

Orica Botany Mercury Independent Review

Stage 1 - Data and Information Collection and Review



Public Information Session



Andrew Kita
Project Director

12 February 2014

**CDM
Smith**
listen. think. deliver.

CDM Smith

- Founded in 1947
- Employee owned / operated
- Approximately 5000 staff / 125+ offices worldwide
- \$1.2 billion in annual revenues
- Our core businesses include water, environment, transportation, energy, and facilities



Introductions

CDM Smith Project Team

- Andrew Kita – 16 Yrs. Principal Engineer (Project Director)
- Loek Munnichs – 15 Yrs. Senior Scientist (Project Manager)
- Katarina David – 16 Yrs. Principal Hydrogeologist
- Dr Jim LaVelle – 30 Yrs. Risk Assessor, Toxicologist
- Dr Laura Green – 30 Yrs. Risk Assessor, Toxicologist
- Ernest Ashley – 30 Yrs. Risk Assessor, Air

Presentation Outline

- Scope of Stage 1 Review
- Community Consultation Process
- Summary of Reports Reviewed
- Mercury Mass Balance
- Conceptual Exposure Site Model
- Mercury Toxicology and Environmental Exposures
- Preliminary Screening Model
- Data Gaps Identified
- Findings & Recommendations for Stage 2



Scope of Stage 1 Review

- Determine if significant public health risk exists, and if possible the level of such risk.
- Identify if there are any sources of community exposure to mercury that are not currently being managed and controlled.
- Ascertain if there are communities and/or individuals at risk.
- Assist in reassuring the community that appropriate actions are, or have been taken, through current and legacy projects managed by Orica and regulated by the EPA at the site.
- Determine exposure pathways and possible sources not currently identified and/or being managed.

Critical Success Factors

- Establish a strong working relationship with the Steering Panel.
- Demonstrate transparency and independence to the affected community.
- Develop a comprehensive review report that is accepted as technically excellent and unbiased by the Panel and the community, that incorporates communities' concerns in its approach and directly answers as many of the questions raised by the community as possible.
- Provide recommendations for additional characterisation of the Site and/or surrounding environs for Stage 2 of the review where appropriate.

CDM Smith Approach

- **Listen**

- Community questionnaire, conduct interviews, reviewed a large number of documents/files (>200) from EPA and Orica (approximately 12,000 pages)

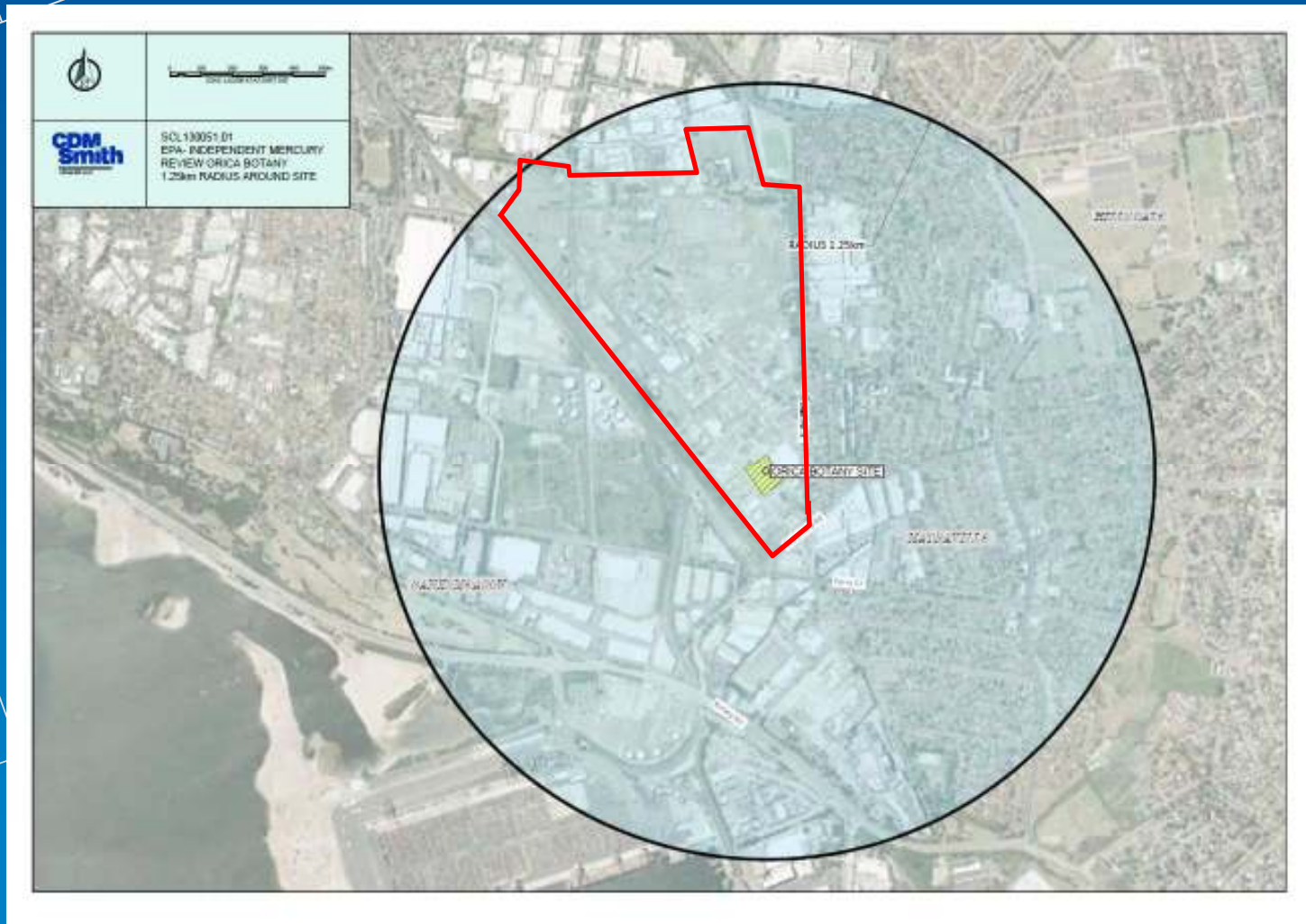
- **Think**

- Developed a Conceptual Site Model, Conceptual Site Exposure Model and a Preliminary Air Dispersion Model (computer simulation of mercury discharged from the FCAP into air from the stack and walls/ceiling)
- Detailed Mercury Mass Balance Calculated

