

Googong Township water cycle project

Environmental assessment
Volume 1



November 2010

cic
AUSTRALIA

Manid's Roberts

Statement of validity

Environmental assessment prepared by

Name:	Paul Keighley Project Manager
Qualifications:	Master of Environmental Science and Law Bachelor of Science (Environmental Science)
Address:	Manidis Roberts Level 9, 17 York Street Sydney NSW 2000
In respect of:	Application number 08_0236 – Googong water cycle project

Proponent details

Proponent name:	CIC Australia Ltd	
Contacts:	Mark Attiwill Project Director	Craig Harris Assistant Project Director
Address:	Level 3 64 Allara Street Canberra ACT 2601	

Statement of validity

Statement of validity:	I certify that I have prepared the contents of the environmental assessment and to the best of my knowledge: <ul style="list-style-type: none">• It is in accordance the Director-General's requirements dated 12 January 2009.• The information contained in the document is neither false nor misleading.
------------------------	--

Signature:	
Date:	11 November 2010

Contents

List of abbreviations	i
------------------------------	----------

Executive summary	iv
--------------------------	-----------

Part A – Introduction and description of the project

1	Introduction	1
1.1	Structure of this report	1
1.2	The Project	2
1.3	The proponent	2
1.4	Background	3
1.4.1	Project background	3
1.4.2	The integrated water cycle	3
1.4.3	Approval process	3
1.5	The study area	4
1.6	Consultation	4
1.7	Assessment of elements of the Googong township under Part 3A and Part 4 of the EP&A Act	4
1.7.2	Water cycle infrastructure elements assessed under Part 3A	9
1.7.3	Elements assessed via development applications under Part 4	10
1.7.4	Elements associated with the township undertaken by public agencies	10
1.8	Director-General's Requirements	11
2	Strategic context	15
2.1	Urban planning and water conservation context	15
2.1.1	Sydney–Canberra Corridor Regional Strategy	15
2.1.2	Queanbeyan Residential and Economic Strategy 2031	16
2.1.3	Memoranda of Understanding on water supply and settlement between the Commonwealth, NSW and ACT governments	16
2.1.4	Regional water security planning	17
2.1.5	Water conservation measures mandated for the Googong township	18
2.2	Rezoning process for the Googong township	18
2.3	Queanbeyan Local Environmental Plan (Googong) 2009	20
2.4	Project need	20
2.4.1	A need to provide essential water and wastewater services	20
2.4.2	A need to deliver necessary water conservation outcomes	20
2.5	Project objectives	22
2.5.1	Delivery of essential water and wastewater services to the Googong township community	22
2.5.2	Water conservation	22
2.5.3	Ecologically sustainable development	22
2.5.4	Specific objectives of the Project	22
2.5.5	Specific objectives of Stage 1 of the Project	23

3	Legislative and planning framework	24
3.1	Commonwealth legislation	24
3.1.1	Environment Protection and Biodiversity Conservation Act 1999	24
3.1.2	Canberra Water Supply (Googong Dam) Act 1974	27
3.2	New South Wales legislation	27
3.2.1	Overview	27
3.2.2	Part 3A of the EP&A Act	27
3.2.3	Land owners' consent	30
3.2.4	Progression of concept and project approval for the Project	30
3.2.5	Environmental planning instruments	31
3.2.6	Other approvals and legislative requirements	31
4	Consideration of project alternatives	34
4.1	Alternative water and wastewater systems for consideration	34
4.1.1	The traditional model	34
4.1.2	The integrated water cycle model	35
4.1.3	Comparison of the two models	35
4.2	Alternative integrated water cycle management scenarios – achieving potable water savings	38
4.2.1	How the alternative scenarios were identified	38
4.2.2	Sustainability criteria used to assess the scenarios	38
4.2.3	The preferred water cycle management scenario – scenario 6b	39
4.3	Alternative options for treatment and discharge	40
4.3.1	Wastewater treatment options	40
4.3.2	Discharge options for excess recycled water	42
4.4	Water supply and storage options	43
4.4.1	Water and recycled water storage	43
4.4.2	Bulk potable water supply options	43
4.5	Further refinement of the concept design	43
4.5.1	Water recycling plant options	44
4.5.2	Bulk water pumping station options	44
4.5.3	Potable and recycled water reservoir options	45
4.6	Summary of the preferred option	45
5	Description of the project	46
5.1	Location and overview of the concept plan	46
5.1.1	Location	46
5.1.2	Overview of the key elements of the concept plan for the Project	48
5.2	Staging of the Project and its elements	50
5.2.1	Stage 1 of the Project	50
5.2.2	Subsequent stages of the Project	52
5.3	Detailed description of the key elements of the Project	54
5.3.1	Potable water system	54
5.3.2	Sewerage system	61
5.3.3	Water recycling plant	63
5.3.4	Recycled water system	70

