

RISK MANAGEMENT OF A FORMER ROAD SALT STORAGE YARD



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Trent Parks
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INTRODUCTION

- This presentation will review the environmental investigation work that has been done, the results and the risk management plan that has been implemented.
- Site operated by The City of Calgary on land owned by Alberta Transportation.



Office

Maintenance
Shed

Salt Tent

Pickled
Sand

Storage

Calcium
Treated
Sand

Gravel

Dugout

Intermittent
Pond

Permanent
Pond













ENVIRONMENTAL INVESTIGATIONS

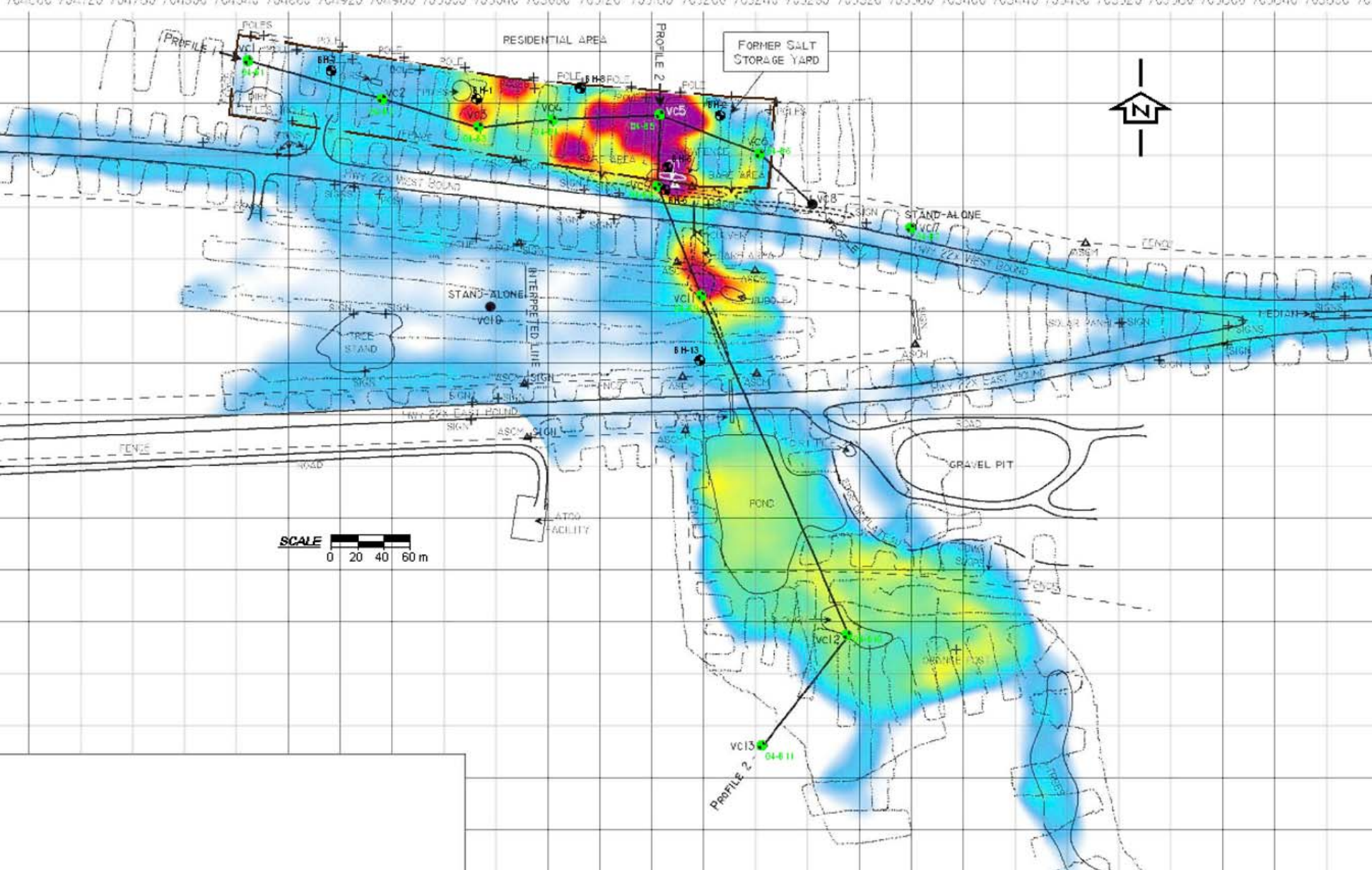
- Environmental Site Assessment, 2001
- Phase II ESA, 2002
- Supplemental Investigation, 2004
- Off-site Investigations, 2004 & 2005
- Risk Management Options, 2005
- Risk Management Plan, 2005
- Detailed Design, 2006
- Installation of Clay Cover, 2006/2007

INVESTIGATION RESULTS

Scope: horizontal EM and 13 vertical EM traces, installing 34 monitoring wells (16 onsite, 18 offsite), soil, groundwater and surface water sampling.