- **Deliver**

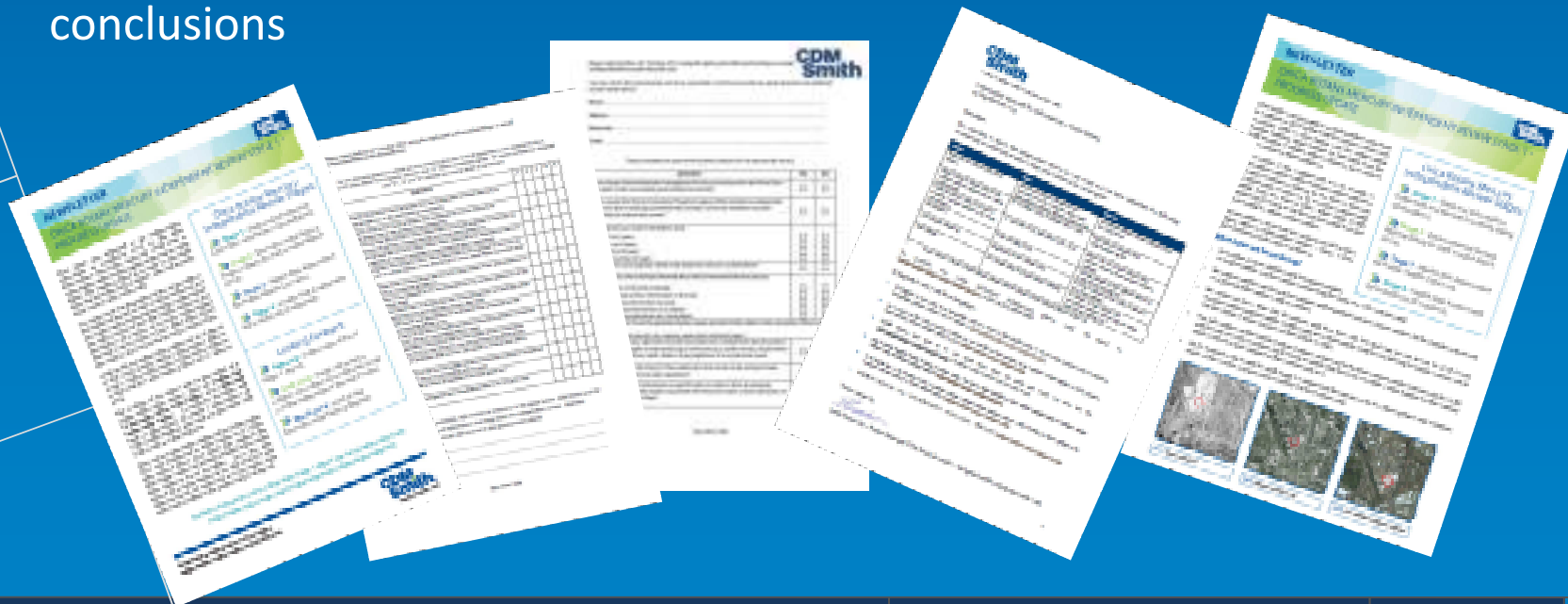
- Comprehensive 300 page report summarising all relevant documents

Study Area – Orica FCAP and 1.25km Radius



Community Consultation / Newsletters

- Questionnaire and request for information delivered to 4,500 local properties in October 2013
- First newsletter delivered prior to Christmas (23 December 2013)
- Second newsletter delivered yesterday (11 February 2014)
- Third newsletter to be delivered within a few weeks summarising the conclusions



Community Consultation / Questionnaire

- 4,500 questionnaires were delivered to local properties within a 1.25km radius of the FCAP, of which 155 were returned (3.4%)
 - 48% lived in the area > 20 years
 - 4 people responded that they previously worked for Orica
 - 35 responses were anonymous
 - 73% were aware that environmental investigations had been conducted
 - 49% were aware of the Independent Review and the Panel
 - 51% wanted more information on possible health impacts
 - 57% wanted their property to be investigated
 - 72% wanted to receive written information in the mail
- 2008/2009 survey by the Institute for Sustainable Futures (Prior/Partridge Survey): 400 residents (3% of 13,000 residents within 5km radius) were interviewed by phone. This is comparable to the 2013 survey in terms of response rates and being representative for the community surveyed.

Community Consultation / Meetings

- 2 open house sessions held (<10 individuals attended)
- 3 interviews conducted with former employees >> valuable information
- Telephone conference with expert representing the community
- Key concerns / questions:
 - ✓ “Where is the Davies report”
 - ✓ “What about the Major Hazard Facility Risk Assessment from 1983”
 - ✓ “Orica only focuses its efforts on addressing the on-site contamination”
 - ✓ “My friends/relatives observed illegal off site dumping”
 - ✓ “Between 6,000 – 9,000 tonnes of mercury believed to have been used at the FCAP for the period 1945-2002”
- In the report we have addressed 34 concerns and questions raised by concerned community members

Strict Confidentiality Maintained

- Questionnaire responses received and contact details remain the property of CDM Smith.
- Contact details have not been provided to EPA/Orica/Steering Panel
- CDM Smith sought permission from individuals that provided comments of a potentially private/personal nature before publishing them in the report

Summary of Historical Reports Reviewed

- EPA documents
 - Dated back to early 1990s
 - Over 200 documents (including previous public submissions)
- Orica documents
 - Dated back to 1942
 - Approximately 12,000 pages of documents held in a data room at Orica, which were reviewed independently. Orica did not supervise or interfere with our review of its documents.

Summary of Historical Reports Reviewed

- Orica documents (cont'd)
 - The documents indicated significant focus by Orica/ICI management since at least the early 1970's onwards, in relation to addressing the issues surrounding mercury.
 - Particular focus appeared to be in relation to mercury consumption, accountability and discharge to waste streams, appropriate disposal of solid wastes to landfill, and subsequent need for environmental investigations and remediation programs to address issues as they were identified.