5.4	Stormwater elements and design	73
5.4.1	Objectives of water-sensitive urban design	73
5.4.2	Googong township stormwater design overview	74
5.5	Phases of Stage 1 of the Project	74
5.5.1	Pre-construction activities	74
5.5.2	Construction	75
5.5.3	Watercourse crossings during trenching	76
5.5.4	Commissioning	80
5.5.5	Operation	80
5.6	Cost estimate	84

Part B – Environmental assessment

6	Environmental risk assessment	85
6.1	Environmental risk assessment process	85
6.1.2	Establish the context	86
6.1.3	Identify risks	86
6.1.4	Analyse risks	86
6.1.5	Evaluate risks	88
6.1.6	Treat risks	88
6.1.7	Monitor and review	88
6.1.8	Communicate and consult	88
6.2	Environmental risk assessment results	88
6.3	Precautionary risks and adaptive management	93
7	Water quality and hydrology	94
7.1	Water quality objectives and guidelines	94
7.1.1	NSW water quality objectives	94
7.1.2	ANZECC guidelines	95
7.2	Existing environment	96
7.2.1	Drainage and hydrology	96
7.2.2	Existing surface water quality	98
7.2.3	Summary of ambient surface water quality in Queanbeyan River	102
7.3	Monitoring of water quality	102
7.4	Construction impacts and mitigation measures	103
7.4.1	Laying pipelines across or near water courses	103
7.4.2	Vegetation clearance and soil disturbance	104
7.4.3	Accidental spills of fuels and chemicals	104
7.4.4	Mitigation and management measures	104
7.5	Operational impacts and mitigation measures	105
7.5.1	Uses of recycled water	105
7.5.2	Wet weather effluent storage and overflows	105
7.5.3	Impacts on surface water quality	106
7.5.4	Impacts on surface water quantity (flows)	110
7.5.5	Disinfection systems	113
7.5.6	Operational mitigation and management measures	113
7.6	Conclusion	114

8	Human health	115
8.1	Application of the AGWR framework	115
8.2	Outline of Recycled Water Risk Management Plan	116
8.3	Consideration of other relevant guidelines/regulatory requirements	117
8.4	Construction impacts and mitigation measures	117
8.5	Operational impacts and mitigation measures	117
8.5.1	How humans could come in contact with recycled water	117
8.5.2	Reducing pathogens in recycled water	118
8.5.3	Specific management measures	119
8.5.4	Stakeholder consultation	120
8.6	Conclusion	120
9	Soils	121
9.1	Scope of the soil impact assessment	121
9.2	Assessment methodology	122
9.3	Existing environment	122
9.3.1	Local geological setting and structural aspects	122
9.3.2	Electromagnetic survey results	123
9.3.3	Soil landscapes	123
9.3.4	Soil landscape suitability for irrigation with recycled water	127
9.3.5	Existing soil contamination	128
9.4	Construction impacts and mitigation measures	133
9.4.1	Soil erosion	133
9.4.2	Soil contamination	134
9.5	Operation impacts and mitigation measures	135
9.5.1	Soil erosion	135
9.5.2	Salinity	136
9.6	Conclusion	141
10	Groundwater	142
10.1	Scope of the groundwater impact assessment	142
10.2	Assessment methodology	143
10.3	Existing environment	143
10.3.1	Bore yields and aquifer hydraulic properties	143
10.3.2	Groundwater quality	144
10.3.3	Standing water levels, groundwater flow and gradients	144
10.3.4	Groundwater recharge and discharge	144
10.3.5	Groundwater utilisation and vulnerability	144
10.3.6	Impacts on groundwater-dependent ecosystems	144
10.4	Potential construction impacts and mitigation measures	145
10.4.1	Increase to the local recharge	145
10.4.2	Groundwater contamination	145
10.5	Potential operational impacts and mitigation measures	146
10.5.1	Potential impacts on existing groundwater uses	146
10.5.2	Groundwater mounding	146

