APPENDIX C

Revised ‘Water Cycle Management Plan Working Paper’ prepared by Jacobs.

New Grafton Correctional Centre

Infrastructure New South Wales

Water Cycle Management Plan Working Paper

Final | V7

10 November 2016

New Grafton Correctional Centre

Project No:	IA101200
Document Title:	Water Cycle Management Working Paper
Document No.:	Final
Revision:	V08
Date:	10 November 2016
Client Name:	Infrastructure New South Wales
Client No:	NGCC EIS Support
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Author:	Russell Beatty
File Name:	\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA101200\02 Documents_Final Report_Revised_20161101_DPE OEH\Water Cycle\IA101200_NGCC_Water Cycle Management_Revised Final_20161110_ToIssue.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
Draft	29/02/2016	Practice Review	Russell Beatty	Nicola Logan	Rachel Vazey
Final draft	22/03/2016	Final draft	Russell Beatty	Caitlin Bennett	Rachel Vazey
Final draft	20/05/2016	Updated to include revised project description	Andrew Spinks	Rachel Vazey	Andrew Spinks
Final draft	22/06/2016	Updated to include revised project description	Rachel Vazey	Andrew Spinks	Rachel Vazey
Final draft	07/07/2016	Updated to include revised project description	Rachel Vazey	Rachel Vazey	Rachel Vazey
Final Version 1	01/08/2016	Updated to include revised project description. Report issued with EIS for public display.	Rachel Vazey	Rachel Vazey	Rachel Vazey
Final Version 2	02/08/2016	Updated to include revised water balance modelling. Report updated following review by DPE and OEH.	Katharine Bond	Russell Beatty	Rachel Vazey

Contents

Terms and acronym used in this document

Acronym	Definition
CSNSW	Correctional Services New South Wales
DECC	Department of Environment and Climate Change
DPE	Department of Planning and the Environment
DPI	Department of Primary Industries
EIS	Environmental Impact Statement
ESD	Ecological Sustainable Development
GFA	Gross Floor Area
INSW	Infrastructure NSW.
LGA	Local government area.
NGCC	New Grafton Correctional Centre.
NOW	NSW Office of Water
NSW	New South Wales
OEH	Office of Environment and Heritage
Project	Comprises the New Grafton Correctional Centre which will provide up to 1,700 new prison beds, within a maximum and minimum security correctional centre with relevant support services and facilities.
Project Site	Comprised of two properties Lot 26 DP 751376 and Lot 1 DP 1190399 and is located at 313 Avenue Road, Lavadia.
Proposal	Comprises the concept proposal and the Stage 1 works development application.
SEARS	Secretary's Environment Assessment Requirements.
SRD SEPP	*State Environmental Planning Policy (State and Regional Development) 2011.*
SSD	State Significant Development.
USA	United State of America
WSUD	Water Sensitive Urban Design

Executive Summary

Infrastructure NSW (INSW) on behalf of Corrective Services NSW (CSNSW), a division of the Department of Justice, is seeking approval under Division 4.1, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the concept proposal and Stage 1 Development Application (DA) for the New Grafton Correctional Centre (the Project). The Project will be located on a 195 hectare site (the Project Site), at 313 Avenue Road, Lavadia, approximately 12.5 kilometres (km) south-east of Grafton within the Clarence Valley Local Government Area. The Project would consist of a 1,700 bed maximum security correctional centre, a 400 bed minimum security correctional centre and relevant support services and facilities. The concept proposal and the Stage 1 works application comprise the Proposal.

This working paper is an assessment of water cycle management associated with operation of the Project. The strategy for water cycle management considers operation of a 1,700 bed facility with 600 to 650 support staff and up to 50 visitors attending site daily. The preparation of the water cycle management strategy involves considering all sources of water and all uses of water in a total catchment context. This includes the consideration of water supply, wastewater collection and treatment and stormwater.

With the location of the Project some distance from the nearest urban centre (Grafton), there is potentially a need to import water and export wastewater from the site over considerable distances. In addition, the Project is a relatively intense, semi-urban development which can generate a number of adverse water cycle outcomes including the generation of significant volumes of polluted and nutrient-laden wastewater and stormwater.

In current best practice water cycle management, it is appropriate to examine each of these impacts and examine a range of water cycle management options before arriving at a preferred water cycle management strategy. The water cycle management strategy focusses primarily on water balance rather than water quality outcomes. Water quality outcomes for stormwater would be considered in the *Stormwater Management Strategy* prepared as part of the Stage 2 Development Application. Water cycle management options considered a range of options for conserving water and utilising recycled wastewater or stormwater and roof water as alternative sources for meeting demand.

The assessment considered four possible scenarios with different configurations of recycled wastewater and roof water use. Water balance outcomes were simulated using Jacobs IWMSim model. With the goals of minimising the import and export of water to and from the site, the harvesting of stormwater was not considered in the scenarios due to a preference to use recycled wastewater (thus minimising discharge) and roof water (being a higher quality than stormwater thus more suitable for a wider range of uses).

The four scenarios were:

1) A base case, which assumed a business as usual approach.
2) The use of recycled wastewater for cooling towers and irrigation and roof water for toilet and urinal flushing
   - Reducing potable demand by 47 per cent (%)
   - Reducing wastewater discharges by 33%.
3) The use of recycled wastewater for cooling towers, irrigation and toilet and urinal flushing and roof water for all other uses.
   - Reducing potable demand by 72%
   - Reducing wastewater discharges by 57%.
4) The use of recycled wastewater for cooling towers, irrigation, toilet and urinal flushing and all other uses. No rainwater use
   - Reducing potable demand by 36%
   - Reducing wastewater discharges by 57%.

With a basic level of runoff water quality control, filtration and disinfection, harvested roof water would be an ideal source of water including for potable water uses. In both harvested roof water scenarios any shortfall in roof water was topped up from the potable supply system.

With the long distances involved for the supply of water and the need for the minimisation of potential wastewater discharge from site, it makes sense to select a water cycle management approach that makes as much use as possible of water generated at the Project. Recycled wastewater and harvested roof water are ideally suited for a variety of fit of purpose uses on site. For this reason, Scenario 3 is the preferred water cycle management scenario for the site. By reusing water on site the proposal also helps to fulfil some of the requirements under the Secretary's Environment Assessment Requirements (SEARs) No 9 issued for the Project in regards to implementing Ecological Sustainable Development (ESD) principles as part of the design of the Project. In the event that rainwater harvesting is not considered feasible the use or recycled wastewater to reduce water demand and wastewater discharges would be the preferred scenario (Scenario 4).