Results

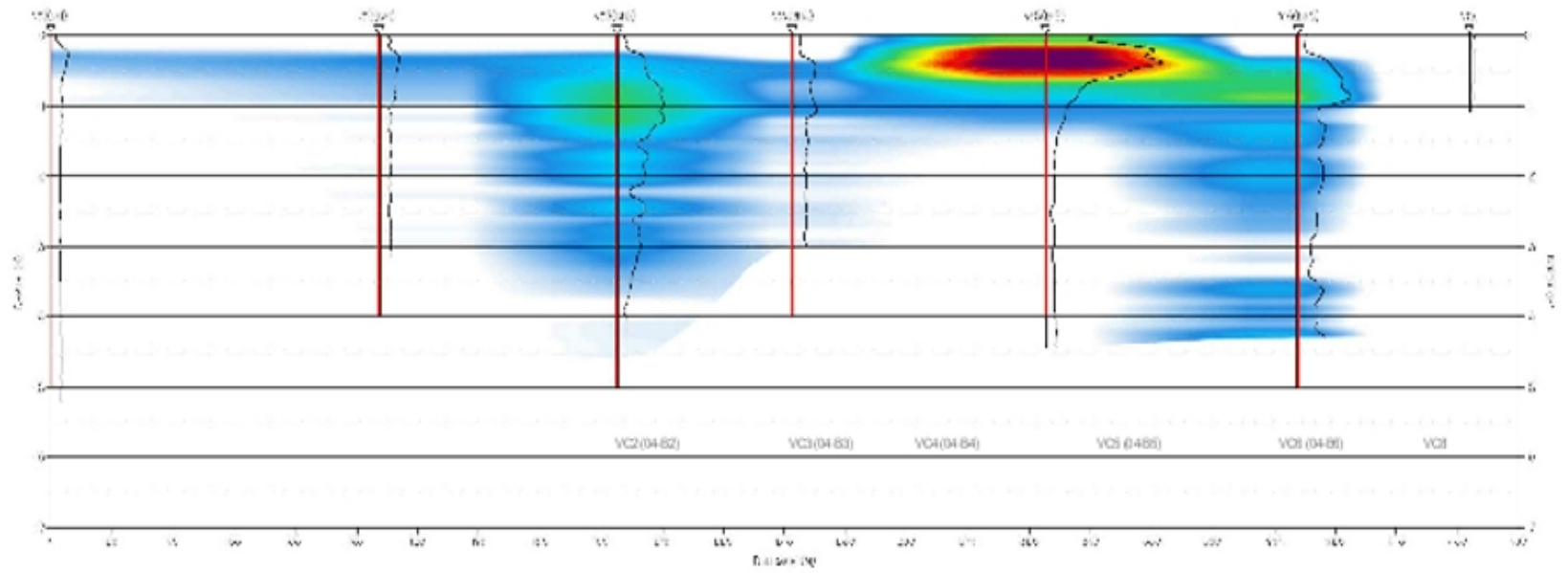
- silty clay with discontinuous sand/gravel lenses. Bedrock within 2.5 m of surface at east end.
- groundwater at 0.2 – 3.8 m bgs; $k = 10^{-10}$ to 10^{-8} m/s
- flow west to east 0.02 m/m and downward from 0.02 to 0.46 m/m.
- Soil:
max. EC = 51 dS/m; max. Cl = 12,100 mg/kg (623 meq/L)
- Groundwater:
max. EC = 84,500 μ S/cm, max. Cl = 42,500 mg/L
- Surface water:
max. EC = 13,800 μ S/cm, max. Cl = 5,500 mg/L



