



# Wildlife Lake Weir at Penrith Lakes Environmental Assessment

LJ2869/R2681v3 Prepared for Penrith Lakes Development Corporation 29 November 2010



#### Cardno (NSW/ACT) Pty Ltd

ABN 95 001 145 035 Level 3, 910 Pacific Highway Gordon NSW 2072 Australia Telephone: 02 9496 7700 Facsimile: 02 9499 3902 International: +61 2 9496 7700 sydney@cardno.com.au www.cardno.com.au

Report No:\_\_\_\_\_

#### **Document Control**

Version	Status	Date	Author		Reviewer	
1	Draft	1 November 2010	Emma Maratea	ERM	Kester Boardman	IKB
			Leonard Drynan	LDD		
2	Final	17 November 2010	Emma Maratea	ERM	Kester Boardman	IKB
			Leonard Drynan	LDD		
3	Revised	29 November 2010	Emma Maratea	ERM	Kester Boardman	IKB
	Final		Leonard Drynan	LDD		

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29 November 2010

# **Declaration**

This Environmental Assessment (EA) assesses the potential environmental impacts associated with the proposed weir construction at the northern boundary of the proposed Wildlife Lake across Hunts Gully. This EA has been prepared to support a Section 75W Modification request to a previously approved Development Application (DA4) for the proposed weir and is based on information available from secondary sources and also specialist studies specifically conducted on heritage, ecological and hydraulic aspects of this proposal.

This EA has been prepared with regard to Section 79C of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and has taken into consideration the range of matters of relevance to the proposed works that are the subject of the accompanying DA modification request.

Based on the information available and presented in this EA, it is concluded that by adopting and implementing the mitigation measures listed in this report there will be no significant environmental impacts from the proposal. It is concluded that proposed weir is necessary for the implementation of the Penrith Lakes Scheme and is suitable and in the public interest.

Certified by:

Kester Boardman Manager – Environment and Sustainability For Cardno (NSW/ACT) Pty Ltd

# **Executive Summary**

The Penrith area has been a major source of supply of medium to coarse grained sand and crushed river gravel for the Sydney construction industry since the 1880s and today provides most of Sydney's requirements for these materials. The ongoing quarrying operations and future rehabilitation of the site has become known as the 'Penrith Lakes Scheme'.

As part of the rehabilitation of the Penrith Lakes Scheme it is proposed that a series of lakes and parklands will be developed on completion of quarrying at the site (**Figure E1**). The rehabilitation works require carefully controlled hydraulic links between the proposed lakes and the Nepean River, primarily to control the inflow of water to the lakes, to control flow between the lakes, and to allow floodwaters entering the lakes to return to the River. This Environmental Assessment (EA) is concerned with the construction of a weir at Hunts Gully, which will control the exchange of water between the proposed Wildlife Lake and the Nepean River.

The structure plan originally proposed for the Penrith Lakes Scheme (Enviro-Managers, 1997) does not include a weir at Hunts Gully. Instead the plan proposed a weir connecting the Wildlife Lake directly to the river. Detailed design assessments undertaken since the development of the structure plan have identified that the weir at Hunts Gully is favoured over the original lake to river weir as it reduces the impact on the sensitive river banks, and the previous weir location had an adverse impact on flood levels downstream as a result of removing a natural pinch point or construction in the river to enable the functioning of the lakes scheme.

A number of possible weir designs have been considered for Hunts Gully. The preferred weir configuration has an indicative cost of \$2.4M, and will consist of:

- A central weir crest at 16m AHD. The design suggests that this would be a conventional concrete structure, with suitable dissipation at both the southern and northern sides of the weir; and,
- Two earthen embankments to act as a high level spillway either side of the crest at a level of 18.5m AHD. These would tie in with existing topography at both the western and eastern ends (the western embankment = 85m length, eastern embankment = 65m length). Both of these would require either good grass cover or reinforced grass.

This EA identifies the environmental constraints and potential environmental impacts associated with the construction of the preferred weir configuration and recommends mitigation measures to prevent or minimise the identified potential impacts.

Environmental constraints and impacts considered in this EA include:

- Terrestrial Ecology;
- Aquatic Ecology;
- Hydrology;
- Aboriginal and Non-Aboriginal Heritage;
- Soils, Sediments and Erosion;
- Contaminated Land;
- Air Quality, Climate and Dust;

- Hazards and Risks;
- Landscape and Visual Impact;
- Land Use Impacts;
- Noise and Vibration Impacts;
- Social and Health Values;
- Traffic Impacts/Access and Accessibility;
- Utilities and Infrastructure;
- Waste Materials and Management; and
- Water Quality Impacts.

The key environmental constraints are shown in **Figure E2**. The key issues identified in the EA relate to management of anticipated aboriginal heritage discoveries and ecological impacts at Hunts Gully. Specifically:

- It is expected that a large number of Aboriginal artefacts could be present in the vicinity of the proposed weir. A program of archaeological testing and salvage will be undertaken in accordance with the existing AHIP (ref: 2595) requirements prior to the commencement of construction;
- The diversion of Hunts Gully creek into the Wildlife Lake will result in cessation of flow in a section of Hunts Gully creek which is approximately 150m in length. This can be expected to lead to changes in the existing riparian vegetation along this corridor. It is noted however that this vegetation is considered to be of low ecological value, and the creation of substantial areas of new habitat by implementation of the Penrith Lakes Scheme will more than offset this loss.

After consideration of all of the environmental issues, this EA concludes that the installation of the proposed weir is unlikely to have any long term significant negative environmental impacts provided that the management measures outlined in this EA and summarised in **Sections 6 and 7** are effectively implemented by incorporation into a suitable Construction Environmental Management Plan.

This EA also recognises that the installation of the weir is an important and necessary component of a larger scheme to create lakes at the site of the existing quarry. Completion of the Penrith Lakes Scheme is expected to significantly improve ecological, visual, and amenity value of the area, and consequently the installation of the weir is expected to facilitate an overall improvement of the area following the cessation of quarrying activities.



Figure E1: Proposed Penrith Lakes Scheme (Provided by PLDC, November 2010).

29 November 2010

# Approximate Extent of Proposed Weir Works PLDC Conservation Zones Area to be Quarried Prior to Weir Construction Hunts Gully Existing Natural Channel Hunts Gully Existing Piped Section Sensitive Receivers Acacia implexa (1 tree) Degraded Riparian Vegetation to be Impacted by Works and Creek Diversion PLDC Property Boundary PLDC Property Boundary 20m Buffer from Property Boundary 6006 60 64 NEPEAN RIVER Proposed Creek **Diversion Point** 200 100 metres

#### Figure E2: Key Environmental Constraints

# **Table of Contents**

D	eclara	tion.	
E	xecuti	ve Sı	ummaryiii
G	ilossar	у	xii
1	Inti	roduc	ction1
	1.1	Intre	oduction1
	1.2	Obj	jectives and Outline of the Proposal1
	1.3	Bac	ckground to the Development of the Penrith Lakes Scheme1
	1.4	Pur	pose of the EA4
	1.5	Stru	ucture of the Document4
2	Pla	nnin	g Context6
	2.1	Bac	ckground6
	2.2	Mo	dification to Development Application 47
	2.3	Leg	gislative Requirements7
	2.3	.1	Environmental Planning and Assessment Act 19797
	2.3	.2	Pollution Control Legislation8
	2.3	.3	Terrestrial Ecology Legislation8
	2.3	.4	Aquatic Ecology Legislation9
	2.3	.5	Water Legislation9
	2.3	.6	Heritage Legislation9
	2.3	.7	Geology and Soil Legislation10
	2.3	.8	Waste and Hazards Legislation10
	2.4	En	vironmental Planning Instruments10
	2.4	.1	Regional Environmental Plans (REPs)10
	2.4	.2	State Environmental Planning Policies (SEPPs)13
	2.4	.3	Local Environmental Plans (LEPs)13
	2.4	.4	Development Control Plans (DCPs)13
	2.5	PL	DC Consents, Agreements and Commitments14
	2.6	Per	mits, Licences and Approvals16

3	Jus	tifica	ation and Alternatives for the Proposal	.18
	3.1	Stra	ategic Need for the Proposal	. 18
	3.1.	1	Lake Filling – Flood Behaviour of Lakes Scheme	. 18
	3.1.	2	Flood Behaviour – Hunts Gully	24
	3.2	Pro	posal Objectives	24
	3.3	Alte	rnatives and Options Considered	. 26
	3.3.	1	Do Nothing Approach	.26
	3.3.	2	Alternative Weir Dimensions	.26
	3.4	Pre	ferred Option	. 27
4	Des	crip	tion of the Proposal	. 29
	4.1	Loc	ation and Site Description	. 29
	4.2	Rela	ationship to the Overall Scheme	. 30
	4.3	Des	ign Parameters	. 30
	4.3.	1	Central Weir	. 30
	4.3.	2	Embankments	.31
	4.4	Cos	st	.31
	4.5	Tim	ing	.31
5	<b>F</b>			
	Env	viron	mental Impact Assessment	. 32
	<b>Env</b> 5.1	r <b>iron</b> Ter	mental Impact Assessment	<b>32</b> 32
	5.1 5.1.	r <b>iron</b> Teri 1	mental Impact Assessment restrial Ecology Aims and Assessment Methodology	32 32 32
	5.1 5.1. 5.1.	riron Ter 1 2	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements	<b>32</b> 32 32 33
	5.1 5.1. 5.1. 5.1.	riron Ter 1 2 3	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment	32 32 33 33
	5.1 5.1. 5.1. 5.1. 5.1.	riron Ter 1 2 3 4	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment Potential Impacts	32 32 33 33 33
	5.1 5.1. 5.1. 5.1. 5.1. 5.1.	riron Ter 1 2 3 4 5	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment Potential Impacts Proposed Mitigation Measures	32 32 33 33 33 39 41
	5.1 5.1. 5.1. 5.1. 5.1. 5.1. 5.2	riron Ter 1 2 3 4 5 Aqu	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment Potential Impacts Proposed Mitigation Measures natic Ecology	32 32 33 33 33 39 41
	5.1 5.1. 5.1. 5.1. 5.1. 5.1. 5.2 5.2.	riron Ter 1 2 3 4 5 Aqu 1	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment Potential Impacts Proposed Mitigation Measures natic Ecology Assessment Methodology	32 32 33 33 33 39 41 42
	5.1 5.1. 5.1. 5.1. 5.1. 5.2 5.2. 5.2.	riron Ter 1 2 3 4 5 Aqu 1 2	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment Potential Impacts Proposed Mitigation Measures hatic Ecology Assessment Methodology Existing Environment	32 32 33 33 33 41 42 42
	5.1 5.1. 5.1. 5.1. 5.1. 5.2 5.2. 5.2. 5.	riron Ter 1 2 3 4 5 4 5 4 1 2 3	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment Potential Impacts Proposed Mitigation Measures natic Ecology Assessment Methodology Existing Environment Potential Impacts Potential Impacts	32 32 33 33 33 33 41 42 42 43 44
	5.1 5.1. 5.1. 5.1. 5.1. 5.2 5.2. 5.2. 5.	riron Ter 1 2 3 4 5 Aqu 1 2 3 4	mental Impact Assessment restrial Ecology Aims and Assessment Methodology Ecological Legislative Requirements Existing Environment Potential Impacts Proposed Mitigation Measures hatic Ecology Assessment Methodology Existing Environment Potential Impacts Proposed Mitigation Measures	32 32 33 33 33 33 33 33

	5.3.	.1 Assessment Methodology	45
	5.3.2	.2 Existing Environment	
	5.3.3	.3 Potential Impacts	
	5.3.4	.4 Proposed Mitigation Measures	
:	5.4	Aboriginal and Non-Aboriginal Herita	ge46
	5.4.	.1 Aboriginal Heritage: Existing Co	ndition46
	5.4.2	.2 Aboriginal Heritage: Potential Im	pacts
	5.4.3	.3 Aboriginal Heritage: Proposed M	litigation Measures48
	5.4.4	.4 Non-Aboriginal Heritage: Existin	g Environment49
	5.4.	.5 Non-Aboriginal Heritage: Potent	al Impacts50
	5.4.	.6 Non-Aboriginal Heritage: Propos	ed Mitigation Measures51
:	5.5	Soils, Sediment and Erosion	51
	5.5.	.1 Existing Environment	51
	5.5.2	.2 Potential Impacts	51
	5.5.3	.3 Proposed Mitigation Measures	
:	5.6	Minor Impacts	
	5.6.	.1 Contaminated Land	
	5.6.2	.2 Hazards and Risks	55
	5.6.	.3 Landscape and Visual Impact	
	5.6.4	.4 Land Use Impacts	
	5.6.	.5 Noise and Vibration Impacts	
	5.6.	.6 Social and Health Values;	
	5.6.	.7 Traffic Impacts/Access and Acce	essibility;58
	5.6.	.8 Utilities and Infrastructure	
	5.6.9	.9 Waste Materials and Manageme	nt60
	5.6.	.10 Water Quality	61
6	Env	vironmental Management	
	6.1	Environmental Management Plans	62
	6.2	Monitoring	62
7	Con	nclusions	

9	Re	ferences	67
0	Qu	anncations	00
0	<u> </u>	alifications	66
	7.2	Conclusion	65
	7.1	Summary of Environmental Safeguard and Management Measures	63

# List of Tables

Table 2.1: Penrith Lakes Scheme Planning Documents	6
Table 2.2 Relevant Permits, Licences and Approvals	16
Table 3.1: Wildlife Lake weir Operations	24
Table 5.1: Declared weed species and their control categories listed under the Noxious Weeds Act (1993)	t 35
Table 5.2: List of native plant species recorded at the Weir site.	36
Table 5.3: Threatened flora species recorded within the Penrith LGA	36
Table 5.4: River-flat Eucalypt Forest species recorded within the weir site.	37
Table 5.5: Threatened Fauns species recorded within the Penrith LGA	38
Table 5.6: Fauna species recorded during the ecological survey at Penrith Lakes	38
Table 5.7: Terrestrial Ecology Mitigation Measures	42
Table 5.8: Aquatic Ecology Mitigation Measures	44
Table 5.9: Aboriginal Heritage Sites Located in and Around the Study Area	46
Table 5.10: Aboriginal Heritage Mitigation Measures	49
Table 5.11: Non-Aboriginal Heritage Mitigation Measures	51
Table 5.12: Soils, Sediment and Erosion Mitigation Measures	52
Table 5.13: Land Parcels affected by the proposed works	52
Table 5.14: Historic land use of Penrith Lakes	53
Table 5.15: Risks and Mitigation Measures	55
Table 7.1: Summary of proposed Environmental Safeguards	63

# **List of Figures**

Figure E1:	Proposed Penrith Lakes Scheme (Provided by PLDC, November 2010)v
Figure E2:	Key Environmental Constraintsvi

29 November 2010

Figure 1.1: Regional context of the Penrith Lakes Scheme (Source: Google Earth).	2
Figure 1.2: Penrith Lakes Scheme Structure Plan (Provided by PLDC)	3
Figure 2.1: PLDC Applied Conservation Zones (source: PLDC)	. 15
Figure 3.1: Stage 1 - Flooding Behaviour	. 19
Figure 3.2: Stage 2 - Flooding Behaviour	20
Figure 3.3: Stage 4 - Flooding Behaviour	21
Figure 3.4: Stage 5 - Post Flood Behaviour	23
Figure 3.5: Current alignment and catchment area of Hunts Gully	25
Figure 3.6: Proposed Wildlife Lake weir design and PLDC Conservation Zones (lighter coloured areas)	28
Figure 4.1: Proposed works site study area	29
Figure 5.1: Extent of riparian vegetation impacted by the proposed weir	. 35
Figure 5.2: Road network surrounding Penrith Lakes	59

# Appendices

Appendix A	Terrestrial Ecology

- Appendix B Aquatic Ecology
- Appendix C Non-Aboriginal Heritage

# Glossary

AHIP	Aboriginal Heritage Impact Permit
ASSMAC	Acid Sulfate Soil Management Advisory Committee
CEMP	Construction Environmental Management Plan
DECC	Department of Environment and Climate Change (now DECCW)
DECCW	Department of Environment, Climate Change and Water
DEWHA	Department of the Environment, Water, Heritage and the Arts
DoP	Department of Planning
DPI	Department of Primary Industries
DWE	Department of Water & Energy
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
GDA	Geocentric Datum of Australia
GMR	Greater Metropolitan Region
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area

LPMA	Land and Property Management Authority
NPW Act	National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service
NRA	National Registration Authority for Agriculture and Veterinary Chemicals
NSW	New South Wales
PCC	Penrith City Council
PoEO Act	Protection of Environment Operations Act 1997
RCE	Riparian, Channel and Environmental Inventory
REF	Review of Environmental Factors
REP	Regional Environmental Plan
RFEF	River-Flat Eucalypt Forest on Coastal Floodplains
RTA	Roads and Traffic Authority of New South Wales
SEPP	State Environmental Planning Policy
SEPP (Major Development)	State Environmental Planning Policy (Major Development) 2005
SIS	Species Impact Statement
TSC Act	Threatened Species Conservation Act 1995
WARR Act	Waste Avoidance and Resource Recovery Act 2001

# 1 Introduction

# 1.1 Introduction

Cardno (NSW/ACT) Pty Ltd has been engaged by Penrith Lakes Development Corporation to prepare an Environmental Assessment (EA) as part of a Section 75W Application under the *Environmental Planning and Assessment Act 1979* for the proposed construction of a weir across Hunts Gully at Penrith Lakes, Castlereagh NSW.

