Sydney Tar Ponds & Coke Ovens Remediation Project

Coastal Zone Marine Environmental Effects Monitoring: Sydney Tar Ponds and Coke Ovens Remediation Project
Topics

• Brief Orientation and History
• The Project
• Marine Effects Monitoring Program
• Monitoring Outcomes
• Lessons Learned
• Questions
Sydney
Site Characteristics

Tar Ponds
- 32 hectare area, 700 000 tonnes coal tar contaminated sediment
- Estuarine Environment
- 45,000 tonnes of sediments contaminated with varying levels PCBs
- Duration: 7 years

Coke Ovens
- Upland 72 hectare area, 25 000 tonnes tar cell, 560 000 tonnes contaminated soils from coking, underground structures & piping
- Duration: 6 years
The Project

Tar Ponds
Treat material in place with solidification and stabilization, then encapsulate with a multi-layered, engineered cap.

Coke Ovens
Treat ex-situ contents of tar cell (25,000 tonnes) with solidification and stabilization, then encapsulate the rest of the site with a multi-layered, engineered cap.
Site Map-Surface Water Stations
Marine Sampling Stations

Figure 3-1
New Marine Water Stations

Legend
- Marine Stations

Marine Areas
- Area 1
- Area 2
- Area 3
- Area 4

Transect for Histogram Figures
Marine Effects Monitoring Program

• Deep and surface layer water quality

• Crab Tissue Chemistry

• Mussel Tissue Chemistry

• Benthic and Inter-Tidal Zone Biodiversity

• Surficial Benthic Sediment Chemistry

• Mass Balance
Deep and Surface Layer Water Quality

• Sampled for all stations monthly during ice free conditions

• Surface and deep layer water column

• 716 samples in total, split evenly

• Analyzed for organics (PAHs and PCBs), metals and physical characteristics (pH, salinity, TSS, turbidity, conductivity)
Marine Water Quality Monitoring Outcomes-TSS

Figure 4-2  Monthly variation in TSS concentrations in shallow (a) and deep (b) water samples during baseline, Year 1, Year 2 and Year 3 Construction.
Marine Water Quality Monitoring Outcomes - PAHs

Figure 4-12: Mean pyrene concentrations in shallow (a) and deep (b) seawater during baseline, Year 1, Year 2 and Year 3 Construction.
Outcomes-Marine Water Quality

• Joint Panel Review concluded no significant biological impacts to marine water quality with mitigation

• For all analytes, no significant increases

• No increasing parameter trends

• EIS predictions confirmed
Outcomes-Crab Tissue Chemistry

• Sampled annually for all marine sampling stations

• Whole body and hepatopancreas targets

• No bioaccumulation noted for PAHs or PCBs (non-detect)

• Very low metal accumulations noted, all within baseline ranges

• Joint Review Panel prediction of no significant biological impacts to marine organisms with mitigation partially confirmed.
Outcomes- Mussel Tissue Chemistry

• Blue Mussels suspended for all sampling stations
• Sampled annually (with replacement)
• Whole body loadings
• No PAH or PCB bioaccumulation
• Metals accumulations were noted for far-field sampling stations at Northwest Arm and Sydney River (sampling areas 3 and 4 respectively)
• Not biologically significant
• Not attributable to Project influences
Outcomes-Sediment Chemistry

• Surficial sediments sampled annually

• Low sedimentation rates required top 1 cm target

• Analysed for PAHs, PCBs, metals and physical characteristics
Total PAH Concentrations in Sediments-All Years

Figure 4-53 Total PAH Concentrations in surface sediments
Outcomes-Sediment Chemistry

- Year 1 PAH results substantively higher than baseline

- Full review of upstream monitoring results and mitigation efficacy

- Exploration of possible alternative sources of PAHs (other urban and industrial activities, re-suspension events).

- Investigation into possible sampling error (none found)

- Evaluation of potential lab protocol errors (none found)

- Two independent confirmatory mass balance calculations
Outcomes- Sediment Chemistry

• Substantive reductions in PAH levels for Year 2

• Ad-hoc sampling at Coal Pier showed very high PAH Signatures

• Site-specific sediment characteristics showed a switch in higher energy areas to coarse grain materials

• Evidence of re-suspension of finer particulates

• Sampling events filmed to assist in evaluating sampling efficacy

• “Floc” capture deemed OK
Outcomes- Sediment Chemistry

• Continued acceptable levels of PAHs for Year 3 showing downward trending for all stations

• Further evidence of re-suspension events

• No significant impact observed
Outcomes-Battery Point Barrier

• Confluence of Site Drainage and Sydney Harbour
• Physical parameter monitoring around the clock
• Real time access to turbidity, pH, salinity and conductivity
• Chemistry auto-sampled where precipitation exceeded 10mm in a 24 hour period
• Chemistry auto sampled where turbidity exceeded 88 NTUs
• Samples also taken to determine tidal effects
• Provided for an ongoing evaluation of upstream mitigation efficacy
Acenaphthylene-Battery Point Barrier Monitoring

Figure 4-20 Acenaphthylene concentrations at Battery Point
Anthracene-Battery Point Barrier

Figure 4-21  Anthracene concentrations at Battery Point
Benzo(a)pyrene- Battery Point Barrier

Figure 4-23  Benzo(a)pyrene concentrations at Battery Point
Benzo(g,h)perylene at Battery Point

Figure 4-25  Benzo(g,h,i)pyrene concentrations at Battery Point
Outcomes-Battery Point Barrier

• No significant impacts

• Upstream mitigation effective

• Elevated levels of organics temporary

• Elevated levels split between incoming and outgoing tides

• Effective early warning system, particularly with respect to turbidity
Outcomes - Mass Balance Calculations

• Prior to Joint Panel review, 770 kilograms of PAHs estimated to be exiting the site annually

• Accepted by Joint Review Panel as an appropriate baseline

• Mass balance calculations performed for years 1, 2 and 3

• Calculated using data from Battery Point, marine water quality sampling, ground water and surface water monitoring and air

• Ground water and air subsequently found to be insignificant
Outcomes- Mass Balance

• Year 1 PAHs- 13% of baseline (97 kg)

• Year 2 PAHs- 2.2% of baseline (19 kg)

• Year 3 PAHs- 7.0% of baseline (60 kg)

• For year 3, slight increases due to larger area, close proximity to the harbour and heterogeneity of materials

• All sediments now treated and capped

• Contaminants effectively immobilized
Lessons Learned

• Ecological Risk Assessment provides monitoring targets

• Conservative approach to monitoring a must (all PAHs assumed to originate from the project). Can work back toward reality at need.

• Select monitoring target based upon sensitivity, availability and cost effectiveness

• Get good help!
Questions?