1. Introduction

1.1 Background

Infrastructure NSW (INSW) on behalf of Corrective Services NSW (CSNSW), a division of the Department of Justice, is seeking approval under Division 4.1, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the concept proposal and Stage 1 Development Application (DA) for the New Grafton Correctional Centre (the Project).

The Project satisfies the criteria of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* as the capital investment value of the correctional centre exceeds $30 million. As such, the Project is declared to be a State Significant Development (SSD) under Division 4.1, Part 4 of the EP&A Act and the Minister for Planning is the consent authority for the application. The Secretary's Environmental Assessment Requirements (SEARs) for the Proposal were issued by the Department of Planning and Environment (DPE) on 21 December 2015.

1.2 Locality

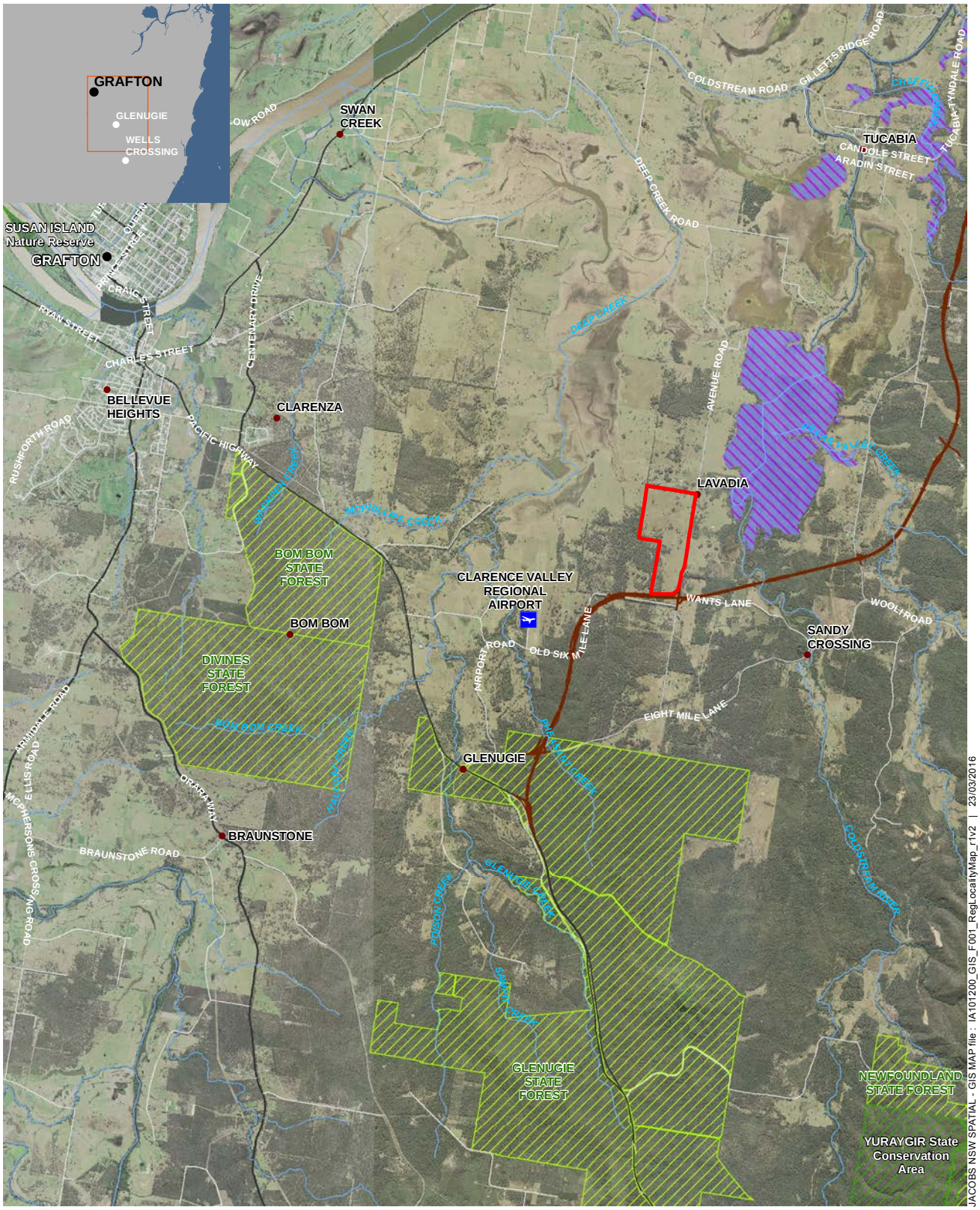
The Project is located approximately 12.5 kilometres (km) southeast of Grafton (refer to **Figure 1-1**) within the Clarence Valley Local Government Area (LGA) at 313 Avenue Road, Lavadia (The Project Site). The Project Site is zoned RU2 – Rural Landscape under the *Clarence Valley Local Environmental Plan 2011.* Development for the purpose of a correctional centre is permissible with consent within the RU2 Rural Landscape zone.

The Project Site includes two properties comprised of Lot 26 DP 751376 and Lot 1 DP 1190399 and is 195 hectares in size; refer to **Figure 1-2**. The site has historically been used for cattle grazing. In July 2015, development consent for a dwelling house in the southeast corner of Lot 1 DP 1190399 was granted by Council and construction of the house and adjacent shed is complete. The Project Site is bounded by Avenue Road (also recognised as Golden Mile Road) to the east, and Old Six Mile Lane to the south. Avenue Road connects to the Pacific Highway via Eight Mile Lane to the south and Old Six Mile Lane connects to the Pacific Highway to the west.

It is noted that the Grafton bypass portion of the upgraded Pacific Highway project (by Roads and Maritime Services) will, in addition to the reconfigured Old Six Mile Lane, form the southern boundary of the site once completed in approximately 2019. As part of that project, Avenue Road will pass over the Pacific Highway and the intersection of Avenue Road and Old Six Mile Road will be upgraded to improve local access, without direct connection to the highway.