- WEST -

PROFILE 1

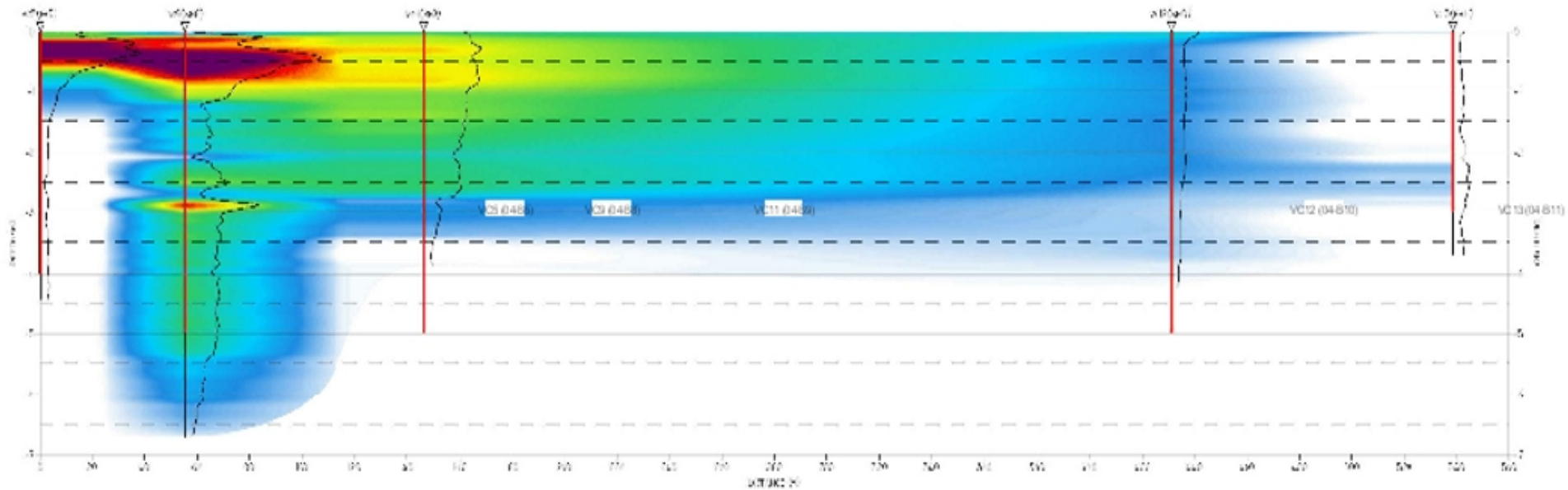
- EAST -

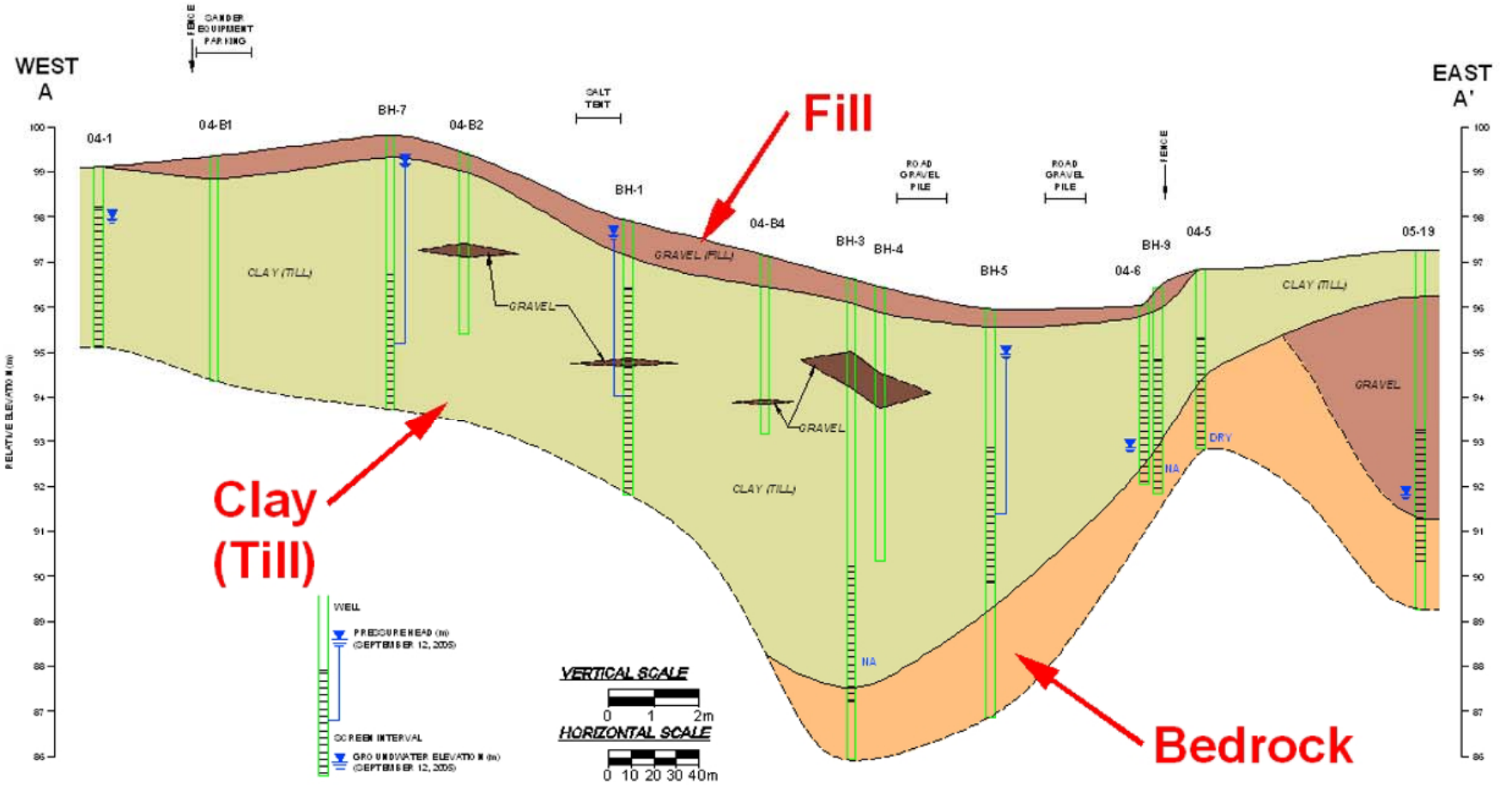


- WEST -

PROFILE 2

- SOUTH - EAST -





IDENTIFIED IMPACTS

SOIL

- 47,000 m² >10 times background
(24,000 m² onsite & 23,000 m² offsite)
- 20,000 m³ “severely” impacted (EC >10 dS/m, Cl >100 meq/L):
18,300 m³ onsite & 1,700 m³ offsite

GROUNDWATER

- salinity impacts correspond closely to extent of soil impacts
- spreading very slowly
- groundwater in bedrock is not impacted

SURFACE WATER

- salinity impact in ditch water at least 230 m east of site
- salinity impact reaching permanent pond 180 m south of site

RISK MANAGEMENT FACTORS

CONTAMINANT

- sodium chloride, toxic to plants, invertebrates, animals

PATHWAYS

- migration in groundwater is slow (20 cm/year)
- migration in surface water very fast

RECEPTORS

- permanent pond and ditch
- no impact to groundwater in bedrock

FUTURE LAND USE

- Incorporate the site into an expanded highway

RISK MANAGEMENT OPTIONS

SOURCE REMOVAL

- Excavate and remove 20,000 m³ of “severely” impacted soil.

Advantages:

- eliminates primary source of salinity
- migration of salinity in groundwater and surface water is reduced

Disadvantages:

- high cost
- does not remove all salinity impacts

RISK MANAGEMENT OPTIONS

SOURCE ISOLATION

Cover “severely” impacted area with impermeable liner (geomembrane or clay)

Advantages:

- reduced off-site migration of salinity in surface water
- reduced vertical migration of salinity in soil column

Disadvantages:

- major source of salinity impact remains
- soil management plan required for redevelopment

SELECTED RISK MANAGEMENT PLAN

IMPERMEABLE CLAY COVER (for short term management)

