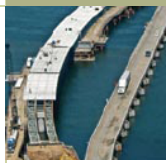
Treatment System Overview (Control System)

Mechanical Aeration Tank

Clarifier

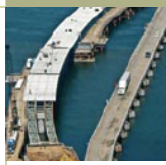


Drum Filter

Site Layout


Settling Pond
Sludge Disposal Area
Artesian Borehole
Princess Pumping Well
Reed bed
Discharge

Conclusion



- New Victoria site reduced the need to construct additional treatment facilities (9 mines treated at one location)
- Treatment Plant operational in early 2013.
- Achieving treatment requirements
- Iron levels consistently less than 1mg/L

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Thank You

Questions