URS

INVESTIGATION INTO THE N.A. OF A CREOSOTE PLUME UNDERNEATH A LARGE TIDALLY INFLUENCED RIVER

Tom Anthony, URS Corporation, Calgary

Luis E. Lesser, Arizona State University

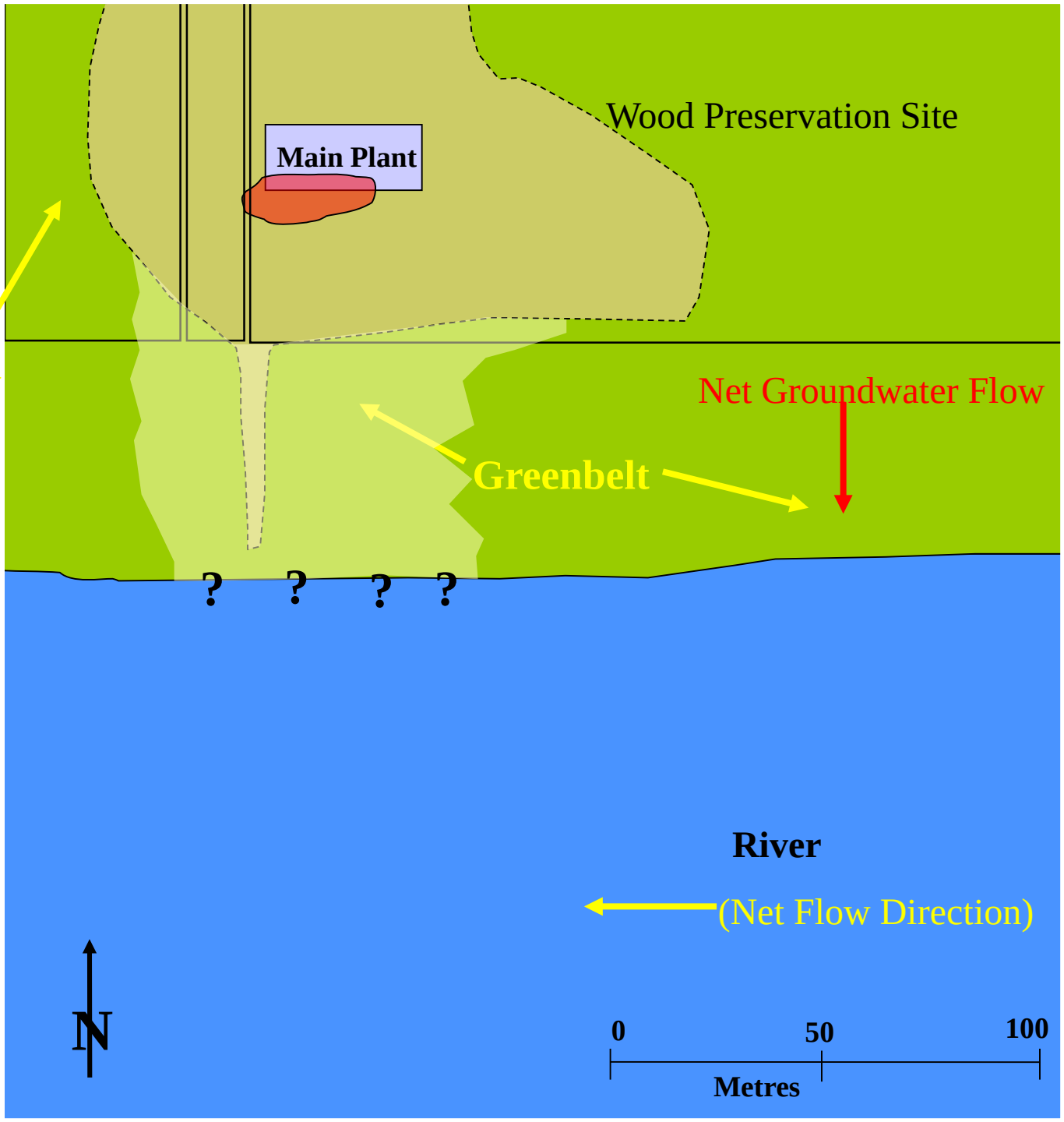
Jim F. Barker, University of Waterloo

Mario Bianchin, Roger D. Beckie, Leslie Smith, University of British Columbia

Plant Area

Looking North to the Site

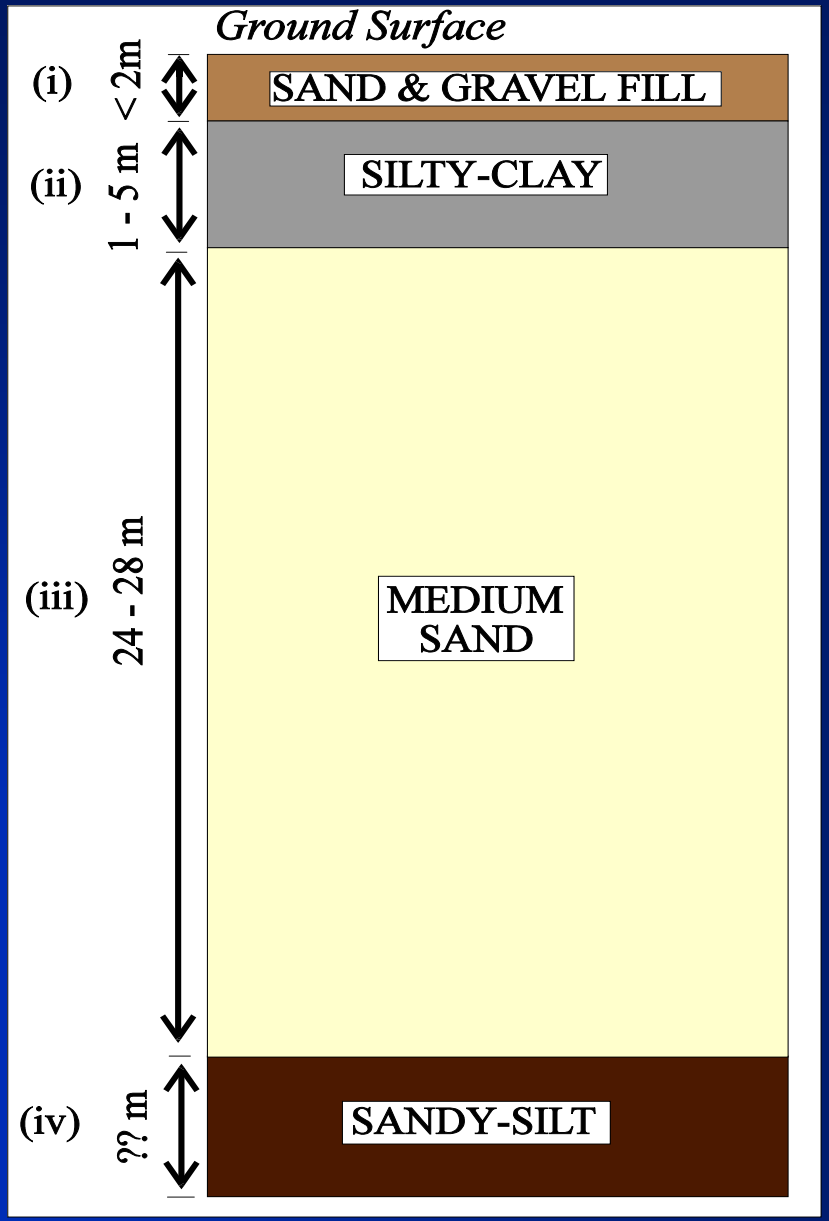
Site Map



Inferred extent of shallow NAPL (<10m)

Inferred extent of deep NAPL (>10m)

