

Hornsby Quarry Land Filling Preliminary Impact Assessment

Hornsby Quarry Filling Assessment

LJ2888

Prepared for
Hornsby Shire Council

April 2013



Document Information

Prepared for Hornsby Shire Council
Project Name Hornsby Quarry Filling Assessment
File Reference Rep2783v2.docx
Job Reference LJ2888
Date April 2013

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9, The Forum, 203 Pacific Highway
St Leonards NSW 2065
PO Box 19 St Leonards NSW 1590

Telephone: 02 9496 7700
Facsimile: 02 9439 5170
International: +61 2 9496 7700

sydney@cardno.com.au
www.cardno.com

Document Control

Version		Date	Author	Author Initials	Reviewer	Reviewer Initials
1	Preliminary Draft	December 2012	Emma Maratea Shani Archer Christina Chiu Jacqui Druce Craig Stoddard	ERM SCA CC JGD CS	Kester Boardman Jenny Smithson	IKB JS
2	Final	April 2013	Emma Maratea Shani Archer Christina Chiu Jacqui Druce Craig Stoddard	ERM SCA CC JGD CS	Kester Boardman Jenny Smithson	IKB JS

© Cardno 2013. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

Executive Summary

Scope and Purpose of Document

Cardno was appointed by Hornsby Shire Council to secure approvals for the filling of Hornsby Quarry under a two stage process.

- Stage 1 required the preparation of a preliminary justification report and consultation with the then Department of Planning (DoP) to seek approval for the project to be determined by the Minister as a Major Project under Part 3A.
- Stage 2 either comprised Concept Approval under Part 3A if the Part 3A request was supported (Stage 2A) or a rezoning (LEP amendment) if it wasn't (Stage 2B).

Cardno completed the Stage 1 work and the required report was submitted to the DoP in December 2010. Around the same time, the DoP wrote to Cardno advising that the Department was not convinced that there was strategic justification for the project to be 'called in' and assessed under Part 3A.

Prior to progressing to Stage 2 of the project for rezoning and reclassification of the land, Council has requested that Cardno provide it with a preliminary evaluation of the environmental, social and economic impacts that can be expected during quarry filling. This information will assist Council in determining whether to progress the necessary amendment to planning controls to facilitate any filling.

Project Description

Hornsby Shire Council acquired the Hornsby Quarry site in 2002. Since that time Council has sought various forms of advice regarding the future use of the site. In 2007, Council engaged Pells Sullivan Meynink (PSM) to prepare a report relating to the geotechnical and hydrogeological constraints and how they impact on potential future land use options for the site. The instability of the quarry walls was identified as a significant constraint. The report listed three available options (including filling) to stabilise and thus remove the risk posed by the quarry walls. Filling the quarry is being considered by Council as a suitable way of ensuring public safety and maximising the area of the site that could be used in the future as public open space. It has since been determined that the best way to achieve this outcome is for the site to receive virgin excavated natural material (VENM) spoil and use this spoil to fill the quarry to approximately RL90m AHD.

The location of the quarry, and the local geography of the area, means any filling of the quarry will require movement of fill material through major roads, business districts, open space and residential areas and will lead to some disruption for local residents and visitors to the area. To assist in minimising disruption, an access options assessment was undertaken (Cardno, 2012a) to identify and evaluate the most appropriate access route to the quarry to facilitate the transportation of fill to Hornsby Quarry. The outcome of this assessment identified four potentially viable access routes. These access routes have been considered in this current assessment and are as follows:

- Access Option 1: Extension of Bridge Road to facilitate direct entry and exit of the quarry;
- Access Option 2: One-way loop access via roads in Options 1 and 4. Entrance to the site via Quarry Road, and exit from the site via Bridge Road;
- Access Option 3: One-way loop access via roads in Options 1 and 4. Entrance to the site via Bridge Road, and exit from the site via Quarry Road; and

- Access Option 4: Access and exit via Quarry Road / Frederick Street / William Street / Pacific Highway.

Project Impact Assessment

Preliminary environmental and social impact assessments have been undertaken as part of the preparation of this document to identify the impacts and benefits associated with the quarry filling and the various access routes associated with these works. This document has not been prepared as a comprehensive Environmental Impact Assessment (EIA) for development application purposes. The purpose of this document is to assist Council with decision making as to the future direction of the proposed filling of Hornsby Quarry. Accordingly, the following key environmental and social issues (as identified by Cardno and Council) have been addressed in this document:

- *Traffic and Transport:* Traffic modelling was undertaken to evaluate the impacts that increased truck movements would have on the surrounding road network and residents.
- *Noise:* Noise modelling was undertaken to determine whether noise emissions associated with the proposed works (including truck movements) would comply with the relevant statutory noise requirements.
- *Air Quality:* Existing air quality data and guidelines were utilised to determine the likely impacts associated with the proposed works.
- *Groundwater:* The work undertaken by PSM (2007) was used as the primary source of data to determine the likely impacts on groundwater associated with the proposed works.
- *Topography and Geology:* The work undertaken by PSM (2007) and Coffey (1989 and 1990) was used as the primary source of data to determine the likely impacts on topography and geology associated with the proposed works.
- *Flora and Fauna:* Relevant government database searches and document reviews were undertaken to identify the existing flora and fauna on site and to determine the likely impacts associated with the proposed works.
- *Heritage:* A review of Aboriginal and Non-Aboriginal Heritage registers and relevant documents was undertaken to identify any existing heritage items or places within or adjacent to the study area and to determine the likely impacts associated with the proposed works.
- *Visual Amenity:* A visual impact assessment was undertaken using site photos, spatial data (including topography and aerial photographs) and site inspections.
- *Social Impacts:* The existing demographic characteristics and economic, business, recreational and community facilities of the area were identified through document reviews and site visits. The likely social impacts associated with the proposed works were generally linked to the impacts associated with the issues listed above.

As a result of the impact assessment, an environmental risk assessment was undertaken, which defined each of the identified environmental risks with regard to its likelihood and consequence, combining to provide a risk rating for each impact. Following the identification of potential mitigation measures, the risk associated with each impact was reassessed assuming the application of the mitigation measures to identify an expected level of residual risk. Following the application of the appropriate mitigation measures, the following impacts were identified as 'High', 'Very High' or 'Extreme':

- As a result of both filling activities on site and trucks approaching and leaving the site, noise levels at receivers will exceed guidelines and significantly increase existing noise levels. Noise will increase over time as the quarry is filled;

- The large volume of heavy vehicles in local streets may impact on pedestrian and local traffic safety;
- Facilities and access associated with filling works may be at risk as a result of instability on the site. This could pose a significant risk to life and property if failure occurs;
- The potential for differential settlement of the ground will pose a risk to end use ground quality, safety and risk;
- The diatrema will be covered up if the quarry is filled;
- During the quarry filling, truck movements will increase and become frequent and may impact upon residential amenity or quality of living;
- During the quarry filling, visual amenity may be impacted; and
- If any of the access options involving access via Bridge Road (Access Options 1, 2 and 3) are adopted, the required removal of flora may have adverse impacts on the flora and fauna of the site and any threatened species in the area.

Economic Analysis

A preliminary economic analysis of the proposed works has been undertaken as part of this assessment, noting that the market for VENM is highly variable. The analysis identified the likely costs associated with the proposed filling of the quarry and assessed potential revenue and cost options associated with the filling material (VENM). The following scenarios were assessed:

- **Scenario 1:** All VENM required to fill the quarry is purchased (at \$15 / tonne)
- **Scenario 2:** In the event of revenue opportunities being available through the receipt of VENM at the site, a cost neutrality analysis was undertaken to identify the price to be put on VENM to achieve a cost neutral outcome.
- **Scenario 3:** An assessment was undertaken on a combined approach to acquiring VENM at the site. This assumed the Council would pay the market rate (\$15 / tonne) for VENM from large suppliers, would accept VENM at zero cost to Council for medium suppliers and would charge to accept VENM from small suppliers.

The outcomes of the economic analysis over an eight and twenty-year period are shown in **Table E-1**. Previous traffic modelling suggests that eight years is the shortest time period which would not have an unacceptable impact on road network performance and a twenty-year period is included to assess the economic impacts associated with a longer fill period.

Table E-1 Economic Analysis Outcomes

				Scenario 1	Scenario 2		Scenario 3		Sensitivity on Scenario 3	
Access Option	Access Option Description	Infrastructure and Operational Costs (including impact mitigation measures) (\$)		Total cost of VENM if Purchased at \$15/tonne (\$)	Required Price of VENM per tonne to Achieve Cost Neutrality (\$ / tonne)		Neutral price for VENM revenue per tonne (\$ / tonne)		Neutral price for VENM revenue per tonne. (\$ / tonne) (50% increase in capital and operating costs)	
							<ul style="list-style-type: none"> 40% VENM purchased at \$15/tonne. 30% VENM at zero cost 30% VENM as Revenue 		<ul style="list-style-type: none"> 40% VENM purchased at \$15/tonne. 30% VENM at zero cost 30% VENM as Revenue 	
		8 Year	20 Year	8 and 20 Year	8 Year	20 Year	8 Year	20 Year	8 Year	20 Year
1	Entry and Exit via Bridge Road	\$31.44M	\$59.95M	\$137.60M	\$3	\$6	\$31	\$40	\$37	\$50
2	One-way loop access via roads in Access Options 1 and 4. Entrance via Quarry Road.	\$33.29M	\$62.04M	\$137.60M	\$3	\$6	\$32	\$40	\$38	\$50
3	One-way loop access via roads in Access Options 1 and 4. Entrance via Bridge Road.	\$33.29M	\$62.04M	\$137.60M	\$3	\$6	\$32	\$40	\$38	\$50
4	Entry and Exit via Quarry Road	\$26.30M	\$55.05M	\$137.60M	\$2	\$5	\$29	\$30	\$34	\$40

The outcomes of the economic analysis undertaken for the filling of Hornsby Quarry are outlined below:

- Under current government policy, it is reasonable to assume that the filling of Hornsby Quarry could be undertaken on a cost neutral basis. However, there is a significant risk associated with this assumption, as the outcome is strongly dependant on several factors which should be considered:
 - If a change in government policy resulted in the disposal of VENM no longer being exempt from Section 88 Waste Contributions, this could have an impact on the price charged to receive VENM at the site. This may result in the Cost Neutral Price no longer being competitive in the market and the suppliers of VENM may turn to other Sydney or regional facilities.

- VENM is a valuable resource; for a supplier to be willing to pay to dispose of VENM, they would have to identify that they have no beneficial use for VENM at that time, have no means of stockpiling for future use and have not sourced a consumer for their VENM.
- Filling periods of greater than 20 years have not been considered in this analysis. If VENM availability is limited or the filling operations are extended for other reasons, this may have an impact on the ability to achieve cost neutrality.
- The closest VENM only receiver is Boral Prospect Recycling Plant, approximately 25 km from Hornsby Quarry.
- If VENM cannot be accepted for a fee to the supplier and all or most of the VENM received at the site is purchased by Council, the total cost of filling the quarry could be up to \$200 Million.
- A detailed cost benefit analysis and economic risk assessment would need to be undertaken in order to assess the viability of the project in greater detail, including negative and positive externalities.

The infrastructure and operating costs, while large, are dominated in the assessment by the potential cost of VENM. In this context, the cost differences between the 4 scenarios considered are relatively insignificant.

Conclusions

The environmental, social and economic assessment undertaken identified that the proposed works result in several significant risks even after the implementation of appropriate mitigation measures. The selection of Access Option 1 (extension of Bridge Road) would reduce these risks to the greatest degree, Access Option 2 (a one way loop entering at Quarry Road) would reduce risks to a lesser degree. Access Option 3 and 4 are less favoured due to more significant impacts associated with trucks exiting the quarry and accessing the road network from Quarry Road.

The noise assessment shows that noise impacts will exceed noise criteria at a number of locations for all access options. Additionally, there are unlikely to be effective mitigation measures which will bring noise impacts below the noise criteria.

The economic analysis of the proposed works found that, if VENM suppliers were willing to pay to dispose of the material, then it may be possible to undertake the filling of Hornsby Quarry with a cost neutral outcome. However, this is dependent on market conditions and government policy (in particular relating to the waste levy) during the quarry filling period.

Table of Contents

Executive Summary	iii
Glossary and Abbreviations	xii
1 Introduction	1
1.1 Document Purpose	1
1.2 Scope of Work	1
1.3 Study Limitations	1
2 Site Location and Context	3
2.1 Site Location	3
2.2 Current and Surrounding Land Use	5
3 Project Description	7
3.1 Project Overview	7
3.2 Strategic Justification	7
3.3 Conceptual Operational Model	8
3.4 Site Establishment	8
3.5 Fill Completion and Site Remediation	8
3.6 Preliminary Access Options Assessment	12
4 Legislative and Planning Context	15
5 Environmental Impact Assessment	19
5.1 Overview	19
5.2 Traffic and Transport	20
5.2.1 Existing Conditions	20
5.2.2 Traffic and Transport Impact Assessment	20
5.2.3 Proposed Mitigations Measures and Residual Impacts	22
5.2.4 Key Findings and Access Option Comparison	23
5.3 Noise	23
5.3.1 Existing Conditions	24
5.3.2 Noise Impact Assessment	25
5.3.3 Proposed Mitigations Measures and Residual Impacts	31
5.3.4 Key Findings and Access Option Comparison	32
5.4 Air Quality	33
5.4.2 Existing Conditions	33
5.4.3 Air Quality Assessment	33
5.4.4 Proposed Mitigation Measures and Residual Impacts	34
5.4.5 Key Findings and Access Option Comparison	35
5.5 Groundwater	36
5.5.2 Existing Conditions	36
5.5.3 Groundwater Impact Assessment	36
5.5.4 Proposed Mitigations Measures and Residual Impacts	37
5.5.5 Key Findings and Access Option Comparison	37
5.6 Topography and Geology	37
5.6.2 Existing Conditions	37
5.6.3 Geological and Topographic Impact Assessment	42
5.6.4 Proposed Mitigation Measures and Residual Impacts	42
5.6.5 Key Findings and Access Option Comparison	44
5.7 Flora and Fauna	44

5.7.2	Existing Conditions	44
5.7.3	Flora and Fauna Impact Assessment	48
5.7.4	Proposed Mitigation Measures and Residual Impacts	49
5.7.5	Key Findings and Access Option Comparison	50
5.8	Heritage	50
5.8.2	Existing Conditions	50
5.8.3	Heritage Impact Assessment	56
5.8.4	Proposed Mitigation Measures and Residual Impacts	58
5.8.5	Key findings and Access Option Comparison	60
5.9	Social Impacts	60
5.9.2	Existing Conditions	60
5.9.3	Social Impact Assessment	62
5.9.4	Proposed Mitigation Measures and Residual Impacts	63
5.9.5	Key Findings and Access Option Comparison	64
5.10	Visual Amenity	64
5.10.2	Existing Environment	64
5.10.3	Visual Impact Assessment	70
5.10.4	Proposed Mitigation Measures and Residual Impacts	73
5.10.5	Key Findings and Option Comparison	73
5.11	Environmental Risk Assessment	74
5.11.2	Likelihood	74
5.11.3	Consequence	74
5.11.4	Risk Rating	77
5.11.5	Risk Identification and Evaluation	77
5.12	Key Findings and Access Options Comparison: Environmental Impacts Associated with Access Options	85
6	Economic Analysis	86
6.3	Costs	86
6.3.2	Site Establishment and Operational Costs	86
6.1.2	Mitigation Costs	87
6.1.3	Total Costs	88
	*These costs are based on data in Table 6-1, with addition of costs specific to each option	88
6.1.4	Section 88 Waste Contributions	88
6.2	Considering VENM as a Project Cost	89
6.2.1	Competing VENM receivers	89
6.2.2	Cost of VENM to the project	89
6.3	Considering VENM as a Revenue, and Cost Neutrality	90
6.4	Combined Costs and Revenue	91
6.5	Sensitivity Analysis	91
6.6	Key Findings and Access Options Comparison	93
7	Conclusions	94
8	References	97

Appendices

Appendix A	Site Photolog
Appendix B	Traffic Report and Addendum
Appendix C	Noise Report
Appendix D	Database Search Results
Appendix E	Economic Analysis
Appendix F	Filling of Hornsby Quarry Access Options Report

Tables

Table E-1	Economic Analysis Outcomes	vi
Table 3-1	Access Options for Detailed Assessment	12
Table 4-1	Overview of Relevant Legislation, Policies and Plans	15
Table 5-1	Access Options	20
Table 5-2	Rating Background Levels	25
Table 5-3	Measured Traffic Noise Levels	25
Table 5-4	Road Traffic Noise Assessment Criteria for Residential Land Uses	26
Table 5-5	Adopted Intrusive Criteria for Industrial Noise Emissions (Based on the INP)	26
Table 5-6	INP Recommended Amenity Criteria	27
Table 5-7	Road Traffic Noise Summary	28
Table 5-8	Assumed Plant and Equipment Sound Power Levels	29
Table 5-9	Onsite Quarry Noise Summary	30
Table 5-10	Groundwater Bores (NSW Government, 2012)	36
Table 5-11	Items Listed on the Heritage Registers – Project Site and Surrounds	52
Table 5-12	Potential Impacts to Diatreme and Mitigation Measures	57
Table 5-13	Key Existing Landscape Features and Subjective Assessment of Existing Visual Quality	64
Table 5-14	Key Landscape Features and Subjective Assessment of Potential Changes in Visual Quality.	72
Table 5-15	Risk Outcome Likelihood Criteria	74
Table 5-16	Risk Consequence Criteria	76
Table 5-17	Risk Ratings	77
Table 5-18	Environment Risk, Mitigation Measures and Residual Risk Assessment	78
Table 5-19	Environmental Impacts of Access Options	85
Table 6-1	Itemised Costs for Site Establishment and Filling Operations Common to All Access Options (to the nearest \$10,000s)	87
Table 6-2	Mitigation Costs for Access Options (to the nearest \$10,000s)	87
Table 6-3	Total Infrastructure and Operating Costs (excluding fill material) (to the nearest \$10,000s)	88
Table 6-4	Total Cost to Fill the Quarry (Site establishment, Filling Operations, Mitigation and VENM Costs at \$15 per Tonne) (to the nearest \$100,000s)	90
Table 6-5	VENM to be Charged per Tonne on Entry to the Quarry to Achieve Cost Neutrality	90
Table 6-6	VENM Price – Combined Source Analysis	91
Table 6-7	Sensitivity Analysis	92
Table 7-1	Economic Analysis Outcomes	95

Figures

Figure 2-1	Study Area	4
Figure 2-2	Zoning Plan	6
Figure 3-1	Conceptual Operational Model	10
Figure 3-2	Cross-Section of Proposed Filling Works	11
Figure 3-3	Access Road Options	13
Figure 3-4	Access Options for Detailed Assessment	14
Figure 5-1	Noise Monitoring Locations	24
Figure 5-2	Acoustic shed and site entry scenario locations (A and B)	30
Figure 5-3	Site Geology and Topography	40
Figure 5-4	Risk of Instability	41
Figure 5-5	Vegetation and Threatened Species	47
Figure 5-6	Non Aboriginal Heritage	54
Figure 5-7	Photograph of the Diatreme Area Located on the Eastern Face of the Quarry Wall.	55
Figure 5-8	Photograph of Old Mans Cemetery (Higgins Family Cemetery) Located to the South-east of the Quarry.	55
Figure 5-9	Photograph of the Heritage House at 3 Bridge Road, Hornsby (looking east on Pacific Highway).	56
Figure 5-10	View Looking North from the Existing Trail in Old Mans Valley towards Fern Tree Close.	66
Figure 5-11	View Looking North-west from the Existing Trail in Old Mans Valley towards the Quarry Pit (screening vegetation shown in middle ground) and Manor Road (in background).	66
Figure 5-12	View Looking North-east from the Existing Trail in Old Mans Valley towards the TAFE facility on Bridge Road.	67
Figure 5-13	View looking north east from the upper part of the fire trail linking Bridge Road to Old Mans Valley towards houses on the corner of Bridge Road and Roper Lane.	67
Figure 5-14	View from the End of Bridge Road (as it makes a Sharp Left Turn towards the TAFE Facility) Looking West towards the Quarry Pit (Source: Google StreetView).	68
Figure 5-15	3D Terrain View from the same Location on Bridge Road, without Screening Vegetation (Source: Google Earth).	68
Figure 5-16	View from Quarry Road Looking North Towards the Quarry Pit (Source: Google StreetView).	69
Figure 5-17	3D Terrain View from the same Location on Quarry Road, without Screening Vegetation (Source: Google Earth).	69
Figure 5-18	View from the End of Fern Tree Close Looking South-west towards the Quarry Pit.	70
Figure 5-19	3D Terrain View from the Same Location on Fern Tree Close, without Screening Vegetation (Source: Google Earth).	70
Figure 5-20	Visual Assessment	71

Glossary and Abbreviations

AHD	Australian Height Datum. A geodetic datum for altitude measurement in Australia
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
Ambient Sound	Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far.
ARI	Average Recurrence Interval
ASS	Acid Sulfate Soils
Background Sound Level	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources.
BoM	Australian Bureau of Meteorology
CBD	Central Business District
CMP	Conservation Management plan
CO ₂	Carbon dioxide
dB	Decibel. A scale used in sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure
dB(A)	A value used for 'A-weighted' sound pressure levels. 'A' frequency weighted is an adjustment made to sound-level measurement to approximate the response of the human ear
DCP	Development Control Plan
DECC	Former NSW Department of Environment and Climate Change (now OEH)
DECCW	Former NSW Department of Environment, Climate Change and Water (now OEH)
Diatreme	A formation of a long vertical pipe when gas filled magma forces its way up overlying strata
DoP	Former NSW Department of Planning (now DP&I)
DP&I	NSW Department of Planning and Infrastructure
DPI	NSW Department of Primary Industries
DSEWPac	Australian Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community, listed under Schedule 1 of the TSC Act
ENM	Excavated Natural Material
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Authority
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
HSC	Hornsby Shire Council
INP	Industrial Noise Policy
L _{A1}	Noise levels exceeded for 1% of the sample time
L _{A10}	Noise levels exceeded for 10% of the sample time
L _{A90}	Noise levels exceeded for 90% of the sample time
L _{Aeq}	A single value of sound levels which takes into account the total sound energy over the sample time
LEP	Local Environmental Plan
LGA	Local Government Area

LIDAR	Laser Imaging Detection and Ranging
LPI	NSW Land and Property Information
NEMP	National Environment Protection Measure
NEPC	National Environment Protection Council
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PM _{2.5}	Particulate Matter less than 2.5 micrometers in diameter
PM ₁₀	Particulate Matter less than 10 micrometers in diameter
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
REP	Regional Environment Plan
RMS	Roads and Maritime Services
RNE	Register of National Estate
RBL	Rating Background Level. The rating background level for each period is the median value of the assessment background level values for the period over all of the days measured. As such, there is a rating background level value for each period –daytime, evening and night time
SEPP	State Environmental Planning Policy
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
TSC Act	<i>Threatened Species Conservation Act 1995</i>
VENM	Virgin Excavated Virgin Material
WHO	World Health Organisation

1 Introduction

1.1 Document Purpose

Cardno was appointed by Hornsby Shire Council to secure approvals for the filling of Hornsby Quarry under a two stage process.

- Stage 1 required the preparation of a preliminary justification report and consultation with the then Department of Planning (DoP) to seek approval for the project to be determined by the Minister as a Major Project under Part 3A.
- Stage 2 either comprised Concept Approval under Part 3A if the Part 3A request was supported (Stage 2A) or a rezoning (LEP amendment) if it wasn't (Stage 2B).

Cardno completed the Stage 1 work and the required report was submitted to the DoP in December 2010. Around the same time, the DoP wrote to Cardno advising that the Department was not convinced that there was strategic justification for the project to be 'called in' and assessed under Part 3A because, inter alia,

- The proposal doesn't involve resource recovery and was therefore not a resource recovery facility; and
- There were alternative planning paths that could be explored by the Council (e.g. resolving permissibility issues through the LEP process and having future proposals considered by the Joint Regional Planning Panel).

Prior to progressing to Stage 2 of the project for rezoning and reclassification of the land, Council has requested that Cardno provide it with an evaluation of the environmental, social and economic impacts that can be expected during quarry filling. This information will assist Council in determining whether to progress the necessary amendment to planning controls to facilitate any filling.

1.2 Scope of Work

The scope of work outlined in this document is;

- To provide an overview of how the quarry could be filled,
- To make a preliminary assessment of the environmental impacts associated with these works,
- To identify appropriate mitigation measures, if available, to manage any environmental impacts, and
- To undertake a preliminary cost benefit evaluation of the project.

1.3 Study Limitations

The environmental assessment undertaken as part of this study involved undertaking new specialist studies for noise and traffic impacts. No other detailed specialist studies were undertaken and the information contained within this document has been obtained only from existing studies for the quarry site and its surrounds. This may limit the extent to which environmental risks can be identified and assessed. In particular, it was found that available data was limited for the following:

- No air quality modelling was undertaken for the proposed filling works.

- No community or stakeholder consultation was undertaken as part of this assessment. Consultation would assist in identifying the likely social impacts and the likely magnitude of these impacts on the community.

More detailed explanation of the specific limitations pertaining to the environmental assessments is contained within **Section 5**. Should the application process for the proposed filling works proceed, further detailed investigations of these issues and of the preliminary risk assessment would need to be undertaken.

It should also be noted that the economic assessment provided in **Section 6** is indicative only. It is considered to be accurate to a reasonable order of magnitude for the purposes of immediate decision making about the future project direction. More detailed economic evaluation would be required to present a final cost benefit analysis for the proposal should the filling proceed.

2 Site Location and Context

2.1 Site Location

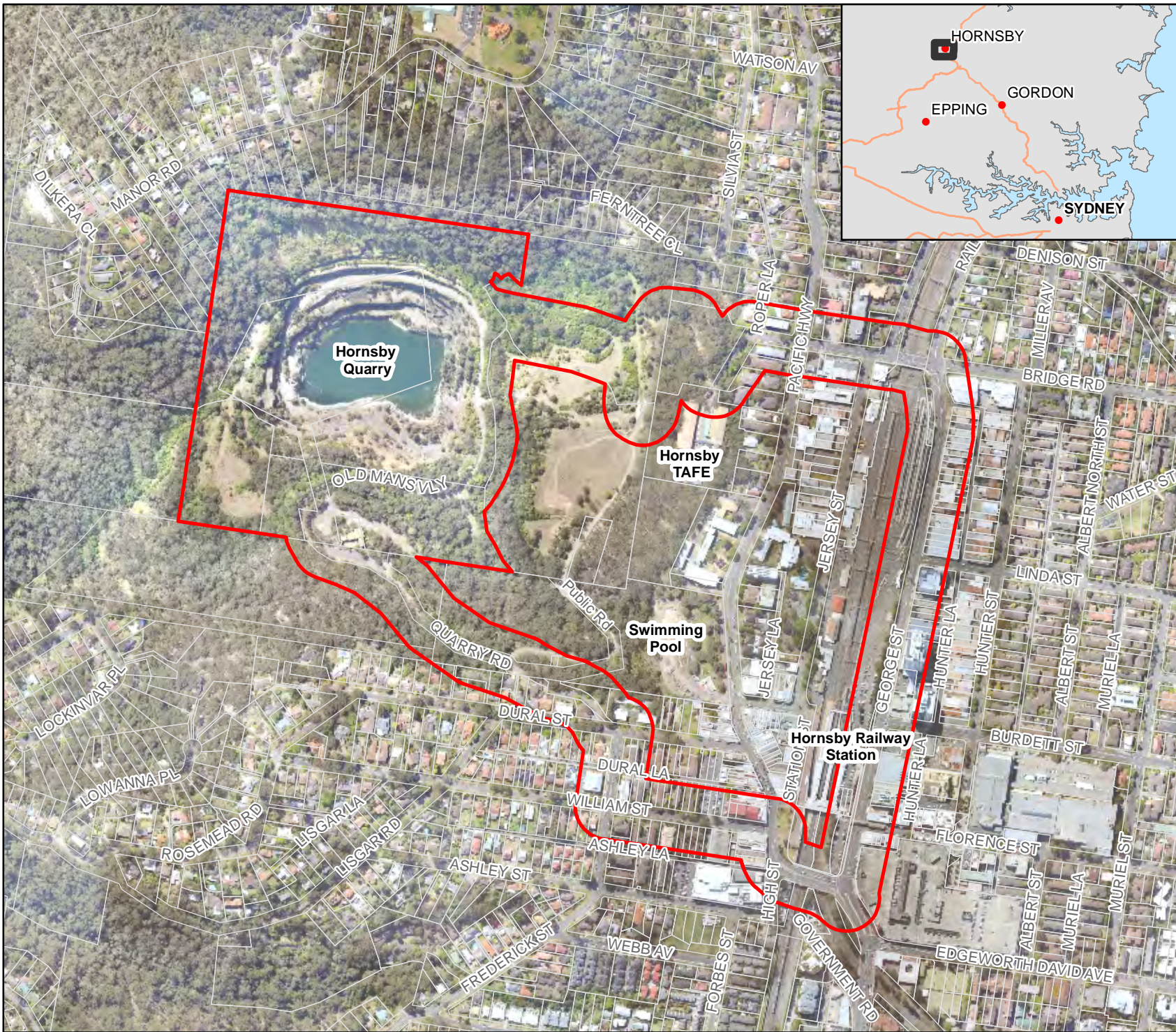
The site is located within the boundaries of the existing disused Hornsby Quarry facility which is described as a combination of Lot 1 DP 926103 and Lots A, B, C, D and E DP318676. The site is located less than 1km north-west of the Hornsby CBD and approximately 24km north of the Sydney CBD. In addition to the quarry site itself, the potential access routes have also been included in the study area for this investigation. Along with the utilisation of the existing access off Quarry Road, this includes the potential access road through Old Mans Valley. As indicated on the Site Plan, a potential new access through Old Mans Valley (Lots 1/114323, 2/169188 plus Lot 1/859646) could link Bridge Road with the quarry site. This potential access does not exist at this time.

The quarry site occupies an area of approximately 22.9 hectares with the quarry void measuring approximately 11.5 hectares (measured at RL90m AHD). Hornsby Quarry has been disused since the late 1990's. The quarry pit extends from RL8m AHD to RL90m AHD, with the quarry void volume estimated at approximately 3.3 million cubic metres. The quarry walls are benched and it is flooded at the base. Council has been pumping water from the pit since late 2009 in order to keep the water level below RL40.

Existing vehicular access to the site is obtained via Dural Street and Quarry Road to the south of the site. This road access was utilised during the operational life of the quarry. A number of facilities associated with the past mining operations remain on the site including concrete block office buildings, crushing and screening plant/pumps, pipeline and an extensive network of security fencing and gates. In addition, a number of unsealed roads provide access into and around the site.

The exposed slopes around the quarry pit are surrounded by dense vegetation. The vegetation and topography of the site and the adjoining lands screen the quarry pit from surrounding residential properties and businesses.



A site plan showing the areas potentially affected by the proposed filling (including truck movements) is provided as **Figure 2-1**, whilst photographs of the site are provided in **Appendix A**.



Study Area

HORNSBY QUARRY LAND FILLING

Legend

-  Study Area
-  Cadastre

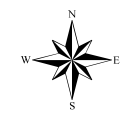
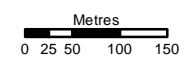


FIGURE 2-1

1:8,000 Scale at A4



Map Produced by Cardno NSW/ACT Pty Ltd (2812)
Date: 2013-04-08
Coordinate System: GDA 1994 MGA Zone 56
Project: LJ2888
Map: G2001_StudyArea.mxd 01
Imagery Source: Hornsby Shire Council and associated third party suppliers

2.2 Current and Surrounding Land Use

The quarry site is owned and managed by Hornsby Shire Council.

To the east, the quarry site is adjoined by an area of public open space known as Old Mans Valley (with an area of approximately 12.1 hectares). Much of the Crown land in this area is managed by Council. Publicly owned facilities adjacent to the site include Hornsby TAFE and Hornsby Aquatic Centre. Privately owned residences and commercial property lie further east of the site, within the Hornsby CBD.

To the north, the quarry site is bounded by low density residential development with houses extending along Manor Road and Fern Tree Close. The quarry site is extensively screened from these residential properties due to substantial stands of trees in the vicinity.