10.5.3	Isolated waterlogging of soils	146
10.5.4	Groundwater quality	147
10.6	Impacts of subdivision and change of land use	148
10.7	Proposed monitoring and adaptive management	148
10.7.2	Other recommendations	150
10.8	Conclusion	150
11	Ecology	151
11.1	Terrestrial flora and fauna	151
11.1.1	Scope of the terrestrial flora and fauna impact assessment	151
11.1.2	Assessment methodology	152
11.1.3	Existing environment	155
11.1.4	Construction impacts and mitigation measures	157
11.1.5	Operational impacts and mitigation measures	160
11.1.6	Conclusions	162
11.2	Aquatic ecology	162
11.2.1	Scope of the aquatic ecology assessment	162
11.2.2	Existing environment and assessment methodology	163
11.2.3	Construction impacts and mitigation measures	167
11.2.4	Operational impacts and mitigation measures	167
11.2.5	Proposed monitoring	169
11.2.6	Conclusion	169
12	Heritage	170
12.1	Scope of the heritage assessment	170
12.1.1	Assessment of Stage 1	170
12.1.2	Assessment of the concept plan	170
12.2	Assessment methodology	171
12.3	Indigenous heritage consultation	171
12.3.1	Consultation associated with the original Googong township assessment (2003)	171
12.3.2	Consultation associated with Neighbourhood 1A and 1B of the Googong township assessment (2008)	172
12.3.3	Consultation associated with additional studies (2009)	172
12.4	Existing environment	174
12.4.1	Indigenous sites	174
12.4.2	Non-indigenous sites	174
12.5	Significance assessment	174
12.5.1	Indigenous heritage	174
12.5.2	Non-indigenous heritage	175
12.6	Construction impacts and mitigation measures	176
12.6.1	Impact assessment	176
12.6.2	Management and mitigation measures	178
12.7	Operational impacts and mitigation measures	178
12.7.1	Impact assessment	178
12.7.2	Management and mitigation measures	178
12.8	Conclusion	178

13	Human amenity	179
13.1	Traffic, transportation and access	179
13.1.1	Scope of the traffic impact assessment	179
13.1.2	Traffic impact assessment methodology	180
13.1.3	Existing environment	181
13.1.4	Other concurrent projects of relevance	182
13.1.5	Construction impacts	184
13.1.6	Operation impacts	187
13.1.7	Conclusion	188
13.2	Waste generation and management	188
13.2.1	Scope of waste generation and management impact assessment	188
13.2.2	Existing environment	188
13.2.3	Waste generation and potential impacts	189
13.2.4	Construction impacts and mitigation measures	194
13.2.5	Operational impacts and mitigation measures	194
13.2.6	Conclusion	195
13.3	Air Quality	196
13.3.1	Scope of air quality impact assessment	196
13.3.2	Existing environment	196
13.3.3	Odour assessment methodology	197
13.3.4	Construction impacts	199
13.3.5	Mitigation measures during construction	199
13.3.6	Operational impacts	200
13.3.7	Mitigation measures during operation	200
13.3.8	Conclusion	201
13.4	Noise and vibration	203
13.4.1	Scope of noise and vibration assessment	203
13.4.2	Existing environment	203
13.4.3	Assessment methodology	204
13.4.4	Construction impacts	206
13.4.5	Operational impacts	208
13.4.6	Conclusion	209
13.5	Hazards and risk	211
13.5.1	Scope of hazards and risk impact assessment	211
13.5.2	Existing environment	211
13.5.3	Methodology	211
13.5.4	Construction hazards and risk	211
13.5.5	Operational hazards and risk	212
13.5.6	Conclusion	214
13.6	Visual amenity	214
13.6.1	Scope of visual impact assessment	214
13.6.2	Existing environment	214
13.6.3	Methodology	216
13.6.4	Construction impacts and mitigation measures	218
13.6.5	Operational visual amenity impacts and mitigation measures	218
13.6.6	Mitigation measures during operation	224
13.6.7	Conclusion	226

