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Moorebank Precinct East - Stage 2 Proposal

Stormwater and Flooding Report

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

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MOOREBANK PRECINCT EAST – STAGE 2

Stormwater and Flooding Environmental Assessment

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REVISIONS

Revision	Date	Description	Prepared by	Approved by
1	21/10/2016	Draft for review		
2	07/11/2016	2nd draft		
3	23/11/2016	Final for DP&E Review	BC/DS	MK

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1 INTRODUCTION

Concept Plan Approval (MP 10_0193) for an intermodal terminal (IMT) facility at Moorebank, NSW (the Moorebank Precinct East Project (MPE Project) (formerly the SIMTA Project)) was received on 29 September 2014 from the NSW Department of Planning and Environment (DP&E). The Concept Plan for the MPE Project involves the development of an IMT, including a rail link to the Southern Sydney Freight Line (SSFL) within the Rail Corridor, warehouse and distribution facilities with ancillary offices, a freight village (ancillary site and operational services), stormwater, landscaping, servicing, associated works on the eastern side of Moorebank Avenue, Moorebank, and construction or operation of any part of the project, which is subject to separate approval(s) under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This Environmental Impact Statement (EIS) is seeking approval, under Part 4, Division 4.1 of the EP&A Act, for the construction and operation of Stage 2 of the MPE Project (herein referred to as the Proposal) under the Concept Plan Approval for the MPE Project, being the construction and operation of warehouse and distribution facilities.

This EIS has been prepared to address:

- The Secretary's Environmental Assessment Requirements (SEARs) (SSD 16-7628) for the Proposal, issued by NSW DP&E on 27 May 2016 (Appendix A).
- The relevant requirements of the Concept Plan Approval MP 10_0913 dated 29 September 2014 (as modified) (Appendix A).
- The relevant requirements of the approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (No. 2011/6229, granted in March 2014 by the Commonwealth Department of the Environment (DoE)) (as relevant) (Appendix A).

This EIS also gives consideration to the MPE Stage 1 Project (SSD 14-6766) including the mitigation measures and conditions of consent as relevant to this Proposal.

This EIS has been prepared to provide a complete assessment of the potential environmental impacts associated with the construction and operation of the Proposal. This EIS proposes measures to mitigate these issues and reduce any unreasonable impacts on the environment and surrounding community.

1.1 Purpose of this report

This report supports the Environmental Impact Statement (EIS) for the Proposal (refer to Section 1.2 below for an overview of the Proposal) and has been prepared as part of a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the EP&A Act.

This report has been prepared to address:

- The Secretary's Environmental Assessment Requirements (SEARs) (SSD 16-7628) for the Proposal, issued by NSW DP&E on 27 May 2016.
- The relevant requirements of Concept Plan Approval MP 10_0913 dated 29 September 2014 (as modified).
- The relevant requirements of the approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (No. 2011/6229, granted in March 2014 by the Commonwealth Department of the Environment (DoE)) (as relevant).

The SEARs and the Concept Plan Conditions of Approval and Statement of Commitments relevant to this study, and the section of this report where they have been addressed are provided in **Table 1-1** and **Table 1-2** respectively.

Table 1-1: Secretary's Environmental Assessment Requirements relevant to this study

Section	Environmental Assessment Requirement	Where addressed in this report
7	Soil and Water – including but not limited to: An assessment of soil and water impacts for the site. The assessment shall:	
7a	assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on Georges River and Anzac Creek;	Sections 4 and 9: Quantity Section 5: Quality (Groundwater is not addressed in this report)
7b	assess flooding impacts and characteristics, to and from the project, with an assessment of the potential changes to flooding behaviour (levels, velocities and direction) and impacts on bed and bank stability, through flood modelling, including: i. hydraulic modelling for a range of flood events; ii. description, justification and assessment of design objectives (including bridge, culvert and embankment design); iii. an assessment of afflux and flood duration (inundation period) on property; and iv. consideration of the effects of climate change, including changes to rainfall frequency and/or intensity, including an assessment of the capacity of stormwater drainage structures; and v. relevant provisions of the *NSW Floodplain Development Manual 2005*.	Section 4 (no bridge)
7c	assess effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas, water dependent fauna and flora (including Ground Dependent Ecosystems);	Section 5
7d	describe any changes to environmental availability;	Section 5
7e	describe any mitigating effects of the proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options;	Section 5
7f	identification of proposed monitoring of hydrological attributes;	Section 5 quality
7g	include a detailed and consolidated site water balance;	Section 6

Section	Environmental Assessment Requirement	Where addressed in this report
7h	address drainage issues associated with the development / site, including the incorporation of Water Sensitive Urban Design measures, stormwater and drainage infrastructure such as on-site detention systems to ensure peak discharges and flow velocities post development shall not exceed existing peak flows and velocities;	Sections 4 and 9: Quantity Section 5: Quality
7i	undertake an assessment of surface water quality during construction (including reference to water quality objectives for the relevant catchment where objectives have been determined), including an identification of works that may impact water quality, and a summary of proposed monitoring and mitigation measures in accordance with Managing Urban Stormwater – Soils & Construction Volume 1 2004 (Landcom) and Volume 2 (DECC 2008);	Section 5
7j	consideration of stormwater quality and management (including monitoring) during operation of the site with the objective of maintaining or improving existing water quality taking into account the Water Quality Objectives;	Section 5
7k	consider whether the existing sewerage system can cater for the proposal and whether environmental performance of the existing system will be impacted;	Appendix F of the MPE Stage 2 EIS (Utilities Strategy Report)
7l	identify and assess the soil characteristics and properties that may impact or be impacted by the project, including acid sulphate soils, salinity, erodibility, unstable or unsuitable ground and unrippable rock;	Section 5
7m	include a bulk earthworks strategy detailing the volume of spoil to be extracted from the site, planned reuse and amount of material to be imported;	Stormwater and drainage design drawings
7n	include a contamination assessment in accordance with the guidelines made under the Contaminated Land Management Act 1997; and	Appendix Q of the MPE Stage 2 EIS
7o	include an assessment of potentially contaminated areas in accordance with the National Environmental Protection Measure 2013 in addition to an assessment of potential areas of Perfluorinated Compounds.	Appendix Q of the MPE Stage 2 EIS

Table 1-2: Concept Plan Conditions of Approval & Statement of Commitments for this study

Issue	Environmental Assessment Requirement*	Where addressed in this report
Conditions of Approval		
Soil and water	a. assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on Georges River and Anzac Creek;	Sections 4 and 9: Quantity Section 5: Quality (Groundwater is not addressed in this report)
	b. assess flooding impacts and characteristics, to and from the project (including rail link), with an assessment of the potential changes to flooding behaviour (levels, velocities and direction) and impacts on bed and bank stability, through flood modelling, including: i. hydraulic modelling for a range of flood events; ii. description, justification and assessment of design objectives (including bridge, culvert and embankment design); iii. an assessment of afflux and flood duration (inundation period) on property; and iv. Consideration of the effects of climate change, including changes to rainfall frequency and/or intensity, including an assessment of the capacity of stormwater drainage structures.	Section 4 (no bridge or culvert)
	c. identify and assess the soil characteristics and properties that may impact or be impacted by the project, including acid sulfate soils;	Not Applicable to the surface water and flooding assessment. Assessment of soils has been provided in Appendix Q of the MPE Stage 2 EIS
	d. Include a contamination assessment in accordance with the guidelines made under the Contaminated Land Management Act 1997 and in consultation with the EPA for the subject site including the Glenfield Waste Facility. The assessment shall include: i. the potential environmental and human health risks of site contamination on the project site; ii. a Remediation Action Plan; iii. consideration of implications of proposed remediation actions on the project design and timing; and iv. a Phase 2 environmental site assessment of the project site including rail corridor.	Not Applicable to the surface water and flooding assessment. A contamination assessment has been provided in Appendix Q of the MPE Stage 2 EIS

Issue	Environmental Assessment Requirement*	Where addressed in this report
Statement of Commitments		
Stormwater and flooding	The Proponent will incorporate stormwater quantity and quality management measures into the detailed applications in accordance with the objectives and performance standard outlined in the Stormwater and flooding Environmental Assessment report and including: • Preparation of a Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP) for both the construction and operation phases;	Section 5
	• Implementation of management plan strategies prior to commencement of the staged construction phase; and	Section 5
	• Monitoring and review performance of sediment and water control structures during construction and operation phases.	Section 5
	• The proponent commits to providing a multi-cell culvert (with elevated 'dry' cells and recessed 'wet' cells) to facilitate aquatic and terrestrial fauna movement in accordance with Witheridge (2003) and Part 7 (Division 3) of the Fisheries Management Act 1994 (FM Act).	(no culvert)
	• The Proponent will prepare and update a flood emergency response plan as necessary to address the staged development of the site. Details are to be provided prior to the construction of each of the three major stages of the development.	Section 4
	• The proponent will investigate opportunities to minimise the number of piers located within Georges River during detail design development.	(no bridge)
Climate change risk	The Proponent will where applicable implement the controls and mitigation measures summarised in the Climate Risk Assessment report and including:	Section 4.2.4
	Incorporate climate change sensitivity analyses for 20 per cent increase in peak rainfall and storm volumes into flood modelling assessment to determine system performance;	Section 4.2.4
	Incorporate appropriate flood mitigation measures, where practical within the design to limit the risk to acceptable levels;	Section 4.2.4

1.2 Overview of the Proposal

The Proposal involves the construction and operation of Stage 2 of the MPE Project, comprising warehousing and distribution facilities on the MPE site and upgrades to approximately 1.4 kilometres of Moorebank Avenue between the northern MPE site boundary and 120 metres south of the southern MPE site boundary.

Key components of the Proposal include:

- Warehousing comprising approximately 300,000m^2 GFA, additional ancillary offices and the ancillary freight village
- Establishment of an internal road network, and connection of the Proposal to the surrounding public road network
- Ancillary supporting infrastructure within the Proposal site, including:
  - Stormwater, drainage and flooding infrastructure
  - Utilities relocation and installation
  - Vegetation clearing, remediation, earthworks, signage and landscaping
- Subdivision of the MPE Stage 2 site
- The Moorebank Avenue upgrade would be comprised of the following key components:
  - Modifications to the existing lane configuration, including some widening
  - Earthworks, including construction of embankments and tie-ins to existing Moorebank Avenue road level at the Proposal's southern and northern extents
  - Raking of the existing pavement and installation of new road pavement
  - Establishment of temporary drainage infrastructure, including temporary basins and / or swales
  - Raising the vertical alignment by about two metres from the existing levels, including kerbs, gutters and a sealed shoulder
  - Signalling and intersection works
- Upgrading existing intersections along Moorebank Avenue, including:
  - Moorebank Avenue / MPE Stage 2 access
  - Moorebank Avenue / MPE Stage 1 northern access
  - Moorebank Avenue / MPE Stage 2 central access
  - MPW Northern Access / MPE Stage 2 southern emergency access

The Proposal would interact with the MPE Stage 1 Project (SSD_6766) via the transfer of containers between the MPE Stage 1 IMT and the Proposal's warehousing and distribution facilities. This transfer of freight would be via a fleet of heavy vehicles capable of being loaded with containers and owned by SIMTA. The fleet of vehicles would be stored and used on the MPE Stage 2 site, but registered and suitable for on-road use. The Proposal is expected to operate 24 hours a day, seven days per week.

An overview of the Proposal is shown in **Figure 1-1**. To facilitate operation of the Proposal, the following construction activities would be carried out across and surrounding the Proposal site (area on which the Proposal is to be developed):

- Vegetation clearance
- Remediation works
- Demolition of existing buildings and infrastructure on the Proposal site

- Earthworks and levelling of the Proposal site, including within the terminal hardstand
- Drainage and utilities installation
- Establishment of hardstand across the Proposal site, including the terminal hardstand
- Construction of a temporary diversion road to allow for traffic management along the Moorebank Avenue site during construction (including temporary signalised intersections adjacent to the existing intersections) (the Moorebank Avenue Diversion Road)
- Construction of warehouses and distribution facilities, ancillary offices and the ancillary freight village
- Construction works associated with signage, landscaping, stormwater and drainage works.

Construction works associated with signage, landscaping, stormwater and drainage works. The Proposal would operate 24 hours a day, 7 days a week.

The footprint and operational layout of the Proposal are shown on **Figure 1-2**.More information relating to the construction and operation of the Proposal is provided in Chapter 4 of the MPE Stage 2 EIS.

1.3 Key terms relevant to the Proposal

Table 1-3 provides a summary of the key terms relevant to the Proposal, which are included throughout this report.

Table 1-3: Summary of key terms used throughout this document

Term	Definition
General terms	
The Moorebank Precinct	Refers to the whole Moorebank intermodal precinct, i.e. the MPE site and the MPW site
Moorebank Precinct West (MPW) Project (formerly the MIC Project)	The MPW Intermodal Terminal Facility as approved under the MPW Concept Plan Approval (SSD_5066) and the MPW EPBC Approval (No. 2011/6086).
Moorebank Precinct West (MPW) site (formerly the MIC site)	The site which is the subject of the MPW Concept Plan Approval, MPW EPBC Approval and MPW Planning Proposal. The MPW site does not include the rail link as referenced in the MPW Concept Plan Approval or MPE Concept Plan Approval.
Moorebank Precinct East (MPE) Concept Plan Approval (formerly the SIMTA Concept Plan Approval)	MPE Concept Plan Approval (SSD_0193) granted by the NSW Department of Planning and Environment on 29 September 2014 for the development of former defence land at Moorebank to be developed in three stages; a rail link connecting the site to the Southern Sydney Freight Line, an intermodal terminal, warehousing and distribution facilities and a freight village.
Moorebank Precinct East (MPE) Project (formerly the SIMTA Project)	The MPE Intermodal Terminal Facility, including a rail link and warehouse and distribution facilities at Moorebank (eastern side of Moorebank Avenue) as approved by the Concept Plan Approval (MP 10_0913) and the MPE Stage 1 Approval (14_6766).

Term	Definition
Moorebank Precinct East (MPE) Site (formerly the SIMTA Site)	Including the former DSNDC site and the land owned by SIMTA which is subject to the Concept Plan Approval. The MPE site does not include the rail corridor, which relates to the land on which the rail link is to be constructed.
Statement of Commitments (SoC)	Recommendations provided in the specialist consultant reports prepared as part of the MPE Concept Plan application to mitigate environmental impacts, monitor environmental performance and/or achieve a positive environmentally sustainable outcome in respect of the MPE Project. The Statement of Commitments have been proposed by SIMTA as the Proponent of the MPE Concept Plan Approval.
MPE Stage 1 Project-specific terms	
Rail Corridor	Area defined as the 'Rail Corridor' within the MPE Concept Plan Approval.
Rail Link	The rail link from the South Sydney Freight Line to the MPE IMEX Terminal, including the area on either side to be impacted by the construction works included in MPE Stage 1.
MPE Stage 1	Stage 1 (14-6766) of the MPE Concept Plan Approval for the development of the MPE Intermodal Terminal Facility, including the rail link at Moorebank. This reference also includes associated conditions of approval and environmental management measures which form part of the documentation for the approval.
MPE Stage 1 site	Includes the MPE Stage 1 site and the Rail Corridor, i.e. the area for which approval (construction and operation) was sought within the MPE Stage 1 Proposal EIS.
MPE Stage 2 specific terms	
MPE Stage 2 Proposal/ the Proposal	The subject of this EIS; being Stage 2 of the MPE Concept Plan Approval including the construction and operation of 300,000m^2 of warehousing and distribution facilities on the MPE site and the Moorebank Avenue upgrade within the Moorebank Precinct.
MPE Stage 2 site	The area within the MPE site which would be disturbed by the MPE Stage 2 Proposal (including the operational area and construction area). The MPE Stage 2 site includes the former DSNDC site and the land owned by SIMTA which is subject to the MPE Concept Plan Approval. The MPE site does not include the rail corridor, which relates to the land on which the rail link is to be constructed.
The Moorebank Avenue site	The extent of construction works to facilitate the construction of the Moorebank Avenue upgrade.
The Moorebank Avenue upgrade	Raising of the vertical alignment of Moorebank Avenue for two kilometres of its length by about two metres, from the Moorebank Avenue/Anzac Road intersection to approximately 200 metres south of the MPE site. The Moorebank Avenue upgrade also includes upgrades to intersections, ancillary works and the construction of an

Term	Definition
	on-site detention basin to the west of Moorebank Avenue within the MPW site.
Construction area	Extent of construction works, namely areas to be disturbed during the construction of the MPE Stage 2 Proposal (the Proposal).
Operational area	Extent of operational activities for the operation of the MPE Stage 2 Proposal (the Proposal).

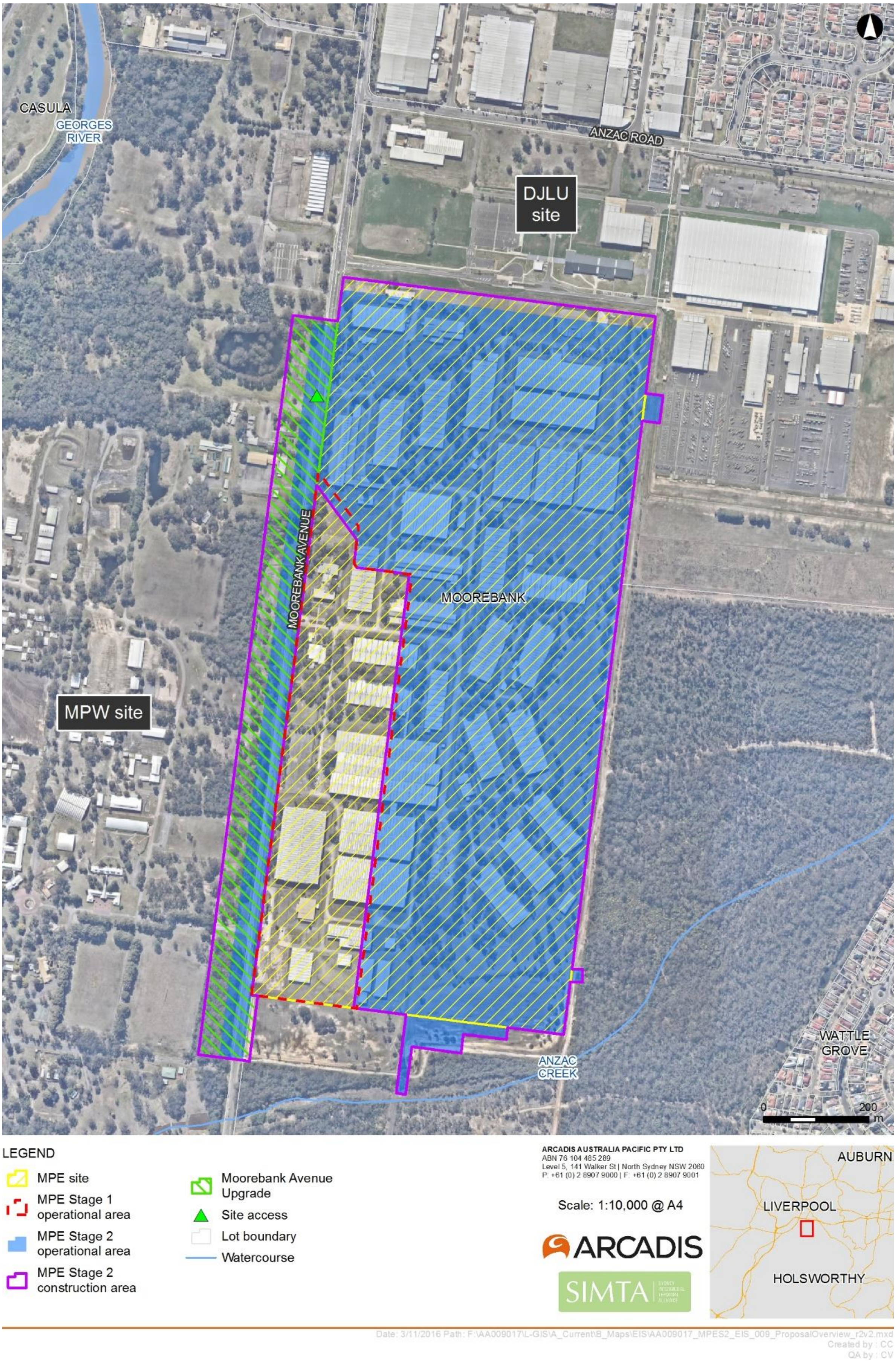


Figure 1-1: Overview of the Proposal

1.4 Structure of this report

This report addresses the flooding and stormwater management items for the MPE Stage 2 site (Proposal site) and includes:

- A locality site description (**Section 2**)
- A summary of previously prepared flooding and stormwater reports and plans (**Section 3**)
- Assessment of the potential impacts of the MPE Stage 2 Proposal, with respect to;
  - Water Quantity (**Section 4**)
  - Water Quality (**Section 5**)
- Site Water Balance (**Section 6**)
- An assessment of flood impact of the Proposal on the Anzac Creek floodplain (**Section 7**).
- A summary of mitigation measures to be implemented during construction and operation of the Proposal to avoid, minimise and mitigate stormwater and flooding-related impacts (**Section 8**)
- An overall conclusion of the report, with respect to stormwater management and potential flood impacts (**Section 9**).

