

What do you get when you mix a source of petroleum hydrocarbons in fractured bedrock, a multi-stakeholder consultation group, a complex hydrogeological site, and a Community Based Risk Assessment? A challenge!

REMTECH 2015

Tanya Shanoff, M.Sc., P.Geo.  
Stantec Consulting Ltd.

And

Kerry O'Shea, M.Sc., P.Geo.  
Stantec Consulting Ltd.

# Overview

1 Background

2 Stakeholders

3 Site Setting and Challenges

4 Emergency Response Phase

5 Environmental Site Assessments and Innovations

6 CBRA and Remedial Options

# 1 Background

- Refined petroleum hydrocarbon release from a pipeline into a sensitive environment
- At the time of the release, limited safe access to the release area
- Major rail infrastructure in impacted area
- Adjacent to provincial park, designated as "area of natural and scientific interest"
- Possible presence of species at risk
- Warm water fishery
- Area used by locals for fishing, hiking, rafting











# 1 Background

- **March 2010** – Notification of release and emergency response; initial investigation and estimate that approx. 90,000 liters released
- **March to May 2010** – Design, construction and operation of groundwater containment system
- **October 2010 to February 2011** – Remedial excavation of soil with PHCs
- **June 2011** – Commencement of large scale groundwater containment program
- **August 2011 to present** – continuation of containment, additional site characterization, development of risk management strategy









# 2 Stakeholders



- Owner and operator of pipeline and their shareholders
- NEB as lead regulator, DFO and EC
- Various Groups within Provincial Ministry of Environment
- Provincial Ministry of Natural Resources
- Local Conservation Authority
- Landowners (National railway, Province of Ontario, major crown corporation, major oil company)
- Local municipality, regional municipality and Local Public
- Discussed at Cabinet table – high profile

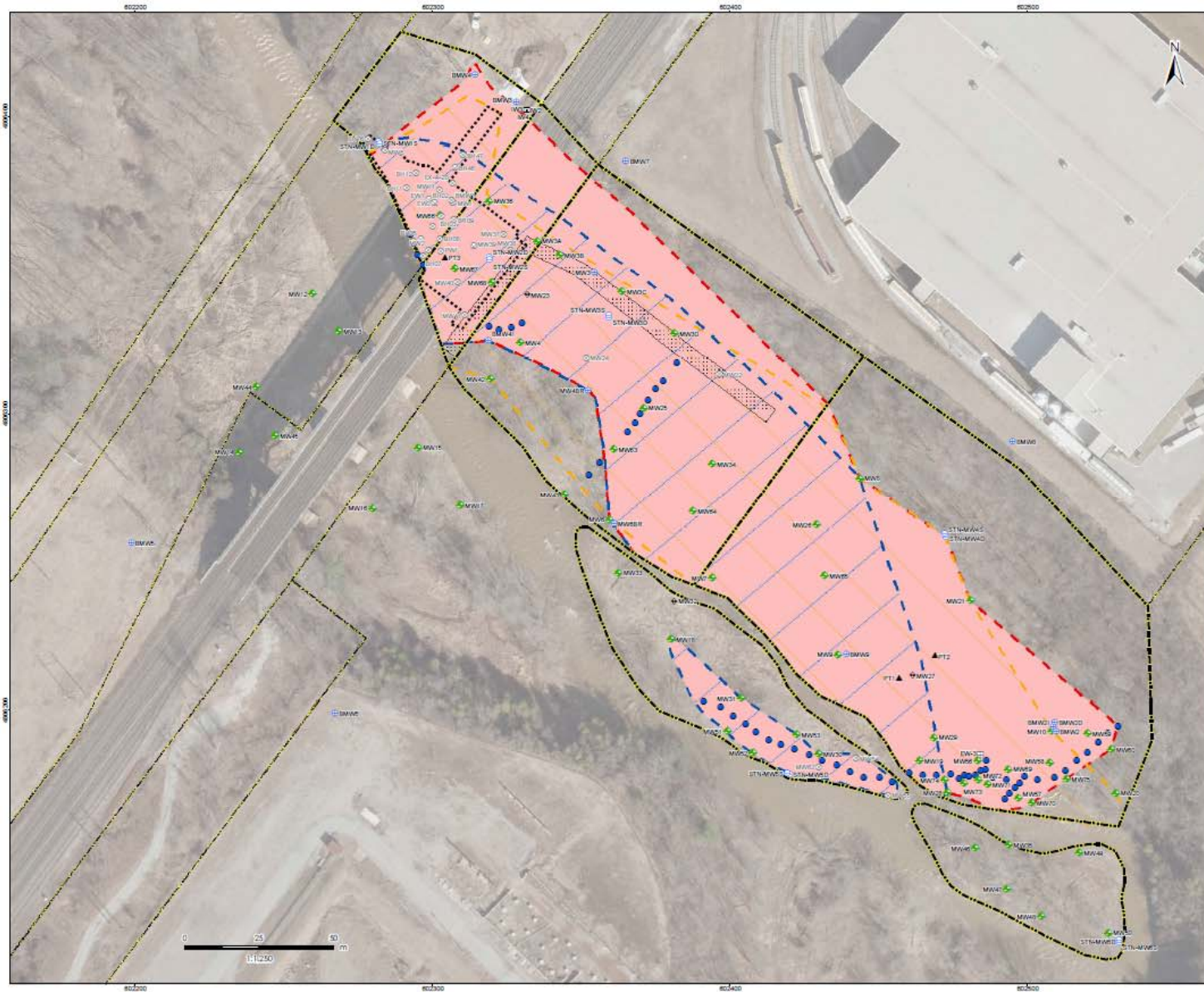


# 3 Site Setting and Challenges

- Soil and Groundwater quality results compared to most sensitive criteria in Province
- Flow in creek from catchment area of 31,550 ha in heavily urbanized setting
- Complex riverine environment with channel incised into shale bedrock
- Uppermost bedrock weathered and fractured
- Spring or Seep located on the slope near the release location
- Groundwater at depth is brackish



