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# **ABATEMENT OPTIONS ASSESSMENT**

## **CAPTAINS FLAT LEAD MANAGEMENT PLAN**

Project name Captains Flat Lead Management Plan  
Project No. 318001193-T12b  
Recipient by Department of Regional NSW  
Document type Report  
Description This report presents an assessment of abatement options for contamination linked to historical metalliferous mining and land-fill activities within Captains Flat at six locations within the community of Captains Flat.

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Draft/Rev0	28/9/21	S Maxwell	S Maxwell	R Salmon	For client review
Rev 1	23/02/2022	S Maxwell	F Robinson	R Salmon	For issue
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F Robinson

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S Maxwell

CEnvP Certification No. SC41184



Ramboll  
Level 2, Suite 18  
50 Glebe Road  
PO Box 435  
The Junction  
NSW 2291  
Australia  
T +61 2 4962 5444  
www.ramboll.com

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## EXECUTIVE SUMMARY

Ramboll recently completed an assessment of risks associated with exposure to mining related contaminants in soil, deposited dust, surface water, sediment, groundwater and air quality as documented in the Conceptual Site Model (CSM)<sup>1</sup> (Ramboll 2021).

Potential contaminant exposure risks for human health and the environment were identified in the CSM based on a tier 1 risk assessment and further assessment or management to mitigate the identified potential risks is recommended.

Potential human health risks for lead in soil are considered to be **high** in the following areas:

- The Old Mine Site and rail corridor
- Public spaces south of the Molonglo River including the preschool, Foxlow Street and the eastern embankment of the Old Mine Site
- Areas where fill appears to have been applied north of the Molonglo River including flood berms adjacent the River and embankments beneath the tennis courts as well as Foxlow Parklet

Potential human health risks for lead in soil are considered to be **moderate** in the following areas:

- The Southern Smelter Area and Keatings Collapse
- Beneath the southern playing field off Foxlow Street
- The southern end of the school playing fields including the new preschool

The identified potential human health risk areas also encompass areas identified as presenting a potential high or moderate risk to the environment.

Abatement option evaluation has been undertaken based on multiplying an initial score for a range of evaluation metrics under each option by the weighting for each metric. Preliminary abatement recommendations have been made based on the evaluation of abatement options presented herein to mitigate potential high and moderate risks to human health and the environment identified in the CSM.

Ongoing management costs have been conservatively projected and significantly affect the evaluation of abatement options. Ramboll sought Taskforce commentary on the following factors to refine option evaluations: evaluation metric weighting,

- parameters used in calculation of ongoing management costs,
- the duration over which ongoing management is projected,
- anticipated capacity to integrate abatement management with existing land management programs,
- provisions for upgrading drainage.

Responses to Taskforce commentary have been integrated in this report.

It is also noted that the privately owned land south of the Preschool and adjoining the Crown land road reserve will be a gap in the abatement coverage in this area. The Taskforce may wish to consider abatement of this privately owned land parcel.

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<sup>1</sup> Air quality monitoring is ongoing

# 1. INTRODUCTION

Ramboll Australia Pty Ltd (Ramboll) was retained by the Department of Regional NSW (Regional NSW) to prepare the Captains Flat Lead Management Plan to address exposure risks from lead within the environment and the community linked to historical metalliferous mining and land-fill activities. A process diagram for preparation of the Captains Flat Lead Management Plan is presented as Figure 1-1 below.

Ramboll recently completed an assessment of risks associated with exposure to mining related contaminants in soil, deposited dust, surface water, sediment, groundwater and air quality as documented in the Conceptual Site Model (CSM)<sup>2</sup> (Ramboll 2021).

This Abatement Options Assessment has been developed to assess potential abatement options and inform the development of abatement plans.

## 1.1 Abatement Requirements

Potential contaminant exposure risks for human health and the environment were identified in the CSM based on a tier 1 risk assessment and further assessment or management to mitigate the identified potential risks is recommended.

Potential human health risks for lead in soil are considered to be **high** in the following areas:

- The Old Mine Site and rail corridor
- Public spaces south of the Molonglo River including the preschool, Foxlow Street and the eastern embankment of the Old Mine Site
- Areas where fill appears to have been applied north of the Molonglo River including flood berms adjacent the River and embankments beneath the tennis courts as well as Foxlow Parklet

Potential human health risks for lead in soil are considered to be **moderate** in the following areas:

- The Southern Smelter Area and Keatings Collapse
- Beneath the southern playing field off Foxlow Street
- The southern end of the school playing fields including the new preschool

Additionally, potential human health risks from exposure to contaminated surface water and groundwater are considered **moderate** though water usage within the Precinct remains as a data gap.

Potential human health risks for lead in soil are considered to be **low** in the following areas:

- In natural soil to depths of greater than five metres on beneath the northern end of Foxlow Street
- In shallow soils in bushland hillside east of the Molonglo River near the southern end of town
- At several other locations in surface soils north of the Molonglo River at concentrations which marginally exceed the health investigation levels.

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<sup>2</sup> Air quality monitoring is ongoing

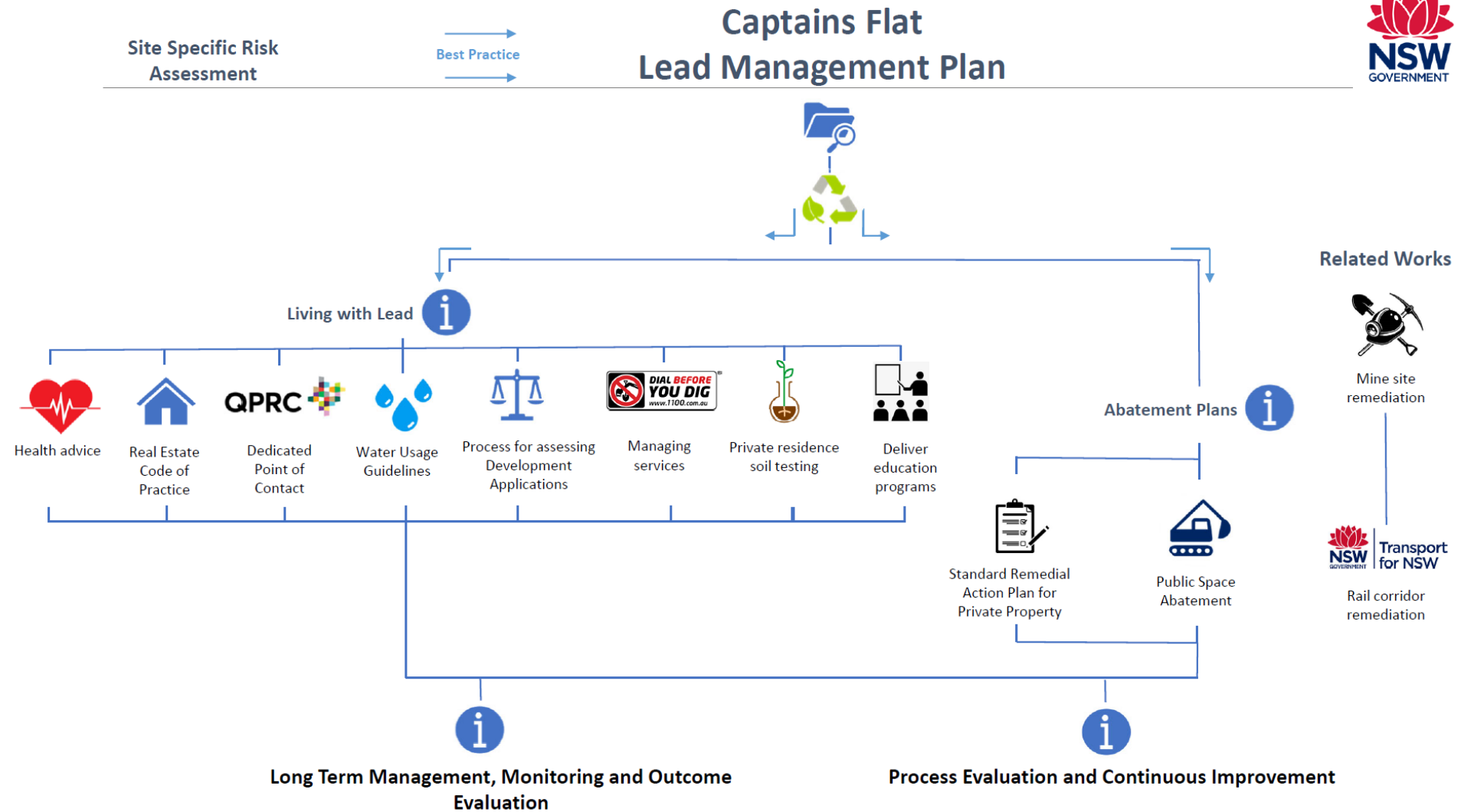


Figure 1-1: Pathway for development of the Captains Flat Lead Management Plan



## 2. ABATEMENT OPTIONS ASSESSMENT

### 2.1 Abatement Goal

The objective for this abatement options assessment is to assess abatement options to address risks from contaminants related to mining activities in identified areas with high and moderate risk to human health. The identified potential high and moderate human health risk areas also encompass areas identified as presenting a potential high or moderate risk to the environment.

It is noted that:

- Abatement options for the Old Mine Site and rail corridor have been assessed in separate projects and are not considered in this report.
- Abatement options for the southern end of the school playing fields including the new preschool are being considered separately by Department of Education and are not considered in this report.
- Assessment of private residences was not undertaken for the CSM and abatement options for private residences are not considered in this report.

### 2.2 Extent of Abatement Required

A summary of abatement requirements is described in Table 2-1 below and on Figures 2a – 2e, Appendix 1.

**Table 2-1: Summary of Abatement Requirements**

Site	Lot references	Area (m <sup>2</sup> )	Average max depth (m)
Foxlow Parklet	Lot 1 DP 251188	630	0.6
Crown Road Reserve adjacent Preschool	Crown Road Reserve 1084055075	1575	> 1
The Eastern Embankment (Crown Land)	Part Lot 1141049 DP 7317	30000	> 1
Council footpaths either side of southern end of Foxlow Street	Road reserve	6000	> 1
Flood berms	Road reserve + part Lot 7004 DP 1020764	2500	Not delineated
Playing Fields	Part Lot 7004 DP 1020764	4000	0.75
Tennis and Basketball Courts <sup>1</sup>	Part Lot 166 DP 754866 + part Lot 7004 DP 1020764	1200	Not delineated
Existing Preschool	Lots 101 and 107 DP 754870	500	> 1

<sup>1</sup>The landform in this area includes fill applied beneath the tennis court, basketball court and around the swimming pool. Assessment of soil contamination has not occurred beneath the courts or within the swimming pool fence line and is conservatively assumed to be present. Further assessment of lead in soils within the swimming pool would inform refinement of abatement requirements at this location.

### 2.3 Hierarchy of Options

A hierarchy of remedial (abatement) options has been adopted from the National Environment Protection Council (NEPC) National Environment Protection (Assessment of Site Contamination) Measure, 1999 Amended 2013 (NEPC 2013) and is presented as follows:

- On-site treatment of the contamination so that it is destroyed or the associated risk is reduced to an acceptable level; and
- Off-site treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which soil is returned to the site; or,

if the above are not practicable,

- Consolidation and isolation of the soil onsite by containment with a properly designed barrier; and
- Removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material;

or,

- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

## 2.4 Preliminary Waste Classification

A preliminary waste classification of the materials encountered in the Precinct was undertaken using data from the CSM report (Ramboll, 2021).

Chemical classification of waste under Part 1 of the NSW EPA Waste Classification Guidelines (2014) can occur through:

- assessment against Contaminant Thresholds (CT) for total contaminant concentrations; or where contaminant concentrations exceed CT criteria
- integrated assessment against Specific Contaminant Concentration (SCC) criteria for total contaminant concentrations and toxicity characteristic leachate procedure (TCLP) criteria for contaminant leachate.

Lead concentrations were qualitatively observed to consistently exceed CT1 criteria for General Solid Waste (GSW) and so assessment against SCC and TCLP criteria was progressed.

A comparison of the average and maximum concentrations of heavy metals across the Precinct to SCC criteria for GSW (SCC1) and Restricted Solid Waste (RSW - SCC2) is presented in **Table 2-2**.

**Table 2-2: Comparison of Average and Maximum Heavy Metal Concentrations Against SCC1 and SCC2**

Heavy Metals	SCC1	SCC2	Average Concentration	Maximum Concentration
Arsenic	500	2000	136	<b>8418</b>
Cadmium	100	400	<LOD	<LOD
Chromium	1900	7600	56	297
Copper	-	-	207	7270
Lead	1500	6000	<b>2146</b>	<b>252,560</b>
Mercury	50	200	44	<b>80</b>
Nickel	1050	4200	81	792
Zinc	-	-	761	39726

Average lead concentrations across the Precinct were above SCC1 indicating the contaminated surface and near surface soils could be expected to be classified as RSW or hazardous waste. TCLP analyses was completed on samples where total lead concentrations exceeded CT1 criteria (GSW limit based on total concentrations only) but fell below SCC2 criteria (RSW limit based total and leachate concentrations); a total of 52 samples.

All of the samples reported leachable concentrations less than the Toxicity Characteristic Leaching Procedure (TCLP1) criteria with the exception of three samples for lead and no samples exceeded the TCLP2 criteria. Therefore, the likely waste classification for contaminants soils throughout the Precinct is restricted solid waste. However, in some locations where maximum concentrations exceed SCC2 a classification of hazardous solid waste would be applicable. It is noted however that waste classification may also occur through assessment against TCLP criteria only where a robust process for chemical immobilisation of contaminants can be demonstrated. This process is described further under Part 2 of the NSW EPA Waste Classification Guidelines and requires a specific immobilisation approval from the NSW EPA. Specific immobilisation is the waste classification pathway considered in abatement option categories described in **Section 2.5**.

## 2.5 Abatement Option Categories

Abatement options are considered separately for each high and moderate risk area though consistently include:

1. Excavation of contaminated soil (i.e.: soils where lead concentrations exceed adopted assessment criteria) and transport to the Northern Tailing Dump. This would be followed by pH buffering to reduce leachate risks and consolidation / isolation within the proposed containment cell. This would be followed by geotechnical stabilisation (where required) and placement of clean backfill layers.
2. Excavation for offsite treatment of excavated soil through chemical immobilisation followed by disposal at an approved facility as immobilised General Solid Waste (GSW).<sup>3</sup> This would be followed by geotechnical stabilisation (where required) and placement of clean backfill layers. A waste facility capable of receiving the volume and type of material proposed to be generated during onsite remediation has not yet been identified. A pathway for offsite disposal exists however through amendment to the Environment Protection License (EPL) of a local landfill to allow treatment (where lead concentrations warrant treatment) as a precursor to disposal as GSW. This pathway would include:
  - A treatability trial to confirm an optimal treatment process
  - Application for an immobilisation approval for disposal of treated waste as immobilised GSW
  - Environmental planning and approvals to allow chemical immobilisation at the waste facility or at the mine site
  - Mixing of soils with immobilising reagents
  - Stockpiling to allow confirmatory sampling to assess success of immobilisation
  - Confirmation of waste classification and disposal as immobilised GSW.
3. Retention of contaminated soil in-situ. This option would include maintenance of existing capping/hardstand or installation of marker layer, geotechnical stabilisation (where required) and placement of clean capping layers<sup>4</sup> and would require ongoing management. This option could include:
  - a. placement of capping layers above the existing landform, where feasible

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<sup>3</sup> Ramboll is currently progressing planning on behalf of Transport for NSW for a similar waste stream to be generated in the NSW Southern Tablelands.

<sup>4</sup> Tilling and pH amendment through upper profiles of contaminated soil may also be considered where leachate risks warrant and where tilling is considered feasible.

- b. excavation of material for mine site containment to accommodate capping layers or
- c. excavation of material for offsite disposal to accommodate capping layers.

The potential presence of other contaminants may impact the feasibility of excavating contaminated soils for containment at the mine or offsite disposal and, where either of these options are preferred, further assessment of potential contaminants of concern should occur as a precursor to detailed abatement planning.

Additionally, abatement areas include areas adjacent private residences and/or natural water courses. All abatement options involving excavation or removal of pavements have the potential to increase contaminant exposure risks via airborne dust and surface water run-off. Protection of the surrounding community and environment during implementation of abatement measures is essential to all options.

## 2.6 Options Evaluation Metrics

A semi-quantitative system for evaluating abatement options was developed based on the evaluation metrics described in Table 2-3.

**Table 2-3: Abatement Option Evaluation Metrics**

Evaluation Metrics	Weighting (1 to 5)	Rationale
Reliability & Effectiveness	5	Reliability and effectiveness of abatement options is a high priority due to the potential for widespread environmental and human health exposure risks.
Ecologically sustainable remediation	2	Large land remediation projects can use significant amounts of energy and emit large quantities of greenhouse gases. Since the late 2000s, there has been a global push to embrace sustainable approaches to remediation that provide a net benefit to the environment.
Cost - Initial works	3	Large areas of contamination have been identified and costs may affect abatement feasibility.
Cost - Ongoing management	2	Allocation of funds is required to ensure long term management if / where ongoing management is required and may affect abatement feasibility.
Community Impact	4	Contaminant exposure risks and responsibility for management of contamination that may remain after abatement could impact current and future generations.