EPA Documents

- Environmental protection Licences
- Studies undertaken by the State Pollution Control Commission (SPCC, now the EPA)
- Hard copies and electronic documents of environmental investigations mainly undertaken by Orica/ICI and overseen by an Independent Expert Panel
- Notes of numerous complaints
- Scientific articles on Mercury toxicity and behaviour
- Public submissions

Orica Documents

- Internal and external reports and letters
- Meeting memo's and minutes
- Corporate strategy and action plans
- Letters to/from various statutory authorities
- Research Papers
- Mercury accountability studies (mass balance)
- Studies on reduction of mercury in waste streams
- Waste transport dockets/contracts
- Design drawings and specifications
- Analytical data (air/water/waste)
- Mercury consumption

What is Mercury



- Mercury is a naturally occurring metal in air/water/soil and exists in elemental, organic and in-organic forms.
- Primary sources of mercury are coal fired power plants, cement kilns, Chlor-Alkali Plants (CAPs), incinerators, gold production, volcanic activity, bush fires, dental amalgam, thermometers.
- Elemental mercury is volatile. 1 drop of mercury takes 2 days to evaporate.
- Some forms are more toxic than others (e.g. methyl-mercury in fish).
- Exposures can occur via inhalation, consumption of fish and shellfish, dental fillings, broken fluorescent lights/thermometers, contaminated soils, medicines and cosmetics.
- Refer fact sheet by the South Eastern Sydney Local Health District for more details (Report Appendix F).

Historical Timeline & Mercury Mass Balance

Year	Event
1945	The original cell room (H-cell, 24 cells, 10.2 m ² cathode area) was built in 1945. There are conflicting statements as to whether H Bank had a concrete floor when first built or whether the floor was added when the MK1 cells were added.
1947	ICI monitored mercury levels in the cell rooms and offices since 1947
1954	A second cell room was added in 1954 (MK-1 cell, 28 cells, 12.5 m ² cathode area)
1958	Prior to 1958, (document 70 and various anecdotal sources) the Orica plant was not connected to sewer and all effluent and sludges went to the Springvale Drain also known as the 'stormwater drain' or the 'Botany Bay effluent'. Some other plants on the site were connected to the noxious effluent which was believed to flow to settling and/or evaporation ponds. An onsite waste water treatment plant was commissioned. Note that the shoreline has changed and that a Caltex carpark is now situated at the historic Springvale Drain outlet. However, the drain itself is present at its historical location.
1965	A third cell room was built in 1965 (B-cell, 28 cells, 20.8 m ² cathode area). This was an open cell room.
1970	Pollution Control Act
1970	ICI become aware of the mercury toxicity issue.
1972	In June/July 1972, the mercury retort was commissioned.
1974	In June/September 1974, a sludge filter was installed to remove mercury contaminated sludges from the aqueous waste stream. The filter cake was retorted, stored onsite awaiting mercury recovery in Japan or immobilised in waste blocks.
1978	Mercury removed from the End Box vents on the cells using carbon filters. Prior to 1978 this was vented to ambient cell room air.
1979	NSW State Pollution Control Commission (SPCC, replaced in 1991 by the NSW EPA)
1979	Prior to 1979, the hydrogen waste that was vented to the atmosphere but was not treated to remove mercury prior to discharge. Around 1978-79, two absorbers (sulphur impregnated carbon) were installed to treat the hydrogen waste. Mercury from the filter sludges was recovered in the retort and later immobilised in waste blocks.
1983	Commissioning of the End Box venting system in early 1983.
1986	In September 1986, the retort was taken out of production. Sludges were stored on site up to 1991, when sludge was immobilised in brine blocks.
1990	Start of the aqueous abatement program.
1990	Solidification Plant was built to chemically fix brine sludge into solid blocks for offsite disposal.
1998	H and MK1 cells are decommissioned.
1999	The Protection of the Environment Operations Act 1997 (POEO Act) commenced operation in NSW on 1 July 1999.
2002	The Chlor-Alkali Plant was taken out of production and replaced by a Chlor-Alkali Plant using non mercury technology.
2006/2007	The former Chlor-Alkali Plant was decommissioned.

- 1945 – 1954 – 1965 (3 cell blocks)
- 1958 connected to sewer
- 1970 ICI becomes aware of mercury issues
- 1970 Pollution Control Act
- 1974 retort and effluent treatment plant commissioned
- 1979 filtering waste hydrogen (stack)
- 1979 NSW EPA established
- 1986 retort decommissioned
- 1990 aqueous abatement program
- 2002 end of mercury use. FCAP ceased production

Mercury Mass Balance

"IN"

- Adjusted for yearly production rates
- Prior to 1970: Based on international data
- After 1971: based on information obtained from Orica files
- Total FCAP life span: an estimated **957** tonnes of mercury used