14	Other environmental issues	227
14.1	Socio-economic issues	227
14.1.1	Potential impacts	227
14.1.2	Mitigation and management	227
14.1.3	Benefits of the Project	228
14.2	Utilities and services	228
14.2.1	Potential impacts	228
14.2.2	Mitigation and management	228
14.2.3	Benefits of the Project	228
14.3	Greenhouse gas emissions and climate change	228
14.3.1	Potential impacts	228
14.3.2	Mitigation and management	229
14.3.3	Benefits of the Project	230
14.4	Cumulative impacts	230
14.4.1	Current and future projects in the region	230
14.4.2	Consequential impacts of the Project	231
14.5	Conclusions	232
15	Residual environmental risk assessment	233

Part C – Consultation, conclusion and commitments

16	Stakeholder engagement and consultation	239
16.1	Agency input into the environmental assessment	239
16.1.1	Planning focus meeting and agency submissions	239
16.1.2	Agency comments during the adequacy review of the draft EA	241
16.2	Status of agency consultation	241
16.2.1	Queanbeyan City Council	241
16.2.2	Palerang Council	242
16.2.3	NSW Department of Planning	242
16.2.4	NSW Health – Greater Southern Area Health Service	242
16.2.5	NSW Department of Water and Energy – Queanbeyan/Wagga office	242
16.2.6	NSW Office of Water	242
16.2.7	NSW Department of Environment, Climate Change and Water	242
16.2.8	NSW Department of Primary Industries	243
16.2.9	NSW Roads and Traffic Authority	243
16.2.10	Commonwealth Department of Environment, Water, Heritage and the Arts	243
16.2.11	ACTEW and ActewAGL	243
16.2.12	ACT Territory and Municipal Services	244
16.2.13	Murrumbidgee Catchment Management Authority	244
16.3	Aboriginal consultation	244
16.4	Community consultation	244
16.5	Combined consultation strategy and commitments	244

17	Conclusion	246
17.1	Suitability of the site	246
17.2	Summary of impacts of the Project	247
17.2.1	Construction impacts	247
17.2.2	Operational impacts	247
17.3	The Project would mitigate environmental impacts and provide essential services	249
17.4	Summary of public benefits of the Project	251
17.4.1	Project benefits	251
17.4.2	Regional strategies and State legislation	252
17.5	Clarification of approvals sought	253
17.6	Conclusion	254
18	Draft Statement of Commitments	255
18.1	Overview	255
18.2	Draft commitments	255
19	References	271

List of appendices

Appendix A	Environmental assessment requirements (DGRs)
Appendix B	Concept design report
Appendix C	Water balance report
Appendix D	Land capability assessment
Appendix E	Groundwater assessment
Appendix F	Terrestrial flora and fauna study
Appendix G	Heritage assessment
Appendix H	Traffic and transport assessment
Appendix I	Odour assessment
Appendix J	Noise and vibration assessment
Appendix K	Hazard and risk assessment
Appendix L	Visual impact assessment
Appendix M	Googong Creek stormwater strategy
Appendix N	Irrigation strategy
Appendix O	Golden Sun Moth survey report
Appendix P	BWPS ecological survey report
Appendix Q	Concept design peer review
Appendix R	Noise assessment for the revised WRP layout

