

Geomembrane Cover on Normétal Reactive Tailings: A Case Study

Prepared by:

Toby Hofton SNC-Lavalin inc.

Rick Schwenger, Xstrata Zinc



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BACKGROUND INFORMATION

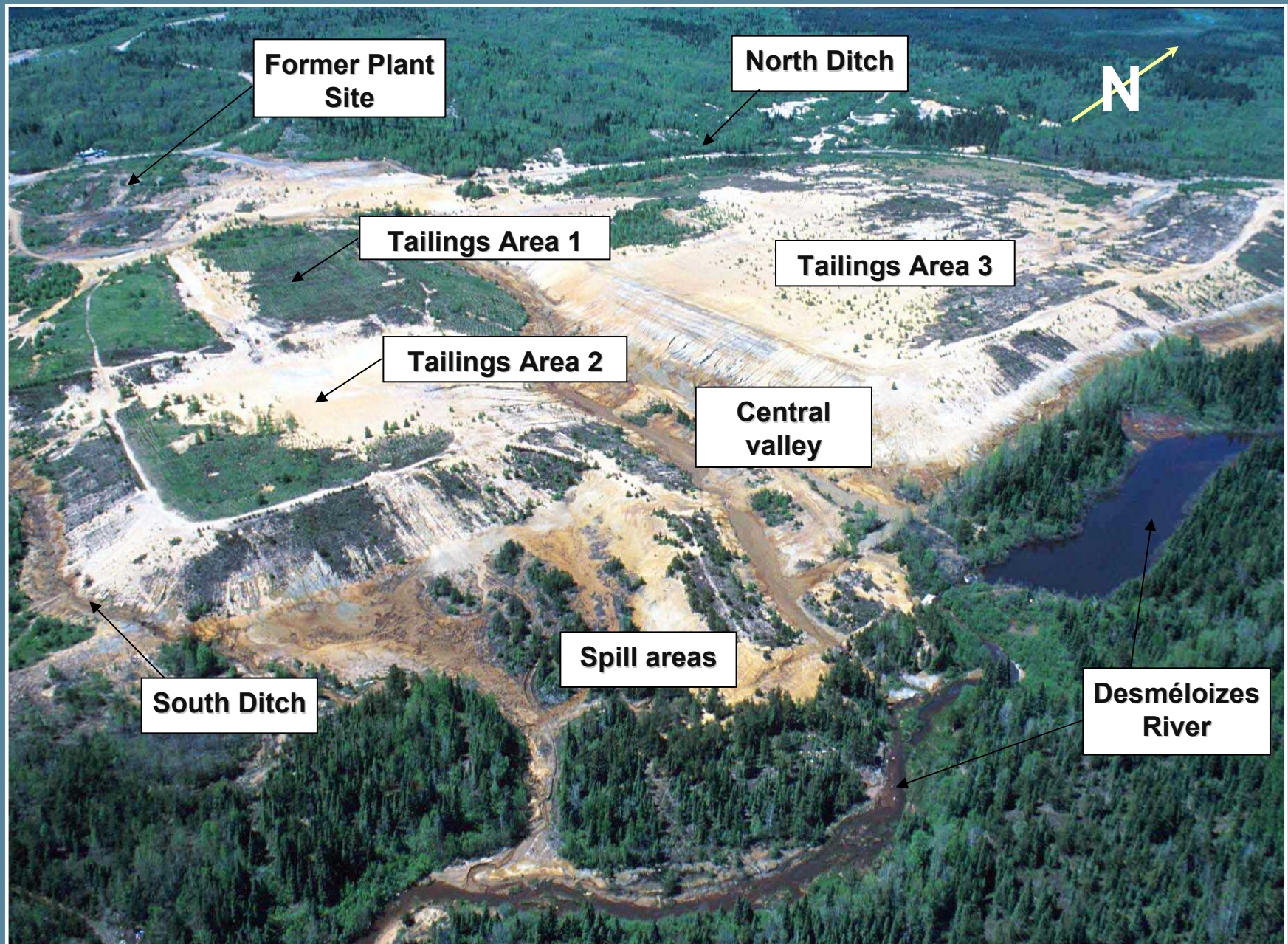
- Underground mine operated between 1937-1975
- > 10 million tonnes of sulphurous ore extracted
- Tailings stored in three impoundments adjacent to Town of Normétal and Desméloizes River
- Initial site restoration conducted in 1980s : sand cover + revegetation
- Over time, surface erosion + acidic seepage into receiving environment via Desméloizes River



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SITE DESCRIPTION



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BACKGROUND INFORMATION (cont'd)