Stratigraphy



Objective

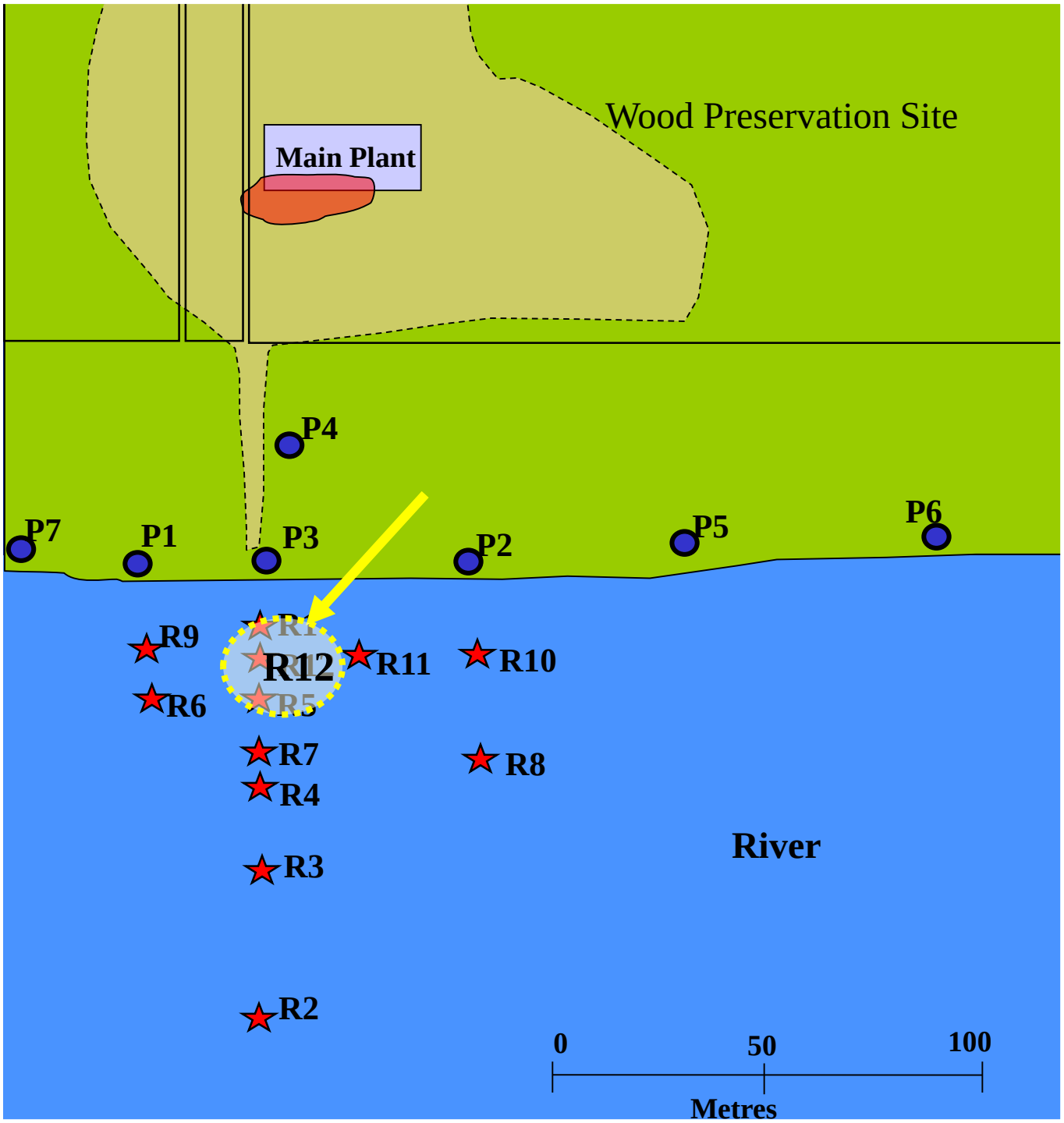
- Develop and implement a methodology to obtain detailed information on the plume that had migrated beneath the river

- Investigate the potential for remediation by Monitored Natural Attenuation (MNA) of the PAHs plume

Methodology

- Detailed site characterization
  - Groundwater
  - Soil
- Microcosms
- $^{13}C/^{12}C$ isotope ratios
- Reactive transport modelling
- ^{14}C-naphthalene tracer test