List of tables

Table ES.1	Summary of approvals sought	xiv
Table 1.1	Director-General's Requirements	11
Table 3.1	Relevant NSW legislation to the Project and reference to the EA	31
Table 4.1	Assessment of a traditional system and an integrated water cycle against the Project objectives	36
Table 4.2	Analysis of the environmental costs and benefits of a traditional system and an integrated water cycle	37
Table 4.3	Sustainability criteria for comparing the water cycle management scenarios (MWH, 2006)	38
Table 4.4	Water cycle management scenarios (adapted from MWH, 2006)	38
Table 4.5	Advantages and disadvantages of conventional BNR and BNR with MBR technology	41
Table 5.1	Outline of the components within the potable water system	55
Table 5.2	Main components of the proposed sewerage system	62
Table 5.3	WRP components to be covered for odour control	67
Table 5.4	Process units required at Stage 1 of the Project and ultimate development	68
Table 5.5	Outline of all components of the recycled water system	70
Table 5.6	Distance of pipelines required for Stage 1 of the Project	75
Table 5.7	Approximate site area required for water cycle project elements	77
Table 5.8	Proposed effluent consent conditions	82
Table 5.9	Average monthly irrigation depths to open spaces of the entire Googong township (mm)	84
Table 5.10	Average monthly irrigation demands for the completed Stage 1 of the Project (ML)	84
Table 5.11	Capital cost estimate	84
Table 6.1	Risk assessment consequence definitions	87
Table 6.2	Risk assessment likelihood definitions	87
Table 6.3	Risk matrix	87
Table 6.4	Risk assessment results before management and mitigation measures are considered	89
Table 7.1	Relevant water quality guidelines/trigger values	95
Table 7.2	Water quality at monitoring sites on Queanbeyan River	101
Table 7.3	Water quality in the Queanbeyan and Molongolo River system	102
Table 7.4	Impact of development on receiving water quality (adapted from Appendix C)	108
Table 7.5	Theoretical total nitrogen and total phosphorus concentrations in the Queanbeyan River (at Wickerslack Lane)	109
Table 7.6	Predicted electrical conductivity values at Googong Dam Road.	109
Table 7.7	Summary of excess recycled water discharge (flows) from NH1A and ultimate development	110
Table 7.8	50 th and 80 th percentile seasonal flows (including stormwater and recycled water) in the Googong Creek at the confluence with the Queanbeyan River	111
Table 7.9	Comparison of flows in the Queanbeyan River, pre- and post-development	112
Table 8.1	Recycled water risk management plan framework	116
Table 8.2	Log reduction requirements of pathogens (viruses, protozoa, bacteria) for recycled water use for the Project	119
Table 8.3	WRP treatment process with indicative log reductions	119
Table 9.1	Soil landscape characteristics	124
Table 9.2	Topographic suitability assessments for recycled water irrigation (DEC 2004)	127
Table 9.3	Soil suitability assessments for recycled water irrigation (refer to Table 6.5 in Appendix D)	128
Table 9.4	Summary of the Stage 1 investigation	129
Table 9.5	Soil contamination assessment process in relation to the subject site	132
Table 9.6	Potential erosion hazards and excavation constraints for soil landscape categories	133
Table 9.7	Predicted TDS concentration values and corresponding electrical conductivity values for different types of water in Googong township	136
Table 9.8	Assessment of foliar sensitivity to salinity using Googong township water sources	137
Table 10.1	Recommended scope of works for future monitoring program	149
Table 11.1	Condition categories used in flora and fauna habitat assessments	153
Table 11.2	Flora and fauna survey effort	154
Table 11.3	AusRivas banding scheme	164
Table 11.4	Performance criteria for monitoring sites used in the environmental flows monitoring program	165
Table 11.5	Summary results of ecological health monitoring of Queanbeyan River relevant to planning of future discharges upstream of Wickerslack Lane	165
Table 11.6	Status of riparian and macrophytes at Queanbeyan River sites	166
Table 12.1	Summary of heritage sites – Stage 1 of the Project.	176