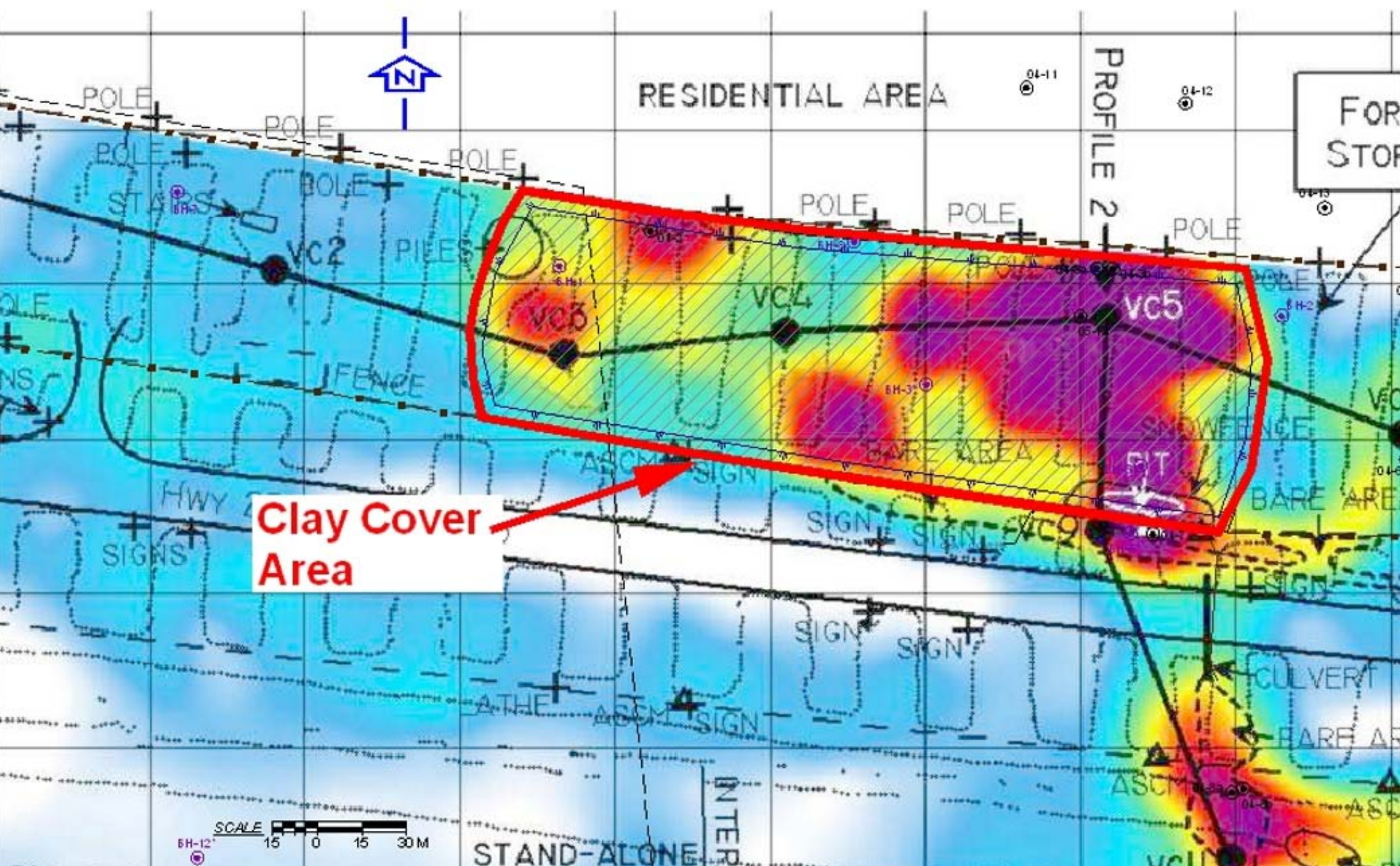
- 30 cm compacted clay over “severely” impacted area (11,700 m²)
- 30 cm subsoil over entire site (24,500 m²)
- 15 cm topsoil over entire site
- vegetate with grasses over entire site

MONITORING

- Semi-annual groundwater monitoring/sampling
- Annual surface water monitoring

TRIGGERS

- Consistent/persistent increase in off-site groundwater chloride concentrations >800 mg/L (AENV Aquatic Life = 860 mg/L)
- Consistent/persistent increase in bedrock groundwater chloride concentrations to >250 mg/L (CDWQ)
- Chloride concentration in surface water discharging from site is >800 mg/L (AENV Aquatic Life = 860 mg/L)



**Clay Cover
Area**

INSTALLATION OF CLAY COVER

SCOPE – detailed design, preparation of request for proposals, bid evaluation, project management

RESULTS

- Monitoring wells extended in September 2006
- Clay cover, sub soil and top soil placed in November 2006
- Seeded in September 2007

SPECIAL CONSIDERATIONS

- Working around monitoring wells
- Removing asphalt, power poles, fencing, foundations
- Working in residential area (noise, dust, curiosity)
- Natural gas pipeline crossing

























KEY QUANTITIES

SOIL QUANTITIES

- Compacted clay = 3,500 m³
- Subsoil = 7,600 m³
- Topsoil = 3,500 m³
- Total Soil Volume = 14,600 m³