Site Map

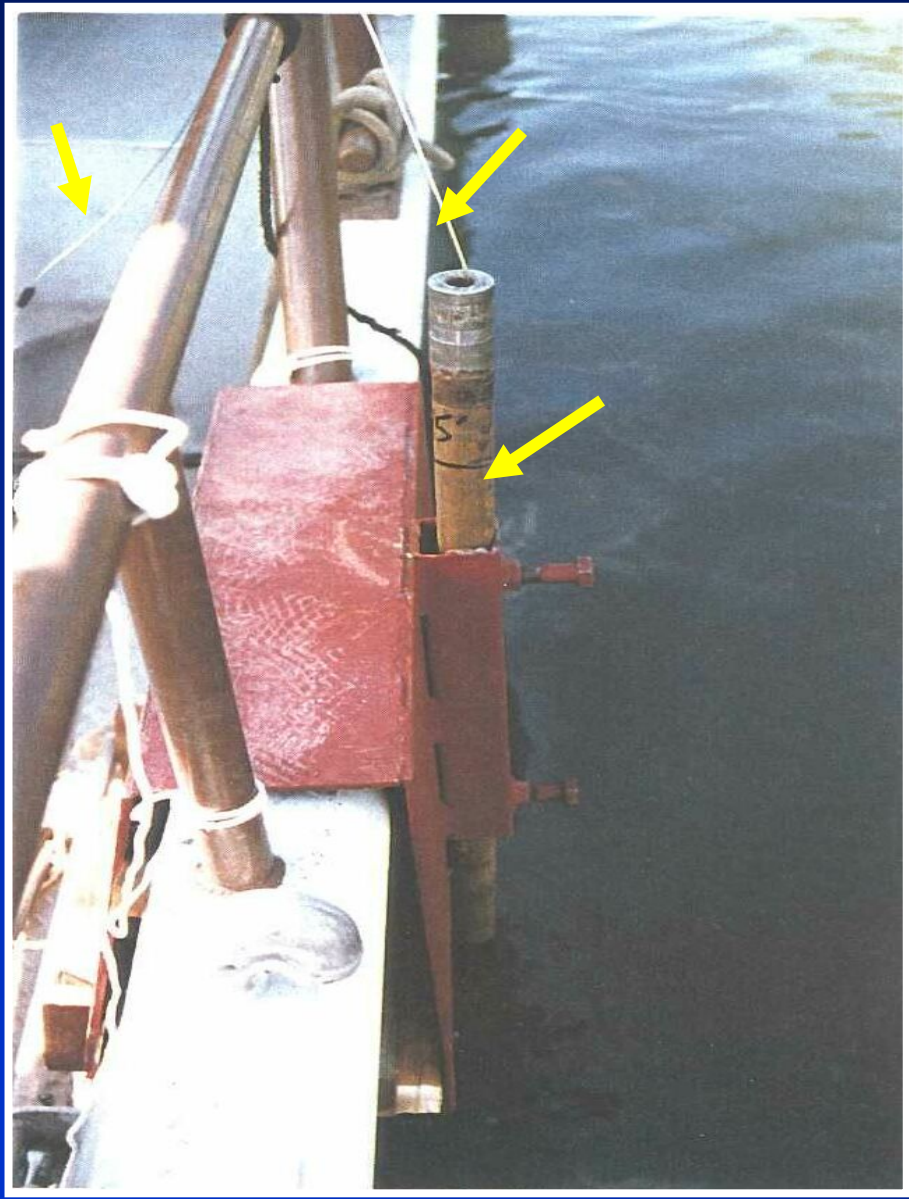


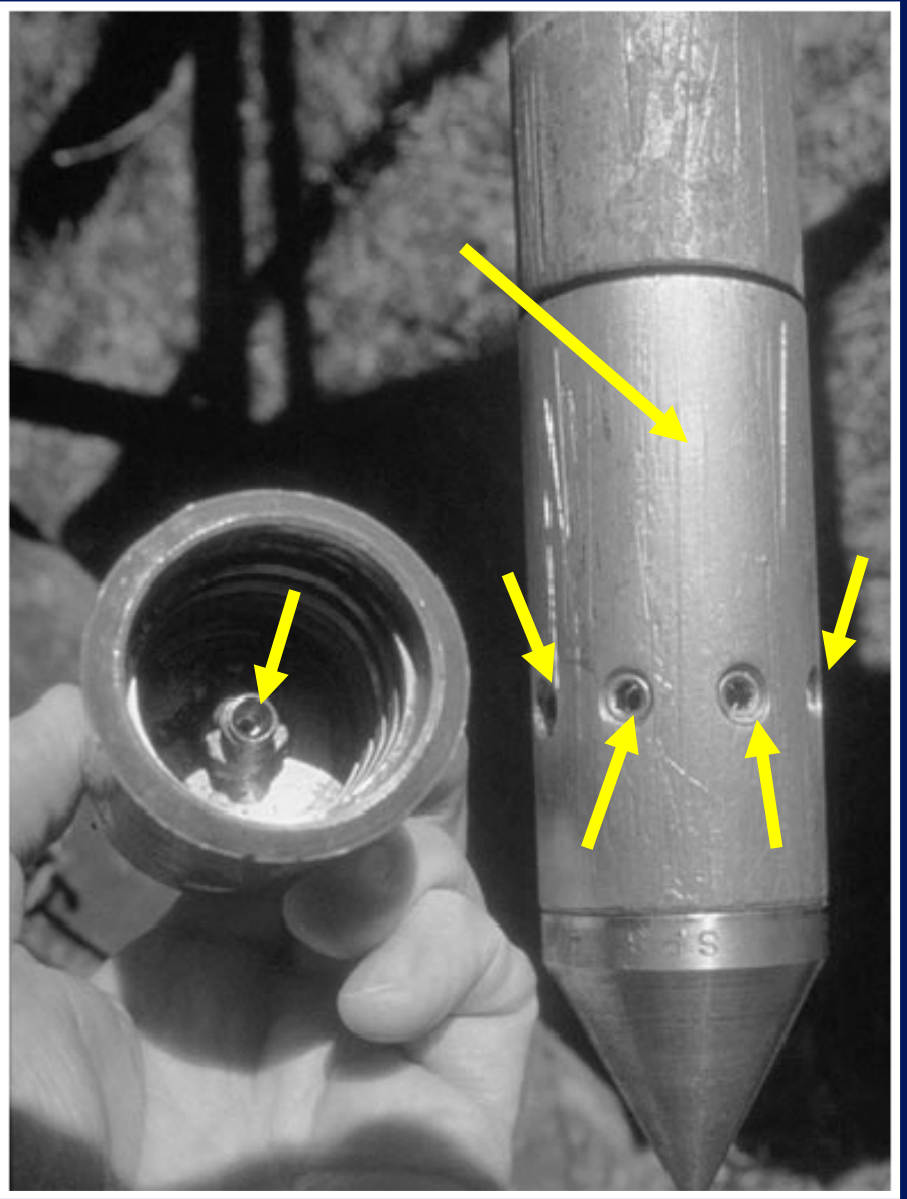
Inferred extent of shallow NAPL (<10m)