# **1.2 Objectives and Outline of the Proposal**

The Penrith Lakes Development Corporation (PLDC) seeks approval to modify the existing development consent (Development Application 4 - continued sand and gravel extraction and the restoration of the area by construction of a lake system) to include a weir along the northern boundary of the proposed Wildlife Lake at Hunts Gully.

The weir has been proposed to ensure the sustainability of the proposed lakes within the Penrith Lakes site during flood events in the Nepean River.

Sections of the eastern bank of the Nepean River along the Penrith Lakes site are sufficiently high that over-topping and flooding will only occur in an ARI event of approximately 100 years. At Hunts Gully water will naturally flow into the gully from the Nepean River during smaller flood events (i.e. less than a 10 year ARI event). The proposed Wildlife Lake weir is designed to be overtopped from the Nepean River in 10 year ARI events.

The weir will provide a sufficiently stable hydrological system to allow the establishment of Wildlife Lake ecosystems. It will also help prevent the ingress of aquatic weeds and invasive fish species that are present in the river.

The proposed weir will cross Hunts Gully floodway. The existing course of Hunts Gully creek will be altered to direct flows into the Wildlife Lake approximately 50m upstream of the Wildlife Lake weir.

## **1.3 Background to the Development of the Penrith Lakes Scheme**

The Penrith area has been a major source of supply of medium to coarse grained sand and crushed river gravel for the Sydney construction industry since the 1880s and today provides most of Sydney's requirements for these materials.

Initially, excavation of sand and gravel was from deposits in the Nepean River; however, as these reserves were depleted during the late 1950s attention was turned to the reserves under the Penrith-Castlereagh floodplain. Development consents to quarry parts of the floodplain to the northwest of Penrith were subsequently obtained by four quarrying companies.

In the late 1960s, the piecemeal manner in which the quarrying operations were being undertaken and the restriction this placed on the rehabilitation of the quarried areas were causing concern. At the request of the Penrith City Council, the State Planning Authority

(now the Department of Planning) examined the concepts for coordinating the extraction of the sand and gravel resources and restoration of the quarried areas. As a result, the Penrith Lakes Scheme Working Party was established, comprising representatives of five State Government Departments, the Penrith City Council and the quarrying companies. Its aim was to examine the feasibility of a program of orderly and economical extraction and comprehensive rehabilitation with a view to creating a regional water-oriented recreation resource in the former quarry areas.

This concept became known as the 'Penrith Lakes Scheme'. The regional context of the Penrith Lakes Scheme as a whole is shown in **Figure 1.1**.



Figure 1.1: Regional context of the Penrith Lakes Scheme (Source: Google Earth).

As part of the rehabilitation of the Penrith Lakes Scheme a series of lakes and parklands have been proposed; Main Lake A, Main Lake B and Wildlife Lake. There are also a number of key flood management structures in the scheme which control the inflow and outflow of floodwaters from the Nepean River into the lakes, as well as the flows between the lakes themselves. This flood infrastructure allows for the controlled filling of the Lakes Scheme under a Nepean River flood and minimises any adverse impacts on flood levels on surrounding properties. The concept plan of the Penrith Lakes Scheme is shown in **Figure 1.2**.

The combination of this flood infrastructure and the proposed Lakes results in a significant flooding benefit to the Penrith and Emu Plains communities. Reductions in flood levels in

the 100 year ARI event are up to nearly 1 metre on Emu Plains, and the reduction in flood damages in a 100 year ARI event is estimated to be in the order of \$3.5M.

The flooding behaviour of the proposed scheme is detailed in the **Section 3.1**. A more detailed discussion on the flooding behaviour is provided in the associated Penrith Lakes Flood Infrastructure Report (Cardno, 2010b). This EA focuses on the construction and operation of Wildlife Lake weir within this broader flood infrastructure system.



Figure 1.2: Penrith Lakes Scheme Structure Plan (Provided by PLDC)

# **1.4 Purpose of the EA**

The purpose of this EA is to describe the proposal, to assess and document the likely impacts of the proposal on the environment, and to detail mitigation measures to be implemented in order to minimise any environmental impacts due to the proposed works.

Under the *Environmental Planning and Assessment Act 1979* (EP&A Act) there is a duty for the consent authority (in this case the Minister) to consider the likely impacts of that development, including environmental impacts on both the natural and built environments. This EA has been prepared in accordance with Schedule 2 of the EP&A Regulation 2000 to allow the Minister to take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the proposal.

Following submission of this report, the Minister, as the determining authority, can consider:

- Whether the proposed works are likely to have any impacts on the environment that have not been considered in the EA that may require further assessment, or for which additional mitigation strategies should be developed;
- Any possible impacts on threatened species as defined by the Threatened Species Conservation Act 1995 (TSC Act);
- Any potential impacts on any Aboriginal or Non-Aboriginal heritage items as defined by the National Parks and Wildlife Act 1974 (NPW Act) and Heritage Act 1977; and
- The potential for the proposal to impact on any matter of national environmental significance or Commonwealth land that would require referral to the Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA) for a decision by the Commonwealth Minister for the Environment, Heritage and the Arts on whether assessment and approval is required under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The Minister would then determine if the proposal should proceed and set relevant conditions.

# **1.5 Structure of the Document**

The structure of this EA is as follows:

- Section 1 Provides the objectives of the application and history and development of the Penrith Lakes Scheme.
- Section 2 Describes the planning context for the Scheme including planning consents and conditions.
- Section 3 Discusses the need for the modification to DA4 (Wildlife Lake Weir) in the context of ensuring the sustainability of the rehabilitation works comprising the Penrith Lakes Scheme.

Consequences of not proceeding with the proposal are also discussed.

Section 4 Describes the proposal in terms of its extent, design and its relationship to the overall Penrith Lakes Scheme. The details associated with cost and timing are also provided.

- Section 5 Describes the existing environment, the potential impacts and benefits associated with the proposal and any mitigation measures to be adopted to manage potential environmental impacts.
- Section 6 Provides an overview of the environmental management plans that need to be prepared prior to construction and monitoring requirements.
- Section 7 Provides a summary of the environmental safeguards and management measures to be undertaken during construction and operational phases of the proposal. Provides a conclusion on the likely impacts of the proposal if all recommended measures are implemented.
- Section 8 Qualifications
- Section 9 References

# 2 Planning Context

### 2.1 Background

The Environmental Planning and Assessment Act 1979 and Regulations (2000) provide for the making of environmental planning instruments for the proper management, development and conservation of the State's natural and man-made resources.

The extensive deposits of sand and gravel occurring in the floodplain of the Nepean River, north of Penrith have been recognised by the State Government as a resource of regional significance to supply the future demands for construction materials in the Sydney Region. As a result, the resource has been identified in a number of planning instruments with the objective of providing a development control process to establish environmental and technical matters which must be taken into account in implementing the Penrith Lakes Scheme in order to protect the environment. Key planning documents produced in relation to the Scheme since 1981 are listed in **Table 2.1**.

Date	Document / Report	Result
April 1981	Development Application (DA1)	Consent granted in July 1982 for interim extraction while preferred Scheme in preparation.
October 1986	Sydney Regional Environmental Plan 9 – Extractive Industry	Indentified Penrith Lakes as a priority for extraction.
November 1986	Sydney Regional Environmental Plan 11 – Penrith Lakes Scheme	Legal framework for implementation of Scheme.
November 1986	Development Application (DA2)	Consent granted in February 1987 for extraction of DA2 area in accordance with SREP11.
May 1989	Amendment no. 2 to SREP11	Amendment extended SREP boundary and made provision to incorporate international standard rowing course into the Scheme.
August 1989	Development Application (Rowing Lake)	Consent granted November 1989 to modify DA2 and extract additional lands to construct the rowing course.
January 1994	Amendment No. 3 to SREP11, the structure plan.	Amendment to incorporate results of flood and drainage studies. Approved November 1994.
April 1994	Development Application (DA3)	Consent granted in June 1995 for extraction of DA3 area in accordance with SREP11.
September 1997	Amendment No. 4 to SREP11, the structure plan.	Proposed amendment to incorporate implications arising from geological review.
November 1997	Development Application (DA4)	Consent granted in September 1998 for continuation of sand and gravel extraction from DA4 area in accordance with SREP11.

#### Table 2.1: Penrith Lakes Scheme Planning Documents

# 2.2 Modification to Development Application 4

As mentioned above, Development Application 4 (DA4) was approved in 1998 for continuation of sand and gravel extraction from the DA4 area of about 737 hectares in order to ensure the continued supply of sand and gravel to the building and construction industry and to meet the commitments for the completion of the Penrith Lakes Scheme.

Detailed water management investigations were undertaken as part of DA4 and reported in the accompanying EA (Enviro-Managers, 1997) to determine the infrastructure required to provide adequate quantities of quality water within the lakes scheme. This included flood infrastructure. PLDC is now proposing to modify the flood infrastructure reported in the previous EA (Enviro-Managers, 1997), specifically, the addition of a weir across Hunts Gully to form the northern boundary of Wildlife Lake.

Since the submission of DA4, detailed hydraulic investigations have been undertaken for the Penrith Lakes Scheme (Cardno, 2010b). These investigations identified that during regular flood events (less than a 10 Year ARI event) Hunts Gully would experience significant flow in both directions – initially from the Nepean River to the Lake systems as levels in the river rise and secondly from the Lakes to the river as the river levels start to fall and the lakes begin to empty. The flow into the lakes scheme would be significant and is likely to cause scour of Hunts Gully and significant scour to the Wildlife Lake as it spills into the Lake. In addition, the fairly regular flood inundation of the proposed lake foreshore areas would cause significant damage to vegetation and recreational facilities. As a result of the detailed hydraulic assessment and updated survey, it was identified that it is necessary to construct a weir across Hunts Gully to protect the area from erosion, protect the lake foreshore areas and to improve flood protection of the downstream properties.

This EA has been prepared in order to evaluate the proposed additional weir. It is proposed that the pipes discharge from the North-Western portion of Wildlife Lake. The need for the inclusion of this weir and its design details have been based on detailed hydraulic investigations (Cardno, 2010B).

# 2.3 Legislative Requirements

## 2.3.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) aims to encourage the proper management, development and conservation of natural and artificial resources to ultimately promote the environment and the economic and social welfare of the community. In addition to this, it seeks to promote the sharing of responsibility between state and local government and facilitate public involvement in the planning and assessment process.

The proposed development requires consent and an associated assessment by the applicant under the EP&A Act. The consent authority is The Minister. The existing approval requires PLDC to obtain the necessary statutory approvals and therefore the relevant approval authorities are DECCW (for Aboriginal heritage matters under the *National Parks and Wildlife Act 1974* and waterfront land matters under the *Water Management Act 2000*) and I&I NSW (for excavation within a waterway matters and obstruction to fish passage matters under the *Fisheries Management Act 1994* (FM Act)).

The proposed development does not constitute 'designated development' as defined in Schedule 3 of the *Environmental Planning and Assessment Regulation 2000*.

## 2.3.2 Pollution Control Legislation

The Protection of Environment Operations Act 1997 (PoEO Act) is administered by DECCW and ultimately aims to protect, enhance and restore the quality of the environment in NSW, to reduce risk to human health and promote mechanisms that minimise environmental degradation through a strong set of provisions and offences.

The Pesticides Control Act 1999 states that pesticides must be registered by the National Registration Authority for Agriculture and Veterinary Chemicals (NRA). The NRA therefore regulates the sale of pesticides, whilst the EPA (DECCW) enforces proper use of pesticides after the point of sale to minimise the impacts on health, the environment and trade. Permits for "off label" use may be obtained under the existing legislation, however Penalty and Clean-up notices will be issued for the improper use and/or management of pesticides.

The Environmentally Hazardous Chemicals Act 1985 governs the use and disposal of potentially hazardous chemicals and waste material. Any use and/or removal of hazardous chemicals and materials defined under this Act require licensing and must be appropriately declared.

Given the comparatively minor nature of the proposed works, which do not fall within the description of a "scheduled activity" under the PoEO Act, a licence is not required. However, liability for pollution events is not waived just because a licence is not required and pollution mitigation measures (e.g. for water quality and sediment and erosion control) must be implemented to mitigate impacts. It is considered unlikely that the proposed works would trigger either the Pesticides Control Act 1999 or the Environmentally Hazardous Chemicals Act 1985.

## 2.3.3 Terrestrial Ecology Legislation

The Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) is Commonwealth legislation requiring that approval is obtained from the Minister for any environmentally significant actions on Commonwealth Land, or actions that are likely to have a significant impact on nationally threatened species, populations and endangered ecological communities, Ramsar wetlands and other nationally significant issues. This EA considers these environmentally significant issues in relation to the proposed site in **Section 5.1**. It has been determined that there would be no significant impact as a result of the proposed works and a referral to the Department of the Environment, Water, Heritage and the Arts (DEWHA) is not required.

The Environmental Planning and Assessment Act 1979 (EP&A Act) requires that the impact that any proposed activity may have upon threatened species, populations or ecological communities and their habitats must be assessed. Lists of threatened species, populations and ecological communities are contained in Schedules 1 and 2 of the Threatened Species Conservation Act 1995 (TSC Act). These matters are considered in **Section 5.1** of this EA.

The Noxious Weeds Act 1993 was implemented to regulate the impacts and spread of weeds within NSW. The Act governs the control of weeds which requires declaration as a noxious weed, classification and removal. Land which is privately occupied requires implementation of appropriate noxious weed controls under Part 4 of the Noxious Weeds Act 1993. Penalties apply if the occupier fails to comply. It is not anticipated that the restrictions of the Noxious Weeds Act 1993 would be triggered under the proposed works.

Clearing of native vegetation or protected regrowth normally requires approval under the Native Vegetation Act 2003. However, under Section 5 of the Act lands within the Penrith LGA are excluded from the operation of the Act.

#### 2.3.4 Aquatic Ecology Legislation

Approval under the Fisheries Management Act 1994 from the Department of Primary Industries (DPI) (NSW Fisheries) is required for any dredging or reclamation works or works that may obstruct free passage of fish. The weir has the potential to affect fish passage as any species upstream (in Hunts Gully Creek) will no longer be able to access the Nepean River along this creek, however it is noted that the presence of an existing piped section of Hunts Gully creek (170m in length) immediately downstream of the proposed weir site currently significantly limits any such fish passage.

#### 2.3.5 Water Legislation

The Water Management Act 2000 replaces the repealed Rivers and Foreshores Improvement Act 1948, and regulates construction activities in close proximity to waterways. Principles set out in the Act generally aim to preserve and or restore water sources, floodplains, and water dependant ecosystems (including groundwater and wetlands). The Act also encompasses the protection of habitats, animals and plants which benefit from water or are potentially affected by managed activities.

A controlled activity approval is required from the Department of Water & Energy (DWE) for the proposed weir.

#### 2.3.6 Heritage Legislation

Heritage within NSW can be generally described under two categories: Aboriginal heritage and Non-Aboriginal heritage. The Heritage Act 1977 applies to deposits, objects or material evidence within NSW which is 50 years old or more and relates to Non-Aboriginal settlement. Under the Heritage Act 1977, it is an offence to harm relics protected by Interim Heritage Orders, the State Heritage Register or environmental planning instruments.