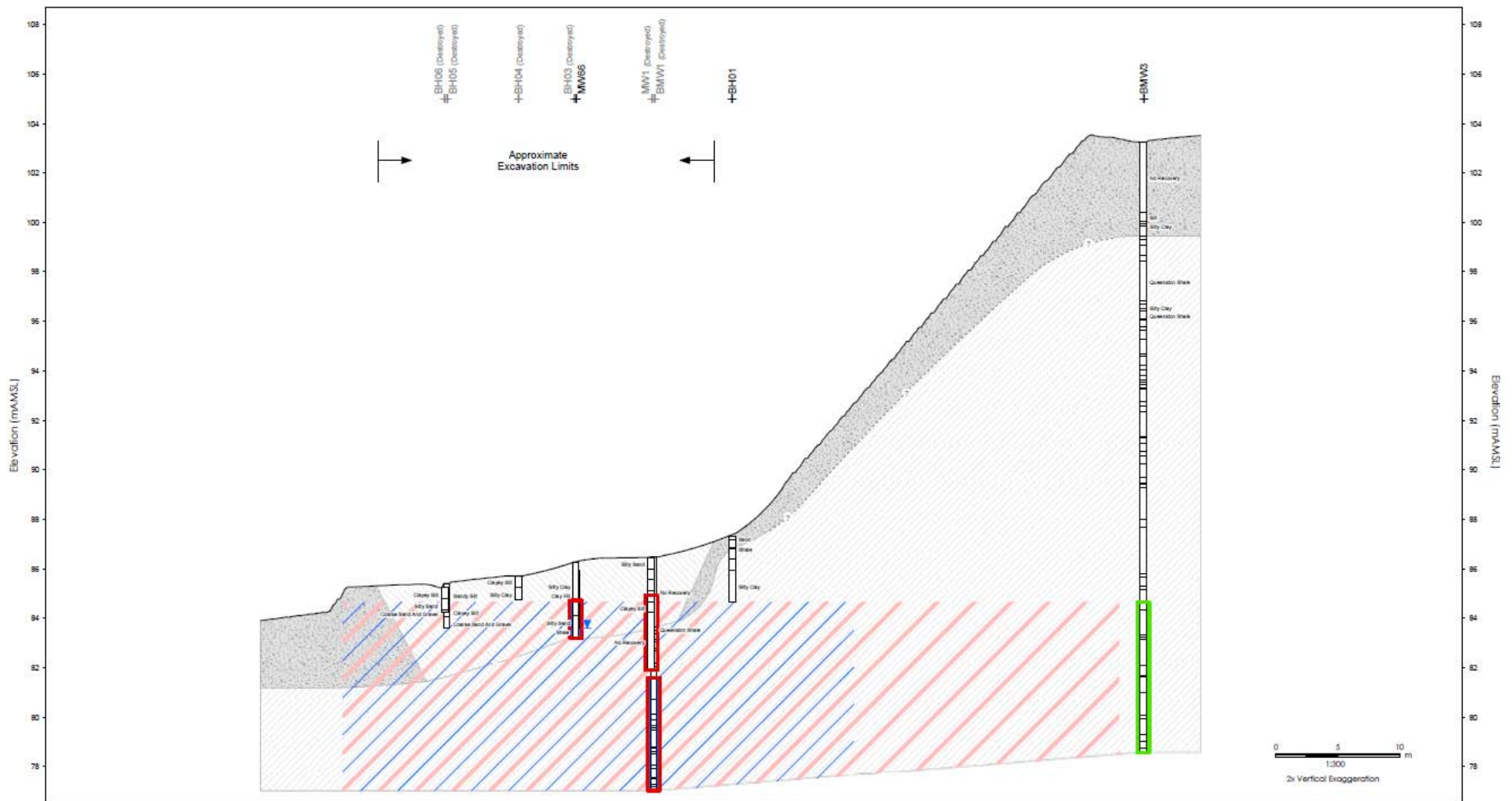
# Plan View of Estimated Extent of Groundwater Impacts



Groundwater Delineation  
- Phase Two Property



# Cross Section from East to West Across Site Showing Groundwater Impacts



Legend

We ID

Stratigraphy

Water Level (May 2, 2012)

Well Screen

—— Ground Surface

 Fill

 Silty Sand to Silty Clay weathered stone

 Tested Parameters Below Regulatory Standards

☐ Tested Parameters Exceed Regulatory Standards

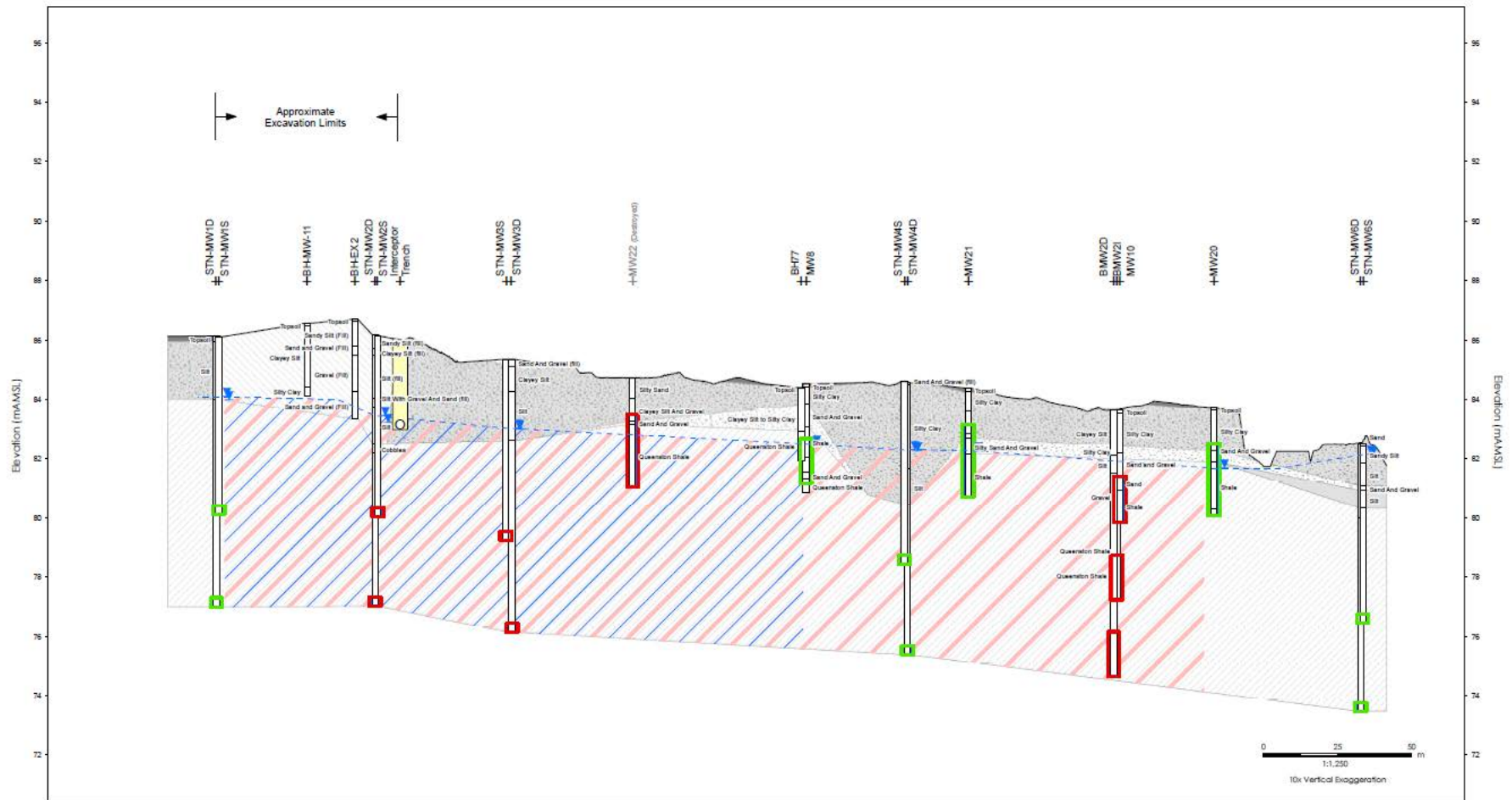
Approximate Extent of BTEX / PHC F1-F4 Exceeding Table 1 SCS