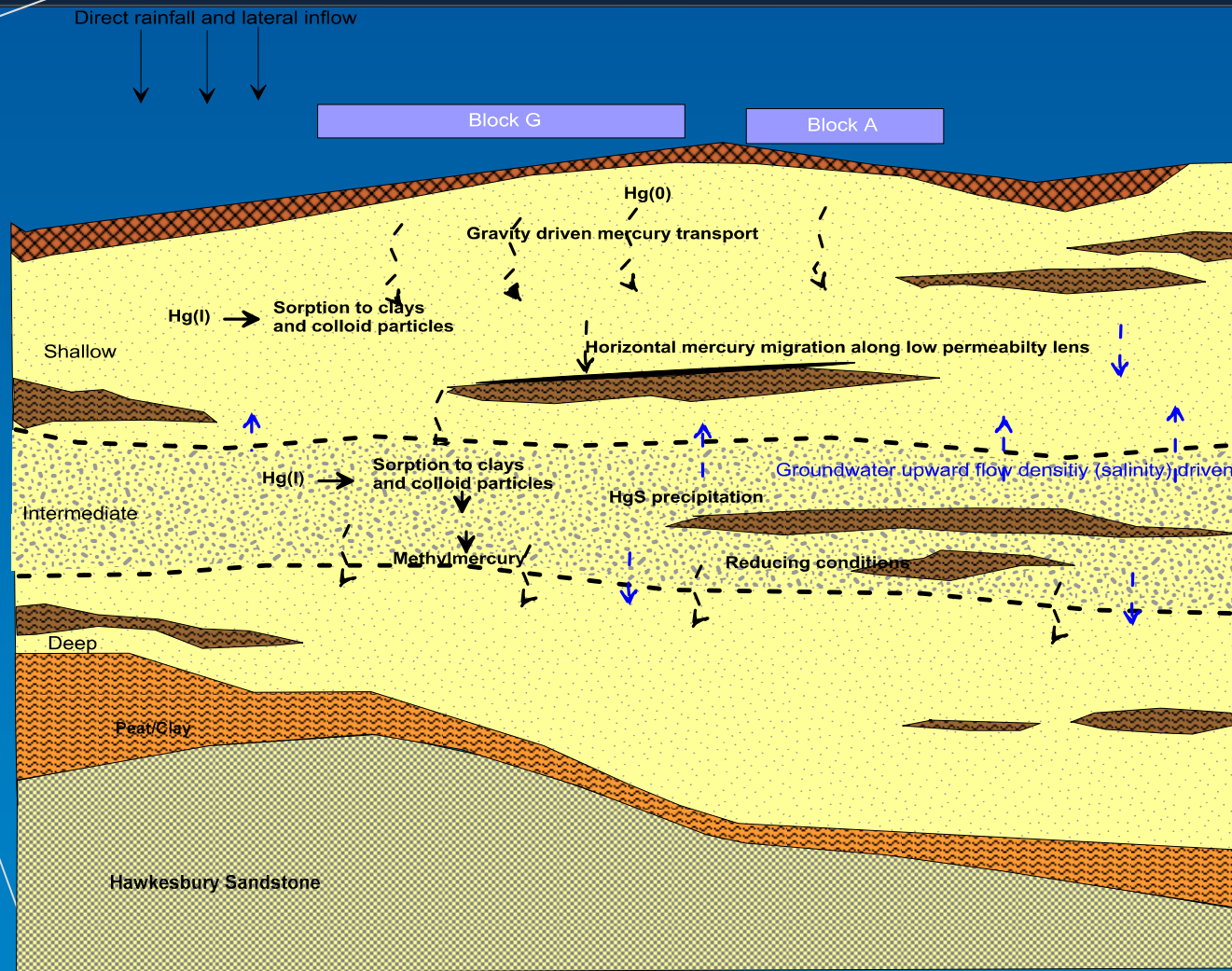
"OUT"

- Effluent 30 tonnes
- Stormwater Unknown
- Product 11 tonnes
- Air 62 – 97 tonnes
- Soil 12 tonnes
- Waste **324 - 784** tonnes (on-site ponds/Botany Bay/Malabar WWTP/secure landfill disposal)
- Groundwater 0.6 tonnes
- Building 10 – 27 tonnes

- Total Losses (450 – 502 tonnes) (upper bound)
- Balance **48% - 53%** (based on 324 tonnes waste)

- Total losses (0 - 47 tonnes) (lower bound)
- Balance **0 – 5%** (based on 784 tonnes waste)

Conceptual Site Model



LEGEND

- Mercury migration
- Interpreted groundwater flow

Penrhyn Estuary

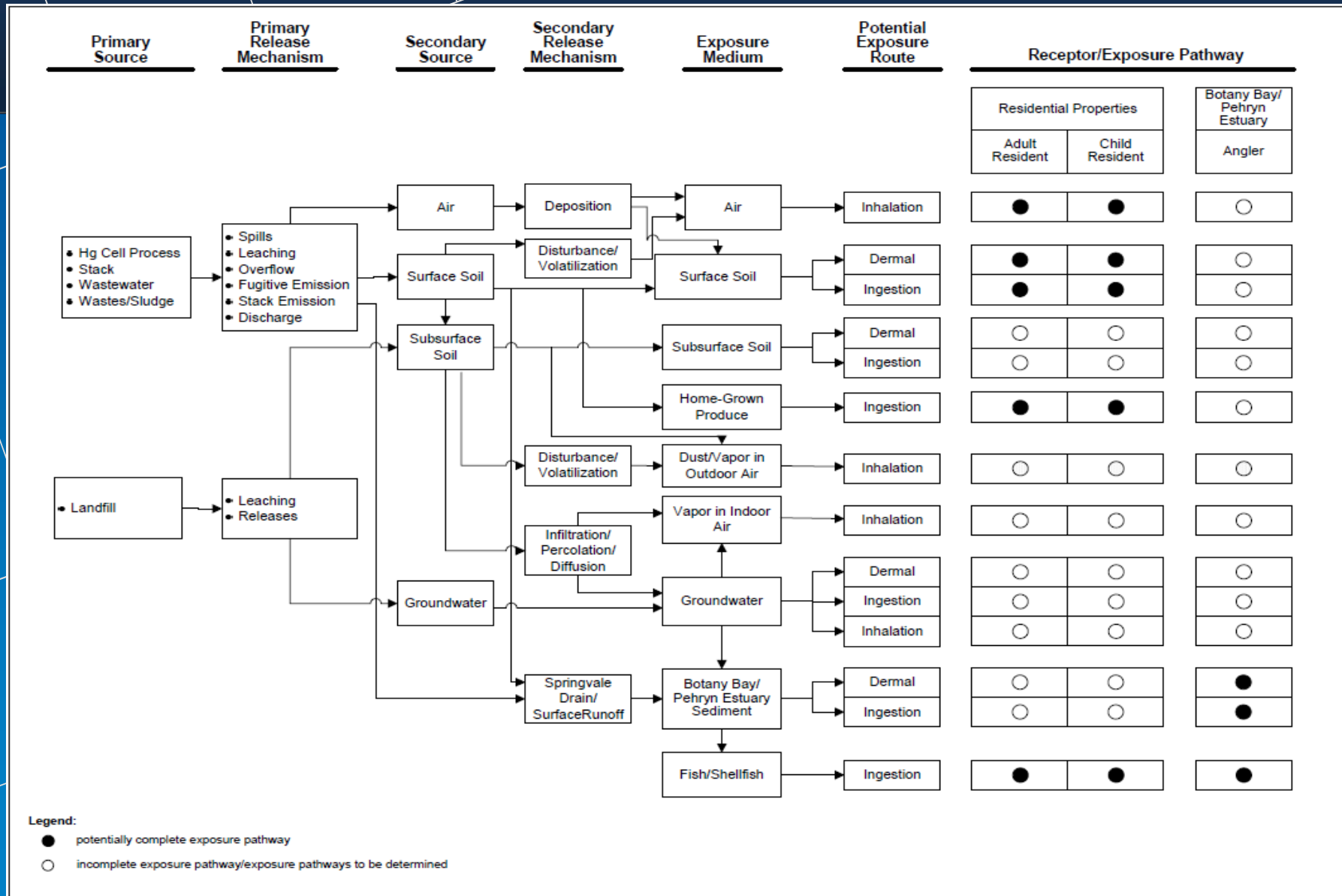
Available biota data (mercury) for Penrhyn estuary (mg/kg)