An overview of these components of the report, relative to the Proposal footprint is provided in **Figure 1-2**.

Stormwater and drainage design drawings have been prepared to support the SSD application for the Proposal as part of the civil design drawings (Arcadis, 2016) and are provided in **Appendix P** of the MPE Stage 2 EIS (Arcadis, 2016).

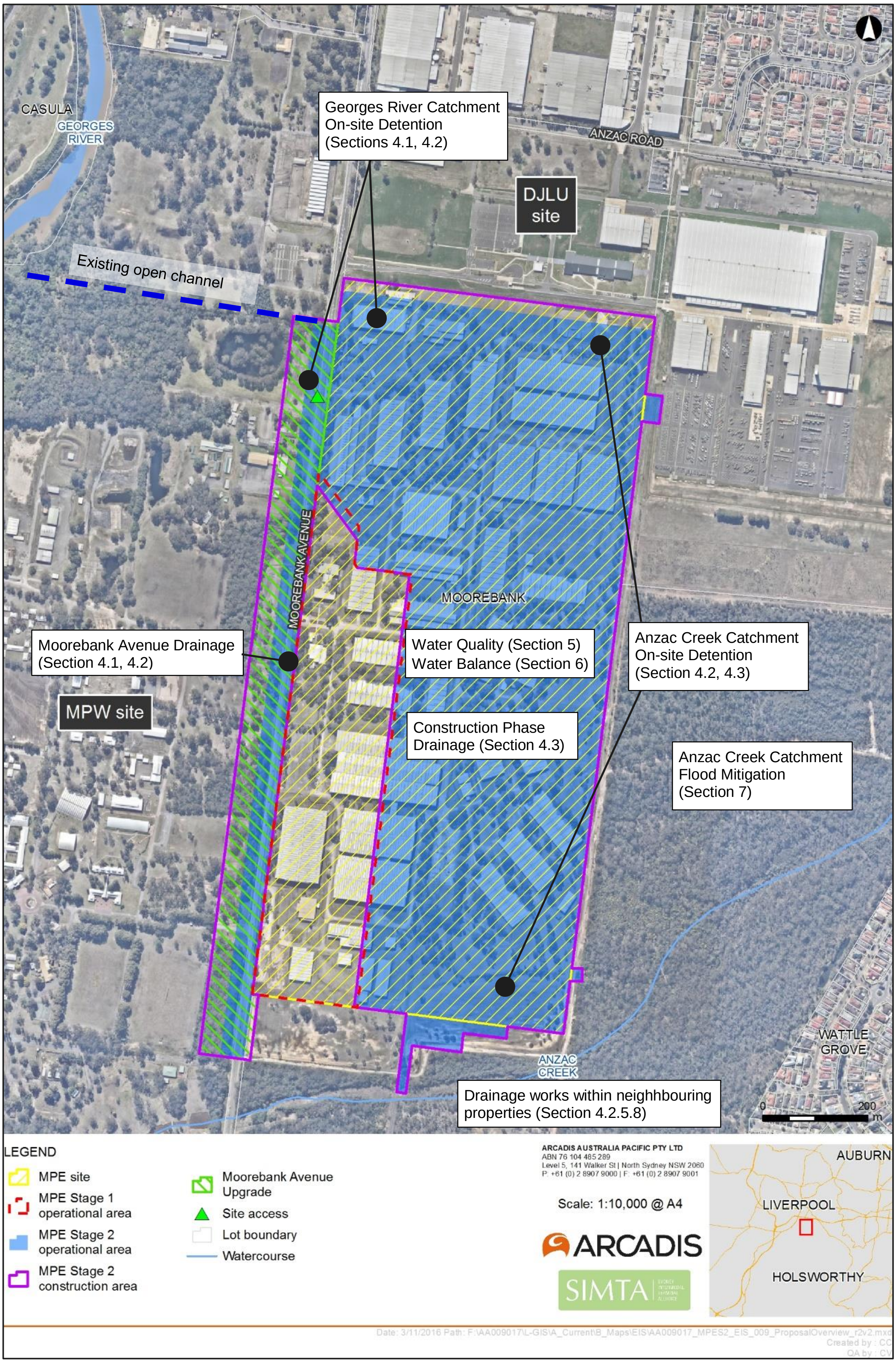


Figure 1-2: Flooding & Stormwater Report Structure

2 SITE DESCRIPTION

2.1 Regional context

The MPE site, including the Proposal site, is located approximately 27 km south-west of the Sydney Central Business District (CBD) and approximately 26 km west of Port Botany (refer to **Figure 2-1**). The MPE site is situated within the Liverpool Local Government Area (LGA), in Sydney's south west sub-region, approximately 2.5 km from the Liverpool City Centre.

The MPE site is located approximately 800 m south of the intersection of Moorebank Avenue and the M5 Motorway. The M5 Motorway provides the main road link between the MPE site, and the key employment and industrial areas within Sydney's West and South-Western Sub-Regions, the Sydney orbital network and the National Road Network. The M5 connects with the M7 Motorway to the west, providing access to the Greater Metropolitan Region and NSW road network. Similarly the M5 Motorway is the principal connection to Sydney's north and north-east via the Hume Highway. The regional context of the Proposal is shown on **Figure 2-1**.

2.2 Local context

The Proposal site is located approximately 2.5 km south of the Liverpool City Centre, 800 m south of the Moorebank Avenue/M5 Motorway interchange and one kilometre to the east of the SSFL providing convenient access to and from the site for rail freight (via a dedicated freight rail line) and for trucks via the Sydney Motorway Network.

The majority of land surrounding the MPE site is owned and operated by the Commonwealth and comprises:

- The MPW site, formerly the School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the MPE site (subject to the MPW Concept Plan Approval)
- The Holsworthy Military Reserve, to the south of the MPE site on the southern side of the East Hills Rail Corridor, which is owned and operated by Sydney Trains.

Residual Commonwealth Land (known as the Boot Land), to the east of the MPE site between the site boundary and the Wattle Grove residential area.

Glenfield Waste Services, south-west of the Proposal is proposing to develop a Materials Recycling Facility on land owned by the Glenfield Waste Services Group within the boundary of the current landfill site at Glenfield. The facility is proposed to recycle a maximum of 450,000 tonnes of material per year. The Glenfield Waste Services Proposal is the subject of a DA (SSD_6249) under Part 4, Division 4.1 of the EP&A Act.

The area immediately south of the MPE site, known as the 'Southern Boot Land', includes an existing rail spur within heavily vegetated remnant bushland. The Southern Boot Land to the south of the proposal and forming part of the MPE Stage 1 Proposal site includes a range of vegetation, varying from remnant bushland to the north-east of the Sydney Trains East Hills Rail Corridor.

A number of residential suburbs are located in proximity to the Proposal site. The approximate distances of these suburbs to the MPE Stage 2 site and the Moorebank Avenue site are provided in **Table 2-1** below.

Table 2-1: Distance to residential suburbs from the Proposal site

Suburb	Distance to MPE Stage 2 site	Distance to Moorebank Avenue site
Wattle Grove	360 m to the north-east	865 m to the north-east
Moorebank	1300 m to the north	1430 m to the north
Casula	820 m to the west	760 m to the west
Glenfield	1830 m to the south-west	1540 m to the south-west

The closest industrial precinct to the Proposal is at Moorebank, comprising around 200 hectares of industrial development. This area includes (but is not limited to) the Yulong and ABB sites to the south of the M5 Motorway and the Goodman MFive Business Park and Miscellaneous industrial and commercial development to the north of the M5 Motorway. The majority of this development is located to the north of the M5 Motorway between Newbridge Road, the Georges River and Anzac Creek. The Moorebank Industrial Area supports a range of industrial and commercial uses, including freight and logistics, heavy and light manufacturing, offices and business park developments.

There are other areas of industrial development near the Proposal at Warwick Farm to the north, Chipping Norton to the north-east, Prestons to the west and Glenfield and Ingleburn to the south-west.

The local context of the Proposal is shown on **Figure 2-2**.

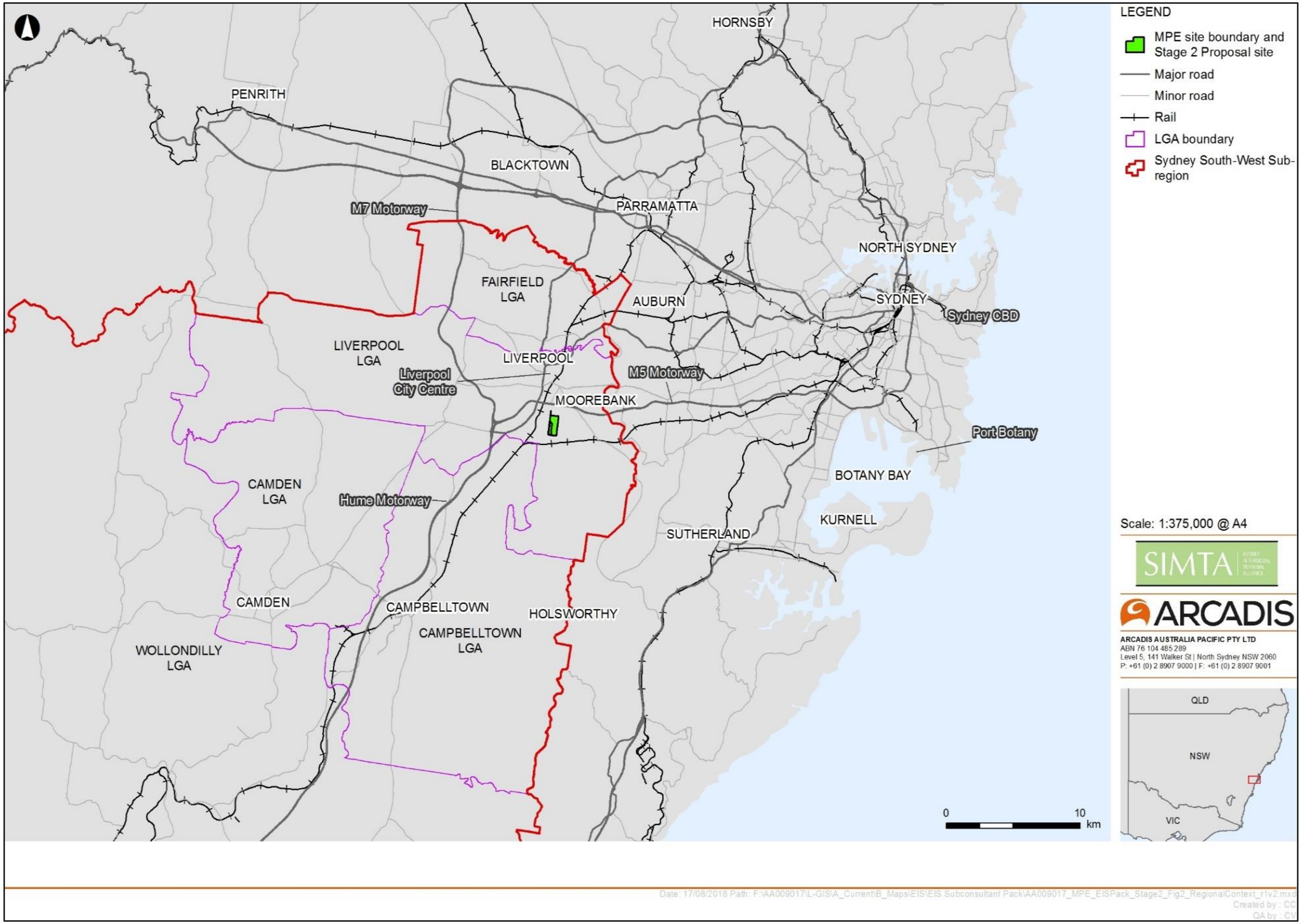


Figure 2-1: Regional context of the Proposal

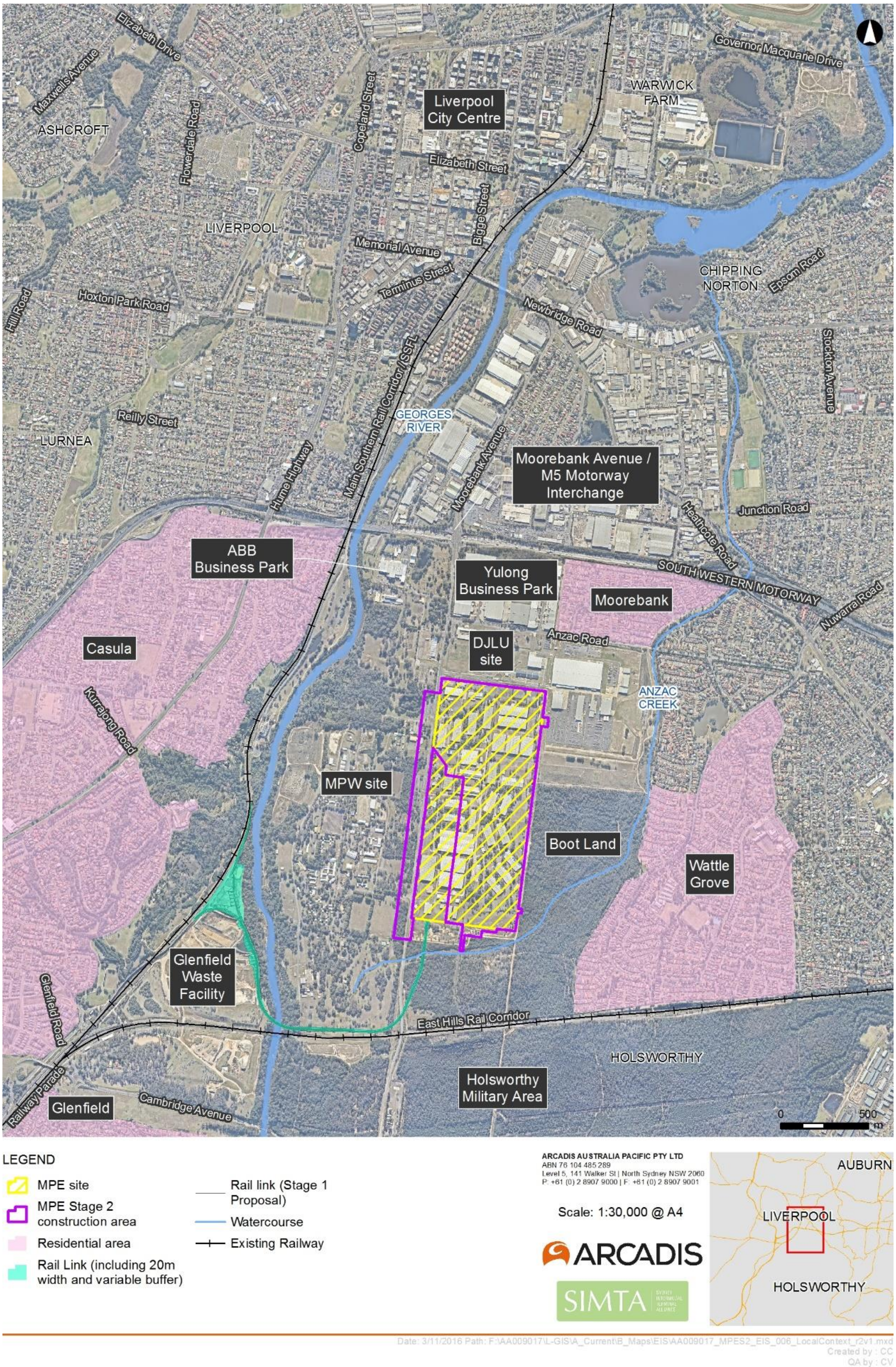


Figure 2-2: Local context of the Proposal

3 PREVIOUS FLOODING AND STORMWATER REPORTS

Previous flooding and stormwater reports that have relevance to the current (MPE Stage 2) proposal include:

1. *SIMTA Sydney Intermodal Terminal Alliance: Flood Study and Stormwater Management Part 3A Concept Plan Application* (12/08/2011) (Concept Plan report). The Concept Plan report was completed to support a Concept Plan application for the development of the SIMTA (MPE) Project. The main components of that August 2011 report have been summarised in the **Section 3.1.**
2. *SIMTA Moorebank Intermodal Terminal Facility – Stage 1 Stormwater and Flooding Environmental Assessment* (10/04/2015). This environmental assessment report was completed to support a state significant development application for the construction and operation of Stage 1 of the SIMTA (MPE) Stage 1. The main findings of the April 2015 report have been summarised in the **Section 3.2**.
3. *Moorebank Intermodal Terminal Surface Water Assessment*' by Parsons Brinkerhoff Australia Pty Ltd (dated 25 June 2014), for the Moorebank Intermodal Company. This surface water assessment report was completed to support a state significant development application for the development of the MPW Project. Findings of the June 2014 report which are relevant to MPE Stage 2 have been incorporated into the MPW Stage 2 summary of **Section 3.3**.
4. *Moorebank Precinct Intermodal Terminal Facility – MPW Stage 2 Stormwater and Flooding Environmental Assessment* (01 August 2016). This environmental assessment report was completed to support a state significant development application for the construction and operation of Stage 2 of the MPW. Findings of the August 2016 report which are relevant to MPE Stage 2 have been summarised in the **Section 3.3**.

3.1 SIMTA Flood Study & Stormwater 12/08/2011

The Concept Plan report was completed to support a Concept Plan application for the development of the SIMTA (MPE) Project, including a rail link and warehouse and distribution facilities on the SIMTA (MPE) site. This previous Concept Plan report:

- detailed existing catchments, hydrology and hydraulics relevant to the SIMTA (MPE) Project.
- presented flooding and stormwater management and mitigation measures for the post-development site condition including concept designs for on-site detention (OSD) and options for managing external (neighbouring area) catchment flows.

The post-development conditions would result in an increased imperviousness with approximately 100 per cent of the site becoming impervious. Measures adopted to mitigate stormwater impacts associated with the development would include:

- The provision of OSD structures to mitigate potential increases in peak flows discharging from the site up to and including the 100 year average recurrence interval (ARI) event. It was anticipated that the mitigating OSD storage would be achieved;
    - By configuring the OSD channels with vertical walls, and horizontal inverts (with rain garden inverts).
    - By raising site ground levels.
    - Where necessary, providing above ground storages within or adjacent to proposed buildings.
- Incorporating swales and culverts to adequately convey neighbouring property flows through the SIMTA (MPE) site in order to prevent adverse flood impacts on adjacent lands as a result of the site development.

- A number of stormwater treatment devices including rainwater tanks, gross-pollutant traps, buffer strips, bio-retention and bio-swales.

3.2 SIMTA Stage 1 Flood Study & Stormwater 10/04/2015

SIMTA (MPE) Stage 1 works areas are outlined in **Figure 3-1**. The MPE Stage 1 works areas are included as base-case (i.e. existing) conditions for the Proposal..

The following conclusions and recommendations (relevant to the Proposal) were made within this earlier report.