Approximate extent of Hexane Exceeding Table 1 SCS

**Cross-Section A-A' Showing BTEX,  
PHC F1-F4, Hexane Exceedances  
in Groundwater**



# Cross Section from North to South Across Site Showing Groundwater Impacts



## Legend

Well ID  
BH101 (CS m)  
Stratigraphy  
Water Level (May 2, 2012)  
Well Screen

Ground Surface  
Water Table (May 2, 2012)  
Fill  
Sand and Gravel  
Silt  
Silty Clay  
Topsoil  
Weathered Shale

Tested Parameters Below Regulatory Standards  
Tested Parameters Exceed Regulatory Standards  
Approximate Extent of BTEX / PHC F1-F4 Exceeding Table 1 SCS  
Approximate Extent of Hexane Exceeding Table 1 SCS  
Interceptor Trench Pipe  
Interceptor Trench

**Cross-Section E-E' Showing BTEX,  
PHC F1-F4, Hexane Exceedances  
in Groundwater**



# 4 Emergency Response Phase

## Access

- Building a temporary bridge for access
- Roads on-site
- Equipment descends from top of slope





# 4 Emergency Response Phase

## Investigation, Delineation and Excavation

- Boreholes and monitoring wells
- Pipeline exposure and confirmatory sampling
- Collection trench on valley floor
- Remedial excavation on valley floor



*Photo from Petroleum Hydrocarbon Subsurface Investigation and Preliminary Remedial Action Plan (April, 2010), MMM Group*



# 4 Emergency Response Phase

## Groundwater Containment System

- Initial design
- Pump testing
- Containment system design and ACMP implementation





OK5





## Slide 17

---

**OK5**

this is the old system....we have much nicer system now if you want to have a transition from old to new? and we need to point out that tis is not a Stantec design.

O'Shea, Kerry, 29/09/2015

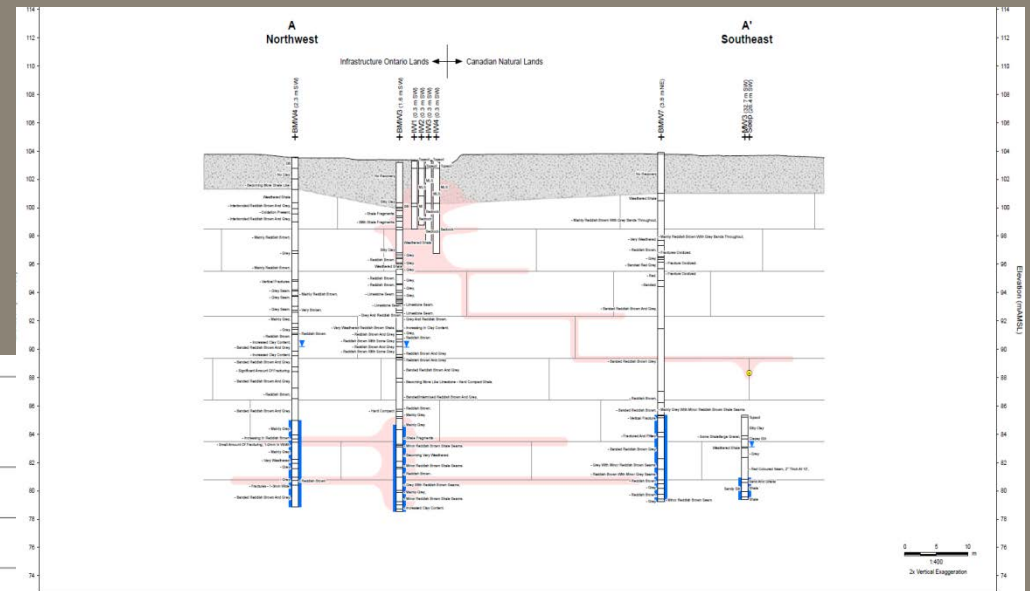
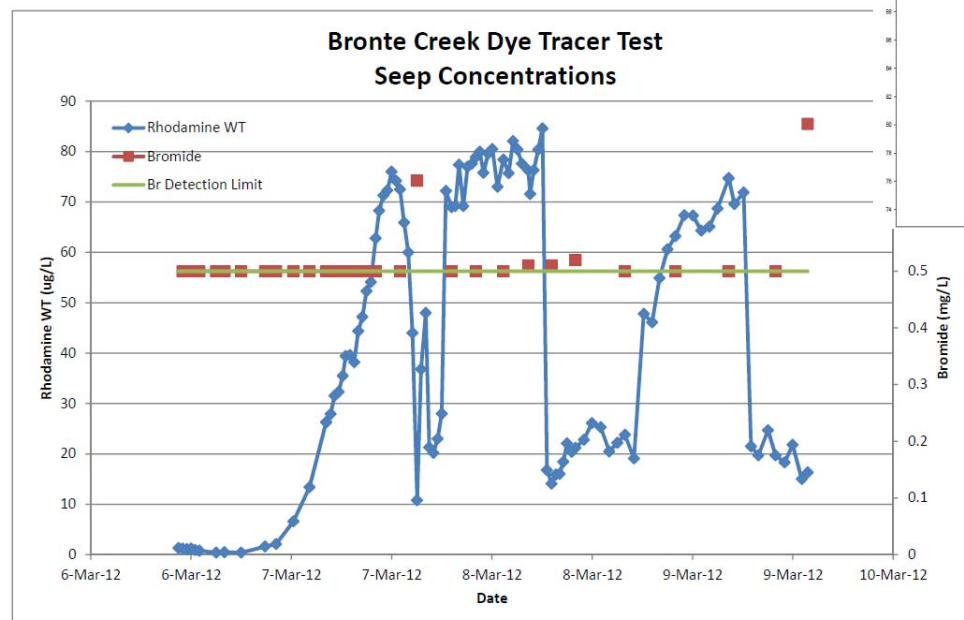
# 5 Environmental Site Assessments and Innovations

- Dye Tracer Test
- Injected 1000L of Rhodamine and Bromide
- Monitored and sampled for 96 hours
- Visual detections at a seep