1.3 Project description

The New Grafton Correctional Centre (NGCC) requires a staged development application that sets out a concept proposal for a new correctional centre at Grafton that provides maximum and minimum security facilities and includes a total of 1,700 beds. The concept proposal includes a maximum built form height of 12 metres (approximately three storeys) with a gross floor area of approximately 100,000 square metres. The staged development application also seeks concurrent Stage 1 approval for site clearance and preparatory works. **Table 1-1** provides a summary of the Proposal's key components and features.



Legend

- The Project
- Grafton Bypass (proposed)
- SEPP 14 Wetlands
- National Park Reserves
- State Forests

0 2 4 Km

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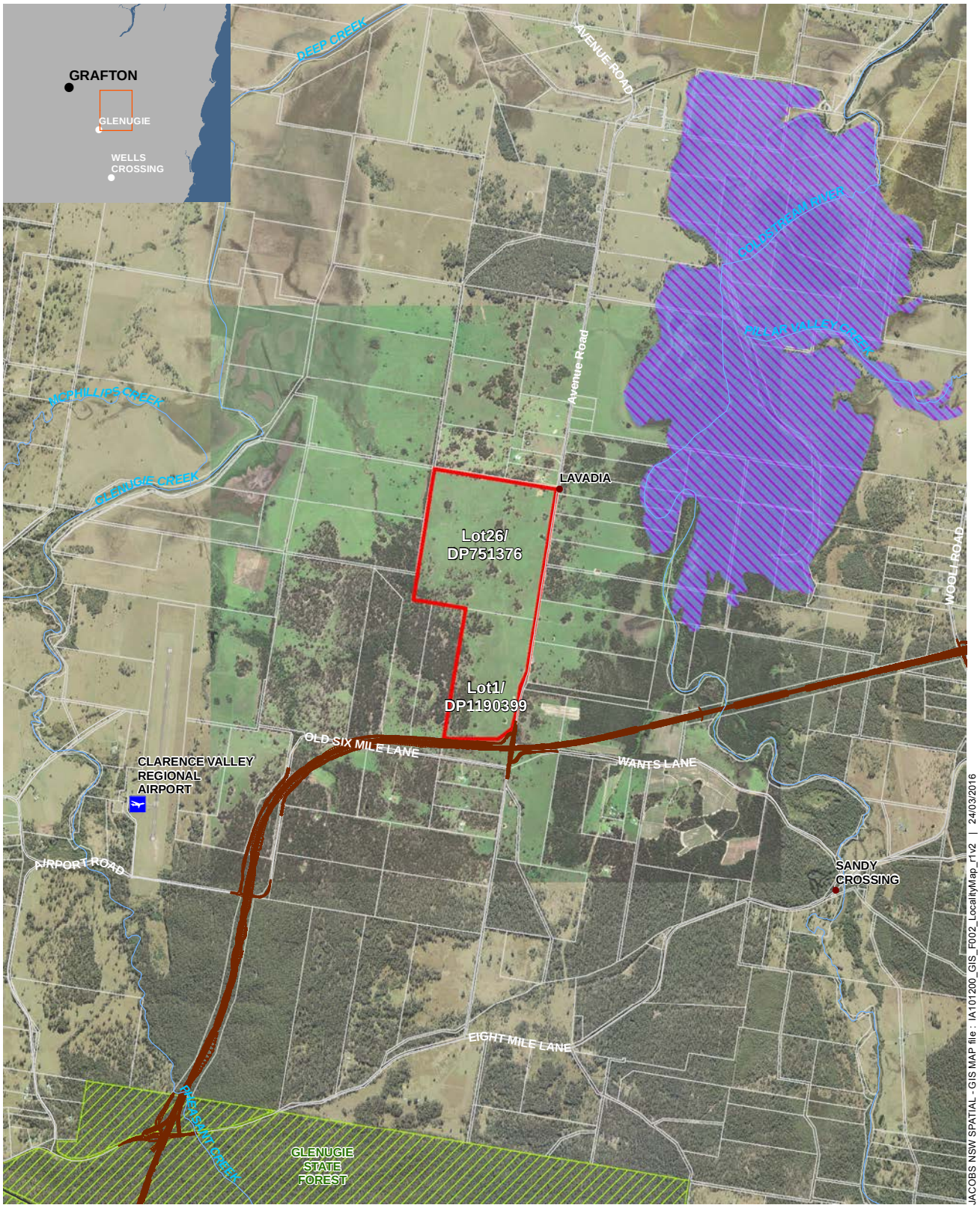
Data sources

Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

Figure 1-1 | Regional Locality



Legend

- The Project
- Grafton Bypass (proposed)
- SEPP 14 Wetlands
- State Forests

0 1 2 Km

1:50,000 @ A4

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Data sources
Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

Figure 1-2 | The Project

Table 1-1 Key Project Components

Stage	Description
Development summary	The staged SSD application seeks approval for: • A concept proposal for the New Grafton Correctional Centre. • First stage site clearance and preparatory works for the Project. Together referred to as the Proposal.
Project Concept Proposal	The NGCC includes a maximum and minimum security correctional centre of 1,700 beds comprised of: • A maximum security section of 1,300 beds that will include: – 1,000 beds for male inmates. – 300 beds for female inmates. • A minimum security section that will include: – 400 bed residential accommodation for male inmates. The building envelope including the configuration, location and number of building structures required for the project would not be determined until the detailed design is complete as part of the Stage 2 works. Consequently, the stage 2 construction works for the Project could occur anywhere within the development zone shown in Figure 1-3. The total footprint around both the maximum and minimum correctional centres, including the carpark, is around 45 hectares. Features of the Project include the following: • The concept proposal includes a maximum built form height of 12 metres (approximately three storeys). • The gross floor area will be approximately 100,000 square metres. • A six metre high fence or wall will be constructed around the perimeter of the facility, with light and security camera poles up to 10 metres in height. • Store buildings, small ancillary facilities and a central energy plant will be located outside the perimeter walls / fences. • Internal access into and out of the correctional centre from Avenue Road will be provided. • Car parking for approximately 500 car spaces. • Other associated facilities include recreational oval, special accommodation units, health facilities, education and programs areas, administration, workshops, staff amenities, visitor facilities and utilities. • A 100-metre wide Asset Protection Zone (APZ) zone would be cleared around the correctional centre and associated facilities and car parking area in accordance with the Rural Fires Act 1997 and requirements of the Planning for Bush Fire Protection (PBP; NSW Rural Fire Service [RFS], 2006). • A vegetation buffer outside the APZ would be provided along the northern, eastern and southern boundaries of the Project Site. The buffer would be 50 metres wide along the northern property boundary, 15 metres wide to the east along Avenue Road and 30 metres wide along the southern property boundary. • Fire access roads on the inside and the outside of the perimeter fence of the facility will be constructed to ensure safe operational access for emergency services personnel responding to a bushfire event. • Water, wastewater, power and communication utilities within the Project Site. • Landscaping of ground cover and /or shrubbery in areas to be defined.