Abatement option evaluation is based on multiplying a ranking (1, 2 or 3) for each metric under each option by the weighting for each metric. *The weightings have been applied as an initial estimate by Ramboll and are to be confirmed by the Taskforce.* Final scores for each option in each area are determined by multiplying the score by the weighting for each criteria and then summing the resultant values. The highest scores represent preferred options.

## 2.7 Abatement Scores

Tabulated evaluations of abatement options for each area are presented in Appendix 2 – Appendix 8. Final scores are presented in summary as Table 2-4.

**Table 2-4: Abatement Scores**

	<b>Foxlow Parklet</b>	<b>Crown Road Reserve Adjacent Preschool</b>	<b>Crown Land (Eastern Embankment)</b>	<b>Southern end of Foxlow Street</b>	<b>Playing Fields and Flood Berms</b>	<b>Tennis / Basketball Courts</b>	<b>Preschool</b>	
Option 1: Mine Site Containment	NA	NA	NA	NA	NA	NA	NA	NA
Options 2: Disposal at Landfill	<b>40</b>	28	28	28	NF	NF	NF	31
Option 3: Cap Existing Landform	38	<b>40</b>	NF	NF	<b>37*</b>	<b>32</b>	NF	NF
Option 3b: Excavate Cap Thickness to Mine then Cap	NA	NA	NA	NA	NA	NA	NA	NA
Option 3c Excavate Cap Thickness to Landfill then Cap	36	33	<b>33</b>	<b>35</b>	30	30	30	<b>37</b>

NF (not feasible) - Capping on top of the existing landform not considered feasible in consideration of adjacent ground levels or complete removal not feasible due to depth of contamination

NA – Not applicable. Abatement options integrating containment of surplus excavation spoil at the mine site scored higher than offsite disposal however the Taskforce has elected to progress planning for offsite disposal.

\* Option 3 for the playing field and flood berms integrates capping of the flood berms after recontouring and excavation of 0.3m from the southern end of the playing fields for offsite disposal followed by application of capping to reinstate existing landform.

## 2.8 Preliminary Abatement Recommendations

Further description of preferred options for each abatement area are presented in the sub-sections below. Ongoing management costs have been conservatively projected and significantly affect the evaluation of abatement options. Ramboll is seeking Taskforce commentary on the following factors to refine option evaluations:

- evaluation metric weighting,
- parameters used in calculation of ongoing management costs,
- the duration over which ongoing management is projected,
- anticipated capacity to integrate abatement management with existing land management programs,
- provisions for upgrading drainage.

### 2.8.1 Foxlow Parklet

Based on the evaluation completed the preferred abatement option for Foxlow Parklet is to excavate all contaminated soil from Foxlow Parklet for offsite immobilisation and disposal. The total cost is estimated at \$210k – 390k (ex GST).

A determining factor between offsite disposal of all materials and capping based options was the projected costs for ongoing management. In addition to the parameters affecting ongoing management cost projections described under Section 2.7, capping options contemplated for Foxlow Parklet include reinstatement with clean soil. Capping with permanent hardstand could be expected to increase capital expenditure moderately though reduce ongoing management costs.

### 2.8.2 Crown Road Reserve Adjacent the Preschool

Based on the evaluation completed the preferred abatement option for Crown land adjacent the preschool is to cap without excavation. The capital expenditure for this option is estimated at \$70k – \$110k (ex GST). The net present value of ongoing management costs are estimated at an additional \$440k (ex GST) over a 100 year capping design life.

It is noted that the privately owned land south of the Preschool and adjoining the Crown land road reserve, shown on Figure 2d, will be a gap in the abatement coverage in this area.

### 2.8.3 The Eastern Embankment (Crown Land)

Based on the evaluation completed the preferred abatement option for Crown land at the eastern embankment is to excavate shallow soils to a depth of 0.3 m to allow capping with clean soils to reinstate current landform levels. This option includes:

- a \$50k (ex GST) provision for landform and drainage design
- embankment stabilisation after removal of shallow soils and offsite immobilisation followed by offsite disposal of excavation spoil at landfill. Provision for removal of upper 0.3 m of existing soils is made though may vary to achieve pre-cap design levels
- a \$250k (ex GST) provision for improvement of drainage at the toe of the embankment. This provision is included to mitigate potential erosion of the contemplated low permeability capping system and to appropriately direct increase in run-off following construction of the low permeability cap. It is assumed that water coming downhill to Miners Rd will be managed under the mine site management program and that water from Miners Rd onwards will be clean post abatement.

The capital expenditure for this option is estimated at \$2.5M – \$4.6M (ex GST). The net present value of ongoing management costs are estimated at an additional \$925k (ex GST) over a 100 year capping design life.

### 2.8.4 The Southern end of Foxlow Street

Based on the evaluation completed the preferred abatement option for the southern end of Foxlow Street is to excavate shallow soils to a depth of 0.1 m to allow capping with hardstand pavement to reinstate current landform levels. Further removal of 300 m<sup>3</sup> is included to allow for drainage tie-ins, in-situ tree / plant boxes etc. This option includes:

- offsite immobilisation and landfill disposal of contaminated excavation spoil
- construction of hardstand pavement along both sides of Foxlow Street from the Molonglo River bridge, south to Jerangle Road
- a \$225k (ex GST) provision for drainage and street landscaping. This provision is included to mitigate potential increase in runoff from proposed hardstand to adjacent private properties.

The capital expenditure for this option is estimated at \$900k – \$1.7M (ex GST). The net present value of ongoing management costs are estimated at an additional \$440k (ex GST) over a 100 year capping design life.

### 2.8.5 Flood Berms / Southern Playing Field

Based on the evaluation completed the preferred abatement option for the flood berms is to recontour the existing landform and cap with clean soils, raising the current landform levels. The preferred abatement option for the southern playing field is to excavate shallow contaminated soils (limited to the southern end of the football field) to allow capping with clean soils that reinstates current landform levels. This option includes installation of marker layer, 0.3 m clean soil and re-turfing the football field. Provision for underground irrigation system for the football field is also included to facilitate ongoing cap maintenance.

The capital expenditure for this option is estimated at \$750k – \$1.45M (ex GST). The net present value of ongoing management costs are estimated at an additional \$440k (ex GST) over a 100 year capping design life.

#### 2.8.6 Playing Courts and Swimming Pool

Based on the evaluation completed the preferred abatement option for the playing courts and swimming pool is to resurface / maintain the existing hardstand. The maintenance of hardstand pavement in these areas as required to retain functionality of these facilities could be expected to result in ongoing maintenance as part of routine operations. Further assessment of accessible soils / pavement within the pool fence may identify additional abatement requirements in this area also. The capital expenditure for this option is estimated at \$150k – \$290k (ex GST). The net present value of ongoing management costs are estimated at an additional \$380k (ex GST) over a 100 year capping design life.

#### 2.8.7 The Preschool

Based on the evaluation completed the preferred abatement option for the preschool is to excavate shallow soils to a depth of 0.3 m to allow capping with clean soils that reinstates current landform levels. Maintenance of existing levels is proposed to align with levels of the existing preschool building which is to be retained. This option includes placement of excavation spoil in the mine site containment cell. This option is proposed to support reuse of the preschool for a limited range of community uses. The capital expenditure for this option is estimated at \$60k – \$90k (ex GST). The net present value of ongoing management costs are estimated at an additional \$350k (ex GST) over a 100 year capping design life.

### 3. CONCLUSIONS

Abatement option evaluation has been undertaken based on multiplying an initial score for a range of evaluation metrics under each option by the weighting for each metric. Preliminary abatement recommendations have been made based on the evaluation of abatement options presented herein to mitigate potential high and moderate risks to human health identified in the CSM. The identified potential high and moderate human health risk areas also encompass areas identified as presenting a potential high or moderate risk to the environment.

Ongoing management costs have been conservatively projected and significantly affect the evaluation of abatement options. Ramboll is seeking Taskforce commentary on the following factors to refine option evaluations:

- evaluation metric weighting,
- parameters used in calculation of ongoing management costs,
- the duration over which ongoing management is projected,
- anticipated capacity to integrate abatement management with existing land management programs,
- provisions for upgrading drainage.

It is also noted that the privately owned land south of the Preschool and adjoining the Crown land road reserve will be a gap in the abatement coverage in this area. The Taskforce may wish to consider abatement of this privately owned land parcel.



## 4. LIMITATIONS

Ramboll Australia Pty Ltd prepared this report in accordance with the scope of work as outlined in our proposal to Regional NSW and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent Ramboll's professional judgment based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided to Ramboll during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

### 4.1 User Reliance

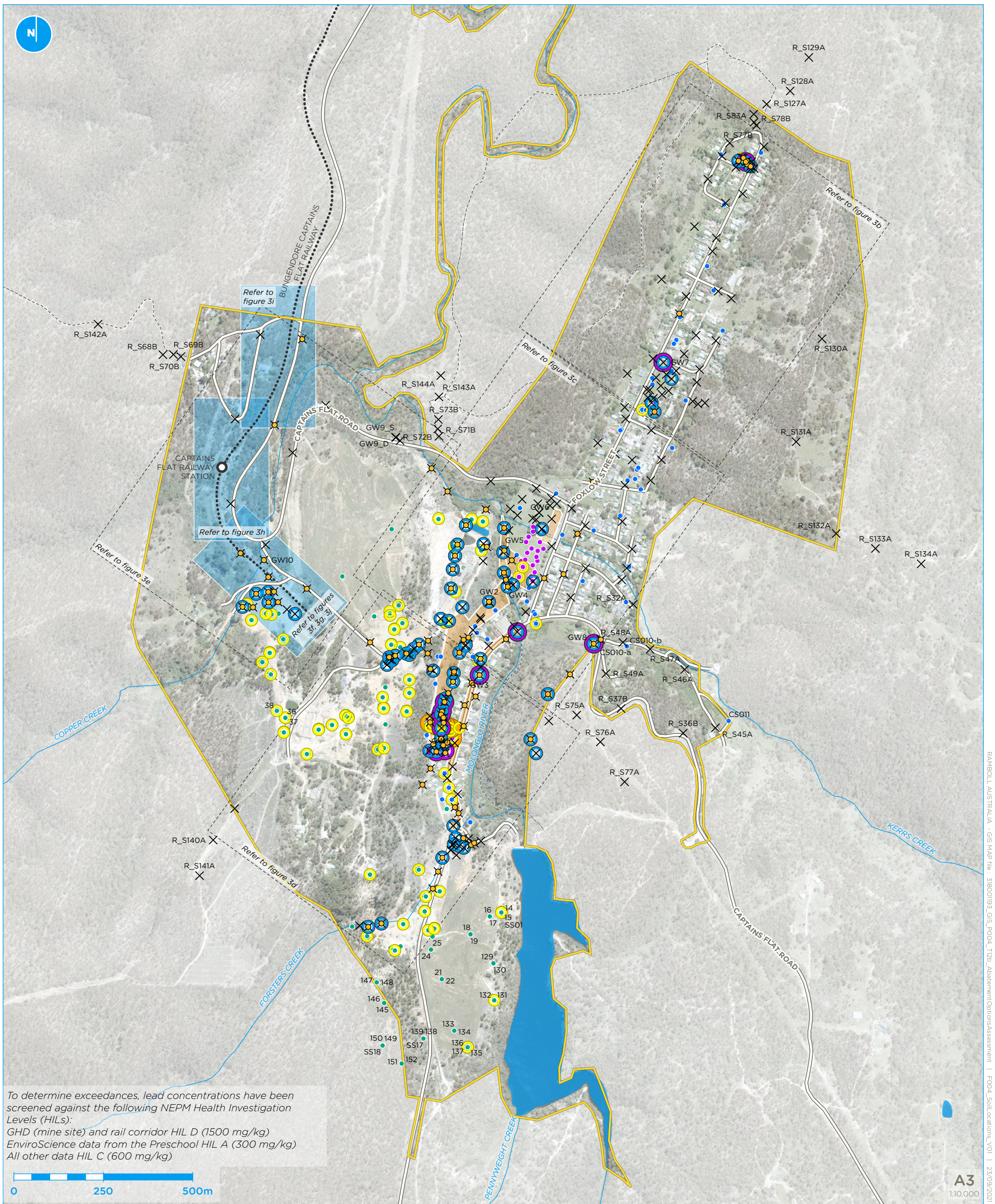
This report has been prepared exclusively for Regional NSW and may not be relied upon by any other person or entity without Ramboll's express written permission.

## 5. REFERENCES

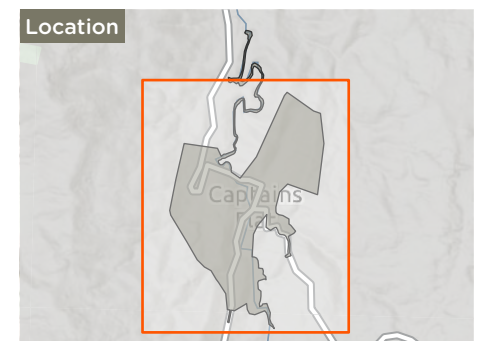
Ramboll (2021a) *Captains Flat Lead Management Plan, Conceptual Site Model*.  
US Department of

## **APPENDIX 1 FIGURES**

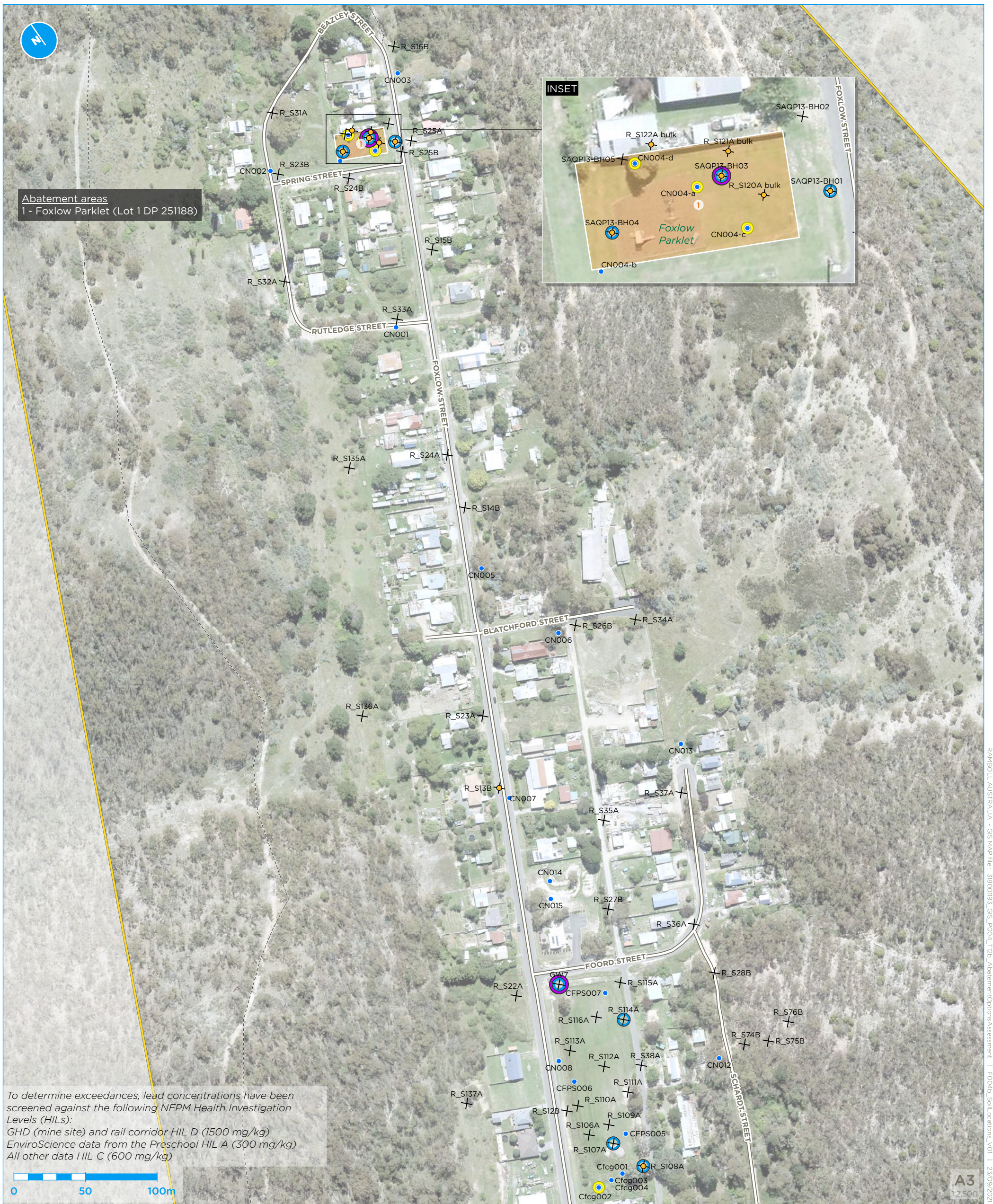




**Figure 3a : Soil sample locations and exceedances**  
 Captains Flat Lead Management Plan - Abatement Options Assessment