Inferred extent of deep NAPL (>10m)

Profiler location

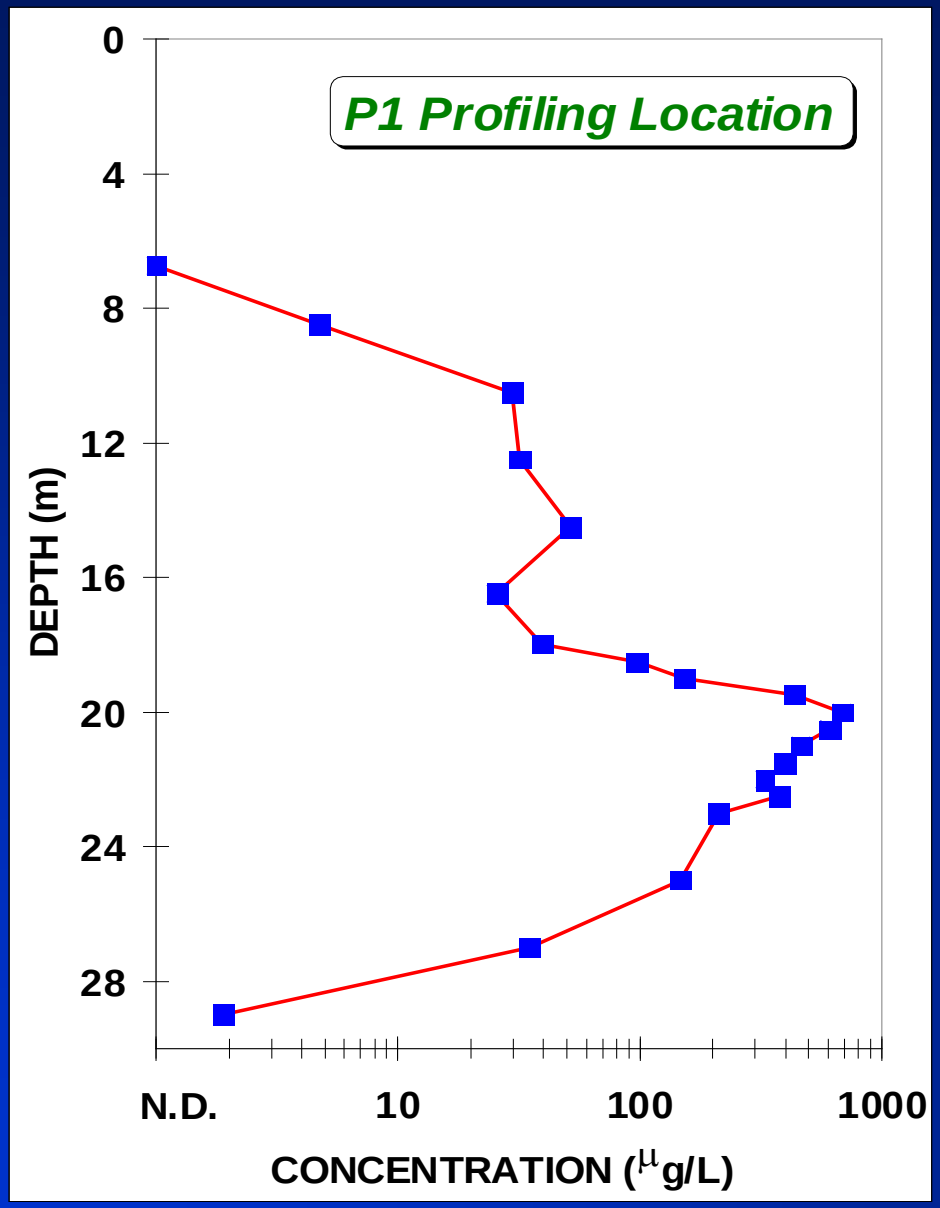
WDPP Set-up

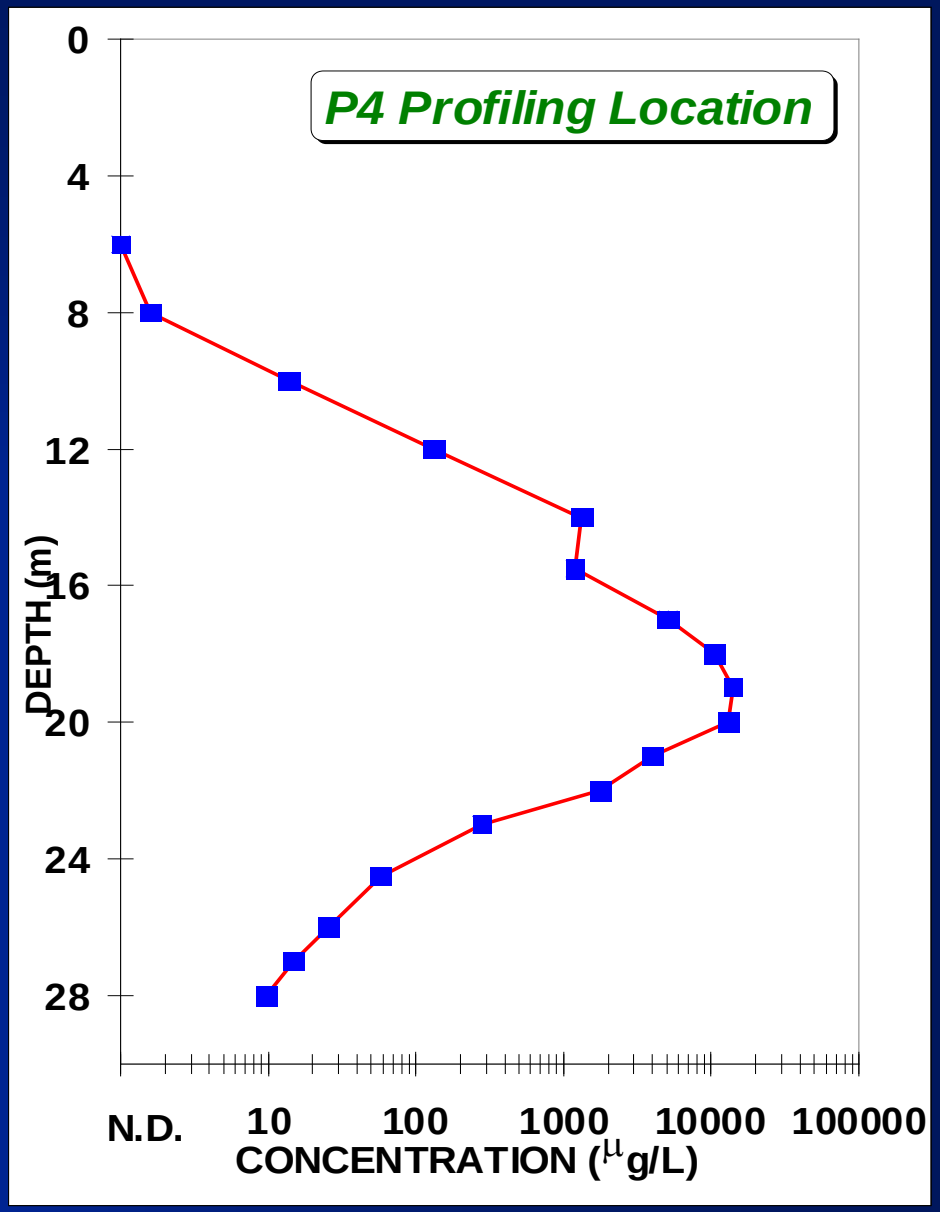