The National Parks and Wildlife Act 1974 (NPW Act), administered by DECCW, is the primary legislation for the protection of Aboriginal cultural heritage in NSW. Part 6 of the NPW Act provides specific protection for Aboriginal objects and places.

An existing Aboriginal Heritage Impact Permit has been issued by DECCW for the PLDC site. An application for amendment of the existing permit to incorporate the proposed weir construction works has been submitted to DECCW.

#### 2.3.7 Geology and Soil Legislation

The Soil Conservation Act 1938 is associated with the preservation of soils and prevention of erosion within a parcel of land. The appointment of a conservation commissioner is primarily to control and protect proclaimed works, notified catchment areas, rivers, lakes, dams, creeks, lagoons and marshes from the effects of soil erosion, land degradation, siltation and sedimentation. Notice may be issued if the commissioner is of the opinion that the land holder has done or is likely to do something that will ultimately lead to land degradation.

The Contaminated Land Management Act 1997 outlines the assessment criteria and management of contaminated land which poses a significant risk to human health or the environment. Under the Act, a person or persons (or a public authority) will be held responsible as an outcome of land contamination. DECCW is responsible for declaring the land as 'contaminated' and will give notice to end the declaration, once satisfied that the land poses no further risk.

It is not anticipated that either of these Acts would be triggered during the proposed works, as discussed in **Section** Error! Reference source not found.

#### 2.3.8 Waste and Hazards Legislation

The Waste Avoidance and Resource Recovery Act 2001 (WARR Act) repeals and replaces the Waste Minimisation and Management Act 1995. No permits are required under the Act, though the responsibilities of land occupiers are clearly defined with regards to waste production, waste management and natural resource usage. The Act makes reference to 'waste strategies' including minimisation and disposal along with efficient use and disposal of natural resources.

## 2.4 Environmental Planning Instruments

#### 2.4.1 Regional Environmental Plans (REPs)

#### Sydney Regional Environmental Plan 9 – Extractive Industry

This aim of this plan are to facilitate the development of extractive resources in proximity to the population of the Sydney Metropolitan Area.

The sand and gravel resources of the Penrith Lakes Scheme were considered resources of regional significance under SREP 9(1) and at the time of gazettal of the REP9 in 1995, were of such significant as to be considered under a separate State Regional Environment Plan, SREP 11.

#### Sydney Regional Environmental Plan 11 – Penrith Lakes Scheme.

The aims and objectives of this plan are to permit the implementation of the Penrith Lakes Scheme. In particular, the aims of this plan are:

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29 November 2010
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- to provide a development control process establishing environmental and technical matters which must be taken into account in implementing the Penrith Lakes Scheme in order to protect the environment,
- to identify and protect items of the environmental heritage,
- to identify land which may be rezoned for urban purposes, and
- to permit interim development in order to prevent the sterilization of land to which this plan applies during implementation of the Penrith Lakes Scheme.

Clause 8(3) of SREP11 requires that a consent authority shall not consent to the carrying out of development for the purposes of implementing the Penrith Lakes Scheme unless the Applicant has submitted an Environmental Assessment of the proposed development addressing the matters specified in Schedule 2 of SREP11. The matters specific in Schedule 2 of the SREP are provided below, with the relevant section of this EA where the matter has been addressed.

Matters to be Included in EA	Section of EA Addressing Matter
(a) justification of the proposed development in the context of Sydney Regional Environmental Plan No 11—Penrith Lakes Scheme,	Section 3
(b) a full description of the proposed development,	Section 4
(c) a statement of the objectives of the proposed development,	Section 3.2
(d) a full description of the existing environment likely to be affected by the proposed development if carried out,	Section 5
(e) identification and analysis of the likely environmental interactions between the proposed development and the environment,	Section 5
(f) analysis of the likely environmental impacts or consequences of carrying out the proposed development (including implications for use and conservation of energy),	Section 5
(g) justification of the proposed development in terms of environmental, economic and social considerations,	Section 3
(h) measures to be taken in conjunction with the proposed development to protect the environment and an assessment of the likely effectiveness of those measures,	Throughout Section 5 and Summarised in Sections 6 and 7.
(i) energy requirements of the proposed development,	Machinery to be run on fuel. No electricity requirements.
(j) any feasible alternatives to the carrying out of the proposed development and the reasons for choosing the latter, and	Sections 3.3 and Section 3.4
(k) the consequences of not carrying out the proposed development.	Section 3.3.1
2 In addition to the matters listed in clause 1, particular regard must be given to the following matters:	
(a) relationship and extent of the proposed development to the completed scheme,	Section 4.2
(b) where appropriate, the integration of the proposed development with development previously carried out,	As previously provided for in DA4 and 2 Year Plans.
(c) the sequence of extraction and rehabilitation where the proposed development is for or includes an extractive industry,	As previously provided for in DA4 and 2 Year Plans.

Matters to be Included in EA	Section of EA Addressing Matter
(d) unless the land is to be dedicated to the Crown, the proposed control and management of the land,	Ultimately the land will become Crown Land, until such time, the land remains under the control and management of PLDC
(e) the management and control of water resources including:	
(i) the source of water in order to fill any lake (including the quality and quantity of water from that source),	N/A
(ii) water reticulation systems from the Nepean River to any lake, from lake to lake and from any lake to the Nepean River,	N/A
(iii) the water quality of any lake (including the aquatic ecosystem),	N/A
(iv) water treatment facilities,	N/A
(v) water depth of any lake,	N/A
(vi) flood control,	Section 3.1
(vii) storm water control,	Section 5.5 and 5.6.11
(viii) the effect that development would have upon the quantity and quality of the existing groundwater as well as the level of the existing groundwater table,	Section 5.6.1
(ix) lake usage,	N/A
(x) staged development of the lakes and their usage during staged development,	N/A
(xi) the need to monitor the water quality of the lakes having regard to their intended use, and	N/A
(xii) the effect upon the Hawkesbury/Nepean River system,	Sections 5.2, 5.3 and 5.6.11
(f) the rehabilitation and reconstruction of the land including:	
(i) landscape design,	Section 5.6.4 and Design report & drawings.
(ii) the structural stability and soil compaction of landforms (including, where appropriate, the land shown on the structure plan as future urban),	Section 5.5
(iii) the stability and impermeability of the Nepean River embankment,	Section 5.5
(iv) soil conservation, and	As previously provided for in DA4 and 2 Year Plans.
(v) revegetation,	Sections 5.1 and 5.6.4 and Design report & drawings.
(g) any effect upon a locality, place or building not listed in Schedule 3 having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations,	Section 5.4
<ul> <li>(h) measures to be taken to conserve and preserve items of environmental heritage listed in Schedule 3 including, where appropriate, a conservation plan, and</li> <li>(i) access to the supply of water from any existing service to and</li> </ul>	Section 5.4 (and summarised in Section 7.1)
the supply of and access to municipal and utility services to, land to which this plan applies other than that part of that land the subject of the application.	

The development in this application is generally in accordance with the structure plan within the meaning of clause 8(2)(a)(iii) of SREP 11. The development is consistent with all of the matters listed in clause 8(4) of SREP 11.

The proposed works are permissible with consent under this Plan.

#### Sydney Regional Environmental Plan 20 – Hawkesbury-Nepean River

The aim of this plan is 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.

#### 2.4.2 State Environmental Planning Policies (SEPPs)

#### State Environmental Planning Policy 19 – Bushland in Urban Areas

The general aim of this Policy is to protect and preserve bushland within the urban areas because of:

- its value to the community as part of the natural heritage,
- its aesthetic value, and
- its value as a recreational, educational and scientific resource.

Bushland areas within the Penrith LGA are identified as part of this SEPP.

#### 2.4.3 Local Environmental Plans (LEPs)

Local Environment Plans (LEPs) provide a statutory framework under the EP&A Act and ensure that local needs and interests are taken into account when planning for development. The proposed works are subject to the following LEPs:

- Penrith Local Environmental Plan 1991 (Environmental Heritage Conservation);
- Penrith Local Environmental Plan 1998 (Urban Land); and
- Penrith Local Environmental Plan 1998 (Lakes Environs).

It is noted that the Draft Penrith Local Environmental Plan 2008 does not apply to the Penrith Lakes site.

#### 2.4.4 Development Control Plans (DCPs)

Development Control Plans (DCPs) provide specific, comprehensive guidelines for certain types of development within LGAs. Whilst the current development proposal is not being assessed by Council (rather by the Minister), the following plans have still been considered in this environmental assessment:

- Penrith Development Control Plan 2006; and
- DRAFT Penrith Development Control Plan 2008.

# 2.5 PLDC Consents, Agreements and Commitments

It is noted that a series of agreements have been formed between PLDC, the NSW State Government and Local Government which will inform the management of the environment on site. Further, PLDC has established on-going commitments consistent with these agreements to comply with requirements and improve the regional environment. These include the following.

<u>Penrith Lakes Scheme 1980:</u> The Department of Planning and Environment undertook a study of the proposed extraction and rehabilitation works to be undertaken by PLDC. This study recommended the establishment of a large lakes area (both wildlife and recreational) as the preferred rehabilitation option for the Scheme.

<u>Deed of Agreement 1987:</u> A formal deed of agreement to implement the Penrith Lakes Scheme was reached between PLDC and the NSW Government. The deed set out processes to be adopted by both parties to both fulfill quarry resource requirements as well as the lake establishment plan.

<u>Penrith Lakes Scheme DA No.4</u>: Development Application consent was granted for PLDC to undertake the extraction of sand and gravel from the northern and western parts of the Penrith Lakes scheme. The proposed works described in this Environmental Assessment occur in close proximity to these approved quarry works and are seen to be consistent with requirements of the development consent.

<u>PLDC Conservation Zones:</u> PLDC established a series of "conservation zones" (**Figure 2.1**). These have no legal standing and encompass land considered unsuitable for quarrying for a variety of reasons including:

- Environmental Values;
- Heritage Values;
- Social Values; and
- Quarrying Value.

The proposed works will occur within both quarried land and declared 'conservation' zones. It is recognised that potential impacts within land previously quarried is likely to be significantly less than that on unquarried lands.



Figure 2.1: PLDC Applied Conservation Zones (source: PLDC)

29 November 2010

# 2.6 Permits, Licences and Approvals

**Table 2.2** lists the full range of permits, licences and approvals associated with the range of legislation that is relevant to the site.

Legislation	Authority	Relevance to the Project	Approval / Licence Other Requirements
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	DEWHA Commonwealth	Approval from DEWHA if any significant impacts are expected on items of NES or significant impacts on Commonwealth Land.	The ecological investigations undertaken as part of this EA did not identify any potential impacts on items of NES.
Environmental Planning and Assessment Act 1979 (EP&A Act)	The Minister for Planning	Approval from government to encourage proper management of natural and artificial resources to promote the environment and the economic and social welfare of the community.	Consent required from The Minister under Section 75W of the Act.
Contaminated Land Management Act 1997	DECCW	Any contaminated land, which presents 'a significant risk of harm'.	Report to DECCW if contaminated land identified. None identified in the Stage 1 assessment undertaken as part of this EA and outlined in <b>Section</b> Error! Reference source not found
Fisheries Management Act 1994 (FM Act)	I&I NSW (Fisheries)	Permit required for dredging, reclamation, removal of aquatic vegetation or obstructing fish passage.	A Section 201 Permit would be required to undertake excavation works within Hunts Gully. A Section 219 Permit is required for the potential obstruction to fish passage in Hunts Gully as a result of the weir construction.
Heritage Act 1977	NSW Heritage Office (DoP)	Non-Aboriginal historic artefacts and / or sites (older than 50 years) if found.	No approvals or licences required.
National Parks and Wildlife Act 1974	DECCW	Disturbance or destruction of any Aboriginal sites and isolated finds.	A series of test excavations is proposed under an existing AHIP (ref: 2595) currently subject to an amendment application to the Department of Environment, Climate Change and Water (DECCW)
		native species.	required.
Noxious Weeds Act	I&I NSW / Blacktown Citv	Removal and disposal of noxious weeds.	No permits or approval required but responsibility for

29 November 2010

Legislation	Authority	Relevance to the Project	Approval / Licence Other Requirements
1993	Council		removal and proper disposal.
Pesticides Act 1999	DECC	Pesticides, if used.	Labelling requirements for pesticides to be adhered to. Certificates for use of restricted pesticides.
Protection of the Environment Operations Act 1997 (PoEO Act)	DECCW	Noise, Air and Water Pollution and Waste Management for scheduled activities or activities that may cause water pollution.	The activity is not a scheduled activity and therefore no licence is required.
Soil Conservation Act 1938	DECCW	Alteration of land that may lead to increased erosion hazard and follow on effects within catchment water bodies.	No Permit required. Commissioner may issue notice if works are considered to induce significant erosion effects. Erosion control practices are to be maintained in accordance with the Act.
Threatened Species Conservation Act 1995 (TSC Act)	DECCW	Threatened species of flora and fauna, endangered ecological communities or critical habitat.	No approvals or licences identified.
Waste Avoidance and Resource Recovery Act 2001 (WARR Act)	DECCW	The Proposal would use resources and generate waste, and as such needs to consider the Resource Management Hierarchy in the Act.	No approvals or licences required.
Water Management Act 2000	NSW Office of Water (DECCW)	Any works taking place in, on or under waterfront land (at present defined as 40m inland from the highest bank of the river) require a Controlled Activity Approval (CAA). Water extraction from waterways for activities such as dust suppression during construction. Construction of temporary earthworks or structure across a floodplain.	The works will be located within the waterway and within 40m from the highest bank of Hunts Gully. Therefore a CAA (under Section 91) is required and will need to be obtained from NSW Office of Water. The works are considered to be flood works and as such approval is required under Section 90. Water for dust suppression will not be sourced from the creek therefore no Access Licence to extract water from a water source is required.

# **3** Justification and Alternatives for the Proposal

## 3.1 Strategic Need for the Proposal

The strategic need for the proposal lies within the need for the wider rehabilitation works proposed at Penrith Lakes. The rehabilitation of the quarry site is required to ensure the ongoing sustainability of the site for future generations. The proposed weir will play an important role in controlling exchange of water between the Lakes and the Nepean River, and is critical to the sustainability of the lakes. This is explained in more detail in the following sections.

#### 3.1.1 Lake Filling – Flood Behaviour of Lakes Scheme

#### 3.1.1.1 Stage 1 – Filling through Hunts Gully

During the early part of the flood event, the Wildlife Lake starts to fill through Hunts Gully in the north (**Figure 3.1**). The crest level of Wildlife Lake weir at Hunts Gully is 16m AHD, while the operating level of the Wildlife Lake is 10m AHD. This will occur in events greater than a 10 year ARI.



#### Figure 3.1: Stage 1 - Flooding Behaviour

#### 3.1.1.2 Stage 2 - Filling through Hunts Gully & Across Weir 1

In the second stage, Weir 1, at a level of 21.6m AHD, starts to overtop (only in events greater than a 25 year ARI). This commences the filling of Quarantine Lake and Main Lake A; meanwhile Wildlife Lake continues to fill through Hunts Gully (**Figure 3.2**).



Figure 3.2: Stage 2 - Flooding Behaviour

#### 3.1.1.3 Stage 3 – Overtopping of Weir 4

Shortly after Main Lake A starts to fill, the low level Weir 4 overtops and starts to fill Main Lake B.

<sup>29</sup> November 2010

#### 3.1.1.4 Stage 4 – Overtopping of Weir 6

Weir 6, at a level of 21m AHD, represents the major control for Main Lakes A and B. Once Main Lakes A and B have filled from 14m AHD (operating level) to 21m AHD, Main Lake B begins to overtop into the Wildlife Lake. Around this time, the direction of flow through the weir at Hunts Gully is reversed (**Figure 3.3**).



Figure 3.3: Stage 4 - Flooding Behaviour

29 November 2010

#### 3.1.1.5 Stage 5 – Post Flood

As the flood through the River recedes, the overtopping of Weir 1 stops, then Weir 6 stops overtopping and finally inflow from Wildlife Lake weir ceases.

After the flood has receded, however, the lakes are elevated above their normal operating levels. For Main Lake A and B, the post-flood level is 21m AHD (the crest level of Weir 6). For the Wildlife Lake, the post-flood level is 16m AHD (the crest level of Wildlife Lake weir).