# 5 Environmental Site Assessments and Innovations

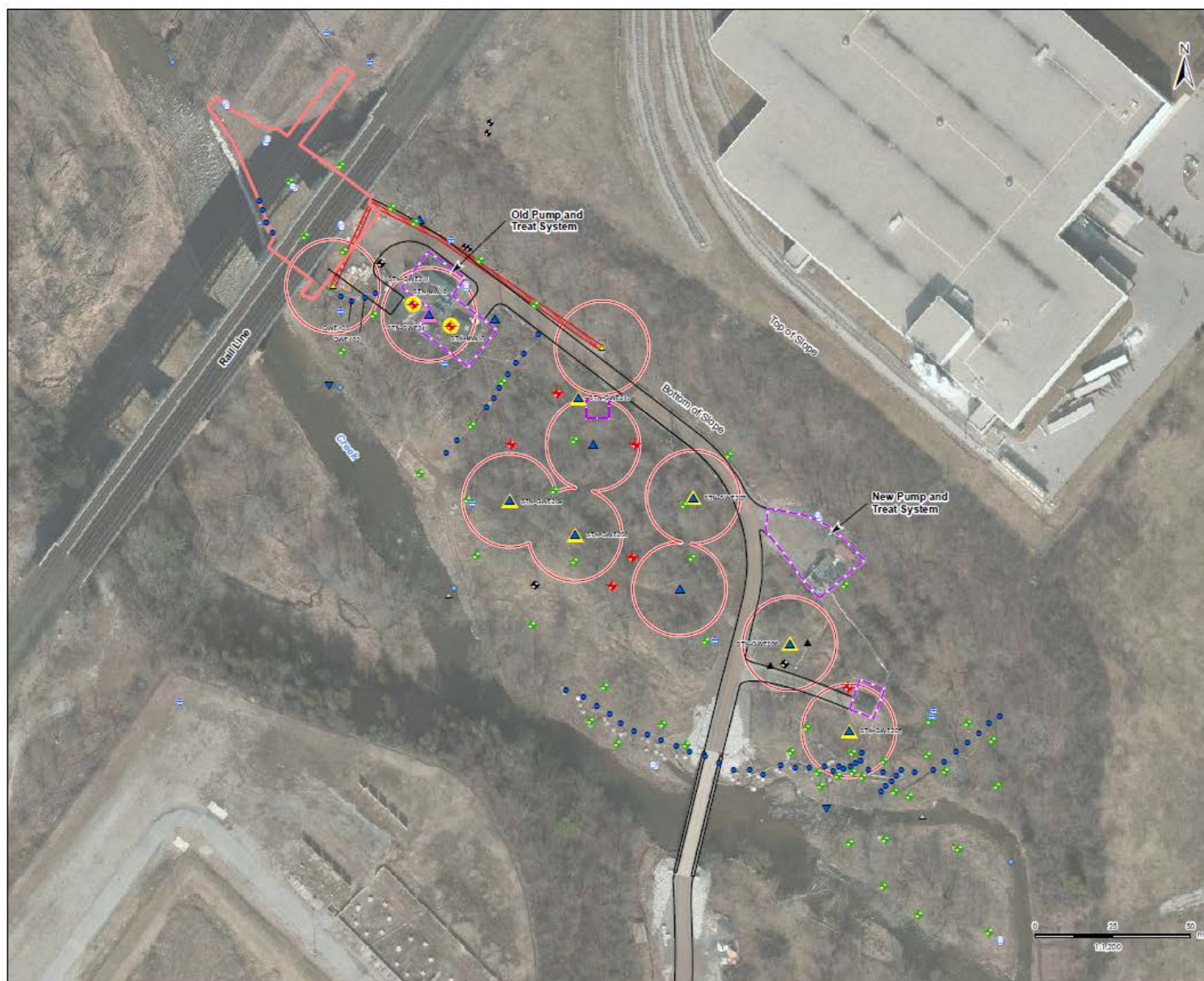


# 5 Environmental Site Assessments and Innovations























- Hydrogeological Assessment and Angled Borehole Drilling Program
- Sediment Sampling







**Legend**

-  2" Monitoring Well
-  4" Monitoring Well
-  2" Monitoring Well (2014)
-  2" Bedrock Monitoring Well Location
-  1" Angled Bedrock Monitoring Well (2013)
-  2" Bedrock Monitoring Well (2012-13)
-  Groundwater Extraction Well
-  Groundwater Extraction Well
-  Surface Water Gauge (2014)
-  Surface Water Gauge (Destroyed)
-  Surface Water Sampling Location
-  Extraction Well Location
-  Pump Test Well Location
-  Sump
-  Interceptor Trench
-  Approximate Limit of Remedial Excavation
-  Access Road
-  Approximate Location of Groundwater Pump and Treat System Infrastructure
-  NEW 2" Monitoring Well (Stantec 2014)
-  NEW Groundwater Extraction Well (2014)
-  NEW Groundwater Extraction Well (2015)
-  Area of influence - 5 cm drawdown

**Notes**

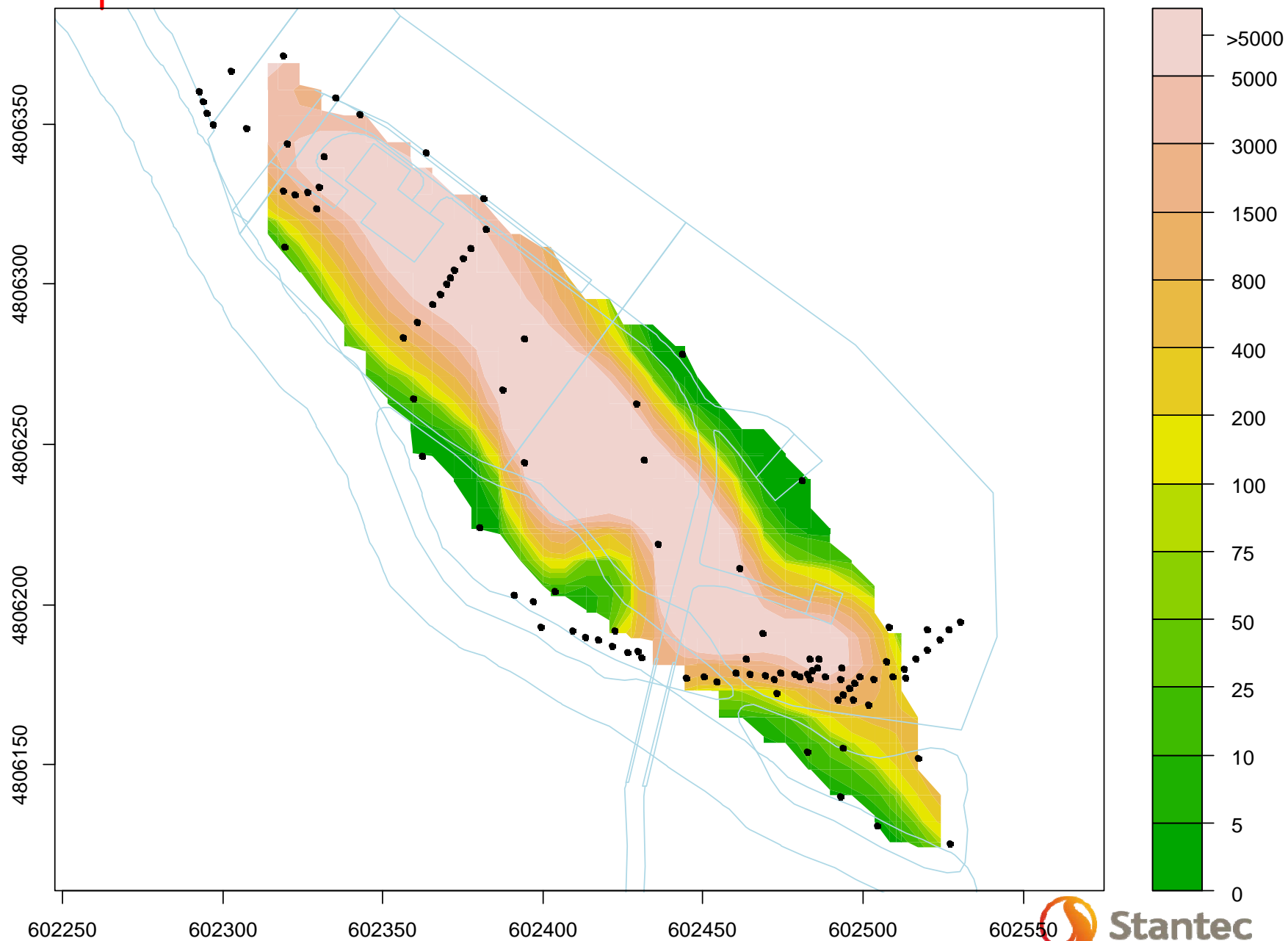
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Aerial Imagery provided by First Base Solutions, 2012.
3. The locations of features shown are approximate.