Stage	Description
Stage 1 Site Clearance and Preparatory Works	Stage 1 (early works), includes preparatory work within the cadastral boundaries of Lot 26 DP 751376 and Lot 1 DP 1190399. This would involve: • Vegetation clearance and biodiversity management activities. • Construction of access roads including fire access roads to the extent required to conduct Stage 1 works. • Construction of auxiliary facilities such as construction compound, construction staff parking facilities and stockpiles sites. • Temporary provision of water, power and communication services within the site to the extent required to conduct Stage 1 works. • Demolition of the existing house and sheds. • Bulk excavation and site stabilisation works. • Landscaping.
Value	The capital investment value for the Project is in excess of $30 million.
Project Site	• Located at 313 Avenue Road, Lavadia. • Lot 26 DP 751376. • Lot 1 DP 1190399. • Project Site is195 hectares (ha) in size.

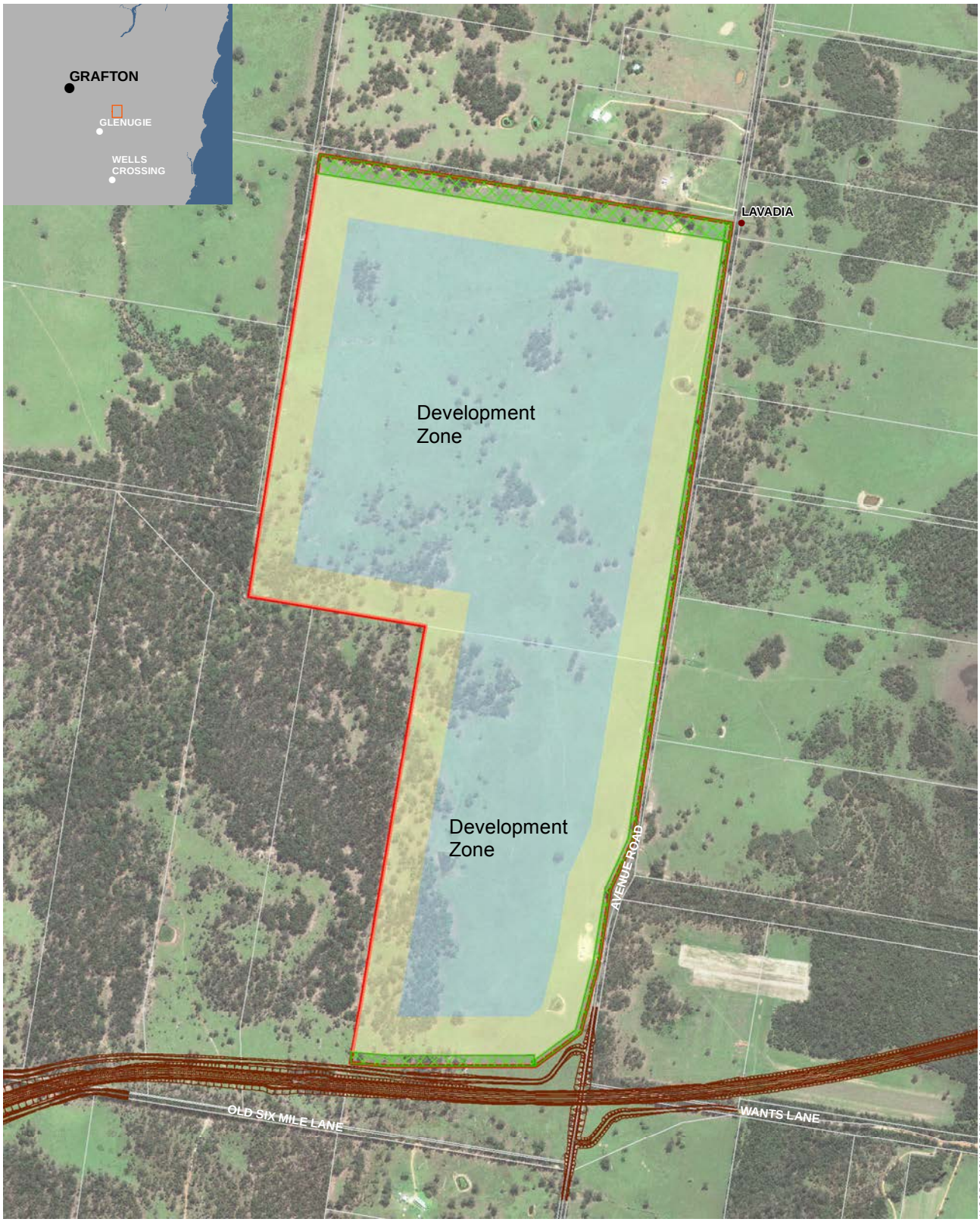
Future works regarding the design, construction and servicing of the Project will be based on the final design and layout of the facilities and will be the subject of future staged development application(s).

The construction activities associated with the Stage 1 site clearance and preparatory works is estimated to take six to 12 months and provide around 50 full time equivalent positions.

1.4 Project objectives

The objectives of the Project are:

1) Be a safe and secure correctional centre.
2) Be a humane and ethically managed centre.
3) Help reduce the risk of re-offending through (among other things) preparing inmates for reintegration into the community on release from the CSNSW network.
4) Manage resources effectively and efficiently, enhancing value for money.
5) Utilise effective governance arrangements.
6) Produce strong economic and social benefits to the local Grafton region, the northern NSW region and the broader NSW community.
7) Be a valuable physical asset for the duration of the Operating Phase and beyond.
8) Be operated in such a way as to keep pace with best correctional practice over the term of its operational life.
9) Be operated so that it links with the broader management strategies and operational needs of the CSNSW network.



Legend

- The Project
- Landscaping zone
- Asset Protection Zone
- Development Zone
- Grafton Bypass (proposed)

0 250 500 Metres

1:15,000 @ A4

N

Data sources

Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

Figure 1-3 | The Project

1.5 Report structure

This is the Water Cycle Management Working Paper that will support the EIS required for the Proposal under Division 4.1, Part 4 of the EP&A Act. The structure of the report is summarised in **Table 1-2**. SEARs relevant to this specialist paper and where they have been addressed in the report are summarised in **Table 1-3**.