OTHER QUANTITIES

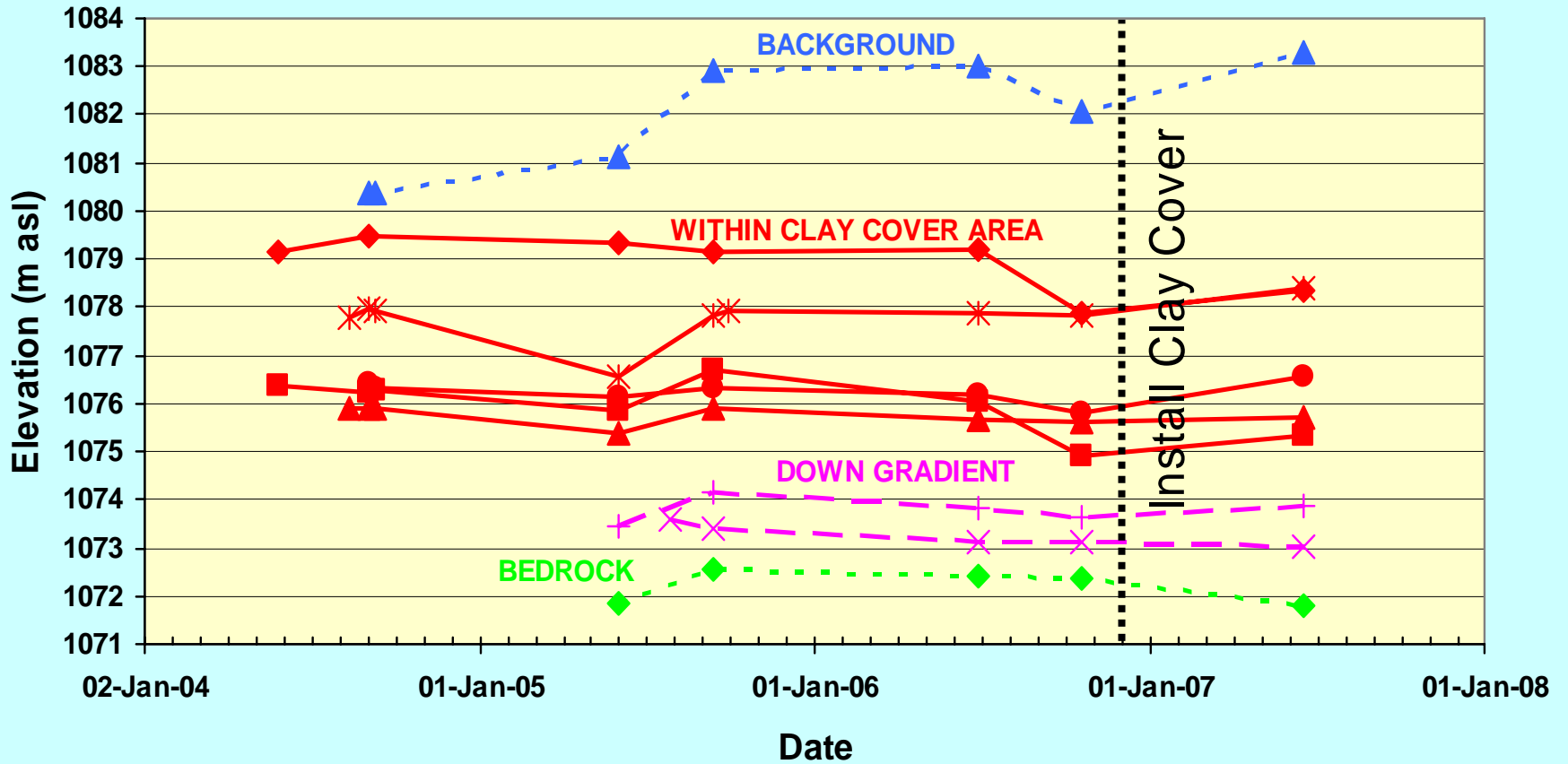
- Asphalt area = 4,500 m²
- Chainlink fence = 840 linear m
- Site surface area (seeding) = 24,500 m²