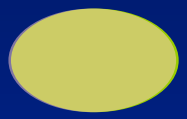
Profiler Set-up

Naphthalene Concentration Profiles





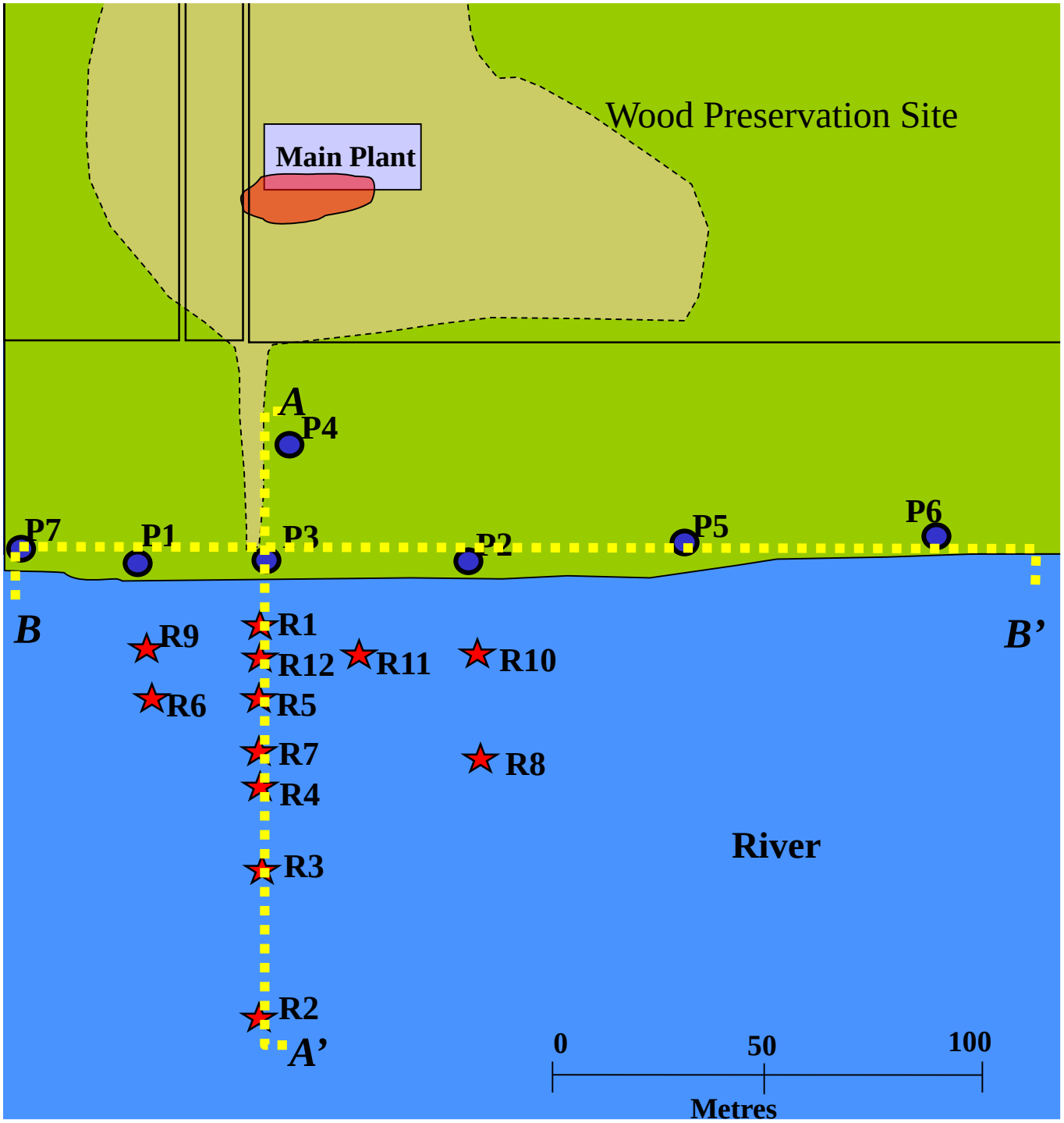