Table 1-2 Report structure

Section reference	Section heading	Description
Executive summary	Executive summary	Concise summary of this technical paper and the key findings
1	Introduction • Background • Locality • Proposal description • Proposal objectives • Report structure	Description of the project and provides an overview of the study objectives and structure of technical report.
2	Assessment requirements	Sets out the drivers for the work undertaken in the development of the water cycle management strategy
3	Water cycle management strategy development	Provides an overview of the approach, outlines the key assumptions, the process of the development of the strategy and provides the water balance modelling results.
4	References	
5	Terms and acronyms used in the document	

Table 1-3 Summary of SEARs relevant to this working paper

SEARs	Cross reference
SEARS No 9 - ESD Detail how Ecological Sustainable Development (ESD) principles (as defined in clause 7(4) of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*) will be incorporated in the design, construction and on-going operation phases of the development. Include a description of the measures that would be implemented to minimise consumption of resources, water (including water sensitive urban design) and energy.	This entire working paper addresses part of SEARs No 9 by reviewing water cycle management strategies and consideration of recycling water as part of the operational phase of the project implementation. Other ESD principles such as consumption of resources and energy will be considered as part of the EIS being prepared for the Project.

2. Assessment requirements

The strategy for water cycle management considers operation of a 1,700 bed facility with 600 to 650 support staff and up to 50 visitors per day for up to a four hour period. The development of a strategy for water cycle management for a new development requires the consideration of all sources of water and all uses of water in a total catchment context. As such a water cycle management strategy will consider the management of the three streams of the water cycle:

- Water supply.
- Wastewater collection and treatment.
- Stormwater.

In considering a new development such as the Project, there are no specific legislative or regulatory requirements that relate to the water cycle management strategy, although there are requirements that relate to the development of infrastructure in each of the three water streams above. Thus this working paper will not be considering any specific requirements.

It is however understood that any modification of land use through development will have a number of adverse environmental impacts relating to the water cycle. For the Project which is a relatively intense, semi-urban development these are:

- The concentrated demand for water leads to the requirement to import water onto the site.
- The concentrated point-source generation of wastewater leads to highly polluted and nutrient-laden volumes of water that is unsuitable for discharge to the environment without treatment.
- The coverage of the site with significant amounts of impervious surface, some of which are roadways, results in:
    - Reduces natural infiltration to soils and groundwater.
    - Increases the volume and intensity of stormwater runoff.
    - Increases the pollutant and nutrient content.

In current best practice water cycle management, it is appropriate to examine each of these impacts and examine a range of water cycle management options before arriving at a preferred water cycle management strategy. This aligns with the consideration of ESD principles outlined in SEARs No.9 in **Table 1-3** above.

3. Water cycle management strategy development

3.1 Overview of Approach

3.1.1 Catchment context

The site is located on a series of ridges on Avenue Road around 12.5 km east of Grafton. The location of the Project on the ridge line creates two separate drainage paths from the site. These are:

1) To the northwest – flowing into Glenugie Creek and then ultimately to the Clarence River.

2) To the northeast – flowing into the Coldstream River and then into the Clarence River.

3.1.2 Options considered

In the development of a water cycle management strategy, there are a range of options that are considered. These are set out in **Table 3-1** below. Part of that strategy is to conserve water, part is to recycle or use alternative sources of water and the third is to maximise the treatment of stormwater at source.

In considering these options, some options, such as Water Sensitive Urban Design (WSUD) and the use of green roofs, will need to be considered at the design stage and as part of the *Stormwater Quality Management Strategy*.

Table 3-1 List of Potential Water Cycle Management Options

Water Cycle Management Option	Target Issue	Other Benefits	Potential Limitations	Coverage in this Working Paper
Water efficient fixtures and appliances	Reducing water use	• Reduces water and energy (hot water and water pumping) usage • Reduces the need for water system amplification	None	Yes
Waterless Urinals	Reducing water use	• Reduces water and energy (water pumping) usage • Reduces the need for water system amplification	Maintenance	Yes
Recycled wastewater for non-potable uses: • Cooling towers • Toilet/urinal flushing • Irrigation	Reducing water use	Reduces discharges to environment	Cost and footprint for on-site wastewater treatment facilities	Yes
Roof water harvesting	Reducing water use	• Large roof areas available • Improves stormwater quality • Reduces stormwater runoff	• Space for location of storages • Limited roof area	Yes

Water Cycle Management Option	Target Issue	Other Benefits	Potential Limitations	Coverage in this Working Paper
Stormwater harvesting	Reducing water use	• Large impervious areas available • Reduces stormwater runoff • Improves stormwater quality	• Limited storage space on site • Competes for demand with recycled wastewater, which is a higher priority due to the need to limit wastewater discharge from site	Yes
Green Roofs	Improving stormwater quality	• Mitigates urban heat island effect	• Maintenance • Interaction with roof-top solar systems • Cannot be used on power station	No. This would be considered at building design stage
Engineered wetlands	Improving stormwater quality	• Mitigates urban heat island effect • Improves public open space and amenity	Land area required	No. This would be considered in Stormwater Management Strategy prepared as part of the Stage 2 Development Application
At-source WSUD: • Drainage swales • Biofiltration swales • Infiltration trenches • Permeable pavings • Gross Pollutant Traps	Improving stormwater quality	• Improves stormwater quality • Reduces stormwater runoff • Mitigating heat island effect from roads and buildings	• Cost • Additional land area	No This would be considered in Stormwater Management Strategy prepared as part of the Stage 2 Development Application

3.1.3 Water balance modelling approach

To undertake the water balance comparison the Jacobs IWMSim model (an integrated water cycle water balance model) was used. The model:

1) Is designed to simulate the operation of all parts of an integrated water system including water demands (seasonal and non-seasonal), wastewater flows (dry weather and wet weather) and stormwater flows.

2) Utilises actual water and wastewater system data to generate demands and flows, so that the supply and demand patterns so critical to understanding urban water balances are precisely simulated.

3) Uses a unique Monte-Carlo simulation of large numbers of virtual water uses. Each group of users has specified “end-uses” of water that can be supplied from either the potable supply, rainwater, recycled

wastewater or recycled stormwater. Each virtual user exhibits individual probabilistic behaviour driven by varying water use behaviour.