Flood Drainage pipes are provided to draw-down the post-flood levels within the lakes back to normal operating conditions. For Main Lakes A and B, this represents a drawdown of approximately 7 metres of water, while for the Wildlife Lake this represents a drawdown of approximately 6 metres of water. Flood water will be discharged from the flood outlet pipes to the Nepean River (**Figure 3.4**).
#### Wildlife Lake Weir at Penrith Lakes – Environmental Assessment Prepared for Penrith Lakes Development Corporation



Figure 3.4: Stage 5 - Post Flood Behaviour

## 3.1.2 Flood Behaviour – Hunts Gully

This environmental assessment is based on the design and construction of the Wildlife Lake weir. As discussed above, this weir represents an integral part of the overall Lakes Scheme, and is necessary to achieve the overall flood benefits of the Lakes Scheme.

Hunts Gully and the Wildlife Lake weir will perform differently at different stages of the flood event and under different design storm recurrence intervals. **Table 3.1** summarises the different flow behaviours during a flood event.

Description	Direction of Flow	Design storm
Filling of the Wildlife Lake through Wildlife Lake weir	From Nepean River to Wildlife Lake	> 10 year ARI
Backflow through Wildlife Lake weir from the Wildlife Lake. This occurs following the peak of the flood event in the Nepean River, and when the Wildlife Lake has filled to a level above the crest of the Wildlife Lake weir.	From Wildlife Lake to Nepean River	> 20 year ARI
Overtopping of Weir 6 and flows from the Main Lake passing through the Wildlife Lake and Wildlife Lake weir. Flows from the Weir 6 will stop once the Main Lake has dropped to 21m AHD.	From Wildlife Lake to Nepean River	> 50 year ARI

#### Table 3.1: Wildlife Lake weir Operations

# 3.2 **Proposal Objectives**

The weir has been proposed to ensure the sustainability of the proposed lakes within the Penrith Lakes site during flood events in the Nepean River.

Hunts Gully has historically drained the Penrith Lakes Site including a number of agricultural properties to the north east of the site adjacent to Castlereagh Rd, West Wilchard Rd and Smith St (a catchment area of approximately 20 sq km). However, the current quarry works have significantly modified the flows received by Hunts Gully to the extent that its catchment area is reduced to approximately 2 sq km. At Lewis Lagoon (**Figure 3.5**) high flows from the catchment are diverted into the Lakes Scheme via a piped culvert. Hunts Gully only receives low flows from the upper catchment and its immediate catchment downstream of Lewis Lagoon.



Figure 3.5: Current alignment and catchment area of Hunts Gully

Elsewhere within the Penrith Lakes Site, the eastern bank of the Nepean River is sufficiently high that over-topping and flooding will only occur in an ARI event of approximately 100 years. At Hunts Gully water will naturally flow into the gully from the Nepean River during smaller flood events (i.e. less than a 10 year ARI event). The proposed Wildlife Lake weir is designed to be overtopped from the Nepean River in 10 year ARI events. As such Wildlife Lake weir will:

- Prevent floodwaters from entering into the Wildlife Lake in events of 10 year ARI or less. This will protect the ecosystem within the Wildlife Lake by preventing the ingress of Nepean River water which may contain weed species and undesirable fish species. It also prevents active flows through the property to the north in events less than a 10 year ARI.
- Control filling of the Wildlife Lake in events greater than a 10 year ARI.

 Control outflow of floodwaters from the Wildlife Lake – this occurs only for flood events greater than a 20 year ARI.

When these elements are considered together, it can be seen that creation of the weir will have a significant positive impact. Details of the design elements considered in the development of the weir are described in the Flood Infrastructure Concept Design (Section 5 of the Application: Cardno 2010b). The weir will provide a sufficiently stable hydrological system to allow the establishment of Wildlife Lake ecosystems. It will also help prevent the ingress of aquatic weeds and invasive fish species that are present in the river.

The proposed weir will cross Hunts Gully. The existing course of Hunts Gully creek will be altered to direct flows into the Wildlife Lake (**Figure 3.6**) approximately 50m upstream of the Wildlife Lake weir.

# 3.3 Alternatives and Options Considered

The following alternatives and options were considered in the development of this proposal.

## 3.3.1 Do Nothing Approach

This option would involve not constructing the weir. This would result in significant scour damage to the Wildlife Lake during a river flood event. This would likely result in a substantial loss of riparian and semi-aquatic vegetation as well as greater flood damage to adjacent properties from increased flow velocities. This option is not considered favourable.

## 3.3.2 Alternative Weir Dimensions

A number of potential dimensions for the weir were considered. The dimensions for the weir were determined based on the following key objectives:

- Prevention of flood events in the Nepean River up to the 10 year ARI from entering the Wildlife Lake;
- Minimise the overall amount of engineered concrete structure required;
- Minimise changes to the velocities within the property to the north of the PLDC property boundary;
- Minimise impacts on surrounding properties.

A number of alternative weir configurations were assessed, and are detailed in the Flood Infrastructure Concept Design (Section 5 of the Application: Cardno 2010b). The configuration of the design was optimised using hydraulic modelling. The following scenarios were included in the assessment:

- Weir height of 16mAHD for a length of 65m, higher weir level of 18.5mAHD until it intersects with the 18.5mAHD contour of the design ground levels.
- Weir height of 15.2mAHD for a length of 65m, higher weir level of 18.5mAHD until it intersects with the 18.5mAHD contour of the design ground levels.
- Weir height of 16mAHD for a length of 40m, higher weir level of 18.5mAHD until it intersects with the 18.5mAHD contour of the design ground levels.
- Weir height of 16mAHD for a length of 100m, higher weir level of 18.5mAHD until it intersects with the 18.5mAHD contour of the design ground levels.

# 3.4 Preferred Option

Consideration of the various designs identified the preferred option to be the construction of a concrete structure with a level of 16mAHD and a length of 65m with a high level spillway earth mounding at 18.5mAHD to tie in with the existing landscape.

The preferred weir (Figure 3.6) will consist of:

- A central weir crest at 16m AHD. The design suggests that this would be a conventional concrete structure, with suitable dissipation at both the southern and northern sides of the weir;
- Two earthen embankments to act as a high level spillway either side of the crest at a level of 18.5m AHD. These would tie in with existing topography at both the western and eastern ends (the western embankment = 85m length, eastern embankment = 65m length); and
- Reinforced grass embankment downstream of the weir crest.

Detailed discussion on the selection of this option is provided in the Flood Infrastructure Concept Design (Section 5 of the Application: Cardno 2010b).

The minimum level of the Hunts Gully / Nepean River junction is 13m AHD. Thus the weir will represent a maximum relative height of 3m on the northern side. This would be overtopped in events larger than a 10 year ARI event from flood waters 'backing up' from the Nepean River along Hunts Gully. As this flow is a backwater from the Nepean River, the flood levels on the property to the north would not be impacted by the construction of Wildlife Lake weir. Further details on this are provided in the Flood Infrastructure Concept Design (Section 5 of the Application: Cardno 2010b).

**Figure 3.6** shows that under the preferred design a 20m buffer will be maintained between the weir and the PLDC property boundary to minimise impacts on adjacent properties. It is also apparent that the eastern embankment will cross Hunts Gully creek. This crossing will terminate the Hunts Gully creek flows. To accommodate this, the creek will be diverted approximately 50m upstream of the weir extent to flow into the Wildlife Lake. The existing creek extent from the diversion point to the weir will run dry. Similarly, the creek downstream of the weir will not receive any flows except under flood events. This and other potential environmental impacts are discussed in **Section 5**.



Figure 3.6: Proposed Wildlife Lake weir design and PLDC Conservation Zones (lighter coloured areas)

# 4 Description of the Proposal

# 4.1 Location and Site Description

The study area is located within the Middle Nepean – Hawkesbury and Blue Mountains catchments, Sydney Bio-region. The Penrith Lakes Scheme is located within the Penrith LGA and is approximately 60km west of Sydney and approximately 2km north-west of Penrith (**Figure 1.1**). It is bound to the north by Smith Road, to the east by Cranebrook Terrace, and to the west and south by the Nepean River. It is approximately 1,937 ha. The proposed works involve the construction of a weir across Hunts Gully at the northern end of the Wildlife Lake which is planned as part of the Penrith Lakes Scheme.

The proposed weir study area (**Figure 4.1**) is within land that has previously been extensively disturbed. To the south of the works site the land is actively quarried. A small bridge crosses Hunts Gully at the southern end of the works site. It is anticipated that this will not be disturbed by the proposed works. Land to the east and west of Hunts Gully are cleared grassland areas. The land immediately west of Hunts Gully extending to the Nepean River will be quarried to within 20m of the PLDC property boundary. To the north the PLDC property is bounded by private estates. The Estate maintains ornamental gardens with limited remnant vegetation.



Figure 4.1: Proposed works site study area

Hunts Gully creek itself has been fenced off by PLDC to protect it during quarrying activities. It is evident that both initial clearing of land for agricultural purposes, and the construction of the Lakes Scheme has modified creek flows, have substantially modified the nature of the creek. The creek passes from PLDC land to private land and runs north for approximately 100m after which it is piped underground for 170m before joining the Nepean River.

# 4.2 Relationship to the Overall Scheme

The overall Scheme design as defined in SREP 11 Structure Plan represents the broad framework for the implementation of the Scheme through to its completion. The main features of the Scheme are a large main lakes (comprising of Main Lake A and Main Lake B) intended for a variety of recreational activities complemented by several small lakes which will provide for both recreational and conservation activities. When fully implemented, the Scheme will include both land-based recreation and potential future urban areas. An immediate benefit of the Scheme has been the completion of the Olympic rowing/canoeing course. This precinct has been available for public use since 1995.

An orderly sequence of extraction and rehabilitation is required to achieve the progressive construction of the lakes and landforms. Factors such as access, stockpiling, affordability and environmental management have been considered in the development of the sequence of works. The proposed weir at Hunts Gully would form a component of Development Application 4 (DA4), which comprises of the fourth stage of the Scheme's development.

As discussed in **Section 3.1** the propose weir is an integral part of the wider rehabilitation works proposed at Penrith Lakes. The rehabilitation of the quarry site is required to ensure the ongoing sustainability of the site for future generations. The proposed weir will play an important role in controlling exchange of water between the Lakes and the Nepean River, and is critical to the sustainability of the lakes.

# 4.3 Design Parameters

The design of Wildlife Lake weir was undertaken as a part of the overall concept design of the Penrith Lakes Scheme. Details on this design are provided in the Flood Infrastructure Concept Design (Section 5 of the Application: Cardno 2010b) and in the plans provided in Section 4 of the Application. The following summarises the key characteristics of the weir.

The weir is proposed to be a two stage weir:

- A central portion at 16m AHD.
- An embankment either side at 18.5m AHD.

Sections 4.3.1 and 4.3.2 provide a description of each of these components.

#### 4.3.1 Central Weir

The central portion of the weir is located at 16m AHD, and prevents the inflow of flood events less than the 10 year ARI from entering the Lakes Scheme from the Nepean River.

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For the design, the central portion of the weir is proposed to be a conventional concrete structure. The conventional concrete structure incorporates a 3m high vertical wall extending from 13m AHD to 16m AHD. This level is close to the invert of the existing creek in Hunts Gully. On the southern side of the weir, a 1 in 5 slope is adopted from 13m AHD to approximately 6m AHD, which is below the proposed operational level of the Wildlife Lake.

On each side of the weir a dissipative structure is proposed. On the southern side, a sloping apron is proposed as the dissipative structure. On the northern side, this is likely to be a concrete slab with suitable dissipative blocks to reduce the energy of the flows. On the northern side, this is to protect Hunts Gully from the flows which overtop once the weir flow direction reverses (**Section 3.1.1**). This is primarily provided as a precautionary measure, as Hunts Gully will be inundated by the backwater from Nepean River at this time.

#### 4.3.2 Embankments

On either side of the central weir, an embankment at 18.5m AHD is proposed. This embankment would extend until it matches the existing levels either side of the weir.

This embankment has been designed such that once floodwaters overtop this embankment, the level within both the Wildlife Lake and the Nepean River will be nearly balanced. As such, the embankment will be primarily drowned and the need for erosion protection is minimised.

Should a slope of 1 in 6 be adopted on the embankment, then it would be possible to have no protection works on the embankment, as long as good grass cover is maintained. This would require suitable irrigation. If irrigation cannot be provided or steeper slopes are required, then reinforced grass or a suitable alternative would be required.

# 4.4 Cost

It is estimated, based on advice from PLDC; that the cost of weir installation would be in the order of \$2.4 Million.

# 4.5 Timing

Based on the designs it is estimated that the proposed construction works will take in the order of 6 months to complete. This will be reviewed at the detailed design stage.

# 5 Environmental Impact Assessment

This section presents an environmental assessment undertaken in order to identify the environmental constraints and potential environmental impacts associated with the construction of Wildlife Lake weir at Penrith Lakes. This section of the EA also identifies site-specific mitigation measures which are recommended to avoid or minimise any identified potential impacts.

The section is divided into sections to describe each of the environmental aspect assessed in this EA. Significant environmental factors considered in this section include:

- Terrestrial Ecological Impacts;
- Riparian and Aquatic Ecological Impacts;
- Hydrological Impacts;
- Aboriginal and Non-Aboriginal Heritage; and
- Soils, Sediments and Erosion.

A range of impacts of relatively lesser significance were also assessed. These aspects include:

- Contaminated Land;
- Air Quality, Climate and Dust;
- Hazards and Risks;
- Landscape and Visual Impact;
- Land Use Impacts;
- Noise and Vibration Impacts;
- Social and Health Values;
- Traffic Impacts/Access and Accessibility;
- Utilities and Infrastructure;
- Waste Materials and Management; and
- Water Quality Impacts.

# 5.1 Terrestrial Ecology

## 5.1.1 Aims and Assessment Methodology

The proposed weir development at Hunts Gully in the Penrith Lakes Scheme is primarily designed to create and protect the Wildlife Lake as well as protect properties to the north of the site during large flood events. It is acknowledged that the proposed works will lead to the formation and then conservation of significant terrestrial and aquatic ecosystems.

It is planned that the proposed weir will be constructed at the northern end of the Wildlife Lake (**Figure 3.1**).

An initial desktop review of threatened flora and fauna records (particularly threatened species) was conducted for the general Penrith Local Government area in February 2010 using the NPWS Wildlife Atlas (2000), EBPC Act Database (1999) and Threatened Species Conservation Act (1995) species lists. A review of historical flora and fauna reports specifically from within the Penrith Lakes Scheme area was also conducted (reports from

Mission Australia and University of Western Sydney 2002; Abel Ecology 2007; Eco Logical 2009).

A terrestrial ecology field study was conducted over two days by Cardno in association with Eco-Logical to assess site specific impacts on existing riparian flora and fauna, and to establish conservation and ecological values. The details of this study are provided in **Appendix A**.

The field survey involved collating information on the vegetation community composition at the proposed weir development site. The survey included meandering vegetation transects to allow for identification of all plant species encountered, a rough estimate of their densities and crown cover, and where possible, qualitative assessment of condition, dominance and habitat value. The survey included the immediate vicinity of the proposed area of the works, and extended upstream within Hunts Gully and downstream to the PLDC boundary to an extent adequate to assess potential in stream impacts. The study area extents are defined in **Figure 4.1**. Threatened flora species which have historically been known to occur in the area (based on the above database searches) and species typical of the River-flat Eucalypt community (historically recorded in the general area) were targeted. The locations of mature trees were recorded, displayed, and mapped.

The survey effort also focused on detecting and assessing the presence of suitable habitat areas and resources for fauna species, with particular emphasis on those species of formally recognised conservation significance that have been previously recorded, or considered likely to occur, in the locality of the site.

# 5.1.2 Ecological Legislative Requirements

This study and report was undertaken with reference to the requirements of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act 1979), the NSW Threatened Species Conservation Act 1995 (TSC Act 1995), the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999) and the Noxious Weeds Act (1993). There was found to be no significant impact on any threatened species, their habitats, populations or endangered ecological communities as a result of the Proposal (further details are provided in the following sections). As such, a Species Impact Statement is not required. Referral to the Federal Minister for the Environment is not deemed to be required in relation to the obligations and objectives of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, as there would be no significant impact on any "Matters of National Environmental Significance".