Site Map



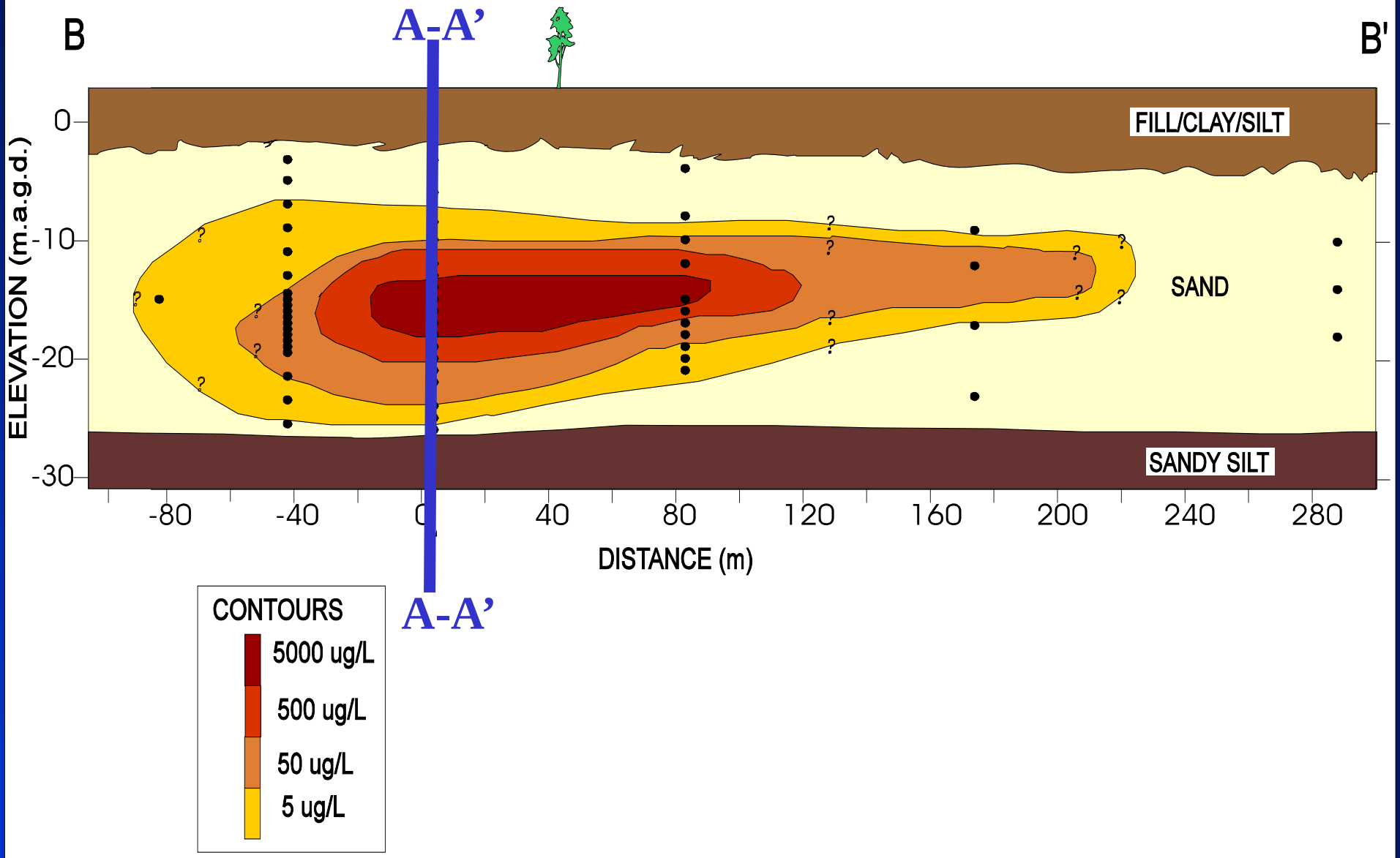
Inferred extent of shallow NAPL (<10m)

Inferred extent of deep NAPL (>10m)