Stormwater flows are generated within IWMSim using the SimHyd hydrological model. The overall structure of the model is shown in **Figure 3-1**.

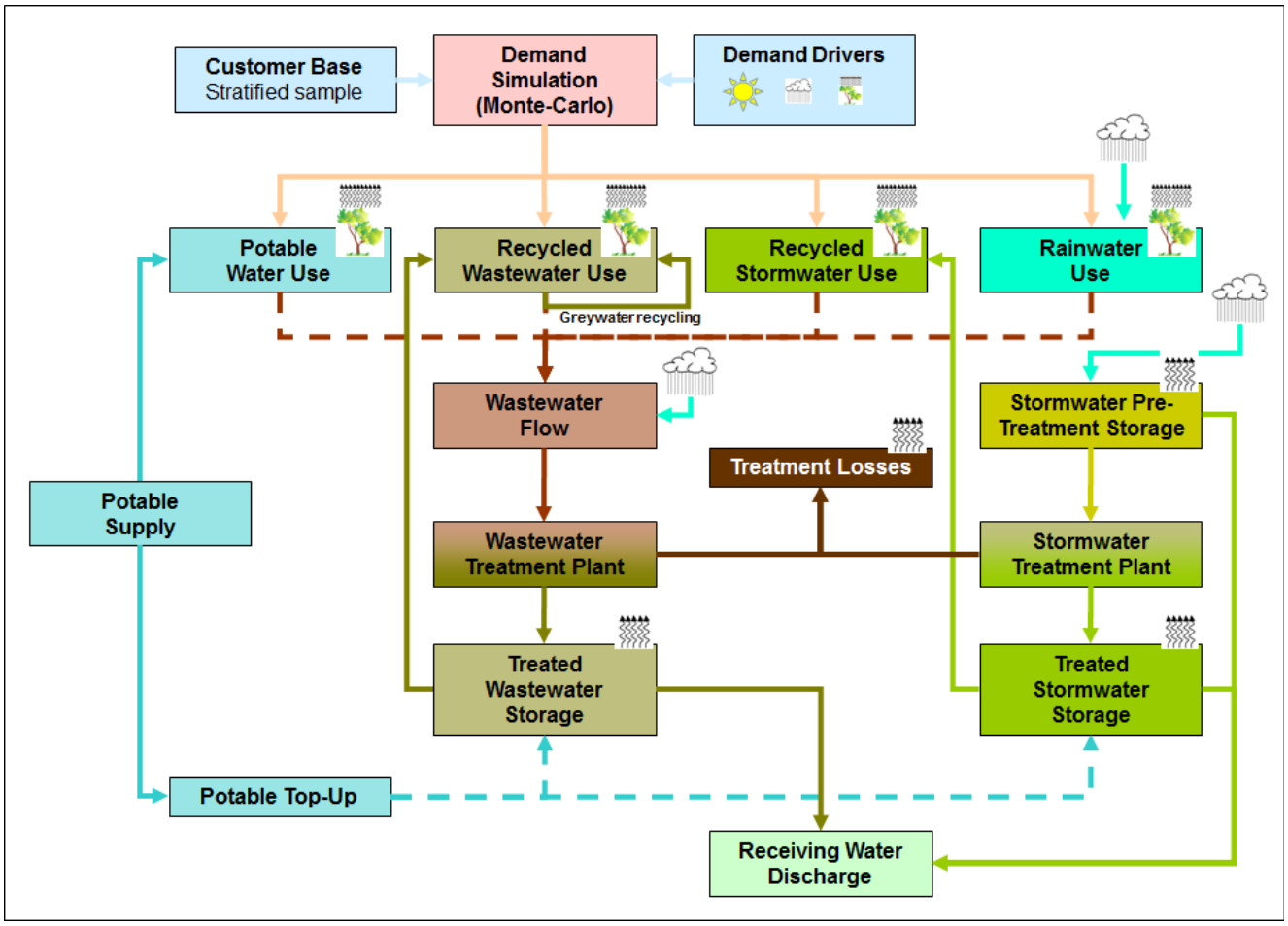


Figure 3-1 IWMSim model structure

Water uses in the model are divided into those generating wastewater flows, and those not. Each water use is assigned a climate-driven demand pattern. The parameters governing the climate-driven variations in demands were derived from the analysis of daily bulk water demand records in typical Australian urban areas. Two climate-driven demand profiles were used:

1) Irrigation (driven by soil moisture and antecedent rainfall).

2) Evaporative cooling (driven by the average maximum daily temperature).

3.2 Key assumptions

As mentioned above, the development of a water cycle requires the consideration of all sources and uses of water. To do this, estimates of different water end uses are required. Unfortunately, there is little in the way of end use water data available from Australian correctional centres. There is however, useful information on the benchmarking on water use such centres (refer to **Table 3-2**).

Table 3-2 Comparison of Water Consumption in Correctional Centres (Sevineratne, 2007)

Water usage	Australia (NSW)	USA	United Kingdom
Typical water usage (m^3/inmate/day)	0.32-1.29	0.3-0.57	0.32-0.39

To generate water use from the correctional centre, five steps were used:

1) Inmate use was assumed to be two times the level of typical water use in residential Australian dwellings (with the same end uses of water). The exception to this is for showering, where advice has been provided that a daily showering time for each inmate of 6 minutes, and the shower head supplies 8 litres/minute should be assumed.
2) Staff and visitor water use was generated by:
    i. Estimating a Gross Floor Area (GFA) for accommodating the staff and visitors based on NSW government office design requirements (State Property Authority, 2010).
    ii. Applying benchmark water uses for commercial office space per unit GFA.
3) Apply benchmark cooling tower water use per GFA over the site by multiplying the roof area over the whole site by two floors.
4) Applying benchmark water use for irrigation water use over two hectares of assumed playing field irrigation.

The water balance modelling was based on the ultimate development for the site.

Water balance assumptions are outlined in **Table 3-3** below.