- TUFLOW model results indicated that the impact of the proposed Rail link and associated culvert would result in negligible flood impacts within the Anzac Creek catchment area.
- The DRAINS and HEC-RAS modelling results indicate that the proposed drainage systems and OSD can provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Stage 1 Operational Area works. Design considerations to optimise stormwater management on the Stage 1 Operational area were identified.
- Stormwater management structures for the Rail link have been identified to predominantly maintain existing surface water conditions.
- Stormwater quality modelling was undertaken for the Proposal, which demonstrated that implementation of the WSUD measures identified, including the use of gross pollutant traps and rain gardens, would result in a ‘net or better effect’ on water quality as a result of the Stage 1 proposal during operation.
- A site water balance was prepared for the Stage 1 proposal that concluded that the Stage 1 proposal would result in an increase in surface water runoff of 30 ML. Opportunities for reuse within the Stage 1 proposal site are limited, however the impacts associated with the increase are expected to be negligible in the context of the Georges River catchment as a whole.

Figure 3-1: SIMTA (MPE) Stage 1 Location Plan and Key Areas

3.3 MPW Stage 2 Stormwater & Flooding 01/08/2016

The MPW Stage 2 works areas are outlined in **Figure 3-2**. The MPW works areas are included as base-case (i.e. existing) conditions for the MPE (SIMTA) Stage 2 proposal.

The following conclusions and recommendations (relevant to the Proposal) were made within this earlier (MPW Stage 2) report.

- The DRAINS modelling results indicate that:
  - The proposed drainage systems and OSDs would provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the MPW Stage 2 Proposal site works.
  - The introduction of a significant channel system downstream of the existing MPE site culvert crossing Moorebank Avenue, would adequately convey flows through the MPW Stage 2 Proposal site to the Georges River.
- Design considerations to optimise stormwater management along Moorebank Avenue have been identified. However:
  - The next stages of design and analysis should include 2-dimensional rainfall-runoff modelling analysis of the Moorebank Avenue corridor (e.g. using TUFLOW software to more adequately quantify flow regimes for existing conditions and Proposal site development conditions). Such modelling is to facilitate design of the northern Moorebank Avenue widening and channel system (at the MPE culvert crossing location) and confirm hydraulic performance and stormwater/flood mitigation adequacy.
  - It is also recommended that consideration be given to the construction timing of future design stages with respect to management of greater than 100 year ARI flows.

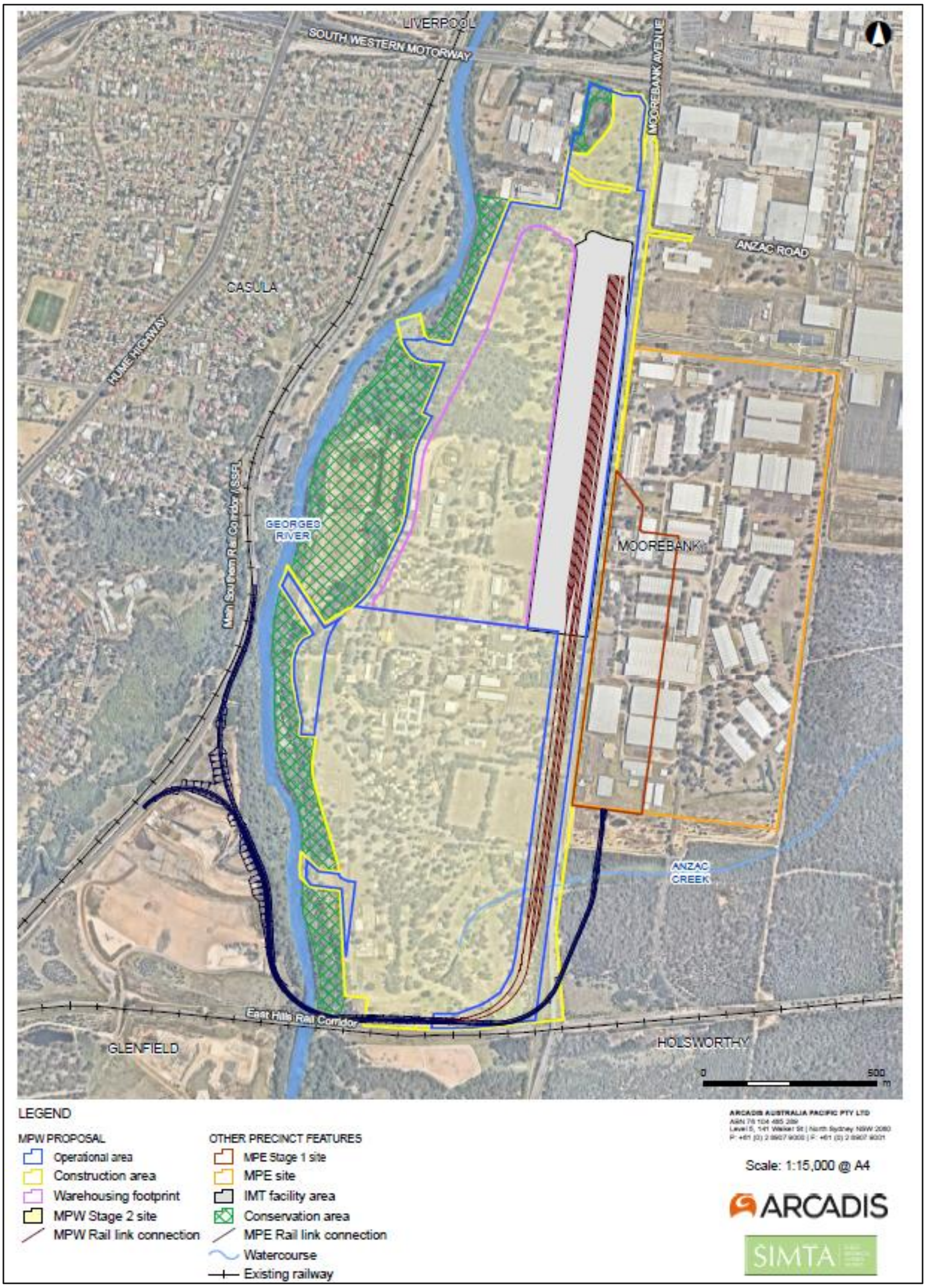


Figure 3-2: MPW Stage 2 Proposal Overview

4 WATER QUANTITY

The Proposal site requires adequate stormwater system capacity and management to support the operation of the Proposal. Furthermore, development of the Proposal site also has the potential to impact upon:

- The hydrology of adjacent land including:
  - the Defence Joint Logistics Unit (DJLU) site to the north and north-east of the Proposal,
  - the bootland to the south and south-east of the Proposal
  - Moorebank Avenue to the north of the Proposal
- Adjacent Proposals and Projects, with interfacing stormwater systems, including :
  - the MPE stage 1 Project.
  - The MPW Project (including the MPW Stage 1 and MPW Stage 2 projects).
- The broader Anzac Creek and Georges River floodplains.

As such, stormwater and flood analysis undertaken for the Proposal has involved several components of analysis and design to address site stormwater requirements, and inform on stormwater and flood management measures necessary to mitigate potential adverse flood impacts that may otherwise result from the Proposal.

DRAINS software has been used to generate rainfall runoff models that represent both existing site conditions and post development site conditions to enable a comparison of discharges and to quantify on-site detention (OSD) performance.

Initially, **Section 4.1** describes existing stormwater drainage conditions for the Proposal site and associated DRAINS modelling.

Stormwater analysis and design for proposed development conditions, including associated flooding and stormwater mitigation measures, are summarised in **Section 4.2**.

Subsequently, commentary is provided on the Proposal site regarding:

- Stormwater management and mitigation works during construction of the Proposal (**Section 4.3**).
- Interfacing with MPE Stage 1 (**Section 4.2.4.9**).
- Flood emergency response planning (**Section 4.4**).

Assessment of the broader Anzac Creek floodplain is presented in **Section 7**.

4.1 Existing Conditions

The topography of the MPE site is relatively flat, with reduced levels (RLs) ranging between 14 and 16 metres Australian Height Datum (mAHD). Along the eastern site boundary, the land rises from about RL14 mAHD at each end to a localised peak of RL22 mAHD about midway along the length. There are three internal catchments within the MPE site and a number of small external catchments that discharge into the site. The site catchments are shown in **Figure 4-1**.

There are three existing stormwater culvert outlets from the site. Two outlets discharge eastward to Anzac Creek and cross under the Greenhills Road formation via pipes and headwalls (Outlets A and B). Stormwater to these two culvert outlets is conveyed through the site via formal open grass lined channels. From Greenhills Road to Anzac Creek the channels appear less formalised.

On the western portion of the site water from both the site and the eastern side of Moorebank Avenue is collected in a formal concrete lined channel which runs within the site parallel to Moorebank Avenue. These channel flows discharge via a culvert under Moorebank Avenue (Outlet C) into a channel which leads to Georges River.

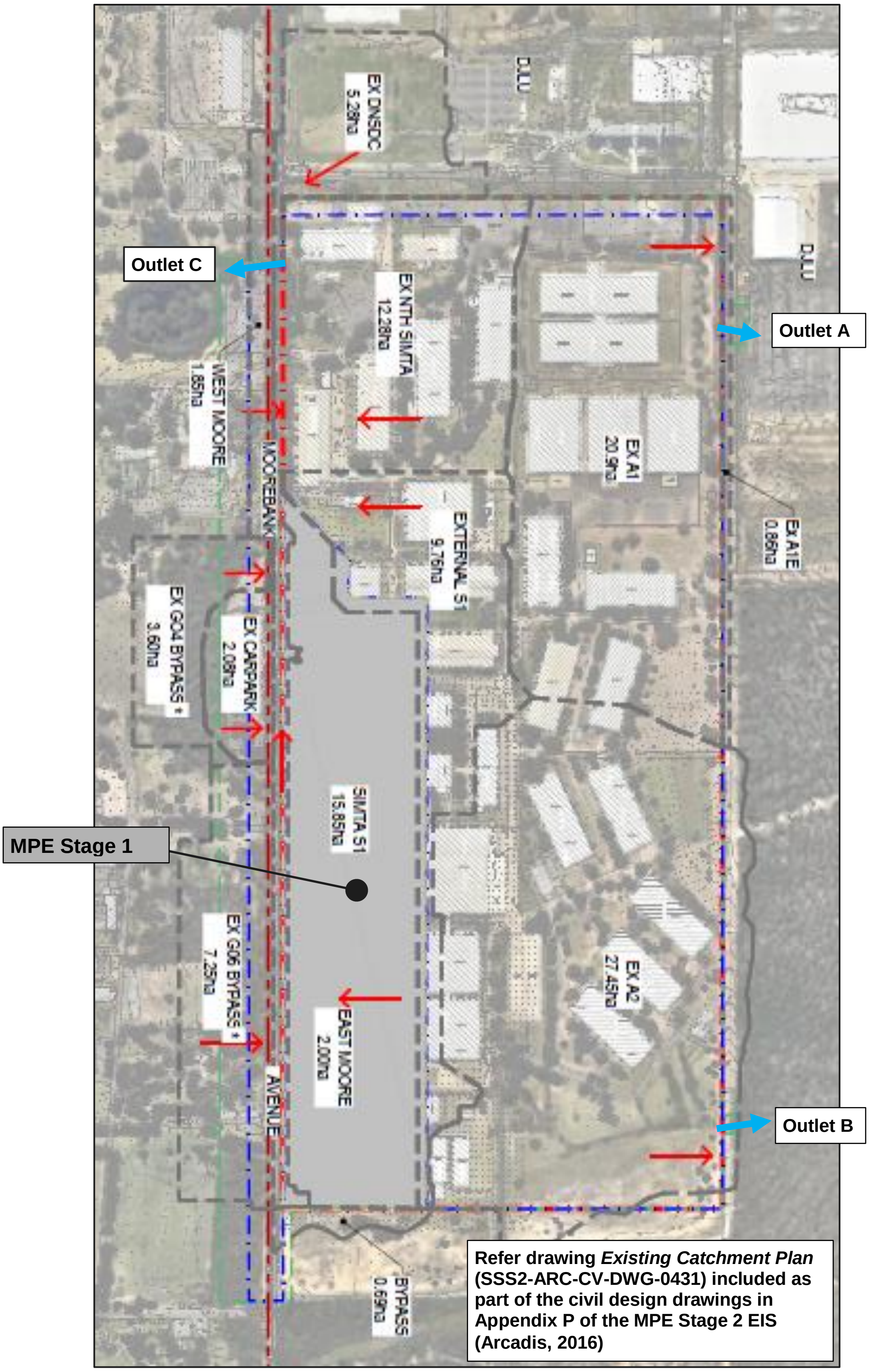


Figure 4-1: Existing Catchments of the MPE Site

The following provides additional drainage information within specific MPE site areas.

4.1.1 MPE site east of Moorebank Avenue

To the east of Moorebank Avenue is the MPE site which is bisected in a north-south direction by a catchment boundary with:

- **The eastern portion** of the MPE site is substantially developed and surface water currently discharges to Anzac Creek via two culvert outlets under the Greenhills Road corridor, one in the north-east of the site (Outlet A) and the other in the south-east (Outlet B).

  North-east Site Area

  This area is outlined in **Figure 4-2** and, as indicated, has significant flood storage capacity.

  The neighbouring land to the north-eastern of the Proposal site has been redeveloped for the DJLU site. A stormwater management plan of the neighbouring development has introduced various new channels, culverts and embankments (refer to **Figure 4-3)**.

  Photo 4-1 shows the new culvert (4, 1.2mx0.375m RCBC) built within the MPE site as part of the recent DNSDC site re-development. The culvert is to serve as the MPE site outlet system under the Greenhills Road corridor. It is noted that the culvert, which is said to have ‘10 year ARI capacity’ on the project design drawing (Dwg No. ACR-0367-0000-CI-SK-0050 issue H 20.07.12, prepared by Acor Consultants for the Australian Government Department of Defence, Defence Support Group), appeared to be 100% blocked at the site visit on 2 November 2015).

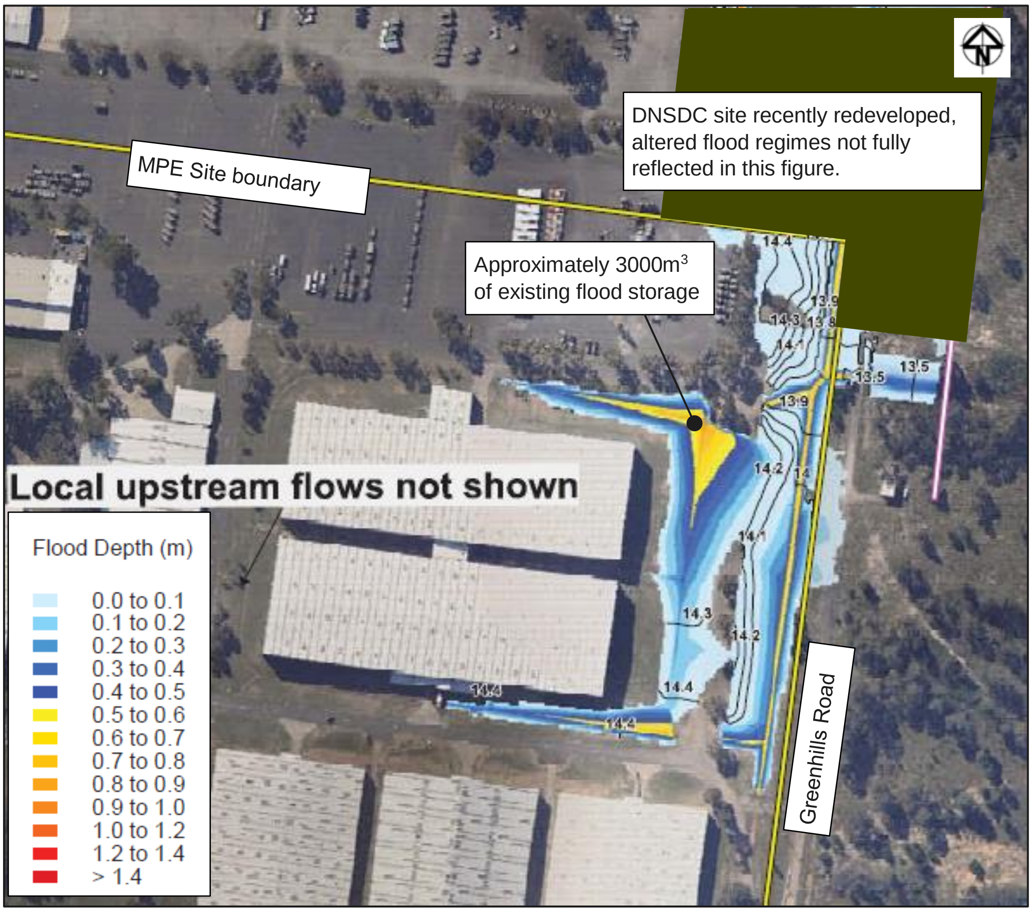


Figure 4-2: NE corner of MPE site 100 year ARI flood levels (mAHD) and flood storage

Photo 4-1: DNSDC re-development project culvert within MPE NE corner, viewing east

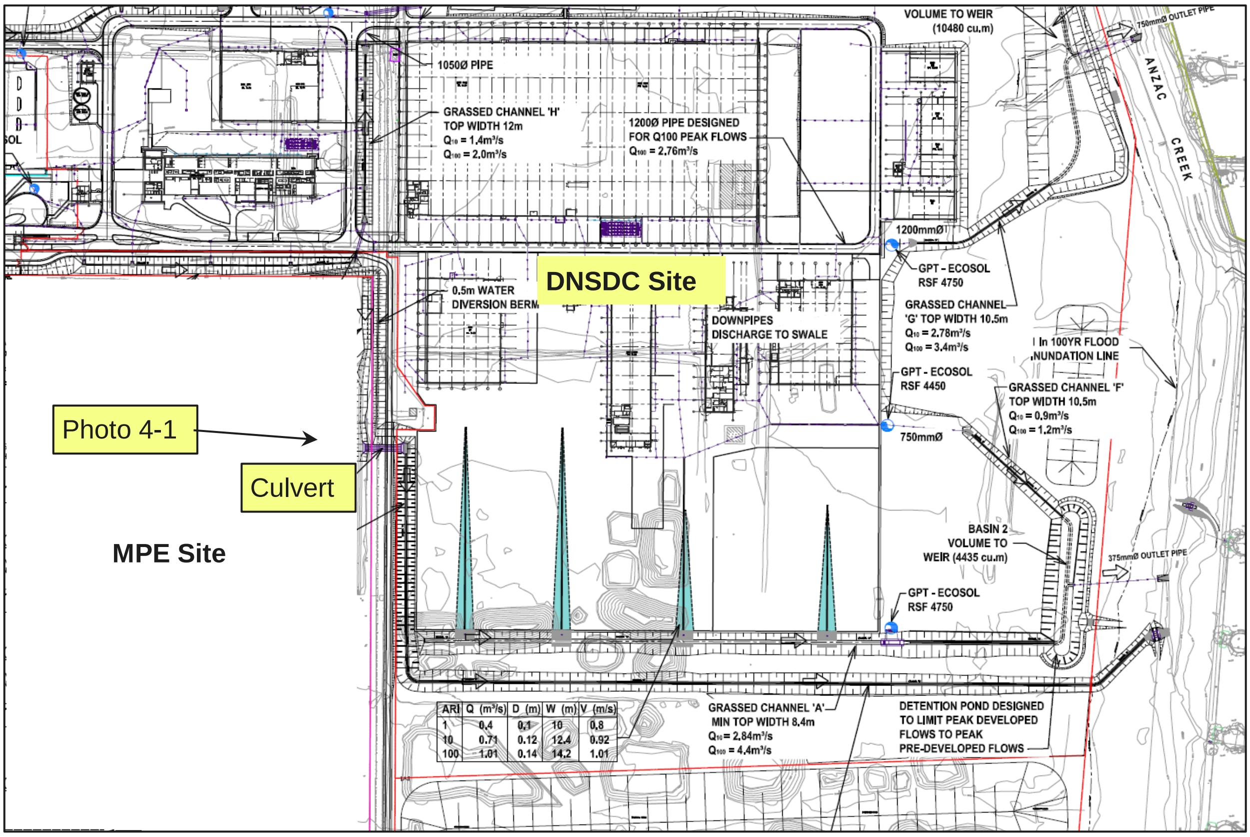


Figure 4-3: NE corner of MPE and surrounding DNSDC re-development

South-east Site Area

This south-eastern portion of the MPE site also has significant flood storage capacity as outlined in **Figure 4-4**).