Table 13.1	Level of service classification summary	180
Table 13.2	Existing traffic flows in the vicinity of the study area	181
Table 13.3	Googong Dam Spillway Project – daily movements and peak-hour movements	182
Table 13.4	Development of Googong Neighbourhood 1A – daily movements and peak-hour movements	184
Table 13.5	Daily vehicle movements (including peak-hour movements) for Stage 1 of the Project	185
Table 13.6	Potential traffic generation for Stage 1 of the Project and concurrent projects	186
Table 13.7	Waste types, classification and general management measures	190
Table 13.8	Impact assessment criteria for Googong WRP	198
Table 13.9	Summary of odour dispersion modelling results	200
Table 13.10	Recommended noise levels for construction of varying durations	205
Table 13.11	Applicable criteria for different types of developments	205
Table 13.12	Construction noise impacts (calm weather conditions)	206
Table 13.13	Summary of the SEPP 33 screening	212
Table 13.14	Visual impacts of the Project during operation	218
Table 13.15	Visual impact mitigation options for the permanent reservoirs	224
Table 14.1	Maximum electrical demands – Stage 1 of the Project	229
Table 15.1	Risk assessment results after management and mitigation measures	233
Table 16.1	Issues raised by government agencies at planning focus meeting or in a submission	240
Table 17.1	How the Project objectives would be achieved	249
Table 17.2	How the Project addresses the objects of the EP&A Act	252
Table 17.3	Summary of approvals sought	253
Table 18.1	Draft Statement of Commitments for the Project	256

List of figures

Figure ES.1	Geographical context – Googong township	vi
Figure ES.2	Overview of the Project	ix
Figure ES.3	Concept plan	x
Figure ES.4	Stage 1 of the Project	xii
Figure 1.1	Geographical context	5
Figure 1.2	Local context	6
Figure 1.3	Master plan	7
Figure 1.4	Aerial photograph of the study area	8
Figure 1.5	Googong township rezoning, and elements under Part 3A and Part 4 of the EP&A Act	9
Figure 2.1	Urban investigation area (2004 LES)	19
Figure 2.2	Queanbeyan City Council Local Environment Plan (2009)	21
Figure 3.1	Commonwealth Land	26
Figure 3.2	Concept and project application process	29
Figure 5.1	Concept plan	47
Figure 5.2	Proposed Googong Water Cycle Project	49
Figure 5.3	Infrastructure for Stage 1 of the Project	51
Figure 5.4	Staging of the Stage 1 infrastructure elements	53
Figure 5.5	Layout and staging of the bulk water pumping station	57
Figure 5.6	Landscape of the proposed temporary reservoir site (located at Hill 765)	58
Figure 5.7	Landscape of the proposed permanent reservoir site (located on Hill 800)	58
Figure 5.8	Temporary reservoirs – site layout	59
Figure 5.9	Permanent reservoirs site layout	60
Figure 5.10	Typical chlorine dosing unit for potable water distribution systems	61
Figure 5.11	Water recycling plant treatment process	64
Figure 5.12	Water recycling plant layout and staging	69
Figure 5.13	A typical recycled water reservoir (10m diameter)	72
Figure 5.14	Indicative construction timing	75
Figure 5.15	Layout of the easement corridors along Googong Dam Road and Old Cooma Road	77
Figure 5.16	Stage 1 of the Project – construction	79
Figure 6.1	Risk assessment process	85
Figure 6.2	Environmental assessment process	93
Figure 7.1	General landscape of the lower reaches of Montgomery Creek	97
Figure 7.2	Catchment areas	99
Figure 7.3	Water quality monitoring sites on the Queanbeyan River	100
Figure 7.4	Secondary treatment of nitrogen in the water recycling plant	107
Figure 7.5	Recycled water discharge as a proportion of total flows in the stormwater system.	112
Figure 8.1	Pathways of human exposure to recycled water	118

Figure 9.1	Typical landscape of the study area	123
Figure 9.2	Electromagnetic survey and proposed sampling sites	125
Figure 9.3	Soil landscapes and groundwater features	126
Figure 9.4	Contaminated land investigation overview	130
Figure 9.5	Soil contamination survey locations within or near NH1A	131
Figure 9.6	The estimated root-zone salinity on the types of irrigation areas in the ultimate stage	138
Figure 11.1	Vegetation communities (adapted from Googong LES 2004)	156
Figure 11.2	Vegetation communities	158
Figure 11.3	Threatened flora and fauna protection measures	161
Figure 12.1	Heritage features – concept plan	173
Figure 12.2	Heritage sites – Stage 1 of the Project	177
Figure 13.1	Intersection at Old Cooma Road and Googong Dam Road	182
Figure 13.2	Existing local road network	183
Figure 13.3	Odour – water recycling plant	202
Figure 13.4	Water recycling plant noise modelling	210
Figure 13.5	Key visual receptors	217
Figure 13.6	Existing view to Hill 765 at road receptor RR8	220
Figure 13.7	Indicative view of the temporary reservoirs on Hill 765 when viewed from road receptor RR8	220
Figure 13.8	Areas that would be potentially visually impacted by the reservoirs at Hill 765	221
Figure 13.9	Existing view of Hill 800 from Old Cooma Road (looking south)	222
Figure 13.10	Indicative view of permanent reservoirs on Hill 800 from Old Cooma Road	222
Figure 13.11	Areas that would be potentially visually impacted by the reservoirs at Hill 800	223
Figure 17.1	Environmental constraints analysis	248

