Flood and Risk Impact Assessment

WSU Campus Milperra

Planning Proposal

May 2023

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS

Prepared by

J. Wyndham Prince
Contact: Sabina Lohani
Phone: 02 4720 3300
Email: jwp@jwprince.com.au
ABN: 67 002 318 621

Prepared for

Mirvac
Contact: Theo Zotos
Phone: 02 9080 8062
Email: theo.zotos@mirvac.com

Version control

SUSTAINABLE CERTIFICATION ISO 9001 AS/NZS 4801 ISO 14001

Issue	Author	Reviewer	Approver	Date approved
A	Francis Lane Amir Zalnezhad Ahmad Albaba	Sabina Lohani	Sabina Lohani	28/04/2023
B	Francis Lane Amir Zalnezhad	Sabina Lohani	Sabina Lohani	03/05/2023
C	Francis Lane	Sabina Lohani	Sabina Lohani 	04/05/2023

TABLE OF CONTENTS

PLATES

TABLES

APPENDICES

1. EXECUTIVE SUMMARY

J. Wyndham Prince has been engaged by Mirvac to undertake a Flood and Risk Impact Assessment in support of a Planning Proposal to rezone approximately 19.62 ha of land at 2 and 2A Bullecourt Avenue, Milperra. The site is formally identified as lot 105 of DP1268911 and is currently zoned as SP2 Infrastructure Educational Establishment and was previously utilised as the Western Sydney University (WSU) Milperra Campus. It is proposed to rezone the site to support residential development, roads, parks and stormwater drainage infrastructure.

This report has been prepared to determine what stormwater quality and quantity measures are required to ensure that pollution reduction targets are achieved and that there is no increase in stormwater runoff due to the proposed development when compared to the existing site. A flood impact assessment has also been undertaken to confirm that there are no adverse flood impacts external to the site due to the proposed residential development of the site.

The investigation has determined that two (2) detention basins in the southern portion of the site with a combined 1% AEP detention volume of approximately 2,310 m³ will ensure that developed conditions flow are no greater than existing conditions flows external to the site. The site regrading has reduced the overall catchment in the north-western portion of the site and the hydrologic assessment confirms that no detention is required in that portion of the site. The future detailed design of the site will need to consider the various site constraints and ensure that appropriate freeboard is provided from the basin top water level to the finished floor and garage levels of the adjacent residential dwellings (both existing and proposed dwellings).

Four (4) Gross Pollutant Traps (GPTs) and three (3) bio-retention raingardens provide stormwater quality management for the proposed subdivision to ensure pollutant removal targets are met prior to discharge from the site. The bio-retention raingardens also ensure that developed conditions durations of stream forming flows are no greater than 3.5 – 5.0 times the duration of existing conditions stream forming flows.

A frequency of inundation assessment was undertaken for the large southern detention Basin 1 which is proposed to predominantly be utilised as open space. Utilising historic rainfall information within MUSIC modelling software, the inundation analysis indicates that on average Basin 1 would empty within approximately 0.5 of an hour. For 95% of the historic rainfall events, the assessment indicates that Basin 1 would hold water for less than 2.5 hours. Considering the limited number of days exceeding a 1 mm depth on average per annum, combined with the limited duration in which the basin holds water, the predominant use of the southern open space is for recreation. It is anticipated that the combined use of this open space area as a detention basin would not result in the closure of the playing field any differently from other playing fields within the Bankstown LGA when relatively large storm events occur.

A flood assessment was undertaken using the hydraulic model that supported the Georges River Flood Study (BMT, 2020), as required by Department of Planning and Environment (DPE) - Environment and Heritage Group (EHG), to determine the flood depth, level and hazard for storm events from the 1% Annual Exceedance Probability (AEP) to the Probable Maximum Flood (PMF) storm events. The flood assessment indicates that the existing site is impacted by the Georges River mainstream flooding 1% AEP event up to 5.55 mAHD with approximately 6,400 m³ of floodplain storage within the site during this event.

The flood assessment indicates that the proposed development will not adversely affect the flood behaviour external to the site. In the developed condition, the flood assessment confirms that the proposed detention basins ensure that flows are not increased external to the site, and there is the capacity to provide regional flood storage of 9600 m³ during 1% AEP flood events without affecting detention basin performance. Therefore, there is no net loss of floodplain storage due to the proposed development. Similarly, there is insignificant change in flood behaviour during proxy climate change scenarios of 0.5% AEP and 0.2% AEP up to PMF flood events.

The southwestern portion of the site is inundated in PMF flood events, and evacuation routes are provided to show the safe evacuation during this event. North-eastern parts of the site are generally flood free during PMF events.

This stormwater management strategy for the proposed development provides a basis for the future detailed design and development of the site to ensure that the environmental, urban amenity, engineering and economic objectives for stormwater management and site discharge are achieved.

2. INTRODUCTION

2.1. Background

The proposed residential development site is located at 2 Bullecourt Avenue, Milperra and is within Canterbury-Bankstown Council (CBC) local government area (LGA). The site is formally identified as Lot 105 of DP1268911.

The site has an approximate area of 19.62 ha and is currently zoned as SP2 Infrastructure Educational Establishment. Previous development of the site is evident and includes a number of large buildings and car parks due to its previous use as a university campus. Plate 2-1 provides an overview of the locality of the existing site.

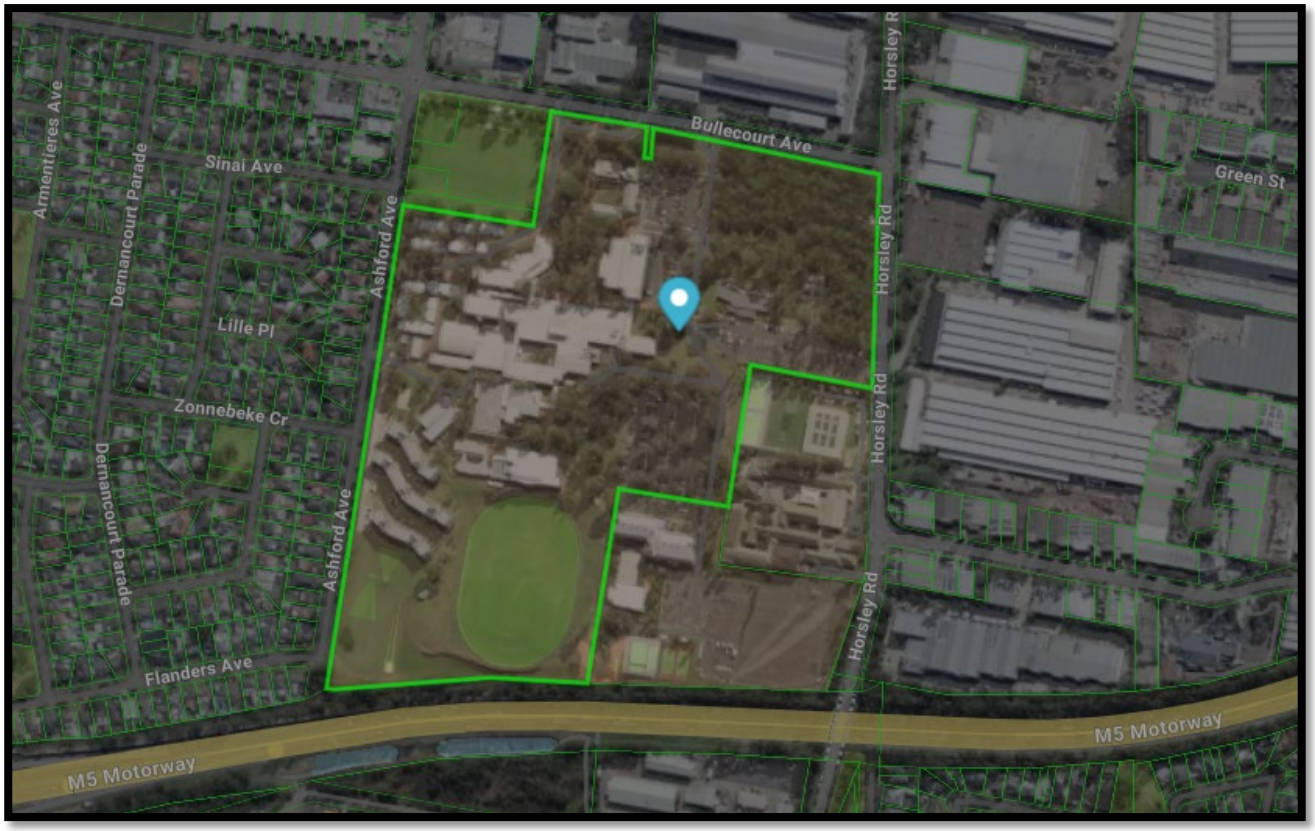


Plate 2-1 – Site Locality

2.2. Objective

The study aims to support the lodgement of the planning proposal of the proposed development at 2 Bullecourt Avenue, Milperra addressing the Gateway Determination (Department Ref: PP-2021-5837) dated 1 June 2022 and Environment and Heritage Group (EHG) comments (DOC22/956174) dated 20 December 2022 from Department of Planning and Environment.