Hornsby Park is located along the southern boundary of the site and separates the site from existing residential development along Dural Street and Rosemead Road. Hornsby Park is owned by the Department of Sustainable Natural Resources and managed by Council. A section of the Great North Walk extends through this area of Crown land.

To the west, the site is bounded by an extensive bushland area known as Berowra Valley Regional Park. The park has an area of approximately 3,830 hectares and is protected under the National Parks and Wildlife (NPW) Act for its biodiversity values which provide habitat for threatened plant and animal species.

The quarry site itself is classified under the current Hornsby Shire LEP (1994) as *Open Space A (Public Recreation - Local)*. The Draft Hornsby LEP provides a similar classification of *RE1 - Public Recreation*.

A zoning plan is provided as **Figure 2-2**.



Legend












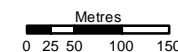
-  Study Area
-  Cadastre
-  Residential A (Low Density)
-  Residential B (Medium Density)
-  Residential C (Medium/High Density)
-  Residential D (High Density)
-  Business F (Town Centre)
-  Business G (Town Centre Support)
-  Industrial B (Light)
-  Special Uses A (Community Purposes)
-  Special Uses B (Transport Corridor)
-  Open Space A (Public Recreation - Local)
-  Open Space B (Public Recreation - District)

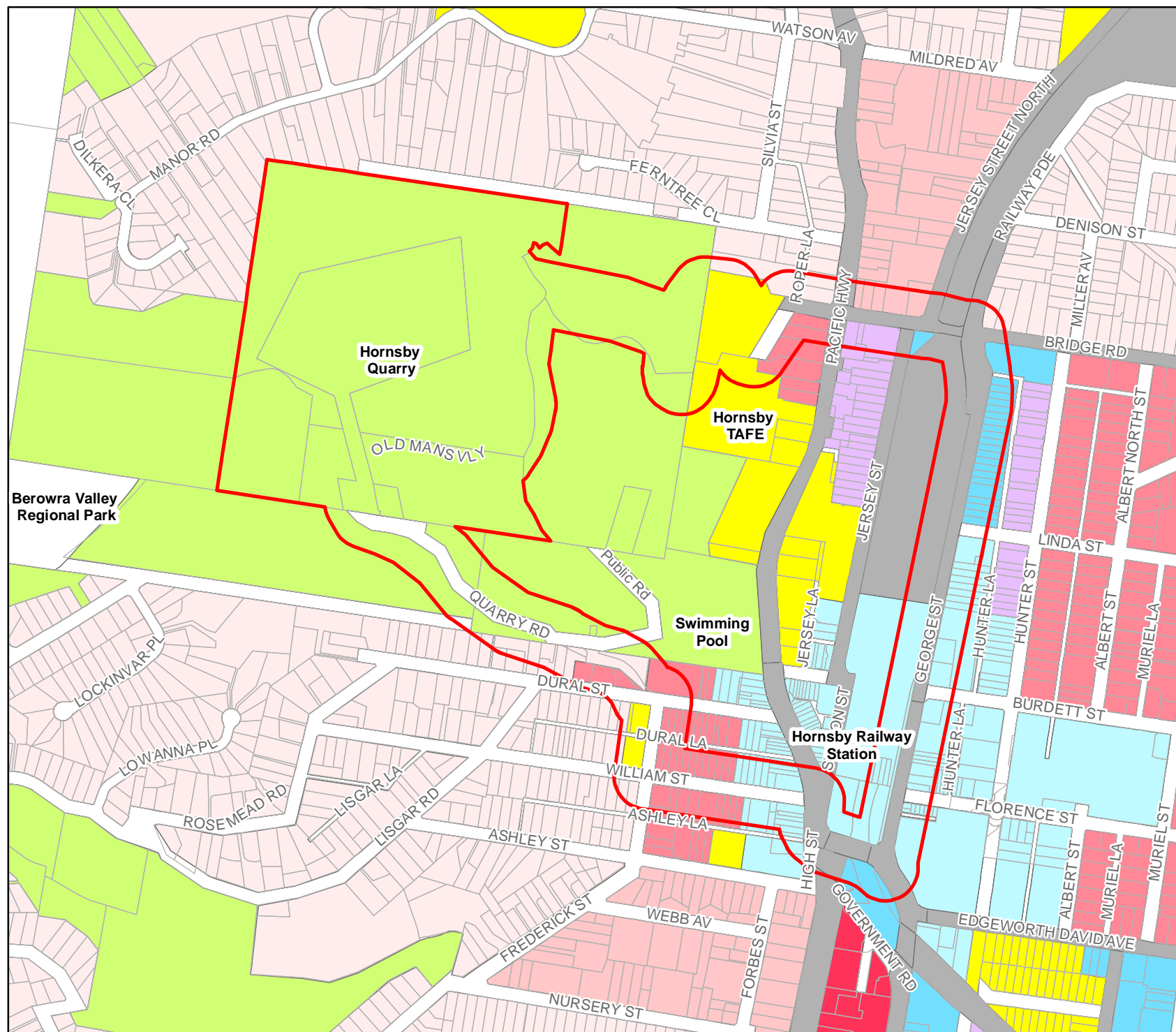


FIGURE 2-2

1:8,000 Scale at A4



Map Produced by Cardno NSW/ACT Pty Ltd (2812)
Date: 2013-04-08
Coordinate System: GDA 1994 MGA Zone 56
Project: LJ2888
Map: G2002_Zoning.mxd 01
Data Source: LPI and Hornsby Shire Council
Imagery Source: Nearthmap and associated third party suppliers



3 Project Description

3.1 Project Overview

Hornsby Shire Council acquired the Hornsby Quarry site in 2002. Since that time Council has sought various forms of advice regarding the future use of the site. In 2007, Council engaged Pells Sullivan Meynink (PSM) to prepare a report relating to the geotechnical and hydrogeological constraints and how they impact on potential future land use options for the site. The instability of the quarry walls was identified as a significant constraint. The report listed three available options to stabilise and thus remove the risk posed by the quarry walls, these being filling, combining filling with cutting back the upper quarry walls, or supporting the walls with a combination of drainage holes, rock bolts, shotcrete, mesh, and scaling.

Filling the quarry was ultimately determined by Council as the most suitable way of ensuring public safety and maximising the area of the site that could be used in the future as public open space. It has since been determined that the best way to achieve this outcome is for the site to receive virgin excavated natural material (VENM) spoil and use this spoil to fill the quarry to RL90m AHD, together with the provision of triangular buttresses against the quarry slopes above RL90m AHD on the northern and southern sides.

3.2 Strategic Justification

Council has identified that the rehabilitation of the quarry and the adjacent degraded open space is paramount. There is a need to stabilise the quarry, manage and restore the bushland, and resolve the future use of open space, existing buildings and roads. The quarry currently presents a risk to public safety and has the potential to further degrade the natural environment. The roads are an erosion hazard and the buildings contain fibro and remnant fuel storage facilities which are potential sources of contamination (Hornsby Shire Council, 2012b). There is a need to ensure that the site is made safe and managed in an environmentally sustainable manner. Redevelopment of part of the site is an option which may provide land management opportunities to improve the environment and reduce the risk to public safety (Hornsby Shire Council, 2012b).

As the land is contiguous with public open space in Old Mans Valley and the Berowra Valley Regional Park, Council's rehabilitation of the site would ensure that appropriate land management strategies are implemented in the public interest (Hornsby Shire Council, 2012b). In the draft Hornsby Local Environment Plan (LEP), the quarry is zoned for Public Recreation. However, the land is currently not suitable for this purpose with the completion of filling, the quarry and its surrounds will most likely be a key feature for public use in the Hornsby Shire LGA.

The proposed facility would provide an opportunity for the disposal of spoil arising from major project developments in the region. Accordingly, the provision of such a facility could have numerous important strategic benefits such as a guaranteed spoil disposal facility for major projects. This would potentially allow the relevant major projects to proceed and be completed more quickly and economically than might otherwise be the case.

The proposal would also achieve the sustainable re-use of the existing quarry and provide certainty to the surrounding community in terms of the nature of spoil to be accommodated at the site. Furthermore, the proposed facility would likely reduce the number of other sites required to accept spoil from major projects thus reducing overall potential impacts within the wider community and environment.

It is also important to note that the location of the site in northern Sydney would likely assist in reducing the cost delivery of some major projects located within the north/north-western region of

Sydney given it is estimated that over 90% of the Sydney Metropolitan Area's non-putrescible capacity is located in Western Sydney. Such a facility in northern Sydney would also counteract any sense of 'geographic inequality' through a more equitable dispersal of non-putrescible capacity across the Sydney Metropolitan Area.

The Metropolitan Strategy identifies Hornsby as the major centre in the North subregion. The Draft North Subregional Strategy states that, due to population growth and demographic change, opportunities for new open space should be identified where possible and that State Government and Local Councils will explore opportunities to improve the quality and accessibility of all local space. Given the significant size of the site and its proximity to Hornsby CBD, the proposed facility (once filling has been completed) would ultimately enable the site to be used as open space as per its zoning. This could be of considerable strategic benefit with regard to the future growth of Hornsby and the overall North subregion.

3.3 Conceptual Operational Model

The operation of the quarry as a landfill site for VENM would involve the transport of fill to the site, placement and compaction of the fill and management of the impacts associated with these activities on the surrounding environment.

The conceptual model shown in **Figure 3-1** provides an overview of the operational aspects of the quarry. The controls on the transport of fill in the conceptual model are based on mitigation measures (**Table 5-18**) resulting from the findings of this report. Operational hours have been advised by Council and are consistent with the Traffic Assessment Report (**Appendix B**).

3.4 Site Establishment

A number of activities would be required at the quarry site prior to the site being able to accept VENM fill. The works would include:

- Some clearing of vegetation to allow safe access to, and from, the site and movement within the site,
- Installation of services (power, water and sewerage),
- Upgrade works to internal roads,
- Dewatering of the quarry,
- Establishment of stormwater collection systems and sumps to collect stormwater,
- Minor traffic management works on external roads,
- Fencing and sediment controls,
- Noise mitigation controls
- Installation of site facilities including an acoustics entry shed, weighbridge, staff amenities, traffic and safety controls, and
- Acquisition of earth movers and compaction machinery.

In addition, an Operational Management Plan for the site would need to be developed.

3.5 Fill Completion and Site Remediation

The PSM (2007) report estimates that the amount of spoil that could be accommodated in the quarry void is approximately **4.3 million m³** (3.3 million m³ for the pit and 1 million m³ for the required northern and southern buttresses).

Figure 3-2 provides a cross-section of the intended earthworks associated with backfilling of the quarry with external fill materials.

Following completion of the filling, it is Council's ultimate aim for the site to be developed for recreational purposes in accordance with its reserved purpose under the Hornsby Shire Local Environmental Plan 1994.

PLACEMENT OF FILL

- VENM to be deposited at tipping face / working front.
- On-site routing of trucks to the working face should be planned to minimise waiting times at the site.
- After loads are deposited, compactors or bulldozers are used to spread and compact the fill on the working face.
- Regular compaction testing to be undertaken.
- Total volume of fill required of approximately 4.2 million cubic metres.
- Number of vehicles required for fill placement to be determined
- Multiple load drop off locations will be required to operate simultaneously to maintain traffic flow.

CONTROL CENTRE (location not yet determined)

- Permanently manned during operation.
- Staff amenities and office.
- CCTV to show entry and exit to the surrounding road network.
- Positioned to see quarry floor views from window or CCTV.
- Weighbridge(s) to be positioned here.
- Operating systems will need to be developed which are capable of controlling the entry and exit of trucks and appropriate staffing and systems will need to be provided to facilitate this.

INTERNAL TRUCK MOVEMENTS

Trucks to access deposition site at the quarry tip site by road.

EXIT (location not yet determined)

- Upgrade of exit roads to accommodate unloaded trucks.
- Exit hours: 7am - 5.00pm weekdays. 8am - 12pm Saturdays.
- Trucks leave site via truck wash.
- Waste water wherever possible will be reused in the truck wash and for dust suppression.
- Trucks to exit via a weighbridge to calculate load weight.
- Traffic management of trucks entering public road network.

ACCESS (location not yet determined)

- Access hours: 7am - 5.00pm weekdays. 8am - 12pm Saturdays.
- Entrance management (boom gates etc).
- Testing of fill as required to comply with VENM guidelines

ONGOING SITE MANAGEMENT

- Safety must be built into the landfill. Examples of unsafe conditions include equipment operating on excessive grades, personnel entering unventilated enclosures.
- Stormwater runoff can be collected and re-used onsite. Excessive runoff volumes to be treated and pumped off-site.
- Effluent from staff facilities will need to be pumped off-site.
- Security to be maintained to prevent unauthorised access
- Monitoring for settlement, groundwater and geotechnical stability



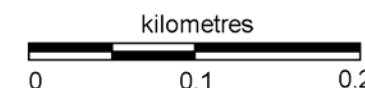
Concept Design for Filling of Hornsby Quarry

HORNSBY QUARRY LAND FILLING



FIGURE 3-1

1:5,000 Scale at A3



Map Produced by Cardno NSW/ACT Pty Ltd (2812)

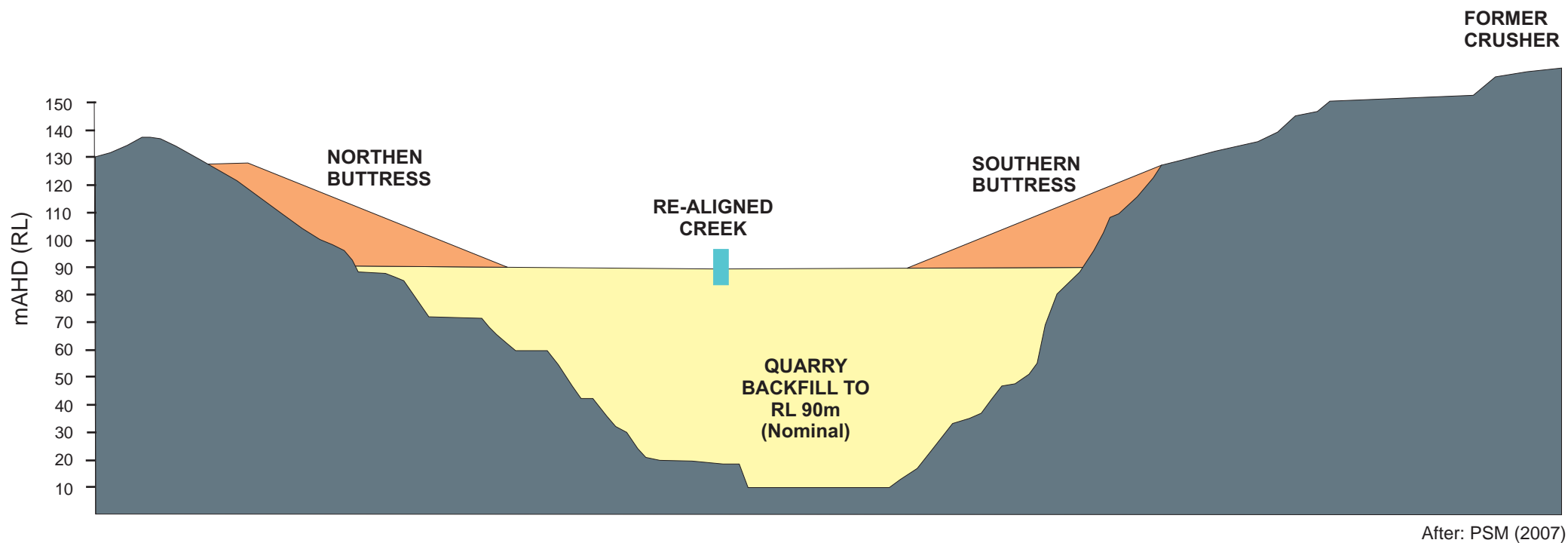
Date: 2013-04-08

Coordinate System: GDA 1994 MGA Zone 56

Project: LJ2888

Map: G3001_Concept Plan.wor

Imagery Source: Nearmap and associated third party suppliers



3.6 Preliminary Access Options Assessment

A preliminary access options assessment was undertaken in order to identify the most feasible access routes in order to inform this preliminary impact assessment. The assessment identified the most feasible access options so that the geographical location of environmental impacts and their extent could be assessed in this report. Additionally, the access options to the quarry informed the indicative economic impacts of the quarry filling exercise.

The location of the quarry, and the local geography of the area, means any filling of the quarry will require movement of fill material through major roads, business districts and residential areas and will lead to some disruption for local residents and visitors to the area. There are numerous access options to the site via various routes and various transportation methods (e.g. truck, train or conveyor). The environmental and social impacts and the costs will vary for each access option. In order to identify the most feasible access option for more detailed assessment, a preliminary access options assessment was undertaken. This assessment is provided in **Appendix F**.

The assessment:

- Identified 20 potential access options (road access options are shown in **Figure 3-3**),
- Set out criteria for project success (screening criteria),
- Compared each potential access option against the agreed screening criteria,
- Compared access options which satisfied the screening criteria using a multi criteria analysis, and
- Identified three road access options for filling the quarry which were determined by the multi criteria analysis to have the lowest level of impact, and were recommended as the preferred access options for future detailed evaluation.

The multi-criteria assessment identified the following access options as having the least impact and the highest degree of feasibility:

- **Option 1B:** Access via Quarry Road / Frederick Street / William Street / Pacific Highway.
- **Option 1C:** Extension of Bridge Road to facilitate direct access to quarry.
- **Option 1H:** One-way loop access via Option 1B and 1C.

These access options have been considered as part of this current assessment. Option 1H has been included in this current study as a one way loop in both directions, resulting in a total of four access options for consideration. The four options included in this assessment are shown below in **Table 3-1** and **Figure 3-4**, and have been renamed as described. It is noted that all access options originate at the junction of George Street and Pacific Highway. The route for material to reach this point is expected to be common to all route options, and to be on the major road network.

Table 3-1 Access Options for Detailed Assessment

Previous Option Number	New Option Number	Access Option
1C	1	Extension of Bridge Road to facilitate direct entry and exit to the quarry.
1H	2	One-way loop access via roads in Options 1 and 4. Entrance to the site via Quarry Road, and exit from the site via Bridge Road.
1H	3	One-way loop access via roads in Options 1 and 4. Entrance to the site via Bridge Road, and exit from the site via Quarry Road.
1B	4	Access and exit via Quarry Road / Frederick Street / William Street / Pacific Highway.



Access Road Options

HORNSBY QUARRY LAND FILLING

Legend

- Study Area
- Option 2A and 2B
- Option 1A
- Option 1B (also part Option 1H)
- Option 1C (also part Option 1H)
- Option 1I
- Option 1J
- Option 1K
- Option 1L
- Option 1M (Road)
- Option 1M (Indicative Walking Track)
- Roads
- Cadastre



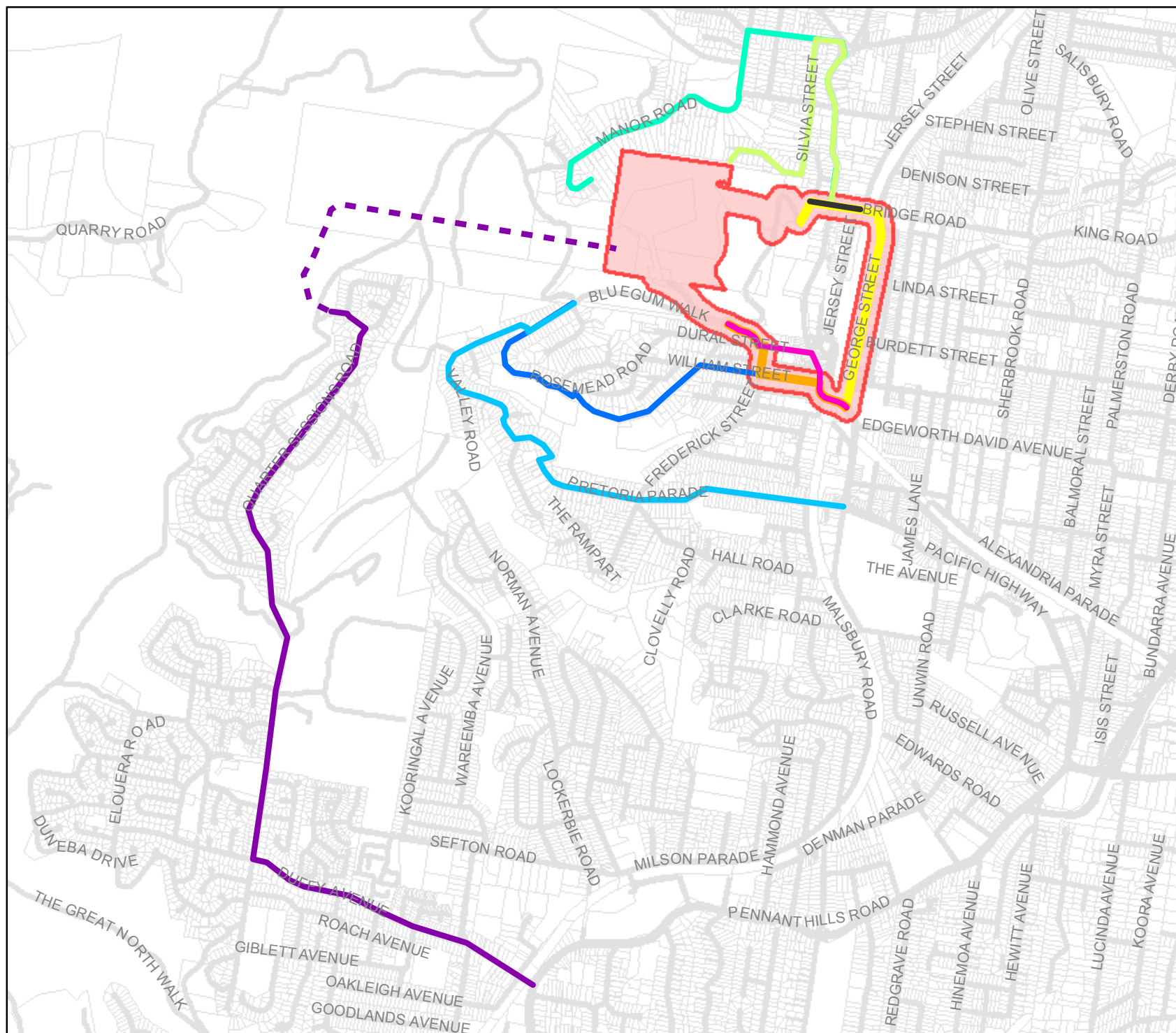
FIGURE 3-3

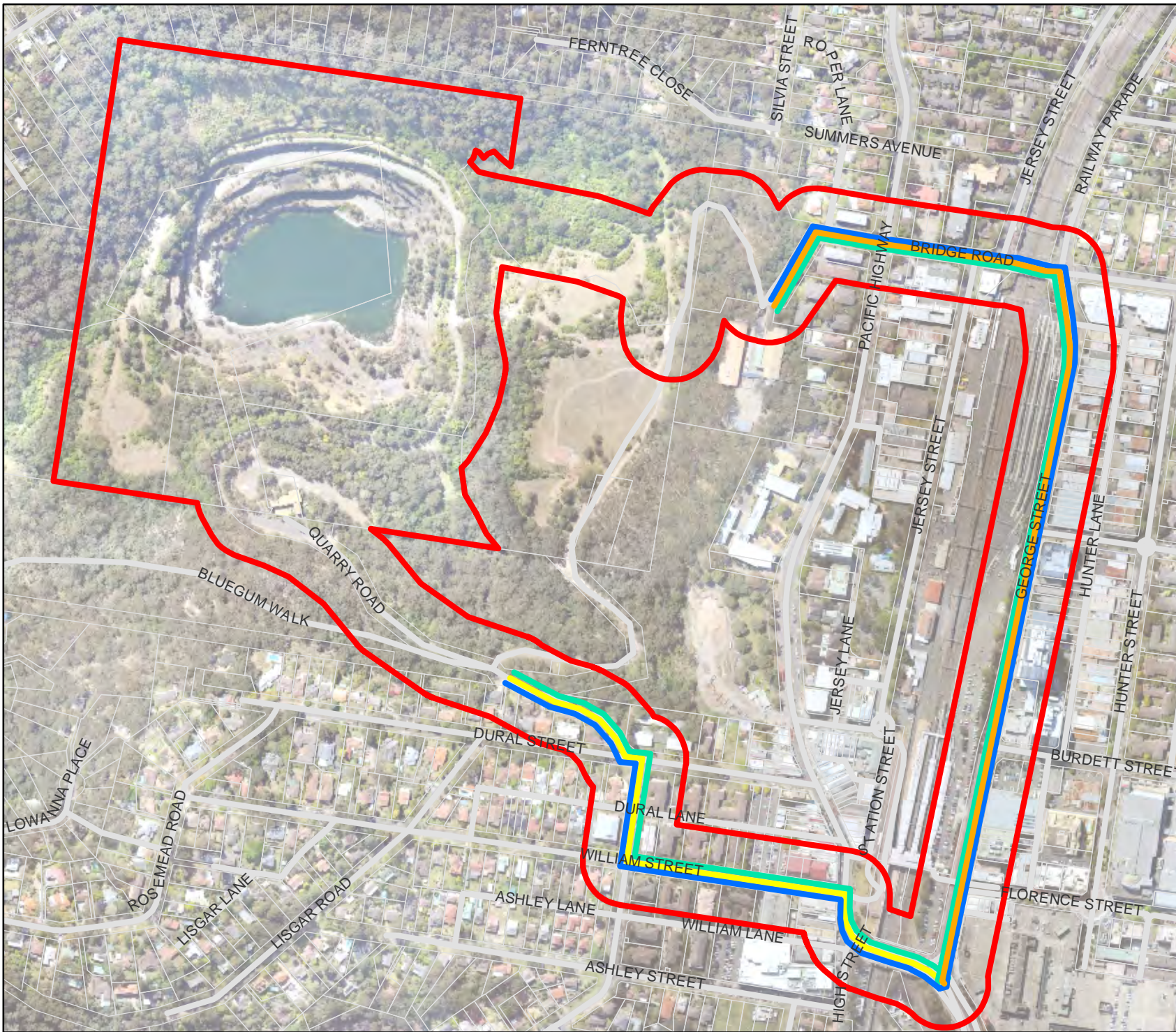
1:22,000 Scale at A4

Metres
0 50 100 200 300 400



Map Produced by Cardno NSW/ACT Pty Ltd (2812)
Date: 2013-04-08
Coordinate System: GDA 1994 MGA Zone 56
Project: LJ2888
Map: G3003_AccessOptions.mxd 01
Data Source: Land and Property Information (LPI)





Access Options for Detailed Assessment

HORNSBY QUARRY LAND FILLING

Legend

- Study Area
- Option 1 - Bridge Road Only
- Option 2 - Quarry Road Ingress, Bridge Road Egress
- Option 3 - Bridge Road Ingress, Quarry Road Egress
- Option 4 - Quarry Road Only
- Roads
- Cadastre

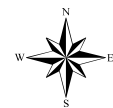
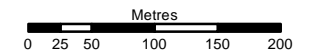


FIGURE 3-4

1:6,000 Scale at A4



Map Produced by Cardno NSW/ACT Pty Ltd (2812)
 Date: 2013-04-08
 Coordinate System: GDA 1994 MGA Zone 56
 Project: LJ2888
 Map: G3004_FurtherAssessedOptions.mxd 01
 Data Source: Land and Property Information (LPI)

4 Legislative and Planning Context

Table 4-1 provides a brief summary of key legislation and planning documents that are relevant to the project. In order to obtain approval for the filling of Hornsby Quarry, full consideration of all relevant legislation would be required as part of the relevant environmental assessment to be undertaken at a later stage. In addition, permits and approvals from various government departments are likely to be required and community consultation would form part of the process.