# 5.1.3 Existing Environment

# Flora

Vegetation composition within the study area was characterised by a dominance of exotic species across all vegetative layers. In general, the riparian vegetation were considered to be of very low ecological value and in very poor condition due to the long history of anthropological land use disturbances in the region (e.g. agriculture and mining), resulting in a high degree of weed infestation. It is considered likely that if no human intervention

takes place to control the spread of weeds the stability of the ecosystem will continue to degenerate. Only one mature tree was recorded at the site, *Acacia implexa* (Figure 5.1).

Two small stands of juvenile trees occur within proximity to the work site (**Figure 5.1**). However, it is understood that the removal of these stands has been approved as part of programmed future quarrying works and that the trees will not be present during construction of the weir.

A total of 56 flora species belonging to 21 families and 49 genera was recorded in the study area. A comprehensive list of all plant species recorded is provided in **Appendix A**, including estimates of their densities and cover, and their biological attributes, such as growth forms, conservation significance (based on EPBC Act 1999, TSC Act 1995) and their weed control category (based on Noxious Weeds Act 1993). Out of the 56 species, 42 species were non-native weed species, six of these were recorded as declared weeds under the Noxious Weed Act (1993) (**Table 5.1**). Weed species dominating the groundcover include many graminoid species such as Pennisetum clandestinum, Setaria parviflora, Eharta erecta, Eragrostis curvula, and Cynodon dactylon. Dominant weedy shrubs include Sida rhombifolia and Solanum linneanum. Weed species dominated all growth forms, including the graminoid groundcover, shrub and tree growth forms. Only 14 species belonging to seven families were recorded to be native (**Table 5.2**).

#### Wildlife Lake Weir at Penrith Lakes – Environmental Assessment *Prepared for Penrith Lakes Development Corporation*



Figure 5.1: Extent of riparian vegetation impacted by the proposed weir.

Table 5.1: Declared weed species and their control categories listed under the Noxious Weeds Act (1993)

Noxious Weed	V	Weir Site		Control Category
Species	Р	D	С	
Cestrum parqui*	1	2	2	3
Lantana camara*	1	2	3	5
Ligustrum sinense*	1	2	2	4
Ludwigia peruviana*	1	2	2	3
Rubus fruiticosus*	1	1	1	4
Salix sp. *	1	1	1	5
Total	6			

P = Presence (1 = present), D = Density (Rough estimates - 1 = 1 individual, 2=2-20 individuals, 3 = 21-100 individuals, 4 = over 100 individuals), C = Crown Cover (Rough estimates - 1 = 1-5%, 2 = 5-25%, 3 = 26-75%, 4 = 76-100%).

		Weir		r	Vegetation Attributes		Conservation
Species	Family	Ρ	D	с	Common Name	Growth Form	Value
Acacia implexa	Fabaceae	1	2	2	Hickory Wattle	Tree	
Bothriochloa macra	Poaceae	1	2	2	Redleg grass	Graminoid	
Carex appressa	Cyperaceae	1	2	2	Tall Sedge	Graminoid	
Carex inversa	Cyperaceae	1	2	2	Knob Sedge	Graminoid	
Carex sp.	Cyperaceae	1	1	2		Graminoid	
Centella asiatica	Apiaceae	1	2	2	Gotu Cola	Herb	Riverflat Eucalypt
Cynodon dactylon	Poaceae	1	3	3	Couch, Bermudagrass	Graminoid	
Gahnia sieberiana	Cyperaceae	1	2	2	Red-Fruit Saw Sedge	Graminoid	
Glycine tabacina	Fabaceae	1	2	2	Gycine Pea	Herb	Riverflat Eucalypt
Juncus usitatis	Juncaceae	1	2	2	Common Rush	Graminoid	
Oplismenus aemulus	Poaceae	1	2	2	Basket Grass	Graminoid	Riverflat Eucalypt
Oxalis perennans	Oxalidaceae	1	2	2		Herb	Riverflat Eucalypt
Persicaria orientalis	Polygonaceae	1	1	1	Princess feathers	Herb	
Persicaria subsessilis	Polygonaceae	1	2	2	Hairy Knotweed	Herb	

#### Table 5.2: List of native plant species recorded at the Weir site.

P = Presence (1 = present), D = Density (Rough estimates - 1 = 1 individual, 2=2-20 individuals, 3 = 21-100 individuals), C = Crown Cover (Rough estimates - 1 = 1-5%, 2 = 5-25%, 3 = 26-75%, 4 = 76-100%).

Threatened flora database searches (EPBC Act 1992, TSC Act 1995, NSW Wildlife Atlas 1999) revealed 13 species which were historically recorded within the Penrith LGA (**Table 5.3**). No threatened species were recorded at the work site and all potential species were considered highly unlikely to occur given the degraded nature of the site.

Table 5.3: Threatened flora species re	ecorded within the Penrith LGA
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Species Name	Common Name	Status *
Allocasuarina glareicola		E1
Leucopoon fletcheri subsp. fletcheri		E1
Hibbertia puberula		E1
Dillwynia tenuifolia		V
Pultenaea parviflora		E1
Acacia bynoeana	Bynoe's Wattle	E1
Micromyrtus minutiflora		E1
Pterostylis saxicola		E1
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V
Personoia hirsuta	Hairy Geebung	E1
Persoonia nutans	Nodding Geebung	E1
Pimelea spicata	Spiked Rice-flower	E1
Allocasuarina glareicola		E1

Species records within relevant databases (the EPBC Act (1999), NSW Wildlife Atlas (1999), species list of the TSC Act (1995)) and reports by Abel Ecology (2007) and Eco-Logical Australia (2009) have recorded in the area the presence of River-Flat Eucalypt Forest on Coastal Floodplains (RFEF). This is an endangered ecological community (EEC) under the TSC Act. However, field work undertaken for this EA identified only a very minor component of the remaining RFEF species within the study area (**Table 5.4**), with four understorey species (three herbs and one graminoid species) observed. All RFEF species generally represented low density and cover values at all sites (**Table 5.4**). The majority of the species within the study area were introduced, constituting 84% of the total species recorded at the site. As a result, it was concluded the only remaining RFEF species were only very broadly analogous to an intact River-flat Eucalypt community (**Appendix A**), and was not significant enough to deem it of conservation value, especially considering the understorey species are most likely to disappear in the future due to the dominating and competitive nature of weeds in the understorey layer.

It is also noted that 100m downstream of the location of proposed weir the open creek enters a twin pipe culvert, from where it flows 170m underground before emerging into private property and then discharging into the Nepean River. All riparian vegetation discontinues once the creek is piped. As a result the existing riparian corridor along the creek does not have any significant connectivity value either for flora or fauna species.

		l l	Weir		Weir		Vegetation A	Attributes
Species	Family	Р	D	С	Common Name	Growth form		
Centella asiatica	Apiaceae	1	2	2	Gotu Cola	Herb		
Glycine tabacina	Fabaceae	1	2	2	Gycine Pea	Herb		
Oplismenus aemulus	Poaceae	1	2	2	Basket Grass	Graminoid		
Oxalis perennans	Oxalidaceae	1	2	2		Herb		
	Total Riverflat spp	4						
	Total Native spp.	14						
	Total Weed spp.	42						
	Total spp	56						

Table 5.4: River-flat Eucalypt Forest species recorded within the weir site.

P = Presence (1 = present), D = Density (Rough estimates - 1 = 1 individual, 2=2-20 individuals, 3 = 21-100 individuals, 4 = over 100 individuals), C = Crown Cover (Rough estimates - 1 = 1-5%, 2 = 5-25%, 3 = 26-75%, 4 = 76-100%).

## Fauna

A threatened species fauna search using NSW Wildlife Atlas (2000) and EBPC Act Database was conducted for the entire Penrith LGA. A total of 26 threatened fauna species were recorded and are listed in **Table 5.5**. Due to the very small disturbance area anticipated for the proposed works and the fact that the site is highly degraded and lacks an overstorey, the proposed work site provides limited fauna habitat resources that are suitable for utilisation by native fauna species, including the 26 species listed below. In addition to the degraded nature of the existing habitat, the presence of feral animals further decreases the value of existing fauna habitat. Previous reports (Mission Australia, 2002; Abel Ecology, 2007) indicate the abundance of feral species is of significant concern and

subsequent further increases in predation / competition pressures may cause local extinction of many native species within the remaining riparian strip.

Order	Species name	Common name	Status
Amphibia	Litoria aurea	Green and Golden Bell Frog	E1
	Pseudophryne australis	Red-crowned Toadlet	V
	Heleioporus australiacus	Giant Burrowing Frog	V
Aves	Xanthomyza phrygia	Regent Honeyeater	E1
	Lathamus discolor	Swift Parrot	V
	Rostratula australis	Australian Painted Snipe	V
	Petroica rodinogaster	Pink Robin	V
	Lophoictinia isura	Square-tailed Kite	V
	Stictonetta naevosa	Freckled Duck	V
	Callocephalon fimbriatum	Gang-gang Cockatoo	V
	Petroica rodinogaster	Pink Robin	V
	Glossopsitta pusilla	Little Lorikeet	V
	Neophema pulchella	Turquoise Parrot	V
	Ninox strenua	Powerful Owl	V
Gastropoda	Meridolum corneovirens	Cumberland Plain Land Snail	E1
Insecta	Petalura gigantea	Giant Dragonfly	E1
Mammalia	Dasyurus maculatus	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll	E1
	Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V
	Potorous tridactylus	Long-nosed Potoroo	V
	Pteropus poliocephalus	Grey-headed Flying-fox	V
	Petaurus norfolcensis	Squirrel Glider	V
	Phascolarctos cinereus	Koala	V
	Pteropus poliocephalus	Grey-headed Flying-fox	V
	Miniopterus schreibersii	Eastern Bentwing-bat	V
	Myotis macropus	Southern Myotis	V
Reptilia	Hoplocephalus bungaroides	Broad-headed Snake	V

Table 5.5:	Threatened	Fauns	species	recorded	within	the Pen	rith LGA

Fauna species opportunistically recorded within the PLDC site during the ecological survey are listed in **Table 5.6**. None of these species were observed within the study area. None of the species are currently listed as endangered or vulnerable under the TSC Act (1995) or EBPC Act (1999). No arboreal and terrestrial mammals were sighted in the area. It is considered unlikely that any arboreal mammals inhabit the gully corridor due to the lack of *Eucalyptus* trees containing potential hollow bearing habitat.

Table 5.6: Fauna si	pecies recorded du	uring the ecological	survey at Penrith Lakes
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Order	Species name	Common name
Aves	Anhinga melanogaster	Darter
	Gymnorhina tibicen	Australian Magpie
	Dacelo novaeguineae	Laughing Kookaburra
	Haliaeetus leucogaster	White Bellied Sea Eagle

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Order	Species name	Common name
	Hirundo neoxena	Welcome Swallow
	Fulica atra	Eurasian Coot
	Falco peregrines	Peregrine Falcon
	Pelecanus conspicillatus	Australian Pelican
Reptilia	Physignathus lesuerii Varanus varius	Easter Water Dragon Lace Monitor
	Pseudechis porphyriacus	Red Bellied Black Snake

Three species of Microbats are historically recorded as occurring further south of the work site (Abel Ecology, 2007). This includes the Large Bentwing Bat (*Miniopterus schriebersii*), Eastern Freetail Bat (*Mormopterus norfolkensis*), and the Large-Footed Myotis (*Myotis adversus*) all listed as Vulnerable under the NSW Threatened Species Act 1995. However, no significant trees, caves or rocks were observed within the works site. It is considered that the proposed works site does not provide suitable habitat for the three threatened species of microbats. Bats may utilise the gully as foraging areas. It is more likely that bats occupy the caves and the Eucalypt forest on the western bank of the Nepean River in the Blue Mountains.

No evidence (i.e. scats, scratches, tracks) of mammal utilisation of the area was observed during the site surveys. Snakes and lizards are considered likely to occur with the grasslands, although none were observed during survey. The striped marsh frog (*Limnodynastes peroni*) was heard to be present within Hunts Gully during survey. This activity during the day likely reflects the recent rainfall received within the catchment prior to the field inspections. No other amphibian species were observed.

#### 5.1.4 Potential Impacts

The construction of the weir will involve diversion of Hunts Gully creek into Wildlife Lake approximately 50m upstream of the proposed weir. Subsequently the remaining section of creek downstream of the Wildlife Lake creek diversion will only receive flows in its immediate catchment and during flood events. The section of creek downstream of the weir (i.e. approximately 100m of open channel prior to entering a culvert) will also only receive flows from its immediate catchment and during flood events. As a result, aquatic and riparian vegetation along Hunts Gully in these sections will potentially change as a result of the altered water availability. The magnitude of these impacts in terms of flora and fauna is discussed below.

#### Flora

Primary flora impacts of the proposed works include:

- Loss of vegetation due to construction of the weir;
- Loss of riparian vegetation (approximately 150m) due to diversion of creek; and
- Smothering of remnant fauna by construction dust.

The direct footprint impact of the proposed weir is limited (1.6 ha). Of this, just 0.11 ha of riparian corridor vegetation will be lost as a result of the weir construction works (**Table** 

**5.1**). The remaining area was seen to comprise exotic grassland. The direct impact due to weir construction is not considered significant.

Riparian vegetation which depends on periodic flows would be impacted by the significantly reduced flows and potentially lost due the diversion of Hunts Gully creek into the Wildlife Lake upstream. This will result in the loss of 0.6 ha of riparian vegetation downstream of the diversion point. As described in **Section 5.1.3** the vegetation to be lost is highly weed infested and no threatened species were found to be present. A single *A.implexa* tree exists within the study area. *A.implexa* are typically hardy species and are not restricted to immediate flowing water habitats; it is considered likely this tree will survive, whereas more riparian dependent species (i.e. the sedges and rushes present (**Table 5.2**)) would gradually be replaced by grassland. It is also noted that the creation of the Wildlife Lake will significantly alter the vegetation character of the area, including this reach of the creek.

Dust production during the bulk earthworks required for construction of the weir embankments has the potential to smother nearby vegetation. No significant vegetation exists in close proximity to the works site, and the impacts are therefore not expected to be significant.

The existing lack of riparian corridor connectivity due to the piping of Hunts Gully downstream of the weir to its junction with the Nepean River means that the potential loss of vegetation as a result of the proposed works will not impact upon habitat connectivity values.

No threatened plant species were recorded in the study area during field work and threatened species historically recorded in the Penrith LGA were considered very unlikely to occur amongst the highly degraded, weed infested habitat that was dominant in all vegetative layers. Due to the high levels of degradation it is considered that the likelihood of any threatened species being present in the soil stored seed bank is negligible.

A very minor component of an Endangered Ecological Community (EEC), the Riverflat Eucalypt (RFEF) community (listed under Schedule 3 of the TSC Act 1995) was detected. The species present comprised only a very small proportion (less than 5%) of the total species composition of a typical Riverflat Eucalypt community (**Table 5.4**), and included none of the characteristic tree species in mature form. It is considered that the species present is only very broadly analogous to the RFEF. It is also predicted that the pervasive nature of the weed community will continue to suppress the survival of any remaining RFEF in the future. It is considered that the proposed works will not have any significant impact upon RFEF in the area.

The removal of weeds and application of a rehabilitation plan may allow for the reestablishment of RFEF in the area. In its current form, the weir site is significantly degraded such that the loss of vegetation resulting from the proposed weir works will not significantly impact any native flora species.

It is considered that the development of the overall Penrith Lakes Scheme will have a significant positive impact upon flora communities across the overall site as well as at the proposed weir site.

#### Fauna

No threatened fauna species were recorded directly inhabiting the proposed weir site. With a corridor width of less than 10m the riparian vegetation aligning Hunts Gully is too narrow to provide any permanent habitat for large ground dwelling fauna. The shrub layer does provide some habitat for small passerine bird species. However, it is considered that the abundance of similar vegetation in the surrounding area and mobility of birds will limit any impact on these species from the proposed works and associated loss of habitat.

There was no evidence of nests, hollows, native fauna burrows, native fauna scats, or markings recorded within the immediate vicinity of the proposed works. The vegetation aligning Hunts Gully is in very poor condition and is generally characterised as having limited habitat value for native fauna dependant on native flora (and fauna) for food resources and protection.

Currently, the Hunts Gully riparian corridor may function as transient habitat for smaller ground dwelling and amphibian species. This function will be lost as a result of weir construction and creek diversion. However, it should be noted that the incorporation of the weir is a crucial component to the overall functioning of the proposed Wildlife Lake and it is expected that the full operation of Wildlife Lake in the future would act as a much larger and greater biodiversity offset which would provide more suitable and permanent habitat for amphibian species and for small and large terrestrial fauna.