To achieve the study objective following specific tasks are undertaken.

- Prepare stormwater quality modelling to confirm the treatment train required to meet industry best practice pollutant removal targets.
- Undertake a Stream Erosion Index assessment to ensure that the developed conditions stream forming flow durations are no greater than 3.5 – 5 times the existing conditions stream forming durations;
- Undertake a hydrologic analysis using ARR 1987 methods to determine the peak flows for the 0.5 EY, 0.2 EY, 10% AEP, 5% AEP, and 1% AEP (2y, 5y, 10y, 20y and 100y ARI) events under existing and developed conditions. Determine the minimum detention storage requirements to ensure developed condition flows are no greater than the existing condition.

- Prepare a flood impact assessment to confirm that there are no unacceptable flood impacts external to the site, no loss in floodplain storage due to the proposed development and to confirm that flood hazard and evacuation requirements in accordance with the NSW Floodplain Development Manual are satisfied.

2.3. Proposed Development

It is proposed that the site is rezoned as R1 General Residential development which will support the subdivision of land and create new residential lots, together with supporting road and drainage infrastructure. The vegetated area shown are Woodland Area in Plate 2-2 below will be retained and enhanced as a conservation area.

The masterplan provides an overview of the proposed development and is provided in Plate 2-2.

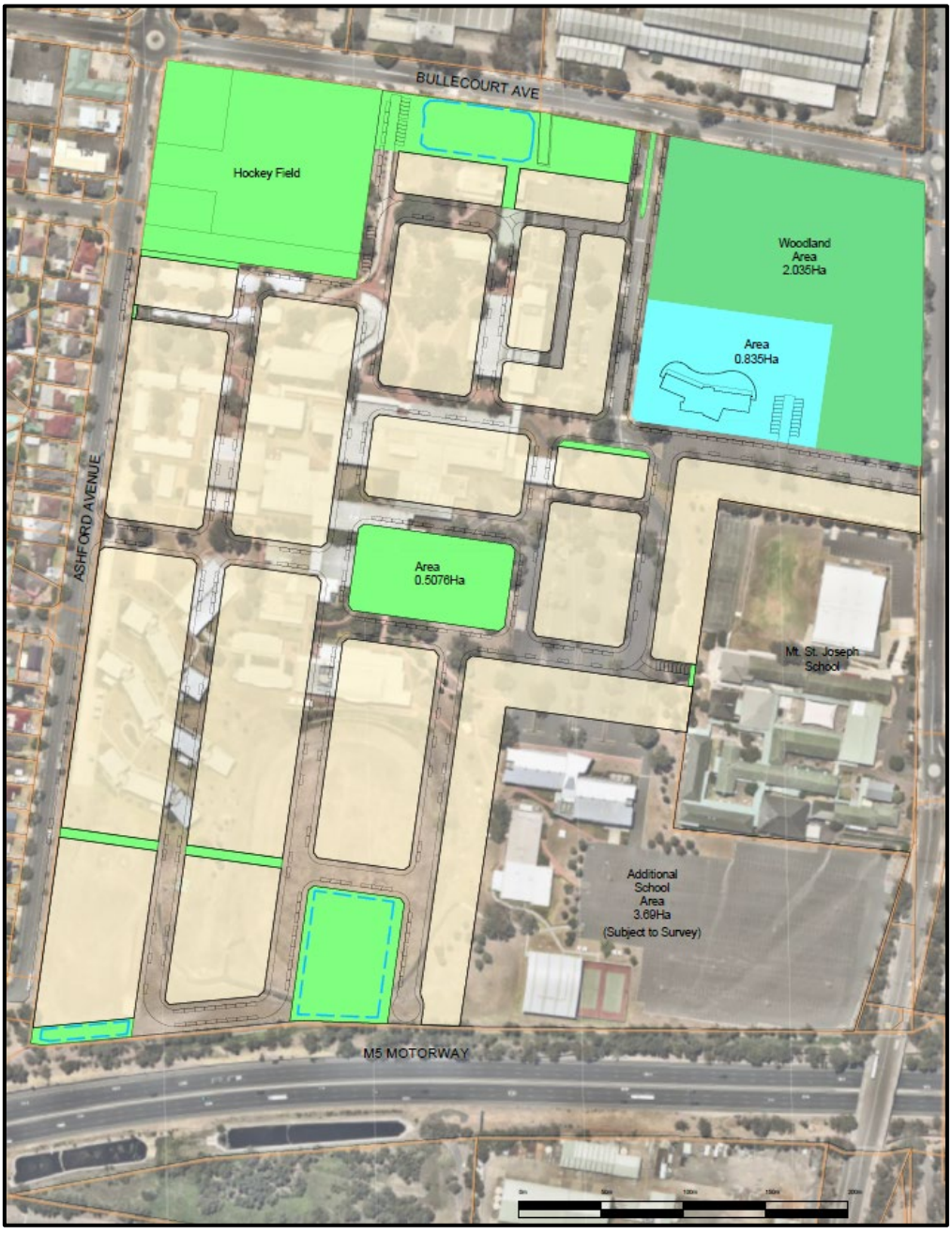


Plate 2-2 – Masterplan

Details of the proposed bio-retention raingardens and detention basins are provided on sketch drawings 110709-02-SK06 and SK07 which are provided in Appendix A.

3. PREVIOUS STUDIES AND COUNCIL LIAISON

3.1. WSU Milperra Rezoning Stormwater Concept Plan (Calibre, 2020)

The *Western Sydney University, Milperra Rezoning Stormwater Concept Plan* was prepared for Mirvac by Calibre Professional Services Pty. Ltd in June 2020 to support the proposed rezoning of the site.

The stormwater strategy for the site included three (3) detention basins with co-located bio-retention basins to ensure that stormwater quality and quantity targets were achieved. This assessment has been further refined as part of the current investigation and has been augmented to include a flood impact assessment.

3.2. Flood and Stormwater Advice (JWP, 2022)

J. Wyndham Prince (JWP) prepared flood and stormwater advice for the proposed development at WSU campus Milperra. The advice provided an assessment of the flood affectation to the future re-development of the site and addressed the Department of Planning and Environment gateway determination letter (ref: PP-2021-5837) dated 1 June 2022. As a part of the flood analysis following studies were reviewed:

- Milperra Flood Study (BMT WBM, 2015)
- Mid Georges River Floodplain Risk Management Study and Plan (BMT WBM, 2017)

The review concluded that the site is located at the upper reach of Milperra and Kelso Swamp catchment, as such overland flooding would not an issue for the proposed development which has no upstream external catchment that drains through the site and flood impact assessment was not deemed necessary. Furthermore, it was adviced that the proposed development is located within the low flood risk precinct and 1% AEP flood fringe would not result in change in flood behaviour and impact external to the site, given that the developed condition flows are managed within the site by restricting the peak flow rate to existing condition flows up to 1% AEP storm events.

The 2022 flood advice formed part of the exhibition of the Planning Proposal for the rezoning of land at Western Sydney University Campus at Milperra. EHG from DPE provided feedback on JWP 2022 flood advice as a part of the planning proposal exhibition on 22 December 2022 to consider the Georges River Flood Study of 2020 prepared by Liverpool City Council in the flood assessment. Furthermore, EHG required the flood assessment to consider the flood impact of the proposed development, within and outside the subject site, for both mainstream and overland flooding for the full range of floods from 1% AEP up to the PMF event together with 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity due to climate change. Hence, the Georges River Flood Study, 2020 has been adopted to undertake the flood and risk assessment of the proposed development at WSU campus Milperra.

3.3. Georges River Flood Study (BMT, 2020)

The Georges River Flood Study (GRFS) was prepared by BMT Commercial Australia on behalf of the Liverpool City Council and was completed in 2020. This flood study covers the Georges River catchment extending from East Hills Railway Line at Casula to downstream of the Salt Pan Creek confluence at Lugarno. The total study area as shown in Plate 3-1 is about 960 km^2 and lies mostly within the five Councils covering 90% of the catchment area including Wollondilly Shire Council, Campbelltown City Council, Liverpool City Council, Fairfield City Council, and Canterbury- Bankstown Council.