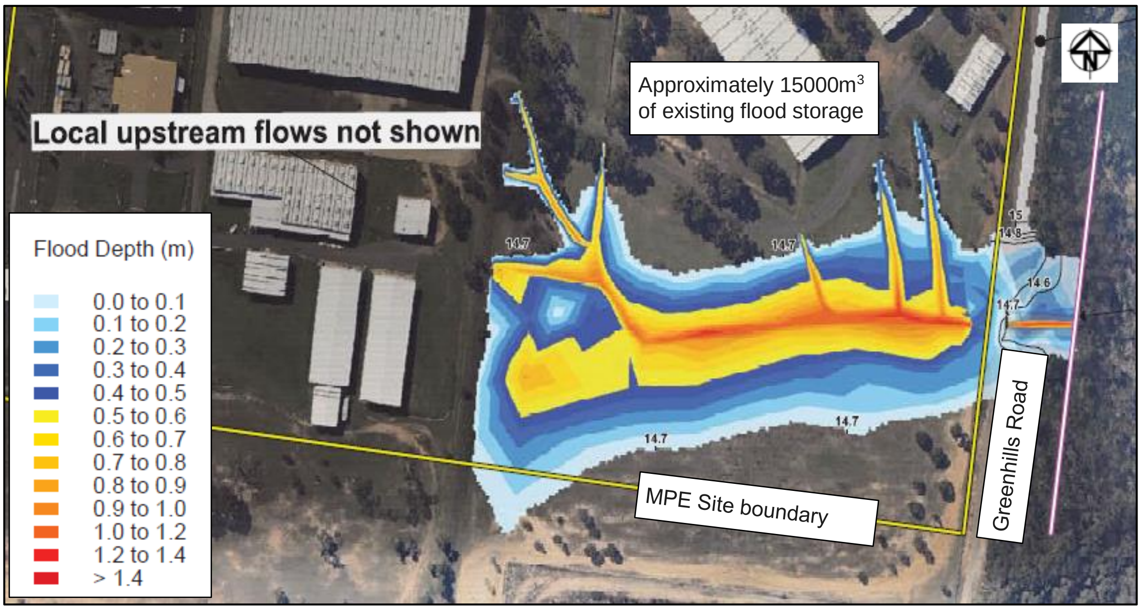


Figure 4-4: SE corner of MPE site 100 year ARI flood levels (mAHD) and flood storage

Photo 4-2: Culvert (guard rail) in SE Corner of MPE site, viewing eastward (downstream)

- **The western portion** discharging to the Georges River via a culvert under Moorebank Avenue, into a channel which conveys flows some 600m to the Georges River. This area is also significantly developed and relatively flat, and includes;
  - A partially covered open channel which captures and conveys surface runoff to the north western corner of the site. This area also has significant flood storage potential (as outlined in **Figure 4-5**).
  - A twin culvert (2, 1.8m(h) x 2.0m(w)) which conveys flows from the MPE site under Moorebank Avenue, into an open channel and to the Georges River. However as shown in Photo 4-3, the upstream headwall entrance appears highly susceptible to blockage due to a combination of full height channel grating, walkway and fencing.
  - A number of small external catchment areas discharge into the MPE site (as outlined in **Figure 4-1** and identified in the 'SIMTA *Moorebank Intermodal Terminal Facility - Stage 1 Stormwater and Flooding Environmental Assessment'* by Hyder Consulting, 10 April 2015).

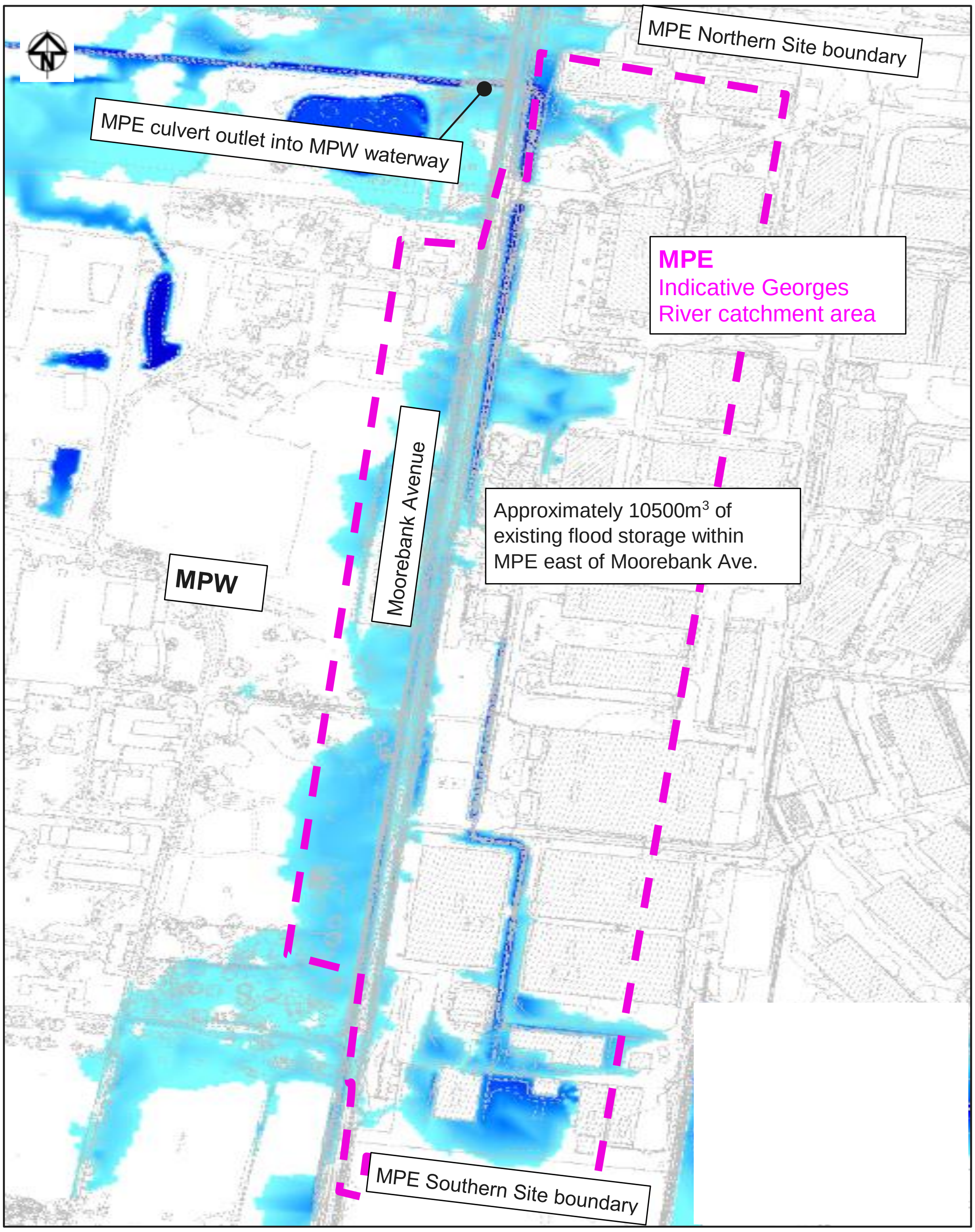


Figure 4-5: 100 year ARI Flood extents and storage within MPE Georges River catchment

Photo 4-3: Moorebank Avenue, upstream of culvert, viewing west (downstream)

4.1.2 Moorebank Avenue

Moorebank Avenue has a crest located just to the south of the MPE site southern boundary. To the south of the road crest, runoff discharges to Anzac Creek. To the north of this (Georges river/Anzac Creek) road crest, overland flows generally discharge northward along the road corridor to the culvert under Moorebank Avenue (located just south of the MPE northern site boundary). There are however a number of local pit and pipe systems on the western side of Moorebank Avenue including:

- A conduit system which discharges from Moorebank Avenue westward under the MPW site then into the Georges River (shown in **Figure 4-7**).
- A conduit from the MPW carpark which discharges eastward under Moorebank Avenue into the MPE Stage 1 drainage system.
- Several other stormwater pits (with uncertain discharge points, not clearly defined by site inspection and survey to date) which may also discharge eastward into the MPE site, northward to the culvert under Moorebank Avenue or westward under the MPW site before discharging to the Georges River.

4.1.3 MPE Works west of Moorebank Avenue

To the west of Moorebank Avenue the MPE works interface with the MPW site.

The south eastern portion of the MPW site drains eastward, and is an upper catchment area of Anzac Creek. The remainder of the MPW site discharges to the Georges River, either via Moorebank Avenue, or more directly from areas grading westward.

As outlined in **Figure 4-5**, the open channel which conveys flows from the MPE site and works area, through the MPW site, and into the Georges River, is initially a concrete lined trapezoidal shape (see Photo 4-4). Approximately halfway between Moorebank Avenue and the Georges River, the concrete lined portion of the open channel is served by an energy dissipater which has catastrophically failed, resulting in major scouring (see Photos 4-5 and 4-6). Downstream is very inaccessible, and appears to be an incised and scoured unlined waterway, dropping away quite steeply down to the Georges River.

Photo 4-4: Channel west of Moorebank Avenue in MPW site

Photo 4-5: Channel failure and scouring upstream (eastward)

Photo 4-6: Channel failure and scouring viewing viewing downstream (westward)

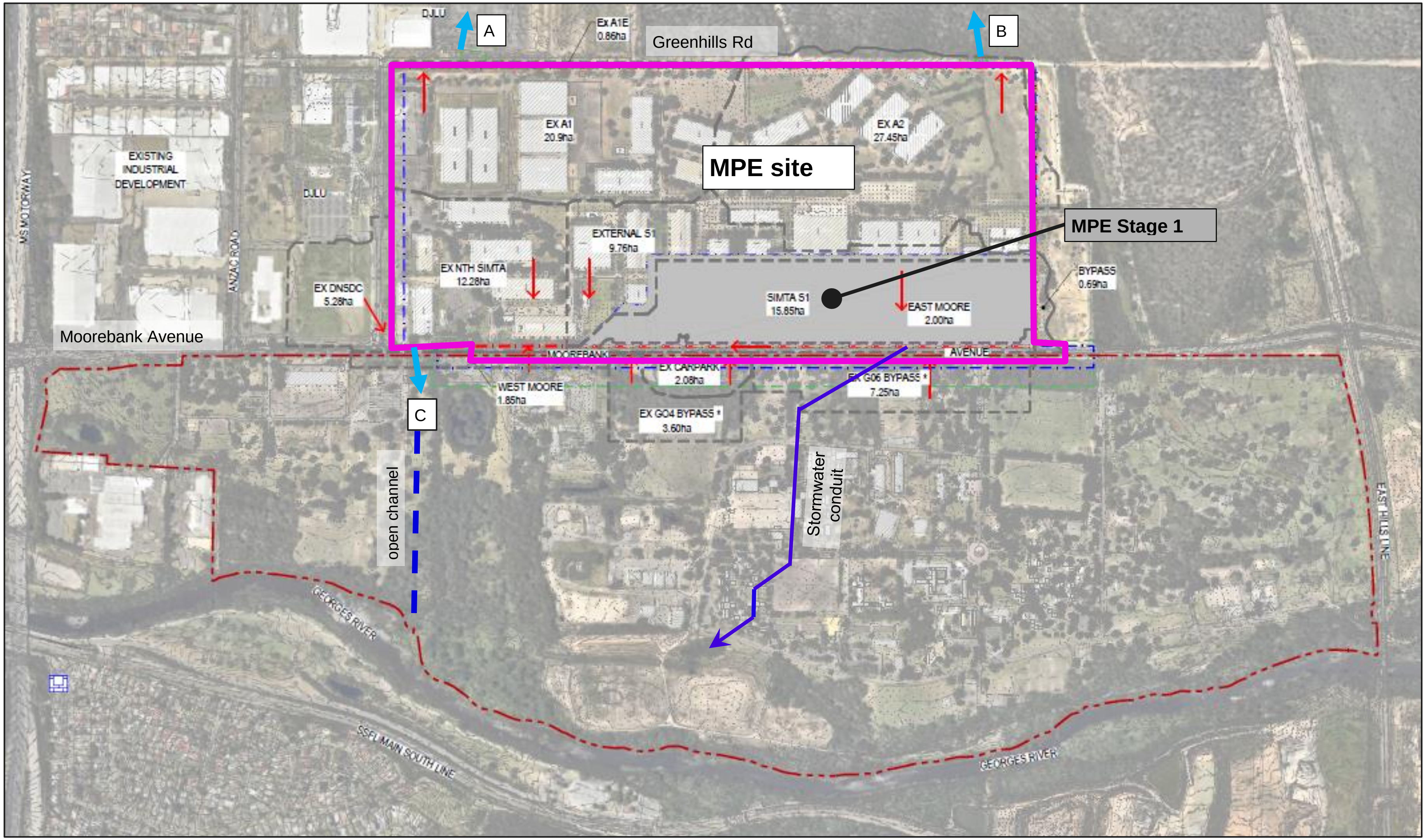


*Figure 4-7: Existing Site Conditions catchment plan (refer also to **Appendix A**)*

4.1.4 Assessment Methodology

Under existing conditions, the model catchments, impervious areas and drainage systems have been determined based on:

- Aerial photography.
- Aerial laser survey.
- Ground survey of the site where available.
- Site inspection carried out during the course of this assessment to clarify catchment features.
- Recent works associated with development of the DJLU site based on:
  - the Australian Government Department of Defence project 'Defence Logistics Transformation Program DNSDC & JLU(V), Defence Project: JP0068P, Drawing Title: DNSDC – Civil Works Stormwatwer Management Plan, Dwg No. ACR-0367-0000-CI-SK-0050, issue: L for tender 22.10.12, prepared by Acor Consultants; and
  - the Australian Government Department of Defence project 'Defence Logistics Transformation Program DNSDC, Defence Project: JP0068P, Drawing Title: Site Wide Consolidated as Constructed Plans, Project Number: 11205, Dwg No. 0367-0000-SU-DG-0026, Rev. 9, 20.01.14, prepared by Usher & Company Consulting Surveyors.

Modelling of existing flooding conditions extends westward across Moorebank Avenue to include the Moorebank Avenue site (refer to **Figure 1-1**).

A catchment plan that represents the layout adopted for the existing conditions DRAINS model is included in **Appendix A**.

It should be noted that although the MPE Stage 2 base case condition includes drainage to be provided as part MPE Stage 1; the assessment of the Proposal has adopted existing condition (i.e. pre-MPE Stage 1) site discharges for the purposes of setting discharges target flows for the MPE Stage 2 works, since:

- The detailed design and construction of the MPE Stage 1 Project is yet to be completed
- The requirements are that MPE Stage 1 discharges are to be no greater than for existing conditions.

The parameters used in the DRAINS modelling include:

- Paved area and Supplementary area depression storage = 1mm, and pervious area depression storage = 5mm.
- Soil type = 3.0.
- Antecedent moisture condition = 3.0 (rather wet).
- Initial and continuing losses of 20mm and 2.5mm/hr for pervious areas represented by the RAFTS module of DRAINS.
- RAFTS module 'Storage Coefficient Multiplication Factor' (Bx) = 1.0.
- Floodplain storage estimates within the Proposal site and tailwater levels on each of the three outlet systems, based on modelling of the outlet waterways.

For the north-eastern and south-eastern waterways, HEC-RAS modelling has been carried out. For the north-western waterway (which continues westward through the MPW site before discharging into Georges River), tailwater levels have been based on uniform flow analysis, indicating a 100 year ARI water level in the waterway of approximately 12.6mAHD.

The DRAINS modelling has been undertaken for storm durations of 5 minute to 24 hours for the 2 year, 5 year, 10 year, 20 year, and 100 year ARIs, and 15 minute to 6 hours probable maximum precipitation (PMP) events.

A summary of the modelling input data is included in **Appendix A**.

4.1.5 Results

A summary of peak flows discharging from the Proposal site is presented in **Table 4-1**. A summary of model outputs and sub-catchment flows leaving the Proposal site are included in **Appendix A** for a range of storm durations.

HEC-RAS model tailwater level information associated with the Proposal site outlet systems are included in **Appendix A**.

4.2 Proposed Site Development Conditions

In demonstrating compliance with the SEARs itemised in **Table 1-1** of this report, analysis and design of the Proposal site under developed conditions has included:

- DRAINS rainfall runoff modelling; and
- Mitigation of potential adverse flood impacts that may otherwise result from the Proposal site development by the provision of:
  - On-site detention (OSD).
  - Drainage and flow relief from Moorebank Avenue westward through the MPW site to the Georges River.

The OSD structures (Basins 1, 2, 9 and 10) that have been incorporated into the design for the Proposal are outlined in **Figure 4-8**.

4.2.1.1 Eastern (Anzac Creek) Detention Storages

Two detention storages; Basin 1 and Basin 2 discharge east into Anzac Creek via outlet A and outlet B, respectively (refer to **Figure 4-8**).

In addition to demonstrating adequate flow mitigation performance discharging from the Proposal area’s eastern site boundary, further Anzac Creek catchment-wide modelling has been carried out, as discussed in **Section 7**.

4.2.1.2 Western (Georges River) Detention Storages

The two detention storages (Basin 9 and Basin 10) that discharge westward from the Proposal’s operational area have been configured such that:

- Basin 9 discharges westward into the channel/culvert system which extends under Moorebank Avenue to the Georges River.
- Basin 10 discharges northward into the channel system which extends from Moorebank Avenue to the Georges River.

4.2.2 Assessment Methodology

To represent proposed development conditions, the existing conditions DRAINS modelling (discussed in **Section 4.1**) was adjusted to represent the post development site conditions as outlined **Figure 4-8** and in the accompanying design drawings. Model adjustments have included:

- Changes to sub-catchment boundaries. A sub-catchment plan that represents the layout adopted for the proposed conditions DRAINS model is included in the design drawings.
- Increased imperviousness and reduced flow travel times representative of the proposed development.
- Introduction of Moorebank Avenue concept cross-drainage and long-drainage systems.
- Detention storages.

A rainfall increase sensitivity analysis has also been undertaken, and a summary of the modelling input data is included in **Appendix A**.

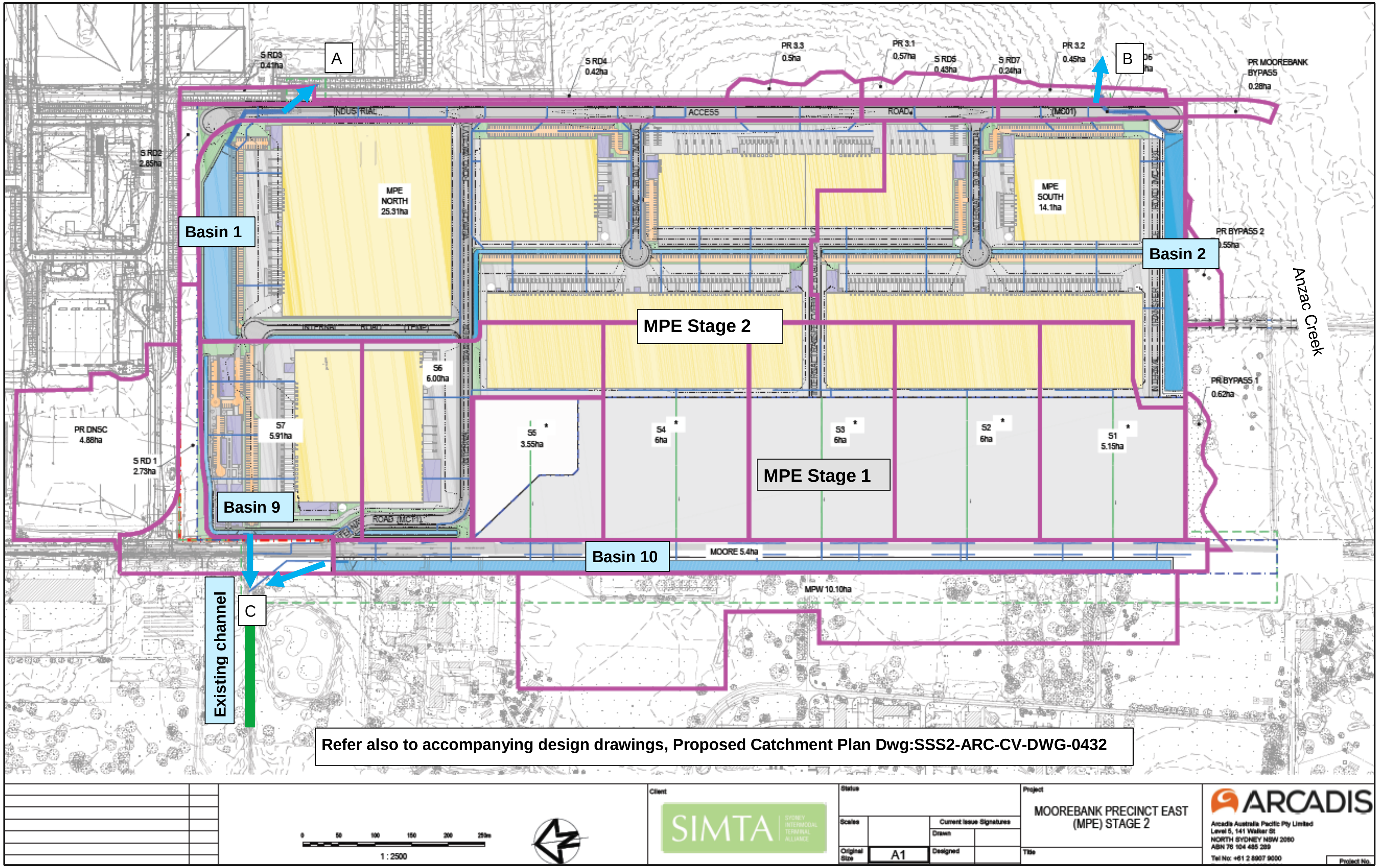


Figure 4-8: Proposal Site catchment plan (with inclusion of the MPE Stage 1)

4.2.3 Results

A comparison of DRAINS model existing condition (**Section 4.1** modelling) and post-development condition flows at downstream locations of the Proposal site is included in **Table 4-1**, with a fuller comparison (being for a range of storm durations) provided in **Appendix A**. These results indicate that the proposed detention storages should adequately mitigate potential flow increases leaving the Proposal site.