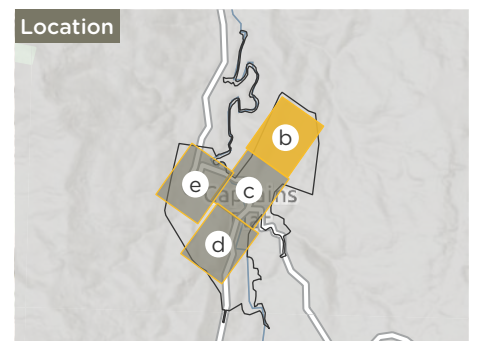




RAMBOLL AUSTRALIA - GIS MAP file: 31800103\_GIS\_P004\_T12b\_AbatementOptionsAssessment | Foordb\_SoilLocations\_V01 | 23/09/2021

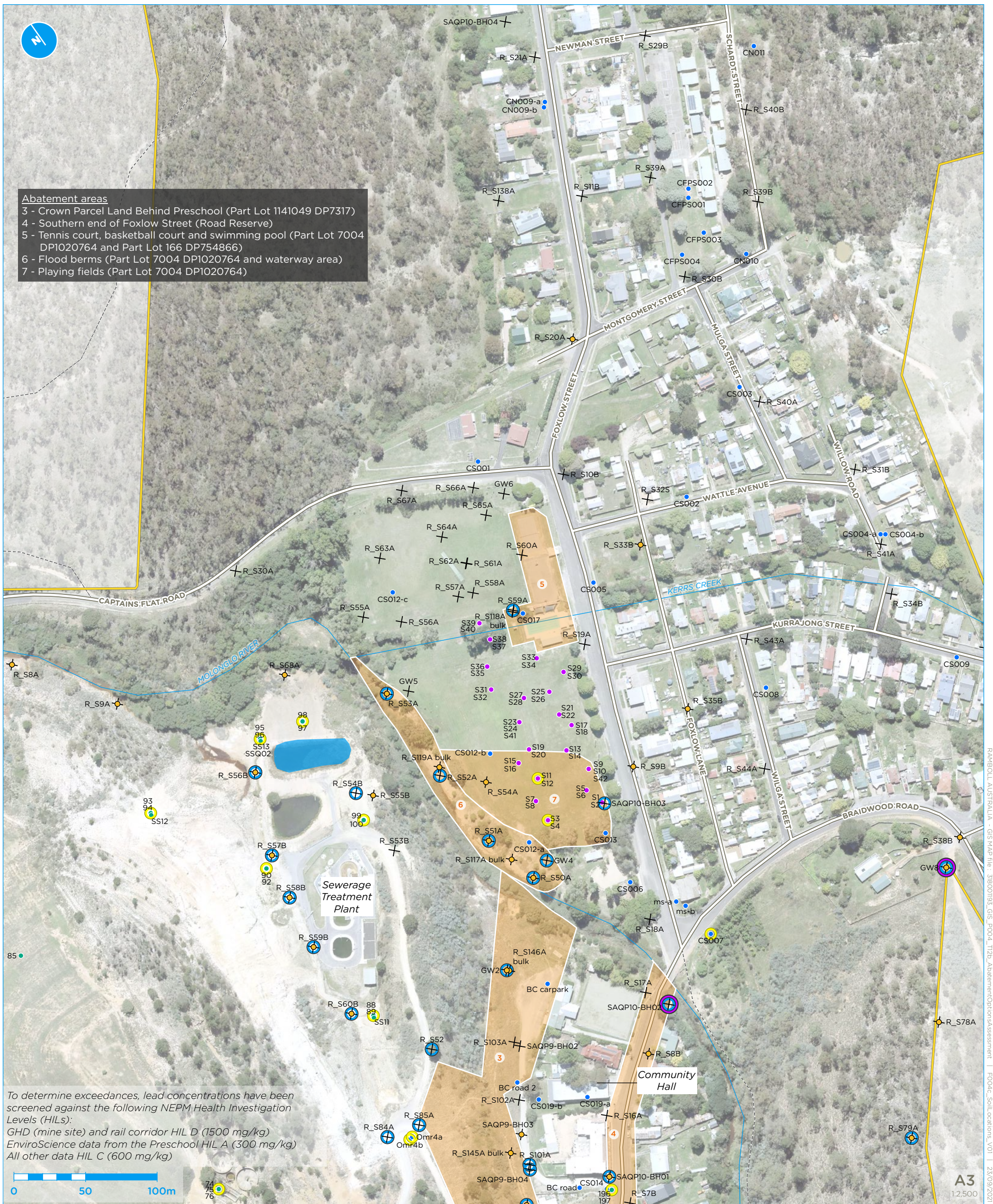
**Legend**

- Indicative precinct boundary
- Abatement area
- Samples (Ramboll 2021)
- X Soil sample
- Lead exceedance at depth
- Surface (<0.05 m)
- 0.05 m-0.5 m
- >0.5 m
- Previous soil samples
- EPA



**Figure 3b : Soil sample locations and exceedances**  
Captains Flat Lead Management Plan - Abatement Options Assessment



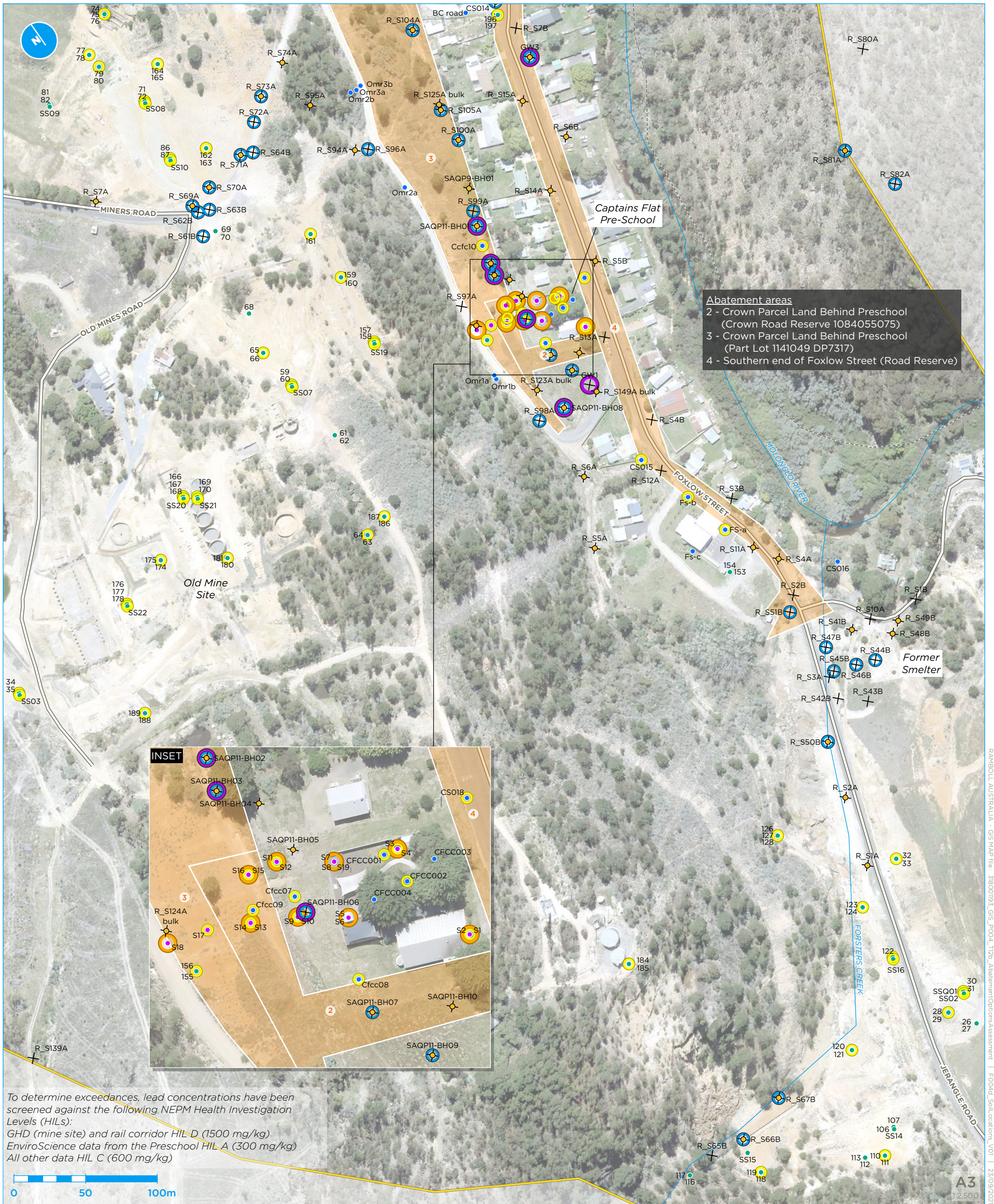


RAMBOLL AUSTRALIA - GIS/Map file : 318001193\_GIS\_POOL\_171b\_AbatementOptionsAssessment | F004c\_SoilLocations\_V01 | 23/09/2021

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Aerial photography by metromap flown on 01/03/2021

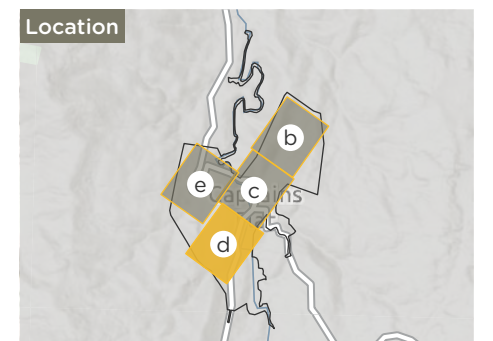




**Legend**

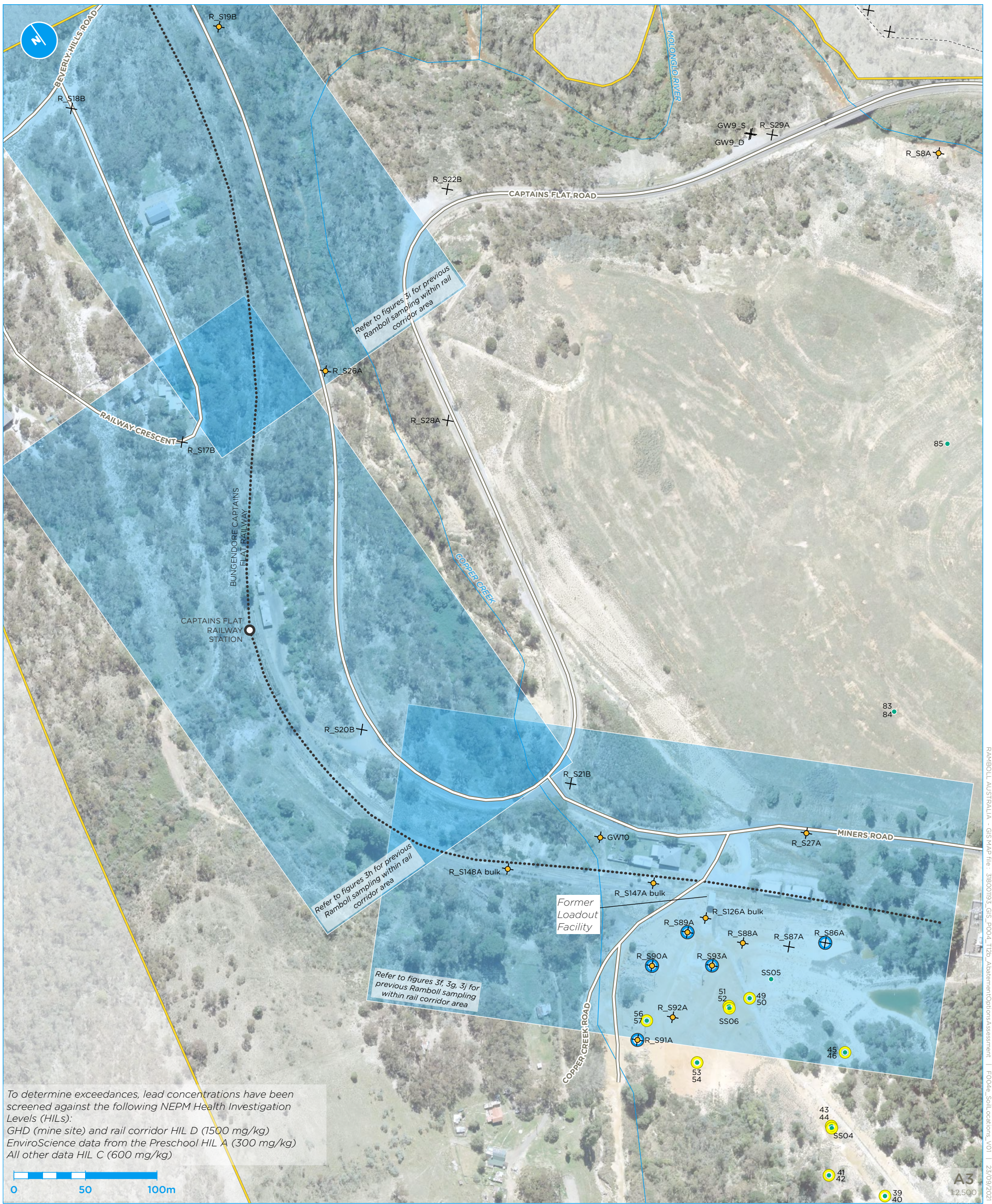
- Indicative precinct boundary
- Abatement area
- Samples (Ramboll 2021)
- × Soil sample
- Lead exceedance at depth
- Surface (<0.05 m)
- 0.05 m-0.5 m
- >0.5 m
- Previous soil samples
- EnviroScience (2021)
- GHD (2017)
- EPA
- Lead exceedance at depth
- Surface
- 0.4-0.5 m

Note: Exceedances of assessment criteria from EPA sampling are not presented on the figures.



**Figure 3d : Soil sample locations and exceedances**  
 Captains Flat Lead Management Plan - Abatement Options Assessment

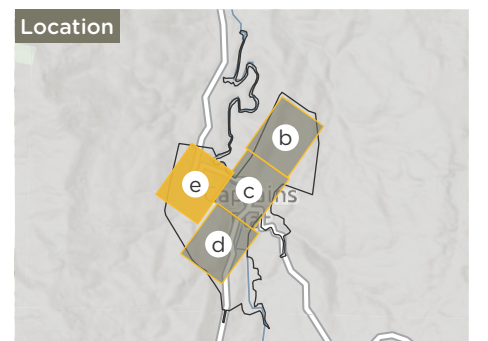




**Legend**

- Indicative precinct boundary
- Previous Ramboll sampling area\*
- X Samples (Ramboll 2021)
- X Soil sample
- Lead exceedance at depth
- Surface (<0.05 m)
- Previous soil samples
- GHD (2017)
- Lead exceedance at depth
- Surface

\*Captains Flat Rail Corridor sampling conducted by Ramboll for John Holland Rail 2020-2021. Refer to figures from DSI in 3f to 3j for sample locations and assessment criteria exceedance locations.