The striped marsh frog (*Limnodynastes peroni*) community heard in proximity to the site is ubiquitous within the region and loss of this habitat is not likely to significantly impact its survival. Readily accessible alternative habitat is present along the Nepean River and will be available within the Wildlife Lake.

As a result of the short duration of the proposed works, the biodiversity offset to be created at the Penrith Lakes Scheme, and the general low numbers of native fauna likely to be utilizing the area, it is expected that the proposed works would not have a significant impact on the survival of native fauna.

It is also noted that the proposed works may impact on the limited creekline vegetation within the property to the north of the scheme along Hunts Gully as a result of reduced flows. While not considered a significant ecological impact due to the cleared status of the vegetation, owners of the property should be made aware of this potential impact prior to works commencing.

## 5.1.5 Proposed Mitigation Measures

**Table 5.7** provides a list of recommended mitigation measures to be implemented to minimise ecological impact. Application of these mitigation measures will ensure there will be no significant impact on native flora and fauna communities within the work site. Where appropriate, these measures should be included within a Construction Environmental Management Plan.

	Development Stage	Description of measure
	Design	The only mature <i>A.implexa</i> (native) tree near the proposed site shall be retained if possible and protected.
	Design	Mark the extent of vegetation to be cleared on all technical drawings and mark in the field.
	Construction	During the vegetation clearing stage it is recommended a qualified animal handler be on call to ensure that any native fauna that may be temporarily occupying the area, are relocated in a safe manner.
	Construction	Limit stockpiling of materials on site and actively manage stockpiles to minimise dust under high wind scenarios to prevent dust smothering and minimise weed establishment.
	Construction	Establish a Fauna log recording any significant species observed on site during construction. In the event that significant fauna is observed on site, works shall cease until the animal moves from the area or a qualified animal handler can remove it from the site.
	Construction	Prohibit works from exceeding the approved disturbance width and enforce boundaries.
	Construction/ Operation	A weed management plan must be employed to limit colonisation of the disturbed areas by weeds. Where possible this should include weed removal of the surrounding areas. This is considered to be important in the context of the broader Penrith Lakes Scheme.
	Construction/ Operation	Rehabilitation and restoration works following installation should aim to reinstate a stable landform that supports a native plant community which resembles the original forest, the Riverflat Eucalypt community. Details of appropriate restoration measures are provided in Section 7.2 of <b>Appendix A</b> .

#### Table 5.7: Terrestrial Ecology Mitigation Measures

# 5.2 Aquatic Ecology

A description of the aquatic ecology and potential impacts of the proposed works were undertaken by Cardno (2010b) (**Appendix B**).

#### 5.2.1 Assessment Methodology

Background information on the possible occurrence of (aquatic) threatened species, populations and ecological communities in the general study area was reviewed using the following legislation and relevant database searches over the internet:

- Threatened Species Conservation Act 1995 (TSC Act 1995);
- Fisheries Management Act 1994 (FM Act 1994);
- Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999);
- NSW Government BioNet Database;
- Commonwealth Department of Environment, Water, Heritage and Arts (DEWHA);
- NSW Department of Environment, Climate Change and Water (DECCW);
- Industry and Investment NSW (I&NSW); and
- Cardno Ecology Specialist library.

Field sampling was conducted by Cardno Ecology Lab on the 17 and 18 February 2010 at the Hunts Gully site. Threatened species recorded in the database searches were targeted during this survey. The 'Riparian, Channel and Environmental Inventory' (RCE) method

was used to describe the adjacent land and condition of Hunts Gully bank. This method creates an RCE score (Appendix 1 of **Appendix B**). The RCE score takes into account the following habitat features:

- Geomorphological characteristics of waterways,
- Types of land use along the waterway,
- Riparian vegetation and instream vegetation; and
- Substratum type (e.g., rock, sand, gravel, alluvial substrata).

The presences of instream macrophytes, macro-invertebrates and fish populations were also recorded.

#### 5.2.2 Existing Environment

#### Background Information

Relevant database searches and ecological reports of aquatic flora and fauna species recorded in the Nepean River and Penrith Lakes Scheme are tabulated in Table 1 of the Aquatic Ecology report in **Appendix B**.

Hunts Gully is a small ephemeral creek, capturing flows from a small partially urbanised catchment. The presence of a piped segment of the creek immediately upstream from the Nepean River is considered to significantly limit its aquatic ecology significance.

Twenty seven fish species were identified as potentially inhabiting or having historically inhabited the wider region of the study site. Of these, 24 are native species and three are exotic species; goldfish (*Carassius auratus*), carp and mosquito fish, the latter two are declared Class 3 noxious species under the FM Act. Two of the identified native species are listed as threatened:

- Macquarie perch (*Macquaria australasica*); and
- Australian grayling (*Prototroctes maraena*).

The Macquarie perch and the Australian grayling are also listed under the EPBC Act as endangered and vulnerable, respectively.

Three species of freshwater mussels are known to be present in the Hawkesbury – Nepean River system; *Hyridella depressa, Hyridella australis* and *Velesunio ambiguous*.

Tall knotweed (Alternanthera philoxeroides) and two invasive species Alligator weed (Alternanthera philoxeroides) and Salvinia (*Salvinia molesta*) are also potentially occurring in the area.

Surveys within and around Penrith Lakes from 1998 – 2009 have identified a total of 11 fish species (**Appendix B**). Australian bass (*Macquaria novemaculeata*) and carp were the most abundant large fish, whilst mosquitofish were the most abundant small fish (I&I NSW 2009). A stocking program from 1996 to 2005 introduced 129,000 bass into the Penrith Lakes.

<sup>29</sup> November 2010

The macroinvertebrate fauna of Penrith Lakes is dominated by species from *Trichoptera* (Caddisflies), *Odonata* (Dragonflies and Damselflies), *Diptera* (True Flies) and to a lesser extent *Hemiptera* (True Bugs) and *Coleoptera* (Beetles) (I&I NSW 2009). Freshwater shrimp and prawns have also been frequently observed (I&I NSW 2009).

#### Field assessment

Hunts Gully is a heavily degraded creek with a very low RCE score (24, **Appendix B**). Only two species of macrophytes, *Juncus usitatus* (Common Rush) and *Persicaria decipiens* (Slender knotweed) were recorded during the survey. No fish species were observed during the site inspection of the creek. It was considered highly unlikely that any threatened species inhabit the narrow stream which had a very low quantity of water with weedy sedges and rushes covering the majority of the stream. Hunts Gully is an ephemeral creek which only flows following rainfall events.

#### 5.2.3 Potential Impacts

The construction of the weir and subsequent diversion of flow from Hunts Gully into Wildlife Lake would entail the loss of all aquatic habitat and biota from the reach of Hunts Gully downstream of the diversion site. Hunts Gully is considered a highly degraded watercourse which flows only during significant rainfall events. In addition, Hunts Gully only runs 100m from the PLDC boundary after which water flows become diverted into twin-pipe culverts which combine with residential pipes and eventually discharge into the Nepean River. Due to the highly degraded nature of the watercourse, no significant impact upon aquatic flora and fauna is expected as a result of the proposed works.

The creation of approximately 750 hectares of aquatic habitat within the Penrith Lakes Scheme is considered a more than adequate environmental offset/compensation for the loss of the reach of Hunts Gully downstream from the proposed weir.

## 5.2.4 Proposed Mitigation Measures

To minimise the potential impacts of the proposed works on the aquatic fauna/flora at Hunts Gully, it is suggested that a Construction Environmental Management Plan (CEMP) is developed incorporating the following mitigation measures:

Development	Description of measure	
Stage		
Construction	Appropriate erosion and sediment control measures should be utilised.	
Construction / Operation	Revegetation and restoration of disturbed areas should take place as quickly as possible. Erosion and sediment control measures should be in place to treat run-off from these areas until adequate cover is established.	
Operation	Minimise the time lag delay between the construction of the weir and the creation of the Wildlife Lake. This will allow an easy migration of possible amphibian populations from Hunts Gully into the Wildlife Lake, when water levels within the discontinued creekline within Hunts Gully become depleted following the weir construction.	

#### Table 5.8: Aquatic Ecology Mitigation Measures

# 5.3 Hydrological Impacts

# 5.3.1 Assessment Methodology

A two-dimensional (2D) hydraulic model was established for the study area using SOBEK 1D/2D. Details of the setup and calibration of this model can be found in Cardno (2010c) (Section 6 of the Application).

The following reports have been prepared by Cardno in undertaking this design:

- Cardno (2010). Penrith Lakes Scheme: Flood Infrastructure Concept Design, prepared for Penrith Lakes Development Corporation, Version 2, May.
- Cardno (2010). Two Lake Scheme Alternative Flood Analysis, prepared for Penrith Lakes Development Corporation, November 2010. Prepared as an addendum to Lakes Scheme – Flood Infrastructure Concept Design.
- Cardno (2010) Penrith Lakes Flood Modelling Model Calibration and Verification, Prepared for PLDC, 10 May 2010, Ref: W4756\_Calibration\_Report\_v7.

These documents have been provided in Sections 5 and 6 of the development application submission respectively.

## 5.3.2 Existing Environment

A detailed description of the flooding behaviour in the area, both prior to the quarry and after the construction of the Lakes Scheme, is provided in Section 5 of the Application (Cardno, 2010b).

## 5.3.3 Potential Impacts

The proposed weir forms a component of the Penrith Lakes Scheme which involves the construction of a number of lakes within the PLDC site. The weir is integral to the functioning of the lake system during larger flood events in the Nepean River. The lakes themselves provide a significant flood benefit to the urban areas upstream of the PLDC site by storing large volumes of flood water from the Nepean River and then slowly discharging the water through pipelines after the peak of the flood event has passed.

There are no expected negative flood impacts associated with the construction of the weir. It is considered that loss of flood storage within Hunts Gully due to the proposed weir is negligible in comparison to the volume of the Nepean River floodplain and would have no observable impact on flood extents downstream.

## 5.3.4 Proposed Mitigation Measures

No potential negative flood impacts have been identified as a result of the proposal. Therefore, mitigation measures are not required. The weir is a significant flood control measure and its potential benefits are discussed in Section 5 of the Application (Cardno, 2010b).

# 5.4 Aboriginal and Non-Aboriginal Heritage

#### 5.4.1 Aboriginal Heritage: Existing Condition

The Penrith Lakes Scheme has been in operation for approximately 20 years. Archaeological surveys, monitoring and assessment have been, and continue to be undertaken in respect of the Scheme.

The majority of the archaeological surveys, monitoring and assessments have been conducted by Dr Jim Kohen on behalf of the Penrith Lakes Development Corporation which were summarised by Kohen in 1997. The archaeological work is ongoing.

Archaeological assessments conducted by Kohen as part of the Penrith Lakes Regional Environmental Study (Dept. of Environment and Planning, 1984) identified 31 Aboriginal Heritage sites within and around the Penrith Lakes Scheme. Since that time many additional sites have been identified. **Table 5.9** summarises the sites identified prior to Kohen's work and sites identified by Kohen in the area.

AHIMS No.	Site Name	Site Type
45-5-0054	Shaws Creek K1 Hawkesbury Lookout	Rock engraving and shelter with deposit
45-5-0056	Upper Castlereagh	Axe grinding groove
45-5-0206	Shaws Creek K1	Axe grinding groove and shelter with deposit
45-1-0219	Penrith Lakes 39	Open camp site
45-5-0278	Shaws Creek K1	Open camp site
45-5-0279	Shaws Creek K2	Open camp site
45-5-0280	Castlereagh South	Axe grinding groove and open camp site
45-5-0281	Cranebrook Creek 1	Contact, Mission, open camps site
45-5-0282	Upper Castlereagh	Open camp site
45-5-0284	Castlereagh 2	Open camp site
45-5-0314	Penrith Lakes 28	Open camp site
45-5-0315	Penrith Lakes 1	Open camp site
45-5-0316	Penrith Lakes 2	Open camp site
45-5-0317	Penrith Lakes 3	Open camp site
45-5-0318	Penrith Lakes 4	Open camp site
45-5-0319	Penrith Lakes 5	Open camp site
45-5-0320	Penrith Lakes 6	Open camp site
45-5-0321	Penrith Lakes 7	Open camp site
45-5-0322	Penrith Lakes 8	Open camp site
	Penrith Lakes 9	Isolated Find
45-5-0323	Penrith Lakes 10	Open camp site
45-5-0324	Penrith Lakes 11	Open camp site
45-5-0325	Penrith Lakes 12	Open camp site
	Penrith Lakes 13	Isolated Find
45-5-0326	Penrith Lakes 15	Open camp site

Table 5.9:	Aboriginal	Heritage Sit	es Located	in and Ar	ound the	Study	Area
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29 November 2010

#### Wildlife Lake Weir at Penrith Lakes – Environmental Assessment Prepared for Penrith Lakes Development Corporation

AHIMS No.	Site Name	Site Type
45-5-0327	Penrith Lakes 16	Open camp site
45-5-0328	Penrith Lakes 17	Open camp site
45-5-0329	Penrith Lakes 18	Open camp site
45-5-0330	Penrith Lakes 19	Open camp site
45-5-0331	Penrith Lakes 20	Open camp site
45-5-0332	Penrith Lakes 21	Open camp site
45-5-0333	Penrith Lakes 23	Open camp site
45-5-0334	Penrith Lakes 24	Open camp site
	Penrith Lakes 25	Artefacts and axe-grinding grooves
45-5-0335	Penrith Lakes 26	Open camp site
	Penrith Lakes 28	Open camp site
45-5-0366	Emu Plains 4	Open camp site
45-5-0371	Fire Trail 1	Open camp site
45-5-0372	Black Falls 1-6	Open camp site
	Shaws Creek K1	Rock shelter
45-5-0518	Shaws Creek K2 area, Springwood	Open camp site
45-5-0520	Castlereagh South 1, Springwood	Axe grinding groove; open camp site
45-5-0530	Upper Castlereagh 1, Penrith	Open camp site
45-5-0589	Penrith Lakes 29	Open camp site
45-5-0590	Penrith Lakes 30	Open camp site
45-5-0591	Penrith Lakes 31	Open camp site
45-5-0592	Penrith Lakes 32	Open camp site
45-5-0593	Penrith Lakes 33	Open camp site
	Penrith Lakes 34	Open camp site
	Penrith Lakes 44	Open camp site
	Penrith Lakes 45	Open camp site
	Penrith Lakes 46	Open camp site
	Castlereagh 1	Open camp site
45-5-2414	Penrith Lakeside Village L1	Open camp site
45-5-2416	Penrith Lakeside Village	Open camp site
	VC/1 (Vincent Creek 1) This site was recorded in 2004 as an extension of PL33	Scarred tree and artefact scatter (6 artefacts)
	Camenzuli 1	Open artefact scatter
	PL47	Open artefact scatter
	PL48	Open artefact scatter
	PL49	Open artefact scatter
	PL50	Open artefact scatter
	PL51	Open artefact scatter
	PL52	Open artefact scatter
	Cranebrook Escarpment (CE) 1 & 2	Open artefact scatter

Kohen (1997) noted that sites that occur within the Penrith Lakes area are particularly likely to occur adjacent to the rivers and creeks. Kohen (1997) also identified that all artefacts

located within the Penrith Lakes area are significantly younger than 40,000 years old and the vast majority are less than 4,000 years old.

Additional surveys and excavations were undertaken by Comber (2006 & 2007) which confirm the previous analysis that sites would be more likely to be located adjacent to the River and to creeks. They also confirmed the significance of the archaeological resource at Penrith Lakes.

The proposed weir is to be located across Hunts Gully. The area immediately to the east of Hunts Gully is a conservation area that has been set aside as a non-quarry zone due its significant Aboriginal cultural heritage values. It is a high area located above the Nepean River and the former Cranebrook Creek. It contains a large number of artefacts at a density of at least 20 per square metre. A bund will be created in the north western section of the conservation area as part of the weir construction.

To the south of Hunts Gully one isolated find was located by Kohen in 1984 (PL9). In 2006 on the western side of Hunts Gully 6 surface artefacts designated PL47-52 were recorded (Comber 2006b). As these sites indicated the possibility for further surface and sub-surface artefacts to exist, archaeological excavation was undertaken to the west and south west of Hunts Gully in an area of 85 ha that was known as PL9.