- In 1998, *Ministère des ressources naturelles et de la faune du Québec (MRNF)* informed current site owner that further reclamation works were required
- As current owner was insolvent, MRNF asked the previous owner to take responsibility for cleaning up the site.
- In 2004, owner mandated SNC-Lavalin inc. to develop the final restoration concept and to supervise the construction activities on-site



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ENVIRONMENTAL OBJECTIVES

- Clean-up of the various tailings spill areas along river
- Prevention of surface erosion and subsequent transport of tailings toward the Des Méloizes river
- Ensuring the long-term stability of retention dams
- Covering of the tailings with a geomembrane liner to reduce the penetration of oxygen and water into tailings
- Abandoned site: No effluent quality targets or treatment



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CLOSURE CONCEPT

- Clean-up of spilled tailings and flattening of dam slopes
- Installation of over 56 ha of HDPE liner: textured on dam slopes and smooth on impoundment surfaces
- Placement of clay cover over liner (0.3 m on slopes, 0.5 m on surface)
- Placement of Riprap on slopes
- Revegetation of covered impoundment surfaces and excavated spill areas using residual fertilizing materials

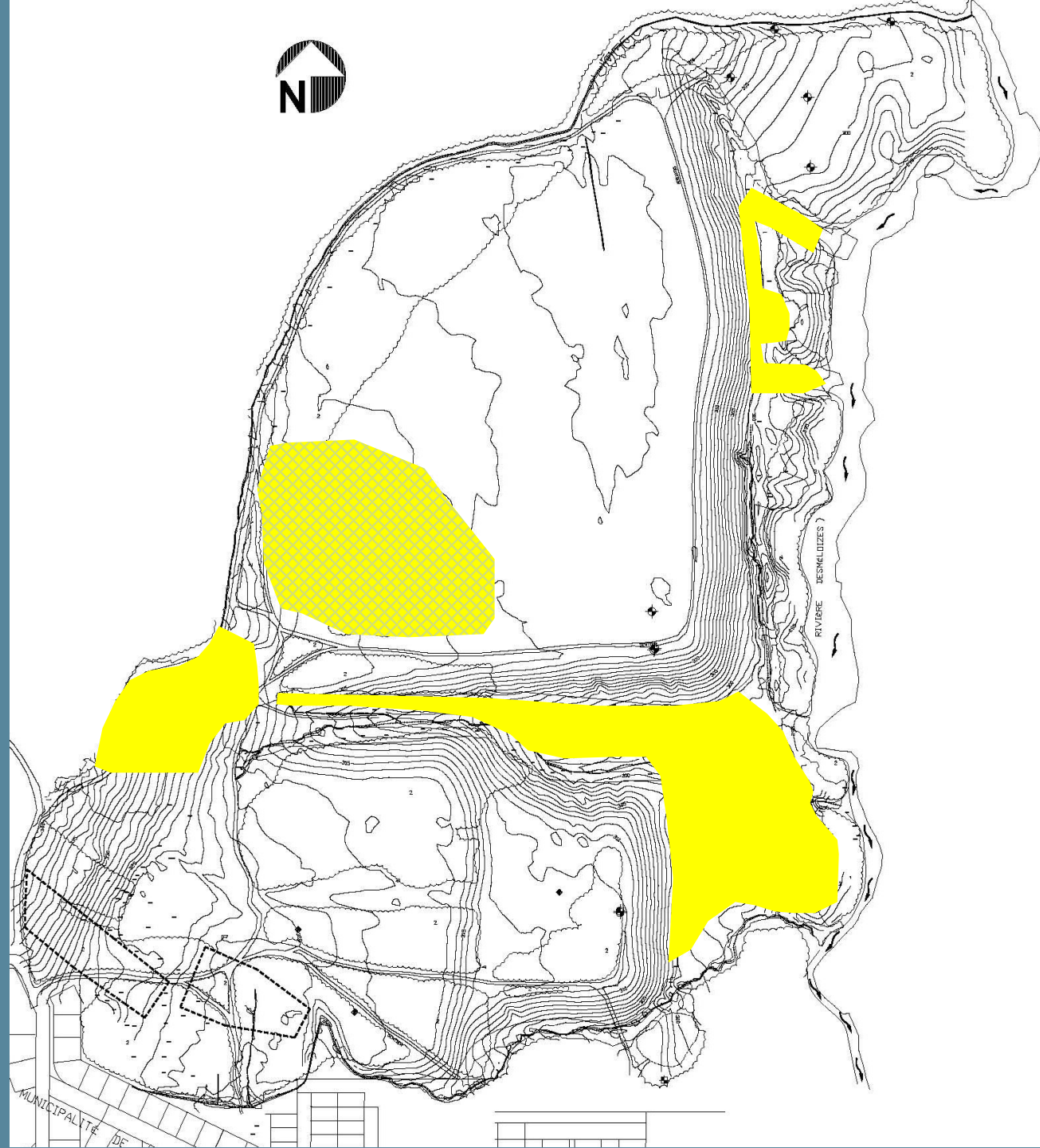


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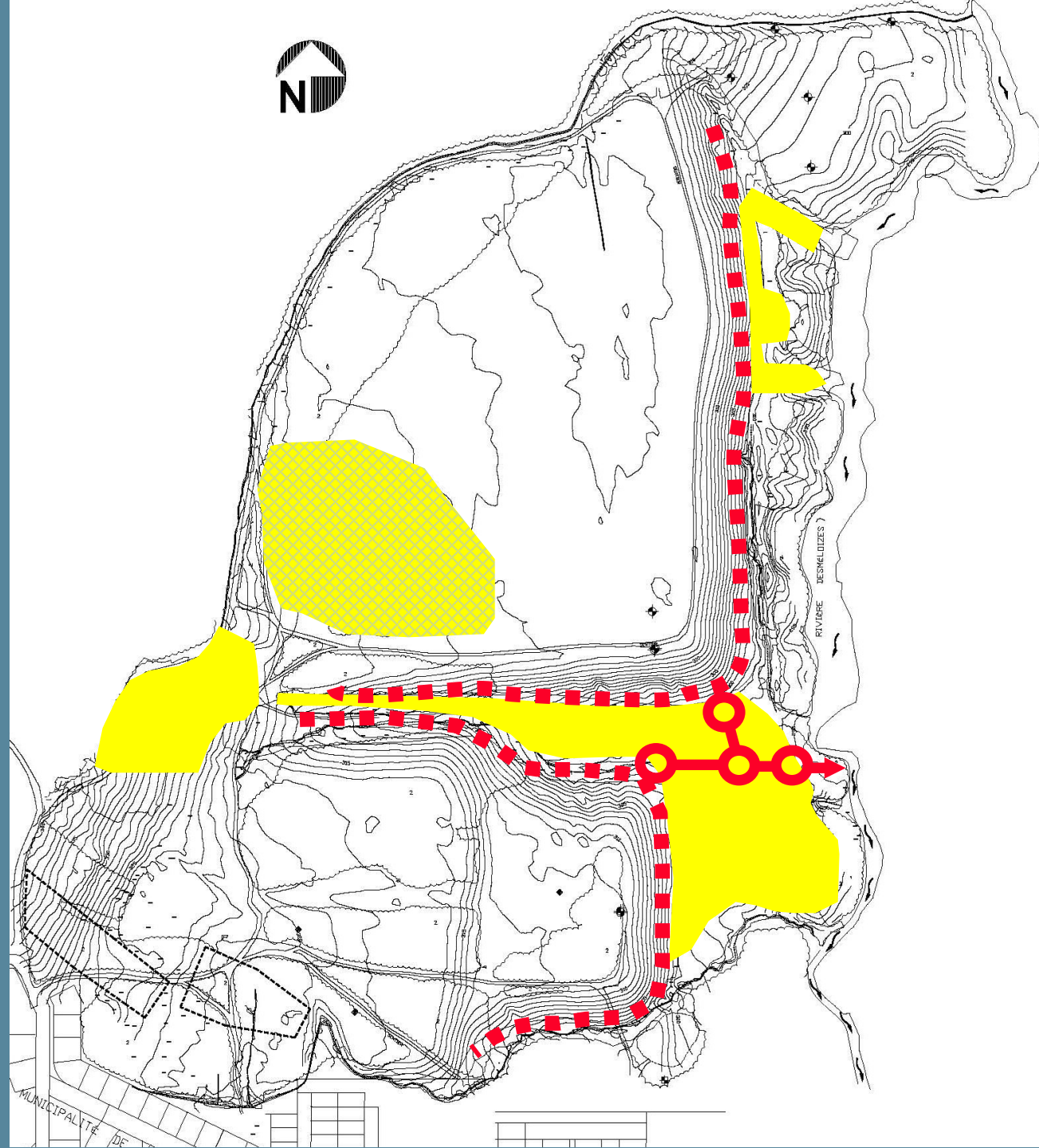
Main Project Components:

1. Clean-up of spilled tailings and transport to TI 3



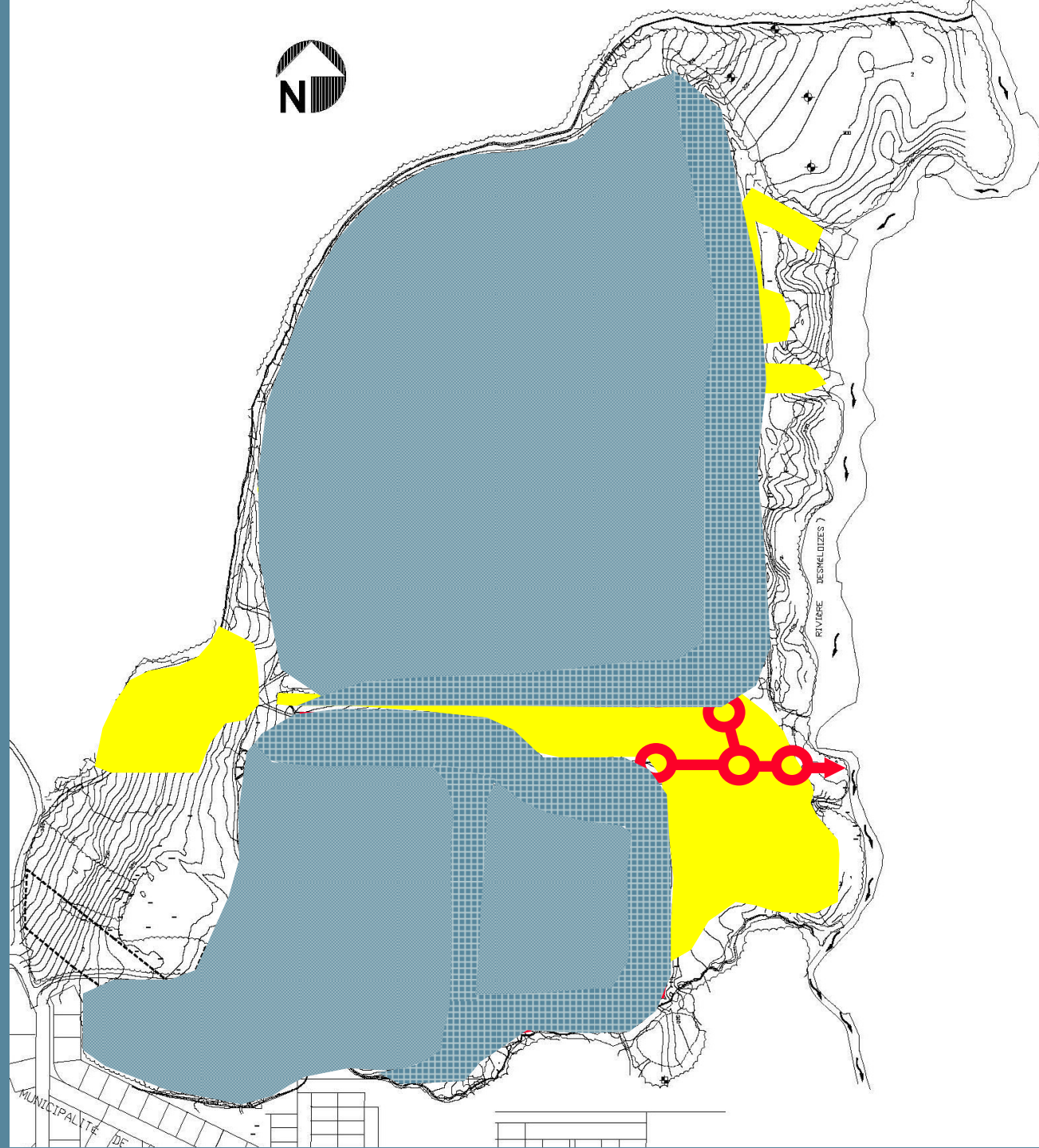
Main Project Components:

1. Clean-up of spilled tailings and transport to TI 3
2. Construction of toe drain and manhole network



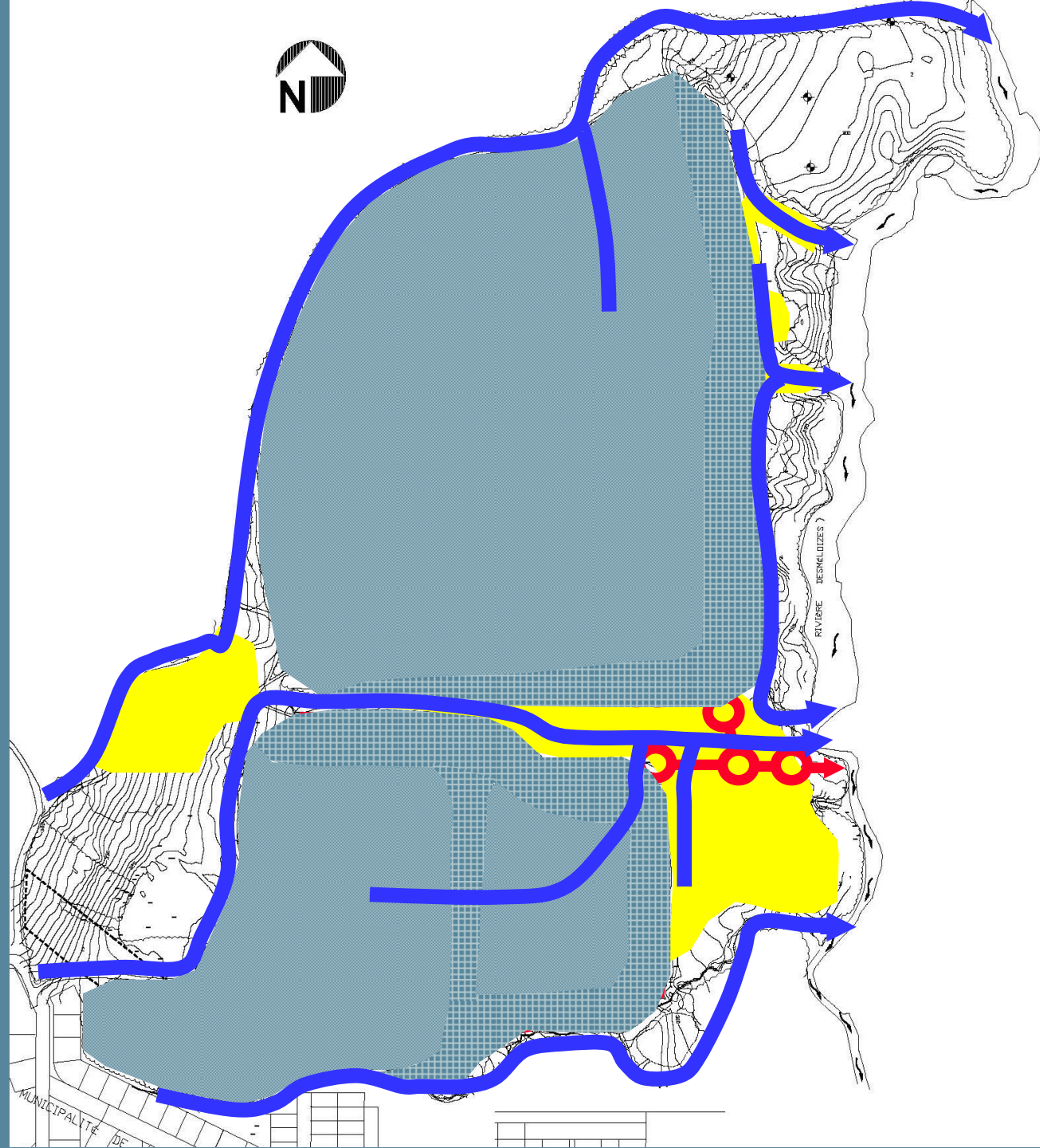
Main Project Components:

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Main Project Components:

1. Clean-up of spilled tailings and transport to TI 3
2. Construction of toe drain and manhole network
3. Installation of liner (textured and smooth)
4. Construction of surface drainage network
5. Slope protection
6. Soil cover and revegetation



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CONSTRUCTION (2005-2006): Some numbers...

- Development of rock quarry and clay borrow pit, both adjacent to site
- Excavation and transport of 146,000 m³ of spilled tailings
- Installation of 2.5 km of toe drains and 4.3 km of ditches for surface drainage
- Installation of 17 ha of textured liner and 37 ha of smooth
- Placement of 210,000 m³ of clay and 150,000 m³ of riprap



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ROCK QUARRY AND CLAY BORROW PIT



TAILINGS CLEAN-UP



SITE PREPARATION: STRIPPING AND BACKFILLING



CONSTRUCTION OF TOE DRAINS



FINAL SURFACE PREPARATION



INSTALLATION OF TEXTURED LINER



INSTALLATION OF CLAY AND ROCKFILL ON SLOPES



CONSTRUCTION OF DITCHES AND GABION SPILLWAYS



An aerial photograph of a large-scale construction project, likely a landfill or industrial site. The image shows several rectangular areas covered with dark, smooth material, which is the smooth liner mentioned in the text. These areas are surrounded by lighter-colored, sandy or gravelly soil. A yellow excavator is visible on the left side, working on the edge of one of the dark-covered sections. The site is bordered by a dense forest of green trees in the background and to the right. A dirt road or path runs along the right side of the construction area.