Table 4-1 Overview of Relevant Legislation, Policies and Plans

Name of Act, Instrument, Plan or Policy	Relevance to Project
<i>Environmental Planning & Assessment Act 1979</i>	Should Council wish to proceed with the submission of a development application for the proposal, this Act would apply. An Environmental Assessment will be required. The proposed facility would require an amendment of the LEP to change the planning controls to facilitate the reclassification of the land. A planning proposal would need to be undertaken in accordance with Section 55 of the Act.
<i>Protection of the Environment Operations Act 1997</i>	Under the Act, the list of scheduled activities provided in Schedule 1 states that a site where only VENM is received (of any amount, from off site and applied to the land) is not considered a waste disposal site that requires an Environmental Protection Licence. However, other licenses under this Act may be required, particularly if there is potential for site operations to impact on ground or surface water, or air quality.
<i>State Environmental Planning Policy (Infrastructure) 2007</i>	Clause 123 of the Policy pertains to 'waste or resource management facilities' where the consent authority has determined a development application under the EP&A Act. It is considered that the proposed facility would be acceptable under the considerations of the Policy and accordingly, where applicable, these matters would be addressed in the Environmental Assessment for the proposal. With regard to Schedule 3 of the SEPP (Traffic Generating Development) the proposal would need to be referred to RMS for comment due to the extensive number of truck movements (a minimum of approximately 367,000) that would be required to fill the quarry to RL90m AHD.
<i>State Environmental Planning Policy 19 – Bushland</i>	Schedule 1 of the SEPP identifies Hornsby as an area to which the policy applies. Accordingly, the SEPP requires that the consent authority takes into account the need to retain any bushland within the study area and the effect that rehabilitation and development of the subject site may have on adjoining bushland areas before granting any approval.
<i>State Environmental Planning Policy 32 – Urban Consolidation</i>	The SEPP aims to ensure that urban consolidation objectives are met in all urban areas of NSW. The ultimate provision of a large area of public open space in close proximity to Hornsby CBD would potentially facilitate increased housing densities within the established urban area of Hornsby by providing additional recreational facilities to address increased demand.
<i>State Environmental Planning Policy No.33 – Hazardous and Offensive Development</i>	The SEPP aims to identify proposed developments with the potential for significant off-site impacts, in terms of risk and/or offence (odour, noise etc.). A potentially offensive industry is defined as follows: <i>A development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:</i> <i>(a) to human health, life or property, or</i> <i>(b) to the biophysical environment,</i> <i>and includes a hazardous industry and a hazardous storage establishment.</i> Given the proposed facility would likely require measures to be employed to reduce or minimise its impact on the locality, it would be deemed a 'potentially offensive industry'. As such, SEPP33 is likely to apply to the proposal.
<i>State Environmental Planning Policy 55 –</i>	Previous site inspections and NSW Workcover records show numerous storage tanks and containers used to store fuel still exist on site. Additionally, there are no records to show if

Name of Act, Instrument, Plan or Policy	Relevance to Project
<i>Remediation of Land</i>	<p>an existing underground storage tank has been decommissioned. Given the past use of the site, explosives and detonators may be found even if records show all explosives and detonators have been expended (PB, 2004). Potential contamination sources include workshop buildings, fuel storage containers, electrical transformer, crushing plant facility, explosive and detonator magazines (PB, 2004).</p> <p>Given the proposal relates to a facility that would allow the quarry pit to be filled with VENM and thereafter the area be used as public open space, the issue of introducing new sources of contamination is unlikely to be a significant impediment to the development or operation of the proposed facility.</p>
<i>Sydney Regional Environmental Plan No.20 – Hawkesbury-Nepean River</i>	<p>The REP aims to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context. Where relevant, the Environmental Assessment for the proposed facility would be expected to fully address the requirements of this plan and the development would seek to comply with the associated planning strategies.</p>
<i>State Environmental Planning Policy 44 - Koala Habitat Protection</i>	<p>Hornsby Shire is included in Schedule 1 of SEPP 44 as a local government area to which the policy applies. Eucalyptus saligna and Eucalyptus pilularis are dominant species found within the vicinity of the quarry however, are not listed as Koala feed tree species on Schedule 2 of SEPP 44. Additionally, the tree species are not considered as primary, secondary or supplementary feed trees within the Region. The closest Koala sighting was 1.3 kilometres north of the quarry in 1968 while the most recent sighting was in 2000, 5 kilometres northwest of the quarry. For these reasons, the quarry is not a potential or core Koala habitat defined under SEPP44 (HSC, 2011).</p>
<i>Sydney Regional Environmental Plan No. 9 – Extractive Industry</i>	<p>This REP aims to facilitate the development of extractive industry, and to promote the carrying out of the development in an environmentally acceptable manner. An "extractive industry" is defined as follows:</p> <p>(a) the winning of extractive material, or</p> <p>(b) an undertaking, not being a mine, which depends for its operations on the winning of extractive material from the land on which it is carried on, and includes any washing, crushing, grinding, milling or separating into different sizes of that extractive material on that land.</p> <p>This project may fall into definition (a) as the nature of this project is to source VENM from other sites therefore SEPP 9 may be applicable to the proposal.</p>
<i>Hornsby Shire Local Environmental Plan 1994</i>	<p>The site and some of its environs are zoned 'Open Space A (Public Recreation – Local)' under the Hornsby Shire Local Environmental Plan 1994. The interim use as a spoil disposal facility is not permissible under the LEP. However, the end use (to create a large area of public open space and resolve environmental issues associated with the existing disused quarry pit) would be consistent with the stated aims for the zone.</p> <p>The land adjoining the eastern boundary of the site, known as Old Mans Valley, is zoned entirely 'Open Space A (Public Recreation – Local)' However, the land does not currently contain formal recreational facilities or landscaping etc. to facilitate the use of the land for recreational purposes.</p> <p>Land to the east of Old Mans Valley is predominantly zoned 'Special Uses (Community Purposes)' and contains Hornsby TAFE and Hornsby public swimming pool. To the north of the special use zonings, the land on the southern side of Bridge Road is zoned 'Residential C (Medium/High Density)' and contains a number of residential apartment buildings.</p> <p>Approximately half of the land adjoining the western boundary of the site contains bushland that is zoned 'Open Space A (Public Recreation – Local)' with the land beyond zoned 'Open Space B (Public Recreation – District)' and forms part of the Berowra Valley Regional Park. The other half of the land adjoining the western boundary is zoned '2(a) Residential A (Low Density)' and contains detached dwellings located at the southern end of Manor Road.</p> <p>Land to the immediate north of the site, together with a small area to the north-east, is also zoned 'Residential A (Low Density)' and predominantly contains detached dwellings located on Manor Road, Fern Tree Close and Roper Lane.</p> <p>Land to the south of the site is zoned 'Open Space A (Public Recreation – Local)' and contains an area of bushland known as Hornsby Park. Residential properties within the 'Residential A (Low Density)' zone are located to the south of this area and include development along Dural Street and Rosemead Road. Some apartment buildings, located within the 'Residential C (Medium/High Density)' zone are also located further east along</p>

Name of Act, Instrument, Plan or Policy	Relevance to Project
	<p>Dural Street.</p> <p>A Zoning Plan is provided as Figure 2-2. The land is classified as community land under the Local Government Act 1993.</p>
<i>Draft Hornsby Local Environmental Plan (HLEP)</i>	<p>Under State Government planning reforms, all NSW councils are required to prepare a new Local Environment Plan in accordance with the State Government's <i>Standard Instrument</i> template. Accordingly, Council has prepared a new Plan which was exhibited for community comment between 5 June and 7 August 2012. At its meeting on 19 December 2012, Council resolved to endorse the draft HLEP for forwarding to the Department of Planning and Infrastructure for its making. The draft HLEP is principally a translation of Council's existing Plan, the <i>Hornsby Shire Local Environment Plan 1994</i>, into the new Local Environment Plan format. When made, the draft HLEP will determine what can be developed and where. The draft HLEP will also determine how much development can occur.</p> <p>The quarry site is currently zoned as Open Space in the Hornsby Shire Local Environment Plan 1994. Under the draft HLEP, the quarry is zoned as Public Recreation. The land use of the site has not changed. Additionally, under Clause 6.6 of the HLEP Council is the consent authority on any local earthworks which are to be undertaken within the LGA, (clause 6.6 of the HLEP). The consent authority must consider the future use of the development. For the quarry to be adequate for Public Recreation, earthworks must be undertaken as per this proposal.</p>
<i>Hornsby Westside Revitalisation Proposed Masterplan Plan and Stage 1 – Coronation Street Upgrade</i>	<p>A proposed Hornsby Westside Revitalisation Masterplan has been developed and adopted by the Council to provide a basis for a program of street upgrades to be designed and implemented over a number of years. The main elements of the Masterplan include:</p> <ul style="list-style-type: none"> • 40 km/h High Pedestrian Activity Area along Pacific Highway from the pedestrian lights at Station Street north of William Street and Cenotaph Park to Hornsby TAFE (Western Campus). • One through lane each way for the entire length of the Pacific Highway between Dural Lane and Bridge Road. • Dedicated right turn lane into William Street from the Pacific Highway. • Dedicated right turn lane into Station Street from the Pacific Highway. • Raised platforms on existing pedestrian crossings on the Pacific Highway at Station Street and Hornsby TAFE. • Traffic signals at Pacific Highway/Coronation Street intersection (subject to 50:50 funding from RTA). • Angle parking in front of Hornsby Park. • Angle parking in front of Council Chambers and Courthouse. • Introduction of street trees (species yet to be determined). • Paving remaining footway areas in clay pavers. • New street furniture.
<i>Development Control Plans</i>	<p>There are no Development Control Plans (DCPs) that are directly applicable or relevant to the proposed spoil disposal facility or future filling operation. However, ancillary aspects of the proposal i.e. heritage conservation, would be fully considered in relation to relevant DCPs at the application stage.</p>
<i>Hornsby Leisure Strategic Plan 2003</i>	<p>With respect to sports grounds, this Plan concluded that there is no excess capacity in the existing open space system capable of absorbing the demands of new populations. The provision of a significant additional area of public open space is considered a desirable and longer term benefit of this proposal.</p>
<i>NSW State Plan</i>	<p>A key aim of this plan is to grow cities and centres as functional and attractive places to live, work and visit. The provision of a significant area of public open space close to the centre of Hornsby is compatible with achieving this aim.</p>
<i>Metropolitan Strategy</i>	<p>This Strategy identifies Hornsby as a Major Centre which currently provides much of the civic, cultural, retail and economic requirements for the subregion. The provision of a significant area of additional open space in close proximity to the Hornsby CBD would provide facilities for increasing numbers of residents and workers in the Hornsby area. The operation of the spoil facility would also provide local employment opportunities.</p>
<i>Draft North Subregional</i>	<p>A key direction of this strategy is to strengthen the major centre of Hornsby. The Strategy</p>

Name of Act, Instrument, Plan or Policy	Relevance to Project
<i>Strategy</i>	pertinently states that, due to population growth and demographic change, opportunities for new open space should be identified where possible and that State government and local councils will explore opportunities to improve the quality and accessibility of all local open space.

5 Environmental Impact Assessment

5.1 Overview

Preliminary environmental and social impact assessments have been undertaken as part of the preparation of this document to identify the impacts and benefits associated with the quarry filling and the various access routes associated with these works. This document has not been prepared as a comprehensive Environmental Impact Assessment (EIA) for development application purposes. The purpose of this document is to assist Council with decision making as to the future direction of the proposed filling of Hornsby Quarry. Accordingly, the following key environmental and social issues (as identified by Cardno and Council) have been addressed in this document:

- *Traffic and Transport:* Traffic modelling was undertaken to evaluate the impacts that increased truck movements would have on the surrounding road network (**Section 5.2**).
- *Noise:* Noise modelling was undertaken to determine whether noise emissions associated with the proposed works (including truck movements) would comply with the relevant statutory noise requirements (**Section 5.3**).
- *Air Quality:* Existing air quality data and guidelines were utilised to determine the likely impacts associated with the proposed works (**Section 5.4**).
- *Groundwater:* The work undertaken by PSM (2007) was used as the primary source of data to determine the likely impacts on groundwater associated with the proposed works (**Section 5.5**).
- *Topography and Geology:* The work undertaken by PSM (2007) and Coffey (1989 and 1990) was used as the primary source of data to determine the likely impacts on topography and geology associated with the proposed works (**Section 5.6**).
- *Flora and Fauna:* Relevant government database searches and document reviews, especially by PB (2004), were undertaken to identify the existing flora and fauna on site and to determine the likely impacts associated with the proposed works (**Section 5.7**).
- *Heritage:* A review of Aboriginal and Non-Aboriginal Heritage registers and relevant documents, especially work undertaken by PB (2004), was undertaken to identify any existing heritage items or places within or adjacent to the study area and to determine the likely impacts associated with the proposed works (**Section 5.8**).
- *Social Impacts:* The existing demographic characteristics and economic, business, recreational and community facilities of the area were identified through document reviews and site visits. The likely social impacts associated with the proposed works were generally linked to the impacts associated with the issues listed above (**Section 5.9**).
- *Visual Amenity:* A visual impact assessment was undertaken using site photos, spatial data (including topography and aerial photographs) and site inspections (**Section 5.10**).

As a result of the impact assessment, an environmental risk assessment was undertaken (**Section 5.11**), which defined each of the identified environmental risks with regards to its likelihood and consequence, combining to provide a risk rating for each impact. Following the identification of potential mitigation measures, the risk associated with each impact was reassessed assuming the application of the mitigation measures to identify an expected level of residual risk.

5.2 Traffic and Transport

A specialist traffic and transport study has been undertaken to support this report (Cardno, 2012b) which can be found in **Appendix B**. A technical addendum (Cardno, 2013a) has been produced to supplement previous work undertaken for this project, and is also included in **Appendix B**.

5.2.1 Existing Conditions

The traffic analysis for the proposed filling works, assessed the four access routes outlined in **Section 3.6** and in **Table 5-1** below.

Table 5-1 Access Options

Option Number	Access Option
1	Extension of Bridge Road to facilitate direct access and egress to the quarry.
2	One-way loop access via roads in Options 1 and 4. Entrance to the site via Quarry Road, and exit from the site via Bridge Road.
3	One-way loop access via roads in Options 1 and 4. Entrance to the site via Bridge Road, and exit from the site via Quarry Road.
4	Access and egress via Quarry Road / Frederick Street / William Street / Pacific Highway.

The existing roads included in the assessments of the access route options are:

- Bridge Road,
- Quarry Road,
- William Street,
- Frederick Street,
- George Street,
- Edgeworth David Avenue, and
- Pacific Highway.

All the streets along the access route options are local two-way roads with 50 km/h speed limits, with the exception of George Street, which is a State Road, and the Pacific Highway which has a 60 km/h speed limit in this section. The Pacific Highway is subject to high traffic volumes and has several signalised intersections along the access route options.

Traffic volumes are generally at their greatest during the AM peak period when traffic movement is predominantly associated with commuters travelling to work and school traffic.

5.2.2 Traffic and Transport Impact Assessment

Part of the overall traffic assessment objective was to evaluate the impacts that increased truck movements would have on the road network. To do this Cardno developed a micro-simulation traffic model of the Hornsby area, and used it as a tool to estimate the likely impacts that the increased truck movements associated with filling the quarry could have within the Hornsby area.

5.2.2.1 Quarry Demands

Based on relevant assumptions for the quarry operation, the estimated number of truck movements per hour in and out of the quarry site has been estimated. This is highly dependent on the number of years it would take to fill the quarry.

The key assumptions are:

- Weekday Operation Hours: 7am - 5pm Monday to Friday.
- Saturday Operation Hours: 8am - 12 midday.

- The quarry requires 4.3 million m³ to fill.
- Vehicles will carry an average load of approximately 12m³ when compacted.
- 75% efficiency factor to take the downtime at the quarry, the material supply location and trucks not delivering full loads into consideration.
- To provide for a worse case modelling scenario in the future, all trucks involved in the quarry infill in the model have been assumed to be semi-articulated.

5.2.2.2 Modelling Analyses

Visual testings for 5 – 10 years were undertaken for the AM and BP (Business Peak) models to analyse the operation of the model. The results indicate:

- 5 & 6 year filling period – significant delays within the road network.
- 7 year filling period – congested at certain road sections but has potential for road network to operate with acceptable delays.
- 8 – 10 year filling period – good operation within the road network with some operational queuing.

Once the visual analyses were carried out on the possible fill periods over the 5 to 10 year range, a preferred filling period emerged which gave a minimum timeframe for quarry fill, which was then subject to more detailed quantitative analysis. This minimum timeframe, which the analysis was undertaken for, is the 8 Year fill period. The analysis was undertaken to determine the performance of the road network with the number of trucks required for an 8 year fill period, and compared to the 2010 and 2021 future scenarios for performance.

The 2021 scenario accounts for increases in traffic which are expected due to a range of non-quarry related factors including an increase in medium density housing and overall population growth.

Modelling tests found the 8 year fill period gave 23 trucks per hour entering and leaving the quarry site, giving a total of 46 trucks per hour. Long queues are expected for future southbound vehicles on the Pacific Highway between Bridge Road and George Street in the 2021 Future Base AM Peak scenario. The overall network operation is satisfactory based on the Levels of Service for each critical intersection of the study area.

5.2.2.3 Modelling Outcomes

Comparison of the additional impacts that quarry filling activities would have on predicted 2021 traffic conditions show that:

- A fill time of 8 years would result in an additional 46 trucks per hour on the proposed access routes.
- Access Option 1 (Bridge Road only) and Access Option 4 (Quarry Road only) concentrate the increased traffic load into a single access route. Access Options 2 and 3 (loop road options) disperse the traffic volumes across both routes.
- Access Option 1 (Bridge Road only) impacts the least number of dwellings, followed by Access Option 4 (Quarry Road only) and then Access Options 2 and 3 (loop road options).
- A fill time of 8 years would not significantly alter performance of the road network for Access Options 1, 2 or 3. However, it should be noted that:
 - Trucks exiting the quarry via Quarry Road and then turning south onto Pacific Highway from William Street (Access Options 3 and 4) have the potential to increase traffic delays expected to exist in 2021 from south bound traffic along Pacific Highway (between Bridge Road and William Street).

- Trucks exiting the quarry via Quarry Road and then turning south onto Pacific Highway from William Street (Access Options 3 and 4) would queue back along William Street with insufficient green time to release the right turning vehicles onto Pacific Highway.

5.2.2.4 Other Impacts

The increased flow of heavy vehicle movements along local and main roads is likely to have an impact on the condition of the road surface.

After the quarry has been filled, there should be no residual impacts in regards to increased traffic from the truck movements. However an increase in the number of smaller (private) vehicles may access the new recreational area that would be created.

The safety and social impacts associated with the truck movements has been assessed in **Section 5.9**.

5.2.3 Proposed Mitigations Measures and Residual Impacts

Mitigation measures (for all access options)

- A Traffic Management Plan (TMP) would be required to be prepared by the Contractor prior to the commencement of works to manage potential traffic impacts and issues. The TMP would outline measures to improve general road safety and should include relevant warning and advisory signage, including speed limits and for maintenance purposes.
- All trucks should be required to access the quarry site by designated access routes only and, if possible, drivers should be familiarised with the approved access routes.
- Coordinating the traffic signals at intersections, with the concurrence of RMS, would be required in order to optimise the flow of vehicles.
- Motorists need to be made aware of any changed traffic conditions and the provision of appropriate alternative access routes if necessary. Signs would need to be erected along any roads in the immediate area, warning motorists to be cautious of the trucks entering and leaving the quarry, and alerting them to any changed traffic conditions.
- Identification of alternate parking areas for residents and businesses along affected routes.
- All equipment and machinery at the works site would need to be contained within the site.
- Ongoing communication with impacted residents.
- Maintenance of roads during and after completion of quarry filling.

Mitigation measures (for Access Options 3 and 4)

- Adjust kerb side parking on William Street to enable a left turn lane.

Residual impacts

The mitigation measures outlined above would only partially manage the impacts associated with the increased number of trucks on the local roads surrounding the site.

The most significant mitigation measure that could be adopted at the site is the selection of Access Option 1 or 2. This is discussed in more detail in **Section 5.11**.

5.2.4 Key Findings and Access Option Comparison

Overall, the quantitative and visual analyses from the modelling undertaken indicate the following:

- Access Option 1 (with quarry trucks entering and exiting the quarry from Bridge Road via George Street) does not significantly impact on the overall network operation. There is spare capacity along the proposed route on George Street and Bridge Road to accommodate additional truck movements in the peak hours.
- Access Option 2 (with quarry trucks entering via Quarry Road and exiting from Bridge Road via George Street) does not significantly impact on the overall network operation. Pacific Highway northbound, between George Street and William Street, has adequate capacity to accommodate the entering quarry traffic.
- Access Option 3 (with quarry trucks entering via Bridge Road and exiting via Quarry Road to travel southbound) has an impact on the already congested Pacific Highway (Southbound) as identified in the 2021 Future Base AM Peak scenario. The additional traffic results in queuing extending back to Bridge Road. Although these do clear, this option causes trucks to queue back along William Street with insufficient green time to release the right turning vehicles onto Pacific Highway.
- Access Option 4 (with quarry trucks entering and exiting via Quarry Road) results in queues extending back to Bridge Road for southbound Pacific Highway. Similar to Access Option 3, trucks queue back along William Street due to insufficient capacity on Pacific Highway for vehicles to turn right to exit the intersection.
- The quantitative assessment shows that the road network has sufficient capacity to cater for the 8 year quarry fill scenario in 2021 when compared with the 2021 Base scenario (i.e. no quarry infill). There are negligible impacts to the road network in terms of level of service (LoS) and there are no significant reductions in level of service across the modelled area.

Based on the findings summarised above, Access Option 1 (Bridge Road only) and Access Option 2 (entry via Quarry Road, exit via Bridge Road) result in the best outcome from a capacity and operations perspective for the 8 year quarry infill operation. The results showed that, when comparing the additional truck movements associated with an 8 year fill scenario to 2021 to the outputs from the base scenario in the same year (i.e. the same but without the truck quarry movements), the road network provides ample capacity for all road based vehicles, with negligible impacts to road and intersection operations for Access Option 1 and Access Option 2. Access Options 3 and 4 were shown to lead to additional queues along William Street for vehicles leaving the quarry.

5.3 Noise

Cardno (2013b) has prepared a Noise Impact Assessment, which can be found in **Appendix C**. The purpose of the assessment was to determine whether noise emissions associated with filling the quarry site would comply with the relevant statutory noise requirements and to identify relevant mitigation measures as appropriate.

5.3.1 Existing Conditions

To establish the existing noise conditions within the study area, unattended and attended monitoring was conducted at the quarry at the following locations (**Figure 5-1**):

- Logger 1 – 2/11 William Street;
- Logger 2 – 24 William Street;
- Logger 3 – 30 Lowanna Place;
- Logger 4 – Quarry Road;
- Logger 5 – Roper Lane;
- Logger 6 – 9 Fern Tree Close; and
- Logger 7 – 98 Manor Road.

Figure 5-1 Noise Monitoring Locations



Unattended monitoring was carried out between 8 and 19 August 2012. The monitoring results were analysed to determine the Rating Background Level (RBL) and traffic noise levels (**Table 5-2**). The RBL was determined to establish noise limits in accordance with the *Industrial Noise Policy* (NSW EPA, 2000) and was used to formulate the design benchmarks for onsite quarry activities.

The noise logger determines L_{A1} , L_{A10} , L_{A90} , L_{Aeq} levels of the ambient noise. L_{A1} , L_{A10} , L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events. The L_{A90} level is normally taken as the background (ambient) noise level during the relevant period. **Table 5-2** outlines the ambient noise levels that each location generally experiences on a daily basis, excluding traffic noise. Ambient noise levels are also described as Rating Background Levels (RBLs).

Table 5-2 Rating Background Levels

Location	Rating Background Level, dB(A) (LA90)		
	Day (7am-10pm)	Evening (6pm-10pm)	Night (10pm-7am)
1	42	40	34
2	39	37	33
3	35	34	33
4	33	31	30 (28)*
5	41	39	34
6	33	32	31
7	32	32	30 (29)*

* Industrial Noise Policy (NSW EPA, 2000): Where this level is found to be less than 30 dB(A), the rating background level is set to 30 dB(A).

The measured traffic noise levels are shown in **Table 5-3**. The 'A' frequency weighted L_{Aeq} noise level is designed to measure a level of annoyance reaction caused by road traffic noise. Surveys indicate that for existing road traffic noise, a daytime level of L_{Aeq} 55 dB(A) equates to about 10% of an exposed population being highly annoyed by the noise.

Weekends and weather affected data (due to rain or wind) were excluded from the calculation of traffic noise levels. The noise monitor at 11 William Street (location 1) was the only location proximate to a roadway with significant traffic volumes to measure traffic noise.

Table 5-3 Measured Traffic Noise Levels

Location	Traffic noise descriptor, dB(A)				
	L_{A10} (18 hour)	Day L_{Aeq} (1 hour)	Night L_{Aeq} (1 hour)	L_{Aeq} (15 hour) 7am-10pm	L_{Aeq} (9 hour) 7am-10pm
1	60	63	53	58	52

The results in **Table 5-3** show that the daytime L_{Aeq} (1 hour) traffic noise levels were recorded at 63 dB(A). These measured noise levels will help in determining the noise increases that are to be expected from the truck movements. This is above the 55 dB(A) level which is expected to lead to 10% of the exposed population being highly affected by noise.

The monitoring locations north and south of the site were characteristic of an area not significantly affected by main roads or commercial activity, with monitoring locations further to the east moderately affected by noise from the Pacific Highway.

5.3.2 Noise Impact Assessment

Noise modelling was undertaken which considered onsite activity such as plant, equipment and truck movements. The predicted noise levels from these activities were compared to the applicable noise limits, to determine the expected level of compliance.

Predicted noise impacts were based on the likely activities at the site, such as truck movements and quarry plant and equipment. The volume of vehicles accessing the site was determined from traffic generation rates (**Appendix B**). Two access arrangements were accounted for in the noise modelling. These were from Quarry Road on the southern boundary of the site, and Bridge Road on the eastern boundary of the site. The noise models also accounted for an increase in the height of noise sources within the quarry as the infill progresses from RL 10 to RL 90.

Predicted noise levels for onsite activity and site generated traffic were required to be addressed separately because there are different guidelines for both. However, the operational (on site) noise modelling includes the movement of trucks within the quarry site between the quarry gate and the pit bottom.

The noise criteria applicable to site generated vehicle noise (including trucks) are addressed in the NSW Road Noise Policy (DECCW, 2011). The applicable road traffic noise criteria at potentially affected residential receivers are shown in **Table 5-4**. These noise criteria have been adopted for this project.

Table 5-4 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/ arterial/ sub-arterial roads generated by land use developments.	60 L _{Aeq} , 15 hour (external)	55 L _{Aeq} , 15 hour (external)
Local roads	Existing residences affected by additional traffic on existing roads generated by land use developments	55 L _{Aeq} , 1 hour (external)	50 L _{Aeq} , 1 hour (external)

The noise criteria for industrial noise emission within NSW are set by the guidelines in the Industrial Noise Policy (INP) (DECC, 2000). The intrusive noise criteria that has been adopted for the receiving sites are shown in **Table 5-5** and are based upon the RBL's displayed in **Table 5-2** at the nearest sensitive receivers. The intrusive criterion used to assess the predicted noise level associated with the project is then determined by adding 5 dB(A) to the RBL level.

The noise limits for onsite quarry noise, as assessed inside the affected dwelling's property boundary, represent the more stringent of the intrusive criteria or the amenity criteria; however for all time periods the intrusive noise criteria was the determining factor.

Table 5-5 Adopted Intrusive Criteria for Industrial Noise Emissions (Based on the INP)

Receiver	Intrusive Noise Criteria, (L _{Aeq} , 15 minute) dB(A)		
	Day (7am-10pm)	Evening (6pm-10pm)	Night (10pm-7am)
2/11 William Street	47	45	39
24 William Street	44	42	38
30 Lowanna Place	40	39	38
Quarry Road	38	36	35
Roper Lane	46	44	39
9 Fern Tree Close	38	37	36
98 Manor Road	37	37	35

The applicable amenity noise criteria for residential receivers near the quarry are shown in **Table 5-6**. The amenity assessment is based upon the noise criteria specific to land use and associated activities, and is expressed in L_{Aeq} over specified time periods. Under the INP (NSW EPA, 2000) guidelines the site would be classified as "suburban", as the acoustic environment is generally dominated by local traffic with intermittent flows and some limited commerce or industry. In the evening it is generally dominated by the natural environment and infrequent human activity.

Table 5-6 INP Recommended Amenity Criteria

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Acceptable L_{Aeq} Noise Level, dB(A)	Recommended Maximum L_{Aeq} , dB(A)
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
Residence	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
Commercial	All	When in use	65	70

5.3.2.1 Road Traffic Noise

Table 5-13 shows that the noise levels from site generated traffic exceed the NSW noise criteria for traffic generated noise for all four access options. As would be expected the noise impact of the site generated traffic on arterial roads is significantly less than on the local roads. This is largely due to the high volume of traffic already present on arterial roads including Pacific Highway. Noise levels from site generated traffic are predicted to exceed the criteria on local roads in cases where dwellings are immediately adjacent to the haulage route. There is also predicted to be a significant increase in the existing traffic noise on local roads. The local roads impacted include William Street, Dural Lane, Frederick Street, and Bridge Street.

The complete road traffic noise findings of this assessment can be found in **Appendix C**. A summary of these findings are in **Table 5-7**.

Table 5-7 Road Traffic Noise Summary

	Access Option 1	Access Option 2 and 3	Access Option 4
Arterial Roads			
Number of locations where traffic noise exceeded criteria*	12	12	0
Number of locations where traffic noise already exceeded criteria prior to truck movements*	12	12	0
Additional number of locations where traffic noise exceeded criteria after implementing truck movements*	0	0	0
Maximum exceedance (dB(A) L Aeq, 1 hour (Max))	9	9	0
Average Exceedance (dB(A) L Aeq, 1 hour (Max))	5	5	0
Predicted Increase (dB(A) L Aeq, 1 hour (Max))	0-1	0-1	0-1
Local Roads			
Number of locations where traffic noise exceeded criteria*	4	17	15
Number of locations where traffic noise already exceeded criteria*	2	11	10
Additional number of locations where traffic noise exceeded criteria after implementing truck movements*	2	6	5
Maximum exceedance (dB(A) L Aeq, 1 hour (Max))	13	13	13
Average Exceedance (dB(A) L Aeq, 1 hour (Max))	7	10	10
Predicted Increase (dB(A) L Aeq, 1 hour (Max))	1-3	1-35	1-38

*Note that **Appendix C** presents data for different floors at the same location. This table only counts each location once, regardless of the number of floors impacted.

Access Option 1 (Bridge Road Access) results in the least significant impact from noise. This is due to the fact that it minimises the site generated traffic on local roads. The contribution from site generated traffic is predicted to increase traffic noise levels by 1-3 dB(A), when Access Option 1 is used. In accordance with the NSW Road Noise Policy, increases of more than 2 dB(A) would be considered discernible to the human ear (DECCW, 2011). It is predicted that Access Option 1 would still result in the noise criteria being exceeded at four locations (all locations being apartment buildings containing multiple dwellings). It should be noted, that the noise levels at two of these locations are already exceeding the criteria under existing traffic conditions.

By comparison, noise impacts from Access Option 4 (Quarry Road access) are predicted to exceed the criteria at up to 15 locations (which includes a mixture of dwellings and apartment buildings). However, noise at up to 10 of these locations is already predicted to exceed the relevant criteria. The additional heavy vehicle traffic predicted as a result of Access Option 4 would lead to exceedance of the relevant criteria at 5 additional locations.

When compared to Access Option 1 (Bridge Road access) and Access Option 4 (Quarry Road access), Access Option 2 and 3 would reduce the predicted noise impact from trucks on these roads by approximately 3 dB(A) as trucks travelling in and out of the quarry would be spread across both Quarry Road and Bridge Road. However, the noise levels are still predicted to exceed the criteria at 17 locations, which include 14 locations along Quarry Road and 3 locations along the Bridge Road access. Existing levels are predicted to exceed the criteria at 11 of these locations;

therefore site generated traffic is predicted to increase traffic noise to levels above the criteria at 6 locations.

Predicted traffic noise levels are discussed further in **Appendix C**.

5.3.2.2 Onsite Quarry Noise

Construction equipment noise sources have been sourced from Industry references and supplemented with values referenced from Australian Standard AS 2436:2010 – “Guide to noise and vibration control on construction, demolition and maintenance sites”. The noise levels that have been used as the basis for the noise assessment are summarised in **Table 5-8**.

Table 5-8 Assumed Plant and Equipment Sound Power Levels

Plant	Quantity	Sound Power Level, dB(A)	Usage	Source Height (m)
Vibratory roller	1	111	daily	1
Loader	1	113	daily	3
4x4 ute	2-3	87	daily	1
Truck	23 (per hour)	99	daily	2
Water Cart	1	110	daily	2
Fuel truck	1	110	daily	2
Reverse beacon	1 per truck	98	daily	1
Wheel wash	1	108	daily	3
Large Padfoot roller	1	111	1 day per month	1
Bulldozer	1	108	1 day per month	3
Excavator	1	113	1 day per fortnight	3
Grader	1	108	1 day per month	2

The assessment of quarry filling operations has taken into consideration the following operation configurations:

- Site access via William Street and Quarry Road;
- Site access via Bridge Road;
- Fill commencing in the quarry pit at RL10, with trucks dumping spoil from RL46; and
- Fill nearing completion at RL90 in the year 2021.

The above operational configurations are incorporated into 4 model scenarios as follows:

Scenario 1: Trucks dumping fill at RL46, with compactors operating at RL10. Acoustic shed and site entry facilities are situated at location ‘A’ as shown in **Figure 5-2**.

Scenario 2: Trucks dumping fill at RL46, with compactors operating at RL10. Acoustic shed and site entry facilities are situated at location ‘B’ as shown in **Figure 5-2**.

Scenario 3: Trucks dumping fill at RL90, with compactors operating at RL90. Acoustic shed and site entry facilities are situated at location ‘A’ as shown in **Figure 5-2**.

Scenario 4: Trucks dumping fill at RL90, with compactors operating at RL90. Acoustic shed and site entry facilities are situated at location ‘B’ as shown in **Figure 5-2**.

Scenario 1 and 3 models site entry facilities at location A, for operations at RL10 and RL 90 respectively while Scenario 2 and 4 models site entry facilities for location B.

Figure 5-2 Acoustic shed and site entry scenario locations (A and B)

Non-compliance during the day, evening and night period is predicted at a number of residential receivers. Noise modelling predicted lower noise levels with the quarry operating at RL10, when compared to results predicted at RL90. Therefore once operational, noise impact may progressively worsen until completion. This is expected because noise sources would gradually move closer to the receivers, and any natural screening afforded by the topography would reduce. A summary of the daytime noise criteria exceedances are shown in **Table 5-9**. Noise levels are expected to exceed guidelines by up to 21 dB(A) during the day and evening period (**Appendix C**) and **Table 5-9**. It should be noted that proposed operation hours are 7am to 5pm Monday to Friday and 8am to 12pm Saturday. Evening and night time noise criteria are only applicable if operations were to extend into the evening or during the night.

Table 5-9 Onsite Quarry Noise Summary

	Modelled Scenario			
	1	2	3	4
	Acoustic shed and site entry facilities are situated at location 'A'	Acoustic shed and site entry facilities are situated at location 'B'	Acoustic shed and site entry facilities are situated at location 'A'	Acoustic shed and site entry facilities are situated at location 'B'
	Trucks dumping fill at RL46, with compactors operating at RL10	Trucks dumping fill at RL46, with compactors operating at RL10	Trucks dumping fill at RL90, with compactors operating at RL90	Trucks dumping fill at RL90, with compactors operating at RL90
Number of exceedances of day time criteria	165	138	168	153
Maximum exceedance (dB(A) L Aeq, 1 hour)	21	20	20	21
Average exceedance (dB(A) L Aeq, 1 hour)	9	7	9	8

Noise impacts are predicted to be slightly higher as a result of locating the entry facility near Quarry Road (Scenario 1 and 3). Noise travels in straight lines, and therefore if you can see the noise source it is possible to hear it. Residents on Manor Road are expected to be the most affected, as they would have a direct line of sight to the quarry activities. Manor Rd has recorded the highest number of noise exceedances (**Appendix C**).

5.3.3 Proposed Mitigations Measures and Residual Impacts

Mitigation Measures

Options for acoustic treatment are limited due to the extensive area under consideration and topographical constraints. The following recommendations may be implemented in order to reduce noise:

- If possible, minimise the number of plant items in use in the quarry area and surrounds at any one time. It is noted that this option is unlikely to achieve strict compliance and may cause significant delays in operations.
- Provide partial acoustic barriers at vehicle entry points.
- Provide acoustic property treatments to affected residential receivers. It is noted that this is unlikely to achieve strict compliance, and that there are practical difficulties in determining which properties should be treated.
- Limit quarry infilling to the proposed hours of operation (7am to 5pm - Monday to Friday, 8am to 12pm - Saturday).
- Design access layout to minimise requirements for visiting trucks to reverse. Require use of 'smart' movement alarms on trucks where possible.