RESULTS TO DATE – June 2007

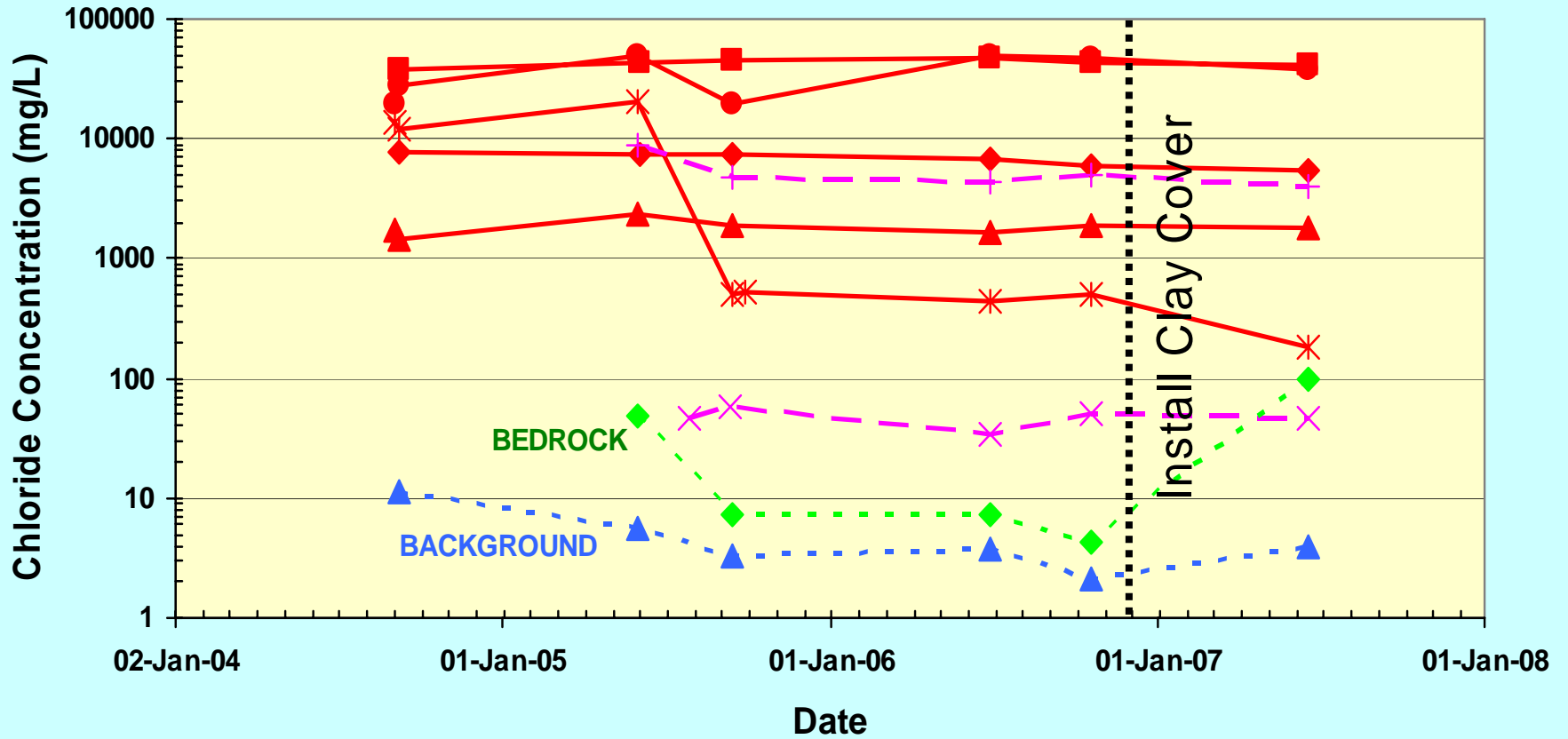
- Groundwater flow regime consistent with historical.
- Groundwater elevations similar to historical.
- Chloride concentrations in groundwater unchanged.
- Chloride concentrations in surface water have generally decreased.