**Figure 3e : Soil sample locations and exceedances**  
 Captains Flat Lead Management Plan - Abatement Options Assessment



**APPENDIX 2**  
**ABATEMENT OPTIONS ASSESSMENT - FOXLOW PARKLET**

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost		Social	Ranking	Final Score		
					Capital Expenditure	Ranking				Financial Assurance	Ranking
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>	
<b>Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform</b>	Excavation of contaminated soils from Foxlow Parklet could likely be achieved. Assessment indicates lead concentrations above criteria are limited to an average maximum depth of 0.6 m however lead in soil in other areas of the Precinct north of the Molonglo River extends to great depths and infers potential for elevated lead in natural soils beneath Foxlow Parklet.	3	This option would eliminate environmental exposure risks for contaminated soils from Foxlow Parklet. Consolidation within the proposed containment cell would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur. Sustainability as measured by carbon footprint and landfill space consumption would be favourable compared with offsite disposal though unfavourable compared to insitu retention.  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	2	The capital expenditure estimate for progressing this option is \$70k - 130k (ex GST).	2	No financial assurance required.	3	Intergenerational equity is achieved through this option as the contaminant is adequately managed with like materials in perpetuity.	3	43
<b>Option 2 - Offsite treatment and disposal of all contaminated soils</b>	Excavation of contaminated soils from Foxlow Parklet could likely be achieved. Assessment indicates lead concentrations above criteria are limited to an average maximum depth of 0.6 m however lead in soil in other areas of the Precinct north of the Molonglo River extends to great depths and infers potential for elevated lead in natural soils beneath Foxlow Parklet.	3	This option would eliminate environmental exposure risks for contaminated soils from Foxlow Parklet and long term management requirements. Environmental sustainability as measured by carbon footprint and landfill space consumption would be unfavourable compared with other abatement options.  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).	2	The capital expenditure estimate for progressing this option is \$210k - \$390k (ex GST).	1	No financial assurance required.	3	Intergenerational equity is achieved as the contaminant is adequately managed within an appropriate management structure in perpetuity.	3	40
<b>Option 3a - Capping without excavation</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	Insitu containment would eliminate exposure risks at Foxlow Parklet except where intentional digging or cap failure occurs.  An LTEMP would be required for Foxlow Parklet to manage these risks.  Environmental sustainability as measured by carbon footprint would be favourable compared to other options.	2	The capital expenditure estimate for progressing this option is \$65k - \$95k (ex GST)	3	Additionally, a financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$380,000 (ex GST) net present value. This integrates costs projected for annual monitoring and replacement of topsoil every 10 years. The cumulative investment is estimated at \$470k - \$530k. These cost projections would reset at completion of the nominated period	1	A need to manage the contaminated soils in the future may impact future generations.	2	38

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost		Social	Ranking	Final Score		
					Capital Expenditure	Ranking				Financial Assurance	Ranking
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>	
<b>Option 3b - Movement of upper 0.3 m soils to the mine site containment cell followed by capping to reinstate the existing landform</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would limit environmental exposure risks for contaminated soils from Foxlow Parklet to risks during intentional excavation or when cap failure occurs. An LTEMP would be required for Foxlow Parklet to manage these risks. Per Option 1, the environmental sustainability would be favourable compared with offsite disposal options.  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	1	The capital expenditure estimate for progressing this option is \$65k - \$95k (ex GST)	3	Additionally, a financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$380,000 (ex GST) net present value. This integrates costs projected for annual monitoring and replacement of topsoil every 10 years. The cumulative investment is estimated at \$470k - \$530k (ex GST). These cost projections would reset at completion of the nominated period	1	A need to manage the contaminated soils in the future may impact future generations.	2	36
<b>Option 3c - Offsite treatment and disposal of upper 0.3 m contaminated soils followed by capping to reinstate existing landform</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would limit environmental exposure risks for contaminated soils from Foxlow Parklet to risks during intentional excavation or when cap failure occurs. An LTEMP would be required for Foxlow Parklet to manage these risks. The environmental sustainability would be favourable compared with offsite disposal of all soils though unfavourable compared to full insitu containment (Option 3a) or options that include containment at the mine site (Option 1 and 3b).  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	1	The capital expenditure estimate for progressing this option is \$130k - \$200k (ex GST)	3	Additionally, a financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$380,000 (ex GST) net present value. This integrates costs projected for annual monitoring and replacement of topsoil every 10 years. The cumulative investment is estimated at \$470k - \$530k. These cost projections would reset at completion of the nominated period	1	A need to manage the contaminated soils in the future may impact future generations.	2	36

**Notes**

Capping could comprise clean soils or permanent hardstand. Costs have been considered based on use of soils as capping layers to be consistent with the existing landform. Permanent hardstand could alternately be used and could be expected to increase capital expenditure and reduce financial assurance.

The projected volumes of contaminated soil may limit the feasibility of chemical immobilisation (and so offsite disposal as contemplated) if this process was proposed in isolation to other abatement areas.

Other contaminants in soils contaminated by mining activities (e.g.: those related to historic and current use of public spaces) may affect the feasibility of containment at the mine site or offsite disposal.

**Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	390	\$19,500
Supply and place 0.5m sub-soil layer	m <sup>3</sup>	\$70	325	\$22,750
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	65	\$3,900
Landscaping and equipment reinstatement	Item	\$20,000	1	\$20,000
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
<b>Estimated Total</b>				<b>\$106,650</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

**Option 2 - Offsite treatment and disposal of all contaminated soils**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	390	\$23,400
Immobilisation of impacted material	Tonne	\$100	702	\$70,200
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	702	\$84,240
Supply and place 0.5m sub-soil layer	m <sup>3</sup>	\$70	325	\$22,750
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	65	\$3,900
Landscaping and equipment reinstatement	Item	\$20,000	1	\$20,000
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$15,000	1	\$15,000
<b>Estimated Total for treatment and disposal</b>				<b>\$289,990</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

### Option 3a: Capping without excavation

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Design	Item	\$15,000	1	\$15,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	650	\$6,500
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	130	\$6,500
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	65	\$3,900
Landscaping and equipment reinstatement	Item	\$20,000	1	\$20,000
Project Management	Week	\$6,500	2	\$13,000
Validation	Item	\$5,000	1	\$5,000
Financial Assurance	Item	NA	1	\$379,000
<b>Estimated Total for treatment and disposal</b>				<b>\$461,400</b>

Note: Option 3a is based on capping with soil. Permanent pavement could replace soil. This would be expected to increase capital expenditure and decrease ongoing management costs.

### Option 3b - Movement of upper soils (0.3m) to the mine site containment cell followed by capping to reinstate the existing landform

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	195	\$9,750
Supply and placement of geofabric	m <sup>2</sup>	\$10	650	\$6,500
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	130	\$6,500
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	65	\$3,900
Landscaping	Item	\$20,000	1	\$20,000
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
Financial Assurance	Item	\$15,000	1	\$379,000
<b>Estimated Total</b>				<b>\$466,150</b>

**Option 3c - Offsite treatment and disposal of upper soils (0.3m) followed by capping to reinstate the existing landform**

<b>Description</b>	<b>Unit</b>	<b>Budget Rate</b>	<b>Estimated Qty</b>	<b>Estimated Total</b>
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	195	\$11,700
Immobilisation of impacted material	Tonne	\$50	351	\$17,550
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	351	\$42,120
Supply and placement of geofabric	m <sup>2</sup>	\$10	600	\$6,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	130	\$6,500
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	65	\$3,900
Landscaping	Item	\$20,000	1	\$20,000
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
Financial Assurance	Item	\$15,000	1	\$379,000
<b>Estimated Total</b>				<b>\$547,270</b>

**APPENDIX 3  
ABATEMENT OPTIONS ASSESSMENT - CROWN LANDS ADJACENT THE  
PRESCHOOL**

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost		Social	Ranking	Final Score			
					Capital Expenditure	Ranking				Financial Assurance	Ranking	
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>		
<b>Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform</b>	The depth of lead contaminated soils has not been accurately delineated and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from the embankment would require significant energy input.  If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area. Consolidation within the proposed containment cell would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	The capital expenditure estimate for progressing this option is \$270k - 410k (ex GST).	1	No financial assurance required.	2	3	Intergenerational equity is achieved through this option as the contaminant is adequately managed with like materials in perpetuity.	3	31
<b>Option 2 - Offsite treatment and disposal of all contaminated soils</b>	The depth of lead contaminated soils has not been accurately delineated and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from the embankment would require significant energy input.  If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area. Offsite disposal would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	The capital expenditure estimate for progressing this option is \$800k - \$1.4M (ex GST).	1	No financial assurance required.	1	3	Intergenerational equity is achieved as the contaminant is adequately managed within an appropriate management structure in perpetuity.	3	28
<b>Option 3a - Capping without excavation</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	Insitu containment would eliminate exposure risks except where intentional digging or cap failure occurs.  An LTEMP would be required to manage these risks.  Environmental sustainability as measured by carbon footprint would be favourable compared to other options.	3	The capital expenditure estimate for progressing this option is 70k - \$110k (ex GST)	3	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$440k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	3	1	A need to manage the contaminated soils in the future may impact future generations.	2	40



Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost		Social	Ranking	Final Score		
					Capital Expenditure	Ranking				Financial Assurance	Ranking
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>	<b>4</b>		
<b>Option 3b - Movement of upper 0.3 m soils to the mine site containment cell followed by capping to reinstate the existing landform</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would limit environmental exposure risks for contaminated soils except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. Per Option 1, the environmental sustainability would be favourable compared with offsite disposal options.  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	2	The capital expenditure estimate for progressing this option is \$90 - 150k (ex GST) .	2	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$440k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	A need to manage the contaminated soils in the future may impact future generations.	2	35
<b>Option 3c - Offsite treatment and disposal of upper 0.3 m contaminated soils followed by capping to reinstate existing landform</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would limit environmental exposure risks for contaminated soils except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. The environmental sustainability would be favourable compared with offsite disposal of all soils though unfavourable compared to full insitu containment (Option 3a) or options that include containment at the mine site (Option 1 and 3b).  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	1	The capital expenditure estimate for progressing this option is \$130k - \$200k	2	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$440k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	A need to manage the contaminated soils in the future may impact future generations.	2	33

**Notes**

Capping could comprise clean soils or permanent hardstand. Costs have been considered based on use of soils as capping layers to be consistent with the existing landform. Permanent hardstand could alternately be used and could be expected to increase capital expenditure and reduce financial assurance.

The projected volumes of contaminated soil may limit the feasibility of chemical immobilisation (and so offsite disposal as contemplated) if this process was proposed in isolation to other abatement areas.

Other contaminants in soils contaminated by mining activities (e.g.: those related to historic and current use of public spaces) may affect the feasibility of containment at the mine site or offsite disposal.

### Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	2,250	\$112,500
Supply and place 1.4m sub-soil layer <sup>1</sup>	m <sup>3</sup>	\$70	2,100	\$147,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	150	\$9,000
Hydromulch	m <sup>2</sup>	\$0.5	1,500	\$750
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
<b>Estimated Total</b>				<b>\$309,750</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

### Option 2 - Offsite treatment and disposal of all contaminated soils

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	2,250	\$135,000
Immobilisation of impacted material	Tonne	\$50	4,050	\$202,500
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	4,050	\$486,000
Supply and place 1.4m sub-soil layer	m <sup>3</sup>	\$70	2,100	\$147,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	150	\$9,000
Hydromulch	m <sup>2</sup>	\$0.5	1,500	\$750
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$15,000	1	\$15,000
<b>Estimated Total for treatment and disposal</b>				<b>\$1,045,750</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

### Option 3a: Capping without excavation

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Design	Item	\$15,000	1	\$15,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	1500	\$15,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	300	\$15,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	150	\$9,000
Hydromulch	m <sup>2</sup>	\$0.5	0	\$0
Project Management	Week	\$6,500	2	\$13,000
Validation	Item	\$5,000	1	\$5,000
Financial Assurance	Item	\$15,000	1	\$440,000
<b>Estimated Total for treatment and disposal</b>				<b>\$524,500</b>

Note: Option 3a is based on capping with soil. Permanent pavement could replace soil. This would be expected to increase capital expenditure and decrease ongoing management costs.

### Option 3b - Movement of upper soils (0.3m) to the mine site containment cell followed by capping to reinstate the existing landform

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	450	\$22,500
Supply and placement of geofabric	m <sup>2</sup>	\$10	1,500	\$15,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	300	\$15,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	150	\$9,000
Hydromulch	m <sup>2</sup>	\$0.5	1,500	\$750
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
Financial Assurance	Item	\$15,000	1	\$440,000
<b>Estimated Total</b>				<b>\$542,750</b>

**Option 3c - Offsite treatment and disposal of upper soils (0.3m) followed by capping to reinstate the existing landform**

<b>Description</b>	<b>Unit</b>	<b>Budget Rate</b>	<b>Estimated Qty</b>	<b>Estimated Total</b>
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	2,250	\$135,000
Immobilisation of impacted material	Tonne	\$50	4,050	\$202,500
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	4,050	\$486,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	600	\$6,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	130	\$6,500
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	65	\$3,900
Hydromulch	m <sup>2</sup>	\$0.5	1,500	\$750
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
Financial Assurance	Item	\$15,000	1	\$440,000
<b>Estimated Total</b>				<b>\$1,341,150</b>

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
q-factor	100.0%	97.1%	94.3%	91.5%	88.8%	86.3%	83.7%	81.3%	78.9%	76.6%	74.4%	72.2%	70.1%	68.1%	66.1%	64.2%	62.3%
Price escalation	100.0%	102.0%	104.0%	106.1%	108.2%	110.4%	112.6%	114.9%	117.2%	119.5%	121.9%	124.3%	126.8%	129.4%	131.9%	134.6%	137.3%
<b>Investment</b>	-106,000																
<b>Ongoing Maintenance and Monitoring Requirements</b>																	
<i>Environmental Monitoring</i>																	
Inspection and reporting		-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000	-5,000
Periodic cap repair											-20,000						
<b>Total (without price escalation)</b>	<b>-106,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
Total (with price escalation)	-106,000	-5,100	-5,202	-5,306	-5,412	-5,520	-5,631	-5,743	-5,858	-5,975	-30,475	-6,217	-6,341	-6,468	-6,597	-6,729	-6,864
<b>NPV</b>	<b>-106,000</b>	<b>-4,951</b>	<b>-4,903</b>	<b>-4,856</b>	<b>-4,809</b>	<b>-4,762</b>	<b>-4,716</b>	<b>-4,670</b>	<b>-4,625</b>	<b>-4,580</b>	<b>-22,676</b>	<b>-4,491</b>	<b>-4,448</b>	<b>-4,404</b>	<b>-4,362</b>	<b>-4,319</b>	<b>-4,277</b>
	-106,000																
<b>Total NPV</b>	<b>-545,344</b>																
NPV Capital	-106,000																
NPV Monitoring and management	-439,344																

**Note:**

The q-factor quantifies the effect of interest and inflation on future costs of long term environmental management and informs calculation of net present value required for financial assurance.

Financial assurance provisions could be expected to be lower if in-situ containment is implemented as the preferred abatement option across multiple areas within the Precinct.



17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
60.5%	58.7%	57.0%	55.4%	53.8%	52.2%	50.7%	49.2%	47.8%	46.4%	45.0%	43.7%	42.4%	41.2%	40.0%	38.8%	37.7%	36.6%	35.5%	34.5%	33.5%	32.5%
140.0%	142.8%	145.7%	148.6%	151.6%	154.6%	157.7%	160.8%	164.1%	167.3%	170.7%	174.1%	177.6%	181.1%	184.8%	188.5%	192.2%	196.1%	200.0%	204.0%	208.1%	212.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
			-20,000										-20,000								
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
-7,001	-7,141	-7,284	-37,149	-7,578	-7,730	-7,884	-8,042	-8,203	-8,367	-8,534	-8,705	-8,879	-45,284	-9,238	-9,423	-9,611	-9,803	-9,999	-10,199	-10,403	-10,611
<b>-4,236</b>	<b>-4,195</b>	<b>-4,154</b>	<b>-20,568</b>	<b>-4,074</b>	<b>-4,034</b>	<b>-3,995</b>	<b>-3,956</b>	<b>-3,918</b>	<b>-3,880</b>	<b>-3,842</b>	<b>-3,805</b>	<b>-3,768</b>	<b>-18,656</b>	<b>-3,695</b>	<b>-3,659</b>	<b>-3,624</b>	<b>-3,588</b>	<b>-3,554</b>	<b>-3,519</b>	<b>-3,485</b>	<b>-3,451</b>



39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31.6%	30.7%	29.8%	28.9%	28.1%	27.2%	26.4%	25.7%	24.9%	24.2%	23.5%	22.8%	22.1%	21.5%	20.9%	20.3%	19.7%	19.1%	18.5%	18.0%	17.5%	17.0%
216.5%	220.8%	225.2%	229.7%	234.3%	239.0%	243.8%	248.7%	253.6%	258.7%	263.9%	269.2%	274.5%	280.0%	285.6%	291.3%	297.2%	303.1%	309.2%	315.4%	321.7%	328.1%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
	-20,000										-20,000										-20,000
<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>
-10,824	-55,201	-11,261	-11,486	-11,716	-11,950	-12,189	-12,433	-12,682	-12,935	-13,194	-67,290	-13,727	-14,002	-14,282	-14,567	-14,859	-15,156	-15,459	-15,768	-16,083	-82,026
<b>-3,418</b>	<b>-16,922</b>	<b>-3,352</b>	<b>-3,319</b>	<b>-3,287</b>	<b>-3,255</b>	<b>-3,223</b>	<b>-3,192</b>	<b>-3,161</b>	<b>-3,130</b>	<b>-3,100</b>	<b>-15,349</b>	<b>-3,040</b>	<b>-3,011</b>	<b>-2,981</b>	<b>-2,952</b>	<b>-2,924</b>	<b>-2,895</b>	<b>-2,867</b>	<b>-2,839</b>	<b>-2,812</b>	<b>-13,922</b>