Stage 1 1989 (range detected)	Stage 2 1993 and 1994 (range detected)	Stage 3 1996 - 1998 (range detected in or near estuary)	URS 2004 mean (max)
	Sea mullet = <0.1 - 0.1	Sea mullet = nd - 0.1	Sea mullet = 0.03 (0.06)
	Sand mullet = <0.1	Sand mullet = nd	
	Silver biddy = <0.1 - 0.1	Silver biddy = nd - 0.4	Silver biddy = 0.16 (0.26)
	Dusky Flat head = <0.1 - 0.1	Dusky flathead = nd - 0.4	
	Yellow fin bream = 0.1 - 0.25	Yellow fin bream = nd - 0.2	
		Flat tail mullet = nd	Flat-tail mullet = 0.04 (0.1)
	Luderick = <0.1 - 0.2		Luderick = 0.26 (0.45)
	Trevally = <0.1 - 0.2		
	Crab = <0.1 - 0.1		
	Mudwhelk = 0.2 - 0.3		
			Tarwhine = 0.07 (0.1)
Oyster 0.2 - 0.3 ¹⁾	Oyster <0.1 ¹⁾	Oyster = 0.07 - 0.12	Oyster = 0.21 - 0.2 (0.29)
Polychaete = 0.5 (worm)			
Crab = 1.0			
Bembicium = 1.3 (shellfish, sea snail)			
Pyrazus = 0.9 - 1.2 (shellfish, sea snail)			
Laternula = 0.9 (clam)			

1) Samples collected from location outside of Penrhyn Estuary

- All measured mercury levels were below the Maximum Permitted Concentration (1mg/kg for mercury)
- Public access is now limited
- A fishing ban exists

Conceptual Site Exposure Model



Screening / Investigation Levels

Agency	Screening Level	Comments
California EPA	0.03 $\mu\text{g}/\text{m}^3$	Long-term exposure. Worker study. Subtle central nervous system effects and developmental considerations. Safety factor of 300. (2008)
ATSDR	0.2 $\mu\text{g}/\text{m}^3$	Long-term exposure. Worker study. Subtle central nervous system effects. Safety factor of 100. (1999)
WHO	0.2 $\mu\text{g}/\text{m}^3$	Long-term exposure for elemental mercury (2007)
US EPA	0.3 $\mu\text{g}/\text{m}^3$	Long-term exposure. Worker study. Subtle central nervous system effects. Safety factor of 30. (1995)
WHO	1 $\mu\text{g}/\text{m}^3$	Long-term exposure. Worker study. Subtle central nervous system effects. Safety factor of 20. (2000)

Air

Soil

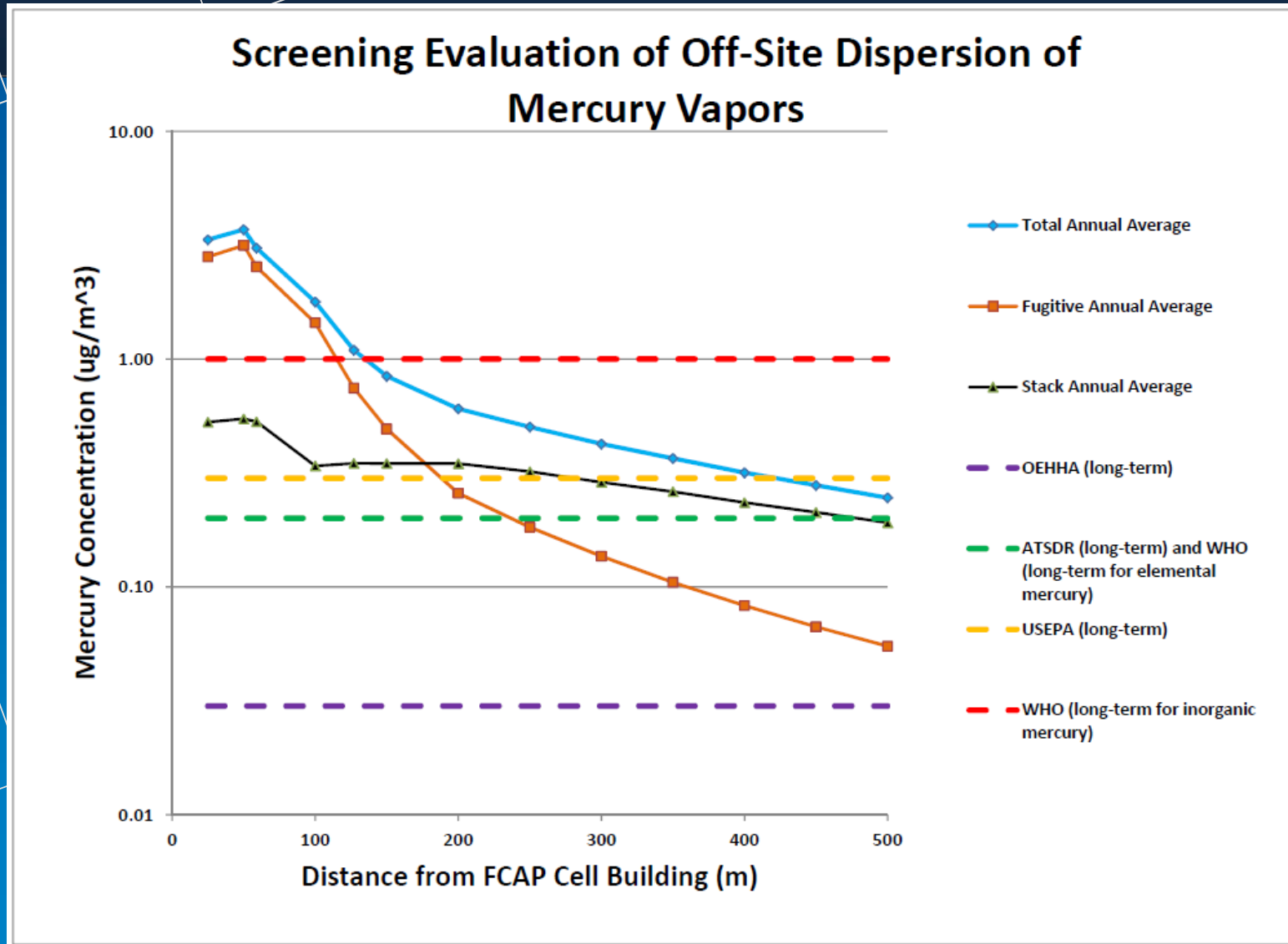
Agency	Screening Level	Comments
NEPM	10 mg/kg	Methyl mercury
US EPA	10 mg/kg	Elemental mercury. Long-term exposure based on volatilization and inhalation. May exceed the soil saturation limit for elemental mercury.
US EPA	23 mg/kg	Inorganic mercury. Long-term exposure. Reference dose of 0.0003 mg/kg-day. Assumes residential land use, direct contact with soil, incidental ingestion of 200 mg soil/day, consumption of home-grown produce is not considered.
NEPM	40 mg/kg	Inorganic mercury. Long-term exposure. Toxicity Reference Value of 0.0006 mg/kg-day. Assumes residential land use, direct contact with soil, incidental ingestion of 100 mg soil/day, includes consumption of home grown produce. Applicable to suburban setting with individual homes with yards.
NEPM	120 mg/kg	Inorganic mercury. Long-term exposure. Toxicity Reference Value of 0.0006 mg/kg-day. Assumes residential land use, direct contact with soil, incidental ingestion of 25 mg soil/day, consumption of home-grown produce is not considered. Applicable to urban and apartment settings where yards are very small or non-existent and where most of the ground is covered with buildings and hardstand (concrete/asphalt).