It should be noted that adoption of some or all of the above recommendations is likely to reduce noise emissions and improve amenity, but is not likely to result in compliance with either the quarry operations or truck noise assessment criteria.

Provision of noise barriers was reviewed as a possible mitigation measure but this was not considered to be practical given that all applicable roads contained driveway access to properties.

Other options considered for reducing noise included upgrading the road surface. However truck noise on local roads with speed limits of 50 km/h would be predominately caused by the truck engine and exhaust, rather than by the friction of the tyres on the road surface. Therefore this option was not considered reasonable and practical, and was not assessed further.

Property purchase or providing financial compensation to affected property owners is not considered to be a viable mitigation measure due to the difficulties in implementing this in a fair and cost effective manner which is likely to be acceptable to the community.

Post filling Impacts

After the quarry has been filled, no significant residual impacts in regards to noise are expected.

5.3.4 Key Findings and Access Option Comparison

Overall, the noise assessment concludes the following:

- All access options would result in noise being experienced at residential receivers from both the quarry operation on-site and the trucks travelling to and from the site at levels above acceptable criteria;
- To limit noise impacts, access from Bridge Road only (Access Option 1) is recommended over access via Quarry Road (Access Options 2, 3 and 4), given that Bridge Road has less residential dwellings to pass between the Pacific Highway and the site;

Quarry Noise

- The noise levels for onsite plant and equipment are predicted to significantly exceed the criteria at receivers located on Manor Road, Fern Tree Close, Dural Lane, Roper Lane, Bridge Road, and the Pacific Highway;
- Options for reducing onsite plant noise to within acceptable levels are limited. Acoustic barriers would not be a feasible option due to constraints from topography. An option to reduce noise may include restricting the number of onsite plant and equipment in use at any one time, although this option is unlikely to achieve strict compliance and may cause significant delays in operations;
- Noise impacts are likely to progressively worsen as the infill operation would progressively increase the relative height of the noise sources operating in the quarry;
- Implementing Access Option 1 and recommended mitigation measures would reduce noise impacts at receivers, but the relevant statutory noise criteria is not likely to be achievable for the quarry fill operations, with any available practical mitigation options outlined in **Section 5.3.3**;

Road Traffic Noise

- The noise levels associated with trucks arriving and leaving the site are predicted to significantly exceed the criteria at residences located on William Street and Frederick Street if Access Options 2, 3 or 4 are selected;
- Access Option 1 provides a better option with regards to noise impacts with increases on existing noise levels between 1 and 3 dB(A). However, noise criteria would still be exceeded at an additional two locations (multi dwelling residences) when compared with the existing case;
- Furthermore, dwellings proximate to Bridge Road are already exposed to higher traffic noise levels from the Pacific Highway;
- Access Option 1 is predicted to exceed traffic noise criteria at an additional 2 locations with truck movements;
- Access Options 2 and 3 are predicted to exceed traffic noise criteria at an additional 6 locations with truck movements; and
- Access Option 4 is predicted to exceed traffic noise criteria at an additional 5 locations with truck movements.

5.4 Air Quality

5.4.2 Existing Conditions

The Hornsby Shire is comprised of mixed land uses including residential land and large areas of reserves and open space (including Ku-ring-gai National Park and Berowra Valley Regional Park). Based on a search of the National Pollutant Inventory for the LGA, existing potential sources of air pollutants include some manufacturing and processing industries, including malting and meat processing facilities within the LGA.

Consideration of air quality data from the closest monitoring station for which records are available, (located at Vineyard north east of the Hornsby Shire), shows that the area has been generally compliant with recommended National Environment Protection Measure (NEPM) Ambient Air Quality standards, set out by the National Environment Protection Council (NEPC). In the past ten years, exceedances of PM₁₀ levels compared to NEPM standard levels have occurred on 33 days. The vast majority of these days occurred in the years of 2002 and 2003. Sulfur dioxide or nitrogen dioxide never exceeded standard levels. Ozone levels have exceeded standard levels 20 times in the last 10 years, however, not in the latter 4 years. No data was available for carbon monoxide, lead and PM_{2.5} levels.

The closest Bureau of Meteorology automatic weather station to the site that collects wind data is located at Macquarie Park (Willandra Village). Data has been recorded at 9am and 3pm for twenty-four years (until 1995). The mornings are dominated by winds from the west at speeds generally below 10km/hr. On average, afternoon winds are from the east south-east, with wind speeds of 20 to 30km/hr.

5.4.3 Air Quality Assessment

5.4.3.1 *Particulate Matter (Dust)*

Due to the nature of the proposed activities, the key air quality impact is likely to be the emission of particulate matter from several potential sources. This may include dust emissions from:

- Truck movements along quarry access roads (wheel-generated dust);
- Construction associated with stabilisation, establishment and maintenance of access roads;
- Illegally uncovered loads of fill during transportation;
- Unloading fill materials from trucks and placement into the quarry void;
- Spreading and compacting works at the site; and
- Stockpiles (if any) during dry and windy conditions.

Dust deposition may cause risks to human health, damage to property, localised air pollution, water pollution and impacts on flora and fauna.

When assessing the likely impacts associated with dust deposition, an investigation undertaken by Amato *et al* (2009) was considered. The investigation indicated that PM₁₀ (particles less than 10 micrometers) generated from the handling, loading and unloading of dusty materials at demolition/construction sites progressively decreases with distance from the source, and at 400m from the source, the impact on PM₁₀ was negligible. This suggests that dust impacts from the site may be confined to within 400m from the site and the proposed access roads.

Given the recorded wind conditions near to the site, afternoon winds are more likely to facilitate dust generation due to higher wind speeds (on average). Generally, afternoon winds are from the east or south-east, meaning that receivers to the west of the quarry site may be more likely to be impacted by dust from the site. This includes Manor Road (north-west of the quarry site) and Fern

Tree Close (north-west of Bridge Road). The receivers are approximately 100m from the site and are therefore within the likely zone of impact. However, this impact may be reduced as a result of screening provided by significant vegetation that exists between the receivers and the site.

There are residential receivers located along and close to the proposed access roads. Residential properties in these areas would be within close proximity of potential sources of particulate matter from trucks carrying dust and materials. There are approximately 99 residential dwellings directly adjacent to the Access Option 1 (Bridge Road) route compared to approximately 149 residential dwellings directly adjacent to Access Option 4 (Quarry Road) route. Therefore, dust impacts are more likely to be experienced by more residents if Option 4 (Quarry Road) was selected compared to Access Option 1. Access Options 2 and 3 would be likely to affect the most residential properties since both roads would be utilised.

In addition to the potential impacts of dust emissions on human health, the deposition of dust onto vegetation may have negative impacts on the biotic environment. Berowra Valley Regional Park lies directly west of the study area. When deposited in relatively large quantities and over periods of time, dust may modify the photosynthetic capacity of leaves within a canopy, and may lead to leaf yellowing and eventual leaf death, resulting in the decreased health of the vegetation community as a whole (Farmer, 1993). The activities proposed as part of the filling of Hornsby Quarry may have some impacts on local vegetation. The afternoon winds from the east or south-east may result in dust deposition on bushland contained within Berowra Valley Regional Park (this area is protected under the National Parks and Wildlife Act). Dust deposition within this area may impact on both the vegetation and the waterways. Land within the vicinity of the quarry drains into the quarry, therefore, deposited dust will most likely drain into the quarry and not into other receiving waters, avoiding increased turbidity and increased nutrient loads into waterways.

5.4.3.2 Vehicle Emissions

Regular truck movements to and from the quarry site during the site establishment and particularly the operational phase would also generate particulate matter from combustion (exhaust) emissions.

5.4.4 Proposed Mitigation Measures and Residual Impacts

The following measures should be considered and implemented during site establishment and operational phases to reduce potential air quality and dust impacts:

- All loads arriving and departing the site should be covered. A policy of no acceptance should be applied to uncovered loads. It should be noted that covering a load is a legal requirement;
- All vehicles leaving the site or moving from unsealed to sealed roads should use a rumble grid and pit prior to exiting, and a suitable wheel wash facility should be implemented to remove excess mud or dirt as required;
- Any stockpiles should be in an appropriate location with respect to likely wind conditions, and should be maintained at a reasonable size so that covering and / or wetting down may be more easily undertaken, as required;
- Where feasible, the area of exposed unconsolidated materials on site should be limited;
- Weather conditions and forecasts should be checked regularly and work practices should be adjusted accordingly, particularly if high wind speeds are predicted or experienced;
- Water sprays should be used to reduce dust emissions during unloading or earth moving activities;
- Stockpiled materials should be covered during times of rain or high winds; and

- Vegetation removal should be minimised around the site. Screening vegetation is likely to reduce the impacts of dust in some locations, especially with increasing distance from potential dust sources.

In order to reduce the impacts of combustion emissions, the following should be undertaken:

- On-site plant and machinery should not be left in idle. Engines should be turned off when parked;
- Vehicle access routes to the site must be clearly defined and enforced to minimise truck distances and confine vehicles to appropriate routes; and
- Equipment, machinery and trucks should be adequately maintained.

Following the implementation of the proposed mitigation measures, the impacts associated with dust emissions are expected to be reduced to an acceptable level, in line with WHO guidelines. WHO guidelines stipulate a $20 \mu\text{g}/\text{m}^3$ annual mean and $50 \mu\text{g}/\text{m}^3$ 24 hour mean for PM_{10} particles, generally associated with construction dust emissions (WHO 2006).

Even with rigorous maintenance of trucks to minimise emissions, the number of trucks entering and exiting the quarry cannot be mitigated. WHO guidelines stipulate a $10 \mu\text{g}/\text{m}^3$ annual mean and $25 \mu\text{g}/\text{m}^3$ 24 hour mean for $\text{PM}_{2.5}$, and $20 \mu\text{g}/\text{m}^3$ annual mean and $50 \mu\text{g}/\text{m}^3$ 24 hour mean for PM_{10} . WHO guidelines suggest that this is achievable in a highly developed and large urban areas (WHO 2006). Given the nature of the residential setting of the study area, the impacts associated with vehicles emissions should be minimal, however, should still be noted.

5.4.5 Key Findings and Access Option Comparison

This air quality assessment finds the following:

- Given the nature and scale of the proposed works, it is anticipated that the construction of the access road (during the construction phase) and the frequent movement of heavy vehicles (during the site establishment phase) are likely to be the key sources of particulates associated with the proposal.
- Implementation of access Option 1 or 4 would restrict dust and exhaust impacts to a more localised area (either Quarry Road or Bridge Road).
- Implementing one of the loop options (Access Options 2 and 3) would generate dust and exhaust impacts on both roads, and therefore more receivers would be potentially impacted, however heavy vehicle movements would be spread across the two routes (entry and exit).
- Implementation of Access Option 1 would result in the least number of affected residential receivers in relation to dust and exhaust emissions from truck movements.
- The concentration of dust impacts would generally be on the entry road, since full trucks entering the site are more likely to generate dust than empty trucks leaving the site.
- Unless properly managed, there are potential impacts associated with dust deposition from the site on Berowra Valley Regional Park

5.5 Groundwater

5.5.2 Existing Conditions

According to PSM (2007) two systems of groundwater occur at the site:

- A shallow perched water system located within the fills and underlying weathered breccia rock; and
- A deeper system located within the fresh breccia and surrounding Hawkesbury Sandstone.

Water levels in the deep aquifer have been drawn down by drainage of groundwater into and out of the quarry pit. The shallow aquifer is disjointed but perennial saturation is evident in portions of the base of the south-western fill area. Recharge to the shallow aquifer occurs by rainfall recharge, and most of the recharge eventually discharges into Old Mans Creek on the western perimeter of the south-western fill area, although seepage into underlying bedrock from this source also occurs (Parsons Brinckerhoff, 2004).

Recharge to the deep aquifer occurs through rainfall recharge, with discharge occurring mainly at the pit through the processes of water extraction, and evaporative losses. The main regional groundwater discharge features prior to quarrying activities were Old Mans and Waitara Creeks (Parsons Brinckerhoff, 2004).

PSM (2007) estimates groundwater inflow to the quarry void to be approximately 0.3 litres per second at a water level of 28.5m AHD. PSM (2007) note that the groundwater inflow is dependent upon the water level in the quarry and the weather conditions.

PSM (2007) reported that overall the groundwater collecting at the quarry lake is approaching potable water standard. Without any further treatment, the water in the quarry lake is likely to be readily usable for use on gardens, parks and playing fields. Further, with some treatment it may be possible to use this water for potable water or industrial use.

There are three existing groundwater bores located within a 3km radius of the site. The details of these sites were obtained from the NSW Natural Resource Atlas (NSW Government, 2012) and are summarised in **Table 5-10**.

Table 5-10 Groundwater Bores (NSW Government, 2012)

Ground Water Number	Purpose	Northing	Easting	Distance from Quarry	Direction from Quarry
GW111576	MONITORING BORE	6270618	324440	1.54 km	North-east
GW108651	DOMESTIC	6271132	323934	1.61 km	North
GW107088	RECREATION (GROUNDWATER)	6267703	325163	2.88 km	South

5.5.3 Groundwater Impact Assessment

Minor excavation (if required) from site establishment activities on the rim of the quarry is unlikely to intersect groundwater from the deeper aquifer above a depth of three metres below ground level. However, excavations may intersect water stored in surface unconsolidated sediments (Parsons Brinckerhoff, 2004). This is unlikely to significantly impact the groundwater flow or existing groundwater extraction bores.

Filling the void with consolidated materials (VENM) is likely to have an impact on the groundwater flow rate through the site once filled. Groundwater currently flows through the surrounding subsurface materials into the void. Filling the void with consolidated VENM is likely to reduce the groundwater flow rate into this location. However, the flow rate is likely to become closer to the groundwater flow rate before quarry activities were undertaken.

The quarry is proposed to be filled using VENM. By definition, this material will be natural material (such as clay, gravel, sand, soil or rock fines) and would not be contaminated or contain sulphuric ores, soils or any other waste (PoEO Act, 1997). As such, it is unlikely that any leachates from the filled quarry site would cause contamination of the groundwater.

Stormwater and sewerage facilities associated with the filling activities have the potential to impact the water quality of the groundwater if not managed appropriately. In addition any oil or petrol spills associated with machinery and fuel storage on site have the potential to contaminate groundwater.

5.5.4 Proposed Mitigations Measures and Residual Impacts

Dewatering of the quarry void prior to filling would be required. This would be a significant activity involving pumping approximately 450 ML of water from the void. Ongoing management would be required for the ongoing inflow of groundwater. It should be noted that Council is currently already managing the water level of the quarry, keeping the water level below RL40 (currently approx. RL30). It may be possible to collect any groundwater inflow to the site for use in wheel wash and dust suppression.

Material used to fill the quarry should be subject to rigorous quality control. Only VENM should be used in order to prevent the introduction of potential contaminant sources.

Should any development that substantially penetrates into the subsurface be envisaged, piezometers should be installed around the quarry to monitor groundwater levels in the deep and shallow aquifers. However, it is unlikely that works of this nature would be required.

Installation of septic, sewerage and stormwater facilities should be undertaken in a manner to avoid contact with the groundwater.

Appropriate spill kits and response procedures should be in place during filling to respond to petrol, oil and other chemical spills.

5.5.5 Key Findings and Access Option Comparison

- There would be no significant difference between the four access options with regards to groundwater impacts.
- Significant groundwater impacts are not expected as a result of this proposal.

5.6 Topography and Geology

5.6.2 Existing Conditions

5.6.2.1 *Topography*

The elevation of the study area surrounding the quarry pit drops dramatically from the east to the west from a high point of 180 mAHD to a low point of 60 mAHD. The rim of the quarry pit is at approximately 90 mAHD and the base of the pit is approximately 8 mAHD. The steep to very steep topography includes many slopes (surrounding the quarry pit) exceeding a gradient of 25 per cent (PB, 2004). PSM (2007) generated contours of the site using 2006 aerial imagery. The contours are shown in **Figure 5-3**. The contours show the site topography after the quarry activities had completed. The site comprises moderately sloping ground to the rim of the pit, at which point the topography becomes very steep, with occasional “steps” relating to the access road within the quarry. The base of the quarry, not currently visible due to water, is relatively flat.

The site is centred around Old Mans Valley, which is the main source of drainage through the site. The natural valley walls slope up to about 35 degrees. Quarry development over time has resulted in Old Mans Creek being diverted through a drainage channel midway along the north wall (PSM, 2007). The current drainage pattern is also shown on **Figure 5-3**.

Hornsby Quarry includes a geological feature known as the Hornsby Diatreme. Surrounding the diatreme is Hawkesbury Sandstone. Ashfield Shale outcrops are located to the east and northeast of the quarry. The diatreme is principally composed of volcanic breccia, which is of high to very high strength. The surrounding Hawkesbury Sandstone is more resistant than volcanic breccia and therefore tends to form escarpments to the north, east and south. Sandstone is generally of high strength. The basic geology of the site is shown on **Figure 5-3**.

5.6.2.2 Diatreme

Diatremes are formed by gaseous explosions forcefully intruding through the surrounding country rock mass and depositing a pipe of tunnel shaped mass of volcanic breccia. The eastern wall of the quarry shows a classic example of basinal layering within a diatreme and for this geological reason; the quarry is on the Register of National Estate as being “worthy of preservation”. Further details of the significance of this formation is provided in **Section 5.8**.

5.6.2.3 Existing Fill

Existing fill material is found in four zones within the study area:

- Eastern fill area;
- Crusher plant areas;
- South western fill area; and
- Upper north slope.

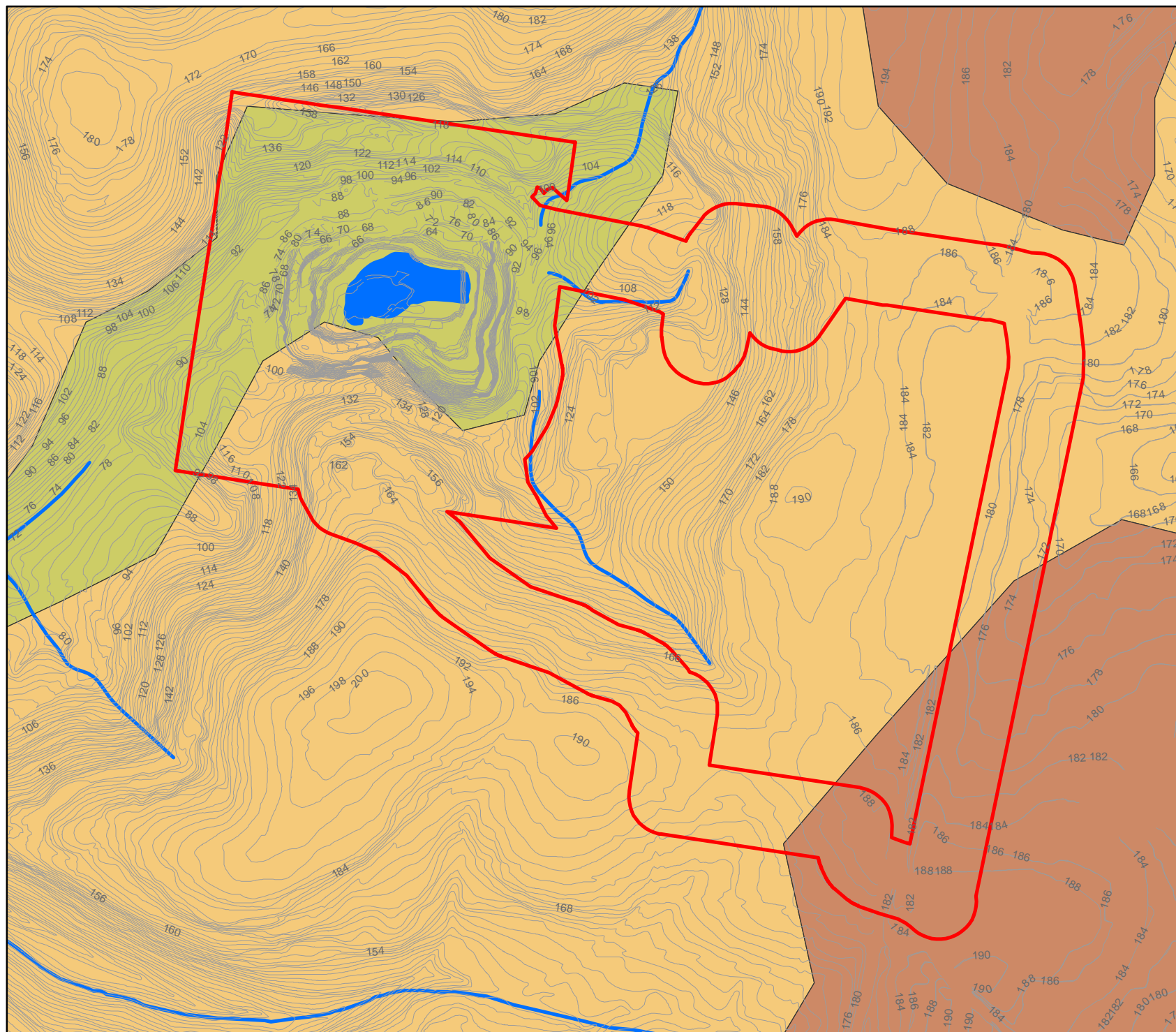
5.6.2.4 Geology and Geotechnical Conditions

The Geotechnical and Hydrological Report (PSM, 2007) notes that there is a moderate to high risk of moderately deep seated sliding of the south-western faces of the quarry. Other faces of the quarry were calculated to have a low or moderate risk of deep seated sliding. The risk of instability associated with the quarry slopes is shown in **Figure 5-4** (from PSM, 2007). Whilst the report concludes that there is no risk to neighbouring residential properties, the risk of slippage is high and represents a significant risk to any persons within the site (including those who access the quarry without authorisation). Hornsby Council has engaged security services to stop illegal entry to the quarry area and in particular to deter illegal swimming in the quarry void. Council is concerned that the ongoing risk of rock falls in the quarry void could eventually lead to serious injury or death to those who enter the quarry void for illegal swimming. The easiest access to the water body is by walking down the old haul road that is directly under the southern quarry wall that regularly has rock falls. Council has declared this area as high risk and no access is allowed.

In 1989 and 1990 Coffey and Partners Pty Ltd (Coffey) undertook detailed geotechnical investigations of the area to the east of the eastern quarry face (largely comprised of Old Mans Valley). Since the time of the Coffey investigation there has been little change to the eastern area. Additional fill was being placed at the south of the existing playing fields while Coffey were undertaking their field work. Since 1990 additional fill has also been placed in the gully area north of the playing fields.

Analysis of the playing fields and other level areas in the eastern area identified a maximum safety factor of 1.2 (PSM, 2007). The normal requirement is for a safety factor of 1.5. The natural hillside area to the north of the playing fields was calculated as having a safety factor greater than 2.0 so therefore there is no overall stability constraints on the development of this area.

The major issue with the eastern area is that control of surface runoff is very poor. The original west east drainage tributary was in-filled with waste material from the quarry. It is known that significant groundwater flow occurs through this in-filled creek following periods of heavy rain (PSM, 2007).



Geology, Topography and Drainage

HORNSBY QUARRY LAND FILLING

Legend

- Study Area
- 2m Topographic Contours
- Watercourses and Waterbodies

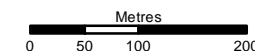
Geology

- Black to dark-grey shale and laminate
- Medium to coarse grained quartz sandstone, very minor shale and laminate lenses
- Volcanic breccia, varying amounts of sedimentary breccia and basalt



FIGURE 5-3

1:7,000 Scale at A4



Map Produced by Cardno NSW/ACT Pty Ltd (2812)
 Date: 2013-04-08
 Coordinate System: GDA 1994 MGA Zone 56
 Project: LJ2888
 Map: G5003_GeoTopoDrainage.mxd 01
 Imagery Source: Nearmap and associated third party suppliers



Instability Risk

HORNSBY QUARRY LAND FILLING

Legend

- Site Location
- 2m Topographic Contours
- Survey Contours
- Watercourses and Waterbodies
- Cadastre
- Instability Risk (PSM, 2007):**
 - Low
 - Low to Moderate
 - Moderate
 - Moderate (Fill)
 - Moderate to High
 - High (Fill)

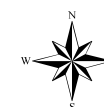
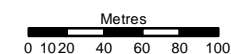


FIGURE 5-4

1:4,000 Scale at A4



Map Produced by Cardno NSW/ACT Pty Ltd (2812)

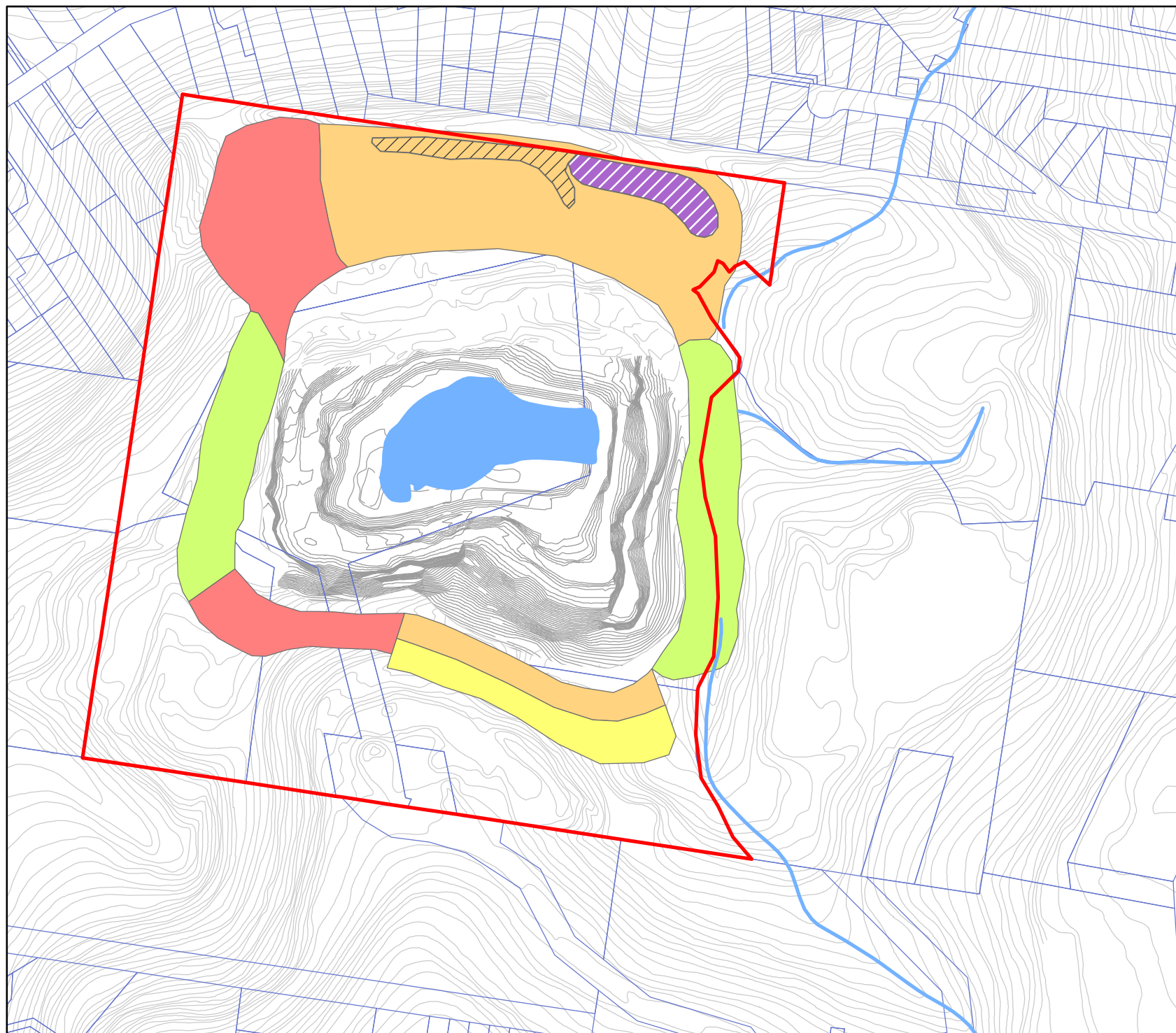
Date: 2013-04-08

Coordinate System: GDA 1994 MGA Zone 56

Project: LJ2888

Map: G5004_InstabilityRisk.mxd 01

Imagery Source: Nearmap and associated third party suppliers



5.6.3 Geological and Topographic Impact Assessment

Filling the quarry has the express purpose of filling the void, and creating a new, flatter and more uniform surface topography, making beneficial use of the land possible. Filling the void in this manner with VENM is also expected to alter groundwater flows, returning them closer to a pre-quarrying groundwater flow regime.

Quarrying operations are based on design criteria for slope stability and filling operations that are quite different from equivalent civil engineering works. Slopes are designed with much lower factors of safety than civil works and filling operations are often not placed in a controlled manner or compacted to the same density targets. The surface drainage system at the quarry was implemented to allow quarry operations to be undertaken, and not designed for typical urban stormwater management criteria (PSM, 2007). These factors all combine to impose geotechnical constraints on potential development of the quarry site.

PSM (2007) identified that there is a moderate to high risk of instability in the immediate surrounds of the quarry and around all of the quarry faces. This poses a risk to site facilities and access associated with any filling works. The installation of site facilities in some locations may increase the risk of instability and use of the area could pose a significant risk to life and property if failure occurs.

Ground levels over filled areas, regardless of compaction methods employed, will generally be subject to some degree of settlement. Settlement is likely to be most significant at the centre of the filling area but other factors may contribute to future settlement such as groundwater intrusion. If no compaction is undertaken, settlements would be in the order of up to 1m in the first 10 years after filling is completed and a further metre during the following 90 years.

It is understood that Council proposes to use the filled site for open space and recreational pursuits. This proposed end use for the site could withstand a higher degree of settlement than other land uses (such as residential). However, significant differential settlement of the grounds can result in loss of playing surface quality for sports fields, safety and risk concerns, ongoing management requirements and costs.

Filling of the quarry will at least partially, if not fully, cover the currently exposed diatreme from view. The impacts and mitigation measures associated with these activities have been discussed in more detail in **Section 5.8**.

5.6.4 Proposed Mitigation Measures and Residual Impacts

The proposed filling of the quarry, in itself, provides the primary mitigation measure to mitigate the impacts associated with the instabilities at the quarry site. The PSM (2007) report identified this option as a suitable method of remediating the site.

In order to be able to access the base of the quarry for filling PSM (2007) identified work methods to be taken into consideration to account for the instability risks associated with the quarry. These work methods included:

- No access to the quarry directly after heavy rainfall;
- Establishment of defined access paths;
- Limited time in the quarry and limited number of visits;
- Only allow workers access to the quarry within the cabs of trucks;
- No walking around site;
- Added protection provided to vehicles working on the quarry floor; and
- Ongoing monitoring of stability.

However, to ensure filling operations do not experience major delays due to instability risks posed by the site, it is likely that additional stabilising works of the quarry faces would be required. These works are likely to involve:

- Rock bolts to support key blocks and defects;
- Shotcrete to support zones of weakness or loose blocks of rocks;
- Mesh to support zones of weakness or loose blocks of rock; and
- Scaling of the rock faces to remove detached blocks and areas of significant blast damage.

If buildings or other structures were proposed for the area to the east of the quarry site (Old Mans Valley), an economical solution to instability posed by this area would be to remove the existing unconsolidated fill and place it in the quarry void. However, if the site is used only for passive recreational pursuits, the site may only require re-contouring of the fill to improve the discharge of surface runoff.

Coffey (1989) identified that stabilisation works are necessary in the eastern area¹ of the quarry and Old Mans Valley either in the form of a toe buttress to the existing fill areas, or improved and maintained drainage measures. PSM (2007) recommended the toe buttress option because it is difficult to retrofit reliable subsurface drainage measures.

As part of any redevelopment of the eastern area, a complete surface drainage plan will need to be formulated. In 1990 Coffey recommended that a large rock drain be constructed within the now filled gully through Old Mans Valley. The suitability of these works or other drainage works should be considered in a surface drainage plan. The plan should consider if and how the surface water would drain into and through the quarry well in advance of the completion of filling.