**CLAY COVER PLACEMENT
ON SMOOTH LINER**

FERTILIZING AND SEEDING



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COVER PERFORMANCE

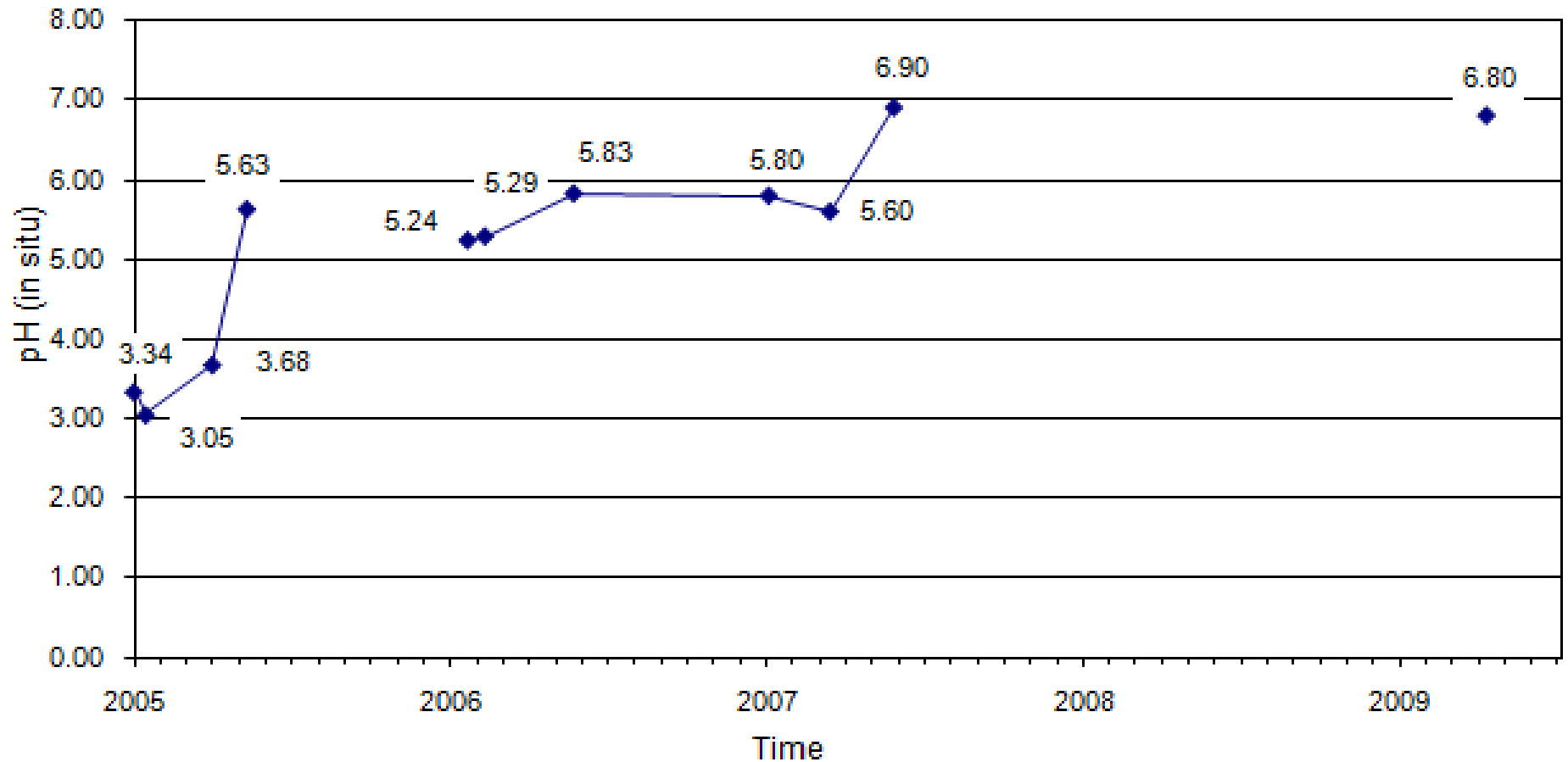
- **Liner cover completed in September 2006.**
- Over time, drawdown of water level within impounded tailings of 5.8 cm/ month
- Reduction hydraulic gradient = reduction in flow rate of contaminated water: 150 L/ min to 103 L/ min between 2006 and 2008
- Improved downstream pH and iron and zinc concentrations