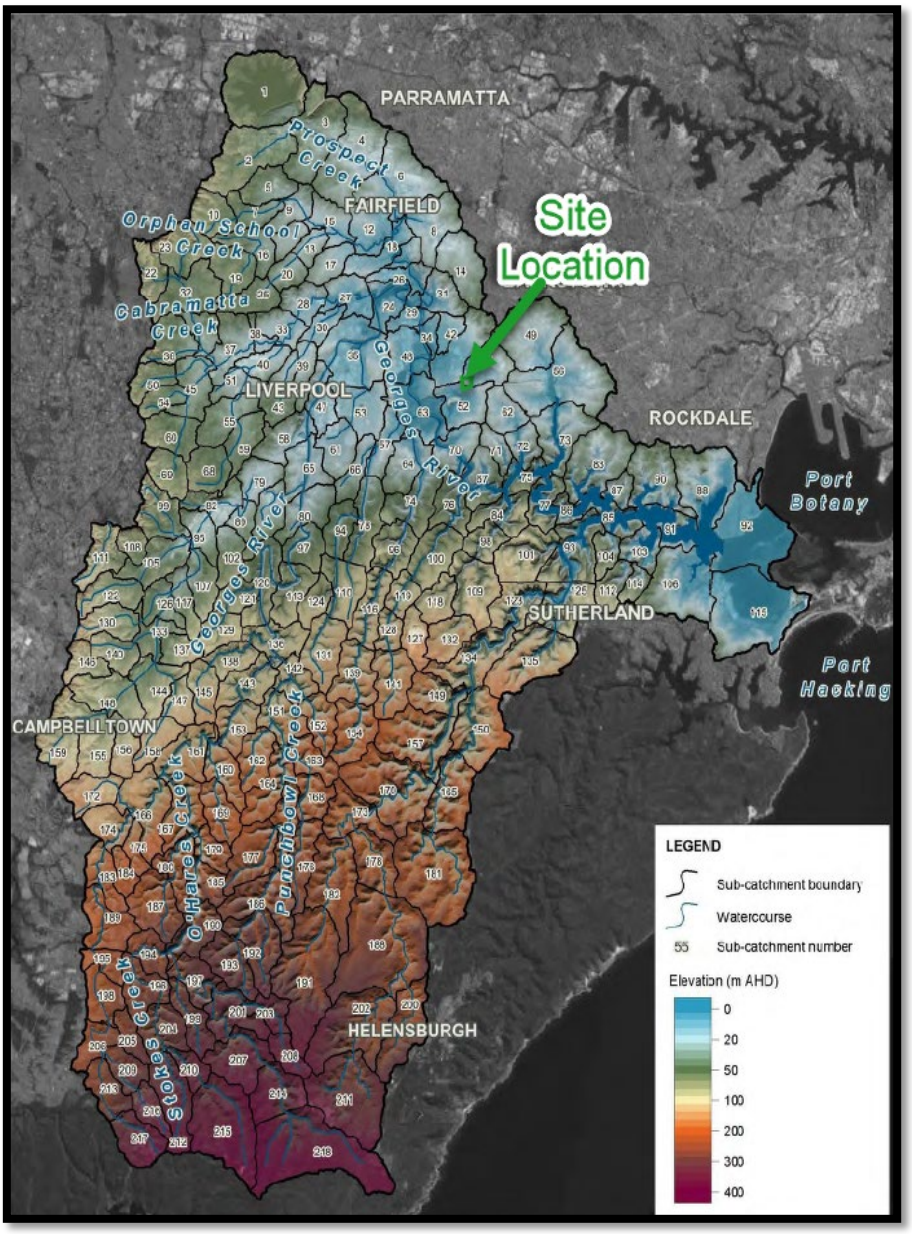


Plate 3-1- Georges River Flood Study 2020 and Subject Site Location

Based on the results of the GRFS (BMT, 2020):

- The subject site is not affected by regional flooding during 1%AEP, 0.5%AEP and 0.2% AEP flood events;
- The results indicate that areas to the south of M5 are affected by regional flooding to a level of 5.55 m AHD during 1% AEP flood events.
- The results indicate that during PMF flood events, the site and surroundings are affected by regional floodings to the level of 11.8 m AHD.
- Interrogation of the TUFLOW hydraulic model that supported the GRFS (BMT, 2020) revealed that a significant culvert under the M5 Motorway was not considered to allow regional flooding to enter the site.

The WSU Milperra assessment has used the GRFS (BMT, 2020) TUFLOW model as a base and has now included 4 x 1450mm diameter reinforced concrete pipes (RCPs) under the M5 Motorway based on survey information to understand the mainstream flood behaviour in the vicinity of the existing site.

4. STORMWATER QUANTITY MANAGEMENT

The hydrologic analysis from this study was undertaken using the rainfall–runoff flood routing model XP-RAFTS version 2018.1 (Runoff and Flow Training Simulation with XP Graphical Interface).

An existing conditions hydrologic model was prepared for the site to determine the peak flows at key discharge locations for a range of storm events. This model was then amended to reflect the proposed development and determine what detention storage is required to ensure that flows from the proposed development are no greater than existing conditions.

4.1. XP-RAFTS Parameters

The adopted intensity-frequency-duration (IFD) data for assessment is consistent with CBC's Development Engineering Standards (June, 2009) and is provided in Table 4-1.

Table 4-1 – Adopted Rainfall Intensities

Rainfall Intensity (mm/hr)			
ARI	Duration		
	1 hr	12 hr	72 hr
50y	72	15.1	5.2
2y	35.5	7.6	2.5

G = 0.00, F2 = 4.29, F50 = 15.80

The adopted pern (n) values and initial & continuing losses parameters are provided in Tables 4-2 and 4-3 respectively.

Table 4-2 – XP-RAFTS Catchment Roughness

Mannings 'n' Value	Post-Development
Catchment Surface	Mannings 'n'
Pervious Catchments	0.025
Impervious Catchments	0.015

Table 4-3 – XP-RAFTS Loss Parameters

Initial / Continuing Losses	
Catchment Surface Type	Loss
Pervious Catchments	
Initial Loss	15.0 mm
Continuing Loss	2.5 mm/hr
Impervious Catchments	
Initial Loss	1.0 mm
Continuing Loss	0.0 mm/hr

4.2. Sub-catchments

The existing condition catchments for this site have been determined using LiDAR information flown in June 2019, accessed from the ELVIS website (https://elevation.fsdf.org.au/). The developed condition catchments are considered a preliminary site grading.

Approximately 5.77 ha of the existing site discharges to the northwest, and approximately 11.00 ha discharges to the south. In the developed condition, the proposed site grading reduces the overall catchment to the northwest, and the increased southern catchments are graded to two (2) proposed detention basins.

Catchment boundaries for the existing and developed conditions are shown in Plate 4-1 and 4-2 respectively.