In order to limit settlements to values less than the settlements outlined above (up to 2m over 100 years), filling would need to involve spreading and compacting. This means access to the bottom of the quarry during filling operations by trucks, dozers and/or compactors to allow materials to be placed and spread with layers of 1 to 2m thickness across the fill area. There are no specific guidelines for compaction rates, except for end uses for residential or commercial structures. However, this style of work is likely to limit settlements to at least half, if not one third, of the settlements given above (PSM, 2007).

¹ "Eastern area" encompasses boundary of the quarry itself extending to the proposed playing fields area. Please refer to Figure PSM1059-3 of the PSM (2007) report.

5.6.5 Key Findings and Access Option Comparison

The findings of the topography and geological assessment are:

- The most significant issue currently facing the quarry is the risk associated with instability of the quarry area. Once completed, the filling of the quarry would stabilise the area and allow for expanded use of the site. To allow filling to occur, the instability of access roads and the quarry walls would need to be stabilised to reduce instability and allow uninterrupted movement of trucks and safe access for staff.
- All access options require the stabilisation of quarry faces and would all result in the covering of the diatrema from view. Therefore no one option has a benefit or impact significantly greater than the others.
- Access Options 1, 2 and 3 would require additional fill and stabilisation (when compared with Access Option 4) associated with the extension of Bridge Road. This is not considered to pose any significant technical constraints although there are additional economic considerations which have been included into the cost benefit analysis in **Section 6**.

5.7 **Flora and Fauna**

5.7.2 Existing Conditions

The proposed works are located at the interface between primarily residential land uses in the suburb of Hornsby (to the east) and a large area of bushland (Berowra Valley Regional Park) to the west. A desktop study was undertaken to collate available information on the existing environment and identify any issues in relation to the proposed activity. The study included a review of available literature and searches of relevant databases. Literature included:

- Hornsby Quarry and Environs Land Capability Study and Master Plan - Land Capability Study (PB, 2004);
- Vegetation Assessment for Proposed Hornsby Mountain Bike Track (Smith and Smith, 2012);
- Targeted Varied Sittella Surveys at Old Mans Valley (Aquila, 2013); and
- Review of Environmental Factors (REF) Old Mans Valley and Hornsby Park Proposed Mountain Bike Trail (Dragonfly Environmental, 2011).

The following databases were searched:

- EPBC Act Database;
- OEHS (NPWS) Bionet (Wildlife Atlas Search);
- OEHS (NPWS) Critical Habitat Register; and
- DPI (Fisheries) Record Viewer for aquatic species.

It is important to note that these databases only provide indicative and incomplete records of flora and fauna species. A number of site visits have been undertaken by the study team to provide a general visual assessment of flora and fauna in the area. However, detailed flora and fauna surveys were not undertaken.

The OEH Critical Habitat register and the DPI Fisheries Record Viewer were accessed on 26 October 2012. There were no listed habitats or threatened aquatic species within the study area.

A search of the EPBC database on 16 October 2012 incorporated an area of 10km² centred near the proposed site. Two matters of national significance were identified within the area, namely:

- 34 listed threatened species; and
- 14 listed migratory species.

A full listing of the results of this database search is provided in **Appendix D**.

A search of the NSW Governments Bionet Database (NPWS Wildlife Atlas) was carried out on 16 October 2012 for a 10km² area around the site of the proposed works. The database search returned 24 threatened flora species and 39 threatened fauna species recorded in the area (**Appendix D**). No threatened flora or fauna species were identified within the quarry itself or in the location of the proposed route access options. However, several threatened fauna species may traverse the area given the resulting records. Many of the records were found in nearby areas including Berowra Regional Park which lies beyond the study area.

A map of vegetation communities and threatened flora and fauna species is provided as **Figure 5-5**. Note that the accuracy of the Wildlife Atlas data provided by OEH is limited and data is likely to be incomplete. In addition, several species are often recorded at the same geographical location. This means that some records (especially flora) are not visible on the map, since there are several recorded in exactly the same location. All species record locations are *indicative only*.

Council vegetation mapping (HSC, 2012) shows that the vegetation surrounding the quarry is comprised primarily of Blackbutt Gully Forest which is a tall open forest that comprises key species *Eucalyptus pilularis*, *Angophora costata* and *Syncarpia glomulifera*. This vegetation community does not represent an Endangered Ecological Community (EEC) under the NSW Threatened Species Conservation Act 1995 (TSC Act), however, it is recognised as a locally significant community in the Biodiversity Conservation Strategy (Hornsby Shire Council 2006 cited by Dragonfly Environment 2011). The community is common within the LGA but it is uncommon and is poorly conserved outside the LGA (Thomas and Benson 1985 cited by Dragonfly Environment).

Some significant stands of Blue Gum Diatreme Forest are located at the south-western corner of the quarry site and within the eastern portion of the quarry, west of Old Mans Valley (Smith and Smith 2012).

PB (2004) identified Glen Forest to the east of the quarry. However, Council has adopted the most recent study of Smith and Smith (2012) and has classified these stands as Blue Gum Diatreme Forest. The profile of this community is consistent with Blue Gum High Forest, the only difference is instead of occurring on Wianamatta Shale, it occurs on volcanic breccia, restricted to gullies on Jurassic diatremes (Smith and Smith 2008 cited by Dragonfly Environment 2011). Blue Gum Diatreme Forest forms part of Blue Gum High Forest listed under NSW Legislation and therefore is listed under the TSC Act in NSW Legislation as a Critically Endangered Ecological Community (CEEC). However, the Commonwealth EPBC Act does not include this community consistent with Blue Gum High Forest which lies on volcanic soils (Threatened Species Scientific Committee 2005). It should be noted that the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) now recognises that Blue Gum Forest also occurs on diatremes but the legal definition of Blue Gum High Forest has not yet changed (Smith and Smith 2012).

Some stands of Glen Forest occur south-west of the quarry. The composition of this community is similar to Blue Gum Diatreme Forest (Hornsby Shire Council 2006), therefore is also much like Blue Gum High Forest occurring on volcanic breccia. Glen Forest is currently under Preliminary Determination as a CEEC under the TSC Act (Hornsby Shire Council 2006) and is nominated for listing under the EPBC Act (PB, 2004). The condition of this community varies within the quarry.

The communities within the west are low in weed invasion and are generally in good condition. However, weed invasion is occurring in the east (PB, 2004).

The quarry itself is devoid of large trees, however, some smaller shrubs and ground cover are present in some locations along the quarry faces.

Within the southern portion of the quarry, north of Quarry Road is open-forest dominated by Sydney Blue Gum (*Eucalyptus saligna*), depauperate in native species and heavily weed-infested. West of this area, at the end of Rosemead Road is richer in native plant species. These Blue Gum stands are consistent with Blue Gum Diatreme Forest (Smith and Smith 2012). It should be noted that there has been severe disturbance from construction of Quarry Road and two sewers located in the vicinity (Smith and Smith 2012).

Forty one species of listed noxious weed have been recorded within Old Mans Valley (Dragonfly International 2011).

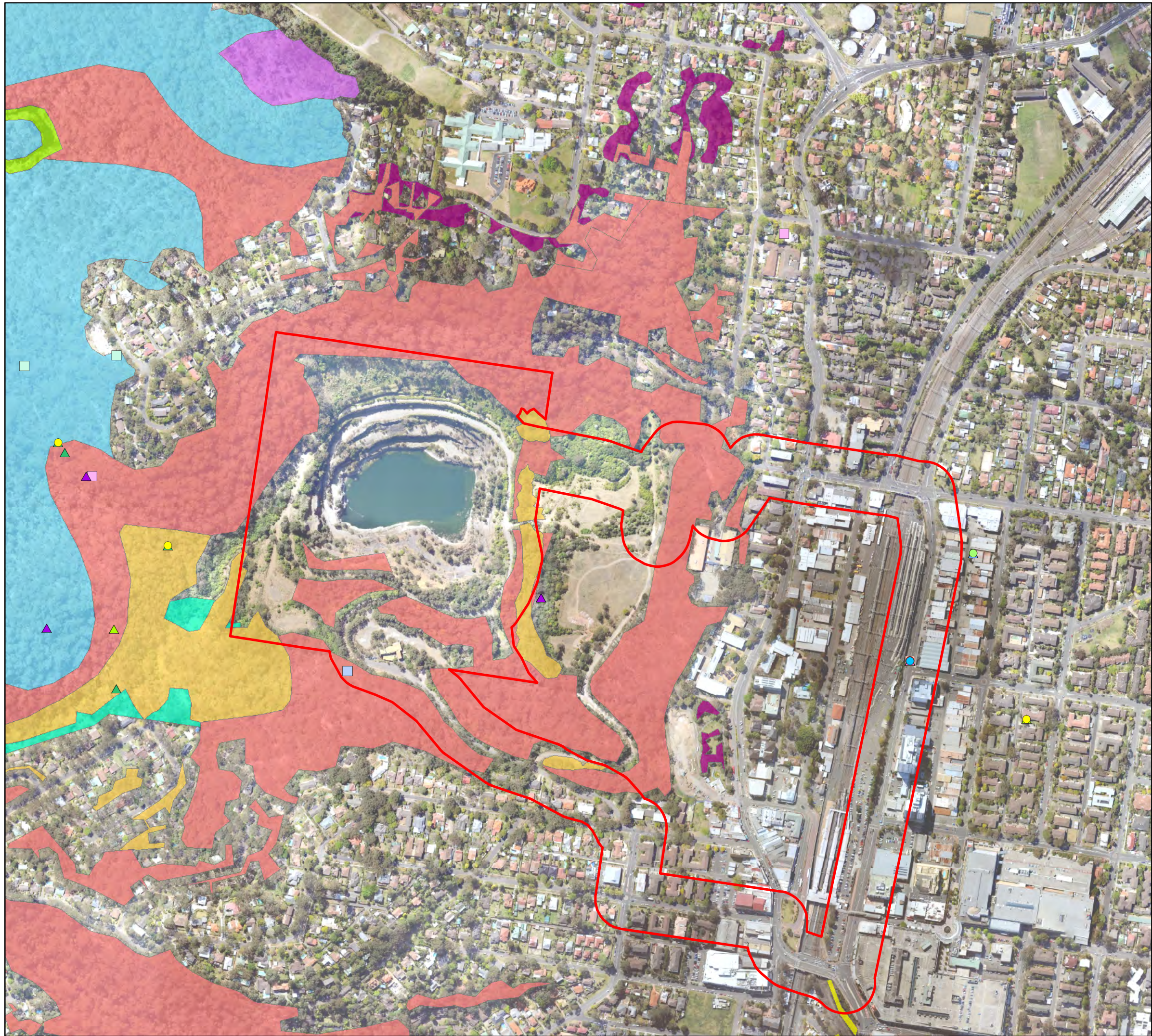
Based on PB (2004) findings, the principal fauna habitats are:

- Tall Open Forest;
- Casuarina Forest (within Blue Gum High Forest);
- Disturbed/cleared areas; and
- Quarry pit.

The western portion of the study area is in fairly good condition for mammalian species. It provides a range of foraging and roosting resources such as myrtaceous trees and hollows (PB, 2004). Much of the surrounding areas of the quarry are suitable foraging habitat for the Powerful Owl, Masked Owl and Varied Sittella, all listed as Vulnerable under the TSC Act. The Varied Sittella has been sighted by members of the public and Aquila ecologists undertaking a survey for these bird species. Three birds have been observed foraging in a Sydney Blue Gum in Old Mans Valley (Aquila 2012). The Masked Owl is likely to also use the quarry surrounds as habitat, even the cleared areas where small ground mammals such as the Black Rat could be preyed upon (Aquila 2011). Additionally, it is thought that wallabies currently feed and possibly live within the site.

The quarry pit has only had one observation of an Eastern Water Dragon (PB, 2004).

Three endangered populations are listed as occurring within Hornsby LGA under the TSC Act: *Darwinia fascicularis* ssp *oligantha* (NSW Scientific Committee 2000 cited by PB 2004), *Wahlenbergia multicaulis* (NSW Scientific Committee 2003 cited by PB 2004) and Gang Gang Cockatoo (NSW Scientific Committee 2001 cited by PB 2004). The study area is considered to provide potential habitat for *Wahlenbergia multicaulis*. Although potential habitat for the Gang Gang Cockatoo does exist within Hornsby Quarry and the surrounds, the nearest record of this species in the Atlas of NSW Wildlife is four kilometres to the northeast and the study area is not likely to provide significant resources for this population of birds (PB, 2004). Hornsby Quarry and the surrounds are not important habitat for any migratory species (PB, 2004).



Vegetation Communities and Threatened Species

HORNSBY QUARRY LAND FILLING

Legend

Study Area

Threatened Flora Records

- Acacia bynoeana
- Acacia gordonii
- Callistemon linearifolius
- Darwinia biflora
- Darwinia peduncularis
- Eucalyptus camfieldii
- Galium australe
- Genoplesium baueri
- Genoplesium plumosum
- Haloragodendron lucasii
- Melaleuca deanei
- Persoonia mollis subsp. maxima
- Pterostylis nigricans
- Tetradlea glandulosa

Threatened Fauna Records

- Glossy Black-Cockatoo
- Grey Falcon
- Masked Owl
- Powerful Owl
- Red-crowned Toadlet
- Spotted-tailed Quoll

Vegetation Communities

- Blackbutt Gully Forest
- Blue Gum Diatreme Forest
- Blue Gum Shale Forest
- Coachwood Rainforest
- Glen Forest
- Peppermint-Angophora Forest
- Scribbly Gum Open-woodland/Heath
- Turpentine-Ironbark Forest

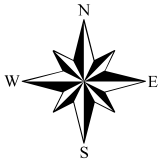
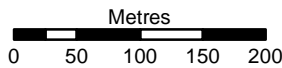


FIGURE 5-5

1:6,000 Scale at A3



Map Produced by Cardno NSW/ACT Pty Ltd (2812)

Date: 2013-04-08

Coordinate System: GDA 1994 MGA Zone 56

Project: <Job Number> <commission>

Map: G5005_ThreatenedSpp_A3.mxd 01

Data Source: OEH, Hornsby Shire Council

Imagery Source: Hornsby Shire Council and associated third party suppliers

5.7.3 Flora and Fauna Impact Assessment

Flora

Given the highly disturbed nature of the quarry site, a substantial portion of the proposed fill area would not be likely to impact on vegetation. However, there may be potential impacts on remnant vegetation in the quarry, particularly at the edges of the site. Filling during the later stages of the project may encroach on some areas of surrounding vegetation since fill material would be placed closer to existing vegetation. Areas of ecological sensitivity at the site have been noted as part of the design and it is envisaged that the operation of the proposed facility and the final end use would not involve any intrusion or other impact on these valuable areas.

In the event that Access Option 1, 2 or 3 is chosen, the construction of the proposed Bridge Road extension is likely to require the removal of some vegetation and excavation of the existing gravel track so that the road carriageway can be widened to support the flow of heavy vehicle (truck) traffic to and from the Hornsby road network and the quarry. From Council's vegetation mapping, the vegetation to be removed would consist of Blackbutt Gully Forest, which is not an EEC. However, a small amount of Glen Forest may need to be removed. While Glen Forest is not an EEC or CEEC, it is currently under Preliminary Determination as a CEEC under the TSC Act (Hornsby Shire Council 2006) and is nominated for listing under the EPBC Act (PB, 2004). However, the condition of this stand of Glen Forest is poor (PB, 2004). The condition of this community varies within the quarry. The level of impact on these stands of vegetation would vary according to the selected access route option.

In the event that Access Option 2, 3 or 4 are chosen, trucks would have to travel past an adjacent stand of Blue Gum Diatreme Forest (mapped by Smith and Smith (2012)), north of Quarry Road adjacent to residential housing. Within the quarry site, trucks would need to pass additional stands of Blue Gum Diatreme Forest in the western portion of Old Mans Valley, east of the quarry. However, these stands are already heavily disturbed (Smith and Smith 2012).

Fauna

The majority of records for threatened fauna were avifauna (bird) species which are likely to frequent mature trees in the surrounding open forest, rather than the quarry pit itself which is relatively devoid of large trees and vegetation. The removal of a relatively small area of Blackbutt Gully Forest to allow for the proposed access roads (the total area removed would be dependent on the access route option being adopted by Council) would be unlikely to have a major impact on any threatened species given that this vegetation community is relatively prevalent in the immediately surrounding areas (approximately 90ha within a 1km radius from the site). Additionally, it is thought that the quarry and its surrounds are unlikely to provide any substantial resources to any fauna (PB, 2004). The protected Berowra Valley Regional Park to the west and Ku-Ring-Gai Chase National Park to the north-east are also likely to provide substantial habitat for threatened species. In regards to Wallabies within the site, they are adaptive when it comes to being in areas with humans (Aquila, 2012).

Filling the quarry would result in the loss of the potential nesting habitat associated with the rocky cliff faces within the quarry. It is currently unknown whether or not these sites are used.

Since the late 1990s when the quarry was decommissioned, the site has collected surface water at the base of the quarry pit. Given that this water has been present for some time, it is possible that aquatic species have established themselves within the aquatic environment. It should be noted that a concrete diversion channel around the northern perimeter of the quarry intercepts rainfall runoff from the north and north east of the site. The majority of the rainfall captured in the quarry void is from the void and the immediate surrounds. Threatened species records indicated two Red-crowned Toadlet sightings approximately 500m west of the quarry pit. The toadlet relies on rainfall to wash the partially developed tadpoles into ephemeral creeks for completion of the

reproductive cycle (OEH, 2011). It may be possible that the water in the quarry performs such a function for this species, however Council staff have only observed turtles and water dragons in the quarry. It is recommended that as part of the quarry dewatering process plan provision is made to net any animals in the water and transfer these to Old Mans Valley Creek (eels, frogs and turtles) and Fishponds (if any fish present).

5.7.4 Proposed Mitigation Measures and Residual Impacts

A detailed flora and fauna impact assessment should be carried out as part of a more detailed Environmental Impact Assessment prior to any works to fill the quarry are undertaken. This may require completion of a Species Impact Statement or 8 Part tests.

Flora

In order to minimise the impact of the proposal on local flora, the following mitigation measures should be employed:

- All native tree and plant species must be retained with the exception of those approved for removal in the final design;
- The removal of threatened vegetation species and communities should be minimised or avoided, if possible;
- Any tree-trimming must be carried out responsibly and only the necessary portions of trees are to be removed; and
- In order to assist in the protection of trees to be retained, temporary fencing should be erected around trees where possible.

In order to help reduce the likelihood of weed dispersal, erosion and sediment control measures should be implemented during the proposed site establishment phase. It is recommended that where appropriate, washing of trucks is undertaken to prevent contamination with weed species, particularly if trucks are coming from non-local areas. Any revegetation taking place on the site should be undertaken using species local to the area.

A *Vegetation Management Plan* should be prepared as part of the Construction Environmental Management Plan to ensure mitigation measures to protect existing native vegetation are observed.

Stringent quality controls should be implemented to ensure that weed species are not introduced with the VENM used as fill material.

Fauna

Many of the mitigation measures proposed for the protection of flora would also protect fauna:

- Where possible, all native tree and plant species must be retained as they are likely to provide habitat for existing fauna;
- If an animal dwelling is discovered in or adjacent to a tree to be removed or trimmed, work must cease immediately so that appropriate management actions can be undertaken where necessary;
- It is recommended that a certified wildlife handler be present on site to assist in the safe removal of any displaced wildlife. If any native animals are injured, the local wildlife rescue service (WIRES) should be contacted; and
- It is recommended that an ornithologist is consulted to determine whether the quarry cliff faces are currently providing nesting habitat for any bird species.

5.7.5 **Key Findings and Access Option Comparison**

- For Access Options 1-3 (Bridge Road access routes) the existing gravel trails in Old Mans Valley would require upgrading and widening. Currently, these trails are approximately 4-5m wide and would require an additional clearance to provide adequate width for dual carriageway truck movements. Council has explored numerous options to provide access to the quarry from Bridge Road through Old Mans Valley. All options through Old Mans Valley require a road that has a maximum grade of 15 % to allow for large fill trucks in accordance with relevant standards. The road therefore crosses Old Mans Valley and in some instances is up to 20m above natural surface level with batters extending more than 50m. The route down to the cleared flat area of Old Mans Valley is approximately 400m in length (including the narrow section of Bridge Road west of Roper Lane which would also require widening). This gives a rough indication of the potential amount of vegetation clearing that would be required for these options.
- For Access Options 2, 3 and 4 (Quarry Road access routes), the route along Quarry Road (from the intersection with Frederick Street) is approximately 900m. Quarry Road is wider in several places in comparison to the Bridge Road route, since this was the original route taken by trucks during the period that the quarry was active. It is assumed in this investigation that widening along this route would not be required and so vegetation clearance would be minimal. As such, vegetation impacts associated with this route would be minor.
- For Access Options 2 and 3 (loop options) there would be some areas of vegetation clearance along the Bridge Road route, which includes Blackbutt Forest and Glen Forest, and minimal vegetation clearance along the Quarry Road route. For the purposes of this investigation, the impacts associated with the two loop route options would equate to the combined impacts of the Bridge Road access and the Quarry Road access.
- Impacts on flora and fauna associated with the Access Option 4 (Quarry Road access route) are likely to be less than the other access options, considering that vegetation clearance would be minimal. Given the scale and nature of the works, impacts on fauna are unlikely to vary significantly with the chosen access route option.

5.8 **Heritage**

5.8.2 **Existing Conditions**

Aboriginal Heritage

A search of the Aboriginal Heritage Information Management System (AHIMS) on 17 October 2012 found that there is one Aboriginal object or place within approximately 300 metres of the site. This object is located to the north-west of the site, within close proximity of Berowra Regional Park. It is not located on the site of the proposed works.

The following qualifications apply to an AHIMS search:

- AHIMS only includes information on Aboriginal objects and Aboriginal places that have been provided to the OEH;

- Large areas of New South Wales have not been the subject of systematic survey or recording of Aboriginal history. These areas may contain Aboriginal objects and other heritage values which are not recorded on AHIMS; and
- Recordings are provided from a variety of sources and may be variable in their accuracy. When an AHIMS search identifies Aboriginal objects in or near the area it is recommended that the exact location of the Aboriginal object be determined by re-location on the ground.

The site of the proposed works falls into the Metropolitan Local Aboriginal Land Council area. A search of the Native Title Tribunal and relevant GIS layers returned no Native Title determination areas within close proximity to the site (the closest being approximately 5 km away). Several applications for Native Title are current; however none are located within close proximity (the closest being over 2 km away).

Koettig (1996) undertook an Aboriginal heritage study, commissioned by Council to assess and identify the Aboriginal heritage in the LGA. Much archaeological evidence of Aboriginal occupation was found. Koettig (1996) found no Aboriginal sites within the quarry area, however, it should be noted that the list of identified sites which resulted from the study represents a very small proportion of the total number of sites which are likely to exist across the LGA (PB, 2004).

Brayshaw (2002) conducted an Aboriginal heritage survey of the quarry and Old Mans Valley. There was no engravings, axe grindings grooves, occupation or art shelters, scarred trees or open artifact scatters to evidence Aboriginal occupation. However, two shelters were identified with Potential Archaeological Deposits, located in the western portion of the study area, near the Benowie Walking Track.

Aboriginal heritage studies which have been undertaken show that the LGA is generally an archeologically sensitive area (PB, 2004).

Non-Aboriginal Heritage

Online heritage database searches and GIS data were utilised to gain an understanding of the presence of heritage items and places within the area of the proposed works. A search of the Australian Heritage Database was undertaken for the Hornsby LGA, and results indicated that two heritage items were located within the site boundary, with one additional item located in the site surrounds. Note that all three nationally-recognised heritage items were listed only on the Register of the National Estate (RNE) (See **Table 5-11**).

The Register of the National Estate (RNE) was closed in 2007 and is no longer a statutory list. All references to the RNE were removed from the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 19 February 2012. As such, where an item or place is recorded on the RNE, it does not necessarily create a requirement to protect the place under Commonwealth law. Items requiring protection under the Commonwealth are instead listed on the *Commonwealth Heritage List* or the *National Heritage List*. However, heritage items listed on the RNE may be protected under state or local government heritage legislation. Information contained in the RNE may continue to be current and may be relevant to statutory decisions about protection.

The State Heritage Register was also searched and several heritage items were listed in the area surrounding the site. Results of the heritage database search were refined according to location, namely the following roads:

- Quarry Road;
- Bridge Road;
- George Street;
- William Street; and

- Frederick Street.

Table 5-11 provides details of the heritage items listed on the searched heritage registers. It is noted that the Diatreme area is listed on the non-statutory RNE and under the Hornsby LEP (1994), however is not listed under the NSW *Heritage Act 1977*.

Old Mans Valley Cemetery (Higgins Family Cemetery) is listed on the RNE, and the State and LEP registers.

Figure 5-6 provides the locations of the heritage items that identified in **Table 5-11**. **Figure 5-7** to **Figure 5-9** show photographs of several of the heritage items identified in this assessment.

Table 5-11 Items Listed on the Heritage Registers – Project Site and Surrounds

Item	Location and Description (if available)	Status
Hornsby Diatreme Area*	<p>Quarry Road, Hornsby</p> <p>A segment of volcanic rock surrounded by sandstone which creates an unusual geological feature in the eastern face of the quarry. A classic, instructive and spectacular cross section through the volcanic neck is displayed. This face is representative of the diatreme phenomenon, known from only a few sites in the region.</p> <p>During the 1930s, bushland walks were created around the quarry as part of unemployment relief (PB, 2004). The steps created at the west end of the quarry have been the subject of rock cut graffiti.</p>	<p>Register of the National Estate (non-statutory)</p> <p>Hornsby Shire LEP (1994)</p>
Old Mans Valley Cemetery (Higgins Family Cemetery, sandstone receptacle, cool room and site of Higgins homestead on which the Higgins Family Memorial is located)*	<p>Quarry Road, Hornsby</p> <p>Located on the south-east portion of the site, this is one of the few fully conserved family cemeteries in New South Wales and contains the graves of the early families that settled in the Hornsby area.</p>	<p>Register of the National Estate (non-statutory)</p> <p>NSW <i>Heritage Act 1977</i></p> <p>Hornsby Shire LEP (1994)</p> <p>National Trust Australia (NSW) (Non-statutory)</p>
Mount Wilga*	<p>2A Manor Road, Hornsby</p> <p>A large manor built in 1913. Located outside the site boundary (to the north).</p>	<p>Register of the National Estate (non-statutory)</p> <p>NSW <i>Heritage Act 1977</i></p> <p>Hornsby Shire LEP (1994)</p>
Hornsby Railway Station Group and Barracks*	Bridge Road	State Government Agency (RailCorp)
House	33 Bridge Road	Hornsby Shire LEP (1994)
House	21 Bridge Road	Hornsby Shire LEP (1994)
House*	3 Bridge Road	Hornsby Shire LEP (1994)
House	32 William Street	Hornsby Shire LEP (1994)
Brinawa	44 William Street	Hornsby Shire LEP (1994)
House	24 William Street	Hornsby Shire LEP (1994)
House	52 William Street	Hornsby Shire LEP (1994)
Street Trees	William Street	Hornsby Shire LEP (1994)
Wirruna and Gardens	33 Frederick Street	Hornsby Shire LEP (1994)

Item	Location and Description (if available)	Status
Sandstone Steps	Quarry Road Lot 7017, DP 1052646 and adjacent Road Reserve	Hornsby Shire LEP (1994)

* Heritage items that are found directly within the quarry site or directly adjacent to proposed access routes



Non-Aboriginal Heritage

HORNSBY QUARRY LAND FILLING

Legend

Site Location

Railway Line

Heritage:

Register of the National Estate

State Heritage

Hornsby LEP, 1994

10m Buffer - Old Man's Valley Cemetery

Heritage Conservation Areas

Roads

Cadastre



FIGURE 5-6

1:10,000 Scale at A4

Metres
0 25 50 100 150 200



Map Produced by Cardno NSW/ACT Pty Ltd (2812)
Date: 2013-04-08
Coordinate System: GDA 1994 MGA Zone 56
Project: LJ2888
Map: G5006_Heritage.mxd 01
Data Source: LPI, RNE, Hornsby Shire Council
Imagery Source: Nemap and associated third party suppliers

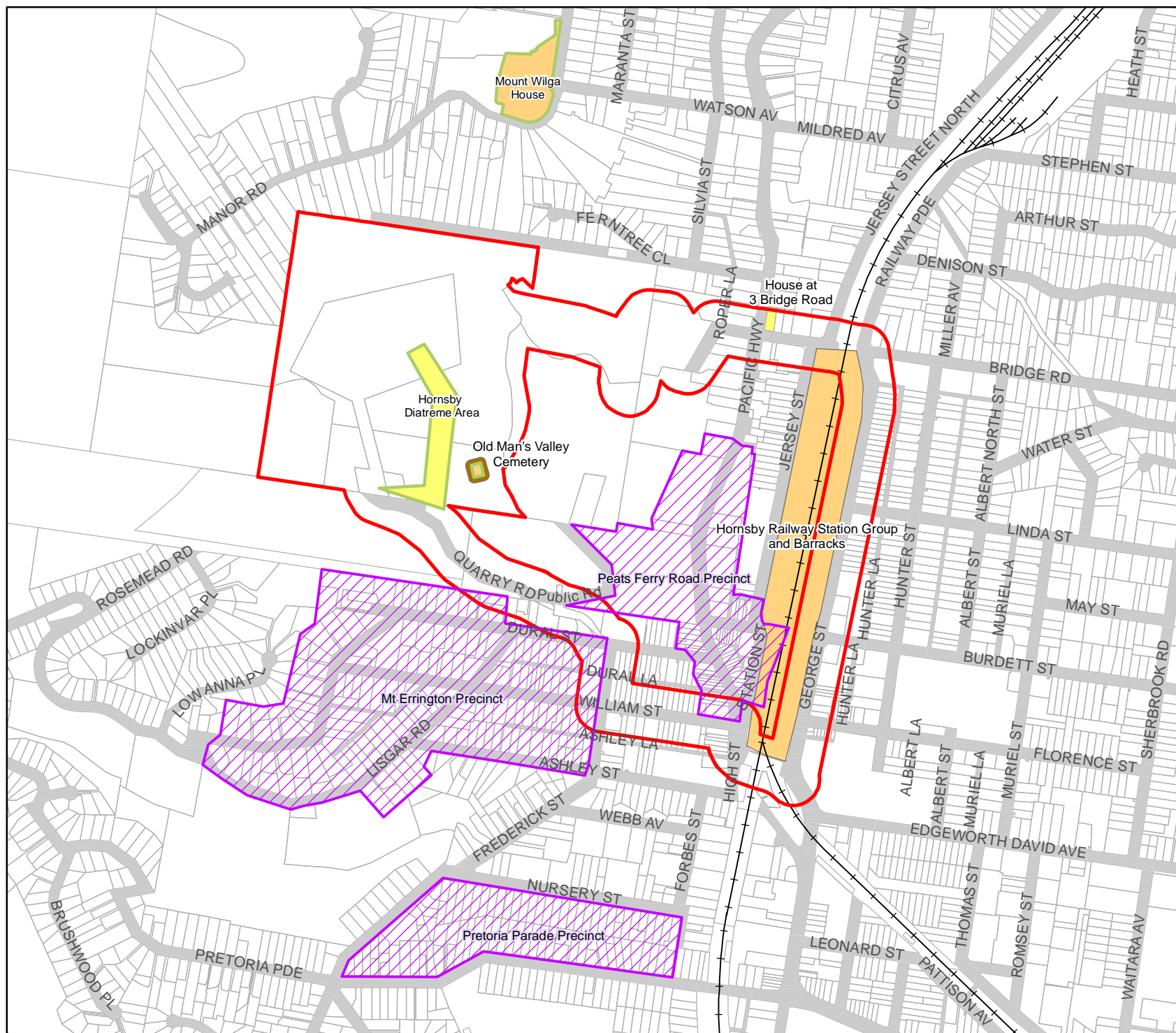




Figure 5-7 Photograph of the Diatrema Area Located on the Eastern Face of the Quarry Wall.



Figure 5-8 Photograph of Old Mans Cemetery (Higgins Family Cemetery) Located to the South-east of the Quarry.



Figure 5-9 Photograph of the Heritage House at 3 Bridge Road, Hornsby (looking east on Pacific Highway).

5.8.3 Heritage Impact Assessment

Aboriginal Heritage

Koettig (1996) found much archaeological evidence of Aboriginal occupation in the LGA, however no Aboriginal sites within the quarry area (PB, 2004). It is not possible to predict the specific location of possible further sites that may occur, however, it is possible to predict the type of sites that are likely to occur within the landscapes (Koettig 1996 cited by PB 2004).