August 2015

Figure No. 3

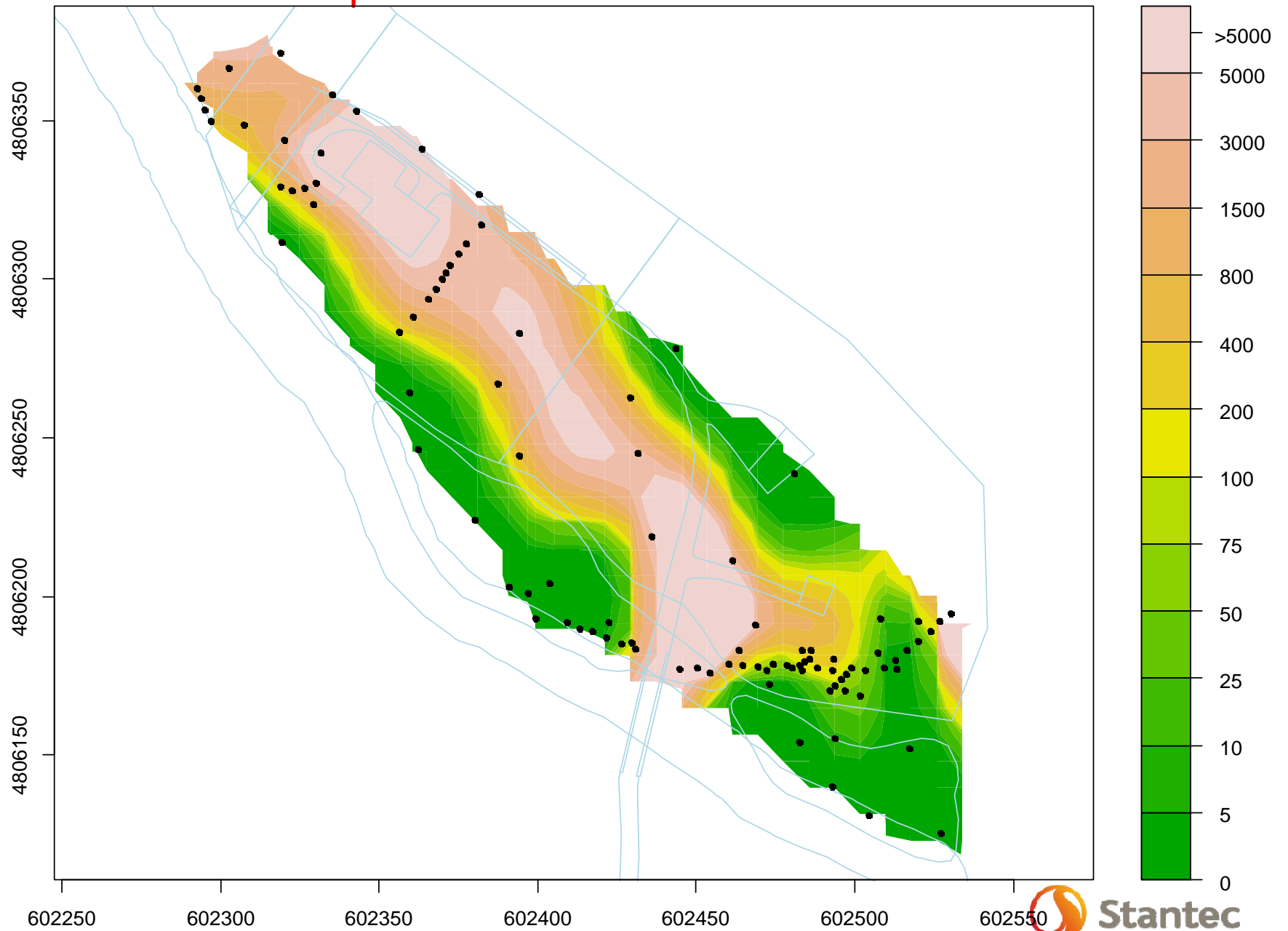
Title  
**Extraction System Infrastructure and Monitoring Wells**