Air Dispersion Model

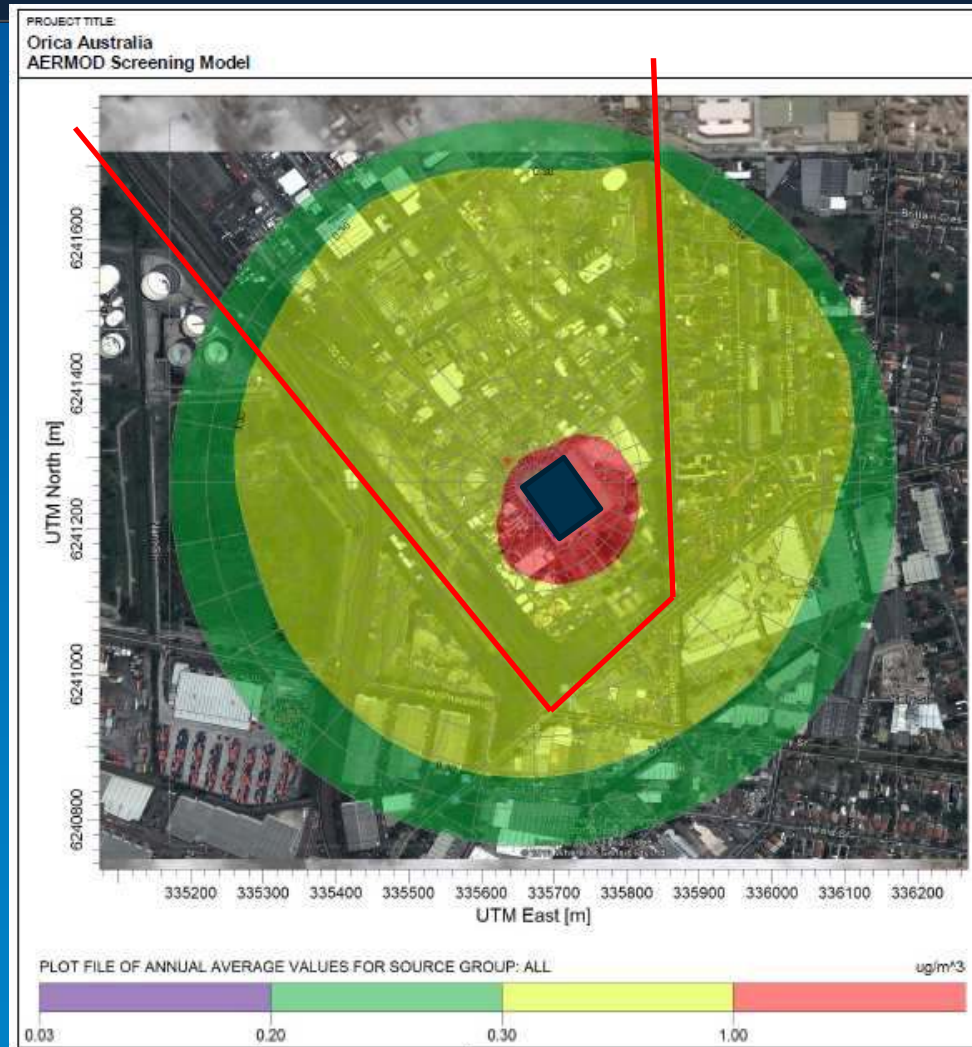
Preliminary modelling of elemental mercury in air emitted from the FCAP (stack and openings in the building) was undertaken in order to identify the possible magnitude and range of historical impacts.