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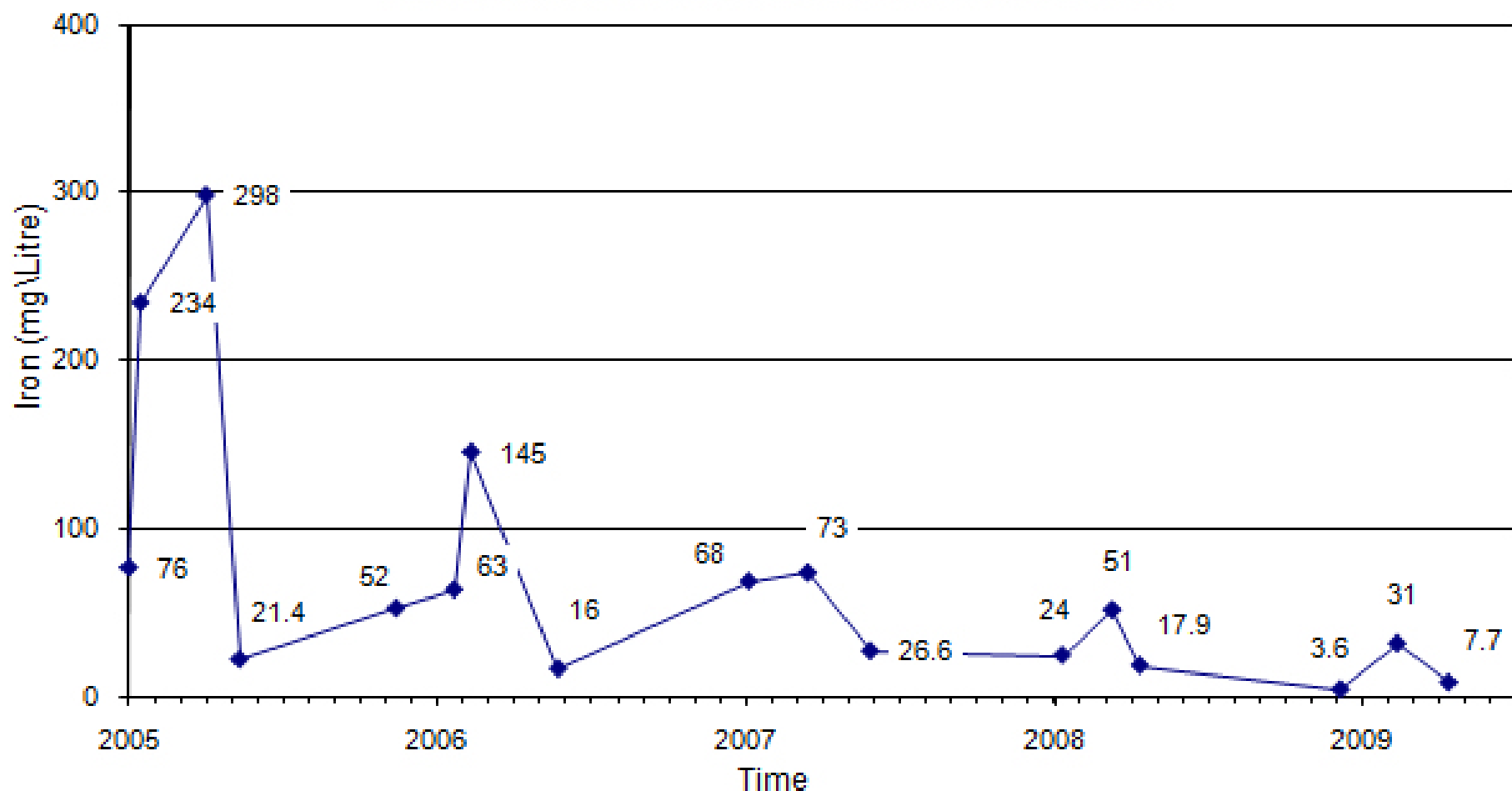
Des Méloizes River - Downstream from site Variation of pH with Time