Benzene : 14-May-2010 to 13-Jun-2010 : Aquifer-A

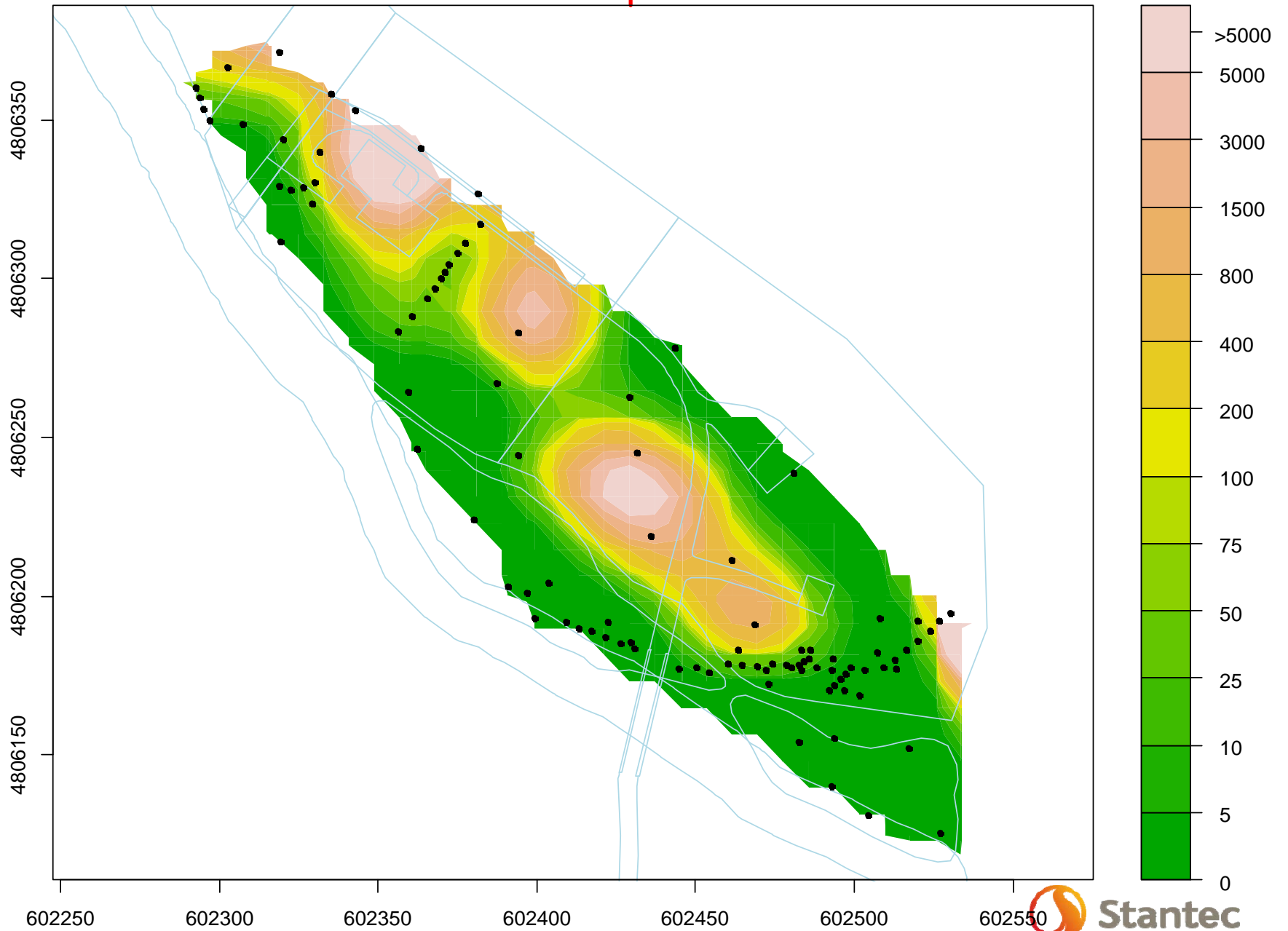




Benzene : 14-Apr-2011 to 13-May-2011 : Aquifer-A

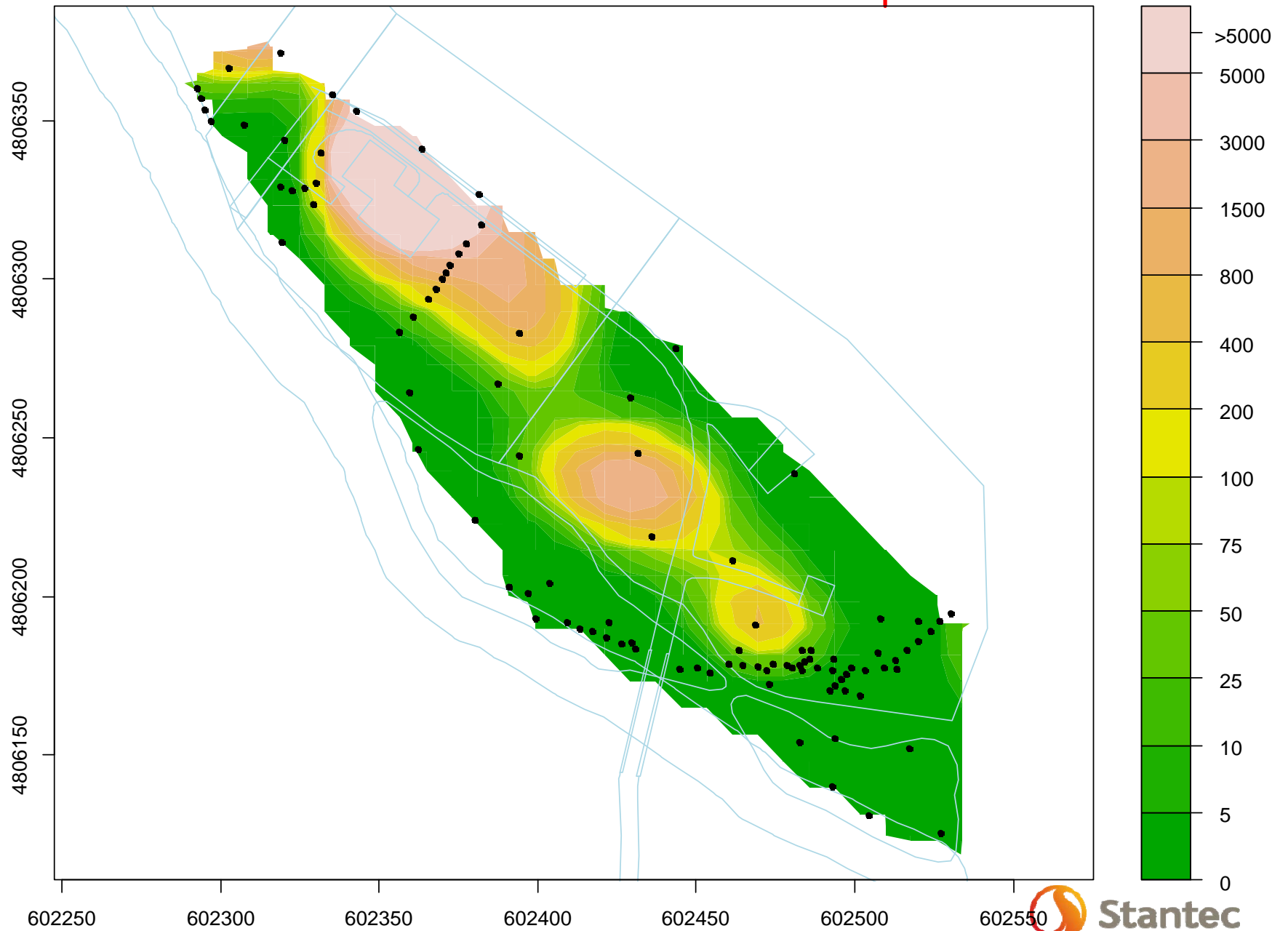


Benzene : 14-Apr-2012 to 13-May-2012 : Aquifer-A

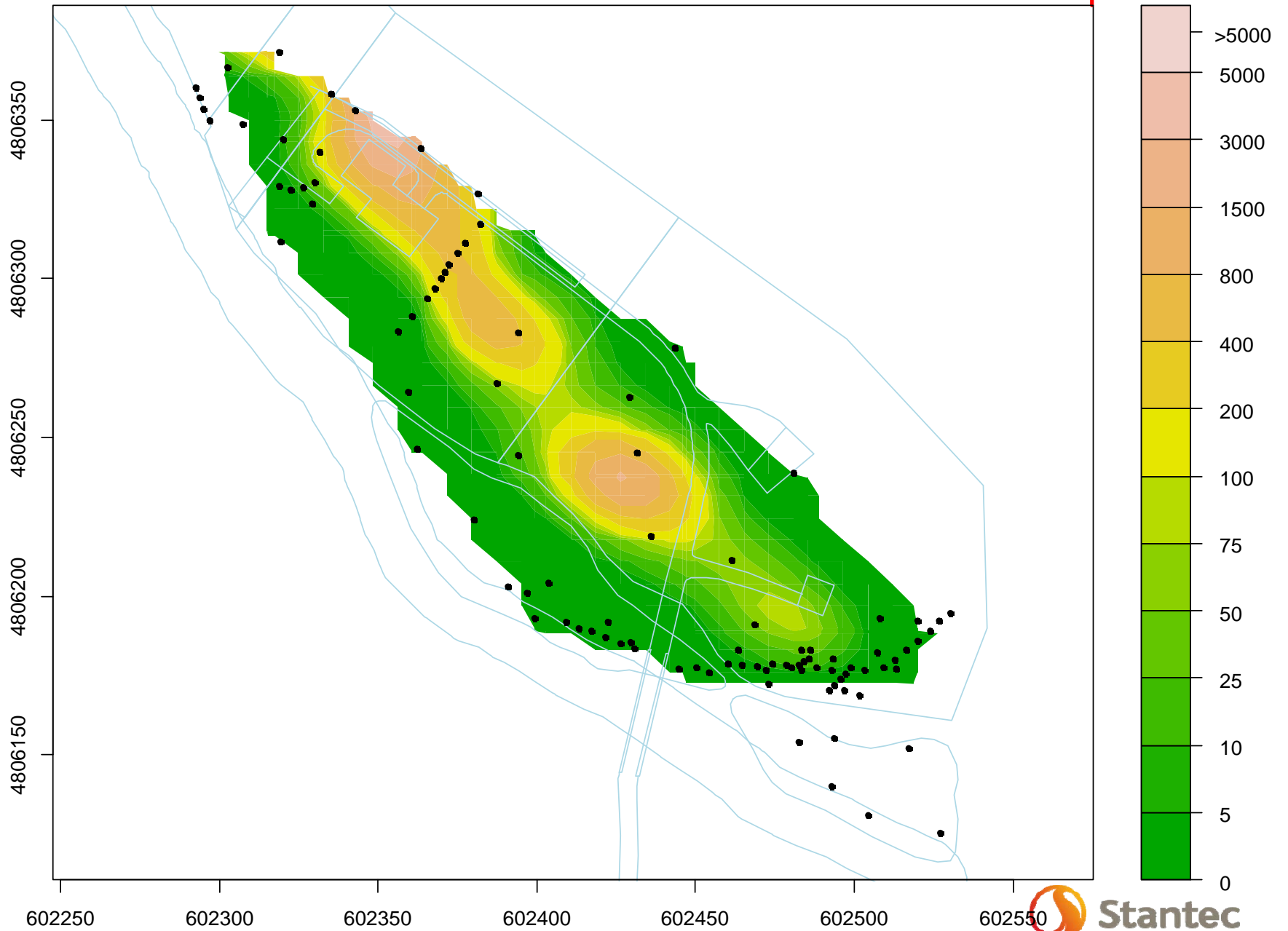




Benzene : 14-Mar-2013 to 13-Apr-2013 : Aquifer-A