The landscape of the study area is Hawkesbury Sandstone. Rock engraving, axe grinding grooves, and rock shelters are likely to occur where there are suitable sandstone outcrops. Middens comprised of meal waste materials usually occur near the coastline; hence, it is unlikely that these will be found within the study area (Koettig 1996 cited by PB 2004).

The majority of the study area is highly disturbed, with the exception of the northern portion of Old Mans Valley, where Bridge Road access is proposed. This area is relatively undisturbed and some scarred and carved trees may be present (Koettig 1996 cited by PB 2004). However, a survey undertaken by Brayshaw (2002) did not find evidence to this effect.

Aboriginal burial sites have been recorded in the Hornsby Shire area and are likely to be found in easily dug soft ground. No burial sites have been found in the study area, however, it should be noted that the possibility of finding these sites should not be discounted during the possible extension of Bridge Road.

Given that the site of proposed works is highly disturbed (i.e. an excavated quarry) it is unlikely to contain previously unidentified Aboriginal heritage items. The use of existing roads during the establishment and operational phase of the project is unlikely to impact on any Aboriginal objects.

Construction of the proposed Bridge Road access route associated with Access Options 1, 2 and 3 has the potential for as yet undiscovered Aboriginal objects to be uncovered. The construction of

this access route would require excavation in the area to the east of the site (Access Options 1, 2 and 3). These areas currently consist of relatively undisturbed areas of parkland with stands of vegetation in some locations. Sillico (1993) surveyed a 0.2 hectare block of land, north of the possible construction of Bridge Road and adjacent to Watson Avenue. No Aboriginal sites or objects were found, however some charcoal markings were found on a long irregular overhang just south of this site. It should be noted that this site was not further investigated nor was it registered with the former Department of Environment and Conservation (DEC).

Aboriginal objects may exist in the area of the proposed extension of Bridge Road due to the relatively undisturbed nature and known previous archaeological findings in its vicinity.

Non-Aboriginal Heritage

Volcanic Diatreme in Hornsby Quarry

It is acknowledged that Council's proposal to fill the quarry to RL90m AHD would necessitate the covering of the volcanic diatreme with fill material. If no additional mitigation actions were taken, this item is unlikely to be completely destroyed, however it may be harmed and would also no longer be visible. The potential impacts of covering the diatreme and possible mitigation measures are considered in **Table 5-12**.

Table 5-12 Potential Impacts to Diatreme and Mitigation Measures

Potential Impacts	Mitigation Measures
Loss of attractions and visitors to Hornsby area	General public access to diatreme is currently not available, therefore there should be no impact to visitors to Hornsby if the diatreme is covered.
Loss of a valuable example of diatreme and its educational value	The diatreme would be well documented in the form of extensive reporting, filming and photographs. These documents should be archived and made publically available. As the diatreme is currently not publically accessible, the documented diatreme will result in being more available to the public for educational purposes.

This item is listed on the non-Statutory Register of the National Estate (RNE) and Schedule D of the HSLEP 1994 as a locally significant heritage item. However, the diatreme is not listed under NSW state level legislation under the *NSW Heritage Act 1997* and therefore has no statutory bearing on the site. As the listing on the RNE is non-statutory, there is no legislative requirement to protect this item nor is a permit to alter/harm this heritage item required on a Commonwealth level. As the item is listed under Schedule D of the HSLEP 1994, there is a legislative requirement to protect items of local heritage significance under the EP&A Act and to lodge a Statement of Heritage Impact (SOHI) to any works done on items of regional or state significance as part of the Development Application (DA) submission. The SOHI can form part of an Environmental Assessment and would assess the heritage significance of the heritage listed item and the impact of development. As the property is not on the State Heritage Register, approval from the NSW Heritage Council is not required.

The following steps to will be required to be undertaken to gain approval on works to the diatreme in regards to heritage impacts:

1. Prepare a Conservation Management Plan (CMP),
2. Have the CMP endorsed by the relevant approval authority (in this case, Council),
3. Consult with approval authority, community and other stakeholders on proposed works,
4. Develop management recommendations for minimising impact of works,
5. Prepare a SOHI, and
6. Submit to the approval authority (Council) for the determination of the application.

Higgins Family Complex

Potential impacts on the Higgins Family Complex (cemetery, cool room, sandstone receptacle and sandstone steps), located on the south-west portion of the site, may include accidental or

unauthorised access and potential desecration or destruction of headstones or graves. Due to the past quarrying activities in the study area, these sites have already undergone vibration impacts. These vibration impacts seem to have had little effect on these sites. The majority of impacts in the past have been due to acts of vandalism.

Other Heritage Items and HCAs

Heritage items along the proposed site access routes on the local road network may be indirectly impacted by the proposal. One house (3 Bridge Road) is located along the proposed Access Option 1, 2 and 3 routes. This item is located on the already busy main road of Bridge Road and additional road traffic impacts on this item are therefore expected to be minimal. The majority of the other items in **Table 5-12** are not located along the proposed access route options, however, several are within close proximity (e.g. 100m away).

Frederick Street in Access Options 2, 3 and 4 runs adjacently east to Mt Errington Precinct Heritage Conservation Area (HCA). These access options are also adjacent to the Peats Ferry Road Precinct HCA with part of William Street and Quarry Road forming the border of the HCA.

Potential indirect impacts on these heritage items and HCAs may include vibration impacts from trucks using nearby roads. The condition of the road surface is considered to be particularly important in determining the impacts of vibration on historic buildings (Hume, 2007). During a site inspection conducted on 18 October 2012, a visual assessment found that proposed access roads that form part of the existing road network are generally in good condition. If roads are maintained in a good condition, vibration impacts are anticipated to be minimal.

5.8.4 Proposed Mitigation Measures and Residual Impacts

Aboriginal Heritage

The contractors and all staff contracted to undertake works on site should be informed and made aware of their responsibilities in the event that any Aboriginal objects are identified. An unexpected finds protocol should be maintained and followed during the works in order to ensure that impacts on unknown items are minimised. If any Aboriginal objects and / or places are located during the construction phase, all work should cease in the vicinity of the find and Council's Project Manager and OEH should be contacted. If skeletal material is identified then NSW Police must also be contacted. In the event that remains are found which are under 100 years old, this comes under the jurisdiction of the State Coroner under the *Coroners Act 2009*. Furthermore, finding Aboriginal remains triggers notification requirements to the Commonwealth Minister for SEWPAC under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*.

Should any Aboriginal objects be uncovered during the works, an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the Act would need to be obtained if the objects are likely to be impacted by the works.

Due to the undisturbed nature of Bridge Road, there may be Aboriginal archaeological artefacts which have yet to be discovered. It is recommended that a heritage survey be undertaken prior to any works in the area.

Non-Aboriginal Heritage

It is recommended that a Heritage Impact Assessment be conducted to assess the impacts of the proposal on the two heritage items located at the quarry site (diatrema and cemetery). In addition, the HIA should also consider impacts on the heritage listed house located at 3 Bridge Road, should any access option that utilises this road be chosen (i.e. Access Option 1, 2 or 3).

Given the potential impacts of the filling works on the volcanic diatrema, Council may want to investigate appropriate means of recording and covering it if this is deemed the most appropriate way to enable future public use of the site. This documentation should be undertaken prior to any works done in the quarry. The benefits and consequences of covering the heritage item should be assessed. A major benefit is due to its current restricted access, documenting and archiving the

diatrema will allow details of the diatrema to be more accessible to the general public. Should it be determined that the item can be covered, it is recommended that video, photographs and written documentation of the item be recorded and archived prior to the item being covered with fill.

With regard to the Higgins Family Cemetery, methods to best retain and protect this heritage item during the operation of the facility will also need to be considered including the adequacy of fencing located around the site. Measures that may be implemented to minimise potential impacts on this heritage item include:

- Creation of a buffer zone (10 metres) and fencing along the boundary of this buffer zone to prevent unauthorised access by vehicles or access on foot;
- Signage to notify site operators and the public of the location of the item; and
- Onsite training so that contractors and personnel on site are made aware of the location and sensitivity of the heritage item.

With regards to vibration impacts, traffic routes to access the works site and any restrictions to avoid heritage items in the vicinity of the works should be specified in a Construction Traffic Management Plan. Heavy vehicles should adhere to road speed limits at all times. All site personnel should be made aware of the presence of the heritage items in the general locality of the works, such that the potential for accidental damage to these heritage items is minimised. It is also suggested that Council should consider undertaking a pre-works dilapidation survey of heritage buildings which may be impacted and the Higgins Family Cemetery in order to clearly document their condition prior to commencement of works. Due to the past activities of the quarry, blasting in the close proximity of these items would have had more vibration impacts than those currently proposed. The vibration impacts of the proposed works will be minimal in comparison. Nonetheless, management measures should be implemented and an assessment on any movement in the ground and/or grave markers should be taken during and after works. If vibration impacts from nearby road traffic appear to be adversely affecting any heritage building or structures, works and traffic movements in the vicinity should be stopped immediately, and OEH (Heritage Branch) informed. Further investigation should then be undertaken by suitably qualified professionals. Mitigation measures for traffic impacts are further discussed in **Section 5.1**.

In addition to the above, measures described elsewhere in this document for dust control, sediment control, and vibration management would minimise the environmental impact at all heritage locations.

5.8.5 Key findings and Access Option Comparison

- Access Option 1 (Bridge Road access only) and Access Options 2 and 3 (loop options) may have some impact on the heritage item at 3 Bridge Road but are not expected to impact the Higgins Cemetery.
- Due to the undisturbed nature of the Bridge Road site, Access Options 1 (Bridge Road access only) and Access Options 2, 3 (Loop options) are more likely to disturb Aboriginal artefacts than Access Option 4 (Quarry Road access only).
- Access Option 4 (Quarry Road access only) is unlikely to have impacts on 3 Bridge Road and Mount Wilga House but will be in closer proximity to the Higgins Cemetery.
- Access Options 2, 3 (loop options) and 4 (Quarry Road access only) are adjacent to HCAs, however, are expected to have minimal impacts on the HCAs.
- All access options will result in the covering of the diatrema, and creating an archival record of this feature should be considered by Council.

5.9 Social Impacts

5.9.2 Existing Conditions

The social impacts of the proposed works are considered throughout **Section 5.9**. To put the social impacts into context, this section provides a background description of the existing social environment and local population.

Socio-Demographic characteristics in the Hornsby Shire

The Hornsby Shire is home to 163,865 people (Estimated Resident Population) as at 30th June 2011, with an estimated growth of between 120,000 – 150,000 people over the next 25 years. Population data for residents of the suburb of Hornsby, which surrounds the quarry, was sourced primarily from the Australian Bureau of Statistics (ABS) 2011 Census and Hornsby Shire Council's Community Profile (HSC and profile id 2012).

The data revealed that the median house price is \$700,000, and the median unit price is \$435,000. In NSW, the median house price is \$440,000, and median unit price is \$445,000 (APM, 2012).

Additionally, English was the only language spoken in approximately 53.1% of homes in Hornsby. The most common languages spoken at home other than English are Mandarin 9.0%, Cantonese 5.3%, Korean 4.5%, Hindi 2.1% and Persian (excluding Dari) 2.1%. This should be considered when any consultation and communications activities are undertaken with the local community.

Research undertaken by Hornsby Shire Council (HSC, 2012a) indicates that members of the community choose to live in Hornsby due to an appreciation of the bushland aspect of the Shire, the sense of space, the sense of community, the village like atmosphere, transport networks, housing and school options; and have a relatively high socio-economic advantage.

The area immediately surrounding the quarry is primarily residential, with a few community facilities. Private vehicular transport is the predominant travel mode, although public transport is also utilised within the study area, as it is in close proximity to the Hornsby Transport Interchange.

Economic and Business Environment

The business strip along the Pacific Highway is made up primarily of restaurants and specialty retail businesses. In the past few years this area has started to undergo a transformation in order to reinvigorate businesses there, which is an outcome of the Hornsby Westside Revitalisation Masterplan adopted by Council in 2008.

Council is also currently progressing a Planning Proposal to provide revised planning controls for Hornsby West Precinct to increase residential and employment development opportunities within the precinct which contribute to the achievement of the revised housing and employment targets identified under the Metropolitan Plan for Sydney 2036 while also reinforcing the role of the Hornsby Town Centre as the major town centre with adequate employment opportunities.

Recreational Facilities and Activities

Hornsby Shire provides a number of recreational facilities for the local community and visitors to the area. The following recreational facilities can be found near Hornsby Quarry:

- Berowra Valley Regional Park covers approximately 4000ha and features expansive bushland scenery, has enormous opportunities for bushwalking and recreation, protects the habitat of native flora and fauna and has many Aboriginal sites. The Park is managed jointly by Council and the National Parks and Wildlife Service;
- Hornsby Park covers an area to the east of the quarry and a section of the Great North Walk extends through the park which has a playground, BBQs, picnic tables and bathroom facilities;
- Hornsby Aquatic Centre is located within Hornsby Park. Hornsby Pool has been demolished and development is currently underway for new pool facilities;
- Old Mans Valley sits above and east of Hornsby Quarry and north of Hornsby Park and is currently being investigated as an opportunity for future recreational development;
- Hornsby Mountain Bike Trail is a six kilometre network of bike trails currently under construction. Once completed, it will extend through Old Mans Valley, Berowra Valley Regional Park and Hornsby Park;
- Lisgar Gardens are sandstone terraced gardens in a gully which include heritage camellias, formal lawns, fishponds, waterfalls and an inclinator;
- Florence Cotton Park is a bushland reserve which backs onto the Lisgar Gardens;
- Hornsby RSL;
- Hornsby Mall; and
- Odeon Cinema.

Community Facilities

There are several community facilities within close proximity to the quarry. These include:

- Hornsby TAFE;
- Childcare centres;
- Mt Wilga Hospital;
- Hornsby Uniting Church;
- Hornsby Council Chambers;
- Hornsby Court House;
- Hornsby Police Station;
- Hornsby Mall; and
- Hornsby Transport Interchange.

5.9.3 Social Impact Assessment

Recreational

The closure of Hornsby Pool in 2010 has already had an impact on the community, with people forced to travel away from Hornsby and use pools in other areas. For the duration of the filling activities, the filling of the quarry is expected to impact (but not prevent) the recreational users of Hornsby Park, specifically those who utilise the walking trails along the Great North Walk and bike riders who use the mountain bike trails in Old Mans Valley.

The Hornsby Shire Housing Strategy identifies that Council currently provides for the recreational needs of an estimated 4,500 dwellings. However, recreational needs are required for an additional 2,600 dwellings by 2016 and 3,900 for 2017-2031.

Currently, there is a shortfall in the recreational services for the LGA (HSC, 2010). There is a requirement for an additional 5 sportsgrounds, 5 specialty parks and 16 local parks forecasted for 2031 (HSC, 2010). Council has ownership of vacant land where these demands can be met. The Hornsby Shire Leisure Strategic Plan (2002) and the Hornsby Shire Sports Facility Strategy (2006) canvassed available sites which have the potential to be developed as sport grounds. These Strategies identify Old Mans Valley as a potential site to provide for these open spaces (HSC, 2010). Additionally, Council at its meeting on 16 July 2008 gave consideration to the future use of Hornsby Quarry and the Old Mans Valley precincts and resolved that the two areas be utilised principally for public recreation and open space (HSC, 2010). These two locations have been zoned as open space in the Draft LEP. Upon completion of the filling activities, the potential for the recreational quality of the LGA would most likely will be increased and have the potential to fulfill the open space targets of the Hornsby Shire Housing Strategy.

Real Estate and Business Impacts

Due to the duration of the project and the impacts associated with it, it is expected that owners of surrounding properties may find it difficult and/or be unable to sell their properties during the time it will take to fill the quarry. Additionally, property and home owners in the vicinity may find a reduction in rents charged and a decrease in property and land values.

Businesses along the Pacific Highway and George Street may find that due to the change in traffic conditions and the constant truck movements, people may avoid the area, which may impact on trade.

Safety

In its present state, the quarry is unstable, which is a risk to public safety. Social benefit is expected to be achieved once the quarry has been filled when it will no longer be a safety hazard. Council intends to develop the site for recreational purposes which would benefit the community, by providing recreational facilities in an area which is currently inaccessible to them.

During the quarry filling phase, there would be a substantial number of truck movements (up to 46 per hour) occurring to transport the fill material to the quarry. Movements would be on streets which include both major and minor roads, and residential streets. The filling operations can therefore be expected to lead to a significant increase in the risk of vehicle related accidents, including both collisions with other vehicles on the roads and with pedestrians or cyclists. Risks in areas which currently have low pedestrian volume including residential streets, and in the vicinity of the pool and child care facility would be significant, and would require careful management if they are to be maintained at acceptable levels.

Traffic

Local traffic would be impacted due to the truck movements, as well as access to transport, services and recreational and community facilities that are located within the study area.

Noise

High noise levels can adversely affect sleep, concentration, and thus learning performance, and mental and physical health. Local residents would be exposed to increased levels of noise due to the altered traffic patterns and the increase in local heavy vehicle movements associated with the infilling of the quarry would have noise and vibration impacts on the wider residential area. The magnitude of noise impacts is discussed in **Section 5.2**, which demonstrates that significant levels of impact are expected during the operating hours, and that it is unlikely to be possible to effectively mitigate against these.

Air Quality

Residents surrounding the quarry may be impacted by the following:

- Dust emissions created by the site establishment and operational activities;
- Regular truck movements to and from the quarry site during the construction and particularly the operational phase will also generate particulate matter from exhaust emissions; and
- Dust deposition may cause risks to human health, damage to property, localised air pollution, water pollution and impacts on flora and fauna, however, is unlikely.

5.9.4 Proposed Mitigation Measures and Residual Impacts

In order to minimise the impacts of the proposal on the community, the following mitigation measures should be considered for implementation:

- A communications strategy should be developed to ensure the community is kept well informed about the potential impacts that they are likely to experience during the works.
- Establish a complaints register, to record any community complaints received during the works.
- Identification of alternate parking areas for residents and businesses along affected routes.
- Works to be undertaken in the recommended standard hours only.
- Adequate signage should be erected with Council and Contractor contact details on site fencing around the works.

Mitigation measures for traffic, noise and air quality impacts are further discussed in **Sections 5.1, 5.2 and 5.3** respectively.

5.9.5 Key Findings and Access Option Comparison

- Although the impacts of noise, traffic, and air quality are discussed elsewhere in this document, it is important to recognise that these issues also directly impact on social values and amenity. The social impacts of all access options would be significant in the vicinity of the quarry, and along the truck route selected.
- All access options will result in the filling of the quarry which will result in social benefits. The filled quarry can be used to provide additional open space and recreational services of which the LGA currently has a shortage.
- During the fillings works, there will be an adverse impact on the current local amenities in the area, for example, disruption to the current established bushwalks in Old Mans Valley.
- Residential areas found in Access Options 2, 3 & 4 are expected to be generally impacted more than in Access Option 1.

5.10 Visual Amenity

5.10.2 Existing Environment

The site of the proposed works is situated in an area of undulating terrain, with surrounding land uses generally consisting of open space, parkland, residential and commercial. The topography of the landscape has slopes of around 35% in steep areas and around 10% in more gently undulating areas. A relatively flat area is located to the east of the site in Old Mans Valley. The character of the site is dominated by extensive stands of tall, native vegetation along the ridgelines and around the quarry perimeter.

Table 5-13 describes the key landscape features surrounding the subject site and gives a subjective indication of the visual quality of the features to provide an overall appreciation of the nature of the visual landscape.

Table 5-13 Key Existing Landscape Features and Subjective Assessment of Existing Visual Quality

Landscape Feature	Description	Visual Quality
Undulating topography with tall open woodland forest	Undulating topography, steep in parts, with corridors of relatively undisturbed open woodland forest consisting of trees generally greater than 10m high.	High
Ridgeline development	Development on ridgelines especially at Hornsby CBD which comprises medium to high-rise residential development, main roads and the train line.	Low
Old Mans Valley	The flat or gently sloping area that directly surrounds the quarry pit. The valley is generally cleared of large trees and shrubs, with short grass species dominating. Several unsealed trails traverse this area.	Moderate-High
Quarry Pit	The pit itself represents a deep cavity in the landscape, with generally terraced faces. Water has collected in the base of the pit and some dense stands of vegetation are located around the perimeter of the pit. Some vegetation is also present on the quarry walls.	Moderate-High
Berowra Valley Regional Park	Generally undisturbed open woodland forest consisting of trees generally greater than 10m high, located on the ridgeline to the west of the site.	High

Landscape Feature	Description	Visual Quality
Road and trail network	Roads traverse the landscape in numerous places, with a concentration of residential roads in areas to the east, south and north of the site. Major roads are located to the east of the site. Unsealed tracks and trails traverse the site and provide linkages between the residential areas and Old Mans Valley.	Low

A site inspection was conducted on 17 October 2012 to undertake an assessment of the visual landscape, and a series of photographs were taken. The site visit revealed that views towards the quarry site from a number of nearby, elevated road locations are often substantially obstructed by tall and dense stands of mature trees and remnant vegetation, particularly at the interface between surrounding residential areas and Old Mans Valley, and also at the boundary of the quarry pit itself. As such, views from residential streets such as Bridge Road, Fern Tree Close and Manor Road towards the proposed site are limited. It is possible that some views may be achieved from the back of properties in these locations (private properties were not accessed on the site inspection). However, it is noted that houses could not be perceived from Old Mans Valley in many areas due to screening vegetation, which suggests that conversely, views of the valley and quarry from these houses would also not be possible due to screening vegetation.

Views in the flat area of Old Mans Valley area are generally unobstructed due to the area being mostly devoid of tall trees and vegetation. Key features that can be observed are the existing unsealed tracks that traverse the valley and vegetation on ridgelines that surround the valley to the north, south, east and west. On the site inspection, views from Old Mans Valley to the quarry pit were not observed due to the nature of the topography and screening vegetation around the quarry pit perimeter.

Figure 5-10 and **Figure 5-11** show views from Old Mans Valley towards nearby locations.



Figure 5-10 View Looking North from the Existing Trail in Old Mans Valley towards Fern Tree Close.



Figure 5-11 View Looking North-west from the Existing Trail in Old Mans Valley towards the Quarry Pit (screening vegetation shown in middle ground) and Manor Road (in background).

Views towards the proposed access roads are likely to be achievable from houses along Quarry Road which have screening vegetation of approximately 15 to 50 metres thickness. Views are also likely to be observed from the end of Bridge Road and primarily from the western side of the upper floors of the TAFE facility. Views of the TAFE facility were achievable from Old Mans Valley (**Figure 5-12**), whilst a view of a house on the corner of Bridge Road and Roper Lane were achievable from the fire trail as it slopes upwards from Old Mans Valley to Bridge Road (**Figure 5-13**). Screening vegetation in both these locations is present with approximately 50 linear metres thickness between the building and the existing fire trail. PB (2004) observed that the TAFE, Hornsby Pool and residential buildings within their vicinity have a degree of detachment from the study area as the structures are located above on a slope and screened by vegetation.

Additionally, Berowra Valley National Park lies to the west, which gives a perception of vast bushland. In the east, a prominent mountain, also within the Berowra Valley Regional Park, gives the quarry a sense of enclosure and isolation (PB, 2004).



Figure 5-12 View Looking North-east from the Existing Trail in Old Mans Valley towards the TAFE facility on Bridge Road.



Figure 5-13 View looking north east from the upper part of the fire trail linking Bridge Road to Old Mans Valley towards houses on the corner of Bridge Road and Roper Lane.

Views of the quarry site from Bridge Road become less obtainable with increasing distance from the quarry site due primarily to screening vegetation. **Figure 5-14** to **Figure 5-19** are provided to demonstrate the difference that the screening vegetation makes with regard to visibility from key roads in the area (Bridge Road, Quarry Road and Fern Tree Close).



Figure 5-14 View from the End of Bridge Road (as it makes a Sharp Left Turn towards the TAFE Facility) Looking West towards the Quarry Pit (Source: Google StreetView).

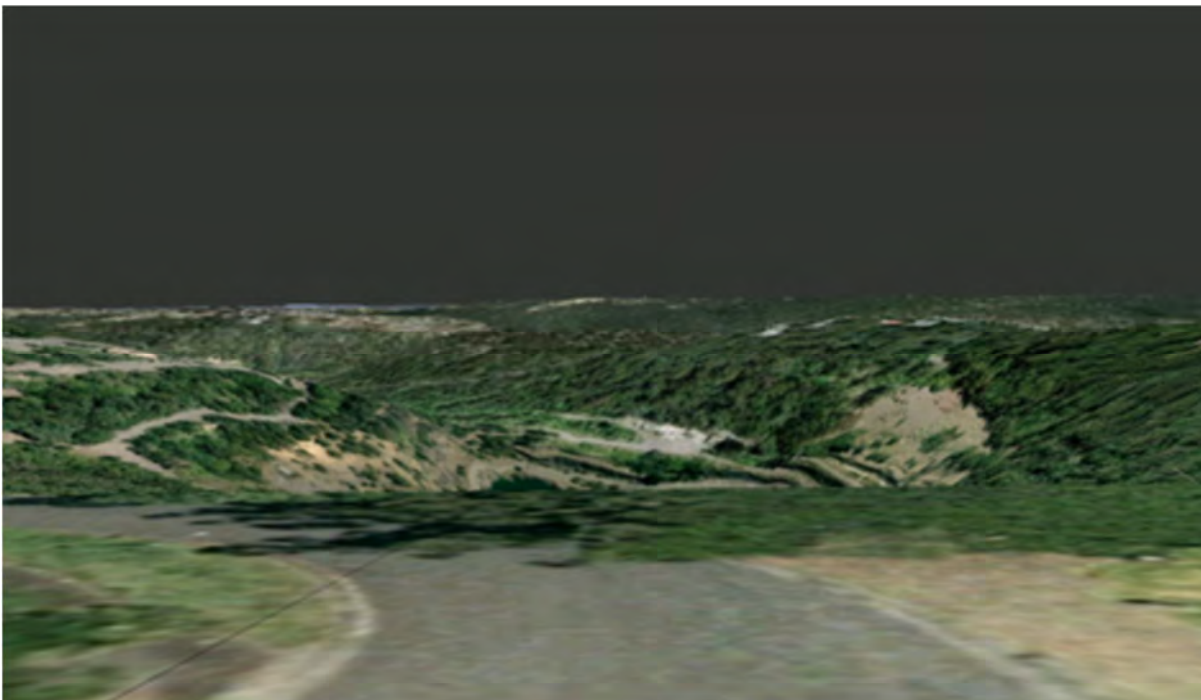


Figure 5-15 3D Terrain View from the same Location on Bridge Road, without Screening Vegetation (Source: Google Earth).



Figure 5-16 View from Quarry Road Looking North Towards the Quarry Pit (Source: Google StreetView).



Figure 5-17 3D Terrain View from the same Location on Quarry Road, without Screening Vegetation (Source: Google Earth).



Figure 5-18 View from the End of Fern Tree Close Looking South-west towards the Quarry Pit.

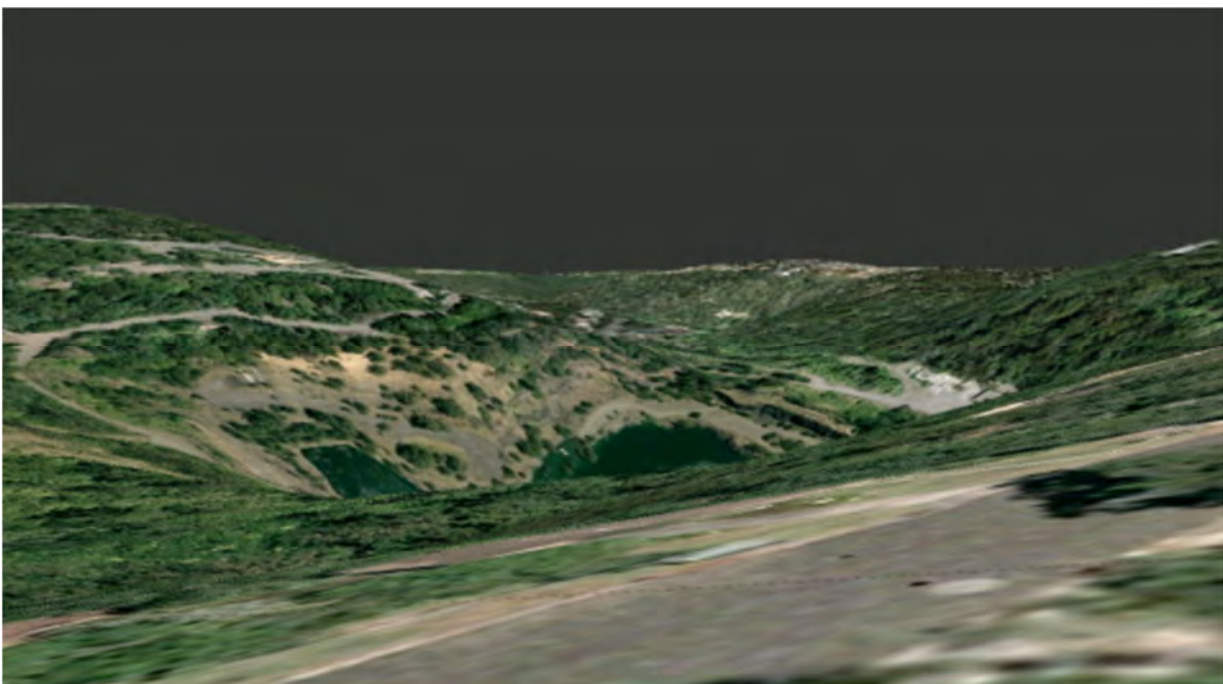
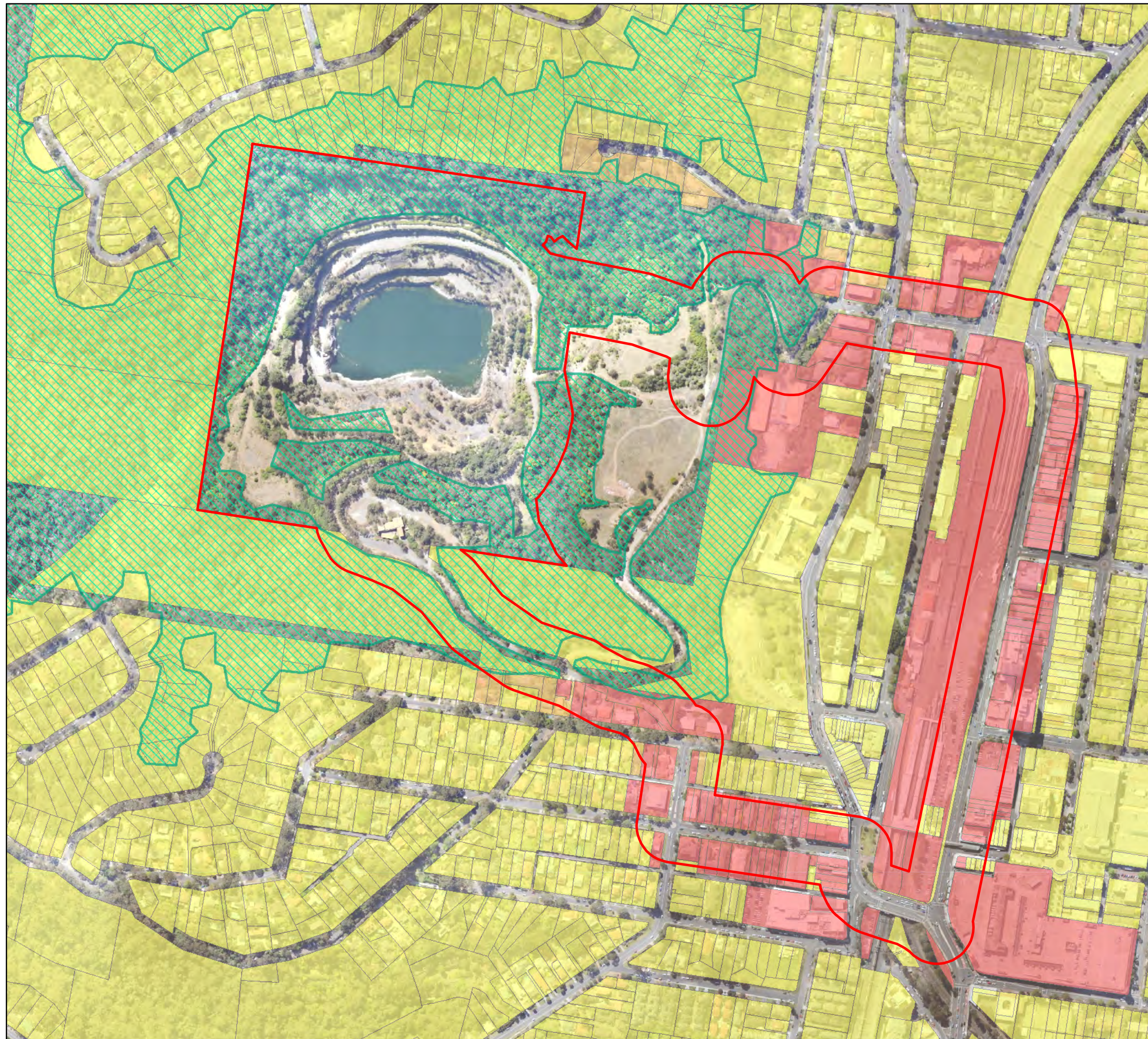


Figure 5-19 3D Terrain View from the Same Location on Fern Tree Close, without Screening Vegetation (Source: Google Earth).