These sites located nearby and the sites located within the Penrith Lakes Scheme indicate the possibility for Aboriginal sites to exist, or to have existed prior to disturbance, within the study area. It is known that artefacts exist within the conservation area.

## 5.4.2 Aboriginal Heritage: Potential Impacts

There is sufficient evidence to suggest that the proposed weir construction may impact Aboriginal objects within the soil. In order to clarify this, a series of test excavations is proposed under an existing Aboriginal Heritage Impact Permit (AHIP: 2595) currently subject to an amendment application to the Department of Environment, Climate Change and Water (DECCW).

## 5.4.3 Aboriginal Heritage: Proposed Mitigation Measures

The excavations proposed as part of the existing AHIP (ref: 2595) will explore the impact area for the purpose of understanding the character and assessing the cultural significance of Aboriginal objects (flaked stone artefacts) and undertake any further salvage excavation as may be warranted to mitigate the impact of the weir construction. The cultural significance assessment will be conducted in consultation with the relevant Aboriginal stakeholders in accordance with PLDC's ongoing Aboriginal consultation programme.

Mitigation measures (**Table 5.10**) will be applied in accordance with the permit requirements.

29 November 2010

Development Stage	Description of measure
Construction	Subject to approval of amendment to the existing AHIP (ref: 2595), all works will
	be undertaken in accordance with the mitigation and management measures
	outlined as part of the AHIP and PLDC heritage conservation plans.

#### Table 5.10: Aboriginal Heritage Mitigation Measures

#### 5.4.4 Non-Aboriginal Heritage: Existing Environment

A Non-Aboriginal archaeological and cultural heritage assessment of the study area (**Figure 4.1**) was conducted by Godden Mackay Logan (GML) Consultants (**Appendix C**). The assessment was undertaken in accordance with the principle of *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance 1999* and is consistent with NSW Heritage Manual (NSW Heritage Office, 1996). The assessment incorporated:

- Data Review: A review of existing relevant information including a search of local, state, and national heritage registers;
- Field Survey: Site archaeological survey involving identification of any Non-Aboriginal objects, sites, or places within the vicinity of the proposed weir; and
- Heritage Impact Assessment: An assessment of the potential impacts from the proposed works upon any heritage items identified by the data review and field survey.

The Castlereagh Plains are significant with regards to the Non-Aboriginal settlement and development of Sydney Basin. Starting from around 1800 the PLDC area has been utilised for either agricultural or quarrying purposes. Numerous small scale agricultural land holdings and quarries were established to source the raw materials for the rapid growth of Sydney and Parramatta. In particular, quarrying (both directly from the Nepean River and the gravel/sand soils of the PLDC areas) expanded during the first half of the 20<sup>th</sup> century to meet construction needs (e.g. Yarramundi Quarry). The Penrith Lakes Development Corporation has managed the operation of quarries within the area since 1979.

Given this history it is considered highly likely that Non-Aboriginal heritage items may occur within or surrounding the proposed study area, and this is supported by evidence from the data review and field survey described in **Appendix C**. It should also be noted that the area is associated with more recent events of cultural significance (e.g. hosting of events as part of the Sydney 2000 Olympics).

Searches of relevant local, state and national databases indicate a number of heritage listed items within the general PLDC area, including:

- Upper Castlereagh School and Residence;
- Hadley Park (Lots 1 and 2, MPOS (OS) 8807);
- Nepean Park (Portion 48);
- McCarthy's Cemetery (part Portion 82);
- Upper Castlereagh Methodist Church and Hall (part Portion 71);
- Upper Castlereagh Methodist Cemetery (part Portion 71);
- Ruin of stone stables associated with Landers Inn (part Portion 43, Castlereagh Road);
- "Puddledock" slab cottage (Lot 1 DP 574481);
- Church Lane Farmhouse, garden and natural vegetation (Lot 1, DP 574481, Church Lane);

- Ruins of pise house (Portion 280, Church Lane);
- The site of Fulton's Church School (Portions 287 and 288);
- McCarthy's Farm, tree and archaeological remains (Portion 82, McCarthys Lane);
- "The Poplars" slab cottage, pise house and garden (Lot 2, DP 229462, Wrights Lane);
- Upper Castlereagh war memorial (Lot 1, DP 735602, Castlereagh Road);
- The Castlereagh Area (comprising floodplain, Upper Castlereagh and the township of Castlereagh); and
- Castlereagh Road upper room chapel, hall and cemetery.

It should be noted that none of these sites are located within the study area.

In order to help preserve these items, as well as other items considered of cultural or environmental value PLDC has established its own "conservation zones" to assist in the protection of these items (**Figure 2.1**) The eastern end of the proposed weir will extend into one of these conservations zones.

Two cultural heritage features of note were identified by GML in proximity to the site. These were:

- An existing property at 43 Smith Road. This includes a number of existing buildings and features, and lies within the Smith Road Residence Management zone, identified in GML's Smith Road Archaeology Handbook, Draft Report September 2008. The property is located at least 150m to the east of the proposed development on top of a hill, and will not be impacted.
- The possible remains of a building known from aerial photography to exist until at least 1965. This would have been located well away from the proposed weir, upslope and to the east of the proposed weir location. No evidence of the building was found during the site inspection, and no records to confirm the purpose or origins of this shed have been located. It may be possible, however, that buried archaeological remains relating to this shed or other buildings occur in the area.

No other items of Non-Aboriginal cultural significance were identified as being present on site.

## 5.4.5 Non-Aboriginal Heritage: Potential Impacts

It is considered that the proposed works at the weir will not impact upon any identified items of heritage significance. The Smith Road Residence is the closest known item, and this is far enough away from the proposed works that it will not be affected by the weir construction. It is considered there is no need for any construction machinery or works to occur within 100m of these buildings.

Given the known utilisation of the area it is recognised that the proposed works may uncover currently unknown heritage items. In particular, the shed on the northern boundary of the PLDC site observed in historical aerial photography may be identified during the proposed works.

<sup>29</sup> November 2010

The works will extend into PLDC's instituted conservation zones. It is noted that these zones have no legal status; however the significance of these impacts will need to be assessed by PLDC and appropriate management measures adopted.

# 5.4.6 Non-Aboriginal Heritage: Proposed Mitigation Measures

Although no direct impacts on Non-Aboriginal heritage values have been identified as likely to occur as a result of the proposed works, due to the sensitive nature of the surrounding area, the following mitigation measures are recommended.

Development Stage	Description of measure
Construction	The historical management zones of the Smith Road Residence should be avoided during excavation and construction works. Staging of machinery and equipment should take place away from this area.
Construction	In the event that intact archaeological remains of the former building identified by aerial photography to the east of the proposed weir site, or any other heritage remains are discovered during excavation, works should cease in the area of the find until an archaeologist has assessed the remains and advised on appropriate actions to be taken, including notification to the Heritage Council of NSW under Section 146 of the Heritage Act.

 Table 5.11: Non-Aboriginal Heritage Mitigation Measures

# 5.5 Soils, Sediment and Erosion

# 5.5.1 Existing Environment

The region surrounding the study site is primarily based upon fluvial sediments typical of the Nepean and Hawkesbury rivers. The soils are a mixture of yellow podzolic soils, and brown earths interspersed with clay loams and sands. Such soils typically represent moderate erosion hazards and tend to promote flooding due to the dispersible and impermeable subsoils (Hazelton *et al.*, 1989).

It is considered unlikely that any acid sulfate soils occur in the area (Land and Water Conservation, 1997).

## 5.5.2 Potential Impacts

During the initial stages of a flood event (greater than 10 Year ARI) flood waters will back up Hunts Gully from the Nepean River and overtop the proposed Wildlife Lake weir into the Wildlife Lake. Once the Main Lake starts contributing flow into the Wildlife Lake, the water level in Wildlife Lake will exceed the water level downstream of the Wildlife Lake weir and the direction of the flow over the weir would change (i.e. flow would occur out of the Wildlife Lake). The hydraulic assessment undertaken as part of the concept design identified that significant flow will occur both into and out of Wildlife Lake over the proposed Wildlife Lake weir. This flow has the potential to cause erosion on both sides of the proposed weir.

#### 5.5.3 **Proposed Mitigation Measures**

In order to minimise erosion and sedimentation during construction and operation of the weir, the following mitigation measures should be implemented.

Development	Description of measure	
Stage		
Design	To minimise erosion, both sides of the weir structure would require protection as significant flows occur both into and out of the Wildlife Lake. The proposed weir structure consists of a conventional concrete structure with a 3 metre high vertical wall extending from 13m AHD to 16m AHD. On the northern side of the weir, a dissipation basin is proposed, incorporating dissipation blocks. On the southern side, a sloping apron is proposed, extending from 13m AHD to 6m AHD. Further details of the scour protection works are provided in Section 5 of the Application (Cardno, 2010b)).	
Construction	During construction it is anticipated that a sediment and erosion control plan would need to be applied with industry standard mitigation measures to ensure erosion risk is minimised. Appropriate diversions or cut-off drains will be required to be installed across Hunts Gully prior to the commencement of works.	

Table 5.12: Soils, Sediment and Erosion Mitigation Measures

# 5.6 Minor Impacts

## 5.6.1 Contaminated Land

#### Assessment Methodology

A Phase 1 (non-intrusive) Contaminated Land Assessment was undertaken for the proposed Wildlife Lake Weir development site. The potential for contamination to be present at the site was assessed based on a review of available historical information, site inspection and interviews with environmental staff on-site.

The proposed works cover a number of different land parcels (Table 5.13)

Table 5.13: Land Parcels affected by the proposed works

Lot and DP (Lot/DP)	
2 / 597776	
420 / 1130185	
421 / 1130185	

Historical information obtained for the purpose of the Phase 1 assessment included title deeds, aerial photography, contamination regulatory notices, and a search of groundwater bore usage. However, WorkCover historic records on the storage of Dangerous Goods were not accessed. Given the findings of the Non-Aboriginal Heritage assessment (**Section 5.4**) it is not anticipated that these documents would identify significant sources of historic contamination within these sites.

The site inspection and interviews were conducted concurrently with the ecological assessment over two days and involved a guided walk-over by site employees during

which time detailed observations of existing landforms and any evidence of contamination or potential indicators/sources were made.

#### Existing Environment

The results of the historical searches describing the present contamination risk across the work site are summarized in **Table 5.14** 

Search	Land Use	Likelihood of Existing Contamination
Historic and Current Title Deeds	A search of historic title deeds provided under the NSW LMPA General Register of Deeds indicates there has been a long history of agricultural practices in the broader area since 1803. Early agriculture predominantly consisted of wheat and maize. Mills were established along the river site to grind wheat and corn. A fruit and dairy industry developed from 1850 – 1950. Quarrying in the area occurred from the 1890's (using wet extraction at first). Quarrying gradually expanded eventually booming in the 1960's.	Low: The agricultural practices and quarrying practices are considered unlikely to have contaminated the proposed weir site
Aerial Photography	Historic aerial photography (1978, 1985, 2006, 2007) demonstrates the progressive replacement of agricultural lands with quarrying. The aerials demonstrate that existing fence lines are largely unchanged from those described in the 1803 agricultural land grants.	Low: No potential contaminating structures were identified from aerial photography.
DECCW Contaminated Land Register	A search of the DECCW Contaminated Land Register identified only seven sites of contaminated land within the Penrith LGA. None of these sites occurred within 5km of the proposed work sites.	Low: Given the extent of existing quarry works and distance between the proposed site and the identified contaminated areas it is unlikely any contamination from offsite would have migrated to the proposed weir site.
Groundwater Bore Usage	A groundwater bore search of the DECCW groundwater database was conducted. 112 current and historic groundwater bores were identified within a1 km radius of the quarry site. This represents a significant number of bores.	Low: A high presence of functional bores indicates the presence of existing Contamination is unlikely.

These historic database searches indicate that there is a low likelihood of existing contamination from historic sources being present on site.

The site inspection and staff interviews conducted confirmed this finding. The sites showed evidence of a highly disturbed grassland, and riparian vegetation in close proximity to active quarrying. Examination of soil profiles, where naturally visible, did not indicate any evidence of contamination. Similarly, neither the extant terrestrial vegetation nor the riparian vegetation suggested the presence of any subsurface contamination. No known contamination events associated with quarry activities were reported.

Given the known land-uses of the area any existing contamination would only have come from migration from external sources (i.e. the quarry) or minor local contamination events (i.e. chemical spills). Given the results of the historic database searches it is considered unlikely that significant contamination will be present at the site.

**Section 5.4** indicates that it is likely that some Non-Aboriginal heritage objects may be found within the study site. It is considered unlikely any such objects would lead to contamination of the study area.

Based on the identified site history a Phase 2 (intrusive) Contaminated Land Assessment is not considered necessary as part of the proposed works.

#### **Potential Impacts**

It is considered unlikely that any contaminants exist with the sites and therefore it is unlikely the proposed works will disturb any existing contamination.

The nature of the proposed works is such that the risk of contamination events occurring as a result of construction or operation of the weir is low. Potential sources of future contamination identified include:

- Petrol and oil spills associated with construction materials;
- Construction run-off and pollutants (i.e. concrete);
- Fertilisers and pesticides utilised during weed control and site rehabilitation; and
- Migration of contaminants from off-site (i.e. from the quarry).

Given the proximity of the sites the Nepean River it is important to ensure no contaminants pass into Hunts Gully or the river system.

#### Mitigation Measures

In order to ensure any potential impacts are minimized during construction and operation, a CEMP should be developed, which as a minimum should incorporate a Spill Management Plan and ensure all construction staff are aware of their responsibilities and procedures under a spill event. In particular it is recommended that:

- All refuelling is carried out in appropriate and designated areas;
- No construction equipment shall be stored within the riparian zone
- The site works manager shall consider the potential for flooding events during construction and designate refuelling and storage areas appropriately;
- Application of fertilizers and pesticides shall not occur during rain events;
- No fuel or oil will be stored within the construction zone;
- A spill kit should be maintained at the work site.

Should any contaminants be encountered during construction, works should be stopped until a further contamination assessment has been undertaken.

#### 5.6.2 Hazards and Risks

Several potential hazards will occur as a result of the proposed weir works. However, most hazards would only be realised during the construction phase while long term hazards are expected to be insignificant or irrelevant, as the presence of the weir would be warned with adequate signage. The types of hazardous risks, a description, and possible mitigation measures are tabulated in **Table 5.15**.

Hazard Risk	Description	Control/ Mitigation measure
Vehicle movements	Construction workers have to enter the quarry to access the proposed site. The quarry site is currently active, and as a result, poses several hazards to the construction workers who are required to manoeuvre different types of heavy machinery (Excavators, Trucks, Bobcats, etc.). This will alter traffic volumes within the quarry site and potentially increase hazardous risks to the quarry workers	A quarry induction is essential for all construction workers. In addition, all workers required to drive into the active quarry should undergo a driving induction test organised by PDLC so they become familiar with all quarry roads or be escorted into and out of the quarry by qualified personnel, be made aware of roads not clearly defined, learn how to operate UHF radios. Current road maps of the quarry site should be provided if possible. Quarry site workers should also be made aware of changed traffic conditions as a result of the proposed works
Changing roads	Roads within the quarrying site are not clearly defined and have the potential to mislead pipeline construction workers	All contractors required to drive through the quarry should be informed of any unclear roads through driving permits or are to be escorted.
Treefelling	Felling of trees may pose a hazard to construction workers on site	All treefelling activity must be undertaken by suitably qualified and competent personnel.
Topography	Movement of heavy machinery in relatively steep terrain poses hazards	Contractors should not drive beyond their vehicle limits.
Slumping	Digging of deep trenches has potential for slumping at the verges, especially if heavy machinery travels alongside the trenches	All workers operating heavy machinery should steer clear a sufficient distance away from the verges or trench edges.
Falls	Contractors working close to the edge of trenches have the risk of falling in	All workers should keep sufficient distance away from trench edges. Adequate signage (e.g., warning/caution tapes) is required adjacent trenches so that everyone is aware of the possible danger.
Animal attack	Presence of venomous snakes, spiders and feral fauna such as pigs pose a threat to construction workers	It is essential that all contractors have access to a First Aid Kit and at least one worker on site has passed the quarry driving induction and have access to a vehicle in the case of emergencies. It is preferred that all workers on site have attended an up-to-date First Aid training course. All workers will be able to contact their supervisor and PLDC in case of emergency.