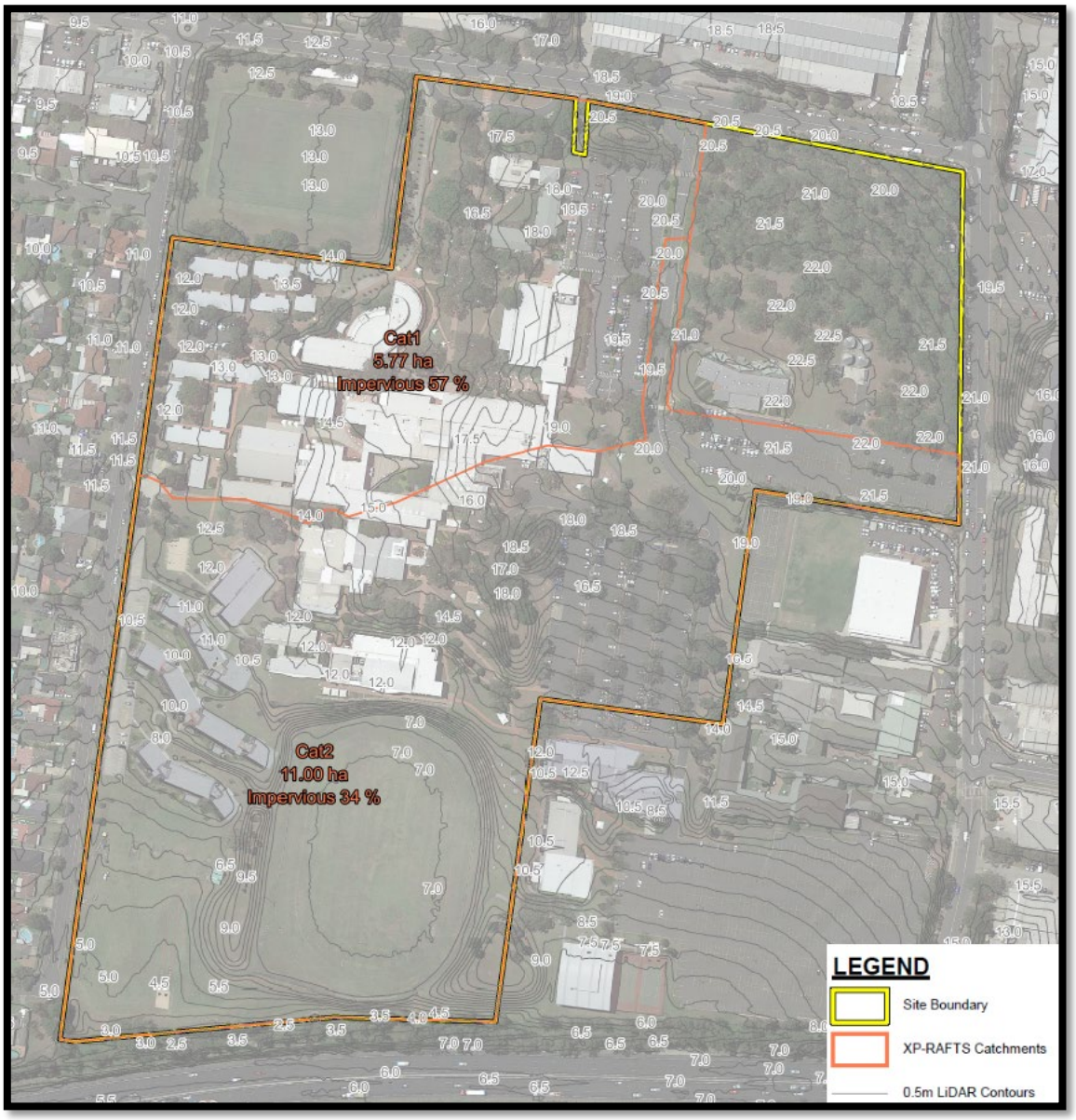


Plate 4-1- Existing Condition Catchment Plan

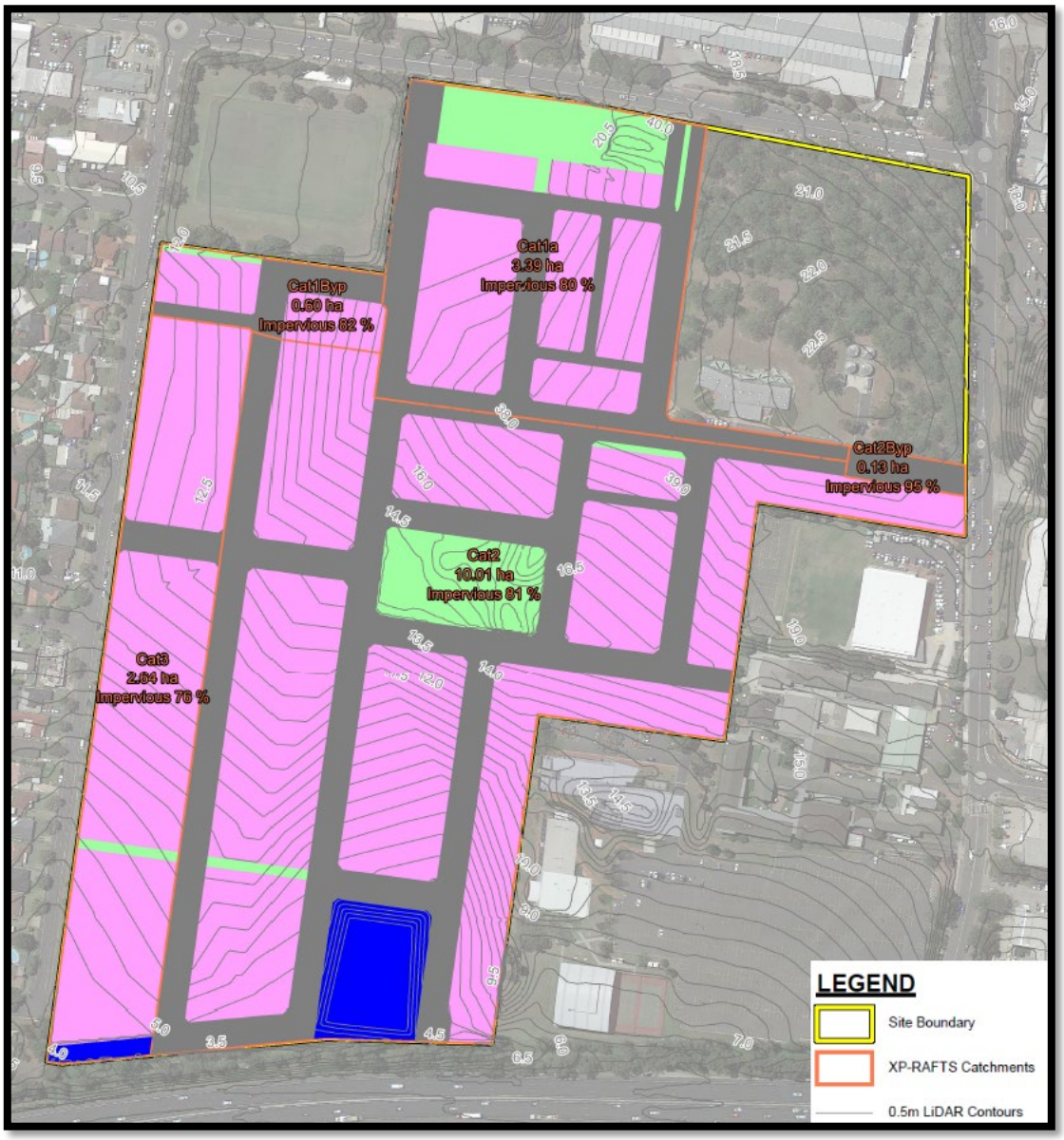


Plate 4-2- Developed Condition Catchment Plan

4.3. Modelled Events

The existing conditions XP-RAFTS hydrologic model was run using the AR&R 1987 techniques for the 0.5 EY, 0.2 EY. 10% AEP, 20% AEP and 1% AEP storm events in accordance with the CBC Development Engineering Standards (as amended June, 2009) to determine existing conditions flow targets from the existing site.

The XP-RAFTS model was then run for the developed condition to confirm whether stormwater detention is required to maintain existing conditions flows. Table 4-4 shows the estimated change in peak flow without detention basins.

Table 4-4 – Existing and Developed Peak Flows (m³/s) Without Detention

Comparison Node	Location	0.5 EY			20% AEP			10% AEP			5% AEP			2% AEP			1% AEP		
		Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex
RptNth	Northwestern Portion	1.229	1.076	0.88	1.80	1.458	0.81	2.12	1.667	0.79	2.51	1.947	0.78	2.80	2.140	0.77	3.14	2.394	0.76
RptSth	Southern Portion of Site	1.734	3.397	1.96	2.78	4.630	1.67	3.39	5.305	1.56	4.15	6.183	1.49	4.73	6.809	1.44	5.37	7.626	1.42
Total	Total Site	2.962	4.473	1.51	4.58	6.088	1.33	5.51	6.973	1.27	6.66	8.129	1.22	7.54	8.950	1.19	8.52	10.019	1.18

The results in Table 4-4 indicate that detention is not required for the north-western portion of the site. Developed condition stormwater discharge is no greater than the existing condition due to the regrading of the site which has reduced the overall catchment discharging to the north-west. However, the southern portion of the site will require detention to ensure that developed condition flows are no greater than existing the condition. The model was updated to include the detention basins shown on engineering sketch SK006 and SK007 in Appendix A and re-run for the range of storm events. Table 4-5 shows the estimated change in peak flow with the inclusion of the southern detention basins.

Table 4-5 – Existing and Developed Peak Flows (m^3/s) With Detention

Comparison Node	Location	0.5 EY			20% AEP			10% AEP			5% AEP			2% AEP			1% AEP		
		Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex	Ex	Dev	Dev/Ex
RptNth	Northwestern Portion	1.229	1.076	0.88	1.80	1.458	0.81	2.12	1.667	0.79	2.51	1.947	0.78	2.80	2.140	0.77	3.14	2.394	0.76
RptSth	Southern Portion of Site	1.734	1.637	0.94	2.78	2.526	0.91	3.39	3.376	0.99	4.15	3.801	0.92	4.73	4.692	0.99	5.37	5.354	1.00
Total	Total Site	2.962	2.672	0.90	4.58	3.886	0.85	5.51	4.300	0.78	6.66	5.737	0.86	7.54	6.664	0.88	8.52	7.583	0.89

Details of the basin performance are provided in Table 4-6 for Basin 1, and Table 4-7 for Basin 2 respectively below.