- Model used is the preferred model for the US EPA.
- No actual metrological data entered in the model (breeze from Botany Bay <southwest> at 9am and see breeze from the ocean <southeast> at 3pm).
- Worst case stack and building emissions were used.
- The model predictions do not estimate the current mercury levels in soil within the community. It only provides an understanding of the target zone for assessing potential impacts, and whether more detailed deposition modelling is warranted.

Air Dispersion Model



Air Dispersion Model (estimate)



— Site Boundary

Identified Data Gaps

- Mercury in Air (historic)
 - More sophisticated modelling is required (including actual metrological data).
 - This will help define the off-site soil sampling rationale.
- Soil Sampling
 - No evidence to suspect off site illegal dumping of wastes occurred.
 - Very limited data exists (only Grace Campbell Reserve).
 - Residual accumulations from historic air emissions and deposition are likely to be low, however further off-site sampling (surface and sub-surface) in residential and public open areas is considered necessary to confirm this, and adequately address community concerns.
 - Detailed review of historical aerial photos recommended.

Data Gaps

- Mercury in Groundwater
 - Not identified as exposure pathway.
 - Groundwater monitoring on yearly basis should be continued. If results depart from CSM, geochemical modelling needs to be considered.
- Mercury in Sediments and Biota (fish)
 - Historically collected data on biota (fish) and sediments can be used for the Risk Assessment.
 - Prudent to collect biota data for comparison with 2004 data (also need to be analysed for methyl mercury).
 - Surface water samples currently collected by Orica on quarterly basis should be analysed for mercury.
 - Fish in middle tropic range (medium size fish) should be analysed.

Stage 2 – Recommendations

- Detailed review of historical aerial photographs.
- Detailed air deposition modelling to help guide sampling location selection for Stage 2.
- Preparation of a detailed sampling analysis and quality plan, and data quality objectives prior to commencement of sampling.
- Sampling of 68 residential properties where owners expressed concerns about possible mercury concentrations (based on the questionnaire responses). Two sample locations per property and two samples per location (four in total per property). Depth of sampling, near surface and 300-500mm.

Stage 2 – Recommendations

- Vapour sampling at all soil sampling locations using a portable mercury vapour analyser.
- Strict QA/QC program.
- CDM Smith will approach individuals to seek permission to release contact details to the Consultant appointed for Stage 2.
- Residents can opt out of the sampling program. It is not obligatory.

Stage 2 – Recommendations

- Sampling from a further 80 locations (including 10 background samples) mostly within 1.25 km of the FCAP. This is greater than considered necessary.
- Sampling locations to be verified after additional air dispersion modelling has been completed in Stage 2.
- Sampling of various (13) public parks and reserves (2-6 boreholes per park).
- All samples up to 500mm, 2 samples per borehole.
- Vapour sampling in stormwater drains and soil sampling locations using a mercury vapour analyser.
- Strict QA/QC program.

Sampling Equipment

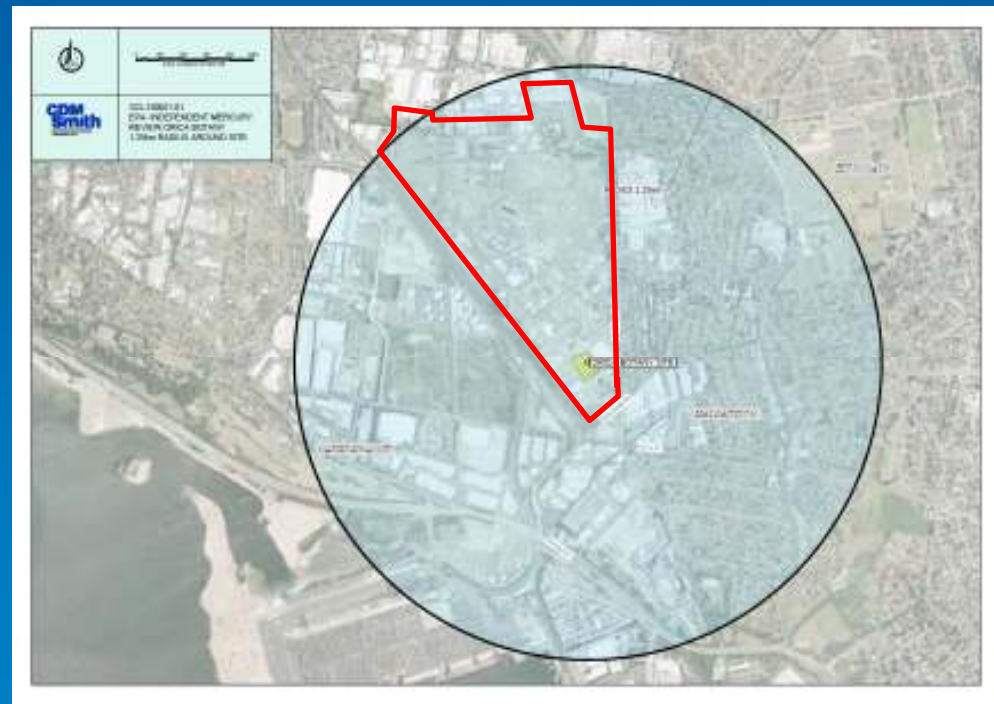
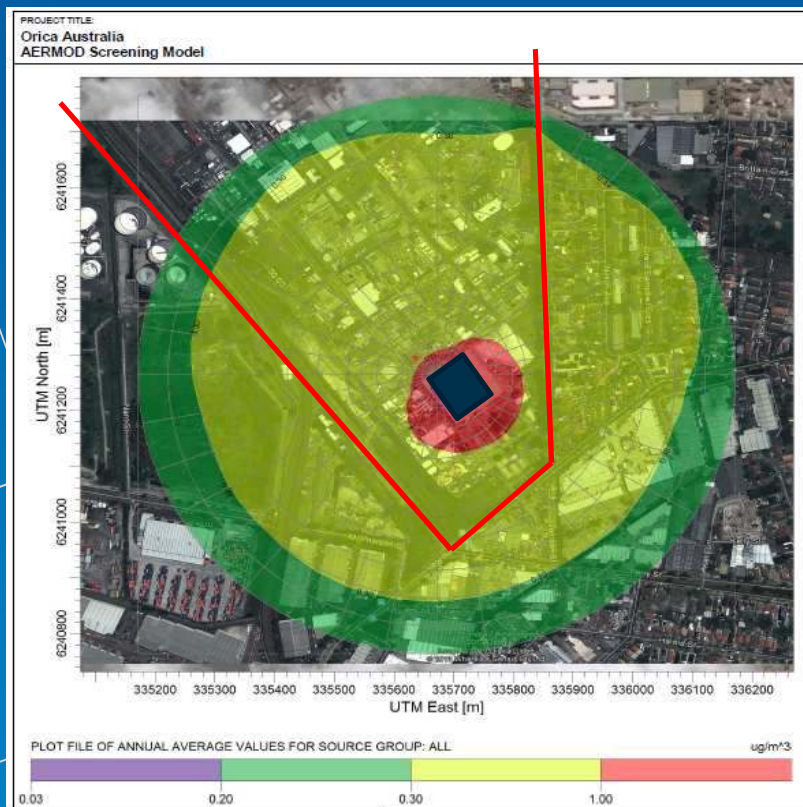
Hand Auger