Table	5.15:	Risks	and	Mitigation	Measures
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Hazard Risk	Description	Control/ Mitigation measure		
Intense rain	Intense rainfall may accelerate slumping effects on the trench and the general riverbank, or make driving conditions dangerous	Limit works if condition become hazardous.		

## 5.6.3 Landscape and Visual Impact

#### Existing Environment

The proposed works will occur across a small section of Hunts Gully, bounded to the east and west by parklands. The proposed weir site is bound to the south by an active quarry. Some degraded riparian vegetation does occur along the Hunts Gully, however, most species were of a weedy nature and only a single large tree, *A.implexa*, occurs in the area. A neighbouring property to the north would have line of sight to the proposed works. A heritage listed residence (located 150m to the east of Hunts Gully within PLDC lands) also has a direct line of site. However, this residence is currently unoccupied and owned by Penrith Lakes.

#### **Potential Impacts**

The location of the site within the quarry site prohibits current public access to the proposed weir works area, and only one occupied residence would receive visual impacts from the proposed works.

In terms of the wider landscape, the current quarry site and activities are of a much larger scale than the proposed works and the disturbance from the quarry represents a much more significant visual impact. In the long term, installation of the weir will result in a significant long term improvement to the landscape as the current quarry site would be transformed to a new system of lakes. In addition, the restoration of native species typical of native vegetation will potentially improve the visual appearance of the works area in comparison to the current vegetation which is highly degraded by weed infestation. The lake perimeters will also be revegetated

Localised and short-term visual impacts as a result of the proposed works include:

- The removal of riparian vegetation;
- Fencing and signage during the construction process;
- Presence of heavy vehicles and equipment on site;
- Rubbish and waste material; and
- Appearance of the weir at Hunts Gully (long term).

#### **Mitigation Measures**

The approximate duration of proposed construction is three to six months, after which rehabilitation with overburden material blending with natural contours and revegetating with native flora species is proposed. In the long term, the weir would be visible to the property to the north of the Penrith Lakes Scheme and recreational users, but is expected to be confined out of sight as much as possible through landscaping and vegetation. Warning

signage indicating the possibility of overflow conditions (during flooding times) may be permanently installed adjacent to the weir.

Any rubbish or waste material as a result of the proposed works should be removed and disposed of correctly, and as frequently as possible. After completion of works, all machinery, fencing, and unnecessary signage is expected to be removed from the site as soon as practicable.

The construction of the Wildlife Lake and surrounding ecosystem will provide a much larger and permanent beneficial change to the existing visual amenity of the area.

# 5.6.4 Land Use Impacts

Current land uses surrounding the proposed works area include mining, agriculture, and a small portion of residential land towards the north east. The weir will be constructed within the quarry area and is not expected to alter any surrounding land use practices. Following construction of the weir, the weir will be blended into the new lake batters and partially revegetated. Revegetation will represent species composition which resembles the original pre-disturbance community type.

No significant land use impacts are expected and the works will not affect any neighbouring land uses.

Land use changes as a result of the construction of the Wildlife Lake will be significant in comparison to those of constructing the weir.

## 5.6.5 Noise and Vibration Impacts

## Existing Environment

The proposed works area encompasses land within a narrow section of PLDC determined conservation zone in Hunt Gully as well as open space. Existing background noise and vibration sources include heavy vehicles and machinery operating within the active quarry. The noise levels were observed to be low to medium during site inspections. The most sensitive receptors are the two occupied residential houses approximately 200 m north east of the proposed weir site as well as the historic, unoccupied cottage directly to the east of the proposed works site.

## **Potential Impacts**

The proposed works would result in some intermittent noise and vibration. Sources of noise during the construction phase would be in the form of excavators, graders, bobcats and other heavy vehicles used to clear vegetation, dig trenches, align and install weir components. However, it is important to note that the background noise and vibration levels from the quarry are the same as the noise and vibration likely to arise from the proposed works. In addition, noise and vibration impacts as a result of the proposed works are only expected to be present for the short term during the construction phase.

The most sensitive noise and vibration receptors are the residents approximately 200m north east of the proposed works, followed by the quarry workers. These receptors are both already exposed to background noise levels arising from the active quarry site. Residents towards the east of Castlereagh Road are unlikely to be affected since they are approximately two kilometres away from the proposed work site. As a result, the additional noise impact arising from the proposed works is expected to be negligible to all receptors.

#### Mitigation measures

Noise mitigation measures should be included in the Construction Environmental Management Plan (CEMP). Mitigation measures should consider:

- Limiting the proposed works to the approved working hours of the quarry; and
- Maintaining all equipment used on site to standards maintained within the quarry.

## 5.6.6 Social and Health Values;

The proposed works would not have significant negative impacts on social and health values of the area, especially considering that there is no public access to the proposed site. On completion of the works, the only visible remains of the works will be the weir.

In the long term, the works are expected to lead to an improvement of social and health values by enabling creation of lakes at the existing quarry site. This will provide improved recreational opportunities for residents of western Sydney.

#### 5.6.7 Traffic Impacts/Access and Accessibility;

## **Existing Environment**

Castlereagh Rd is the largest arterial road near the proposed works, and is predominantly a north-south route serving the towns of Penrith, Cranebrook, Castlereagh, and through to Richmond. The existing road network is displayed in **Figure 5.2**. Old Castlereagh road will be used to access the quarry administration area in accordance with quarry access conditions. Some trucks may be authorised to utilise an existing gate located off Old Castlereagh Rd to the North as per current quarry operations. Alternatively, smaller vehicles may access the site through the Smith Street entrance to the quarry site.

Access to the proposed weir site would involve travel within the quarry using the quarry's own network of roads.


Figure 5.2: Road network surrounding Penrith Lakes

#### **Potential Impacts**

A range of vehicle types would be required for the proposed works, including excavators, trucks, dump trucks, bobcats etc. Local traffic network volumes may marginally increase along major roads (Castlereagh Rd, Old Castlereagh Rd) to provide contractor access. This impact would be restricted to the construction phase period. It is noted that the local road network is currently regularly used by heavy vehicles accessing the quarry site, and that junctions and access routes are suitable for heavy traffic and large vehicles.

Within the active quarry site, there will be minor changes in internal traffic volumes resulting from construction workers entering the quarry premises to access the proposed sites.

### Mitigation measures

On site vehicle traffic will be required to comply with the existing traffic rules of the site which includes:

- Site driver training;
- Minimum vehicle requirements;
- Radio network; and
- Sign in/sign out procedures.

The quarry maintains its own strict traffic management plan and procedures. The vehicle movements associated with the proposed works would be considered part of quarry activities and subject to their requirements.

### 5.6.8 Utilities and Infrastructure

Site inspections and consultation with PLDC has confirmed that no significant utilities are present at the proposed work site. A fence surrounding the premises of the quarry does exist approximately 20 m north of the weir works. A 20m boundary buffer is proposed to be applied to the proposed works (**Figure 3.6**) and no sections of fencing will be removed.

Immediately south of the weir site two small road bridges adjacent to each other (one active and the other disused) cross Hunts Gully with associated culverts. The proposed works will not impact upon these structures or vehicle access along the bridges and road.

A Utilities Management Plan which includes the accurate locations of utilities in the general area is to be prepared by the contractor and should be incorporated into a suitable CEMP. It is expected that the contractor will inspect the site to locate the presence of any utilities nearby.

### 5.6.9 Waste Materials and Management

Prior to the commencement of works, an approved Waste Management Plan will be required as part of the CEMP. The plan should specify suitable locations and appropriate disposal methods for excess soil or rock material, where the material cannot be re-used. It is expected quarry waste management procedures should be applicable for the proposed works. Coordination with the quarry will be required in terms of overburden / fill storage and provision. Any other forms of rubbish and waste material present on site are required to be disposed of in the correct manner, as frequently as possible.

An Erosion and Sediment Control plan should be developed as part of the CEMP, and should take into account methods to prevent erosion of stockpiled material. It is not expected that the weir construction would generate substantial amounts of excess material, since substantial fill is required to construct the embankments. It is expected that fill material will be able to be obtained from else-where on the quarry site and not require external transport of fill material. The cleared understorey vegetation resulting from construction works can be returned post-filling as a source of mulch for the revegetation programme.

#### 5.6.10 Water Quality

It is considered unlikely that the proposed works will have any significant water quality impacts as all flows associated with Hunts Gully will be diverted prior to construction of the weir. Rain events during construction may lead to erosion and short term increased turbidity in flows into the Nepean River. However, the turbidity levels generated are likely to be significantly lower than those within the Nepean River during a rain event.

In operation, the weir will act to separate Nepean River waters from Wildlife Lake waters under normal operating conditions. Interaction between these waters over the weir will only occur during flood events. Water quality impacts of the weir during operation are considered negligible.

## **6** Environmental Management

## 6.1 Environmental Management Plans

In accordance with relevant legislation and the requirements of this EA, the following subplans would need to be created and implemented during the proposed works as constituents of the Construction Environmental Management Plan (CEMP):

- Fauna Management Sub-Plan
- Aquatic Flora and Fauna Management Sub-Plan
- Dust Management Sub-Plan
- Hazards Management Sub-Plan
- Contamination Management Sub-Plan;
- Erosion and Sediment Control Sub-Plan (ESCSP);
- Environmental Health and Safety Sub-Plan;
- Vegetation Management Sub-Plan;
- Waste Management Sub-Plan;
- Water Quality Management Sub-Plan;
- Aboriginal Heritage Management Sub-Plan; and
- Non-Aboriginal Heritage Sub-Plan.

## 6.2 Monitoring

Monitoring will be undertaken as part of the overall approved works for the Penrith Lakes Scheme in accordance with the tests recording and reporting requirements outlined in conditions 65 – 68 inclusive of the Approval for Development Application 4 (NSW Department of Urban Affairs and Planning, 1998, ref: P97/00237).

# 7 Conclusions

## 7.1 Summary of Environmental Safeguard and Management Measures

Environmental safeguards relating to each of the aspects considered in this EA are summarised in Table 7.1

Environmental Parameter(s)	Environmental Safeguards and Management Measures
Terrestrial Flora and Fauna	<ul> <li>The mature Acacia implexa tree should be retained if possible. All construction machinery should keep a sufficient distance from the tree (i.e. outside the canopy drip line) to limit root damage.</li> <li>During the vegetation clearing stage, it is recommended a qualified animal handler be on call to ensure that any native fauna that may be temporary occupying the area is relocated in a safe manner.</li> <li>Establish a Fauna log recording any significant species observed on site during construction. In the event that significant fauna is observed on site, works shall cease until the animal moves from the area or a qualified animal handler can remove it from the site;</li> <li>A weed management plan must be employed to limit colonisation of the disturbed areas by weeds. Where possible, this should include weed removal of the surrounding areas. This is considered to be important in the context of the broader Penrith Lakes Scheme;</li> <li>Rehabilitation and restoration works following installation, should aim to reinstate a stable landform that supports a native plant community which resembles the pre-disturbed, original forest (the Riverflat Eucalypt community). Details of appropriate restoration measures are provided in detail in Section 7.2 of Appendix A.</li> </ul>
Aquatic Flora and Fauna	<ul> <li>Minimise the time lag delay between construction of the weir and the creation of Wildlife Lake. This will facilitate migration of (possible) amphibian populations from Hunts Gully into the Wildlife Lake;</li> <li>Appropriate erosion and sediment control measures should be implemented to minimize disturbance;</li> <li>Revegetation and restoration of disturbed areas should take place as quickly as possible.</li> </ul>
Hydrology	The proposed weir represents a significant flood mitigation measure. No additional mitigation measures are required.
Aboriginal Heritage	Subject to approval of amendment to the existing AHIP (ref: 2595), all works will be undertaken in accordance with the mitigation and management measures outlined as part of the AHIP and PLDC heritage conservation plans.
Soils, Sediment and Erosion	<ul> <li>To minimise erosion, both sides of the weir structure require protection as significant flows occur both into and out of the Wildlife Lake</li> <li>Weir detailed design is to include appropriate measures to ensure the safe functioning of the weir in its operational phase.</li> </ul>

Table 7.1: Summary of proposed Environmental Safeguards

#### Wildlife Lake Weir at Penrith Lakes – Environmental Assessment Prepared for Penrith Lakes Development Corporation

Environmental Parameter(s)	Environmental Safeguards and Management Measures
Contaminated Land	<ul> <li>All refuelling should be carried out in appropriate and designated areas;</li> <li>No construction equipment shall be stored within the riparian zone;</li> <li>The site works manager shall consider the potential for flooding events during construction;</li> <li>Application of fertilizers and pesticides shall not occur during rain events;</li> <li>No fuel or oil will be stored within the construction zone;</li> <li>A spill kit should be maintained at the work site.</li> <li>Should any contaminants be encountered during construction, works should be stopped until a further contamination assessment has been undertaken.</li> </ul>
Air Quality and Dust	<ul> <li>Scheduled regular visual inspections of dust levels are conducted in accordance with the site CEMP;</li> <li>Weather is monitored, and work should cease during periods of very strong winds (above 40km/hr) unless dust can be suppressed by water carts;</li> <li>Dust suppression techniques should be regularly applied to any exposed surfaces and stockpiled materials;</li> <li>The work shall be scheduled so to minimise duration of construction activity and time to revegetation establishment;</li> <li>Regular servicing of construction equipment and vehicles shall be undertaken to minimise exhaust emissions; and</li> <li>Immediate neighbours shall be made aware of the proposed works.</li> </ul>
Hazards and Risks	<ul> <li>An Environmental Health and Safety Plan for the works should be prepared prior to the commencement of works.</li> <li>A quarry induction is essential for all contractors. In addition, contractors required to drive through the quarry should undergo a quarry driving induction, and be familiar with all quarry roads and procedures/rules (e.g., use of UHF radios, flashing beacon/light, flag, four wheel drive) required for driving in the mines;</li> <li>Quarry workers should be notified of the changed traffic conditions and volumes (signs may be required) operating in the quarry;</li> <li>The work sites should be fenced off and secured from public access;</li> <li>The site induction for contractors should address the risk of encountering venomous snakes, spiders and feral pigs;</li> <li>A safe evacuation programme needs to be developed in case of bushfires;</li> <li>All contractors should have access to a First Aid Kit, and at least one member on site should have access to a four-wheel drive vehicle, in case of emergencies.</li> <li>Weather forecasts should be monitored daily, and all operations should cease if conditions become hazardous.</li> </ul>
Traffic And Access	<ul> <li>Traffic shall be managed in accordance with quarry Traffic Management Plans.</li> <li>On site vehicle traffic will be required to comply with the existing traffic rules of the site which includes: Site driver training; Minimum vehicle requirements; Radio network; and Sign in/sign out procedures.</li> </ul>

Environmental Parameter(s)	Environmental Safeguards and Management Measures
Landscape and Visual impact	<ul> <li>Proposed activities are expected to be short term after which rehabilitation of overburden soil to follow natural contours, and revegetation with native species should proceed;</li> <li>Any rubbish or waste material should be removed and disposed of correctly, and as frequently as possible;</li> <li>All temporary fencing and unnecessary signage is expected to be removed from the site as soon as practicable.</li> </ul>
Noise and vibration	<ul> <li>Limit proposed works to approved working hours and noise limits of the quarry.</li> <li>All equipment used on site should be maintained to standards employed for equipment operating within the quarry.</li> </ul>
Utilities and Infrastructure	<ul> <li>A Utilities Management Plan should be prepared by the contractor for the proposed site;</li> <li>The contractor must investigate the nature and location of all services that may be encountered, and consult with relevant authorities prior to the commencement of any works if any services are located.</li> </ul>
Waste Materials	<ul> <li>A Waste Management Plan for the site would be required prior to the commencement of the proposed works;</li> <li>Any rubbish and waste material generated from the works is required to be disposed of in the correct manner, and as frequently as possible.</li> </ul>

## 7.2 Conclusion

In conclusion, the installation of the weir at Hunts Gully is unlikely to have any long term significant negative environmental impacts provided that the mitigation measures recommended in **Section 7.1** are effectively implemented by incorporation into a suitable Construction Environmental Management Plan.

The installation of the weir is an important component of a larger scheme to create lakes at the site of the existing quarry. Completion of the Penrith Lakes Scheme is expected to significantly improve ecological, visual, and amenity value of the area.

# 8 **Qualifications**

This report has been prepared on the basis of the following information and assumptions:

- That all information contained within secondary sources referenced is correct; and
- That all data from database searches were correct at the time of viewing.

<sup>29</sup> November 2010

## 9 References

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