Table 4-6 – Basin 1 Detention Performance

Event	Active Storage Used (m^3)	Storage Depth (m)
0.5 EY	504	0.25
20% AEP	842	0.36
10% AEP	1084	0.43
5% AEP	1423	0.54
2% AEP	1582	0.58
1% AEP	1779	0.64

110709-02_RA03_Dev.xp

Table 4-7 – Basin 2 Detention Performance

Event	Active Storage Used (m^3)	Storage Depth (m)
0.5 EY	251	0.55
20% AEP	451	0.98
10% AEP	482	1.05
5% AEP	505	1.10
2% AEP	512	1.12
1% AEP	529	1.16

110709-02_RA03_Dev.xp

Full details of the detention basins and outlet structures will be determined and provided as part of the future subdivision works application. Provided that the stormwater management objectives are achieved, alternate detention basin configurations could be investigated as part of the detailed design phase. The assessment confirms that sufficient land is available to provide the required detention storage.

4.4. Freeboard

In the future detail design phase of the development, the detention basin design and adjacent subdivision grading will need to ensure that a freeboard is provided between the 1% AEP basin top water level and any adjacent finished floor level. CBC's Development Engineering Standards (June 2009) require the following freeboard from the maximum design basin top water level and spillway level of the detention basin:

- 0.3 m to finished floor levels of existing and new buildings.
- 0.1 m to garage floor levels.

Schedule 3 in Part B12 of the Bankstown Development Control Plan (DCP, 2015) requires the following floor-level controls for residential development in the Georges River Floodplain Medium Flood Risk Precinct:

- Habitable floor levels to be no lower than the 100-year (1% AEP) flood level plus freeboard of 0.5 m.
- Non-habitable floor levels to be no lower than the 20-year (5% AEP) flood unless justified by site-specific assessment.
- A restriction is to be placed on the title of the land, pursuant to S.88B of the Conveyancing Act, where the lowest habitable floor area is elevated more than 1.5m above finished ground level, confirming that the undercroft area is not to be enclosed. The use of roller shutters or similar measures (such as hit and miss brickwork) to enclose this area is however permissible.

Based on the flood assessment described in Section 7 of this report, the southern portion of the site is affected by regional Georges River flooding. Therefore the requirements of Schedule 3 in Part B12 of the Bankstown Development Control Plan (DCP, 2015) will take precedence in that portion of the site.

Chapter 2 of the draft consolidated Canterbury-Bankstown DCP 2021 has also been reviewed and Schedule 3 relating to development controls for land affected by the Georges River Flooding is consistent with the current DCP 2015.

5. STORMWATER QUALITY MANAGEMENT

The stormwater quality analysis for this study was undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). This water quality modelling software was developed by the Cooperative Research Centre (CRC) for catchment hydrology, which is based at Monash University and was first released in July 2002. Version 6.3 was adopted for this study.

The model provides a number of features relevant to the development including:

- It is able to model the potential nutrient reduction benefits of GPTs, constructed wetlands, grass swales, Bio-retention systems, sedimentation basins, infiltration systems, ponds and it incorporates mechanisms to model stormwater reuse as a treatment technique; and
- It provides mechanisms to evaluate the attainment of water quality objectives.

The MUSIC modelling was undertaken to demonstrate that the stormwater management system proposed for the development will result in reductions in overall post-development pollutant loads. As CBC does not currently have adopted stormwater quality pollution removal targets, the target pollutant removal rates of 90 % Gross Pollutants (GP), 85 % Suspended Solids (TSS), 65 % Total Phosphorus (TP) and 45 % Total Nitrogen (TN) has been adopted, consistent with the adjacent Liverpool City Council WSUD Technical Guidelines (Alluvium, 2016). It is noted that these pollution removal targets are consistent with current industry best practices and are adopted by a number of Councils in Western Sydney.

5.1. MUSIC Model Development

A MUSIC model was prepared to reflect the proposed development. The model considers all catchments discharging to the bio-retention basins and compensates for a relatively small amount of bypassing catchment in the east and west.

Plate 5-1 provides an overview of the MUSIC model arrangement.

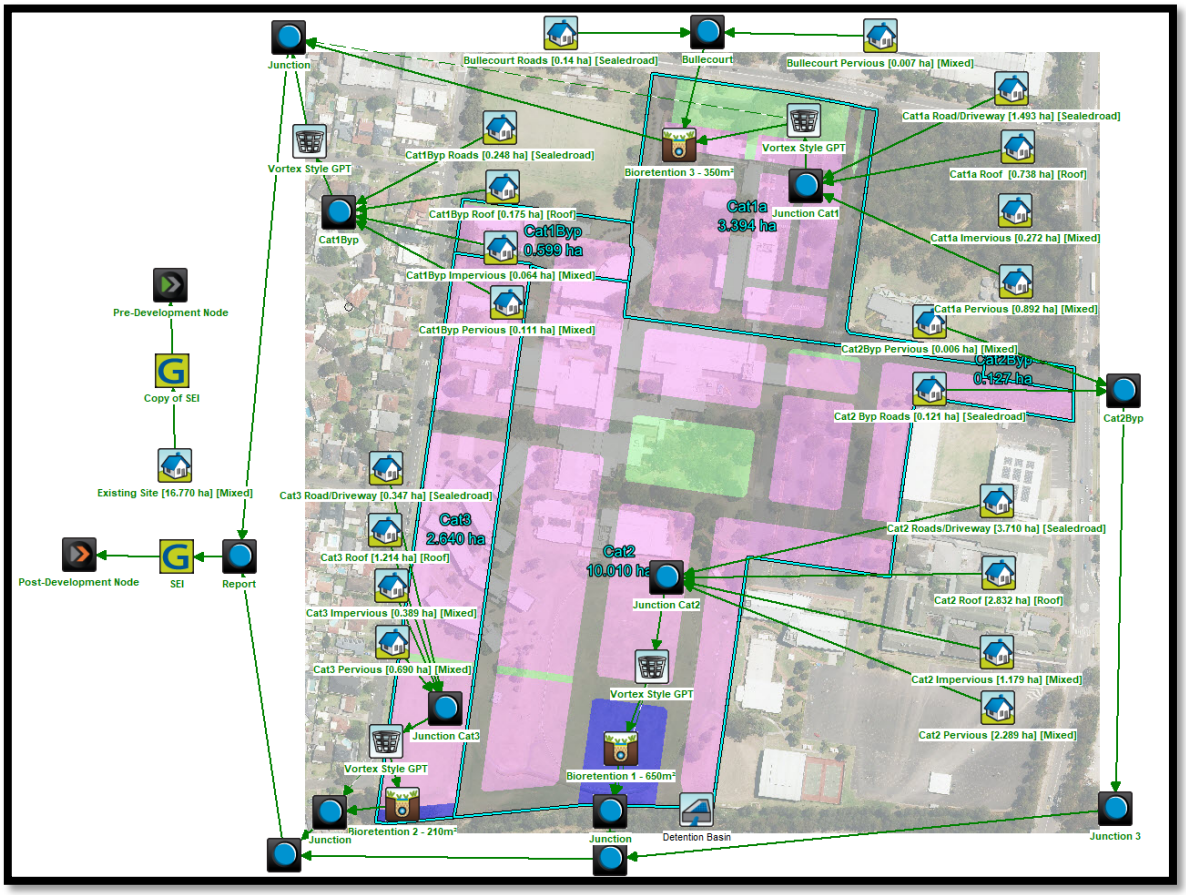


Plate 5-1 – MUSIC Model Layout (110709-02_MU03.sqz)

5.2. Modelling Parameters and Assumptions

The following catchment assumptions were adopted in the MUSIC model:

- Proposed catchment areas have adopted a total percentage impervious of 75% for the residential lots and are broken up as follows:
  - Roof Area = 50% of lot area
  - Road Area (driveways) = 10% of lot area
  - Other Impervious area = 15% of lot area
  - Pervious area = 25% of lot area
- Road Reserve = 95% Impervious
- Active Open Space = 50% Impervious
- Passive Open Space = 10% Impervious
- At the request of CBC, treatment of a portion (0.147 ha) of Bullecourt Avenue has been considered in the sizing of the northern bio-retention raingarden (Bio 3). The future detail design will need to consider the existing drainage constraints and capture as much of Bullecourt Avenue as possible in Bio 3.
- While rainwater tanks will need to be provided to meet BASIX requirements, Council requested that the stormwater quality modelling conservatively exclude rainwater tanks from the stormwater treatment train.
- Vortex style Gross Pollutant Traps will be provided upstream of the bio-retention raingardens. Details of the assumed GPT pollution removal performance is provided in Table 5-1 below.

Table 5-1 – Assumed GPT Pollutant Removal Performance

Parameter			
Gross Pollutants	Input (kg/ML)	Output (kg/ML)	Reduction (%)
	0	0	0%
	100	2	98%
Total Suspended Solids	Input (mg/L)	Output (mg/L)	Reduction (%)
	0	0	0%
	75	75	0%
	1000	300	70%
Total Phosphorous	Input (mg/L)	Output (mg/L)	Reduction (%)
	0	0	0%
	0.5	0.5	0%
	10	7	30%
Total Nitrogen	Input (mg/L)	Output (mg/L)	Reduction (%)
	0	0	0%
	50	50	0%

- Stormwater inflow in excess of the 4EY (3mth ARI) event will bypass the GPTs and bio-retention raingardens.
- Modelled raingarden parameters are provided in Table 5-2. Typically, the average surface area is in the order of 20% to 30% larger than the media bed area due to 1:4 batters within the extended detention zone. It was conservatively assumed that the average surface area is 10% larger than the media bed area for bio-retention Basins 1 & 3. Due to the relatively small footprint, bio-retention Basin 2 will likely be formed via retaining walls. Hence the average surface area is conservatively assumed to be the same as the media bed area for that basin.