5.10.3 Visual Impact Assessment



Due to the terrain and vegetation characteristics of the site, it is anticipated that visual impacts associated with the proposed works are more likely to be as a result of the proposed quarry access roads rather than the filling of the quarry pit itself. Based on the results of the site inspection, a map has been prepared (**Figure 5-20**) that provides an indication of the potential impacts resulting from the quarry filling operations in terms of the visual landscape.






Potential Visual Impacts

HORNSBY QUARRY LAND FILLING

Legend

-  Study Area
-  Existing Screening Vegetation (Approximate)

Visual Impacts

-  Likely to experience minor impacts
-  May experience minor impacts
-  Unlikely to experience impacts

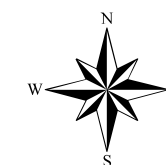
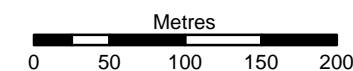


FIGURE 5-20

1:5,000 Scale at A3



Map Produced by Cardno NSW/ACT Pty Ltd (2812)
Date: 2013-04-08
Coordinate System: GDA 1994 MGA Zone 56
Project: LJ2888
Map: G5020_VisualImpact.mxd 02
Imagery Source: Nearmap and associated third party suppliers

The access roads proposed for the site would traverse the terrain downslope from Bridge Road and/or Quarry Road (depending on the preferred access option) and flatten out in the vicinity of Old Mans Valley before descending into the quarry pit. Potential impacts on nearby residential areas may be experienced, since works to the east of the site (along Bridge Road for the proposed extension/access routes) would require the removal of some screening vegetation so as to provide adequate road widths for heavy vehicle traffic. The amount of vegetation requiring removal would depend on the route selected by Council. Decreased visual amenity along the proposed route may be experienced due to the removal of vegetation. One location that is likely to experience a moderate level of visual impact as a result of the proposed access roads is the nearby TAFE facility located to the east of the site (off Bridge Road) (Access Options 1, 2 and 3). This facility lies adjacent to the proposed works location and the screening vegetation is at its thinnest in this location. As such, people utilising this facility are likely to experience some visual impacts from the proposal, however these impacts are not anticipated to be particularly problematic since the TAFE represents a facility for students and teachers who are intermittent visitors only.

In addition for Access Options 1-3, the visibility of trucks travelling on Bridge Road during the operational phase would increase. Heavy vehicle movements would be very frequent and this is likely to have some impact on visual amenity as residents view the road from their home or nearby areas. Residents may be somewhat accustomed to the presence of some larger/heavy vehicles since Bridge Road is directly connected to main roads (George Street and Pacific Highway).

For Access Options 2, 3 and 4, the route along Quarry Road has previously been used by trucks for access to the quarry, however it has not been utilised for this purpose for approximately 15 years. Based on expected truck sizes and turning circles, it is expected that trucks could be accommodated on the existing road. Although there would be minimal vegetation clearance along this route, properties on Quarry Road are likely to experience visual impacts with regard to increased heavy vehicle traffic. This area is predominately residential and does not connect directly to a main road and as such existing traffic is predominantly generated by the immediate local area.

Unobstructed views of the proposed access roads would be achievable from Old Mans Valley which is relatively devoid of vegetation. However, this location represents an area for occasional recreation and visitation. As such, any impacts are likely to be experienced on an intermittent basis by visitors to the area.

Table 5-14 provides a subjective assessment of the potential changes to visual landscape quality in the area should the proposal be undertaken.

Table 5-14 Key Landscape Features and Subjective Assessment of Potential Changes in Visual Quality.

Landscape Feature	Visual Quality (Existing)	Visual Quality (Site Establishment)	Visual Quality (Operation)	Visual Quality (Completion)
Undulating topography with tall open woodland forest	High	High	High	High
Ridgeline development	Low	Low	Low	Low
Old Mans Valley	Moderate-High	Moderate	Moderate	Moderate-High
Quarry Pit	Moderate-High	Moderate-High	Low-Moderate	Moderate-High
Berowra Valley Regional Park	High	High	High	High
Road and trail network	Low	Low	Low	Low

Table 5-14 indicates that during the site establishment phase there is likely to be a minor decrease in the visual quality of the landscape, since the use of plant and equipment would be required in Old Mans Valley to construct the access roads.

During the operational stage of the works, visual amenity is likely to be somewhat regained in Old Mans Valley as construction equipment and debris from the access roads is removed from the site. However, large trucks would still be frequently present in the landscape due to the requirement for transport of VENM fill material to the site. The activities taking place within the quarry are unlikely to be able to be observed due to screening vegetation around the quarry pit perimeter. It is possible that the activities within the quarry pit may be able to be observed from some elevated vantage points towards the end of the project, as fill levels become higher. Further investigation should be undertaken to provide an assessment of the potential visual impacts of the activities within the quarry pit particularly during the later stages of the project. This could be undertaken through the use of tree and building height surveys or LIDAR analysis to assess views to the quarry pit, especially from locations that were unreachable as part of this assessment (e.g. from the back of private properties).

On completion of the project, visual amenity is likely to increase (as compared to visual amenity during the site establishment and operation phases) due to cessation of filling works, rehabilitation of the site and revegetation or landscaping of the area.

5.10.4 Proposed Mitigation Measures and Residual Impacts

Construction of the access roads (particularly the Bridge Road extension if Access Options 1, 2 and 3 are adopted) should be undertaken in a manner that does not allow excessive site equipment, debris or waste to accumulate nearby. Once construction of the access roads is completed, all debris should be removed from the site and disposed of appropriately. Site equipment and any temporary facilities/amenities should also be removed in a timely manner.

Given the surrounding landscape features and vegetation, visual impacts during the operational phase of the proposed works are not anticipated to be major and so mitigation measures relate primarily to the maintenance of screening vegetation. Only vegetation that has been approved for removal should be removed from the site. All other vegetation should be maintained wherever possible.

5.10.5 Key Findings and Option Comparison

- Access Option 1 (Bridge Road only) would require the removal of some screening vegetation and is therefore likely to slightly modify the visual landscape in the area. The construction of the access road (during the construction phase) and the frequent movement of heavy vehicles (during the operational phase) are likely to be visible from some locations, potentially including a limited number of residential properties. However, Bridge Road is closer to a main road than Quarry Road so residents in this location may be more accustomed to heavy traffic.
- For the purposes of this investigation, Access Option 1 (Bridge Road access) and Access Option 4 (Quarry Road access) impacts would equate to the combination of impacts associated with either of the two loop route options. This means that some impacts on visual amenity would be experienced on both roads. Heavy vehicle movements would, however, be spread across two access routes (entry and exit) instead of being concentrated on one road.

5.11 Environmental Risk Assessment

Risks are an inherent part of any project. Risk pertains to the uncertainty of outcome resulting from a given action. Any one action creates the potential for a diversity of potential outcomes, including both favourable and unfavourable outcomes. These outcomes may affect the achievement of project objectives. For the purpose of this risk assessment, the study has focussed on the potential for negative outcomes as a result of the proposed quarry filling. Depending on the negative risks faced (i.e. the potential negative impacts identified in the environmental impact assessment), the project may be deemed too costly to undertake.

A risk assessment was conducted for the site establishment works and operational aspects associated with the filling of Hornsby Quarry in accordance with the Australian and New Zealand Standard for risk management ASNZS 4360:2004. The risk assessment focused specifically upon project risks. The purpose of the risk assessment is to identify the project risks and to estimate the likelihood and consequence of the potential associated outcomes/impacts.

Risk is a function of likelihood and consequence, which are described in the following sections.

5.11.2 Likelihood

The likelihood of an impact occurring is best described in terms of its associated probability. Typically, the probability of a particular outcome occurring is determined through qualitative assessment by experienced practitioners. However, in all qualitative assessments there is also a further degree of uncertainty associated with the ability for qualitative assessments to be made (i.e. reflecting the availability of knowledge, human error etc.). Consequently, in the assignment of probabilities it is considered best practice to adopt a conservative approach (i.e. over-estimate the probability of impact occurrence) to account for the underlying uncertainty.

For the purposes of this assessment a series of 'Occurrence Probability Categories' were established to capture the likelihood of a specific impact occurring. The categories developed are summarised in **Table 5-15**.

Table 5-15 Risk Outcome Likelihood Criteria

Occurrence Probability Category	Description	Probability
Improbable	The outcome is not expected to occur	<5%
Unlikely	The outcome will only occur in a few circumstances	6 – 35%
Possible	The outcome may occur	36 – 65%
Likely	The outcome will occur in most circumstances	66 – 95%
Probable	The outcome is expected to occur.	>95%

5.11.3 Consequence

The consequence of an outcome refers to the foreseeable magnitude of its impact on the applicable range of 'sensitive' receivers. As such, whether a specific outcome has an impact or not is dependent on whether any 'sensitive' receivers are present to be impacted upon. The range of sensitive receivers considered for the purposes of this study include:

- Natural Systems – the existing natural environment;
- Social Systems – the human and built environment; and
- Economic Systems – the financial environment.

It is noted that any one outcome may impact on one or more of these receivers.

Further, the magnitude of consequence will vary in regard to the sensitivity of the receptors within each of the identified systems (e.g. highly degraded environmental systems are likely to be less sensitive to disturbance than pristine environmental systems).

Collectively, all these elements can be qualitatively assessed to ascribe a consequence magnitude categorisation for all potential outcomes resulting from a specific action. For the purpose of this assessment a series of 'Consequence Magnitude Categories' were developed to qualitatively capture the consequence of a specific action. The categories adopted, and relevant triggers within the range of sensitive receivers (examples provided), are displayed in **Table 5-16**. All qualitative assessments carry with them a further level of systemic uncertainty. In recognition of this, a conservative approach has been adopted (i.e. over-estimating the magnitude of consequence). The final categorisation of any one particular risk was determined by the average categorisation of the impact across the relevant consequence elements.

Table 5-16 Risk Consequence Criteria

Consequence Element		Consequence Magnitude Categories and Examples				
		Minimal	Minor	Moderate	Major	Catastrophic
Magnitude	Spatial	A single pool	A reach or river or part of a catchment	Multiple reaches or whole catchment	Multiple catchments	Whole of basin
	Intensity	Low level behavioural, lifespan or condition effect	Moderate impact on growth, recruitment or survival rates	Acute impacts on some species	Lethal impacts on some species	Lethal for individuals or a community
Temporal	Duration	Single incident or transient effect	Short term impact, single generation	Medium term	Long term, multiple generations	Permanent
Ecological	Values	Previously disturbed areas	Parkland	Native fauna and flora	Conservation area of listed species	Wilderness or Nationally threatened species
	Sensitivity	Will recover completely	Will recover with some changes	Moderate change to ecosystem functioning	Significant change to ecosystem functioning	Will not recover
Social	Number of People	Some people indirectly impacted	Some people directly impacted or several indirectly	Several people directly impacted or many indirectly	Large number of people directly impacted	Loss of Life
	Heritage	Impact on item of minimal significance	Impact on multiple items of low significance	Impact on significant item	Impact on multiple significant items	Major impact on protected item
	Political	Single negative press article	Multiple negative press articles	Significant public interest	Leads to an enquiry	Change of Government
Economic	Financial	Minimal losses	Several thousand dollars lost revenue or remediation costs	Half million dollars in lost revenue or remediation costs	One million dollars lost in revenue or remediation costs	Several million dollars in lost revenue or remediation costs.

5.11.4 Risk Rating

Utilising both the likelihood and consequence categories, it is possible to develop a risk rating matrix to identify a qualitative estimate of risk associated with any one particular impact resulting from the proposed works. The matrix (**Table 5-17**) demonstrates that risk is greatest where both likelihood and consequence are large (i.e. 'probable' likelihood and 'catastrophic' consequence).

Table 5-17 Risk Ratings

Likelihood	Consequence				
	Minimal	Minor	Moderate	Major	Catastrophic
Improbable	Negligible	Negligible	Very Low	Low	Medium
Unlikely	Negligible	Very Low	Low	Medium	High
Possible	Very Low	Low	Medium	High	Very High
Likely	Low	Medium	High	Very High	Extreme
Probable	Medium	High	Very High	Extreme	Extreme

5.11.5 Risk Identification and Evaluation

The environmental impact assessment outlined in **Sections 5.1** to **5.10** identified the impacts associated with the proposed quarry filling and mitigation measures available to reduce the risks associated with these impacts. For each impact identified, a risk rating has been determined both prior to and after the implementation of mitigation measures. The resultant risk level is indicated by colour coding, consistent with **Table 5-17**.

The outcomes of the risk assessment are provided in **Table 5-18**.

Table 5-18 Environment Risk, Mitigation Measures and Residual Risk Assessment

Aspect	Issue	Impact	Access Option	Likelihood	Consequence	Risk	Mitigation Measure	Final Likelihood	Final Consequence	Residual Impact Risk
Traffic and Transport	Traffic delays - Traffic generation due to delivery of fill by trucks on local roads.	Trucks exiting the quarry via Quarry Road and then turning south onto Pacific Highway from William Street have the potential to increase traffic delays expected to exist in 2021 from south bound traffic along Pacific Highway (between Bridge Road and William Street).	1	Improbable	Minimal	Negligible	None Necessary	Improbable	Minimal	Negligible
			2	Improbable	Minimal	Negligible	None Necessary	Improbable	Minimal	Negligible
			3	Probable	Minimal	Medium	Coordinating the traffic signals at intersections in order to optimise the flow of vehicles.	Likely	Minimal	Low
			4	Probable	Minimal	Medium	Coordinating the traffic signals at intersections in order to optimise the flow of vehicles.	Likely	Minimal	Low
Traffic and Transport	Queuing - Traffic generation due to delivery of fill by trucks on local roads.	Trucks exiting the quarry via Quarry Road and then turning south onto Pacific Highway from William Street causes trucks to queue back along William Street with insufficient green time to release the right turning vehicles onto Pacific Highway.	1	Improbable	Minimal	Negligible	None Necessary	Improbable	Minimal	Negligible
			2	Improbable	Minimal	Negligible	None Necessary	Improbable	Minimal	Negligible
			3	Probable	Moderate	Very High	Coordinating the traffic signals at intersections in order to optimise the flow of vehicles. Adjust kerb side parking on William Street to enable left turn lane.	Likely	Minor	Medium
			4	Probable	Moderate	Very High	Coordinating the traffic signals at intersections in order to optimise the flow of vehicles. Adjust kerb side parking on William Street to enable left turn lane.	Likely	Minor	Medium
Traffic and Transport	Traffic generation due to delivery of fill by trucks on local roads.	The increased flow of heavy vehicle movements along local and main roads is likely to have an impact on the condition of the road surface.	All	Likely	Moderate	High	Ongoing maintenance of affected roads.	Possible	Moderate	Medium
Traffic and Transport and Social	A fill time of 8 years will result in an addition 46 trucks per hour on the proposed access routes (23 in each direction).	The large volume of heavy vehicles in local streets may impact on pedestrian and local traffic safety.	1	Likely	Moderate	High	A Traffic Management Plan (TMP) must be prepared and implemented by the Contractor prior to the commencement of works to manage potential traffic impacts and issues. The TMP will improve general road safety and should include relevant warning and advisory signage.	Likely	Minor	Medium
			2	Probable	Moderate	Very High		Probable	Minor	High
			3	Probable	Moderate	Very High		Probable	Minor	High
			4	Probable	Moderate	Very High		Probable	Minor	High
Noise	Increase in local heavy vehicle movements will cause road traffic noise.	Noise levels at receivers will exceed guidelines and significantly increase existing noise levels.	1	Probable	Moderate	Very High	Provide acoustic property treatments to affected residential receivers.	Probable	Minor	High
			2	Probable	Major	Extreme		Probable	Moderate	Very High
			3	Probable	Major	Extreme		Probable	Moderate	Very High
			4	Probable	Major	Extreme		Probable	Moderate	Very High
Noise	Infill operations within the quarry site will generate noise.	Noise levels at receivers will exceed guidelines and significantly increase existing noise levels.	All	Probable	Major	Extreme	~ Minimising the number of plant items in use in the quarry area and surrounds at any one time. ~ Installation of an acoustics shed at entry point. ~ Limit any onsite works to quarry opening hours.	Probable	Major	Extreme
Air Quality	Truck movements along quarry access roads after	Dust deposition may cause risks to human health, damage to property, localised air	1	Likely	Minimal	Low	All vehicles leaving the site or moving from unsealed to sealed	Unlikely	Minimal	Negligible

Aspect	Issue	Impact	Access Option	Likelihood	Consequence	Risk	Mitigation Measure	Final Likelihood	Final Consequence	Residual Impact Risk
	leaving the site may generate dust emissions (wheel-generated dust).	pollution, water pollution and impacts on flora and fauna.	2	Likely	Minor	Medium	roads should use a rumble grid and pit prior to exiting, and a wheel wash facility should be implemented to remove excess mud or dirt as required.	Unlikely	Minor	Very Low
			3	Likely	Minor	Medium		Unlikely	Minor	Very Low
			4	Likely	Minor	Medium		Unlikely	Minor	Very Low
Air Quality	Uncovered loads of fill arriving at the site may generate dust emissions.	Dust deposition may cause risks to human health, damage to property, localised air pollution, water pollution and impacts on flora and fauna.	All	Unlikely	Moderate	Low	No uncovered loads should be accepted for entry to the quarry.	Unlikely	Moderate	Low
Air Quality	Unloading fill materials from trucks and placement into the quarry void may generate dust emissions.	Dust deposition may cause risks to human health, damage to property, localised air pollution, water pollution and impacts on flora and fauna.	All	Likely	Moderate	High	~ Use water sprays to reduce dust emissions during unloading activities. ~ Regularly check weather conditions and forecasts and adjust work practices accordingly, particularly if high wind speeds are predicted or experienced.	Possible	Minor	Low
Air Quality	Spreading and compacting works at the site may generate dust emissions.	Dust deposition may cause risks to human health, damage to property, localised air pollution, water pollution and impacts on flora and fauna.	All	Likely	Moderate	High	~Where feasible, limit the area of exposed excavated materials on site. ~ Use water sprays to reduce dust emissions	Possible	Minor	Low
Air Quality	Stockpiles (if any) during dry and windy conditions may generate dust emissions.	Dust deposition may cause risks to human health, damage to property, localised air pollution, water pollution and impacts on flora and fauna.	All	Likely	Moderate	High	~ Any stockpiles should be in an appropriate location with respect to likely wind conditions, and should be maintained in a reasonable size so that covering and/or wetting down may be more easily undertaken if needed. ~ Regularly check weather conditions and forecasts and adjust work practices accordingly, particularly if high wind speeds are predicted or experienced.	Possible	Minor	Low
Air Quality	Regular truck movements to and from the quarry site during the site establishment and particularly the operational phase will also generate combustion (exhaust) emissions.	Exhaust emissions from trucks and machinery can have human health implications and CO ₂ emissions can contribute to climate change.	1	Likely	Minimal	Low	~ On-site plant and machinery should not be left in idle. Engines should be turned off when parked. ~ Ensure that equipment, machinery and trucks are adequately maintained.	Likely	Minimal	Low
			2	Probable	Minimal	Medium		Probable	Minimal	Medium
			3	Probable	Minimal	Medium		Probable	Minimal	Medium
			4	Probable	Minimal	Medium		Probable	Minimal	Medium

Aspect	Issue	Impact	Access Option	Likelihood	Consequence	Risk	Mitigation Measure	Final Likelihood	Final Consequence	Residual Impact Risk
Air Quality	The afternoon winds from the east or south-east may result in dust deposition on bushland contained within Berowra Valley Regional Park.	Dust deposition within this area may impact on both the vegetation and the waterways in Berowra Valley Regional Park.	All	Likely	Moderate	High	~Onsite management of dust should be undertaken. Any stockpile should be maintained at a reasonable size, covered and wetted as required. ~Regularly check weather conditions and forecasts to adjust work practices accordingly, especially if high wind speeds are predicted or experienced.	Possible	Minimal	Very Low
Groundwater	Excavation from development activities on the rim of the quarry is unlikely to intersect groundwater from the deeper aquifer above a depth of three metres below ground level. However, excavations may intersect water stored in surface unconsolidated sediments.	Excavations may impact the groundwater flow or existing groundwater extraction bores.	All	Improbable	Moderate	Very Low	None Necessary	Improbable	Moderate	Very Low
Groundwater	Filling the void with consolidated materials (VENM) may have an impact on the groundwater flow rate through the site once filled.	Groundwater currently flows through the surrounding subsurface materials into the void. Filling the void with consolidated VENM is likely to reduce the groundwater flow rate into this location. However, the flow rate is likely to be closer to the groundwater flow rate before quarry activities were undertaken.	All	Likely	Minimal	Low	None Necessary	Likely	Minimal	Low
Groundwater	Groundwater quality can be impacted by filling materials.	Contaminants in the filling material have the potential to cause contamination of groundwater.	All	Possible	Major	High	Material acceptance criteria will require that all material received at the facility is actually VENM.	Improbable	Major	Low
Groundwater	Groundwater quality can be impacted by quarry filling facilities and machinery.	Stormwater and sewerage facilities have the potential to impact the water quality of the groundwater if not managed appropriately.	All	Possible	Moderate	Medium	Installation of septic, sewerage and stormwater facilities should be contained in a manner to avoid contact with the groundwater.	Unlikely	Moderate	Low
Groundwater	Groundwater quality can be impacted by quarry filling facilities and machinery.	Oil and petrol spills from machinery could contaminate groundwater.	All	Possible	Moderate	Medium	Appropriate procedures, spill kits and response procedures should be in place to prevent / respond to petrol, oil and other chemical spills.	Unlikely	Moderate	Low

Aspect	Issue	Impact	Access Option	Likelihood	Consequence	Risk	Mitigation Measure	Final Likelihood	Final Consequence	Residual Impact Risk
Topography and Geology	High risk of instability on the southern quarry wall.	Access to the base of the quarry (when filling is below RL46) by Compactor, utes and fuel truck would be at risk from rock falls from the southern quarry wall.	All	Possible	Catastrophic	Very High	~ Until stabilisation works have been completed: no access to the quarry after heavy rainfall, establishment of defined access paths, limited time and number of visits to the quarry, only allow workers access to the quarry within the cabs of trucks, added protection provided to vehicles working in the quarry floor, ongoing monitoring of stability. ~ Stabilisation works to be completed prior to filling operations commencing. ~ All works would need to be carried out in accordance with Safe Work Method Statements. ~ Geotechnical advice would be sought for all works.	Unlikely	Catastrophic	High
Topography and Geology	Ground levels over filled sites will be subject to degrees of settlement.	Differential settlements of the ground will pose a risk to end use ground quality, safety and risk, ongoing management and costs.	All	Probable	Moderate	Very High	~ To minimise the amount of settlement, filling should involve spreading and compacting fill. ~ End uses of the site should consider settlement issues.	Probable	Minor	High
Flora and Fauna	The construction and/or upgrade of the proposed Bridge Road access routes to the quarry site may require the removal of vegetation including Blackbutt Gully Forest and small amounts of Blue Gum Diatreme Forest.	Removal of vegetation may have adverse impacts on the flora and fauna of this site and any threatened species in the area.	1	Probable	Moderate	Very High	~ A Vegetation Management Plan should be prepared and implemented. ~ All native flora species must be retained with the exception of those approved for removal in the final design. ~ Temporary fencing should be erected around trees. ~ If an animal dwelling is discovered, work must cease until appropriate management actions can be undertaken.	Probable	Minor	High
			2	Probable	Moderate	Very High		Probable	Minor	High
			3	Probable	Moderate	Very High		Probable	Minor	High
			4	N/A	N/A	N/A		N/A	N/A	N/A
Flora and Fauna	Filling the quarry may encroach on remnant vegetation at the edge of the quarry site.	Removal of vegetation may have adverse impacts on the flora and fauna of this site and any threatened species in the area.	All	Possible	Minor	Low	~ A Vegetation Management Plan should be prepared and implemented. ~ All native flora species must be retained with the exception of those approved for removal in the final design. ~ Temporary fencing should be erected around trees. ~ If an animal dwelling is discovered, work must cease until appropriate management actions can be undertaken.	Possible	Minor	Low

Aspect	Issue	Impact	Access Option	Likelihood	Consequence	Risk	Mitigation Measure	Final Likelihood	Final Consequence	Residual Impact Risk
Flora and Fauna	Truck movements and other operations may disturb vegetation.	Truck movements may promote weed dispersal, erosion and sedimentation.	All	Likely	Minor	Medium	Erosion and sediment control measures should be put in place during the proposed site establishment phase. Washing of trucks is undertaken to prevent contamination with weed species, especially those coming from non-local areas. Any revegetation should use local native species.	Possible	Minor	Low
Flora and Fauna	Dewatering of the quarry may impact on aquatic habitat.	Dewatering of the quarry may remove habitat for some aquatic fauna.	All	Possible	Moderate	Medium	~A more detailed investigation of threatened aquatic fauna species should be undertaken, particularly within the quarry pit. This will assist in determining the consequence of these activities and appropriate management measures to be implemented (such as establishment of alternative habitat). ~When dewatering occurs, netting any animals in the bottom of the quarry is recommended with their transfer to local water bodies e.g. Old Mans Valley Creek.	Possible	Minimal	Very Low
Heritage	Construction of the proposed Bridge Road access route has the potential for as yet undiscovered Aboriginal objects to be uncovered. The construction of this access route would require excavation in the area to the east of the site (Access Options 1, 2 and 3). These areas currently consist of parkland with stands of vegetation in some locations. Aboriginal objects may potentially exist in this area.	Aboriginal heritage objects may be discovered during operational works and could be desecrated.	1	Possible	Moderate	Medium	~Contractors and all staff contracted to undertake works should be informed of their responsibilities in the event that Aboriginal objects are identified. ~An appropriate protocol should be maintained to ensure impacts are minimised. Should any Aboriginal objects be uncovered during the works, an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the Act would need to be obtained if the item is likely to be impacted by the works.	Possible	Minor	Low
			2	Possible	Moderate	Medium		Possible	Minor	Low
			3	Possible	Moderate	Medium		Possible	Minor	Low
			4	Improbable	Moderate	Very Low		Improbable	Minor	Negligible
Heritage	Higgins Family Cemetery is near the quarry site and listed on the RNE (non-statutory), State and LEP registers.	Work in the quarry area may cause accidental or unauthorized access and potential desecration or destruction of the Higgins Family Cemetery.	1	Improbable	Moderate	Very Low	Heritage items should be avoided and routes which avoid them should be specified in a Construction Traffic Management Plan which includes speed limits that should be adhered to. All persons on site should be made aware of the heritage sites.	Unlikely	Moderate	Low
			2	Unlikely	Moderate	Low		Unlikely	Moderate	Low
			3	Unlikely	Moderate	Low		Unlikely	Moderate	Low
			4	Unlikely	Moderate	Low		Unlikely	Moderate	Low

Aspect	Issue	Impact	Access Option	Likelihood	Consequence	Risk	Mitigation Measure	Final Likelihood	Final Consequence	Residual Impact Risk
Heritage	Higgins Family Cemetery is near the quarry site and listed on the RNE (non-statutory), State and LEP registers.	Work in the quarry area may have vibration impacts on the Higgins Family Cemetery	1	Improbable	Moderate	Very Low	If roads are maintained in a good condition, vibration impacts are anticipated to be minimal. If any vibrations caused by the works are affecting the heritage items, work should stop immediately and the OEH (Heritage Branch) should be informed.	Improbable	Moderate	Very Low
			2	Unlikely	Moderate	Low		Unlikely	Moderate	Low
			3	Unlikely	Moderate	Low		Unlikely	Moderate	Low
			4	Unlikely	Moderate	Low		Unlikely	Moderate	Low
Heritage	The diatreme, a RNE (non-statutory) item, is within the quarry.	The diatreme will be covered up if the quarry is filled.	All	Probable	Moderate	Very High	Investigate and implement appropriate means of recording the value of the site via photographs, video, and written documentation.	Probable	Minor	High
Social	Quality of living may be impacted due to noise, dust, and increased traffic	Owners of surrounding properties may find it difficult and/or be unable to sell their properties during the time it will take to fill the quarry.	1	Likely	Moderate	High	Implementation of mitigation measures noted above concerning noise, dust and traffic.	Likely	Minor	Medium
			2	Likely	Major	Very High		Likely	Moderate	High
			3	Likely	Major	Very High		Likely	Moderate	High
			4	Likely	Major	Very High		Likely	Moderate	High
Social	Increased traffic and workers in the area may cause social nuisance.	Due to the increase of workers and increased traffic, there may be a lack of parking for local residents and businesses.	1	Possible	Moderate	Medium	~Identify and provide alternate parking areas for residents and business along affected routes and ongoing traffic monitoring. ~Provide worker parking within the quarry site. ~Do not allow trucks travelling to or from the quarry site to park along the access roads.	Unlikely	Minor	Very Low
			2	Possible	Moderate	Medium		Unlikely	Minor	Very Low
			3	Possible	Moderate	Medium		Unlikely	Minor	Very Low
			4	Possible	Moderate	Medium		Unlikely	Minor	Very Low
Visual Amenity	Due to the proposed works of establishing the Bridge Road extension, the visual appearance of the quarry will be changed.	During the construction of the Bridge Road extension, the visual impact of the site and its surrounds will be adversely impacted by equipment, trucks and changes of terrain.	1	Likely	Minor	Medium	Construction of the Bridge Road extension should be undertaken so that excessive site equipment and debris should be removed as soon as possible. In regards to the surrounding landscape vegetation, maintenance of screening vegetation is key.	Possible	Minor	Low
			2	Likely	Minor	Medium		Possible	Minor	Low
			3	Likely	Minor	Medium		Possible	Minor	Low
			4	Improbable	Minor	Negligible		Improbable	Minor	Negligible
Visual Amenity	Removal of vegetation along the proposed access routes.	Decreased visual amenity along the proposed access routes may impact residents and users of the nearby TAFE.	1	Likely	Minor	Medium	~Maintain existing vegetation as much as practicable to provide visual screening to adjacent properties. ~Consider planting new screenings in affected locations.	Likely	Minor	Medium
			2	Likely	Minor	Medium		Likely	Minor	Medium
			3	Likely	Minor	Medium		Likely	Minor	Medium
			4	Possible	Minimal	Very Low		Possible	Minimal	Very Low
Visual Amenity	Removal of vegetation along the proposed access routes.	Unobstructed views of the proposed Bridge Road extension would be achievable from Old Mans Valley which is relatively devoid of vegetation. Decreased visual amenity would be experienced by visitors to the area.	1	Probable	Minor	High	~Maintain existing vegetation as much as practicable to provide visual screening to adjacent properties. ~Consider planting new screenings in affected locations.	Likely	Minimal	Low
			2	Probable	Minor	High		Likely	Minimal	Low
			3	Probable	Minor	High		Likely	Minimal	Low
			4	Improbable	Minor	Negligible		Improbable	Minimal	Negligible
Visual Amenity	Visibility of trucks travelling on access roads	During the operational phase of the quarry filling, truck movements will increase and become	1	Likely	Minor	Medium	The community should be well informed about the potential	Likely	Minor	Medium

Aspect	Issue	Impact	Access Option	Likelihood	Consequence	Risk	Mitigation Measure	Final Likelihood	Final Consequence	Residual Impact Risk
		frequent and may impact upon the visual amenity as residents view the road from their home or nearby areas.	2	Probable	Minor	High	impacts that are likely to be experienced. A complaints register should be established to record any community complaints.	Probable	Minor	High
			3	Probable	Minor	High		Probable	Minor	High
			4	Probable	Minor	High		Probable	Minor	High

5.12 Key Findings and Access Options Comparison: Environmental Impacts Associated with Access Options

Table 5-19 lists the unique and common environmental impacts of each access option, which have been discussed within this report. The table gives a summary of the comparative environmental impacts associated with each access option.