61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
16.5%	16.0%	15.5%	15.1%	14.6%	14.2%	13.8%	13.4%	13.0%	12.6%	12.3%	11.9%	11.6%	11.2%	10.9%	10.6%	10.3%	10.0%	9.7%	9.4%	9.1%	8.9%
334.7%	341.4%	348.2%	355.1%	362.3%	369.5%	376.9%	384.4%	392.1%	400.0%	408.0%	416.1%	424.4%	432.9%	441.6%	450.4%	459.4%	468.6%	478.0%	487.5%	497.3%	507.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
									-20,000										-20,000		
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>
-16,733	-17,068	-17,409	-17,757	-18,113	-18,475	-18,844	-19,221	-19,606	-99,989	-20,398	-20,806	-21,222	-21,646	-22,079	-22,521	-22,971	-23,431	-23,899	-121,886	-24,865	-25,362
<b>-2,757</b>	<b>-2,731</b>	<b>-2,704</b>	<b>-2,678</b>	<b>-2,652</b>	<b>-2,626</b>	<b>-2,601</b>	<b>-2,575</b>	<b>-2,550</b>	<b>-12,628</b>	<b>-2,501</b>	<b>-2,477</b>	<b>-2,453</b>	<b>-2,429</b>	<b>-2,405</b>	<b>-2,382</b>	<b>-2,359</b>	<b>-2,336</b>	<b>-2,313</b>	<b>-11,454</b>	<b>-2,269</b>	<b>-2,247</b>





83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
8.6%	8.3%	8.1%	7.9%	7.6%	7.4%	7.2%	7.0%	6.8%	6.6%	6.4%	6.2%	6.0%	5.9%	5.7%	5.5%	5.4%	5.2%
517.4%	527.7%	538.3%	549.1%	560.0%	571.2%	582.7%	594.3%	606.2%	618.3%	630.7%	643.3%	656.2%	669.3%	682.7%	696.3%	710.3%	724.5%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
							-20,000										-20,000
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>
-25,869	-26,387	-26,914	-27,453	-28,002	-28,562	-29,133	-148,578	-30,310	-30,916	-31,535	-32,165	-32,808	-33,465	-34,134	-34,817	-35,513	-181,116
<b>-2,225</b>	<b>-2,203</b>	<b>-2,182</b>	<b>-2,161</b>	<b>-2,140</b>	<b>-2,119</b>	<b>-2,098</b>	<b>-10,390</b>	<b>-2,058</b>	<b>-2,038</b>	<b>-2,018</b>	<b>-1,998</b>	<b>-1,979</b>	<b>-1,960</b>	<b>-1,941</b>	<b>-1,922</b>	<b>-1,903</b>	<b>-9,424</b>

**APPENDIX 4**  
**ABATEMENT OPTIONS ASSESSMENT – EASTERN EMBANKMENT**

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost				Social	Ranking	Final Score
					Capital Expenditure	Ranking	Financial Assurance	Ranking			
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>	
<b>Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform</b>	The depth of lead contaminated soils has not been accurately delineated (i.e.: >1 m depth) and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from the embankment would require significant energy input.  If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area. Consolidation within the proposed containment cell would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	The capital expenditure estimate for progressing this option is \$4.4M - \$8.2M (ex GST).	1	No financial assurance required.	2	Intergenerational equity is achieved through this option as the contaminant is adequately managed with like materials in perpetuity.	3	31
<b>Option 2 - Offsite treatment and disposal of all contaminated soils</b>	The depth of lead contaminated soils has not been accurately delineated (i.e.: >1 m depth) and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from the embankment would require significant energy input.  If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area. Offsite disposal would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	The capital expenditure estimate for progressing this option is \$14M - \$26M (ex GST).	1	No financial assurance required.	1	Intergenerational equity is achieved as the contaminant is adequately managed within an appropriate management structure in perpetuity.	3	28
<b>Option 3a - Capping without excavation</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	2	Insitu containment would eliminate exposure risks except where intentional digging or cap failure occurs.  An LTEMP would be required to manage these risks.  Environmental sustainability as measured by carbon footprint would be favourable compared to other options.	3	The capital expenditure estimate for progressing this option is \$1.3M - \$1.9M (ex GST)	3	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$925k (ex GST)	3	A need to manage the contaminated soils in the future may impact future generations.	1	35

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost		Social	Ranking	Final Score		
					Capital Expenditure	Ranking				Financial Assurance	Ranking
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>	<b>4</b>		
<b>Option 3b - Movement of upper 0.3 m soils to the mine site containment cell followed by capping to reinstate the existing landform</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would eliminate contaminant exposure risks except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. Per Option 1, the environmental sustainability would be favourable compared with offsite disposal options.  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	2	The capital expenditure estimate for progressing this option is \$1.5M - \$2.7M (ex GST)	3	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$925k (ex GST)	1	A need to manage the contaminated soils in the future may impact future generations.	2	38
<b>Option 3c - Offsite treatment and disposal of upper 0.3 m contaminated soils followed by capping to reinstate existing landform</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would eliminate contaminant exposure risks except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. The environmental sustainability would be favourable compared with offsite disposal of all soils though unfavourable compared to full in situ containment (Option 3a) or options that include containment at the mine site (Option 1 and 3b).  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	1	The capital expenditure estimate for progressing this option is \$3.5M - \$6.5M (ex GST)	2	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$925k (ex GST)	1	A need to manage the contaminated soils in the future may impact future generations.	2	33

**Notes**

Capping could comprise clean soils or permanent hardstand. Costs have been considered based on use of soils as capping layers to be consistent with the existing landform. Permanent hardstand could alternately be used and could be expected to increase capital expenditure and reduce financial assurance.

The projected volumes of contaminated soil may limit the feasibility of chemical immobilisation (and so offsite disposal as contemplated) if this process was proposed in isolation to other abatement areas.

Other contaminants in soils contaminated by mining activities (e.g.: those related to historic and current use of public spaces) may affect the feasibility of containment at the mine site or offsite disposal.

**Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing levels (landform altered to amend drainage)**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$25,000	1	\$25,000
Mobilisation and site establishment	Item	\$20,000	1	\$20,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$50,000	1	\$50,000
Excavation and transport of contaminated soils to mine site	m <sup>3</sup>	\$50	30,750	\$1,537,500
Earthworks and drainage to achieve design / drainage objectives	Item	\$250,000	1	\$250,000
Supply and place 1.4m sub-soil layer <sup>1</sup>	m <sup>3</sup>	\$70	28,700	\$2,009,000
Supply and install cellular confinement system (Presto 0.3m Geoweb™ or similar)	m <sup>2</sup>	\$15	20,500	\$307,500
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	2,050	\$123,000
Hydromulch	m <sup>2</sup>	\$0.5	20,500	\$10,250
Landscaping and equipment reinstatement	Item	\$20,000	1	\$20,000
Demobilisation	Item	\$20,000	1	\$20,000
Validation	Item	\$30,000	1	\$30,000
<b>Estimated Total</b>				<b>\$4,441,250</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

**Option 2 - Offsite treatment and disposal of all contaminated soils**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$25,000	1	\$25,000
Mobilisation and site establishment	Item	\$20,000	1	\$20,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$50,000	1	\$50,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Excavation and transport of contaminated soils to local landfill	m <sup>3</sup>	\$60	30,750	\$1,845,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$250,000	1	\$250,000
Immobilisation of impacted material	Tonne	\$50	55,350	\$2,767,500
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	55,350	\$6,642,000
Supply and place 1.4m sub-soil layer	m <sup>3</sup>	\$70	28,700	\$2,009,000
Supply and install cellular confinement system (Presto 0.3m Geoweb™ or similar)	m <sup>2</sup>	\$15	20,500	\$307,500
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	2,050	\$123,000
Hydromulch	m <sup>2</sup>	\$0.5	20,500	\$10,250
Demobilisation	Item	\$20,000	1	\$20,000
Validation	Item	\$30,000	1	\$30,000
<b>Estimated Total for treatment and disposal</b>				<b>\$14,158,250</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

### Option 3a: Capping without excavation

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$25,000	1	\$25,000
Mobilisation and site establishment	Item	\$20,000	1	\$20,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$50,000	1	\$50,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$250,000	1	\$250,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	20500	\$205,000
Supply and install cellular confinement system (Presto 0.3m Geoweb™ or similar)	m <sup>2</sup>	\$15	20,500	\$307,500
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	4,100	\$205,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	2,050	\$123,000
Demobilisation	Item	\$20,000	1	\$20,000
Validation	Item	\$30,000	1	\$30,000
Financial Assurance	Item	\$15,000	1	\$925,000
<b>Estimated Total for treatment and disposal</b>				<b>\$2,199,500</b>

Note: Option 3a is based on capping with soil. Permanent pavement could replace soil. This would be expected to increase capital expenditure and decrease ongoing management costs.

### Option 3b - Movement of upper soils (0.3m) to the mine site containment cell followed by capping to reinstate the existing landform

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$25,000	1	\$25,000
Mobilisation and site establishment	Item	\$20,000	1	\$20,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$50,000	1	\$50,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$250,000	1	\$250,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	6,150	\$307,500
Supply and placement of geofabric	m <sup>2</sup>	\$10	20,500	\$205,000
Supply and install cellular confinement system (Presto 0.3m Geoweb™ or similar)	m <sup>2</sup>	\$15	20,500	\$307,500
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	4,100	\$205,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	2,050	\$123,000
Hydromulch	m <sup>2</sup>	\$0.5	20,500	\$10,250
Demobilisation	Item	\$20,000	1	\$20,000
Validation	Item	\$30,000	1	\$30,000
Financial Assurance	Item	\$15,000	1	\$925,000
<b>Estimated Total</b>				<b>\$2,517,250</b>

\$1,592,250

**Option 3c - Offsite treatment and disposal of upper soils (0.3m) followed by capping to reinstate the existing landform**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$25,000	1	\$25,000
Mobilisation and site establishment	Item	\$20,000	1	\$20,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$50,000	1	\$50,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	6,150	\$369,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$250,000	1	\$250,000
Immobilisation of impacted material	Tonne	\$50	11,070	\$553,500
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	11,070	\$1,328,400
Supply and placement of geofabric	m <sup>2</sup>	\$10	20,500	\$205,000
Supply and install cellular confinement system (Presto 0.3m Geoweb™ or similar)	m <sup>2</sup>	\$15	20,500	\$307,500
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	4,100	\$205,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	2,050	\$123,000
Hydromulch	m <sup>2</sup>	\$0.5	20,500	\$10,250
Demobilisation	Item	\$20,000	1	\$20,000
Validation	Item	\$30,000	1	\$30,000
Financial Assurance	Item	\$15,000	1	\$925,000
<b>Estimated Total</b>				<b>\$4,480,650</b>

**Notes**

A \$250,000 provision is made under all abatement options for improvement of drainage. This includes drainage upgrades at the toe of the embankment assumes that water coming downhill to Miners Rd will be managed under the mine site management program and that water from Miners Rd onwards will be clean post abatement.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
q-factor	100.0%	97.1%	94.3%	91.5%	88.8%	86.3%	83.7%	81.3%	78.9%	76.6%	74.4%	72.2%	70.1%	68.1%	66.1%	64.2%	62.3%
Price escalation	100.0%	102.0%	104.0%	106.1%	108.2%	110.4%	112.6%	114.9%	117.2%	119.5%	121.9%	124.3%	126.8%	129.4%	131.9%	134.6%	137.3%
<b>Investment</b>	-1,664,000																
<b>Ongoing Maintenance and Monitoring Requirements</b>																	
<i>Environmental Monitoring</i>																	
Inspection and reporting		-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
Periodic concrete / soft fall repair											-100,000						
<b>Total (without price escalation)</b>	<b>-1,664,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
Total (with price escalation)	-1,664,000	-5,100	-5,202	-5,306	-5,412	-5,520	-5,631	-5,743	-5,858	-5,975	-127,994	-6,217	-6,341	-6,468	-6,597	-6,729	-6,864
<b>NPV</b>	<b>-1,664,000</b>	<b>-4,951</b>	<b>-4,903</b>	<b>-4,856</b>	<b>-4,809</b>	<b>-4,762</b>	<b>-4,716</b>	<b>-4,670</b>	<b>-4,625</b>	<b>-4,580</b>	<b>-95,240</b>	<b>-4,491</b>	<b>-4,448</b>	<b>-4,404</b>	<b>-4,362</b>	<b>-4,319</b>	<b>-4,277</b>
<b>Total NPV</b>	<b>-1,664,000</b>																
	<b>-3,138,495</b>																
NPV Capital	-1,664,000																
NPV Monitoring and management	-1,474,495																

**Note:**

The q-factor quantifies the effect of interest and inflation on future costs of long term environmental management and informs calculation of net present value required for financial assurance.

Financial assurance provisions could be expected to be lower if in-situ containment is implemented as the preferred abatement option across multiple areas within the Precinct.





17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
60.5%	58.7%	57.0%	55.4%	53.8%	52.2%	50.7%	49.2%	47.8%	46.4%	45.0%	43.7%	42.4%	41.2%	40.0%	38.8%	37.7%	36.6%	35.5%	34.5%	33.5%	32.5%
140.0%	142.8%	145.7%	148.6%	151.6%	154.6%	157.7%	160.8%	164.1%	167.3%	170.7%	174.1%	177.6%	181.1%	184.8%	188.5%	192.2%	196.1%	200.0%	204.0%	208.1%	212.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
			-100,000										-100,000								
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
-7,001	-7,141	-7,284	-156,024	-7,578	-7,730	-7,884	-8,042	-8,203	-8,367	-8,534	-8,705	-8,879	-190,193	-9,238	-9,423	-9,611	-9,803	-9,999	-10,199	-10,403	-10,611
<b>-4,236</b>	<b>-4,195</b>	<b>-4,154</b>	<b>-86,387</b>	<b>-4,074</b>	<b>-4,034</b>	<b>-3,995</b>	<b>-3,956</b>	<b>-3,918</b>	<b>-3,880</b>	<b>-3,842</b>	<b>-3,805</b>	<b>-3,768</b>	<b>-78,357</b>	<b>-3,695</b>	<b>-3,659</b>	<b>-3,624</b>	<b>-3,588</b>	<b>-3,554</b>	<b>-3,519</b>	<b>-3,485</b>	<b>-3,451</b>



39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31.6%	30.7%	29.8%	28.9%	28.1%	27.2%	26.4%	25.7%	24.9%	24.2%	23.5%	22.8%	22.1%	21.5%	20.9%	20.3%	19.7%	19.1%	18.5%	18.0%	17.5%	17.0%
216.5%	220.8%	225.2%	229.7%	234.3%	239.0%	243.8%	248.7%	253.6%	258.7%	263.9%	269.2%	274.5%	280.0%	285.6%	291.3%	297.2%	303.1%	309.2%	315.4%	321.7%	328.1%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
	-100,000										-100,000										-100,000
<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>
-10,824	-231,844	-11,261	-11,486	-11,716	-11,950	-12,189	-12,433	-12,682	-12,935	-13,194	-282,617	-13,727	-14,002	-14,282	-14,567	-14,859	-15,156	-15,459	-15,768	-16,083	-344,508
<b>-3,418</b>	<b>-71,073</b>	<b>-3,352</b>	<b>-3,319</b>	<b>-3,287</b>	<b>-3,255</b>	<b>-3,223</b>	<b>-3,192</b>	<b>-3,161</b>	<b>-3,130</b>	<b>-3,100</b>	<b>-64,467</b>	<b>-3,040</b>	<b>-3,011</b>	<b>-2,981</b>	<b>-2,952</b>	<b>-2,924</b>	<b>-2,895</b>	<b>-2,867</b>	<b>-2,839</b>	<b>-2,812</b>	<b>-58,474</b>



61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
16.5%	16.0%	15.5%	15.1%	14.6%	14.2%	13.8%	13.4%	13.0%	12.6%	12.3%	11.9%	11.6%	11.2%	10.9%	10.6%	10.3%	10.0%	9.7%	9.4%	9.1%
334.7%	341.4%	348.2%	355.1%	362.3%	369.5%	376.9%	384.4%	392.1%	400.0%	408.0%	416.1%	424.4%	432.9%	441.6%	450.4%	459.4%	468.6%	478.0%	487.5%	497.3%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
									-100,000											-100,000
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>
-16,733	-17,068	-17,409	-17,757	-18,113	-18,475	-18,844	-19,221	-19,606	-419,954	-20,398	-20,806	-21,222	-21,646	-22,079	-22,521	-22,971	-23,431	-23,899	-511,921	-24,865
<b>-2,757</b>	<b>-2,731</b>	<b>-2,704</b>	<b>-2,678</b>	<b>-2,652</b>	<b>-2,626</b>	<b>-2,601</b>	<b>-2,575</b>	<b>-2,550</b>	<b>-53,039</b>	<b>-2,501</b>	<b>-2,477</b>	<b>-2,453</b>	<b>-2,429</b>	<b>-2,405</b>	<b>-2,382</b>	<b>-2,359</b>	<b>-2,336</b>	<b>-2,313</b>	<b>-48,109</b>	<b>-2,269</b>