Table 5-2 – Bio-retention Raingarden Node Inputs

Parameter	Bio 1	Bio 2	Bio 3
High Flow Bypass (m³/s)*	100	100	100
Extended Detention Depth (m)	0.3	0.3	0.3
Average surface Area (m²)	715	210	385
Filter Area (m²)	650	210	350
Filter Depth (m)	0.40	0.40	0.40
Unlined Filter Mdia Perimeter (m)	0.01	0.01	0.01
Saturated Hydraulic Conductivity (mm/hr)	200	200	100
TN content of Filter Media (mm/kg)	600	600	600
Orthophosphate Content of Filter Media (mg/kg)	30.0	30.0	30.0
Exfiltration rate (mm/hr)	0.00	0.00	0.00
Overflow Weir Width (m)	12.8	3.4	4.5

*A diversion link at the GPT directs stormwater flow in excess of the 4EY (3mth ARI) around the bio-retention raingarden.

Full details of the MUSIC area breakdown and node inputs are provided in Appendix B.

5.3. Pollutant Load Estimates

Total annual pollutant load estimates were derived from the results of the MUSIC model based on a 'mean' assessment of the developed site incorporating the proposed water quality treatment system. It was found that GPTs upstream of a 650 m² (Bio 1), a 210 m² bio-retention raingarden (Bio 2) in the south and a 350 m² bio-retention raingarden (Bio 3) in the north together with a GPT on the bypassing north-western catchment (Cat1Byp) would be required to ensure that the adopted pollutant reduction targets are met prior to discharge from the site. Table 5-3 details the results of the assessment.

Table 5-3 – Summary of Pollutant Loads and Reductions

Pollutant	Total Source Nodes	Minimum Reduction Required	Total Residual Load from Site	Total Reduction Achieved	Target Reduction Required	Reduction Achieved
	(kg/yr)	(kg/yr)	(kg/yr)	(kg/yr)	(%)	(%)
TSS	19700	16745	2850	16850	85.0%	85.5%
TP	37	24	10.1	27	65.0%	72.8%
TN	234	105	113	121	45.0%	51.7%
Gross Pollutants	2570	2313	47	2524	90.0%	98.2%

A MUSIC-Link report demonstrating compliance with the adopted Liverpool City Council WSUD Technical Guidelines (Alluvium, 2016) is provided in Appendix C.

5.4. Stream Erosion Index

The potential for stream erosion is assessed by estimating the increase in the relative frequency of flows from the site greater than the identified "stream forming flow" resulting from urbanisation of the catchment. This measure is referred to as the Stream Erosion Index (SEI) and is considered to be an appropriate means of assessing and addressing the impacts of urbanisation on the frequency of regular flows.

Consistent with the adjacent Liverpool City Council WSUD Guidelines, an assessment has been undertaken in accordance with the NSW MUSIC Modelling Guidelines (BMT, 2015) to ensure that the developed condition stream forming flows are not greater than 3.5 - 5 times the duration of existing condition streaming flows from the site.

Details of the SEI assessment is provided in Table 5-4.

Table 5-4 – SEI Results

Assessment Location	Determination of Critical Flow							Stream Erosion Index		
	Area (km^2)	$t_c = 0.76A^{0.38}$ (hour)	t_c (minutes)	I_2 (mm/hr)	C_2	Q_2 (m^3/s)	Q_{crit} (m^3/s)	Pre Dev Outflow (ML/yr)	Post Dev Outflow (ML/yr)	SEI
Overall Site	0.169169	0.39	23	59.8	0.444	1.249	0.6243	4.53	8.04	1.8

Results indicate that the SEI for the proposed development is a maximum of 1.8. This is less than the typically adopted maximum targets of 3.5 to 5.0 in western Sydney. The provision of WSUD elements within the development will assist in minimising the impact of urbanisation on the waterway stability of the receiving watercourse.

As part of the future detailed design process, if required, alternate GPT and bio-retention configurations could be implemented, provided that the pollution reduction and stream erosion index targets are achieved.

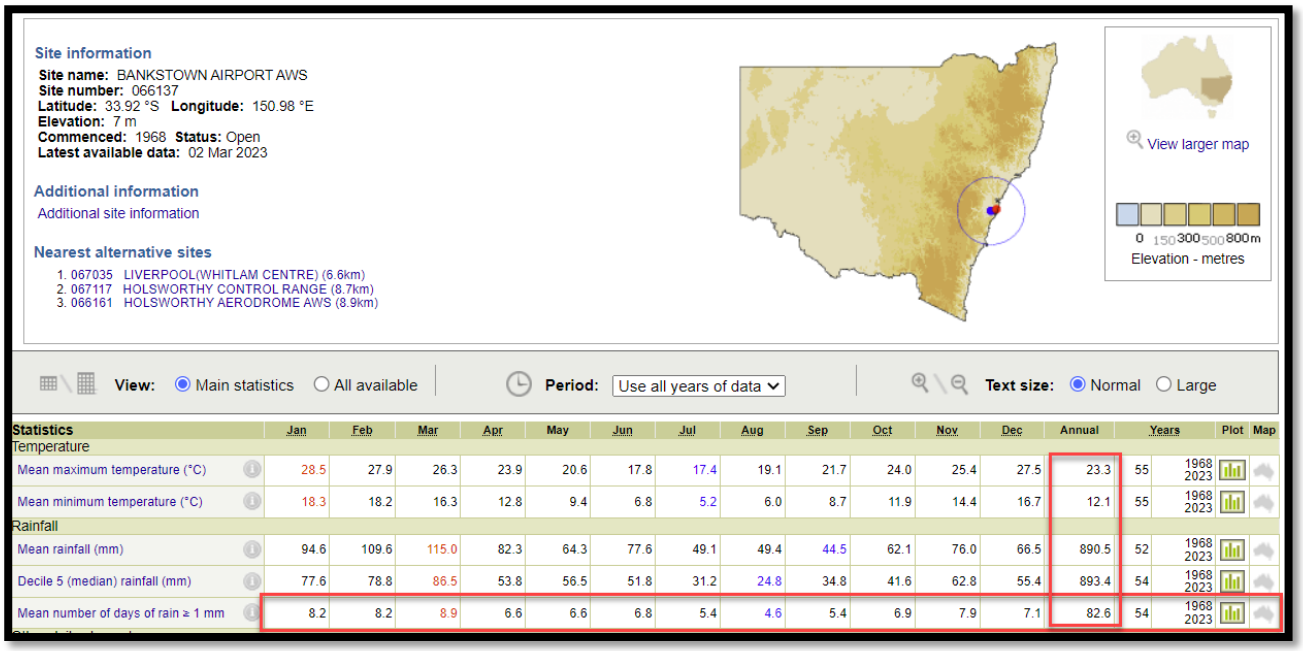
5.5. Frequency of Inundation Assessment

A basin inundation assessment was undertaken for Basin 1 using historic rainfall information in MUSIC software. A detention basin node was included in the MUSIC model which reflects the storage and discharge properties for Basin 1 from the XP-Rafts modelling described in Section 4. The following methodology was adopted:

- The Australian Bureau of Meteorology data for the nearby Bankstown Airport was reviewed to determine how frequently rainfall events occur.
- The flux file for the basin node was written using 6-minute timestep data and the water level has been analysed to determine how long the basin is inundated when a rainfall event occurs.