The environmental impacts which are unique to each access option are summarised in **Table 5-19**.

Table 5-19 Environmental Impacts of Access Options

Access Option	Impacts (after mitigation measures applied)
All Access Options	<ul style="list-style-type: none"> Facilities and access associated with filling works may be at risk as a result of instability of the site. There may be a risk to property and life if failure occurs. Differential settlements of ground may affect the end use due to ground quality, safety, ongoing management and costs. The diatreme will be covered up if the quarry is filled. Owners of surrounding properties may find it difficult and/or be unable to sell their properties during the time it will take to fill the quarry. During the operational phase of the quarry filling, truck movements will increase and become frequent and may impact upon the visual amenity as residents view the road from their home or nearby areas. The increased flow of heavy vehicle movements along local and main roads is likely to have an impact on the condition of the road surface. Noise from the filling operations within the quarry will exceed relevant noise criteria at several locators around the quarry.
Access Option 1	<ul style="list-style-type: none"> Traffic noise criteria is exceeded at two locations. The Bridge Road extension may require removal of vegetation, which may have adverse impacts on flora/fauna. Decreased visual amenity along the proposed access routes may impact residents and users of the nearby TAFE.
Access Option 2	<ul style="list-style-type: none"> Traffic noise criteria is exceeded at six locations. The Bridge Road extension may require removal of vegetation, which may have adverse impacts on flora/fauna. Decreased visual amenity along the proposed access routes may impact residents and users of the nearby TAFE. More residences are probably going to experience more exhaust emissions from trucks and machinery than Access Option 1.
Access Option 3	<ul style="list-style-type: none"> Some additional traffic delays for southbound vehicles at Pacific Highway. This access option causes trucks to queue back along William Street. Traffic noise criteria is exceeded at six locations. The Bridge Road extension may require removal of vegetation, which may have adverse impacts on flora/fauna. Decreased visual amenity along the proposed access routes may impact residents and users of the nearby TAFE. More residences are probably going to experience more exhaust emissions from trucks and machinery than Access Option 1.
Access Option 4	<ul style="list-style-type: none"> Some additional traffic delays for southbound vehicles at Pacific Highway. This access option causes trucks to queue back along William Street. Traffic noise criteria is exceeded at five locations. More residences are probably going to experience more exhaust emissions from trucks and machinery than Access Option 1.

6 Economic Analysis

An assessment was undertaken of the indicative costs for filling operations and mitigation measures for each access option as well as an analysis to determine the economic viability of filling the quarry with VENM. The analysis has been undertaken for an eight-year and a twenty-year period. Previous traffic modelling suggests that eight years is the shortest time period which would not have an unacceptable impact on road network performance and a twenty-year period is included to assess the economic impacts associated with a longer fill period. There is uncertainty over the source of supply of VENM, which may extend the project length. It should be noted that noise and traffic modelling (and hence impact assessments) only considered an eight-year filling period.

There is also uncertainty as to the value of VENM in the market place, and it is expected that depending on the source, and the timing, there would be circumstances when Council may need to pay to purchase VENM, and other circumstances when people would be prepared to pay for disposal of the material. A range of scenarios are explored in this section.

All economic data provided in this assessment is indicative only, and is accurate only to a reasonable order of magnitude. However, it is considered that this is appropriate for the objective of providing sufficient information for the purposes of this report. More detailed economic evaluation would be required to present a final cost benefit analysis for the proposal should filling proceed.

6.3 Costs

6.3.2 Site Establishment and Operational Costs

Table 6-1 presents indicative costs for the filling operations which have been estimated by an experienced Civil Engineer based on available information and experience on similar projects. Costs listed in this analysis are present day costs, unless otherwise stated. A more detailed breakdown of these costs and the associated assumptions can be found in **Appendix E**.

Costs have been estimated for site establishment and infrastructure, filling operations and labour and include initial and ongoing costs associated with these items. It should be noted that costs for the establishment of the end use of the site have not been included (e.g. landscaping and public amenities). Itemised costs which are common to all access options are shown in **Table 6-1**.

Table 6-1 Itemised Costs for Site Establishment and Filling Operations Common to All Access Options (to the nearest \$10,000s)

Cost Items	8 year	20 year
Site Establishment	\$950,000	\$1,310,000
Access Works (including stabilisation)	\$2,030,000*	\$2,600,000*
Entrance facility (Acoustic shed)	\$1,050,000	\$1,610,000
Plant Maintenance Shed/Store	\$160,000	\$230,000
Stormwater management	\$130,000	\$220,000
Plant Items	\$10,480,000	\$25,250,000
Personnel	\$6,770,000	\$15,790,000
Survey	\$540,000	\$1,150,000
Geotechnical works	\$290,000	\$650,000
Preliminaries	\$1,030,000	\$2,410,000
Demobilisation	\$250,000	\$250,000
TOTAL	\$23,680,000	\$51,470,000

*Access Options including access via Quarry Road Options (Access Option 2, 3 and 4) would require an additional \$360,000 to provide access

In addition to the costs shown in **Table 6-1**, Council engineers have estimated the extension of Bridge Road to be \$6 million based on a concept design, and construction to a condition where minimal to no annual costs are required. This cost is only applicable to Access Options 1, 2 and 3. Since Quarry Road is in fairly good condition, only minor works are needed to make Quarry Road suitable for use and a capital cost is estimated to be \$200,000. However, maintenance costs of approximately \$20,000 per annum are expected to be required. Quarry Road works are only applicable for Access Option 2, 3 and 4.

6.1.2 Mitigation Costs

Costs would be incurred during site establishment and during the filling operations in order to manage the environmental and social impacts identified in **Section 5**. Estimated mitigation cost totals for each access option are listed in **Table 6-2**. A further breakdown of itemised mitigation cost items can be found in **Appendix E**. As noise has been identified as a key issue, mitigation costs include acoustic treatments. While it is acknowledged that a potential mitigation measure is to offer financial compensation for those properties affected by noise, application of this measure is not currently proposed due to practical difficulties in its application.

Capital mitigation costs will be one off costs at the start of the project, while demobilisation mitigation costs occur at the close of the project. Annual mitigation costs refer to per annum costs which will feature throughout the project.

Table 6-2 Mitigation Costs for Access Options (to the nearest \$10,000s)

Access Option	Capital Mitigation Costs	Annual Mitigation Costs	Demobilisation Mitigation Costs	Total Mitigation Costs	
				8 years	20 years
Option 1	\$1,180,000	\$60,000	\$100,000	\$1,760,000	\$2,480,000
Option 2	\$2,670,000	\$60,000	\$100,000	\$3,250,000	\$3,970,000
Option 3	\$2,670,000	\$60,000	\$100,000	\$3,250,000	\$3,970,000
Option 4	\$1,680,000	\$60,000	\$100,000	\$2,260,000	\$2,980,000

6.1.3 Total Costs

In addition to costs for site establishment and mitigation measures, costs (including staff costs) would be incurred for operation of the site. The total infrastructure and operating costs estimated for the project for each of the access options, are outlined in **Table 6-3**.

Table 6-3 Total Infrastructure and Operating Costs (excluding fill material) (to the nearest \$10,000s)

Access Option	Infrastructure and Operating Costs*	Costs of Impact Mitigation Measures	Total
8 Year Filling Period			
Option 1	\$29,680,000	\$1,760,000	\$31,440,000
Option 2	\$30,040,000	\$3,250,000	\$33,290,000
Option 3	\$30,040,000	\$3,250,000	\$33,290,000
Option 4	\$24,040,000	\$2,260,000	\$26,300,000
20 Year Filling Period			
Option 1	\$57,470,000	\$2,480,000	\$59,950,000
Option 2	\$58,070,000	\$3,970,000	\$62,040,000
Option 3	\$58,070,000	\$3,970,000	\$62,040,000
Option 4	\$52,070,000	\$2,980,000	\$55,050,000

*These costs are based on data in **0**, with addition of costs specific to each option

6.1.4 Section 88 Waste Contributions

The *Protection of the Environment Operations Act* 1997 (POEO Act) requires licensed waste facilities in NSW to pay a contribution levy in respect of each tonne of waste received for disposal at the facility. The levy aims to reduce the amount of waste being disposed of and promote recycling and resource recovery.

The levy applies in the regulated area of NSW which comprises the Sydney Metropolitan Area, the Extended Regulated Area (Illawarra and Hunter regions) and since 1 July 2009, the Regional Regulated Area which includes the north coast Local Government Areas from Port Stephens to the Queensland border as well as the Blue Mountains and Wollondilly Local Government Areas.

Facilities that are used solely for the purposes of recovering, recycling or processing waste, other than liquid waste, do not have to pay the waste and environment levy.

The current levy rate (2012 – 2013) for the Sydney Metropolitan Area is \$95.20 per tonne of waste deposited.

Under current government policy, a site that only receives VENM (any amount) is not required to become licenced as a landfill (GHD, 2009). Since the Waste Levy only applies to material received at licenced landfills, it does not apply to facilities that only receive VENM. Sites such as Kimbriki Resource Recovery Centre at Ingleside/Terrey Hills is a mixed waste facility and therefore must apply the Waste Levy to VENM and currently charges \$125 per tonne which is equivalent to \$29.80 per tonne without the levy.

For the reasons outlined above, the Section 88 Waste Levy has not been included in this economic assessment, however, it is noted that the fact that it would not apply to VENM materials used as fill

at the quarry has the potential to make this a more attractive option to a VENM holder than sending it to a licensed landfill site.

6.2 Considering VENM as a Project Cost

Due to a high degree of uncertainty in the construction industry and waste / resource market, it is uncertain whether VENM can be considered for the purposes of this project as a cost or a revenue source. An economic assessment has been undertaken for both situations and a combination of the two. This section considers VENM as being a cost to the project, and the following sections consider the scenarios when Council may be paid to receive VENM at the landfill.

6.2.1 Competing VENM receivers

GHD (2009) identified other receivers of VENM in the Sydney region, the potential competitors of Hornsby Quarry. The closest facility which receives VENM is Greenwood Landfill Waste Recovery Facility which accepts non-putrescible waste, located approximately 10km from Hornsby Quarry. However, as it is a receiver of other materials which are not VENM, the \$95.20 / tonne waste levy applies which may not be cost efficient for VENM suppliers.

GHD (2009) has identified six facilities which receive only VENM in the Sydney Region. The closest is Boral Prospect Recycling Plant, approximately 25km from Hornsby Quarry.

6.2.2 Cost of VENM to the project

The purchase price of VENM is highly variable due to the nature of the market, therefore, a detailed analysis of VENM costs is difficult to achieve. Additionally, there is reluctance from operators to divulge commercially sensitive information as the purchase price of VENM is dependent on both the nature of construction projects and its commercial arrangements. In our experience, VENM can usually be purchased at a cost anywhere between \$5 and \$55 / tonne. At the higher end of the purchase cost range, the VENM is generally of a very high quality. In this analysis, \$15 / tonne has been adopted, based on Cardno's and Council's experience in the industry for the quality and type of fill appropriate for this project. This price also includes transport costs for the fill. It is common practice that the appropriate VENM classification (including testing, if appropriate) is undertaken by the supplier prior to the fill arriving at the site. Therefore no costs have been included for testing.

Due to the variable nature and the uncertainty of the price of VENM outlined above, sensitivity analysis has been undertaken in **Section 6.5** to assess the impact of the possible price variations in VENM.

During the writing of this report, the NSW State Government announced amendments to the General Exemption for Excavated Natural Material (ENM) in mid-October 2012. The aim of the changes is to increase the ease for the reuse of ENM. This may decrease the demand for dumping fill, impacting on the rate of which the quarry is filled. Estimates of the price of VENM are based on the VENM market prior to these changes.

It has been estimated that the total cost of VENM, if purchased at \$15 / tonne to fill the quarry, would be approximately \$137,600,000. The total estimated costs to fill the quarry site are listed in **Table 6-4**, which include site establishment, operational (including the cost of VENM) and mitigation costs. Cost estimates have been provided for 8 year and 20 year filling periods.

Table 6-4 Total Cost to Fill the Quarry (Site establishment, Filling Operations, Mitigation and VENM Costs at \$15 per Tonne) (to the nearest \$100,000s)

Access Option	Total Costs	
	8 Year Filling Period	20 Year Filling Period
Option 1	\$169,000,000	\$198,100,000
Option 2	\$170,900,000	\$199,600,000
Option 3	\$170,900,000	\$199,600,000
Option 4	\$163,900,000	\$192,700,000

6.3 Considering VENM as a Revenue, and Cost Neutrality

Depending on market conditions and opportunities, VENM suppliers have been prepared, in the past, to pay a fee to dispose of VENM. The industry suggests that suppliers may be willing to pay in the order of \$120 to \$190 per tonne to dump VENM to a commercial licensed landfill. This rate includes the \$95.20 / tonne waste levy. However, VENM is also a valuable resource; for a supplier to be willing to pay to dispose of VENM, they will have to identify that they have no beneficial use for VENM at that time, have no means of stockpiling for future use and have not sourced a consumer for their VENM.

As mentioned previously, it is common practice that the appropriate VENM classification (including testing, if appropriate) is undertaken by the supplier prior to the fill arriving at the site. Therefore no costs have been included for testing.

A cost neutrality analysis has been undertaken to identify the fees that would need to be charged to receive VENM at the quarry to achieve a cost neutral basis for the quarry filling. The cost of VENM that would be required is provided in **Table 6-5**.

Table 6-5 VENM to be Charged per Tonne on Entry to the Quarry to Achieve Cost Neutrality

Access Option	Average \$ per Tonne required to achieve cost neutrality	Revenue (equivalent to total infrastructure and operating costs of project)	Average \$ per Tonne required to achieve cost neutrality	Revenue (equivalent to total infrastructure and operating costs of project)
	8 Year Filling Period		20 Year Filling Period	
Option 1	\$3	\$31,440,000	\$6	\$59,950,000
Option 2	\$3	\$33,290,000	\$6	\$62,040,000
Option 3	\$3	\$33,290,000	\$6	\$62,040,000
Option 4	\$2	\$26,300,000	\$5	\$55,050,000

To achieve cost neutrality, the quarry needs to charge an average of approximately \$2 to \$6 per tonne of VENM to the supplier. This rate is extremely competitive when compared to the prices being charged at existing landfill sites in the Sydney area. This is primarily as a result of the exemption of the Waste Levy at the site. However, since VENM is also considered to be a valuable resource in many situations, market conditions are variable, and there is no guarantee that holders

of VENM material would be prepared to pay for its disposal. This analysis assumes that the transport and testing costs are borne by the material supplier.

6.4 Combined Costs and Revenue

Due to the uncertainties in the market with regards to the cost and especially the supply of VENM, it is reasonable to expect that in order to fill the quarry VENM may have to be both purchased and charged for, at different times, and depending on the source of the material. However, if the quarry sets a precedent of purchasing VENM, it may lose the ability to charge for it. Therefore, this analysis has assumed that VENM suppliers would pay the quarry to supply small tonnages of VENM, medium tonnages may be accepted by the quarry at a zero cost to the quarry and larger tonnages may be purchased by the quarry at a reasonable rate.

It is further assumed that:

- 40% of quarry fill will be purchased at a cost of \$15 / tonne.
- 30% of quarry fill will be accepted at zero cost to the quarry.
- 30% of quarry fill will attract revenue from the supplier.

Based on these assumptions, the following rates in **Table 6-6** would need to be charged to suppliers (30% of the total VENM requirement) to achieve cost neutrality.

Table 6-6 VENM Price – Combined Source Analysis

Access Option	VENM Revenue Cost to Achieve Cost Neutrality	
	8 Year	20 Year
Option 1	\$31	\$40
Option 2	\$32	\$40
Option 3	\$32	\$40
Option 4	\$29	\$30

The results of this analysis would indicate that it would be reasonable to assume that the project could have a cost neutral outcome if combined sources of VENM (cost and revenue raising) were to be received at the quarry.

6.5 Sensitivity Analysis

A contingency has not been provided for in the estimation of site costs, therefore, sensitivity analysis has been undertaken to demonstrate the impact of site cost fluctuations on the economic viability of the project. Additionally, there may be potential variations in VENM costs. Given these uncertainties, a sensitivity analysis has been undertaken to determine the following:

- The impact of the price of VENM (variation of \$10) on the project cost when VENM is to be purchased only (i.e. no revenue);
- The impact on the total project cost when infrastructure and operating costs are increased by 50%. This is an important analysis as no contingency has been applied to these costs;
- The impact on the ability to achieve a cost neutral project when infrastructure and operating costs are increased by 50%; and
- The impact on the ability to achieve a cost neutral project when Council is purchasing 40% of VENM at \$15 per tonne, receiving 30% of VENM at zero cost and acquiring the

remaining 30% of VENM as a revenue with the addition of infrastructure and operating costs increased by 50%.

The results of the sensitivity analysis are provided in **Table 6-7**. An explanation of the results is provided following the table.

Table 6-7 Sensitivity Analysis

Sensitivity test	Sensitivity of Total Costs to VENM Cost		Sensitivity of Total Cost to Site Establishment and Operating Costs		Sensitivity of Cost Neutral Price for VENM (\$/tonne) to Site Establishment and Operating Costs		Sensitivity of Cost Neutral Price for VENM (\$/tonne) to Site Establishment and Operating Costs for a Combined VENM Source	
Assumed external change	% Increases and decreases to Total Costs when VENM costs \pm \$10 per Tonne		% Increases and decreases to Total Costs when \pm 50% to Site Establishment and Operating Costs		Neutral Price for VENM when there is a +50% to Site Establishment and Operating Costs		Neutral Price for VENM when there is a +50% to Site Establishment and Operating Costs for a Combined VENM Source	
Key assumptions	Assuming all VENM is Purchased by Council		Assuming all VENM is Purchased by Council at a constant rate of \$15		Assuming no VENM is purchased by Council		Assuming: 40% of VENM is purchased at \$15/tonne 30% of VENM is at zero cost 30% of VENM is a revenue	
	8 Year	20 Year	8 Year	20 Year	8 Year	20 Year	8 Year	20 Year
Option 1	54%	46%	9%	15%	\$5	\$9	\$37	\$50
Option 2	54%	46%	10%	15%	\$5	\$10	\$38	\$50
Option 3	54%	46%	10%	15%	\$5	\$10	\$38	\$50
Option 4	56%	48%	8%	14%	\$4	\$8	\$34	\$40

Note: Data shown as percentages (%) represents percentage change. Data shown in dollars (\$) represents the final VENM costs.

The results indicate that if VENM is to be purchased by Council to fill the site, then this is a significant cost and any increase in the assumed price of VENM (assumed to be \$15/tonne) would result in a significant increase in the project costs. The sensitivity analysis shows that an increase in the VENM cost from \$15 / tonne to \$25 / tonne (66%) resulted in up to 56% increase in project costs.

The dominance of the VENM price (when Council is purchasing VENM) is further highlighted by the sensitivity analysis to the site establishment and operating costs. Even when these costs were increased by 50%, the total project cost only increased by up to 15%.

The analysis also showed that when the site establishment and operating costs were increased by 50% the price Council needs to charge for VENM to achieve a neutral price for the project increased by up to 66%. However, the maximum price was still only \$10 / tonne. This is still well below current market prices at other Sydney facilities.

The sensitivity analysis of the price of VENM to achieve a cost neutral outcome on the combined source analysis (**Section 6.4**) found that the price of VENM needed to increase by up to 25% when the site establishment and operating costs were increased by 50%. However, as above, the price of VENM would still be well below current market prices at other Sydney facilities. As mentioned previously, this is largely due to the fact the existing waste levy of \$95.20 / tonne of waste deposited, under current government policy, would not apply to this site.

6.6 Key Findings and Access Options Comparison

The outcomes of the economic analysis undertaken for the filling of Hornsby Quarry are outlined below:

- Under current government policy, it is reasonable to assume that the filling of Hornsby Quarry could be undertaken on a cost neutral basis. However, there is a significant risk associated with this assumption, as the outcome is strongly dependant on several factors which should be considered.
- If a change in government policy resulted in the disposal of VENM no longer being exempt from Section 88 Waste Contributions, this could have an impact on the price charged to receive VENM at the site. This may result in the Cost Neutral Price no longer being competitive in the market and the suppliers of VENM may turn to other Sydney or regional facilities.
- VENM is a valuable resource; for a supplier to be willing to pay to dispose of VENM, they would have to identify that they have no beneficial use for VENM at that time, have no means of stockpiling for future use and have not sourced a consumer for their VENM. Furthermore, an alternative site that does not charge is not available.
- Filling periods of greater than 20 years have not been considered in this analysis. If VENM availability is limited or the filling operations are extended for other reasons, this may have an impact on the ability to achieve cost neutrality.
- The closest VENM only receiver is Boral Prospect Recycling Plant, approximately 25 km from Hornsby Quarry.
- If VENM cannot be accepted for a fee to the supplier and all or most of the VENM received at the site is purchased by Council, the total cost of filling the quarry could be up to \$200 Million.
- A detailed cost benefit analysis and economic risk assessment would need to be undertaken in order to assess the viability of the project in greater detail, including negative and positive externalities.
- The infrastructure and operating costs, while large, are dominated in the assessment by the potential costs of VENM. In this context, the cost differences between the 4 access options considered are relatively insignificant.

7 Conclusions

This document has been prepared to provide a preliminary environmental, social and economic impact assessment for the proposed filling of Hornsby Quarry. This involved environmental and social impact assessment based on existing information and detailed traffic and noise modelling. Appropriate or available mitigation measures were then identified to manage the potential impacts associated with the filling works. An economic analysis was then undertaken to identify the project costs and potential costs and revenue options associated with sourcing VENM to fill the quarry.

As a result of the environmental and social impact assessment, an environmental risk assessment was undertaken which defined each environmental risk with regards to its likelihood and consequence, combining to provide a risk rating for each impact. Following the identification of potential mitigation measures, the risk associated with each impact was reassessed assuming the application of the mitigation measures to identify an expected level of residual risk. Following the application of the appropriate mitigation measures, the following impacts were identified as 'High', 'Very High' or 'Extreme':

- As a result of both filling activities on site and trucks approaching and leaving the site, noise levels at receivers will exceed guidelines and significantly increase existing noise levels. Noise will increase over time as the quarry is filled;
- The large volume of heavy vehicles in local streets may impact on pedestrian and local traffic safety;
- Facilities and access associated with filling works may be at risk as a result of instability on the site. This could pose a significant risk to life and property if failure occurs;
- The potential for differential settlement of the ground will pose a risk to end use ground quality, safety and risk;
- The diatrema will be covered up if the quarry is filled;
- During the quarry filling, truck movements will increase and become frequent and may impact upon residential amenity or quality of living;
- During the quarry filling, visual amenity may be impacted; and
- If any of the access options including access via Bridge Road (Access Options 1, 2 and 3) are adopted, the required removal of flora may have adverse impacts on the flora and fauna of the site and any threatened species in the area.

The preliminary economic analysis undertaken for this project identified the likely costs associated with the proposed filling of the quarry and assessed potential revenue and cost options associated with the filling material (VENM). In the event of revenue opportunities being available through the receipt of VENM at the site, it was found that the project could feasibly be undertaken as a cost neutral project.

The outcomes of the economic analysis over an eight and twenty year period are shown below in **Table 7-1**. This information assumed the following market rates:

- Average price paid to acquire VENM: \$15 / tonne.
- Average fees charged to accept VENM at existing landfill sites: \$120 - \$190 / tonne which includes the Waste Levy of \$95.20 / tonne. (\$25 - \$95 / tonne without Levy)

Table 7-1 Economic Analysis Outcomes

				Scenario 1	Scenario 2		Scenario 3		Sensitivity on Scenario 3	
Access Option	Access Option Description	Infrastructure and Operational Costs (including impact mitigation measures) (\$)		Total cost of VENM if Purchased at \$15/tonne (\$)	Required Price of VENM per tonne to Achieve Cost Neutrality (\$ / tonne)		Neutral price for VENM revenue per tonne (\$ / tonne)		Neutral price for VENM revenue per tonne. (\$ / tonne) (50% increase in capital and operating costs)	
							<ul style="list-style-type: none"> 40% VENM purchased at \$15/tonne. 30% VENM at zero cost 30% VENM as Revenue 		<ul style="list-style-type: none"> 40% VENM purchased at \$15/tonne. 30% VENM at zero cost 30% VENM as Revenue 	
		8 Year	20 Year	8 and 20 Year	8 Year	20 Year	8 Year	20 Year	8 Year	20 Year
1	Entry and Exit via Bridge Road	\$31.44M	\$59.95M	\$137.60M	\$3	\$6	\$31	\$40	\$37	\$50
2	One-way loop access via roads in Access Options 1 and 4. Entrance via Quarry Road.	\$33.29M	\$62.04M	\$137.60M	\$3	\$6	\$32	\$40	\$38	\$50
3	One-way loop access via roads in Access Options 1 and 4. Entrance via Bridge Road.	\$33.29M	\$62.04M	\$137.60M	\$3	\$6	\$32	\$40	\$38	\$50
4	Entry and Exit via Quarry Road	\$26.30M	\$55.05M	\$137.60M	\$2	\$5	\$29	\$30	\$34	\$40

An assessment was also undertaken on a combined approach to acquiring VENM at the site. This assumed the Council would pay the market rate for VENM from large suppliers, would accept VENM at zero cost to Council for medium suppliers and would charge to accept VENM from small suppliers. Based on a breakdown of 40%, 30%, 30% for large, medium and small scale suppliers respectively, it was found that for 40% of the VENM received, Council would need to charge approximately \$31 per tonne for an 8 Year fill period and \$38 per tonne for a 20 year fill period. However, increasing infrastructure and operating costs by 50% for this scenario, Council would need to charge a higher rate, on average, \$37 per tonne for an 8 year fill period and \$48 per tonne for a 20 year fill period.

The environmental, social and economic assessment undertaken identified that the proposed works result in several significant risks even after the implementation of appropriate mitigation measures. The selection of Access Option 1 (extension of Bridge Road) would reduce these risks

to the greatest degree, Access Option 2 (a one way loop entering at Quarry Road) would reduce risks to a lesser degree.

The economic analysis of the proposed works found that, if VENM suppliers were willing to pay to dispose of the material, then it may be possible to undertake the filling of Hornsby Quarry with a cost neutral outcome. However, this is dependent on market conditions and government policy (in particular relating to the waste levy) during the quarry filling period.

If a change in government policy resulted in the disposal of VENM no longer being exempt from Section 88 Waste Contributions, this could have an impact on the price charged to receive VENM at the site. This may result in the Cost Neutral Price no longer being competitive in the market and the suppliers of VENM may turn to other Sydney or regional facilities.

VENM is a valuable resource; for a supplier to be willing to pay to dispose of VENM, they will have to identify that they have no beneficial use for VENM at that time, have no means of stockpiling for future use and have not sourced a consumer for their VENM.

Filling periods of greater than 20 years have not been considered in this analysis. If VENM availability is limited or the filling operations are extended for other reasons, this may have an impact on the ability to achieve cost neutrality.

If VENM cannot be accepted for a fee to the supplier and all or most of the VENM received at the site is purchased by Council, the total cost of filling the quarry could be up to \$200 Million.

A detailed cost benefit analysis and economic risk assessment will need to be undertaken in order to assess the viability of the project in greater detail, including negative and positive externalities.

8 References

- Amato, F., Pandolfi, M., Viana, M., Querol, X., Alastuey, A. and Moreno, T. (2009) Spatial and chemical patterns of PM10 in road dust deposited in urban environment. *Atmospheric Environment* 43:1650-1659.
- Aquila (2013) *Targeted Varied Sittella Surveys at Old Man Valley*. Prepared for Hornsby Shire Council. Aquila Ecological Surveys
- Brayshaw, H. 2002. Hornsby Quarry: Aboriginal Heritage Assessment. Prepared for to CSR Limited
- Cardno (2011) *Hornsby Quarry Filling - Paramics Modelling Documentation Draft Report*. Prepared for Hornsby Shire Council.
- Cardno (2012a) *LJ2888 Filling of Hornsby Quarry Access Options Report*. Prepared for Hornsby Shire Council
- Cardno (2012b) *Hornsby Quarry Filling Paramics Modelling*. Prepared for Hornsby Shire Council.
- Cardno (2013a) *Technical Addendum - Hornsby Quarry Additional Paramics Modelling; Summary of Findings*. Prepared for Hornsby Shire Council.
- Cardno (2013b) *Noise Impact Assessment - Hornsby Quarry Infill*. Prepared for Hornsby Shire Council.
- Coffey (1989) *Report on proposed filling - Old Mans Valley, Hornsby*. Prepared for Hornsby Shire Council.
- Coffey (1990) *Old Mans Valley Geotechnical Investigations*. Prepared for Hornsby Shire Council.
- DECCW (2011) *Road Noise Policy*. NSW Government.
- Department of Environment and Heritage (2005) *National Standards for Criteria Air Pollutants in Australia: Air Quality Fact Sheet*. Accessed on 29/10/2012 at <http://www.environment.gov.au/atmosphere/airquality/publications/standards.html>
- Dragonfly Environmental (2011) *Review of Environmental Factors (REF) Old Mans Valley and Hornsby Park Proposed Mountain Bike Trail*. Prepared for Hornsby Shire Council. Dragonfly Environmental.
- EPA (2011) *Compilation of Air Pollutant Emission Factors AP 42*, Fifth Edition, United States Environment Protection Agency, Research Triangle Park, North Carolina
- Farmer A.M. (1993) The effects of dust on vegetation--a review. *Environmental Pollution*. 79(1):63-75.
- GHD (2009) *Review of Options for Filling Hornsby Quarry Discussion Paper*. Prepared for Hornsby Shire Council.
- Hornsby Shire Council (2010) *Hornsby Shire Council Housing Strategy Volume 1*. Hornsby Shire Council.
- Hornsby Shire Council (2011) *Planning Proposal Hornsby Quarry*. Hornsby Shire Council.
- Hornsby Shire Council (2012a) *A snapshot of the Hornsby Shire in 2012*. Hornsby Shire Council.
- Hornsby Shire Council (2012b) *Hornsby Quarry Frequently Asked Questions*. Accessed on 12/12/2012 at <http://www.hornsby.nsw.gov.au/planning-and-building/hornsby-quarry/hornsby-quarry-frequently-asked-questions>

Hornsby Shire Council and profile id (2012) Profile ID Community Profile Welcome to Hornsby Shire Community Profile. Accessed on 06/02/213 at <http://profile.id.com.au/hornsby/home>

NPEC (2011) Methodology for setting air quality standards in Australia Part A. National Environment Protection Council.

NSW Government (2012). *NSW Natural Resource Atlas website*. Accessed on 16/10/2012 at <http://www.nratlas.nsw.gov.au>

OEH (2011). *Red-crowned toadlet - vulnerable species listing*. Accessed on 26/10/2012 at <http://www.environment.nsw.gov.au/determinations/RedcrownedToadletVulSpListing.htm>

Parsons Brinckerhoff (2004) *Hornsby Quarry and Environs Land Capability Study and Master Plan - Land Capability Study*. Prepared for Hornsby Shire Council.

Cardno (2012a) *Hornsby Quarry Access Options Assessment*. Prepared for Hornsby Shire Council.

PSM (2007), *Geotechnical and hydrogeological constraints relevant to the land use options within Hornsby Quarry*. Pells Sullivan Meynink Pty Ltd.

Richard Heggie Associates (2000) *Hornsby Shire Council Policy and Guidelines for Noise and Vibration Generating Development*. Prepared for Hornsby Shire Council.

Silcox, R. 1993. Archaeological survey of proposed sub-division at Hornsby, Sydney, NSW. Prepared for W. Eldridge.

Smith and Smith (2012), *Vegetation Assessment for Proposed Hornsby Mountain Bike Track*. Prepared for Hornsby Shire Council. P & J Smith Ecological Consultants

Tweed Shire Council (2009) *Sportsfield Construction Guidelines - Appendix J to Development Design Specification D14*.

WHO (2006) *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005, Summary of risk assessment*. World Health Organisation.