Table 3-3 Water Balance Modelling Assumptions

Parameter	Value Used
Total Roof Area	104,440 m^2
Number of Inmates	1,700
Number of Staff and Visitors	650
Average Daily Water use Per Inmate	331 L/d
Cooling Tower Use per GFA	0.57 L/d/m^2
Staff and visitor water use per GFA	0.57 L/d/m^2
Staff and visitor water unit GFA	15 m^2/person
Area of playing field irrigation	2 Ha
Average playing field application rate	10 mm/m^2/week

Water use breakdowns for inmates and staff/visitors are provided in **Figure 3-2** and **Figure 3-3**. These breakdowns were adapted from studies into the residential (Yarra Valley Water, 2004) and commercial (American Water Works Association Research Foundation, 2000) end uses of water.

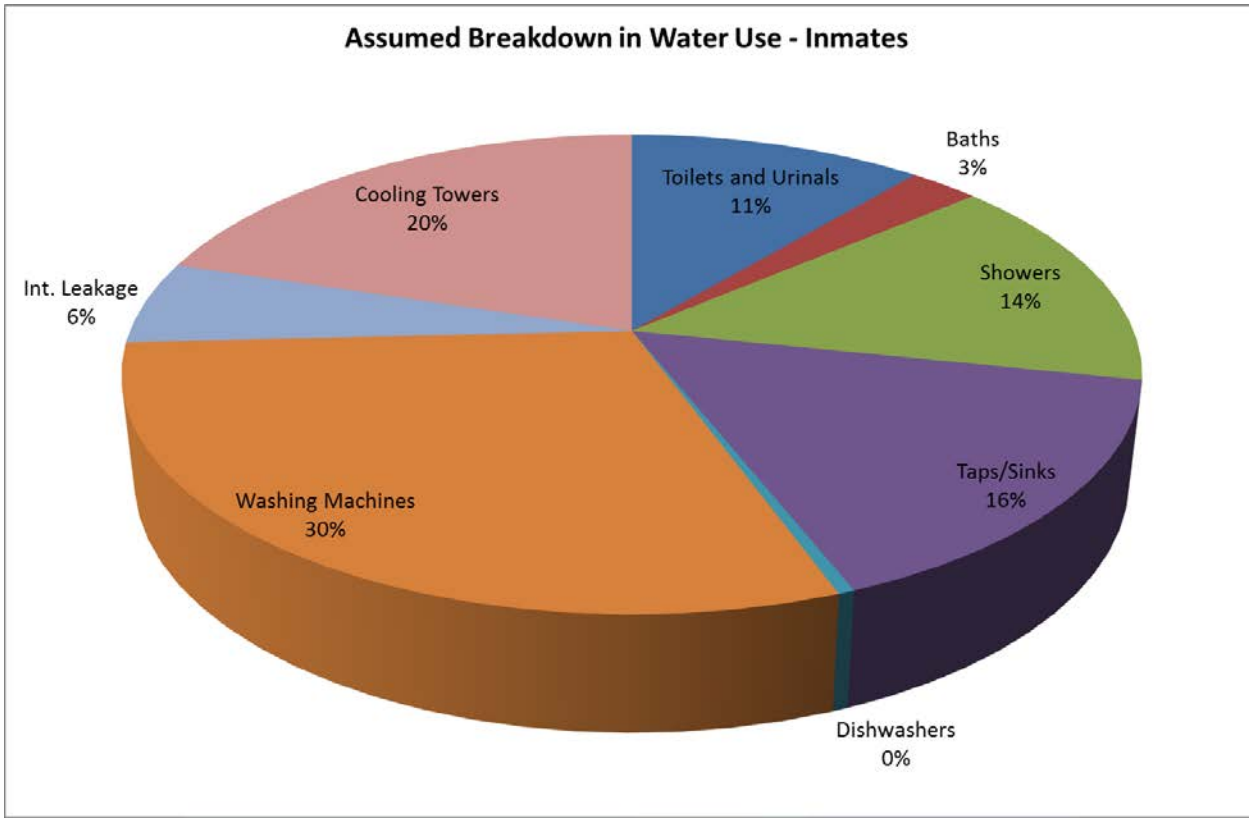


Figure 3-2 Assumed Breakdown in Water Use – Inmates

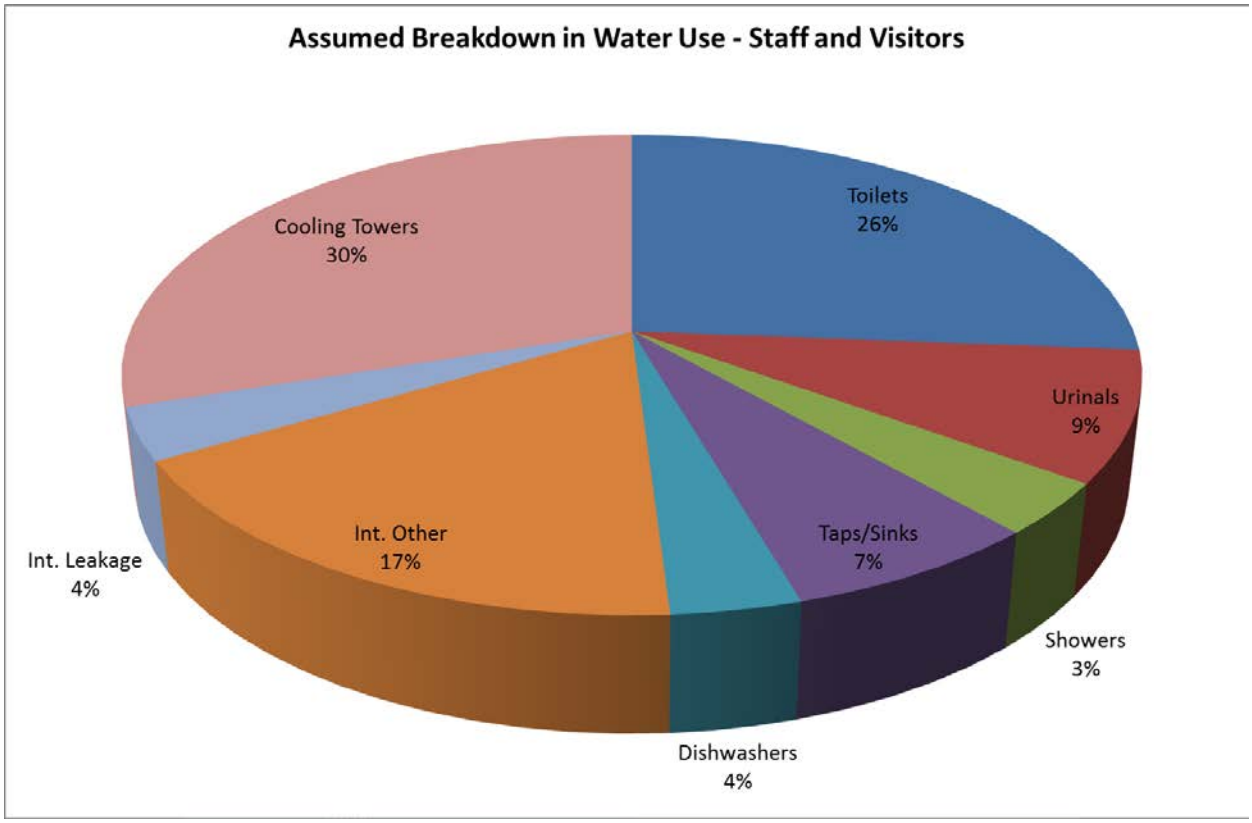


Figure 3-3 Assumed Breakdown in Water Use – Staff and Visitors

3.3 The development of water cycle management scenarios

The list of potential water cycle management options considered in the water balance modelling are shown in **Table 3-4**. In considering alternative water sources to potable water, the supply of recycled stormwater was considered, however as there is a need to minimise wastewater discharges from the site and that there is anticipated to be an excess of wastewater, recycled wastewater was seen to be the preferred alternative water source for non-potable uses. With a basic level of runoff water quality control, filtration and disinfection, harvested roof water would be an ideal source of water including for potable water uses.

It should be noted that while recycled water use is considered for building and playing field use, the potential broad acre irrigation over the large areas of the site as a measure to further reduce wastewater discharges is considered in the Wastewater Servicing Strategy working paper.

Table 3-4 List of Potential Water Cycle Management Options

Water Cycle Management Option	Scenario 1 – Business as Usual – Traditional Development	Scenario 2 – Concurrent Rainwater and Recycled Wastewater Harvesting	Scenario 3 – Maximised Rainwater and Recycled Wastewater Harvesting	Scenario 4 – Recycled Wastewater Harvesting only	Notes
Water efficient fixtures and appliances	No	Yes	Yes	Yes	Standard approach in modern building design
Waterless Urinals	No	No	No	No	Not specifically considered – may be part of a package of more water efficient fixtures and appliances.
Recycled wastewater	No	Yes: • Cooling towers • Irrigation	Yes: • Cooling towers • Toilet/urinal flushing • Irrigation	Yes	Preferred over stormwater harvesting due to the need to reduce wastewater discharges from site
Roof water harvesting	No	Yes: • Toilet and urinal flushing	Yes • All other uses • Hot water system uses	No	Preferred over stormwater harvesting due to better water quality and reduced need for treatment.

Water Cycle Management Option	Scenario 1 – Business as Usual – Traditional Development	Scenario 2 – Concurrent Rainwater and Recycled Wastewater Harvesting	Scenario 3 – Maximised Rainwater and Recycled Wastewater Harvesting	Scenario 4 – Recycled Wastewater Harvesting only	Notes