A summary of the performance of the OSD storages is provided in **Table 4-2**, with concept OSD outlet designs provided in the accompanying **Drawings** (Appendix P of the MPE Stage 2 EIS). The low flow outlet configurations, and high level outlet weirs have been sized to control 100 year ARI flows for conditions entering basins with 'extended detention' (~3 month) water levels and low flow raingarden outlets fully blocked at the onset of the storm event.

Table 4-1: Comparison of Existing Conditions and Proposed Development Peak Flows

Discharge Location	Site Condition	Catchment Area (ha)	DRAINS Model Label	Flow (m^3/s)#		
				5yr ARI	100yr ARI	PMF
Outlet A (Greenhills Road Nth)	Existing	21.76	F EX A1 E	3.4	4.1	23
	Proposed	**29.49**	**F Outlet 1**	**1.4**	**1.9**	**32**
Outlet B (Greenhills Road Sth)	Existing	27.45	F EX A2	0.5	3.0	15
	Proposed	**17.79**	**F PR Outlet 2**	**0.3**	**1.8**	**21**
Outlet C (just downstream of Moorebank Avenue)	Existing	59.95	EX Channel	6.9	12.9	75
	Proposed	**61.72**	**Channel**	**4.7**	**6.9**	**120**

The tabulated peak flows do not indicate mitigation adequacy in themselves, rather refer to Appendix A for same storm duration comparisons

Table 4-2: Detention Storage Performance Summary

Storage [water quality extended detention level mAHD]	Catchment Area (ha)	Event	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Water Level (mAHD)	Volume * (m^3)
Basin 1 Anzac Creek Greenhills Road Nth – u/s of Outlet A [14.0]	28.99	100 year	14.5	1.8	15.66	27400
		PMF	67	31	17.8	63000
Basin 2 Anzac Creek Greenhills Road Sth – u/s of Outlet B [14.7]	16.17	100 year	8.1	1.7	16.19	16600
		PMF	38	22	17.1	27400
Basin 9 Georges Riv. Moorebank Avenue – u/s of Outlet C [13.5]	11.91	100 year	7.0	0.9	15.87	8000
		PMF	30	26	16.7	10800
Basin 10 West Georges Riv. Moorebank Ave – u/s of Outlet C [13.5]	42.20	100 year	25.1	3.1	15.57	24000
		PMF	105	80	17.5	46400

* Approximate active storage above water quality extended detention water level (see **Figure 4-8** for Basin locations)
Storage parameters & outlet configuration are included in **Appendix A**. PMF flows, levels & volumes are approximate only.

4.2.4 Sensitivity Assessment

OSD/Rainfall

A sensitivity assessment has been carried out with 100 year rainfall intensities increased by 10% and 20%. This resulted in an increase in OSD water levels (compared with 100 year ARI conditions): of approximately:

For a 10% rainfall increase

- 0.1m for Basin 1.
- 0.05m for Basin 2.
- 0.2m for Basin 9.
- 0.25m for Basin 10.

For a 20% rainfall increase

- 0.2m for Basin 1.
- 0.15m for Basin 2.
- 0.4m for Basin 9.
- 0.5m for Basin 10.

Based on these sensitivity results, consideration of OSD water levels should be given to the setting of minimum floor levels for the Proposal (discussed further in **Section 4.2.5.7**).

In doing so, it should be noted that a 10% rainfall intensity increase assessment is considered representative of potential climate change impacts for the Sydney metropolitan area (being consistent with projected rainfall increases in accordance with the New South Wales Department of Environment and Climate Change (DECC) 'Floodplain Risk Management Guideline Practical Consideration of Climate Change' (Table 1, October 2007).

Furthermore, such mitigation measures should take into consideration:

- the design life of the Proposal, and
- establishing a median flood risk commensurate with a design period of equivalent risk under existing climate conditions.

That is, the median climate change condition for the Proposal design life, be the basis for stormwater system design capacity (not the end of design life, say the last day of a (100 year) design life for climate change design storm event estimates.

Such considerations would indicate that for a 100 year (Proposal) design life, and for climate change rainfall increase (of say 10%), OSD 100 year water level increases of approximately half of the (0.05m to 0.25m) estimated water level increase may be appropriate for providing 'climate change' drainage system capacity with respect to Proposal site floor level flood protection.

4.2.5 Future Design Consideration

The DRAINS modelling results indicate that the proposed drainage systems and OSDs would provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Proposal.

There are, however, several design issues and potential refinements (itemised below) that should be taken into consideration during detailed design.

4.2.5.1 On-Site Detention (OSD) Configurations

Design of the OSDs allows for alternative configurations with respect to landscaping and OSD form (than simply the vertical sided walls indicated on the accompanying design drawings). That said, it should be noted that:

1. Batter slopes of landscape storage systems that would comply with Liverpool City Council (LCC) requirements are 1(V):4(H) (OSD Stormwater Detention Technical Specification, LCC, January 2003), noting that basin side slopes should be 'preferably no steeper than 1 in 6 to allow easy egress' (Development Design Specification D5 Stormwater Drainage Design, LCC, January 2003)
2. Trees are not to be planted on basin embankments (Development Design Specification D5 Stormwater Drainage Design, LCC, January 2003), with trees to be located away from the toe of batters. Trees are also to be located away from OSD walls to avoid adverse structural impacts.
3. A minimum freeboard of 0.3m above the 100 year water level is necessary.
4. Spillways to manage greater than 100 year ARI events should be located and configured so as to limit potential flow impacts on downstream neighbouring development(s). This is particularly relevant to:
   - OSD Basin 1 where spillway discharges should be directed to the east, towards the existing neighbouring open channel (rather than northward).
   - OSD Basin 9 where spillway discharges should be directed to the west, to the Moorebank Avenue culvert crossing (rather than northward, nor westward to OSD Basin 10).

There is also flexibility to alter catchment boundaries and areas, however such changes would require a similar process of pre and post development rainfall-runoff analysis (for multiple recurrence interval and rainfall durations) to demonstrate adequate mitigation of potential flow increases discharging to neighbouring and downstream areas. Furthermore, should such OSD and/or catchment area changes be considered, then all of the catchments and OSDs require assessing individually and in combination (with respect to mitigation performance).

All OSD outlets are to be set above the 100 year ARI water levels/hydraulic grade lines of the downstream systems into which they discharge. That is, the OSD outlets are to be freely discharging up to 100 year ARI events.

Design analysis and drawings of all above ground detention storages are to be submitted to the NSW Dam Safety Committee for review, approval and classification.

4.2.5.2 Catchments and Development Flexibility

Catchment areas and site levels/gradings will be a crucial component of the development with respect to OSD sizes and locations, and interfacing the broader land-use and aims of the Proposal site.

In particular, since warehouse roof areas/buildings are a dominant feature of the Proposal site, development controls will be necessary, ensuring that individual building development discharge areas and locations are adhered to in order to effectively utilise the stormwater conduits and OSDs, and hence comply with flooding and stormwater mitigation requirements. Flexibility for individual warehouse developments would still remain (following the installation of stormwater infrastructure) however such flexibility would require assessment of adequacy of the OSDs and associated stormwater systems to support the altered warehouse arrangements.

4.2.5.3 Warehouse Area Drainage

An indicative concept site trunk drainage layout is provided in the accompanying **Drawings** (Appendix P of the MPE Stage 2 EIS).

The proposed building/warehouse footprints cover a significant portion of the Proposal site. All roof area and building drainage is to capture and convey (from roof to ground level stormwater systems) rainfall-runoff for all storm events up to and including 100 year ARI events.

The proposed OSD/open channel systems serve a dual purpose role of mitigation and conveyance. As such they are integral to drainage configurations, site surface levels and gradings. In particular the OSD/open channel systems are to have minimum grades of 0.5% unless inverts are provided with soak away/subsoil drainage systems.

The introduction of sections of covered over open waterways require consideration of blockage potential incorporated into the associated design.

4.2.5.4 Moorebank Avenue

As indicated in the civil design drawings provided in Appendix P of the MPE Stage 2 EIS, Moorebank Avenue is to be serviced by long drainage and cross drainage systems which are to discharge into the proposed OSD Basin 10 (refer to **Figure 4-8** for location of OSD Basin 10). However, as indicated in the drawings, additional (east-west) cross drainage systems which service MPE Stage 1 and the western area of the Proposal site are also necessary.

While it is anticipated that the Moorebank Avenue long drainage and cross drainage systems drainage conduits would be at a higher level than the proposed 'east-west' drainage conduits (which service MPE Stage 1 Project and the MPE Stage 2 sites eastern portion (refer to **Section 4.2.5.9** for more information)), it may be that in certain locations these systems would combine. This combining may occur at locations where the east-west systems are raised to provide clearance over existing assets located within the Moorebank Avenue road corridor.

4.2.5.5 Pavement Grades

Across the Proposal site there may be varying pavements types and associated drainage configurations, with a key consideration being the surface grading. To minimise local ponding and breakdown of pavement areas, minimum grades are necessary across the Proposal site. For concrete pavements, 1% minimum grading is recommended and for pavers and bitumen surfaces, 2% minimum grading. Steeper than the minimum grades may further limit potential water damage to pavement.

All pavements are to grade away from building footprints. In the case of sunken loading docks, the loading dock areas require drainage system capacities as detailed in **Section 4.2.5.6** below.

4.2.5.6 Drainage System Capacities and Grades

Drainage systems are to have:

- 10 year ARI minor drainage system capacity for the Proposal site (in accordance Liverpool City Council's *New South Wales Development Design Specification D5 Stormwater Drainage Design,* January 2003).
- surface gradings and inlets that, in combination with stormwater conduit capacities, would limit 100 year ARI surface ponding to no greater than 0.2m, and depth x velocity limited to no greater than $0.4m^2/s$ within the Proposal site (excluding open waterways).
- 20 year ARI minor drainage system capacity and limit 100 year ARI surface ponding to no greater than 0.2m, and depth x velocity limited to no greater than $0.4m^2/s$, for the proposed Moorebank Avenue widening.

Drainage conduits are to typically have:

- minimum grades of 1%, however where necessary 0.5% minimum grades may be adequate as long as it can be demonstrated that self-cleansing minimum velocities of 0.6m/s are achieved.
- 20mm minimum fall across stormwater pits.

- 0.6m minimum cover for pipe systems, with additional minimum cover requirements as necessary for pavement performance, loadings and clearance requirements.

Stormwater inlets are to be designed for:

- minimum 20% blockage on grade
- minimum 50% blockage at sags.

4.2.5.7 Minimum Site and Floor Levels

In accordance with Liverpool City Council requirements:

All habitable floor levels are to be a minimum of 300mm and garage/non habitable floor levels to be a minimum of 150mm above the maximum design storage water surface level and flow path levels (Liverpool Development Control Plan 2008 Part 1 General Controls for all Development, p23).

The design storage water surface and flow path levels are to be based on 100 year ARI events.

4.2.5.8 Works Within Neighbouring Properties

Adjacent to Southern MPE Stage 2 Boundary

Catchment runoff from neighbouring areas along the southern MPE Stage 2 boundary is proposed to be managed by regrading and if necessary, the introduction of drainage swales to capture and convey flows to Anzac Creek. These proposed drainage systems (outlined in the accompanying design drawings) are to be located within neighbouring property and will require approval from the land owner(s).

Drainage Outlet Works

OSD Basin 1 and 2 outlets discharge eastward into waterways located in neighbouring property. These proposed outlets (outlined in the accompanying design drawings) will require local shaping and scour protection works within neighbouring property and will require approval from the land owner(s).

4.2.5.9 Interfacing with MPE Stage 1

As indicated in the accompanying **Drawings**, drainage from the western portion of the Proposal site is to extend westward through MPE Stage 1 (which is subject to a separate approval, SSD 6766).

4.3 Construction Phase

To avoid potential adverse flood impacts on neighbouring properties during construction, flood mitigation measures necessary to maintain existing condition flow regimes and distributions leaving the construction area (so as to maintain runoff to no greater than for existing conditions) should include consideration of such alternatives as:

- Maintaining existing site catchment/sub-catchment boundaries.
- Limiting site imperviousness and grades to no greater than under existing development conditions.
- Provision of all the Proposal site OSDs (with associated catchment areas) in a completed operational state prior to the introduction of impervious areas (additional to existing conditions).
- Smaller detention storages that provide adequate rainfall runoff mitigation during partial construction/site development. If proposed, all such alternative/temporary

detention storages will require analysis (as per **Section 4.2.7**) to determine the adequacy of their flood mitigation performance.

Furthermore, Flood Emergency Response Plans (FERPs) will be necessary for each of the Proposal site areas as discussed in **Section 4.4**.

4.4 Flood Emergency Response Plans

Part of the approach to the overall stormwater management for the Proposal is the consideration of evacuation and refuge. For this reason site conditions under construction and operation of the Proposal during a PMF are to be considered.

It will be necessary to develop FERPs for the construction and operational stages of the Proposal taking into consideration site flooding and broader flood emergency response plans for the Georges River and Anzac Creek floodplains, and Moorebank area.

For areas impacted by Georges River flooding, flood warning may be available, and FERPs could be quite different in terms of flood readiness, evacuation and recovery, than for say the areas of the Proposal site away from the Georges River flooding areas, e.g. works within the MPE Stage 2 operational area to the east of Moorebank Avenue.

Although proposed filling will generally raise the Proposal site above the regional PMF levels, areas not impacted by regional flooding can still be affected by local PMF flow regimes.

The Proposal site is located within upper catchment areas and, as recognised in the NSW Floodplain Management Manual (April 2005, Section L6.2), there would be little if any available warning time for people to undertake action. As such, in developing an evacuation and refuge plan, it should include safe refuge within the Proposal site (above PMF flood levels) until hazardous flows have subsided and safe evacuation is possible.

It may be necessary to carry out refined two dimensional PMF modelling across the site to determine minimum floor levels for refuge areas.

5 WATER QUALITY

5.1 Objectives and Performance Targets

The stormwater quality objectives and performance targets for the Proposal have been derived from the following key documents:

- ***Liverpool Development Control Plan 2008*** (Liverpool City Council, 12 November 2014) – provides general objectives and controls that apply to development within Liverpool LGA.
- ***Georges River Estuary Coastal Zone Management Plan*** (Georges River Combined Council's Committee, July 2013) – provides objectives and targets specifically for the Georges River Estuary and its catchment.
- ***SEARs for MPE – Stage 2 SSD*** (NSW Department of Planning & Environment, May 2016) – provides specific environmental assessment requirements and objectives for the Proposal.
- Statement of Commitments and Conditions of Approval for the MPE Concept Plan Approval (as modified) – provides specific requirements for all planning applications to be submitted under the MPE Concept Plan Approval.

5.1.1 Objectives

The key objectives for stormwater quality management for the Proposal include:

- Maintain or improve existing water quality.
- To protect the aquatic environment of the downstream waterways including the Georges River.
- Prevent bed and bank erosion and instability of waterways.
- Provide sufficient flows to support aquatic environments and ecological processes.
- Incorporate a Water Sensitive Urban Design (WSUD) approach.

5.1.2 Performance targets

Water quality performance targets for the Proposal have been derived from the key documents identified previously and are summarised in **Table 5-1**.

Table 5-1: Water Quality Performance Targets

Pollutants	Liverpool DCP 2008	Georges River Estuary CZMP 2013	SEARs May 2016 (Item 7. h)
Total Suspended Solids (TSS)	80%	**85%**	**NorBE**
Total Phosphorus (TP)	45%	**60%**	**NorBE**
Total Nitrogen (TN)	45%	**45%**	**NorBE**
Gross Pollutants (GP)	90%	**90%**	**NorBE**

Table Key:

- *Percentage (%) values are the pollutant reduction targets relative to post development pollutant loads without any treatment*
- *NorBE = Neutral or Beneficial Effect (ie. 'maintain or improve existing water quality' as required by the SEARs)*
- **Bold** values are the adopted targets

While the percentage reduction targets contained in Georges River Estuary CZMP are more stringent than the targets contained in Liverpool DCP 2008, given that they have been developed specifically for the Georges River catchment it is considered appropriate to adopt these for the Proposal. In addition to these percentage reduction targets, the SEARs require existing water quality to be maintained or improved (ie. 'NorBE' / Neutral or Beneficial Effect). Whether NorBE is more stringent than the percentage reduction targets depends on the existing water quality conditions and it is considered appropriate to check the performance of the proposed WSUD strategy against both targets. Therefore, both the Georges River Estuary CZMP percentage reduction and NorBE targets have been adopted for the site.

It should also be noted that the percentage reduction targets are considered applicable to the Proposal ground level, but should not necessarily be applied to the roof areas of the site. Where significant roof areas are proposed, it is considered inappropriate to apply percentage reduction targets due to the significant difficulties and appropriateness of treating relatively clean water to achieve these targets. In these cases the adoption of the NorBE target on its own is considered appropriate.

5.2 Proposed Stormwater Quality Measures

To address potential impacts on stormwater quality, WSUD principles and a treatment train approach have been applied. Two key treatment measures are proposed for the Proposal to meet the performance targets:

- Gross Pollutant Traps (GPTs)
- Rain gardens (Bioretention systems).

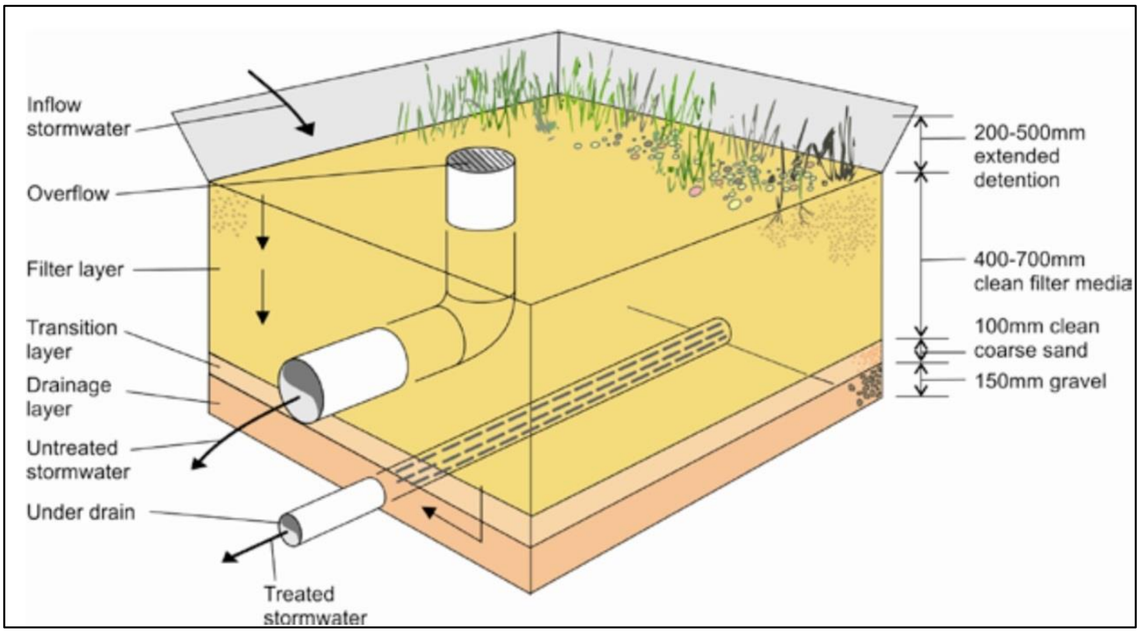
5.2.1 Gross Pollutant Traps

Gross pollutant traps (GPTs) are primary stormwater treatment measures, typically applied as the first measure in a stormwater treatment train. GPTs come in varying forms from simple trash racks through to more complex devices with continuous deflection screens and hydrodynamic separation.