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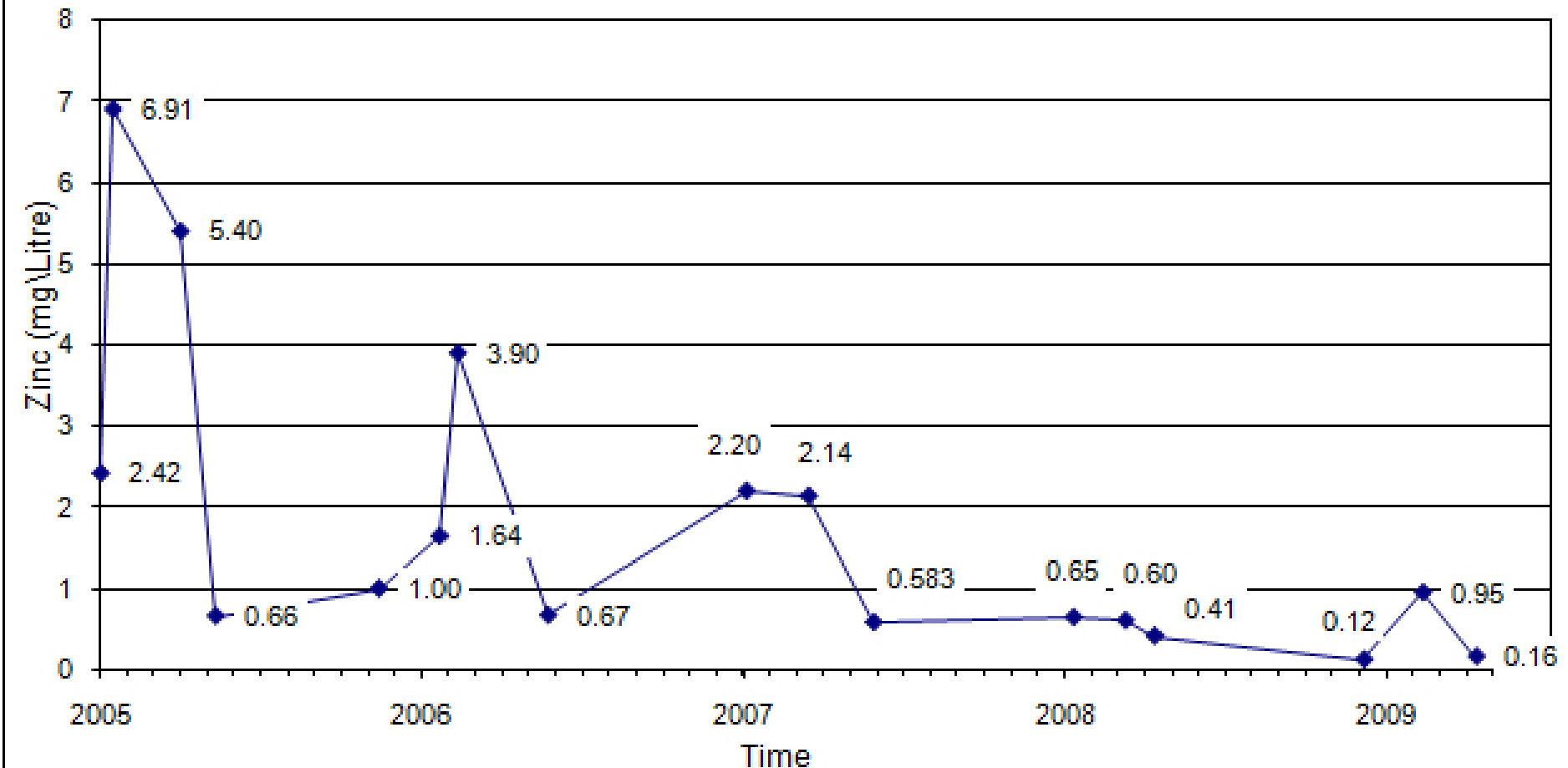
Des Méloizes River - Downstream from site Variation of Iron Concentration with Time



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Des Méloizes River - Downstream from site Variation of Zinc Concentration with Time



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SITE MONITORING

- Reclamation plan included 5-year post-construction monitoring plan.
- In 2009, seepage collection pipes between manholes were partially blocked by slime, a mixture of bacterial mass and insoluble iron precipitate
- Slime caused by “Iron bacteria” growth on pipe walls due to presence of dissolved iron and oxygen in seepage
- Possible solution: air-tight manhole covers



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CONCLUSIONS

- Environmental benefits were observed immediately following completion of construction works
- Elimination of sediment transport, stable dams, improved water quality and lowered water level in tailings
- Unanticipated technical issues: sliming of seepage collection system
- Nevertheless, results so far confirm project success...



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NORMÉTAL SITE PRE-CONSTRUCTION



NORMÉTAL SITE SEPTEMBER 2007