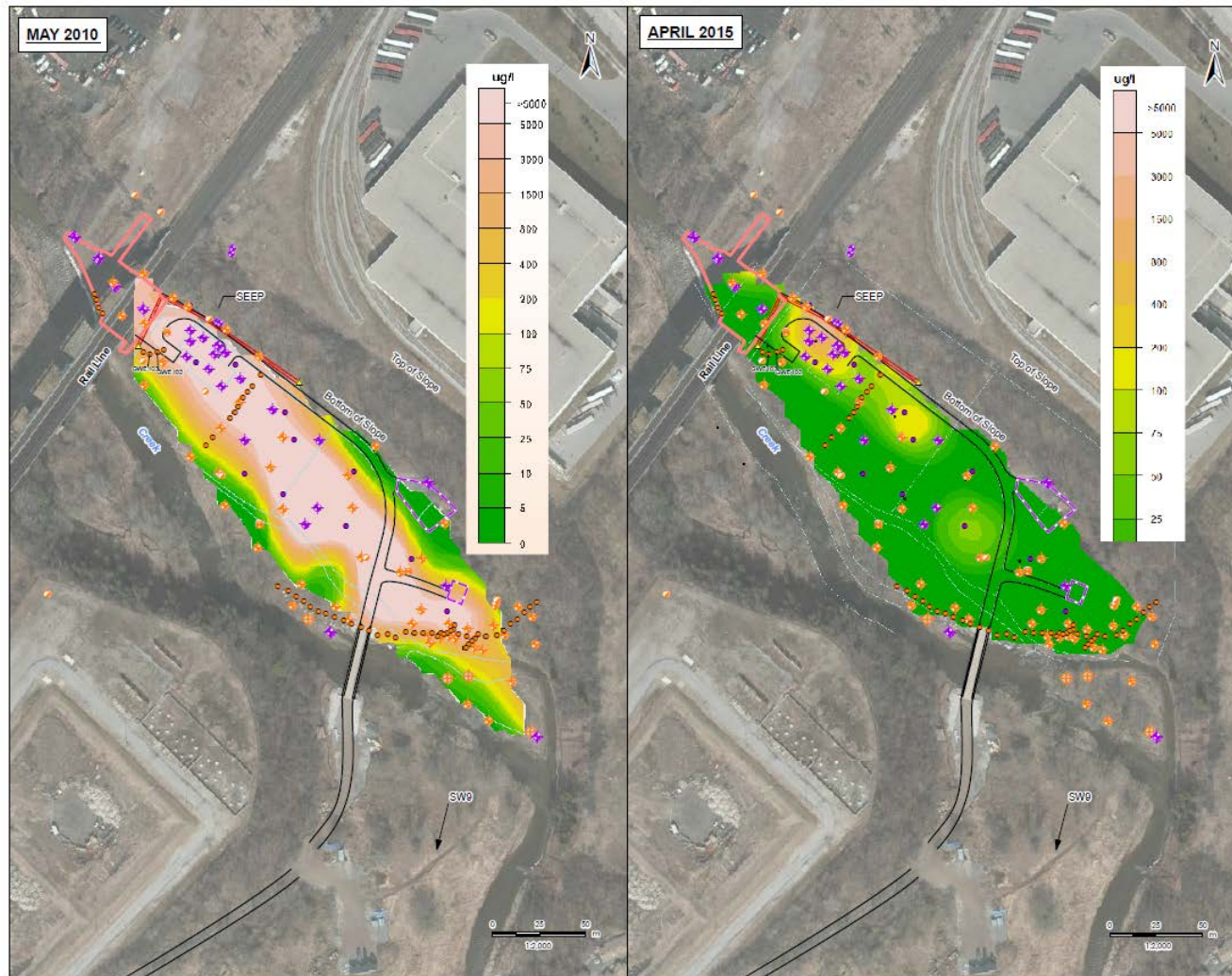


Benzene : 14-Dec-2013 to 13-Jan-2014 : Aquifer-A





# Overburden Benzene Concentrations May 2010/April 2015



# 6 CBRA and Remedial Options



- **Approach 1** – Do Nothing
- **Approach 2** – Dig and Dump
- **Approach 3** – Excavation and Hydraulic Containment
- **Approach 4** – CBRA and Remediation