82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
8.9%	8.6%	8.3%	8.1%	7.9%	7.6%	7.4%	7.2%	7.0%	6.8%	6.6%	6.4%	6.2%	6.0%	5.9%	5.7%	5.5%	5.4%	5.2%	5.1%	4.9%
507.2%	517.4%	527.7%	538.3%	549.1%	560.0%	571.2%	582.7%	594.3%	606.2%	618.3%	630.7%	643.3%	656.2%	669.3%	682.7%	696.3%	710.3%	724.5%	739.0%	753.7%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
								-100,000										-100,000		
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-105,000</b>	<b>-5,000</b>	<b>-5,000</b>
-25,362	-25,869	-26,387	-26,914	-27,453	-28,002	-28,562	-29,133	-624,029	-30,310	-30,916	-31,535	-32,165	-32,808	-33,465	-34,134	-34,817	-35,513	-760,688	-36,948	-37,687
<b>-2,247</b>	<b>-2,225</b>	<b>-2,203</b>	<b>-2,182</b>	<b>-2,161</b>	<b>-2,140</b>	<b>-2,119</b>	<b>-2,098</b>	<b>-43,637</b>	<b>-2,058</b>	<b>-2,038</b>	<b>-2,018</b>	<b>-1,998</b>	<b>-1,979</b>	<b>-1,960</b>	<b>-1,941</b>	<b>-1,922</b>	<b>-1,903</b>	<b>-39,581</b>	<b>-1,866</b>	<b>-1,848</b>

**APPENDIX 5  
ABATEMENT OPTIONS ASSESSMENT – SOUTHERN END OF FOXLOW  
STREET**

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost				Social	Ranking	Final Score	
					Capital Expenditure	Ranking	Financial Assurance	Ranking				
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>		
<b>Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform</b>	The depth of lead contaminated soils has not been accurately delineated (i.e.: >1 m depth) and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from the this area would require significant energy input.  If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area (with potential exception of gravity fed services). Consolidation within the proposed containment cell would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	The capital expenditure estimate for progressing this option is \$1.4M - \$2.6M (ex GST).	1	No financial assurance required.	2	Intergenerational equity is achieved through this option as the contaminant is adequately managed with like materials in perpetuity.	3	31	
<b>Option 2 - Offsite treatment and disposal of all contaminated soils</b>	The depth of lead contaminated soils has not been accurately delineated (i.e.: >1 m depth) and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from the embankment would require significant energy input.  If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area. Offsite disposal would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	The capital expenditure estimate for progressing this option is \$3.4M - \$6.2M (ex GST).	1	No financial assurance required.	1	Intergenerational equity is achieved as the contaminant is adequately managed within an appropriate management structure in perpetuity.	3	28	
<b>Option 3a - Capping without excavation</b>	Capping is a proven strategy for managing lead contamination in soil however raising the level of the street by the thickness of capping may not be practical.	2	This option would eliminate contaminant exposure risks except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks.  Environmental sustainability as measured by carbon footprint would be favourable compared to other options.	3	The capital expenditure estimate for progressing this option is \$700k- \$1.3M (ex GST)	3	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$925k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	3	A need to manage the contaminated soils in the future may impact future generations.	1	2	35

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost		Social	Ranking	Final Score		
					Capital Expenditure	Ranking				Financial Assurance	Ranking
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>	
<b>Option 3b - Movement of upper 0.1 m soils to the mine site containment cell followed by capping to reinstate the existing landform<sup>1</sup></b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would eliminate contaminant exposure risks except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. Per Option 1, the environmental sustainability would be favourable compared with offsite disposal options.  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	3	The capital expenditure estimate for progressing this option is \$700k - \$1.3M (ex GST)	3	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$925k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	A need to manage the contaminated soils in the future may impact future generations.	2	40
<b>Option 3c - Offsite treatment and disposal of upper 0.1 m contaminated soils followed by capping to reinstate existing landform<sup>1</sup></b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness.	3	This option would eliminate contaminant exposure risks except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. The environmental sustainability would be favourable compared with offsite disposal of all soils though unfavourable compared to full insitu containment (Option 3a) or options that include containment at the mine site (Option 1 and 3b).  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.	2	The capital expenditure estimate for progressing this option is \$900k - \$1.7M (ex GST)	2	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$925k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	A need to manage the contaminated soils in the future may impact future generations.	2	35

**Notes**

<sup>1</sup>An average excavation depth of 0.15 m has been projected for Options 3b and 3c integrating 0.1 m excavation for pavement construction and a nominal allowance of 0.5 m (300 m<sup>3</sup> across the 6000m<sup>2</sup> area) to allow for contaminant free in-situ tree pits, drainage tie-ins etc. The projected volumes of contaminated soil may limit the feasibility of chemical immobilisation (and so offsite disposal as contemplated) if this process was proposed in isolation to other abatement areas. Other contaminants in soils contaminated by mining activities (e.g.: those related to historic and current use of public spaces) may affect the feasibility of containment at the mine site or offsite disposal.

**Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing levels (landform altered to amend drainage)**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$25,000	1	\$25,000
Excavation and transport of contaminated soils to mine site	m <sup>3</sup>	\$50	9,000	\$450,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$200,000	1	\$200,000
Supply and place 1.4m sub-soil layer <sup>1</sup>	m <sup>3</sup>	\$70	8,400	\$588,000
Supply and construct permanent hardstand pavement	m <sup>2</sup>	\$100	6,000	\$600,000
Landscaping and drainage tie-ins	Item	\$50,000	1	\$50,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
<b>Estimated Total</b>				<b>\$2,012,000</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

**Option 2 - Offsite treatment and disposal of all contaminated soils**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$25,000	1	\$25,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Excavation and transport of contaminated soils to local landfill	m <sup>3</sup>	\$60	9,000	\$540,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$200,000	1	\$200,000
Immobilisation of impacted material	Tonne	\$50	16,200	\$810,000
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	16,200	\$1,944,000
Supply and place 1.4m sub-soil layer	m <sup>3</sup>	\$70	8,400	\$588,000
Supply and construct permanent hardstand pavement	m <sup>2</sup>	\$100	6,000	\$600,000
Landscaping and drainage tie-ins	Item	\$50,000	1	\$50,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
<b>Estimated Total for treatment and disposal</b>				<b>\$4,876,000</b>



<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

**Option 3b - Movement of upper soils (0.1 m) to the mine site containment cell followed by capping with hardstand pavement to reinstate the existing landform levels**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$25,000	1	\$25,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$200,000	1	\$200,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	900	\$45,000
Supply and construct permanent hardstand pavement	m <sup>2</sup>	\$100	6,000	\$600,000
Landscaping and drainage tie-ins	Item	\$50,000	1	\$50,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
Financial Assurance	Item	\$15,000	1	\$440,000
<b>Estimated Total</b>				<b>\$1,459,000</b>

**Option 3c - Offsite treatment and disposal of upper soils (0.1 m) followed by capping to reinstate the existing landform**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	6	\$39,000
Detailed Landform / Drainage Design	Item	\$25,000	1	\$25,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Excavation and transport of impacted material to local landfill	m <sup>3</sup>	\$60	900	\$54,000
Earthworks and drainage to achieve design / drainage objectives	Item	\$200,000	1	\$200,000
Immobilisation of impacted material	Tonne	\$50	1,620	\$81,000
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	1,620	\$194,400
Supply and construct permanent hardstand pavement	m <sup>2</sup>	\$100	6,000	\$600,000
Landscaping and drainage tie-ins	Item	\$50,000	1	\$50,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
Financial Assurance	Item	\$15,000	1	\$440,000
<b>Estimated Total</b>				<b>\$1,763,400</b>

**Notes**

A \$200,000 preliminary provision is made under all abatement options for improvement of roadside drainage to reduce potential for run-off from increased hardstand area to adversely affect adjacent private properties. This provision can be refined after drainage objectives are determined and after detailed design to achieve these objectives is completed.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
q-factor	100.0%	97.1%	94.3%	91.5%	88.8%	86.3%	83.7%	81.3%	78.9%	76.6%	74.4%	72.2%	70.1%	68.1%	66.1%	64.2%	62.3%
Price escalation	100.0%	102.0%	104.0%	106.1%	108.2%	110.4%	112.6%	114.9%	117.2%	119.5%	121.9%	124.3%	126.8%	129.4%	131.9%	134.6%	137.3%
<b>Investment</b>	-1,094,000																
<b>Ongoing Maintenance and Monitoring Requirements</b>																	
<i>Environmental Monitoring</i>																	
Inspection and reporting		-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
Periodic concrete / soft fall repair											-20,000						
<b>Total (without price escalation)</b>	<b>-1,094,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
Total (with price escalation)	-1,094,000	-5,100	-5,202	-5,306	-5,412	-5,520	-5,631	-5,743	-5,858	-5,975	-30,475	-6,217	-6,341	-6,468	-6,597	-6,729	-6,864
<b>NPV</b>	<b>-1,094,000</b>	<b>-4,951</b>	<b>-4,903</b>	<b>-4,856</b>	<b>-4,809</b>	<b>-4,762</b>	<b>-4,716</b>	<b>-4,670</b>	<b>-4,625</b>	<b>-4,580</b>	<b>-22,676</b>	<b>-4,491</b>	<b>-4,448</b>	<b>-4,404</b>	<b>-4,362</b>	<b>-4,319</b>	<b>-4,277</b>
	-1,094,000																
<b>Total NPV</b>	<b>-1,533,344</b>																
NPV Risk realistic	-376,792																
NPV Risk worst	-305,589																
NPV Capital	-1,094,000																
NPV Monitoring and management	-439,344																

**Note:**

The q-factor quantifies the effect of interest and inflation on future costs of long term environmental management and informs calculation of net present value required for financial assurance.

Financial assurance provisions could be expected to be lower if in-situ containment is implemented as the preferred abatement option across multiple areas within the Precinct.



17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
60.5%	58.7%	57.0%	55.4%	53.8%	52.2%	50.7%	49.2%	47.8%	46.4%	45.0%	43.7%	42.4%	41.2%	40.0%	38.8%	37.7%	36.6%	35.5%	34.5%	33.5%	32.5%
140.0%	142.8%	145.7%	148.6%	151.6%	154.6%	157.7%	160.8%	164.1%	167.3%	170.7%	174.1%	177.6%	181.1%	184.8%	188.5%	192.2%	196.1%	200.0%	204.0%	208.1%	212.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
			-20,000										-20,000								
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
-7,001	-7,141	-7,284	-37,149	-7,578	-7,730	-7,884	-8,042	-8,203	-8,367	-8,534	-8,705	-8,879	-45,284	-9,238	-9,423	-9,611	-9,803	-9,999	-10,199	-10,403	-10,611
<b>-4,236</b>	<b>-4,195</b>	<b>-4,154</b>	<b>-20,568</b>	<b>-4,074</b>	<b>-4,034</b>	<b>-3,995</b>	<b>-3,956</b>	<b>-3,918</b>	<b>-3,880</b>	<b>-3,842</b>	<b>-3,805</b>	<b>-3,768</b>	<b>-18,656</b>	<b>-3,695</b>	<b>-3,659</b>	<b>-3,624</b>	<b>-3,588</b>	<b>-3,554</b>	<b>-3,519</b>	<b>-3,485</b>	<b>-3,451</b>



39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31.6%	30.7%	29.8%	28.9%	28.1%	27.2%	26.4%	25.7%	24.9%	24.2%	23.5%	22.8%	22.1%	21.5%	20.9%	20.3%	19.7%	19.1%	18.5%	18.0%	17.5%	17.0%
216.5%	220.8%	225.2%	229.7%	234.3%	239.0%	243.8%	248.7%	253.6%	258.7%	263.9%	269.2%	274.5%	280.0%	285.6%	291.3%	297.2%	303.1%	309.2%	315.4%	321.7%	328.1%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
	-20,000										-20,000										-20,000
<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>
-10,824	-55,201	-11,261	-11,486	-11,716	-11,950	-12,189	-12,433	-12,682	-12,935	-13,194	-67,290	-13,727	-14,002	-14,282	-14,567	-14,859	-15,156	-15,459	-15,768	-16,083	-82,026
<b>-3,418</b>	<b>-16,922</b>	<b>-3,352</b>	<b>-3,319</b>	<b>-3,287</b>	<b>-3,255</b>	<b>-3,223</b>	<b>-3,192</b>	<b>-3,161</b>	<b>-3,130</b>	<b>-3,100</b>	<b>-15,349</b>	<b>-3,040</b>	<b>-3,011</b>	<b>-2,981</b>	<b>-2,952</b>	<b>-2,924</b>	<b>-2,895</b>	<b>-2,867</b>	<b>-2,839</b>	<b>-2,812</b>	<b>-13,922</b>



61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
16.5%	16.0%	15.5%	15.1%	14.6%	14.2%	13.8%	13.4%	13.0%	12.6%	12.3%	11.9%	11.6%	11.2%	10.9%	10.6%	10.3%	10.0%	9.7%	9.4%	9.1%	8.9%
334.7%	341.4%	348.2%	355.1%	362.3%	369.5%	376.9%	384.4%	392.1%	400.0%	408.0%	416.1%	424.4%	432.9%	441.6%	450.4%	459.4%	468.6%	478.0%	487.5%	497.3%	507.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
									-20,000										-20,000		
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>
-16,733	-17,068	-17,409	-17,757	-18,113	-18,475	-18,844	-19,221	-19,606	-99,989	-20,398	-20,806	-21,222	-21,646	-22,079	-22,521	-22,971	-23,431	-23,899	-121,886	-24,865	-25,362
<b>-2,757</b>	<b>-2,731</b>	<b>-2,704</b>	<b>-2,678</b>	<b>-2,652</b>	<b>-2,626</b>	<b>-2,601</b>	<b>-2,575</b>	<b>-2,550</b>	<b>-12,628</b>	<b>-2,501</b>	<b>-2,477</b>	<b>-2,453</b>	<b>-2,429</b>	<b>-2,405</b>	<b>-2,382</b>	<b>-2,359</b>	<b>-2,336</b>	<b>-2,313</b>	<b>-11,454</b>	<b>-2,269</b>	<b>-2,247</b>



83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
8.6%	8.3%	8.1%	7.9%	7.6%	7.4%	7.2%	7.0%	6.8%	6.6%	6.4%	6.2%	6.0%	5.9%	5.7%	5.5%	5.4%	5.2%
517.4%	527.7%	538.3%	549.1%	560.0%	571.2%	582.7%	594.3%	606.2%	618.3%	630.7%	643.3%	656.2%	669.3%	682.7%	696.3%	710.3%	724.5%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
							-20,000										-20,000
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>
-25,869	-26,387	-26,914	-27,453	-28,002	-28,562	-29,133	-148,578	-30,310	-30,916	-31,535	-32,165	-32,808	-33,465	-34,134	-34,817	-35,513	-181,116
<b>-2,225</b>	<b>-2,203</b>	<b>-2,182</b>	<b>-2,161</b>	<b>-2,140</b>	<b>-2,119</b>	<b>-2,098</b>	<b>-10,390</b>	<b>-2,058</b>	<b>-2,038</b>	<b>-2,018</b>	<b>-1,998</b>	<b>-1,979</b>	<b>-1,960</b>	<b>-1,941</b>	<b>-1,922</b>	<b>-1,903</b>	<b>-9,424</b>

## **APPENDIX 6**

### **ABATEMENT OPTIONS ASSESSMENT – FLOOD BERMS**



Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost				Social	Ranking	Final Score	
					Capital Expenditure	Ranking	Financial Assurance	Ranking				
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>		
<b>Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform.</b>	Uncertainty on the depth of contaminated soil and complications associated with excavating adjacent the Molonglo River limit the practicality of this option.		NA		NA		NA		NA		0	
<b>Option 2 - Offsite treatment and disposal of all contaminated soils</b>	Uncertainty on the depth of contaminated soil and complications associated with excavating adjacent the Molonglo River limit the practicality of this option.		NA		NA		NA		NA		0	
<b>Option 3a - Capping flood berms without excavation and excavation of 0.3 m from playing fields followed by capping</b>	<p>Capping is a proven strategy for managing lead contamination in soil however retention of contaminated soil adjacent the Molonglo River leaves potential for leachate to enter the River and contribute to contaminant loads in surface water and sediment.</p> <p>Excavation of the upper 0.3 m of the southern end of the playing fields would facilitate application of capping and reinstatement of surface level consistent with the northern end of the playing field. Further, maintenance of the playing surface of the field as required to retain functionality of these facilities could be expected to limit potential exposure risks to underlying soils.</p>	3	<p>This option would limit contaminant exposure risks to potential for secondary exposure to sediment or surface water except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks.</p> <p>Environmental sustainability as measured by carbon footprint would be favourable compared to other options.</p>		3	<p>The capital expenditure estimate for progressing this option is \$750k-\$1.45M (ex GST)</p>	2	<p>A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$440k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of soil and turf every 10 years and complete recapping after 100 years.</p>	1	<p>A need to manage the contaminated soils in the future may impact future generations.</p>	2	37



**Option 3a: Capping flood berms without excavation and excavation of upper soils from playing field (0.3m) for offsite disposal**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	3	\$19,500
Flood Berms				
Recontouring flood berms and pH amendment	Item	\$35,000	1	\$35,000
Detailed Landform / Drainage Design	Item	\$25,000	1	\$25,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	3200	\$32,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	640	\$32,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	320	\$19,200
Hydromulch	m <sup>2</sup>	\$0.5	3200	\$1,600
Playing Fields				
Bench-scale immobilisation trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	1,800	\$108,000
Immobilisation of impacted material	Tonne	\$50	3,240	\$162,000
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	3,240	\$388,800
Supply and place geofabric	m <sup>2</sup>	\$10	6,000	\$60,000
Construct irrigation	Item	\$30,000	1	\$30,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	800	\$40,000
Supply and place 0.1 m topsoil layer	m <sup>3</sup>	\$60	400	\$24,000
Supply and place turf	m <sup>2</sup>	\$10	4,000	\$40,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
Financial Assurance	Item	\$15,000	1	\$380,000
<b>Estimated Total for treatment and disposal</b>				<b>\$1,477,100</b>

Note: Option 3a is based on capping with soil. Permanent pavement could replace soil. This would be expected to increase capital expenditure and decrease ongoing management costs.