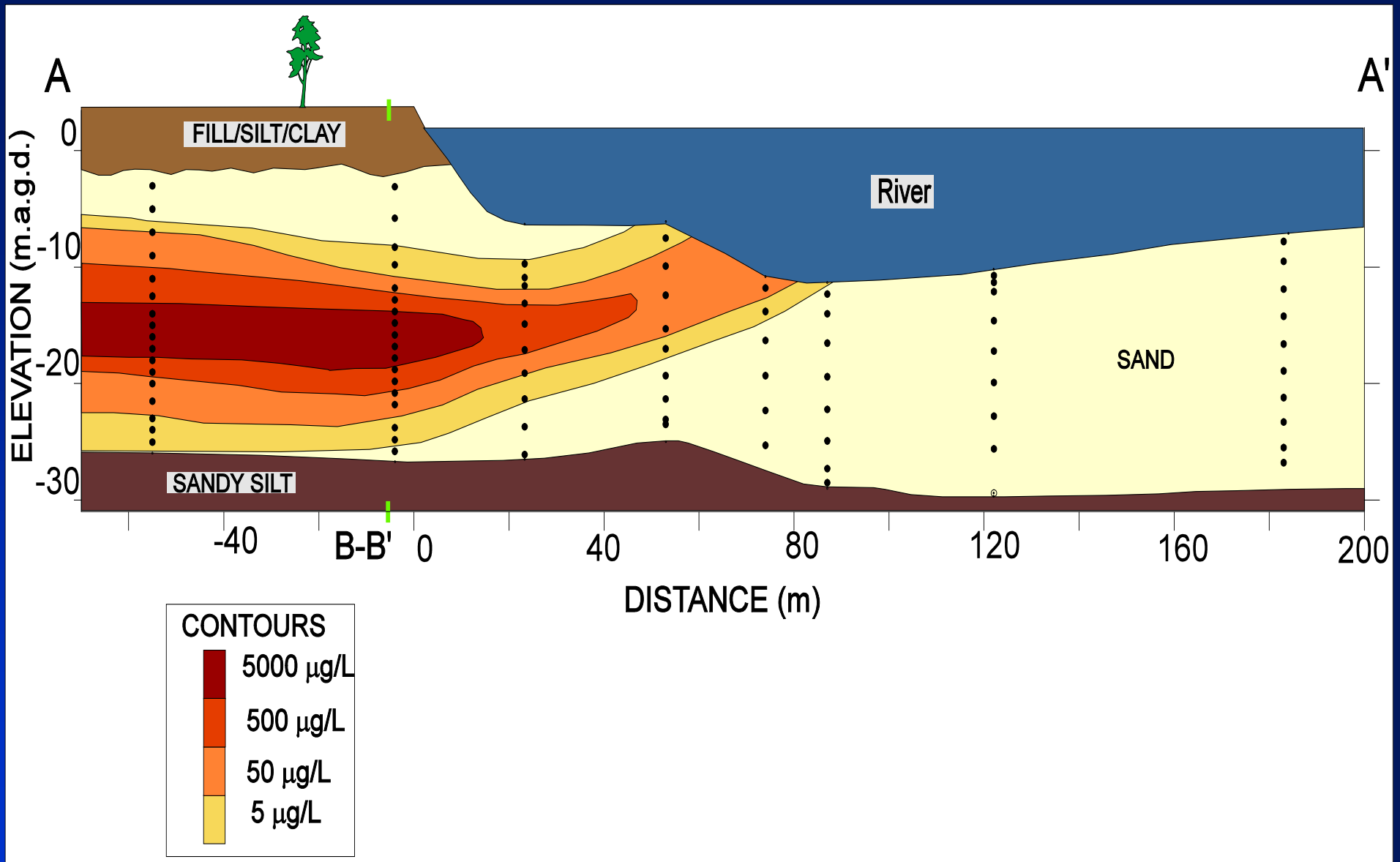
Profiler location



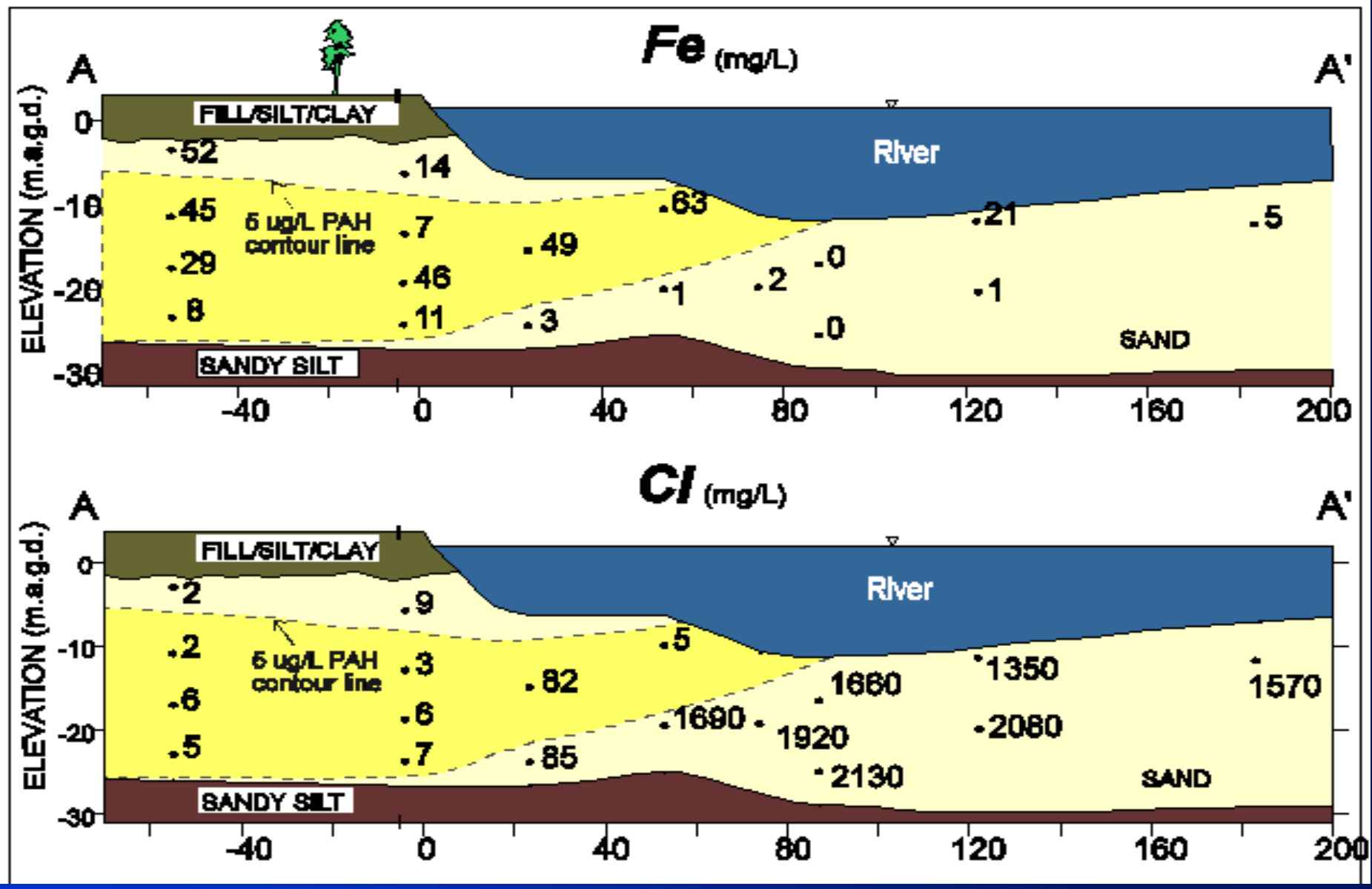
B-B’ Cross Section - Naphthalene



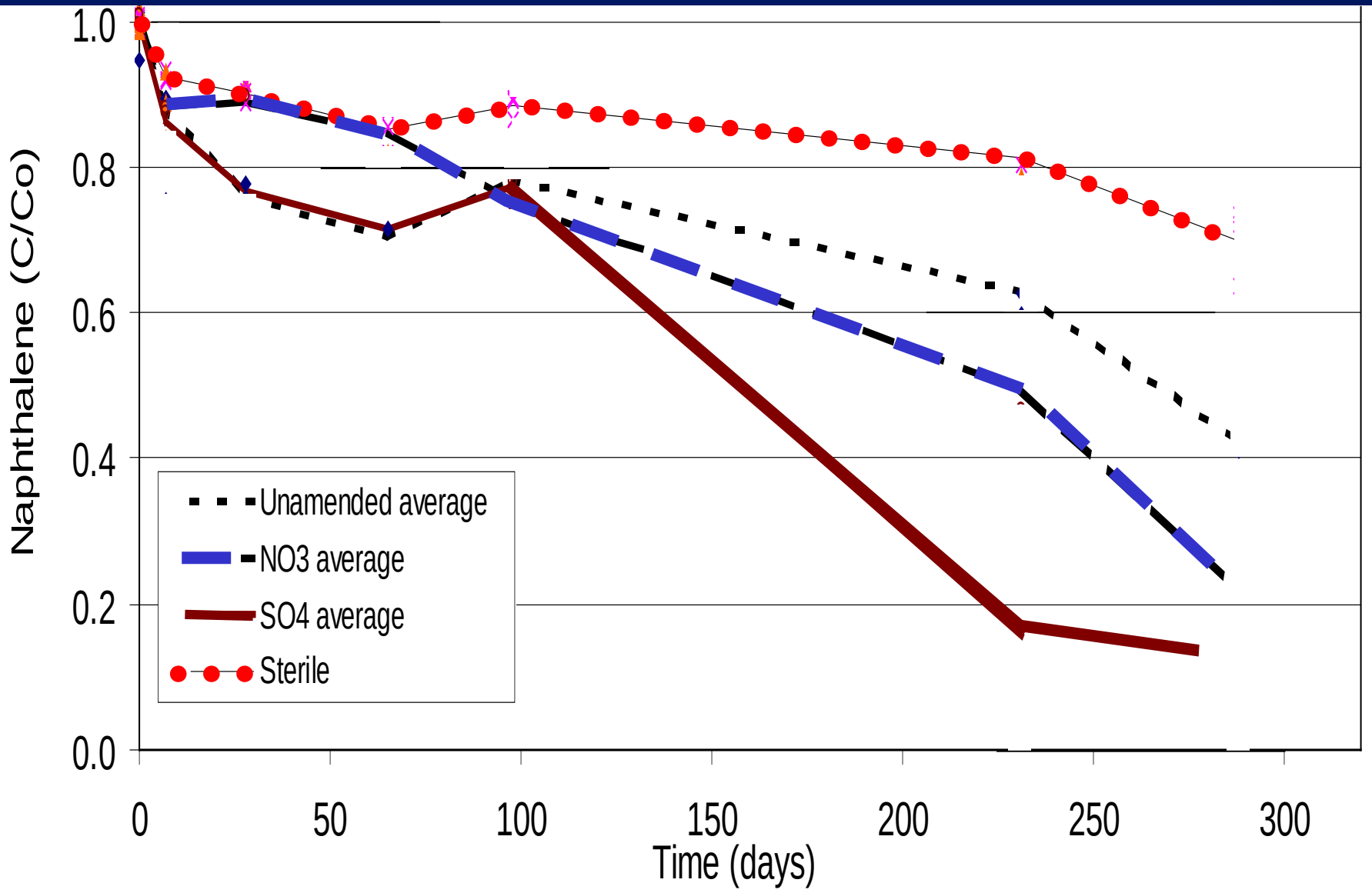
A-A’ Cross Section - Naphthalene



A-A' Cross Sections - Inorganics



Anaerobic Microcosm Results



$\delta^{13}C$ Composition of Naphthalene

- Anaerobic microcosm results
  - Enrichment between 0.7±0.3‰and 1.3±0.3‰
- Plume profiling results
  - Single point more enriched by 1.2±0.08‰
  - Other points show less enrichment
- Results provide some support that anaerobic biodegradation is occurring

^{14}C-Naphthalene Tracer Test

- C/C_0 bromide tracer at approximately 0.8
- Highest detected total radioactivity = 1900 DPM/5ml
  - approximately 35% of average initial radioactivity during injection
- 15 to 71 DPM/5ml as $^{14}CO_2$
  - biodegradation is in part controlling naphthalene concentrations

Reactive Transport Modelling

- Used SALTFLOW
- Modelled transport of 5 PAHs
- Sorption and dispersion alone could not account for drop in naphthalene concentrations
- Needed to include degradation in order to fit model output to field data

Conclusions

- Monitoring of plumes that migrate under deep, fast flowing rivers can be accomplished successfully and economically
- Difficult to obtain high quality data on degradation rates when t_0>1yr
- Further monitoring is needed before MNA can be implemented as a long term solution
  - Anaerobic biodegradation of naphthalene is probably taking place
  - More information on the hyporheic zone needed

Acknowledgements

- Domtar Inc.
- NSERC
- Barbara Butler, University of Waterloo
- Daniel Hunkler, University of Waterloo
- Ramon Aravena, University of Waterloo
- Guy Patrick, Golder Associates