# Approach 1 – Do Nothing

Political + a challenge due to potential input of PHCs into creek + no stakeholder buy-in + NEB order to remediate

= **Not an option**

# Approach 2 – Dig and Dump



- Remove contaminated soil to depth
- Estimate removal from 3 to 4 mbgs
- Area of contamination extends approximately 100 m by 350 m
- Estimated volume of soil and weathered shale = 140,000 m<sup>3</sup>
- Require truck traffic for soil transport and disposal



# Approach 2 – Dig and Dump

Over 15,000 truck loads of material removed/replaced  
+ full year program in excess of 12 hrs/day + Impacts to  
roads, surrounding neighbourhood

= Fishery decimated, 100% destruction of existing eco-  
system and generations for growth/diversity to reach  
current levels

# Approach 3 - Excavation and Hydraulic Containment

Selected excavation of zones with PHCs + groundwater control to contain dissolved phase PHCs + treat water and monitor site for years

= Long term process that is disruptive to local ecosystem and end point potentially cannot be achieved



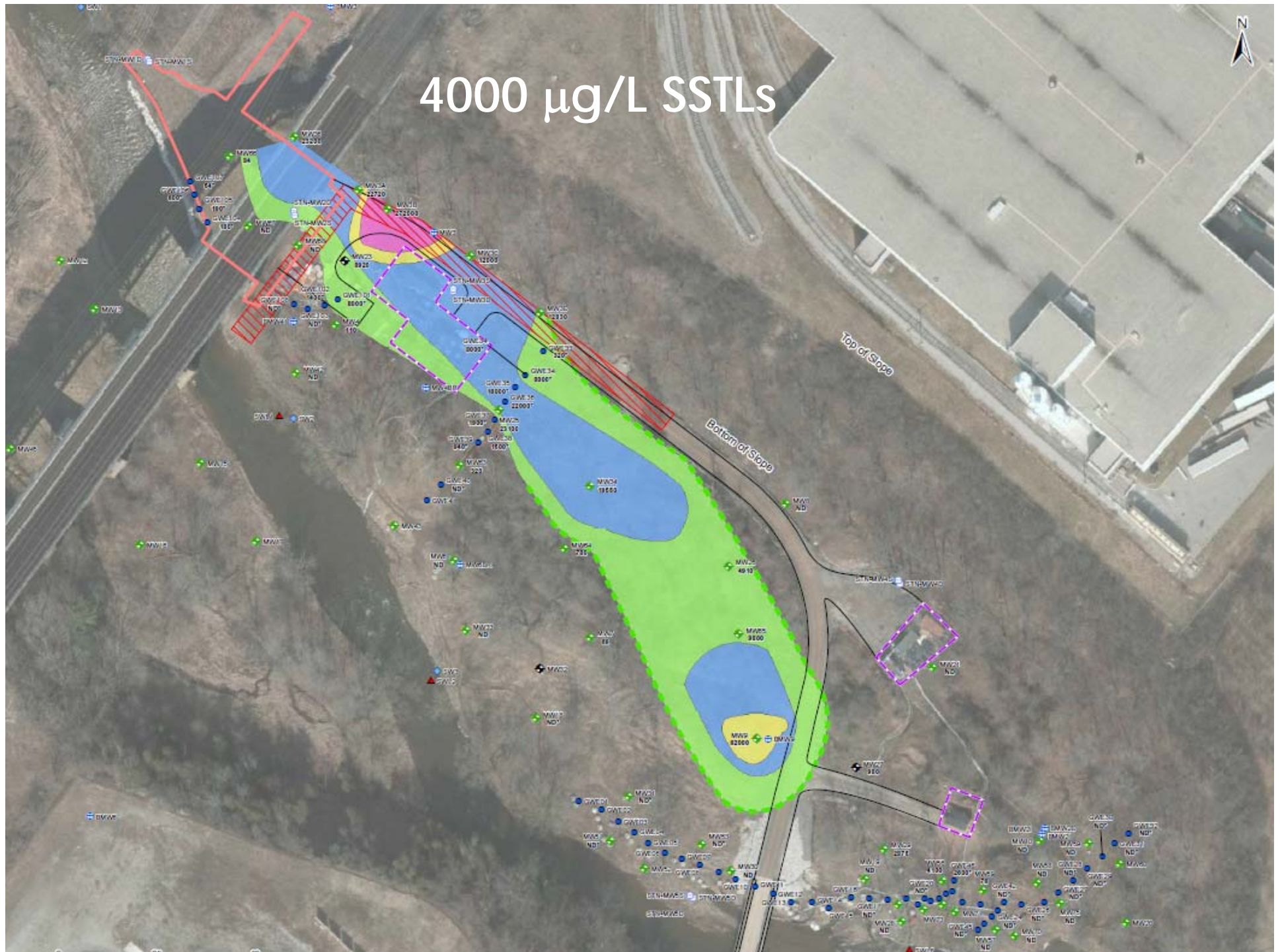
# Approach 4 - CBRA and Remediation

- Use site specific target levels (SSTLs) that are protective of ecological and human health
  - Completed following government and scientifically accepted process of determining risks based on exposure pathways and toxicological data
  - Follows standard approach – problem formulation, tox assessment, exposure assessment, risk characterization
  - Supplemented by toxicity testing (lab trials) of sediments, water and soil
- Groundwater, surface water, sediment and soil considered
- Soil removal not required or recommended\*
- Groundwater containment system remains operational but modifications being implemented

**= Protective of Ecosystem**

\*Discussions with MOE SDB ongoing regarding these SSTLs

4000  $\mu\text{g/L}$  SSTLs





# Remediation Strategy



- Risk Assessment establishes achievable soil and groundwater target levels
- Literature review suggest near river environments may have high rates of biodegradation
- Assess naturally occurring biodegradation of PHC to determine if this process will remove mass

# Conclusions



- Complex Site Setting
- Multiple approaches for site characterization and delineation
- Groundwater containment system has been key/will continue to be part of remedial approach
- Using RA approach, and focusing on sustainable remediation, provides best alternative
- Working with existing site characteristics and natural processes provides opportunity to retain key characteristics of the creek valley



Questions?