**Option 3b - Movement of upper soils (0.3m) to the mine site containment cell followed by capping to reinstate the existing landform**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	3	\$19,500
Flood Berms				
Detailed Landform / Drainage Design	Item	\$25,000	1	\$25,000
Recontouring flood berms and pH amendment	Item	\$35,000	1	\$35,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	960	\$48,000
Recontouring flood berms	Item	\$25,000	1	\$25,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	3,200	\$32,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	640	\$32,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	0	\$0
Hydromulch	m <sup>2</sup>	\$0.5	0	\$0
Playing Fields				
Loading impacted material into truck and dogs and transport to mine site	m <sup>3</sup>	\$60	1,800	\$108,000
Supply and place geofabric	m <sup>2</sup>	\$10	6,000	\$60,000
Construct irrigation	Item	\$30,000	1	\$30,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	800	\$40,000
Supply and place 0.1 m topsoil layer	m <sup>3</sup>	\$60	400	\$24,000
Supply and place turf	m <sup>2</sup>	\$10	4,000	\$40,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
Financial Assurance	Item	\$15,000	1	\$380,000

**Estimated Total** **\$958,500**

**Option 3c - Offsite treatment and disposal of upper soils (0.3m) from the flood berms and playing fields followed by capping to reinstate the existing landform.**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	6	\$39,000
Bench-scale immobilisation trial and obtain SIA	Item	\$20,000	1	\$20,000
Detailed Landform / Drainage Design	Item	\$25,000	1	\$25,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	2,700	\$162,000
Immobilisation of impacted material	Tonne	\$50	4,860	\$243,000
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	4,860	\$583,200
Supply and placement of geofabric	m <sup>2</sup>	\$10	9,000	\$90,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	1,800	\$90,000
Supply and place 0.1 m topsoil layer	m <sup>3</sup>	\$60	900	\$54,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
Financial Assurance	Item	\$15,000	1	\$380,000
<b>Estimated Total</b>				<b>\$1,746,200</b>

Notes

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
q-factor	100.0%	97.1%	94.3%	91.5%	88.8%	86.3%	83.7%	81.3%	78.9%	76.6%	74.4%	72.2%	70.1%	68.1%	66.1%	64.2%	62.3%
Price escalation	100.0%	102.0%	104.0%	106.1%	108.2%	110.4%	112.6%	114.9%	117.2%	119.5%	121.9%	124.3%	126.8%	129.4%	131.9%	134.6%	137.3%
<b>Investment</b>	-170,000																
<b>Ongoing Maintenance and Monitoring Requirements</b>																	
<i>Environmental Monitoring</i>																	
Inspection and reporting		-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
Periodic topdressing and turf repairs											-20,000						
<b>Total (without price escalation)</b>	<b>-170,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
Total (with price escalation)	-170,000	-5,100	-5,202	-5,306	-5,412	-5,520	-5,631	-5,743	-5,858	-5,975	-30,475	-6,217	-6,341	-6,468	-6,597	-6,729	-6,864
<b>NPV</b>	<b>-170,000</b>	<b>-4,951</b>	<b>-4,903</b>	<b>-4,856</b>	<b>-4,809</b>	<b>-4,762</b>	<b>-4,716</b>	<b>-4,670</b>	<b>-4,625</b>	<b>-4,580</b>	<b>-22,676</b>	<b>-4,491</b>	<b>-4,448</b>	<b>-4,404</b>	<b>-4,362</b>	<b>-4,319</b>	<b>-4,277</b>
	-170,000																
<b>Total NPV</b>	<b>-609,344</b>																
NPV Risk realistic	-376,792																
NPV Risk worst	-305,589																
NPV Capital	-170,000																
NPV Monitoring and management	-439,344																

**Note:**

The q-factor quantifies the effect of interest and inflation on future costs of long term environmental management and informs calculation of net present value required for financial assurance.

Financial assurance provisions could be expected to be lower if in-situ containment is implemented as the preferred abatement option across multiple areas within the Precinct.



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60.5%	58.7%	57.0%	55.4%	53.8%	52.2%	50.7%	49.2%	47.8%	46.4%	45.0%	43.7%	42.4%	41.2%	40.0%	38.8%	37.7%	36.6%	35.5%	34.5%	33.5%	32.5%
140.0%	142.8%	145.7%	148.6%	151.6%	154.6%	157.7%	160.8%	164.1%	167.3%	170.7%	174.1%	177.6%	181.1%	184.8%	188.5%	192.2%	196.1%	200.0%	204.0%	208.1%	212.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
			-20,000										-20,000								
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
-7,001	-7,141	-7,284	-37,149	-7,578	-7,730	-7,884	-8,042	-8,203	-8,367	-8,534	-8,705	-8,879	-45,284	-9,238	-9,423	-9,611	-9,803	-9,999	-10,199	-10,403	-10,611
<b>-4,236</b>	<b>-4,195</b>	<b>-4,154</b>	<b>-20,568</b>	<b>-4,074</b>	<b>-4,034</b>	<b>-3,995</b>	<b>-3,956</b>	<b>-3,918</b>	<b>-3,880</b>	<b>-3,842</b>	<b>-3,805</b>	<b>-3,768</b>	<b>-18,656</b>	<b>-3,695</b>	<b>-3,659</b>	<b>-3,624</b>	<b>-3,588</b>	<b>-3,554</b>	<b>-3,519</b>	<b>-3,485</b>	<b>-3,451</b>



39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31.6%	30.7%	29.8%	28.9%	28.1%	27.2%	26.4%	25.7%	24.9%	24.2%	23.5%	22.8%	22.1%	21.5%	20.9%	20.3%	19.7%	19.1%	18.5%	18.0%	17.5%	17.0%
216.5%	220.8%	225.2%	229.7%	234.3%	239.0%	243.8%	248.7%	253.6%	258.7%	263.9%	269.2%	274.5%	280.0%	285.6%	291.3%	297.2%	303.1%	309.2%	315.4%	321.7%	328.1%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
	-20,000										-20,000										-20,000
<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>
-10,824	-55,201	-11,261	-11,486	-11,716	-11,950	-12,189	-12,433	-12,682	-12,935	-13,194	-67,290	-13,727	-14,002	-14,282	-14,567	-14,859	-15,156	-15,459	-15,768	-16,083	-82,026
<b>-3,418</b>	<b>-16,922</b>	<b>-3,352</b>	<b>-3,319</b>	<b>-3,287</b>	<b>-3,255</b>	<b>-3,223</b>	<b>-3,192</b>	<b>-3,161</b>	<b>-3,130</b>	<b>-3,100</b>	<b>-15,349</b>	<b>-3,040</b>	<b>-3,011</b>	<b>-2,981</b>	<b>-2,952</b>	<b>-2,924</b>	<b>-2,895</b>	<b>-2,867</b>	<b>-2,839</b>	<b>-2,812</b>	<b>-13,922</b>



61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
16.5%	16.0%	15.5%	15.1%	14.6%	14.2%	13.8%	13.4%	13.0%	12.6%	12.3%	11.9%	11.6%	11.2%	10.9%	10.6%	10.3%	10.0%	9.7%	9.4%	9.1%	8.9%
334.7%	341.4%	348.2%	355.1%	362.3%	369.5%	376.9%	384.4%	392.1%	400.0%	408.0%	416.1%	424.4%	432.9%	441.6%	450.4%	459.4%	468.6%	478.0%	487.5%	497.3%	507.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
									-20,000											-20,000	
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>
-16,733	-17,068	-17,409	-17,757	-18,113	-18,475	-18,844	-19,221	-19,606	-99,989	-20,398	-20,806	-21,222	-21,646	-22,079	-22,521	-22,971	-23,431	-23,899	-121,886	-24,865	-25,362
<b>-2,757</b>	<b>-2,731</b>	<b>-2,704</b>	<b>-2,678</b>	<b>-2,652</b>	<b>-2,626</b>	<b>-2,601</b>	<b>-2,575</b>	<b>-2,550</b>	<b>-12,628</b>	<b>-2,501</b>	<b>-2,477</b>	<b>-2,453</b>	<b>-2,429</b>	<b>-2,405</b>	<b>-2,382</b>	<b>-2,359</b>	<b>-2,336</b>	<b>-2,313</b>	<b>-11,454</b>	<b>-2,269</b>	<b>-2,247</b>





83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
8.6%	8.3%	8.1%	7.9%	7.6%	7.4%	7.2%	7.0%	6.8%	6.6%	6.4%	6.2%	6.0%	5.9%	5.7%	5.5%	5.4%	5.2%
517.4%	527.7%	538.3%	549.1%	560.0%	571.2%	582.7%	594.3%	606.2%	618.3%	630.7%	643.3%	656.2%	669.3%	682.7%	696.3%	710.3%	724.5%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
							-20,000										-20,000
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-25,000</b>
-25,869	-26,387	-26,914	-27,453	-28,002	-28,562	-29,133	-148,578	-30,310	-30,916	-31,535	-32,165	-32,808	-33,465	-34,134	-34,817	-35,513	-181,116
<b>-2,225</b>	<b>-2,203</b>	<b>-2,182</b>	<b>-2,161</b>	<b>-2,140</b>	<b>-2,119</b>	<b>-2,098</b>	<b>-10,390</b>	<b>-2,058</b>	<b>-2,038</b>	<b>-2,018</b>	<b>-1,998</b>	<b>-1,979</b>	<b>-1,960</b>	<b>-1,941</b>	<b>-1,922</b>	<b>-1,903</b>	<b>-9,424</b>

**APPENDIX 7  
ABATEMENT OPTIONS ASSESSMENT – TENNIS / BASKETBALL COURTS  
AND FOOTBALL FIELD**

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost				Social	Ranking	Final Score
					Capital Expenditure	Ranking	Financial Assurance	Ranking			
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>	
<b>Option 3a - Capping without excavation</b>	Capping is a proven strategy for managing lead contamination in soil. Further, maintenance of hardstand pavement as required to retain functionality of the playing courts and swimming pool facilities could be expected to limit potential exposure risks to underlying soils.	2	This option would eliminate contaminant exposure risks except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks.  Environmental sustainability as measured by carbon footprint would be favourable compared to other options.	3	The capital expenditure estimate for progressing this option is \$150k-\$290k (ex GST)	2	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$420k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	A need to manage the contaminated soils in the future may impact future generations.	2	32

**Notes**

<sup>1</sup>Excavation beneath tennis courts is not proposed as maintenance of existing hardstand pavement is considered an equally reliable, more sustainable and more cost effective approach.

Other contaminants in soils contaminated by mining activities (e.g.: those related to historic and current use of public spaces) may affect the feasibility of containment at the mine site or offsite disposal.

### Option 3a: Capping without excavation

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$15,000	1	\$15,000
Mobilisation and site establishment	Item	\$10,000	1	\$10,000
Project Management	Week	\$6,500	2	\$13,000
Resurfacing tennis courts	m <sup>2</sup>	\$50	3,000	\$150,000
Demobilisation	Item	\$10,000	1	\$10,000
Validation	Item	\$25,000	1	\$25,000
Financial Assurance	Item	\$15,000	1	\$380,000
<b>Estimated Total for treatment and disposal</b>				<b>\$603,000</b>

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
q-factor	100.0%	97.1%	94.3%	91.5%	88.8%	86.3%	83.7%	81.3%	78.9%	76.6%	74.4%	72.2%	70.1%	68.1%	66.1%	64.2%	62.3%
Price escalation	100.0%	102.0%	104.0%	106.1%	108.2%	110.4%	112.6%	114.9%	117.2%	119.5%	121.9%	124.3%	126.8%	129.4%	131.9%	134.6%	137.3%
<b>Investment</b>	-160,000																
<b>Ongoing Maintenance and Monitoring Requirements</b>																	
<i>Environmental Monitoring</i>																	
Inspection and reporting		-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
Periodic concrete / soft fall repair											-10,000						
<b>Total (without price escalation)</b>	<b>-160,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
Total (with price escalation)	-160,000	-5,100	-5,202	-5,306	-5,412	-5,520	-5,631	-5,743	-5,858	-5,975	-18,285	-6,217	-6,341	-6,468	-6,597	-6,729	-6,864
<b>NPV</b>	<b>-160,000</b>	<b>-4,951</b>	<b>-4,903</b>	<b>-4,856</b>	<b>-4,809</b>	<b>-4,762</b>	<b>-4,716</b>	<b>-4,670</b>	<b>-4,625</b>	<b>-4,580</b>	<b>-13,606</b>	<b>-4,491</b>	<b>-4,448</b>	<b>-4,404</b>	<b>-4,362</b>	<b>-4,319</b>	<b>-4,277</b>
	-160,000																
<b>Total NPV</b>	<b>-538,547</b>																
NPV Risk realistic	-376,792																
NPV Risk worst	-305,589																
NPV Captial	-160,000																
NPV Monitoring and management	-378,547																

**Note:**

The q-factor quantifies the effect of interest and inflation on future costs of long term environmental management and informs calculation of net present value required for financial assurance.

Financial assurance provisions could be expected to be lower if in-situ containment is implemented as the preferred abatement option across multiple areas within the Precinct.



17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
60.5%	58.7%	57.0%	55.4%	53.8%	52.2%	50.7%	49.2%	47.8%	46.4%	45.0%	43.7%	42.4%	41.2%	40.0%	38.8%	37.7%	36.6%	35.5%	34.5%	33.5%	32.5%
140.0%	142.8%	145.7%	148.6%	151.6%	154.6%	157.7%	160.8%	164.1%	167.3%	170.7%	174.1%	177.6%	181.1%	184.8%	188.5%	192.2%	196.1%	200.0%	204.0%	208.1%	212.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
			-10,000										-10,000								
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
-7,001	-7,141	-7,284	-22,289	-7,578	-7,730	-7,884	-8,042	-8,203	-8,367	-8,534	-8,705	-8,879	-27,170	-9,238	-9,423	-9,611	-9,803	-9,999	-10,199	-10,403	-10,611
<b>-4,236</b>	<b>-4,195</b>	<b>-4,154</b>	<b>-12,341</b>	<b>-4,074</b>	<b>-4,034</b>	<b>-3,995</b>	<b>-3,956</b>	<b>-3,918</b>	<b>-3,880</b>	<b>-3,842</b>	<b>-3,805</b>	<b>-3,768</b>	<b>-11,194</b>	<b>-3,695</b>	<b>-3,659</b>	<b>-3,624</b>	<b>-3,588</b>	<b>-3,554</b>	<b>-3,519</b>	<b>-3,485</b>	<b>-3,451</b>



39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31.6%	30.7%	29.8%	28.9%	28.1%	27.2%	26.4%	25.7%	24.9%	24.2%	23.5%	22.8%	22.1%	21.5%	20.9%	20.3%	19.7%	19.1%	18.5%	18.0%	17.5%	17.0%
216.5%	220.8%	225.2%	229.7%	234.3%	239.0%	243.8%	248.7%	253.6%	258.7%	263.9%	269.2%	274.5%	280.0%	285.6%	291.3%	297.2%	303.1%	309.2%	315.4%	321.7%	328.1%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
	-10,000										-10,000										-10,000
<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>
-10,824	-33,121	-11,261	-11,486	-11,716	-11,950	-12,189	-12,433	-12,682	-12,935	-13,194	-40,374	-13,727	-14,002	-14,282	-14,567	-14,859	-15,156	-15,459	-15,768	-16,083	-49,215
<b>-3,418</b>	<b>-10,153</b>	<b>-3,352</b>	<b>-3,319</b>	<b>-3,287</b>	<b>-3,255</b>	<b>-3,223</b>	<b>-3,192</b>	<b>-3,161</b>	<b>-3,130</b>	<b>-3,100</b>	<b>-9,210</b>	<b>-3,040</b>	<b>-3,011</b>	<b>-2,981</b>	<b>-2,952</b>	<b>-2,924</b>	<b>-2,895</b>	<b>-2,867</b>	<b>-2,839</b>	<b>-2,812</b>	<b>-8,353</b>