List of abbreviations

Abbreviation	Definition
AEC	Areas of environmental concern
ANZECC	Australian and New Zealand Environment Conservation Council
AS	Australian standard
BC	Brown Consulting
BNAC	The Buru Ngunawal Aboriginal Corporation
BNR	Biological nutrient removal
BOD	Biological oxygen demand
BoM	Bureau of Meteorology
BWPS	Bulk water pumping station
CBLDA	Consultative Body on Land Development and Artefacts
CEMP	Construction environmental management plan
CIC	CIC Australia Ltd
CMJA	C. M. Jewell & Associates
COD	Chemical oxygen demand
DA	Development application
DECCW	Department of Environment, Climate Change and Water
DEWHA	Department of Environment, Water, Heritage and the Arts
DGRs	Director General Requirements
DO	Dissolved oxygen
DoP	Department of Planning
DWE	Department of Water and Energy
EC	Elton Consulting
EA	Environmental assessment
ECRTN	Environmental Criteria for Road Traffic Noise
EEC	Endangered ecological communities
EIS	Environmental impact statement
EM	Electromagnetic
ENCM	Environmental Noise Control Manual
EP	Equivalent population
EPI	Environmental planning instrument
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>

Abbreviation	Definition
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
ESD	Ecologically sustainable development
GDA	Googong Dam Area
GDE	Groundwater-dependent ecosystems
GSAHS	Greater Southern Area Health Service
HLZ	High-level zone
INP	Industrial Noise Policy
IPART	Independent Pricing and Regulatory Tribunal
IWC	Integrated water cycle
IWCMS	Integrated water cycle management strategy
L	Litre
LAeq	Equivalent continuous noise level
LEP	Local Environmental Plan
LES	Local Environmental Study
LoS	Level of Service
m	Metre
m ²	Square metre
MBR	Membrane bioreactor
ML	Megalitre
MoU	Memoranda of understanding
MR	Manidis Roberts
MSDS	Material safety data sheet
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NES	National environmental significance
NH ₄	Ammonium
NH1A	Neighbourhood 1A
NLALC	Ngunnawal Local Aboriginal Land Council
NSW	New South Wales
NTU	Turbidity
NO _x	Oxides of nitrogen
O/E	Observed and expected ratio
OEMP	Operational environmental management plan
ou	Odour units
PAC	Planning Assessment Commission
PAD	Potential archaeological deposits

Abbreviation	Definition
PC	Palerang Council
PEA	Preliminary environmental assessment
PoEO Act	<i>Protection of the Environment Operations Act 1997</i>
PER	Public environment report
PFM	Planning focus meeting
PHA	Preliminary hazard analysis
PLC	Program logic controller
PPR	Preferred project report
PSNL	Project specific noise level
QCC	Queanbeyan City Council
REP	Regional Environmental Plan
RTA	NSW Roads and Traffic Authority
SCADA	Supervisory Control and Data Acquisition
SEPP	State Environmental Planning Policy
SoC	Statement of commitments
SPS	Sewage pumping stations
STP	Sewage treatment plant
TDS	Total dissolved solids
TN	Total nitrogen
TNE	Traditional Ngarigo Elders
TP	Total phosphorous
TSR	Traveling stock reserves
TSS	Total suspended solids
UV	Ultraviolet
VIA	Visual impact assessment
VPA	Voluntary Planning Agreement
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001</i>
WRP	Water recycling plant
WSA	Title prefix for codes developed by Water Services Association of Australian
WSAA	Water Services Association of Australia
WSUD	Water-sensitive urban design
WTP	Water treatment plant