GROUNDWATER ELEVATIONS



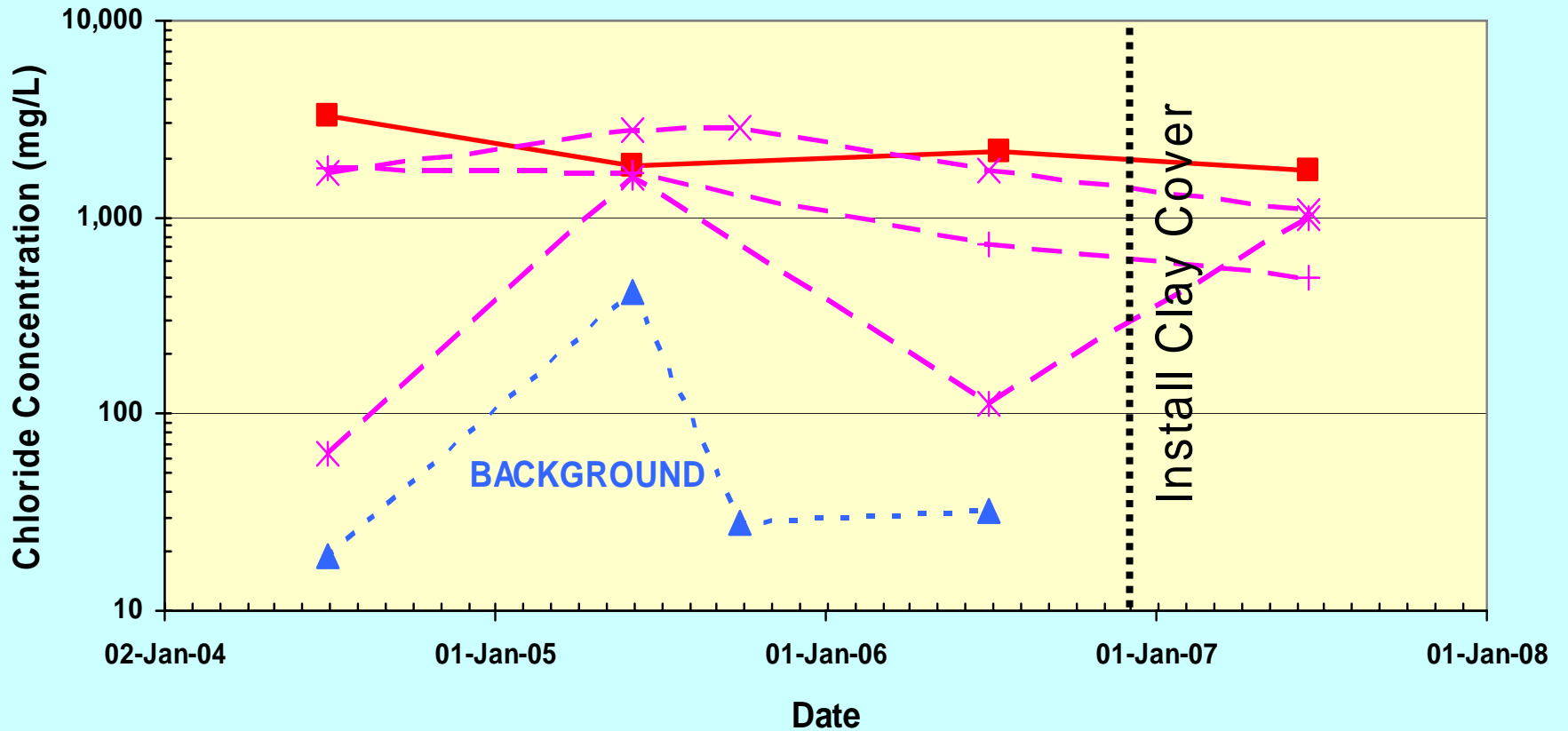
- - ▲ - - 04-1 - ◆ - - BH-1 - ■ - - BH-6 - ▲ - - 04-3a - * - - 04-3b - ● - - 04-7 - + - - 05-16 - × - - 05-19 - ◆ - - 05-14

CHLORIDE CONCENTRATIONS IN GROUNDWATER



- - ▲ - - 04-1
 - ◆ - BH-1
 - ■ - BH-6
 - ▲ - 04-3a
 - * - 04-3b
 - ● - 04-7
 - + - 05-16
 - × - 05-19
 - ◆ - 05-14

CHLORIDE CONCENTRATIONS IN SURFACE WATER



-▲- Background -■- Ditch N Hwy 22X-WB -×- Culvert S Hwy 22X-EB -+- Permanent Pond -*- Ditch 240m E

SUMMARY

- The storage of road salt at a former road salt storage yard has resulted in salinity impacts to shallow soil and groundwater, as well as off-site surface water.
- Risk management by source isolation and monitoring of the salinity impact was implemented, based on an assessment of the source, pathways and receptors, as well as future land use.
- The groundwater and surface water will be monitored to track changes in quality.
- Key features favoring this plan are:
 - Very slow salinity migration in the soils.
 - No impact to a potential groundwater aquifer.
 - Current land use presents no human health risks.
 - The site will be re-developed in the future.

- Thanks to the City of Calgary and Trent Parks
- Questions?