The performance of GPTs varies according to the type of device selected. In this case, a device has been selected with continuous deflection screens and hydrodynamic separation to target the removal of a significant proportion of the Total Suspended Solid (TSS) load. Removal of TSS is important for protecting and minimising maintenance of downstream treatment devices such as rain gardens which are sensitive to high TSS loads.

5.2.2 Rain Gardens

Rain gardens are bioretention systems that comprise a combination of vegetation and filter substrate (refer **Figure 6-1**). They provide treatment of stormwater through the processes of settling, filtration and biological uptake and are very effective in the removal of fine sediments and nutrients. Rain gardens are proposed in the base of the OSD basin/channel (refer Section 5).



Source: Using MUSIC in Sydney's Drinking Water Catchment (Sydney Catchment Authority, Dec. 2012)
Figure 5-1: Typical Rain Garden Concept

In general, rain gardens are lined to protect adjacent structures or if there are known salinity hazards. The Proposal site is located in an area of 'moderate salinity potential' as defined by the 'Salinity Potential in Western Sydney 2002' map distributed by the NSW Office of Environment and Heritage (OEH). This salinity classification in itself does not mean the proposed rain gardens need to be lined, however the site's soils are predominantly clays and sandy clays which are associated with shrinkage and differential settlement. Lining of the rain gardens will therefore be required when located within existing site soils and adjacent to footings of structures such as retaining walls and buildings. It is noted that significant sandstone based fill is proposed to be imported for this development. Where the base of the rain gardens and adjacent footings are located within this fill, then lining is unlikely to be required. Further consultation with a geotechnical engineer is expected to be undertaken during detailed design.

5.3 Assessment Methodology

Assessment of the performance of the proposed stormwater quality measures has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC V6.2).

A MUSIC model for the MPE Stage 2 Proposal has been developed by applying the land uses and imperviousness values for existing and proposed conditions included in **Table 5-2**. The MUSIC model layout and other key modelling parameters are included in **Appendix C**.

Table 5-2: MPE Stage 2 Land Use Areas and Imperviousness

Land use	Existing		Proposed	
	Area (ha)	Imperviousness (%)	Area (ha)	Imperviousness (%)
Roof	18.0	100	27.2	100
Road	4.5	100	6.5	100
Stacking Area	-	-	-	100
Other	46.4	5	35.2	100

5.4 Results and Comments

Based on the proposed stormwater quality measures to be implemented as part of the Proposal (refer to **Section 5.2** and **Appendix C** for preliminary rain garden sizes) the performance of the system included in the Proposal is presented in **Table 5-3** and **Table 5-4** relative to percentage reduction and NorBE targets respectively.

In summary, the water quality assessment has demonstrated that the performance of the proposed treatment measures (i.e. GPTs and rain gardens) complies with the catchment specific targets of the Georges River Estuary CZMP and also the site specific targets contained in the SEARs.

Table 5-3: Treatment Performance Relative to Percentage Reduction Targets

Scenario	Gross pollutants	TSS	TP	TN
Proposed (no treatment)*	14,000	93,200	182	1200
Proposed (with treatment)*	0	9,460	38.2	501
% Reduction Achieved	100	90	79	58
% Reduction Targets	*90*	*85*	*60*	*45*

** Node: “Receiving Node”, Model: AA003760_Moorebank_MPE2_Dev_20160923.sqz*

Table 5-4: Treatment Performance Relative to NorBE Targets

Scenario	Gross pollutants	TSS	TP	TN
Existing#	5,550	24,800	62.3	564
Proposed (with treatment)+	0	9,460	38.2	501
Reduction Achieved	5,550	15,340	24.1	63

Node: “Receiving Node”, Model: AA003760_Moorebank_MPE2_Exg_20160926.sqz

+ Node: “Receiving Node”, Model: AA003760_Moorebank_MPE2_Dev_20160923.sqz

In summary, the water quality assessment has demonstrated that the performance of the proposed treatment measures (i.e. GPTs and rain gardens) complies with the catchment specific targets of the Georges River Estuary CZMP and also the site specific targets contained in the SEARs.

5.5 Monitoring

Monitoring of water quality for the Proposal is to be undertaken for both Anzac Creek and the Georges River during operation. The monitoring program as a minimum would include sampling for the following:

- Total suspended solids
- Total phosphorous
- Total nigtrogen
- Oils and grease

A water quality monitoring program for the Proposal would be prepared as part of the OEMP for the Proposal and would detail:

- The frequency and duration of sampling
- Background water quality conditions
- Sampling methodology
- Reporting requirements.

5.6 Construction

The SEARs for the Proposal include a requirement to undertake an assessment of surface water quality during construction, identify works that may impact water quality and provide a summary of proposed mitigation measures (refer to **Table 1-1**).

This section should be read in conjunction with civil design drawings, provided at Appendix P of the MPE Stage 2 EIS.

5.6.1 Proposed Works

While all construction activities have the potential to impact on water quality, the key activities are:

- vegetation clearing and demolition works;
- bulk earthworks;
- stormwater and drainage works.

5.6.2 Erosion and Sediment Controls

Without any mitigation measures and during typical construction activities, site runoff would be expected to convey a significant sediment load. A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be implemented and implemented for the construction of the Proposal as part of the CEMP. The SWMP and ESCPs would be developed in accordance with the principles and requirements of Managing Urban Stormwater – Soils & Construction Volume 1 ('Blue Book')(Landcom, 2004) and Volume 2 (DECC 2008).

In accordance with the principles included in the Blue Book, a number of controls have been incorporated into a preliminary ESCP (refer to accompanying Drawings).

The proposed controls are outlined in **Section 5.6.2.1** to **Section 5.6.2.5**. An overview of the proposed erosion and sediment controls for construction of the Proposal, as per the civil design drawings (SSS2 ARC CV DWG-0101-03) provided at Appendix P of the MPE Stage 2 EIS.

5.6.2.1 Sediment Basins

Sediment basins have been sized and located to ensure sediment concentrations in site runoff are within acceptable limits. Preliminary basin sizes have been calculated in accordance with the Blue Book and are based on Berkshire Park Group soils ('Type F'). These soils are fine grained and require a relatively long residence time to allow settling.

The sediment basins have been located generally along the western and eastern boundary of the site in the proposed drainage channel to treat any flows that may discharge to the Georges Rive and Anzac Creek.

Sediment basins for 'Type F' soils are typically wet basins which are pumped out following a rainfall event when suspended solids concentrations of less than 50 mg/L have been achieved.

5.6.2.2 Sediment Fences

During construction sediment fences are to be located around the perimeter of the Proposal site to ensure no untreated runoff leaves the site. They have also been located around the existing and proposed drainage channels to minimise sediment migration into waterways and sediment basins.

5.6.2.3 Stabilised Site Access and Truck Washdown

A stabilised site access and truck washdown area is proposed at the MPE Stage 2 site access, at the north western end of the site. This will limit the risk of sediment being transported onto Moorebank Avenue and other public roads by vehicles exiting the Proposal site.

5.6.2.4 Anzac Creek Controls

The drainage works to the south of the MPE site would involve landforming works to establish a drainage swale, and connection of the swale to Anzac Creek. While the majority of these works are expected to be undertaken on land adjacent to the Anzac Creek, there is the potential that some excavation would be required within Anzac Creek to provide adequate site levels to ensure the drainage swale functions effectively. The following mitigation measures would be implemented during construction works within or adjacent to Anzac Creek:

- All reasonable efforts would be taken to program construction activities during those periods when flood flows and fish passage is not likely to occur.
- Temporary side-track crossings would be constructed from clean fill (free of fines) using pipe or box culvert cells to carry flows, or a temporary bridge structure.
- All temporary works, flow diversion barriers and in-stream sediment control barriers would be removed as soon as practicable and in a manner that does not promote future channel erosion.
- The construction site would be left in a condition that promotes native revegetation and shading of habitat pools.
- The management principles outlined in the Blue Book for sites with high erosion potential would be implemented.

5.6.2.5 Other Management Measures

Other management measures that will be employed throughout construction of the Proposal to minimise erosion and sedimentation would include:

- minimising the extent of disturbed areas across the Proposal site at any one time;
- progressive stabilisation of disturbed areas as earthworks activities are completed;
- regular monitoring and maintenance to maintain the efficiency of all controls.

It is noted that the controls included in the preliminary ESCP are expected to be reviewed and updated as the design, staging and construction methodology is further developed for the Proposal.

6 SITE WATER BALANCE

6.1 Objectives

The objective of the site water balance is to identify any potential impacts on surface water and assess management options where appropriate. This is in accordance with the SEARs item 7. g (refer **Table 1-1**).

6.2 Methodology

Given that rainfall-runoff processes dominate the water balance for the site, a site water balance model was established using MUSIC (the same model used to assess water quality impacts, refer **Section 5**) for both existing and proposed conditions. MUSIC enables a continuous simulation of rainfall-runoff processes to be undertaken for a long time period. In this case, a 10 year period of rainfall was selected which includes a range of rainfall depths across both wet and dry years.

Other components of the site water balance include potable water supply to the Proposal and wastewater discharge to sewer, although the volumes associated with these are relatively minor and have therefore not been assessed in detail.

6.3 Water Demand & Wastewater Generation

The water demands for the Proposal are small relative to the size of the development and are largely associated with the offices adjacent to each warehouse. The demands have been estimated to be a maximum of approximately 45,000 kL / year as per the 'MPE Stage 2 Utilities Strategy Report' (Arcadis, November 2016). This is proposed to be supplied from Sydney Water's potable water supply network via a connection from MPE Stage 1. No extraction from any local surface water or groundwater resources is proposed.

Wastewater generation, allowing for an 80% sewer discharge factor relative to the water demands, is estimated to be approximately 36,000 kL / year. This is proposed to be discharged to sewer via MPE Stage 1.

The water demands and wastewater generation associated with the previous land use for the site (i.e. as the DNSDC) are unknown. However, given that the previous and proposed land uses are relatively similar, while previous water demands and wastewater generation are most likely less than for the proposed conditions, they would be a similar order of magnitude for the purpose of the water balance assessment.

6.4 Rainfall Runoff Processes

The existing conditions for the site include impervious surface areas in the form of roads and roofs and pervious surfaces. From aerial photos it has been estimated that the existing nature of the Proposal site is approximately 30% impervious. While the remainder of the Proposal site is pervious (grassed or treed), it is underlain by predominantly clay soils which limit the potential for infiltration.

The proposed conditions for the Proposal are predominantly paved surfaces. It is conservatively assumed to be 100% impervious, however there would be some pervious landscaped areas.

The average annual rainfall-runoff volumes for the site are shown in **Figure 6-1**.

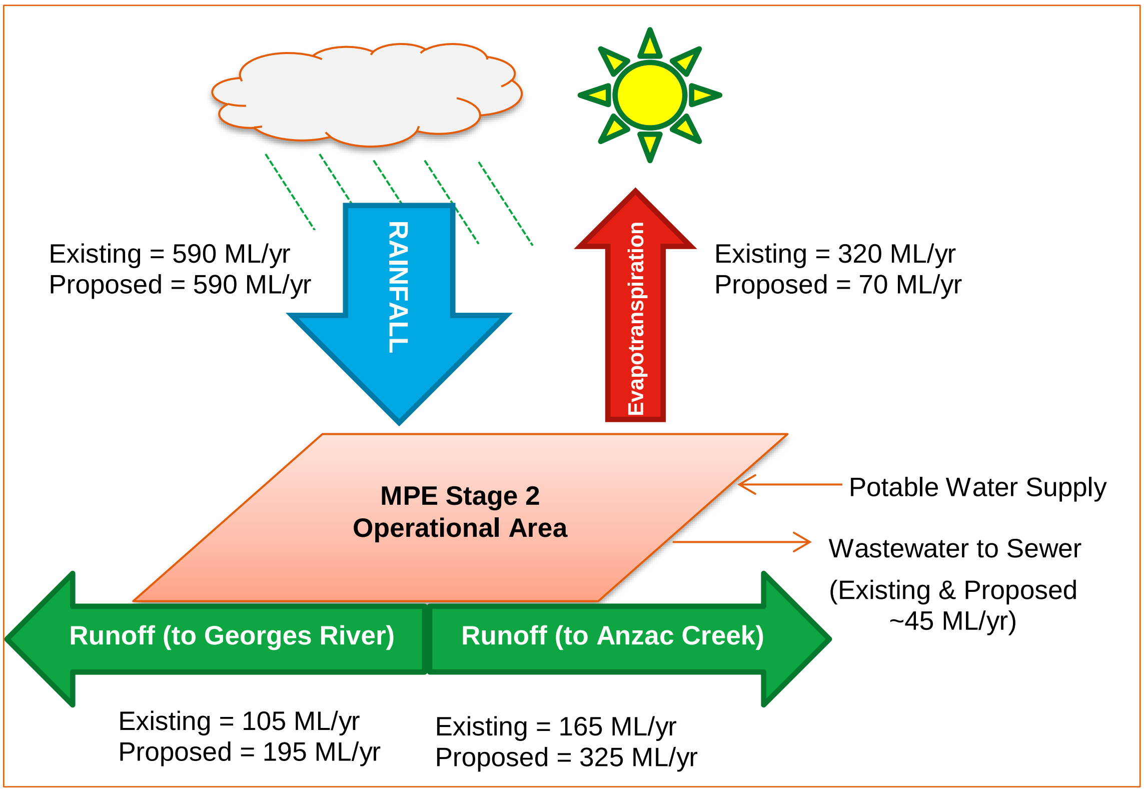


Figure 6-1: MPE Stage 2 Operational Area Water Balance Existing & Proposed Conditions

6.5 Stream Erosion Index

Given there is a significant increase in flow volumes to Anzac Creek and the Proposal site is in the upper reaches of the catchment, the Stream Erosion Index (SEI) was calculated for Anzac Creek, using the method developed in the Draft NSW MUSIC Modelling Guidelines (SMCMA, August 2010) and adapted from Blackham and G. Wettenhall (2010). The SEI is the ratio of flow volumes exceeding the 'stream forming flow' from the developed case, to the flows from the existing case.

The 'stream forming flow' was defined as 25% of the 2 year ARI as per Blacktown City Council recommendations (Liverpool City Council do not have guidelines in relation to the SEI). The peak 2 year ARI flow for the existing Anzac Creek catchments was estimated to be 2.95 m^3/s using results derived from DRAINS modelling (refer Section 5) and hence the 'stream forming flows' was calculated to be 0.74 m^3/s. An estimation of the mean annual flow volume entering Anzac Creek from the developed and existing cases, greater than the 'stream forming flow' was extracted from the MUSIC models outlined in Section 6.

The resultant SEI for Anzac Creek was 2.3, which is less than Blacktown City Council's target of 3.5. Ideally the SEI would be as close to 1 as possible as this would represent minimal change in the erosive power of stream flows. It is expected that the ultimate value will become closer to this ideal value as opportunities for rainwater harvesting are identified and implemented during subsequent design phases.

6.6 Comments

The key changes to the Proposal site water balance from existing to proposed conditions are a reduction in evapotranspiration of 250 ML/yr and an increase of the same magnitude to runoff. This is largely a result of the increase in impervious areas from existing conditions (30%) to proposed conditions (95%).

Options considered to reduce the runoff volume from the site included collecting runoff for reuse purposes and/or infiltration. Potential for reuse of rainwater can be considered to reduce the site potable water demand of 45 ML/yr. In relation to infiltration, the clay soils would limit infiltration rates and the groundwater is also expected to have high levels of salinity. Infiltration is therefore not considered to be practical or desirable.

For the Georges River, the potential increase in runoff volume from the Proposal site should be considered in the context of flow volumes conveyed in the Georges River. The total Georges River catchment area is approximately 960 km^2 and would generate annual flow volumes many orders of magnitude greater than from the Proposal site (which represents less than 0.07% of the total catchment area).

For Anzac Creek, the results of the SEI calculations suggest that the increase in flow volume is unlikely to have any significant impact on the downstream system.

Furthermore, the total pollutant loads contained in the runoff from the Proposal site (to both the Georges River and Anzac Creek) would be less than or equal to loads under existing conditions (refer **Section 5**) and the pollutant concentrations would be significantly less than existing (the total pollutant load is less than or equal to existing conditions and the runoff volume has increased, hence the concentration of pollutants will decrease).

7 ANZAC CREEK FLOODPLAIN MODELLING

Anzac Creek is within the larger Georges River catchment and a sub-catchment of the Liverpool District catchment. The creek is 4 kilometres long, forming in the (former) Royal Australian Engineers Golf Course, owned by the Department of Defence, and flowing northward past the suburb of Wattle Grove and underneath the M5 at the intersection with Heathcote Road. From there the creek continues northwards through Ernie Smith Recreation Reserve, flanked by the Moorebank Industrial Area to the west and the suburb of Moorebank to the east, under Newbridge Road, through McMillan Park, and into Lake Moore at Chipping Norton.

Following the initial DRAINS modelling of on-site detention (OSD) the post development site flow hydrographs were used as inputs into a TUFLOW model of Anzac Creek to identify potential flood impacts extending along Anzac Creek, and if necessary revised OSD requirements. This assessment process and findings are discussed as follows.

7.1 Background

Existing condition flow regimes along Anzac Creek have been previously determined by Liverpool City Council in the process of conducting their Anzac Creek Floodplain Risk Management Study and Plan (by BMT WBM Pty Ltd, 30 May 2008), and the Georges River Floodplain Risk Management Study & Plan (by Bewsher Consulting, May 2004). The Council modelling indicates that only the 100 year ARI and larger events along Anzac Creek impact on the Proposal site, as such only the 100 year ARI and PMF events have been assessed.

The RAFTS catchment rainfall runoff model files developed for the abovementioned studies were obtained from Council. The provided files were re-run by Arcadis and the hydrographs for both the 100 year ARI nine-hour event and PMF one hour event used in the studies were replicated.

Council also provided to Arcadis the 100 year ARI nine hour event and PMF one hour event TUFLOW model files. The provided files were re-run by Arcadis and the Council's 100-year nine hour results were reproduced. PMF TUFLOW results were not provided by Council, nonetheless the provided files were used in developing an adjusted 'existing conditions' Anzac Creek model.

Council provided a number of TUFLOW run files incorporating various degrees of blockage for structural elements across the system. For the purposes of this regional assessment the 25 per cent blockage scenario was adopted for existing conditions.

Specific refinements incorporated into the Council model has involved modification to the digital elevation model (DEM) to include the:

- recent redevelopment of the Defence Joint Logistics Unit (DJLU), neighbouring the north-east corner of the Proposal site.
- MPE Stage 1 operational area (assumed completed)
- MPE Stage 1 rail across the Anzac Creek floodplain.

7.1.1 Hydrology

Council's RAFTS model catchments were adjusted to exclude the Proposal site, which has been more accurately defined in the site drainage assessment DRAINS software (as discussed in the earlier sections of this report). Hence hydrographs generated from the RAFTS and DRAINS models have been used as flow inputs for TUFLOW modelling to define flow regimes as discussed below. RAFTS model input data and output are included in **Appendix B**.