5.5.1 Rainfall Frequency

The BoM data for Bankstown Airport covers the years 1968 to 2023 and indicates that, on average, there are 83 days of rainfall depth >= 1mm per year. Please see Plate 5-2 below for further details.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years		Plot	Map
Temperature																	
Mean maximum temperature (°C)	28.5	27.9	26.3	23.9	20.6	17.8	17.4	19.1	21.7	24.0	25.4	27.5	23.3	55	1968 2023		
Mean minimum temperature (°C)	18.3	18.2	16.3	12.8	9.4	6.8	5.2	6.0	8.7	11.9	14.4	16.7	12.1	55	1968 2023		
Rainfall																	
Mean rainfall (mm)	94.6	109.6	115.0	82.3	64.3	77.6	49.1	49.4	44.5	62.1	76.0	66.5	890.5	52	1968 2023		
Decile 5 (median) rainfall (mm)	77.6	78.8	86.5	53.8	56.5	51.8	31.2	24.8	34.8	41.6	62.8	55.4	893.4	54	1968 2023		
Mean number of days of rain ≥ 1 mm	8.2	8.2	8.9	6.6	6.6	6.8	5.4	4.6	5.4	6.9	7.9	7.1	82.6	54	1968 2023		

Plate 5-2 – BoM Data Bankstown Airport

5.5.2 Inundation Assessment

Analysis of the Basin 1 flux file data from the MUSIC model indicates that, on average, the basin only holds water for 0.54 hours (32 minutes), and during 95% of the rainfall events the basin holds water for less than 2.23 hours (134 minutes). The maximum recorded time of inundation was 9.6 hours with a maximum basin depth of 0.42 m. Based on correlation with XP-Rafts data (see Table 4-6 in Section 4 above), this would suggest that a storm in the order of a 10% AEP event occurred within the historic dataset utilised by MUSIC software. It should be noted that the rainfall dataset in the MUSIC modelling reflects a relatively wet 10-year period from 1967 to 1976 and therefore the assessment is considered conservative.

The inundation analysis confirms that the basin will empty relatively quickly in local storm events, and therefore it is not anticipated that the combined use of this open space area as a detention basin would result in the closure of the playing field any differently to other playing fields within the Bankstown LGA when relatively large storm events occur.

It is noted that regional floodwater from the Georges River would take some days to recede. However, as per the above discussion on local inundation, we do not anticipate that this would affect the open space nature of Basin 1 any differently to the closure of parks and playing fields within the Bankstown LGA when significant rainfall events within the catchment occur.

Considering the limited number of days exceeding a 1mm depth on average per annum, combined with the limited duration in which the basin holds water in local catchment events, the predominant use of the southern open space is for recreation.

5.6. Construction Stage

Erosion and sediment control measures are to be implemented during the construction phase in accordance with the requirements of Council and the guidelines set out by Landcom (the "Blue Book" 2004).

As the operation of 'bio-retention' (raingarden) water quality treatment systems are sensitive to the impact of sedimentation, construction phase controls should generally be maintained until the majority of site building works (approximately 80%) are complete.

6. OPERATION AND MAINTENANCE MANUAL

Regular maintenance of the stormwater quality treatment devices is required to control weeds, remove rubbish and monitor plant establishment and health. Some sediment build-up may occur on the surface of the raingardens and may require removal to maintain the high standard of stormwater treatment. Regular management and maintenance of the water quality control systems will ensure long-term, functional stormwater treatment. A site-specific Operation and Maintenance (O & M) Manual has been prepared for the system and should be updated as part of future Development Applications. The O & M manual provides information on the Best Management Practices (BMP's) for the long-term operation of the treatment devices.

The manual provides site-specific management procedures for:

- Maintenance of the GPT structures, including rubbish and sediment removal;
- Management of the raingarden, including plant monitoring, replanting guidelines, monitoring and replacement of the filtration media and general maintenance (i.e. weed control, sediment removal); and
- Indicative costing of maintenance over the life of the device.

For detail refer to the Operation and Maintenance manual for the stormwater quality and quantity management devices prepared by J. Wyndham Prince in April 2023.

7. FLOOD IMPACT ASSESSMENT

TUFLOW modelling software has been utilised to determine the flood depths, levels, and impacts within the study area due to the proposed development. TUFLOW has the ability to accurately model the complex interaction of pipe drainage networks on the adjoining floodplain. TUFLOW has the ability to dynamically link 1D and 2D flow regimes together with mainstream and local overland flows all in one model, making it an ideal software package for the assessment of flood impacts for the proposed development.

The GRFS (BMT, 2020) has formed the basis of the WSU Milperra flood impact assessment. The GRFS (BMT, 2020) adopted the following approach/parameters:

- An XP -RAFTS hydrologic model was developed to simulate the rate of storm runoff from the catchment. The model predicts the amount of runoff from rainfall and the attenuation of the flood wave as it travels down the catchment.
- A TUFLOW-HPC hydraulic model with 10 x 10 metre grid was then developed to simulate the passage of a flood through the catchment to Botany Bay at the downstream end of the system.
- Initial and continuing losses are:
  - Urban catchments – initial loss 15 mm, continuing loss 1.5 mm/h; and
  - Rural catchments – initial loss 25 mm, continuing loss 2.5 mm/h.
- Manning's 'n' roughness value for hydraulic model (floodplain) ranging from 0.03 to 0.15 was used in this study, these values were adjusted locally (within reasonable bounds) to provide the best fit for peak water level profiles. Variability largely reflects degree of vegetation and land use on the floodplain (developed, cleared and forested)

Amendments to the GRFS (BMT, 2020) TUFLOW hydraulic model have been made to support the WSU Milperra flood impact assessment and are described below.

7.1. Existing Conditions Model Development

7.1.1 Existing Conditions Model

The GRFS (BMT, 2020) flood model was amended to reflect existing conditions for the WSU Milperra site as follows:

- Detailed survey information for the site in DEM format was read over the top of the underlying terrain used in the Georges River Model.
- The XP-RAFTS models described in Section 4 of this report were run for all storm durations to determine the critical storm durations occurring within the study area. The critical local flow duration adopted in the TUFLOW modelling was the 90-minute duration storm. The regional critical flow duration of 24 hours was adopted to find the worst-case regional flood levels at the site.
- Existing condition hydrographs for the site from the XPRAFTS model described in Section 4 were applied to reflect basin inflows in the south and site discharge in the north.
- An existing 4 x 1450mm diameter RCP culvert crossing under the M5 Highway to the south of the site has been added to the model. Invert levels were adopted based on ALS/survey terrain information.
- All other model parameters are consistent with the GRFS model (BMT, 2020).

The resultant flood mapping provided as part of this report considers the 'peak of peaks' flood levels from the suite of modelled durations. The existing condition TUFLOW model setup and adopted parameters are presented in Figures 7-1 and 7-2 in Appendix D.

7.2. Development Conditions Model Development

The existing conditions WSU Milperra flood model was then augmented to reflect the proposed development. The following model refinements were made:

- Updated terrain with a developed conditions surface was read over the top of the detailed survey for the site. A terrain modification within the TUFLOW model was applied to ensure that the level of the proposed lots has 0.5 m freeboard to the regional 1% AEP flood level of 5.55 m AHD (i.e. lots >=6.05 m AHD).

- Developed condition hydrographs for the site from the XPRAFTS model described in Section 4 were applied to reflect basin inflows in the south and site discharge in the north. The 90-minute and 24 hour critical flow durations were adopted in the TUFLOW modelling.
- Detention basin outlet structures for the site were included to ensure the operation of the detention basins was represented in the flood modelling in both local and regional flooding.

The developed Condition TUFLOW model setup and adopted parameters are presented on Figure 7-3 in Appendix D.

7.3. Flood Mapping and Discussion on Results

7.3.1 Model Validation

The GRFS (BMT, 2020) TUFLOW model supplied by Council was run for the 1% AEP event to confirm that Council's results are replicated. Plate 7-1 below provides a comparison between the re-run of the GRFS and the results provided by Council and confirms that the results have been replicated in the 1% AEP event. The regional 1% AEP flood level to the south of the site during a 1% AEP flood event is approximately 5.55 m AHD.