Handheld Mercury Analysers



Off-Site Sampling



— Site Boundary

Stage 2 – Parks Proposed to be Sampled

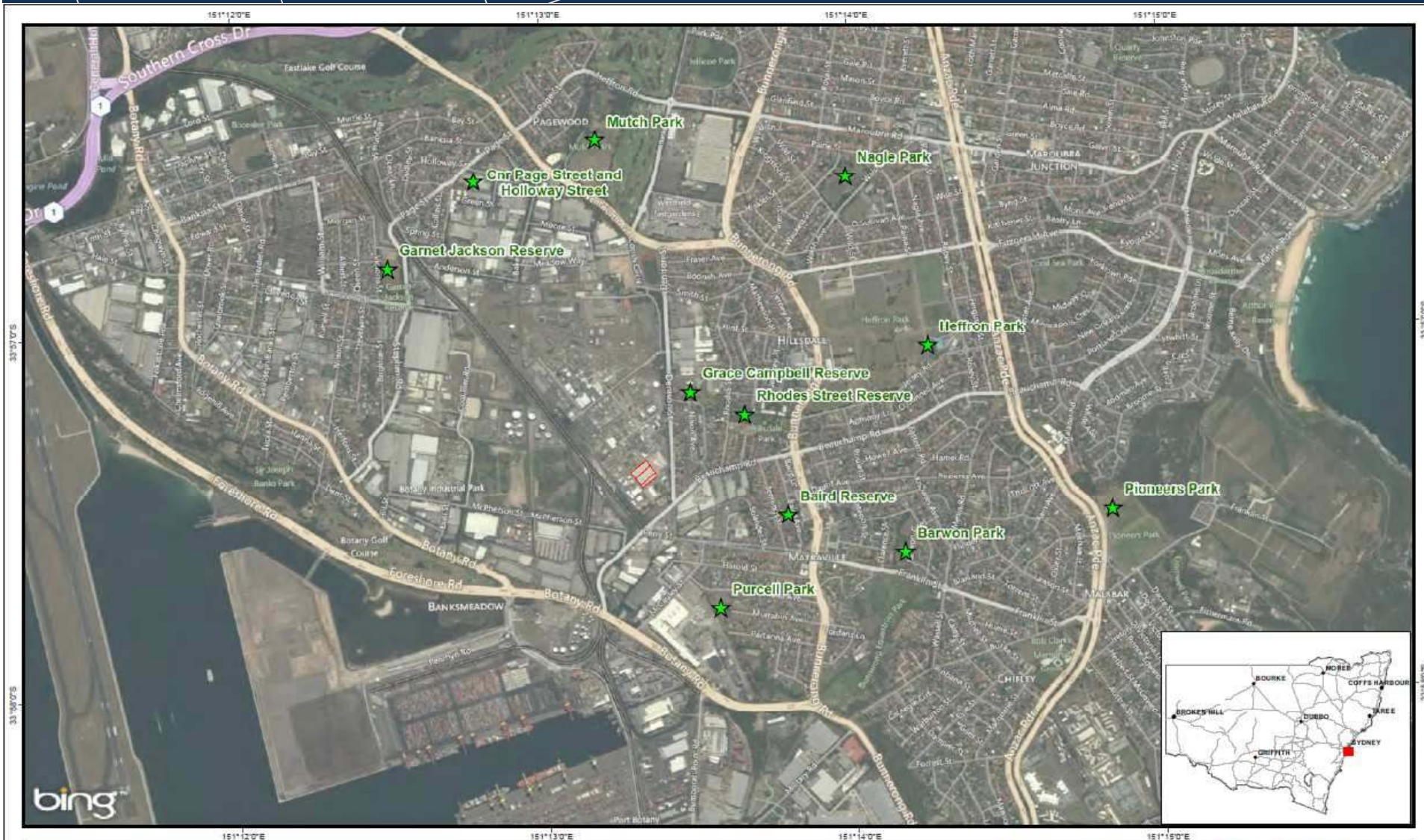



Figure 10-2 Public Parks and Reserves Proposed for Limited Sampling

Key
 Former Chlor-Alkali Plant

0 500 1,000
 Metres
 GCS GDA 1994 MGA Zone 55



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DISCLAIMER
 CDM Smith has endeavoured to ensure accuracy and completeness of the data. CDM Smith assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

Data Source:
 BingMaps, 2011.

Date: 11/21/2013

Overall Conclusions

- Orica / ICI used approximately 950 tonnes of mercury during the lifetime of the Former Chlor-Alkali Plant
- No evidence or indication found for potential offsite dumping of mercury contaminated waste materials in the past
- Significant focus by Orica / ICI management on dealing with mercury issues since the early 1970's
- Risk of potential off-site soil contamination with mercury is low
- Additional soil and fish sampling is recommended to fill in indentified data gaps and adequately address community concerns (Stage 2)
- A Health Risk Assessment should be undertaken (Stage 3)

Contact Details

CDM Smith contact details:

- Phone - 02 8918 8800
- Email - independentmercury@cdmsmith.com

Our report can be downloaded from:

<http://www.epa.nsw.gov.au/oricabotanycttee/indrevoricabotany.htm>

Questions and Answers