7.1.2 Flow regimes

The 100 year ARI nine hour duration hydrographs from the DRAINS and adjusted RAFTS models have been used to assess flow regimes along Anzac Creek, in accordance with the files provided by council, in TUFLOW. Similarly, an adjusted existing conditions PMF one hour event model has also been assessed in TUFLOW using DRAINS and adjusted RAFTS hydrograph inputs.

The adjusted existing condition TUFLOW model flow regime figures (for 100 year and PMF conditions) are included in **Appendix B**. The 100 year results were compared with that of Council's and flood level variations found to generally vary by less than 0.025 metres.

The adjusted existing conditions model has been adopted as a base for comparing potential impacts in Anzac Creek due to the Proposal site development.

7.2 Post Development Conditions

7.2.1 Hydrology

Hydrographs generated from the Proposal site development conditions DRAINS model of the site have been used as input into the TUFLOW modelling, in conjunction with existing conditions RAFTS model hydrographs which represent the Anzac Creek catchment areas external to the subject site.

7.2.2 Flow regimes

Using the 100 year ARI nine hour event hydrographs, and PMF one hour event hydrographs from the proposed conditions DRAINS modelling, TUFLOW modelling indicates that with respect to potential flood impacts:

- There is no increase in flood levels in the100 year ARI nine hour event.
- For the PMF one hour event, the Proposal would:
  - generally result in no increase in flood levels along the broader Anzac Creek floodplain; however
  - result in localised flood level increases adjacent to the proposal area of approximately 0.2 metre immediately south of the site, and approximately 0.3 metre increase in the area to the north-east of the proposal area (i.e. the vicinity of DJLU).

The modelling results for these assessments are included in **Appendix B**.

7.3 Comments

Potential adverse flood impacts have been adequately mitigated along the Anzac Creek floodplain up to 100 year events, and generally along the overall floodplain for events greater than the 100 year.

However, the TUFLOW modelling indicates that there may be local flood level increases impacting on the neighbouring (DJLU) property immediately to the north-east of the proposal area. Such impacts would appear to be limited to open vehicular parking areas, and only in extremely rare events (of greater than 100 year ARI).

It is recommended that future design stages carry out refined TUFLOW flood modelling (with improved waterway, local drainage and surface level definition) of the north-eastern Proposal area and neighbouring site, so as to more adequately define the local area flow regimes of extreme event flooding, and determine whether further flood mitigation measures are necessary.

To facilitate the refined flood modelling, traditional ground survey of the neighbouring areas and associated waterway structures is anticipated.

8 MITIGATION MEASURES

Measures to avoid, minimise and mitigate potential stormwater and flooding impacts during construction and operation of the Proposal are summarised in **Section 8.1** and **Section 8.2** below.

8.1 Construction

During the construction phase the provision of flooding and stormwater mitigation measures incorporated into the Proposal is to include:

- A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be incorporated into the CEMP for the construction of the Proposal. The SWMP and ESCPs would be developed in accordance with the principles and requirements of Managing Urban Stormwater – Soils & Construction Volume 1 ('Blue Book') (Landcom, 2004) and Volume 2 (DECC 2008) and consider the Preliminary ESCPs (Appendix P of this EIS). The following aspects would be addressed within the SWMP and ESCPs:
  - Construction traffic restricted to delineated access tracks, and maintained until construction complete
  - Appropriate sediment and erosion controls to be implemented prior to soil disturbance
  - Stormwater management to avoid flow over exposed soils which may result in erosion and impacts to water quality
  - Location of stockpiles outside of flow paths on appropriate impermeable surfaces as well as outside of riparian corridors
  - Inspection of all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area
  - Wheel wash or rumble grid systems installed at exit points to minimise dirt on roads.
- To minimise potential flood impacts as a result of construction of the Proposal, the following measures would be implemented and documented in the SWMP:
  - The existing site catchment and sub-catchment boundaries would be maintained as far as practicable
  - To the extent practicable, site imperviousness and grades should be limited to the extent of existing imperviousness and grades under existing development conditions.
- A Flood Emergency Response and Evacuation Plan, or equivalent, would be prepared and implemented for the construction phase of the Proposal to allow work sites to be safely evacuated and secured in advance of flooding occurring at the Proposal site.

8.2 Operation

Under operational conditions, the provision of flooding and stormwater mitigation measures incorporated into the Proposal site development is to include:

- On-site detention (OSD) storages which capture, convey and adequately control site discharges to the existing downstream waterways.
- Stormwater quality improvement devices would be designed to meet the performance targets identified in Georges River Estuary and would include:
  - Gross Pollutant Traps (GPTs)
  - Raingardens, or equivalent, in the base of the OSD channels

- A water quality monitoring program for the operational phase of the Proposal would be prepared as part of the OEMP for the Proposal and would detail:
  - The frequency and duration of sampling
  - Background water quality conditions
  - Sampling methodology
  - Reporting requirements

  Water quality monitoring would be undertaken for both Anzac Creek and the Georges River and would include the following parameters:
  - Total suspended solids (TSS)
  - Total phosphorous (TP)
  - Total nitrogen (TN)
  - Oils and grease.
- A Flood Emergency Response Plan (FERP) would be developed for operational phase of the Proposal. The FERP would take into consideration, site flooding and broader flood emergency response plans for the Georges River and Anzac Creek floodplains and Moorebank area. The FERP would also include the identification of an area of safe refuge within the Proposal site that would allow people to wait until hazardous flows have receded and safe evacuation is possible.

9 CONCLUSION

This Stormwater and Flooding Assessment has been prepared for approval of the MPE Stage 2 Proposal (the Proposal). This report has been prepared to support a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and in accordance with the Secretary's Environmental Assessment Requirements (SEARs, ref: SSD 16-7628 and dated 27 May 2016).

The following conclusions and recommendations have been made within this report:

- The DRAINS and TUFLOW analysis indicate that the proposed drainage systems and OSDs would provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Proposal site works.
- Approval is required from neighbouring land owner(s) for proposed drainage works to be carried out, including:
  - Areas adjacent to the southern MPE Stage 2 boundary.
  - Drainage outlet works to the east of MPE Stage 2.
- It is recommended at future design stages to carry out refined TUFLOW flood modelling (with improved waterway, local drainage and surface level definition) of the north-eastern Proposal area and neighbouring site, to more adequately define the local area flow regimes of extreme event flooding, and determine whether further flood mitigation measures are necessary.
- The water quality modelling has demonstrated that the water quality targets for the site can be met.

The stormwater and flood analysis, design and management summarised in this report for the Proposal site addresses the necessary stormwater and flooding environmental assessment requirements and demonstrates compliance with the SEARs and the Concept Plan Conditions of Approval and Statement of Commitments relevant to this study (as listed in **Table 1-1** and **Table 1-2** respectively).

APPENDIX A

Water Quantity Model Information

Existing Conditions (Includes MPE Stage 1)

- DRAINS Information
  (Input & Output 5 year, 100 year, PMF
  Catchment Figure
  Existing DRAINS Model Screenshot (Labels and worst case 100 year)

Proposed Conditions (Includes MPE Stage 1)

- DRAINS Information
  (Input & Output 5 year, 100 year, 100 year + 10% rainfall increase, 100 year + 20% rainfall increase, PMF
  Stage Discharge Tables
  Outlet Details
  Stage 2 Drainage Plan
  Proposed DRAINS Model Screenshot (Labels and worst case 100 year)

Flow Comparison

- For each Basin and each comparison point

HEC-RAS NE & SE Outlets Model Information

- NE Outlet
- SE Outlet

Job	MPE Stage 2	Design	AZ	Office	Sydney
	Existing	Date	Oct-16	Job No	AA009335
		Checked	BC		
		Date	Oct-16		

Calculation Sheet

MPE Stage 2

ARCADIS Design & Consultancy for natural and built assets

ARCADIS Design & Consultancy for natural and built assets

PROJECT	MPE Stage	JOB No	AA009335			DATA
		PREPARED	AZ	DATE	13/10/2016	
TITLE	DRAINS	CHECKED	BC	DATE	13/10/2016	

DRAINS File Path:	F:\AA003760\D-Calculations\Civil\A-Stormwater\E0-SIMTA STAGE 2\MPE_Exg.drn
DRAINS Version:	DRAINS results prepared 6 July, 2016 from Version 2016.07
Modeller's Name:	AZ
Description:	MPE Existing

PIT / NODE DETAILS			Version 13											
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
Ex SimtaChann	Node							0		305168.85	6241764.1		114765372	
Ex Combined SIMTA	Node					10		0		306099.41	6241715.3		66886585	
EX G SIM	Node							0		305766.98	6241713.2		66886579	
EX S1	Node							0		306156.77	6241471.5		66886570	
MPW	Node							0		305469.44	6241555.6		66418913	
EX DNSDC	OnGrade	Special	DNSDC		0	14		0	0	306147.21	6241966.3	No	66418895	1 x Ku
EX dummy DNSDC	Node					20		0		305887.09	6241810		65741985	
Ex Mo HW 1	Headwall				0.5	14.15		0		305631.33	6241733.3		66418818	
Ex Top Chan	Node					14.2		0		305567.28	6241737.2		66354021	
Carpark HW	Headwall				0.5	14.7		0		305545.96	6241255.1		66354014	
EX Carpark	Node					11		0		305581.48	6241255.1		65742025	
EX A2	Node							0		306304.17	6240616.2		65742001	
EX A1 E	Node					10		0		306343.53	6241049		65741998	
E Moore	Node					10		0		305966.76	6241562.7		117904849	
EX E S1	Node					10		0		306237.26	6241625.6		117904865	
EX A1	Node					10		0		306549.62	6241054.6		119788497	
W Moore	Node					10		0		305593.51	6241576.7		121800214	
N621911	Node							0		305540.68	6241015.8		122115309	
N621913	Node					14.2		0		305542.15	6241687.5		122115325	

DETENTION BASIN DETAILS														
Name	Elev	Volume	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length
Store A2	13.24	0		None						306059.64	6240648.2	No		
	13.3	0.015												
	13.4	0.19												
	13.5	4.125												
	13.6	22.806												
	13.7	74.754												
	13.8	171.018												
	13.9	342.16												
	14	630.48												
	14.1	1118.78												
	14.2	1926.27												
	14.3	3160.4												
	14.4	4835.58												
	14.5	6964.12												
	14.6	9563.34												
	14.7	12682.6												
	14.8	16390.2												
	14.9	20816.7												
	15	25941.6												
	15.1	31774.6												
	15.2	38137.8												
	15.3	44975.1												
	15.4	52117.8												
	15.5	59590.3												
	15.6	67356.2												
	15.7	75203.2												
	15.8	83103.9												
	15.9	91063.6												
	16	99109.7												
	16	99109.7												
Store A1	12.65	0		None						306135.26	6241275.5	No		
	12.9	0.03												
	13	0.039												
	13.1	2.114												
	13.2	14.038												
	13.3	39.629												
	13.4	81.294												
	13.5	146.75												
	13.6	248.51												
	13.7	411.632												
	13.8	706.865												
	13.9	1251.34												
	14	2109.65												
	14.1	3230.35												
	14.2	4564.46												
	14.3	6071.14												
	14.4	7765.32												
	14.5	9687.54												
	14.6	11834.3												
	14.7	14174.2												
	14.8	16701.3												
	14.9	19417.7												
	15	22401.9												
Ex Sto C1	11.579	0		None						305953.48	6241715.7	No		
	12	2000												
	12.32	3640.5												
	12.43	4677												
	12.49	5700												
	12.52	5800												
	12.61	6000												
	12.65	7000												
	12.7	7300												
	13.07	10300												
	13.21	12000												
	14.315	16000												

SUB-CATCHMENT DETAILS														
Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %
C EX NTH SIM	Ex Combined SIM	12.28	60.7	39.3	0	12	15	0						
C EX S1	EX S1	15.851	60.9	39.1	0	15	20	0						
C EX DNSDC	EX DNSDC	5.28	82	18	0	5	5	0						
C EX Carpark	Carpark HW	2.08	61.2	38.8	0	5	5	0						
C EX A2	Store A2	27.45	33.4	66.6	0	14.5	24	0						
C EX A1	Store A1	20.9	50	50	0	14	15	0						
C EX A1 E	EX A1 E	0.8585	50	50	0	5	7	0						
C E Moore	E Moore	2	80	20	0	5	20	10						
C EX E S1	EX E S1	9.76	60.9	39.1	0	15	20	0						
C W Moore	W Moore	1.85	50	50	0	5	20	10						
Ex G06	N621911	7.25	5	95	0	15	15	0						

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Ex G04	MPW	3.6	10	0.5	0.04	0	1	Moorebank RAFTS

PIPE DETAILS														
Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg
P EX dummy DNSDC	EX DNSDC	EX dummy DNSI	10	10	9.9	1	RCP Class 2	600	600	0.3	New	1	EX DNSDC	0
P EX UNDER MOOR	Ex Mo HW 1	Ex Top Chan	18.15	11.58	11.4	0.99	Box Culverts	2W x 1.8H		0.3	Existing	2	Ex Mo HW	0
P EX Carpark	Carpark HW	EX Carpark	8.77	14.31	13.87	5.02	RCP Class 2	300	300	0.3	NewFixed	1	Carpark HW	0

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg	Bottom	Height of Service	Chg	Bottom	Height of S	Chg	Bottom	Height of S	etc				
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc				
CHANNEL DETAILS														
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Width	L.B. Slope	R.B. Slope	Manning	Depth	Roofed	
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)		
OVERFLOW ROUTE DETAILS														
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth	SafeDepth	Safe	Bed	D/S Area		id
			Time	Level	Length	Coeff. C	Section	Major Storm	Minor Storm	DxV	Slope	Contributing		
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%		
F Ex Comb SIMTA	Ex Combined SIM	Ex Sto C1	0.1				Dummy used to model flow across r	0.3	0.3	0.6	1	0		66886586
F EX G SIM	EX G SIM	Ex Mo HW 1	0.1				Dummy used to model flow across r	0.3	0.3	0.6	1	0		66886581
F EX S1	EX S1	Ex Combined SIM	7				Dummy used to model flow across r	0.3	0.3	0.6	1	0		66886571
F MPW	MPW	N621913	4				West Moorebank	0.15	0.2	0.6	0.2	0		66418872
F EX DNSDC	EX DNSDC	EX G SIM	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		65742028
F EX dummy DNSDC	EX dummy DNSD	Ex Sto C1	0.1				Dummy used to model flow across r	0.3	0.3	0.6	1	0		66418902
F EX OVER MOORE	Ex Mo HW 1	Ex Top Chan	0.1	14.15			Dummy used to model flow across r	0.3	0.3	0.6	1	0		66418832
Ex Channel	Ex Top Chan	Ex SimtaChann	5				Concrete Channel	0.3	0.3	0.6	0.1	100		65745589
F Ex Carpark Bypass	Carpark HW	N621913	10	0	20	1.6	West Moore CP	0.2	0.2	0.6	0.2	0		121800256
F EX Carpark	EX Carpark	E Moore	0.1				Dummy used to model flow across r	0.3	0.3	0.6	1	0		66418914
F EX A2	Store A2	EX A2	0.1	13.24			Really Long Weir	0.3	0.3	0.6	1	0		65770283
F EX A1	Store A1	EX A1 E	0.1	12.65			Really Long Weir	0.3	0.3	0.6	1	0		65770282
F EX A1 E	EX A1 E	EX A1	0.1				Dummy used to model flow across r	0.3	0.3	0.6	1	0		119788502
F Ex Sto 3	Ex Sto C1	EX G SIM	0.1	11.579			Really Long Weir	0.3	0.3	0.6	1	0		117017831
F E Moore	E Moore	Ex Combined SIM	15				Dummy used to model flow across r	0.2	0.05	0.6	1	0		117904855
F EXE S1	EX E S1	Ex Combined SIM	7				Dummy used to model flow across r	0.2	0.05	0.6	1	0		117904870
F W Moore	W Moore	Ex Top Chan	15				Dummy used to model flow across r	0.2	0.05	0.6	1	0		121800217
F Ex G06	N621911	N621913	20				West Moorebank	0.15	0.2	0.6	0.2	0		122115311
OF542838	N621913	Ex Top Chan	0.1				West Moorebank	0.15	0.2	0.6	0.2	0		122115331
PIPE COVER DETAILS														
Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)										
P EX dummy DNSDC	RCP Class 2	600	0.6	3.35										
P EX UNDER MOOR	Box Culverts	0	0.6	0.62										
P EX Carpark	RCP Class 2	300	0.6	-3.2	Unsafe									

ARCADIS Design & Consultancy for natural and built assets

PROJECT	MPE Stage 2	JOB No	AA009335		
		PREPARED	AZ	DATE	13/10/2016
TITLE	5 YEAR ARI RESULTS	CHECKED	BC	DATE	13/10/2016

DRAINS File Path:	F:\AA003760\D-Calculations\Civil\A-Stormwater\E0-SIMTA STAGE 2\MPE_Exg.drn
DRAINS Version:	DRAINS results prepared 6 July, 2016 from Version 2016.07
Modeller's Name:	AZ
Description:	MPE Existing

DRAINS results prepared from Version 2016.14

5 Year ARI

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint	Blocking Factor
EX DNSDC	11.14		1.908		2.86	0	None	
EX dummy DNSDC	10.48		0					
Ex Mo HW 1	12.43		5.285		1.72	0	None	
Ex Top Chan	11.75		1.661					
Carpark HW	14.77		0.723		-0.07	0.618	Headwall height/system capacity	
EX Carpark	11		0					

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C EX NTH SIM	2.849	2.196	0.705	12	15	0	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
C EX S1	3.174	2.537	0.692	15	20	0	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
C EX DNSDC	1.908	1.617	0.291	5	5	0	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
C EX Carpark	0.723	0.476	0.247	5	5	0	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
C EX A2	4.28	2.083	2.301	14.5	24	0	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
C EX A1	4.299	2.42	1.893	14	15	0	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
C EX A1 E	0.278	0.16	0.118	5	7	0	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
C E Moore	0.638	0.598	0.045	5	20	10	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
C EX E S1	1.954	1.562	0.426	15	20	0	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
C W Moore	0.443	0.324	0.128	5	20	10	AR&R 5 year, 1.5 hours storm, average 33.3 mm/h, Zone 1
Ex G06	1.328	0.081	1.247	15	15	0	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1

Name	Max Flow (cu.m/s)	Due to Storm
Ex G04	0.275	AR&R 5 year, 12 hours storm, average 9.0 mm/h, Zone 1