61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
16.5%	16.0%	15.5%	15.1%	14.6%	14.2%	13.8%	13.4%	13.0%	12.6%	12.3%	11.9%	11.6%	11.2%	10.9%	10.6%	10.3%	10.0%	9.7%	9.4%	9.1%	8.9%
334.7%	341.4%	348.2%	355.1%	362.3%	369.5%	376.9%	384.4%	392.1%	400.0%	408.0%	416.1%	424.4%	432.9%	441.6%	450.4%	459.4%	468.6%	478.0%	487.5%	497.3%	507.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
									-10,000											-10,000	
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>
-16,733	-17,068	-17,409	-17,757	-18,113	-18,475	-18,844	-19,221	-19,606	-59,993	-20,398	-20,806	-21,222	-21,646	-22,079	-22,521	-22,971	-23,431	-23,899	-73,132	-24,865	-25,362
<b>-2,757</b>	<b>-2,731</b>	<b>-2,704</b>	<b>-2,678</b>	<b>-2,652</b>	<b>-2,626</b>	<b>-2,601</b>	<b>-2,575</b>	<b>-2,550</b>	<b>-7,577</b>	<b>-2,501</b>	<b>-2,477</b>	<b>-2,453</b>	<b>-2,429</b>	<b>-2,405</b>	<b>-2,382</b>	<b>-2,359</b>	<b>-2,336</b>	<b>-2,313</b>	<b>-6,873</b>	<b>-2,269</b>	<b>-2,247</b>





83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
8.6%	8.3%	8.1%	7.9%	7.6%	7.4%	7.2%	7.0%	6.8%	6.6%	6.4%	6.2%	6.0%	5.9%	5.7%	5.5%	5.4%	5.2%
517.4%	527.7%	538.3%	549.1%	560.0%	571.2%	582.7%	594.3%	606.2%	618.3%	630.7%	643.3%	656.2%	669.3%	682.7%	696.3%	710.3%	724.5%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
							-10,000										-10,000
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-15,000</b>
-25,869	-26,387	-26,914	-27,453	-28,002	-28,562	-29,133	-89,147	-30,310	-30,916	-31,535	-32,165	-32,808	-33,465	-34,134	-34,817	-35,513	-108,670
<b>-2,225</b>	<b>-2,203</b>	<b>-2,182</b>	<b>-2,161</b>	<b>-2,140</b>	<b>-2,119</b>	<b>-2,098</b>	<b>-6,234</b>	<b>-2,058</b>	<b>-2,038</b>	<b>-2,018</b>	<b>-1,998</b>	<b>-1,979</b>	<b>-1,960</b>	<b>-1,941</b>	<b>-1,922</b>	<b>-1,903</b>	<b>-5,654</b>

**APPENDIX 8**  
**ABATEMENT OPTIONS ASSESSMENT – THE PRESCHOOL**

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost				Social	Ranking	Final Score	
					Capital Expenditure	Ranking	Financial Assurance	Ranking				
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>		<b>4</b>		
<b>Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform</b>	The depth of lead contaminated soils has not been accurately delineated (i.e.: > 1 m) and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from this area would require significant energy input.  1 If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area. Consolidation within the proposed containment cell would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	1	The capital expenditure estimate for progressing this option is \$100k - 160k (ex GST).	2	2	No financial assurance required.	3	3	31
<b>Option 2 - Offsite treatment and disposal of all contaminated soils</b>	The depth of lead contaminated soils has not been accurately delineated (i.e.: > 1 m) and so excavation may not be an effective / achievable option. For example, excavation to remove all contaminated soil may intercept groundwater complicating removal and backfill.	1	The depth of lead contaminated soils has not been accurately delineated however excavation, transport and placement of contaminated material from this area would require significant energy input.  1 If successful complete excavation would eliminate environmental exposure risks for contaminated soils from this area. Offsite disposal would simplify long term management in an area where similar contaminant concentrations will be present and where long term management can effectively occur.	1	1	The capital expenditure estimate for progressing this option is \$280k - \$520k (ex GST).	1	1	No financial assurance required.	3	3	28
<b>Option 3a - Capping without excavation</b>	Capping is a proven strategy for managing lead contamination in soil however raising the landform surface level by the thickness of capping may impact on surrounding areas. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness. This option is proposed to support reuse of the preschool for a limited range of community uses.	2	Capping would eliminate exposure risks except where intentional digging or cap failure occurs.  An LTEMP would be required to manage these risks.  Environmental sustainability as measured by carbon footprint would be favourable compared to other options.	3	3	The capital expenditure estimate for progressing this option is \$40k - \$80k (ex GST)	2	2	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$350k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	2	32

Option	Reliability and Effectiveness	Ranking	Sustainability	Ranking	Cost		Social	Ranking	Final Score			
					Capital Expenditure	Ranking				Financial Assurance	Ranking	
<b>Weighting</b>		<b>5</b>		<b>2</b>		<b>3</b>		<b>2</b>	<b>4</b>			
<b>Option 3b - Movement of upper 0.3 m soils to the mine site containment cell followed by capping to reinstate the existing landform</b>	In-situ containment is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness. This option is proposed to support reuse of the preschool for a limited range of community uses.	3	This option would limit environmental exposure risks for contaminated soils except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. Per Option 1, the environmental sustainability would be favourable compared with offsite disposal options.  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.		2	The capital expenditure estimate for progressing this option is \$60 - 90k (ex GST) .	3	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$350k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	A need to manage the contaminated soils in the future may impact future generations.	2	38
<b>Option 3c - Offsite treatment and disposal of upper 0.3 m contaminated soils followed by capping to reinstate existing landform</b>	Capping is a proven strategy for managing lead contamination in soil. Maintenance and management would be required in perpetuity to ensure ongoing effectiveness. This option is proposed to support reuse of the preschool for a limited range of community uses.	3	This option would limit environmental exposure risks for contaminated soils except during intentional excavation or when cap failure occurs. An LTEMP would be required to manage these risks. The environmental sustainability would be favourable compared with offsite disposal of all soils though unfavourable compared to full insitu containment (Option 3a) or options that include containment at the mine site (Option 1 and 3b).  Controls would be required to manage impacts through abatement (dust, noise, erosion etc).  Movement of contaminated soils within the Precinct remains subject to planning and approvals.		1	The capital expenditure estimate for progressing this option is \$110k - \$170k	3	A financial assurance value has been modelled based on a 100 year containment system design life and estimated at \$350k (ex GST) net present value. This integrates costs projected for annual monitoring and repair of concrete / soft fall every 10 years and complete recapping after 100 years.	1	A need to manage the contaminated soils in the future may impact future generations.	2	36

**Notes**

Capping could comprise clean soils or permanent hardstand. Costs have been considered based on use of soils as capping layers to be consistent with the existing landform. Permanent hardstand could alternately be used and could be expected to increase capital expenditure and reduce financial assurance.

The projected volumes of contaminated soil may limit the feasibility of chemical immobilisation (and so offsite disposal as contemplated) if this process was proposed in isolation to other abatement areas.

Other contaminants in soils contaminated by mining activities (e.g.: those related to historic and current use of public spaces) may affect the feasibility of containment at the mine site or offsite disposal.

**Option 1 - Containment of all contaminated soils in the mine site containment cell followed by reinstatement of the existing landform**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	3,000	\$150,000
Supply and place 1.4m sub-soil layer <sup>1</sup>	m <sup>3</sup>	\$70	2,800	\$196,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	200	\$12,000
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
<b>Estimated Total</b>				<b>\$398,500</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

**Option 2 - Offsite treatment and disposal of all contaminated soils**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	3,000	\$180,000
Immobilisation of impacted material	Tonne	\$50	5,400	\$270,000
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	5,400	\$648,000
Supply and place 1.4m sub-soil layer	m <sup>3</sup>	\$70	2,800	\$196,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	200	\$12,000
Hydromulch	m <sup>2</sup>	\$0.5	1,500	\$750
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$15,000	1	\$15,000
<b>Estimated Total for treatment and disposal</b>				<b>\$1,372,250</b>

<sup>1</sup>Supply and placement of sub-soil is estimated at \$70/m<sup>3</sup> (instead of \$50/m<sup>3</sup> estimated for shallower excavation areas) as a nominal provision for compaction during placement

**Option 3a: Capping without excavation**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
-------------	------	-------------	---------------	-----------------

Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Design	Item	\$15,000	1	\$15,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	2000	\$20,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	400	\$20,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	50	\$3,000
Supply and application of turf	m <sup>2</sup>	\$10	500	\$5,000
Project Management	Week	\$6,500	2	\$13,000
Validation	Item	\$5,000	1	\$5,000
Financial Assurance	Item	\$15,000	1	\$350,000
<b>Estimated Total for treatment and disposal</b>				<b>\$443,500</b>

Note: Option 3a is based on capping with soil. Permanent pavement could replace soil. This would be expected to increase capital expenditure and decrease ongoing management costs.

### Option 3b - Movement of upper soils (0.3m) to the mine site containment cell followed by capping to reinstate the existing landform

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Excavation of impacted material and transport to mine site	m <sup>3</sup>	\$50	600	\$30,000
Supply and placement of geofabric	m <sup>2</sup>	\$10	500	\$5,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	400	\$20,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	50	\$3,000
Supply and application of turf	m <sup>2</sup>	\$10	500	\$5,000
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
Financial Assurance	Item	\$15,000	1	\$350,000
<b>Estimated Total</b>				<b>\$453,500</b>

\$103,500

**Option 3c - Offsite treatment and disposal of upper soils (0.3m) followed by capping to reinstate the existing landform**

Description	Unit	Budget Rate	Estimated Qty	Estimated Total
Preliminaries and Management Plans	Item	\$5,000	1	\$5,000
Mobilisation and site establishment	Item	\$7,500	1	\$7,500
Project Management	Week	\$6,500	2	\$13,000
Bench-scale trial and obtain SIA	Item	\$20,000	1	\$20,000
Loading impacted material into truck and dogs and transport to local landfill	m <sup>3</sup>	\$60	600	\$36,000
Immobilisation of impacted material	Tonne	\$50	1,080	\$54,000
Disposal of immobilised material as GSW at landfill (TBC)	Tonne	\$120	1,080	\$129,600
Supply and placement of geofabric	m <sup>2</sup>	\$10	500	\$5,000
Supply and place 0.2m sub-soil layer	m <sup>3</sup>	\$50	400	\$20,000
Supply and place 0.1m topsoil layer	m <sup>3</sup>	\$60	400	\$24,000
Supply and application of turf	m <sup>2</sup>	\$10	500	\$5,000
Demobilisation	Item	\$5,000	1	\$5,000
Validation	Item	\$10,000	1	\$10,000
Financial Assurance	Item	\$15,000	1	\$350,000
<b>Estimated Total</b>				<b>\$684,100</b>

\$334,100

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
q-factor	100.0%	97.1%	94.3%	91.5%	88.8%	86.3%	83.7%	81.3%	78.9%	76.6%	74.4%	72.2%	70.1%	68.1%	66.1%	64.2%	62.3%
Price escalation	100.0%	102.0%	104.0%	106.1%	108.2%	110.4%	112.6%	114.9%	117.2%	119.5%	121.9%	124.3%	126.8%	129.4%	131.9%	134.6%	137.3%
<b>Investment</b>	-69,950																
<b>Ongoing Maintenance and Monitoring Requirements</b>																	
<i>Environmental Monitoring</i>																	
Inspection and reporting		-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
Periodic concrete / soft fall repair											-5,000						
<b>Total (without price escalation)</b>	<b>-69,950</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-10,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
Total (with price escalation)	-69,950	-5,100	-5,202	-5,306	-5,412	-5,520	-5,631	-5,743	-5,858	-5,975	-12,190	-6,217	-6,341	-6,468	-6,597	-6,729	-6,864
<b>NPV</b>	<b>-69,950</b>	<b>-4,951</b>	<b>-4,903</b>	<b>-4,856</b>	<b>-4,809</b>	<b>-4,762</b>	<b>-4,716</b>	<b>-4,670</b>	<b>-4,625</b>	<b>-4,580</b>	<b>-9,070</b>	<b>-4,491</b>	<b>-4,448</b>	<b>-4,404</b>	<b>-4,362</b>	<b>-4,319</b>	<b>-4,277</b>
	-69,950																
<b>Total NPV</b>	<b>-418,099</b>																
NPV Risk realistic	-376,792																
NPV Risk worst	-305,589																
NPV Captial	-69,950																
NPV Monitoring and management	-348,149																

**Note:**

The q-factor quantifies the effect of interest and inflation on future costs of long term environmental management and informs calculation of net present value required for financial assurance.

Financial assurance provisions could be expected to be lower if in-situ containment is implemented as the preferred abatement option across multiple areas within the Precinct.





17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
60.5%	58.7%	57.0%	55.4%	53.8%	52.2%	50.7%	49.2%	47.8%	46.4%	45.0%	43.7%	42.4%	41.2%	40.0%	38.8%	37.7%	36.6%	35.5%	34.5%	33.5%	32.5%
140.0%	142.8%	145.7%	148.6%	151.6%	154.6%	157.7%	160.8%	164.1%	167.3%	170.7%	174.1%	177.6%	181.1%	184.8%	188.5%	192.2%	196.1%	200.0%	204.0%	208.1%	212.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
			-5,000										-5,000								
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-10,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-10,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>
-7,001	-7,141	-7,284	-14,859	-7,578	-7,730	-7,884	-8,042	-8,203	-8,367	-8,534	-8,705	-8,879	-18,114	-9,238	-9,423	-9,611	-9,803	-9,999	-10,199	-10,403	-10,611
<b>-4,236</b>	<b>-4,195</b>	<b>-4,154</b>	<b>-8,227</b>	<b>-4,074</b>	<b>-4,034</b>	<b>-3,995</b>	<b>-3,956</b>	<b>-3,918</b>	<b>-3,880</b>	<b>-3,842</b>	<b>-3,805</b>	<b>-3,768</b>	<b>-7,463</b>	<b>-3,695</b>	<b>-3,659</b>	<b>-3,624</b>	<b>-3,588</b>	<b>-3,554</b>	<b>-3,519</b>	<b>-3,485</b>	<b>-3,451</b>



39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31.6%	30.7%	29.8%	28.9%	28.1%	27.2%	26.4%	25.7%	24.9%	24.2%	23.5%	22.8%	22.1%	21.5%	20.9%	20.3%	19.7%	19.1%	18.5%	18.0%	17.5%	17.0%
216.5%	220.8%	225.2%	229.7%	234.3%	239.0%	243.8%	248.7%	253.6%	258.7%	263.9%	269.2%	274.5%	280.0%	285.6%	291.3%	297.2%	303.1%	309.2%	315.4%	321.7%	328.1%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
	-5,000										-5,000										-5,000
<b>-5,000</b>	<b>-10,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-10,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-10,000</b>
-10,824	-22,080	-11,261	-11,486	-11,716	-11,950	-12,189	-12,433	-12,682	-12,935	-13,194	-26,916	-13,727	-14,002	-14,282	-14,567	-14,859	-15,156	-15,459	-15,768	-16,083	-32,810
<b>-3,418</b>	<b>-6,769</b>	<b>-3,352</b>	<b>-3,319</b>	<b>-3,287</b>	<b>-3,255</b>	<b>-3,223</b>	<b>-3,192</b>	<b>-3,161</b>	<b>-3,130</b>	<b>-3,100</b>	<b>-6,140</b>	<b>-3,040</b>	<b>-3,011</b>	<b>-2,981</b>	<b>-2,952</b>	<b>-2,924</b>	<b>-2,895</b>	<b>-2,867</b>	<b>-2,839</b>	<b>-2,812</b>	<b>-5,569</b>



61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
16.5%	16.0%	15.5%	15.1%	14.6%	14.2%	13.8%	13.4%	13.0%	12.6%	12.3%	11.9%	11.6%	11.2%	10.9%	10.6%	10.3%	10.0%	9.7%	9.4%	9.1%	8.9%
334.7%	341.4%	348.2%	355.1%	362.3%	369.5%	376.9%	384.4%	392.1%	400.0%	408.0%	416.1%	424.4%	432.9%	441.6%	450.4%	459.4%	468.6%	478.0%	487.5%	497.3%	507.2%
-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000	-5000
									-5,000												
<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-10,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-5,000</b>	<b>-10,000</b>	<b>-5,000</b>	<b>-5,000</b>
-16,733	-17,068	-17,409	-17,757	-18,113	-18,475	-18,844	-19,221	-19,606	-39,996	-20,398	-20,806	-21,222	-21,646	-22,079	-22,521	-22,971	-23,431	-23,899	-48,754	-24,865	-25,362
<b>-2,757</b>	<b>-2,731</b>	<b>-2,704</b>	<b>-2,678</b>	<b>-2,652</b>	<b>-2,626</b>	<b>-2,601</b>	<b>-2,575</b>	<b>-2,550</b>	<b>-5,051</b>	<b>-2,501</b>	<b>-2,477</b>	<b>-2,453</b>	<b>-2,429</b>	<b>-2,405</b>	<b>-2,382</b>	<b>-2,359</b>	<b>-2,336</b>	<b>-2,313</b>	<b>-4,582</b>	<b>-2,269</b>	<b>-2,247</b>