Stormwater harvesting	No	No	No	No	Stormwater harvesting not included in scenarios due to better sources of water being available: • Roof water. • Recycled wastewater

3.4 Water cycle outcomes and preferred option

Water balance outcomes were modelled using the IWMSim model outlined above. Summary results are provided in **Table 3-5** below. Scenario 3 is the preferred approach due to its maximisation of recycled wastewater use on site and the minimisation of the need for imported potable water.

Table 3-5 Water Cycle Water Balance Outcomes

Parameter	Scenario 1 - Base Case: Traditional Development	Scenario 2 - Concurrent Rainwater and Recycled Wastewater Harvesting	Scenario 3 - Maximised Rainwater and Recycled Wastewater Harvesting	Scenario 4 – Recycled Wastewater Harvesting only
Potable Water Demands				
Average Day Potable Water Demand (ML/d)	0.64	0.34	0.18	0.41
Peak Day Potable Water Demand (ML/d)	0.99	0.64	0.53	0.53
% Reduction in Potable Water Demand	N/A	47%	72%	36%
Wastewater Flows				
Average Day Wastewater Flows (ML/d)	0.47	0.47	0.47	0.47
Peak Day Wastewater Flow (ML/d)	0.61	0.61	0.61	0.61
Average Wastewater Discharge (ML/d)	0.47	0.32	0.23	0.23
Peak Wastewater Discharge (ML/d)	0.61	0.51	0.40	0.40
% Reduction in Wastewater Discharge	N/A	33%	57%	57%
Rainwater System Demand				
Average Day Rainwater Demand (ML/d)	N/A	0.25	0.38	N/A
Peak Day Rainwater Demand (ML/d)	N/A	0.33	0.50	N/A

Parameter	Scenario 1 - Base Case: Traditional Development	Scenario 2 - Concurrent Rainwater and Recycled Wastewater Harvesting	Scenario 3 - Maximised Rainwater and Recycled Wastewater Harvesting	Scenario 4 – Recycled Wastewater Harvesting only
Rainwater Storage Size (kL)	N/A	1,261	1,882	N/A
Reliability of Rainwater Supply	N/A	61%	61%	N/A
Recycled Water System Demand				
Average Day Recycled Water System Demand (ML/d)	N/A	0.16	0.24	0.24
Peak Day Recycled Water System Demand (ML/d)	N/A	0.49	0.58	0.58

3.5 Conclusions

With the long distances involved for the supply of water and the need for the minimisation of potential wastewater discharge from site, it makes sense to select a water cycle management approach that makes as much use as possible of water generated at the Project. Recycled wastewater and harvested roof water are ideally suited for a variety of fit of purpose uses on site. For this reason, Scenario 3 is the preferred water cycle management scenario for the site. By reusing water on site the proposal also helps to fulfil some of the requirements under the SEARs No 9 (**Table 1-3**) in regards to implementing ESD principles as part of the design of the Project. In the event that rainwater harvesting is not considered feasible the use or recycled wastewater to reduce water demand and wastewater discharges would be the preferred scenario (Scenario 4).

4. References

American Water Works Association Research Foundation. (2000). *Commercial and Insitutional End Uses of Water.*

Sevineratne, M. (2007). *A Practical Approach to Water Conservation for Commercial and Industrial Facilities.* Queensland Water Commission.

State Property Authority. (2010). *NSW Government Office Design Requirements.*

Yarra Valley Water. (2004). Residential End Use Measurement Study.