Outflow Volumes for Total Catchment (51.9 impervious + 57.2 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ru cu.m (Runoff	Pervious Runoff cu.m (Runoff %)
AR&R 5 year, 5 minutes s	12502.4	6040.12 (48.3	5414.57 (91.0	625.54 (9.5%)
AR&R 5 year, 25 minutes	31369.71	21325.52 (68.	14307.27 (95	7018.25 (42.7%)
AR&R 5 year, 45 minutes	41138.58	28758.27 (69.	18977.10 (96	9781.17 (45.4%)
AR&R 5 year, 1 hour stor	46457.38	32810.76 (70.	21486.69 (97	11324.07 (46.5%)
AR&R 5 year, 1.5 hours s	54597.04	38663.17 (70.	25363.80 (97	13299.37 (46.5%)
AR&R 5 year, 2 hours sto	60887.36	43115.86 (70.	28376.95 (97	14738.91 (46.2%)
AR&R 5 year, 3 hours sto	70648.03	50126.86 (71.	33079.18 (98	17047.68 (46.0%)
AR&R 5 year, 4.5 hours s	81790.48	56965.35 (69.	38332.54 (98	18632.81 (43.5%)
AR&R 5 year, 6 hours sto	90766.14	62885.70 (69.	42639.55 (98	20246.15 (42.6%)
AR&R 5 year, 9 hours sto	105371.67	71913.21 (68.	49562.66 (98	22350.54 (40.5%)
AR&R 5 year, 12 hours s	117422.88	79950.55 (68.	55300.50 (99	24650.05 (40.1%)
AR&R 5 year, 18 hours s	137104.33	88222.19 (64.	64671.63 (99	23550.56 (32.8%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
P EX dummy DNSDC	1.913	6.77	11.142	10.5	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
P EX UNDER MOORE	5.285	3.74	11.933	11.753	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
P EX Carpark	0.105	3.6	14.439	13.999	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
F Ex Comb SIMTA	7.65	7.65	0	0.2	0.32	43.96	1.62	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
F EX G SIM	5.285	5.285	0	0.172	0.25	38.4	1.47	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
F EX S1	3.174	3.174	0	0.14	0.18	31.93	1.3	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
F MPW	0.275	0.275	0	0.129	0.03	45.5	0.25	AR&R 5 year, 12 hours storm, average 9.0 mm/h, Zone 1
F EX DNSDC	0	0	0	0	0	0	0	
F EX dummy DNSDC	1.913	1.913	0	0.114	0.13	26.72	1.14	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
F EX OVER MOORE	0	0	0	0	0	0	0	
Ex Channel	6.912	6.912	0	1.358	2.35	4.24	1.73	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
F Ex Carpark Bypass	0.618	0.618	0	0.228	0.04	45.59	0.18	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
F EX Carpark	0.105	0.105	0	0.035	0.02	11.09	0.5	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
F EX A2	0.499	0.499	0	0.004	0	699.9	0.18	AR&R 5 year, 12 hours storm, average 9.0 mm/h, Zone 1
F EX A1	3.361	3.361	0	0.013	0	699.9	0.37	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
F EX A1 E	3.426	3.426	0	0.144	0.19	32.83	1.32	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
F Ex Sto 3	5.285	5.285	0	0.017	0.01	699.9	0.45	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
F E Moore	0.743	0.743	0	0.077	0.07	19.36	0.89	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
F EXE S1	1.954	1.954	0	0.115	0.13	26.9	1.14	AR&R 5 year, 25 minutes storm, average 69.0 mm/h, Zone 1
F W Moore	0.443	0.443	0	0.062	0.05	16.48	0.76	AR&R 5 year, 1.5 hours storm, average 33.3 mm/h, Zone 1
F Ex G06	1.328	1.328	0	0.168	0.08	50.07	0.45	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1
OF542838	1.552	1.552	0	0.173	0.08	50.75	0.48	AR&R 5 year, 2 hours storm, average 27.9 mm/h, Zone 1

DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
Store A2	14.67	11742.7	0.499	0	0.499
Store A1	13.8	712.7	3.361	0	3.361
Ex Sto C1	12.64	6696.8	5.285	0	5.285

CONTINUITY CHECK for AR&R 5 year, 12 hours storm, average 9.0 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Chan	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Ex SimtaChann	7746.68	7746.68	0	0
Ex Combined SIMTA	5673.05	5673.07	0	0
EX G SIM	6507.23	6507.22	0	0
EX S1	2143.23	2143.23	0	0
MPW	426.08	426.08	0	0
EX DNSDC	835.28	835.29	0	0
EX dummy DNSDC	835.29	835.29	0	0
Ex Mo HW 1	6507.22	6508.35	0	0
Ex Top Chan	7747.36	7747.34	0	0
Carpark HW	282.38	282.38	0	0
EX Carpark	239.63	239.63	0	0
Store A2	2890.34	2030.68	5160.36	-148.8
Store A1	2580.97	2580.75	1.35	0
EX A2	2029.9	2029.9	0	0
EX A1 E	2686.88	2686.9	0	0
Ex Sto C1	6508.37	6507.24	6.83	-0.1
E Moore	551.48	551.49	0	0
EX E S1	1319.66	1319.66	0	0
EX A1	2686.9	2686.9	0	0
W Moore	228.27	228.27	0	0
N621911	542.15	542.15	0	0
N621913	1010.74	1010.74	0	0

Run Log for SIMTA2_Exg_160819.drn run at 16:25:08 on 12/10/2016

No water upwelling from any pit. Freeboard was adequate at all pits.

The maximum flow in the following overflow routes is unsafe: F Ex Carpark Bypass, F W Moore, F EX A1 E, F EXE S1, F E Moore, Ex Channel

The following overflow routes carried water uphill (adding energy): F Ex Sto 3 F EX A2

These results may be invalid. You should check for water flowing round in circles at these locations. You may need to reformulate the model.

ARCADIS Design & Consultancy for natural and built assets

PROJECT	MPE Stage 2	JOB No	AA009335		
		PREPARED	AZ	DATE	13/10/2016
TITLE	100 YEAR ARI RESULTS	CHECKED	BC	DATE	13/10/2016

DRAINS File Path:	F:\AA003760\D-Calculations\Civil\A-Stormwater\E0-SIMTA STAGE 2\MPE_Exg.drn
DRAINS Version:	DRAINS results prepared 6 July, 2016 from Version 2016.07
Modeller's Name:	AZ
Description:	MPE Existing

100 Year ARI

DRAINS results prepared from Version 2016.14

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
EX DNSDC	11.30		2.90		2.70	0.79	Inlet Capacity
EX dummy DNSDC	10.48		0.00				
Ex Mo HW 1	13.41		9.40		0.74	0.00	None
Ex Top Chan	13.36		3.30				
Carpark HW	14.80		1.08		-0.10	0.97	Headwall height/system capacity
EX Carpark	11.00		0.00				

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C EX NTH SIM	4.65	3.31	1.50	12.00	15.00	0.00	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C EX S1	5.24	3.93	1.60	15.00	20.00	0.00	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C EX DNSDC	2.90	2.55	0.35	5.00	5.00	0.00	AR&R 100 year, 5 minutes storm, average 224 mm/h, Zone 1
C EX Carpark	1.08	0.70	0.39	5.00	5.00	0.00	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C EX A2	7.94	3.24	4.70	14.50	24.00	0.00	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
C EX A1	7.30	4.39	3.24	14.00	15.00	0.00	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C EX A1 E	0.42	0.23	0.19	5.00	7.00	0.00	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C E Moore	0.98	0.94	0.04	5.00	20.00	10.00	AR&R 100 year, 5 minutes storm, average 224 mm/h, Zone 1
C EX E S1	3.23	2.42	0.99	15.00	20.00	0.00	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
C W Moore	0.75	0.50	0.26	5.00	20.00	10.00	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
Ex G06	2.30	0.14	2.17	15.00	15.00	0.00	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1

Name	Max Flow (cu.m/s)	Due to Storm
Ex G04	0.57	AR&R 100 year, 4.5 hours storm, average 27.8 mm/h, Zone 1

Outflow Volumes for Total Catchment (51.9 impervious + 57.2 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ru cu.m (Runoff	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes st	20383.72	13223.34 (64.	9158.56 (94.4	4064.77 (38.0%)
AR&R 100 year, 25 minutes s	51103.02	40596.19 (79.	23726.57 (97.	16869.61 (63.0%)
AR&R 100 year, 45 minutes s	67230.42	54412.81 (80.	31399.55 (98.	23013.27 (65.3%)
AR&R 100 year, 1 hour storm	76134.21	62006.03 (81.	35634.42 (98.	26371.61 (66.1%)
AR&R 100 year, 1.5 hours sto	89891.04	73587.05 (81.	42199.29 (98.	31387.76 (66.6%)
AR&R 100 year, 2 hours storm	100620.50	82459.17 (82.	47289.89 (98.	35169.28 (66.7%)
AR&R 100 year, 3 hours storm	117422.87	96111.73 (81.	55326.39 (99.	40785.34 (66.3%)
AR&R 100 year, 4.5 hours sto	136787.77	111015.46 (8	64540.07 (99.	46475.39 (64.8%)
AR&R 100 year, 6 hours storm	152594.08	122514.17 (8	72075.96 (99.	50438.21 (63.1%)
AR&R 100 year, 9 hours storm	178743.22	139769.34 (7	84533.05 (99.	55236.29 (59.0%)
AR&R 100 year, 12 hours sto	200766.14	156098.35 (7	94963.43 (99.	61134.92 (58.1%)
AR&R 100 year, 18 hours sto	237782.17	178674.05 (7	112598.11 (9	66075.95 (53.0%)

PIPE DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
P EX dummy DNSDC	2.12	7.51	11.30	10.50	AR&R 100 year, 5 minutes storm, average 224 mm/h, Zone 1
P EX UNDER MOORE	9.40	1.31	13.39	13.36	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
P EX Carpark	0.11	3.63	14.44	14.00	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1

CHANNEL DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
F Ex Comb SIMTA	12.77	12.77	0.00	0.23	0.48	49.99	2.08	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F EX G SIM	9.40	9.40	0.00	0.22	0.37	47.38	1.71	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F EX S1	5.24	5.24	0.00	0.17	0.25	38.40	1.46	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F MPW	0.57	0.57	0.00	0.14	0.05	47.03	0.33	AR&R 100 year, 4.5 hours storm, average 27.8 mm/h, Zone 1
F EX DNSDC	0.79	0.79	0.00	0.08	0.07	19.90	0.89	AR&R 100 year, 5 minutes storm, average 224 mm/h, Zone 1
F EX dummy DNSDC	2.12	2.12	0.00	0.12	0.14	27.80	1.16	AR&R 100 year, 5 minutes storm, average 224 mm/h, Zone 1
F EX OVER MOORE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Ex Channel	12.92	12.92	0.00	1.80	3.67	7.02	2.04	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F Ex Carpark Bypass	0.97	0.97	0.00	0.26	0.05	50.23	0.20	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F EX Carpark	0.11	0.11	0.00	0.04	0.02	11.27	0.50	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F EX A2	3.00	3.00	0.00	0.01	0.00	699.90	0.36	AR&R 100 year, 9 hours storm, average 18.2 mm/h, Zone 1
F EX A1	3.94	3.94	0.00	0.01	0.01	699.90	0.39	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F EX A1 E	4.07	4.07	0.00	0.16	0.21	34.98	1.37	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
F Ex Sto 3	9.40	9.40	0.00	0.02	0.01	699.90	0.56	AR&R 100 year, 2 hours storm, average 46.1 mm/h, Zone 1
F E Moore	1.09	1.09	0.00	0.09	0.09	22.05	0.97	AR&R 100 year, 5 minutes storm, average 224 mm/h, Zone 1
F EXE S1	3.23	3.23	0.00	0.14	0.18	32.11	1.30	AR&R 100 year, 25 minutes storm, average 112 mm/h, Zone 1
F W Moore	0.75	0.75	0.00	0.08	0.07	19.54	0.88	AR&R 100 year, 1.5 hours storm, average 54.9 mm/h, Zone 1
F Ex G06	2.30	2.30	0.00	0.19	0.11	52.42	0.55	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1
OF542838	3.08	3.08	0.00	0.21	0.13	53.02	0.61	AR&R 100 year, 1 hour storm, average 69.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q								
			Total	Low Level	High Level								
Store A2	14.78	15646.40	3.00	0.00	3.00								
Store A1	14.09	3099.30	3.94	0.00	3.94								
Ex Sto C1	13.09	10540.10	9.40	0.00	9.40								

CONTINUITY CHECK for AR&R 100 year, 4.5 hours storm, average 27.8 mm/h, Zone 1				
Node	Inflow	Outflow	Storage Chan	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Ex SimtaChann	20855.01	20855.01	0.00	0.00
Ex Combined SIMTA	14733.37	14733.35	0.00	0.00
EX G SIM	16756.04	16755.96	0.00	0.00
EX S1	5659.79	5659.79	0.00	0.00
MPW	1171.63	1171.63	0.00	0.00
EX DNSDC	2049.17	2049.99	0.00	0.00
EX dummy DNSDC	2049.99	2049.99	0.00	0.00
Ex Mo HW 1	16755.88	16753.74	0.00	0.00
Ex Top Chan	20860.05	20859.97	0.00	0.00
Carpark HW	744.11	744.19	0.00	0.00
EX Carpark	436.36	436.36	0.00	0.00
Store A2	8692.03	5761.69	8793.15	-67.50
Store A1	7130.95	7169.47	0.00	-0.50
EX A2	5760.27	5760.27	0.00	0.00
EX A1 E	7462.52	7462.54	0.00	0.00
Ex Sto C1	16783.34	16756.11	81.76	-0.30
E Moore	1206.47	1206.47	0.00	0.00
EX E S1	3484.93	3484.93	0.00	0.00
EX A1	7462.54	7462.54	0.00	0.00
W Moore	631.01	631.01	0.00	0.00
N621911	1996.21	1996.21	0.00	0.00
N621913	3475.31	3475.31	0.00	0.00
Run Log for SIMTA2_Exg_160819.drn run at 16:46:15 on 12/10/2016				
No water upwelling from any pit. Freeboard was adequate at all pits.				
The maximum flow in the following overflow routes is unsafe: OF542838, F Ex G06, F Ex Carpark Bypass, Ex Channel				
The following overflow routes carried water uphill (adding energy): F Ex Sto 3 F EX DNSDC F EX A2				
These results may be invalid. You should check for water flowing round in circles at these locations. You may need to reformulate the model.				

ARCADIS Design & Consultancy for natural and built assets

PROJECT	MPE Stage 2	JOB No	AA009335		
		PREPARED	AZ	DATE	13/10/2016
TITLE	PMF RESULTS	CHECKED	BC	DATE	13/10/2016

DRAINS File Path:	F:\AA003760\D-Calculations\Civil\A-Stormwater\E0-SIMTA STAGE 2\MPE_Exg.drn
DRAINS Version:	DRAINS results prepared 6 July, 2016 from Version 2016.07
Modeller's Name:	AZ
Description:	MPE Existing

PMF

DRAINS results prepared from Version 2016.14

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
EX DNSDC	11.36		12.958		2.64	10.848	Inlet Capacity
EX dummy DNSDC	10.48		0				
Ex Mo HW 1	14.58		54.562		-0.43	43.003	Headwall height/system capacity
Ex Top Chan	14.5		62.34				
Carpark HW	14.99		5.062		-0.29	4.928	Headwall height/system capacity
EX Carpark	11		0				

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C EX NTH SIM	23.193	15.608	8.475	12	15	0	15min PMP
C EX S1	26.503	17.151	10.024	15	20	0	30min PMP
C EX DNSDC	12.958	10.77	2.262	5	5	0	15min PMP
C EX Carpark	5.062	3.167	1.921	5	5	0	15min PMP
C EX A2	40.382	16.334	27.525	14.5	24	0	30min PMP
C EX A1	38.029	20.278	18.351	14	15	0	15min PMP
C EX A1 E	1.985	1.068	0.984	5	7	0	15min PMP
C E Moore	4.208	3.98	0.527	5	20	10	15min PMP
C EX E S1	16.319	10.56	6.172	15	20	0	30min PMP
C W Moore	2.989	2.301	1.218	5	20	10	15min PMP
Ex G06	12.775	0.681	12.095	15	15	0	15min PMP

Name	Max Flow (cu.m/s)	Due to Storm
Ex G04	4.492	45min PMP

Outflow Volumes for Total Catchment (51.9 impervious + 57.2 pervious = 109 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ri cu.m (Runoff	Pervious Runoff cu.m (Runoff %)
15min PMP	185571.16	176226.40 (9	87712.00 (99	88514.40 (91.0%)
30min PMP	272898.78	261389.59 (9	129244.99 (9	132144.59 (92.4%)
45min PMP	338394.47	325278.41 (9	160437.78 (9	164840.63 (92.9%)
1hr PMP	392883.25	378459.27 (9	186384.89 (9	192074.38 (93.3%)
1.5hr PMP	447463	430939.25 (9	212380.48 (9	218558.77 (93.2%)
2hr PMP	491217.78	472800.05 (9	233211.48 (9	239588.56 (93.1%)
2.5hr PMP	523965.63	503851.84 (9	248805.31 (9	255046.53 (92.9%)
3hr PMP	556986.38	535222.13 (9	264525.28 (9	270696.84 (92.7%)
4hr PMP	600377.31	575290.47 (9	285183.97 (9	290106.50 (92.2%)
5hr PMP	654957.06	626617.47 (9	311159.69 (9	315457.78 (91.9%)

PIPE DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
P EX dummy DNSD	2.16	7.64	11.364	10.5	30min PMP
P EX UNDER MOO	11.559	1.61	14.52	14.5	45min PMP
P EX Carpark	0.133	3.83	14.479	14.018	15min PMP

CHANNEL DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
F Ex Comb SIMTA	61.663	61.663	0	0.23	2.31	49.99	10.03	30min PMP
F EX G SIM	54.562	54.562	0	0.23	2.04	49.99	8.88	45min PMP
F EX S1	26.503	26.503	0	0.23	0.99	49.99	4.31	30min PMP
F MPW	4.492	4.492	0	0.232	0.16	53.81	0.71	45min PMP
F EX DNSDC	10.848	10.848	0	0.229	0.41	49.89	1.77	15min PMP
F EX dummy DNSD	2.16	2.16	0	0.12	0.14	27.98	1.16	30min PMP
F EX OVER MOOR	43.003	43.003	0	0.23	1.61	49.99	7	45min PMP
Ex Channel	74.675	74.675	0	2.932	2.43	120.05	0.83	45min PMP
F Ex Carpark Bypas	4.928	4.928	0	0.294	0.22	55.81	0.74	15min PMP
F EX Carpark	0.133	0.133	0	0.039	0.02	11.81	0.54	15min PMP
F EX A2	15.312	15.312	0	0.032	0.02	699.9	0.68	1hr PMP
F EX A1	22.084	22.084	0	0.04	0.03	699.9	0.79	45min PMP
F EX A1 E	22.841	22.841	0	0.23	0.85	49.99	3.72	45min PMP
F Ex Sto 3	52.484	52.484	0	0.067	0.07	699.9	1.11	30min PMP
F E Moore	4.34	4.34	0	0.159	0.22	35.7	1.41	15min PMP
F EXE S1	16.319	16.319	0	0.23	0.61	49.99	2.65	30min PMP
F W Moore	2.989	2.989	0	0.137	0.17	31.39	1.26	15min PMP
F Ex G06	12.775	12.775	0	0.242	0.45	54.14	1.86	15min PMP
OF542838	17.719	17.719	0	0.242	0.62	54.14	2.58	30min PMP

DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q	Max Q	Max Q

			Total	Low Level	High Level
Store A2	15.48	58022.3	15.312	0	15.312
Store A1	15.04	23554.2	22.084	0	22.084
Ex Sto C1	19.12	33401.8	52.484	0	52.484
CONTINUITY CHECK for 15min PMP					
Node	Inflow	Outflow	Storage Chan	Difference	
	(cu.m)	(cu.m)	(cu.m)	%	
Ex SimtaChann	95595.51	95595.51	0	0	
Ex Combined SIMT	65446.86	65446.84	0	0	
EX G SIM	73215.45	73211.96	0	0	
EX S1	25915.93	25915.93	0	0	
MPW	5320.32	5320.32	0	0	
EX DNSDC	8810.89	8809.8	0	0	
EX dummy DNSDC	2335.61	2335.61	0	0	
Ex Mo HW 1	73208.51	72973	0	0.3	
Ex Top Chan	95805.73	95802.09	0	0	
Carpark HW	3419.83	3419.88	0	0	
EX Carpark	141.95	141.95	0	0	
Store A2	43720.34	30865.18	12857.77	0	
Store A1	33923.74	33929.96	0	0	
EX A2	30860.1	30860.1	0	0	
EX A1 E	35328.69	35328.7	0	0	
Ex Sto C1	67782.46	66744.65	1039.49	0	
E Moore	3465.66	3465.65	0	0	
EX E S1	15957.33	15957.33	0	0	
EX A1	35328.7	35328.7	0	0	
W Moore	2996.32	2996.32	0	0	
N621911	11331.58	11331.58	0	0	
N621913	19922.14	19921.93	0	0	
Run Log for SIMTA2_Exg_160819.drn run at 16:31:10 on 12/10/2016					
The maximum water level in the following storages exceeds the maximum elevation you specified: Ex Sto C1, Store A1.					
DRAINS has extrapolated the Elevation vs Storage table to a higher Elevation. Please provide accurate values for higher elevations.					
No water upwelling from any pit. Freeboard was adequate at all pits.					
The maximum flow in the following overflow routes is unsafe: OF542838, F Ex G06, F Ex Carpark Bypass, F W Moore, F EX A1 E, F EXE S1, F E Moore, F EX DNSDC, Ex Channel, F EX OVE					
The following overflow routes carried water uphill (adding energy): F Ex Sto 3 F EX DNSDC F EX A2					
These results may be invalid. You should check for water flowing round in circles at these locations. You may need to reformulate the model.					