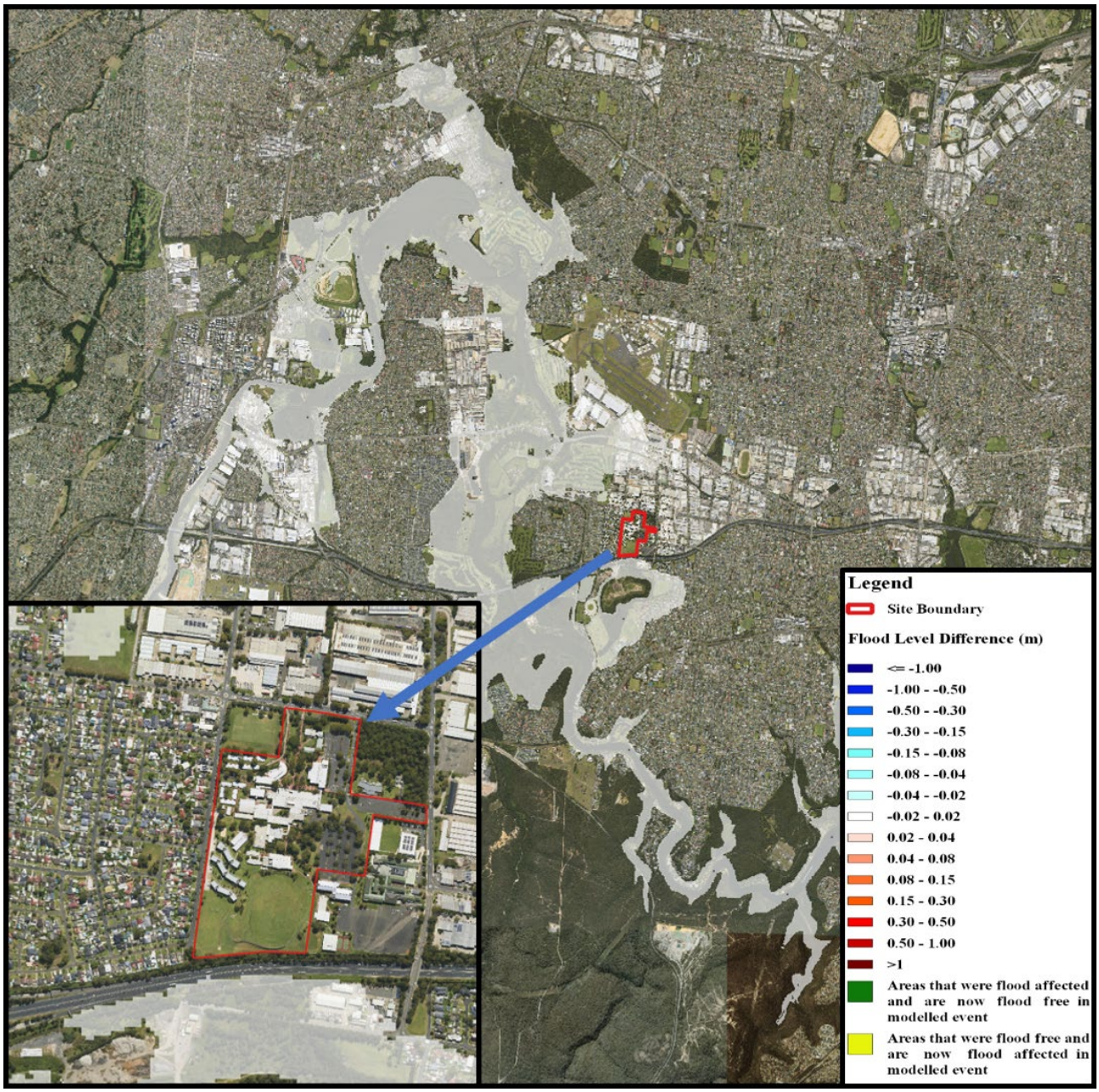


Plate 7-1 – Replication of the GRFS (BMT, 2020) Results for the 1% AEP Event

The GRFS model was then updated to reflect the existing condition WSU Milperra site as described in Section 7.1.1. Flood level difference mapping provided in Plate 7-2 compares flood levels in the existing site model with the GRFS (BMT, 2020) model. The results indicate a new flood-affected area due to amended inflow hydrograph locations on the site and the inclusion of the 4 x 1450mm diameter RCPs under the M5 motorway. Generally, flood levels are consistent with the GRFS (BMT, 2020). The regional 1% AEP flood level now encroaches the WSU Milperra site due to the inclusion of the culvert crossing under the M5 motorway and is approximately 5.55 m AHD.

This has been adopted as the base condition for the flood assessment of the site.

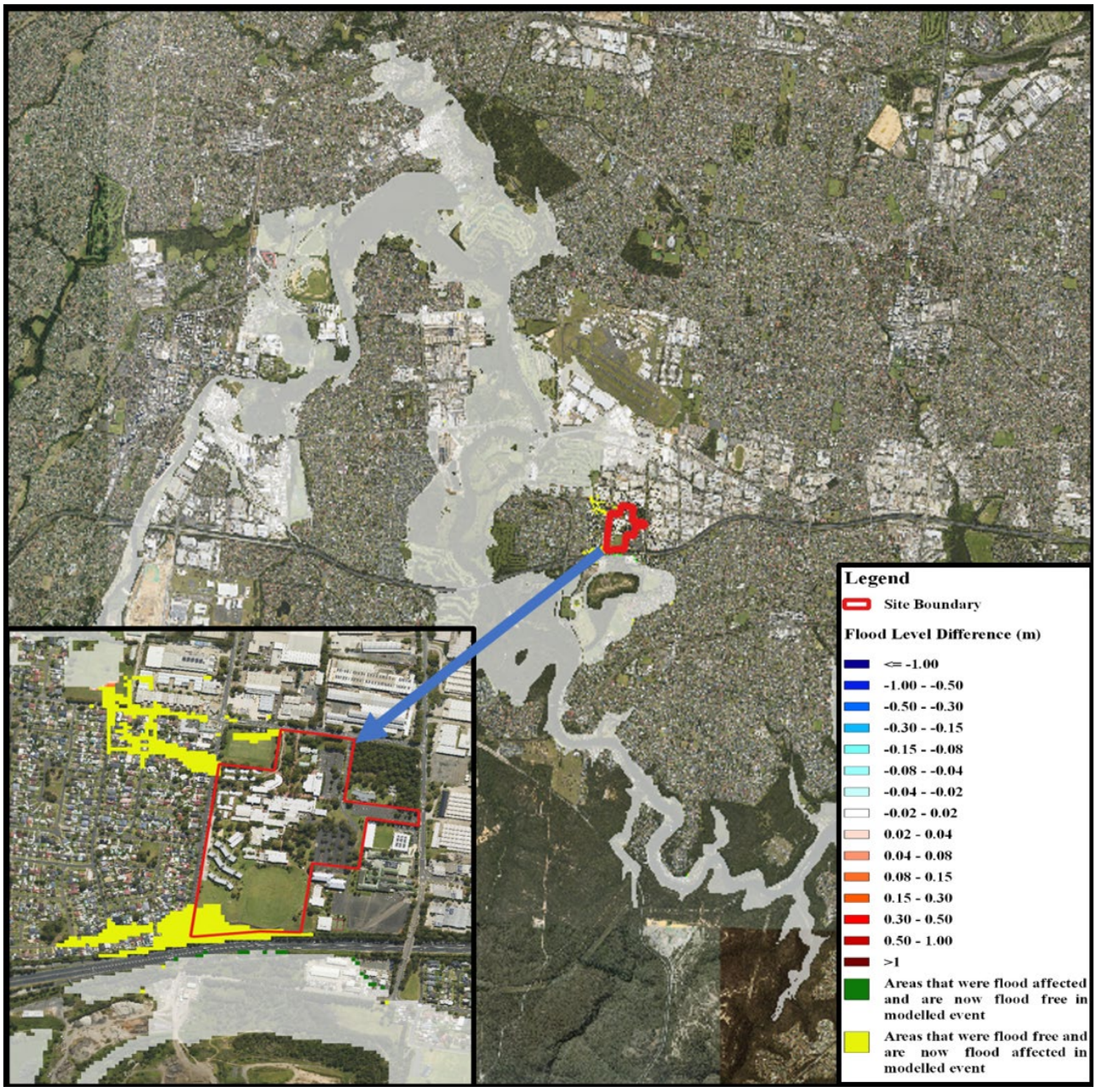


Plate 7-2 – Existing WSU Model vs GRFS (BMT, 2020) Flood Difference for 1% AEP Event

7.3.2 Existing Condition Flood Behaviour

Existing condition flood depth and level mapping for the 1% AEP event is provided in Figure 7-4 in Appendix D. The results indicate that the southern portion of the site is affected by regional flooding to a level of 5.55 m AHD. Some minor overland flow at existing site discharge locations are evident in the northern portion of the site. Figure 7-5 in Appendix D shows the existing condition flood depth and level mapping for PMF flood events. The results indicate flood levels of 11.8 m AHD at and around the site, which is consistent with the GRFS (BMT, 2020).

7.3.3 Developed Condition Flood Behaviour

Developed condition flood depth and level mapping for the 1% AEP event provided in Figure 7-6 indicates that flow from the site is adequately managed within the proposed detention basins. The 1% AEP flood level in the southern portion of the site is 5.55 m AHD, consistent with the existing regional flood level. Figure 7-7 in Appendix D shows the developed condition flood depth and level mapping for PMF flood events. The results indicate flood levels of 11.8 m AHD at and around the site, which is consistent with the existing condition.

There is no significant change in the flood behaviour as a result of the development external to the site when compared to the existing conditions.

7.3.4 Flood Impact

The flood level difference mapping provided in Figure 7-8 in Appendix D indicates that there are no adverse flood level impacts external to the site in the 1% AEP event. Some minor areas of new flood affectation are where depth are less than 50 mm on lots which are already flood affected and therefore inconsequential. Results confirm that flood level reductions in the order of 26 mm would occur downstream of the site to the northwest of the site.

7.3.5 Floodplain Storage

It is noted that the site is affected by regional flooding in the 1% AEP event. The flood surface and terrain information was interrogated and a 1% AEP flood storage volume of approximately 6,400 m³ is available on the existing site.

In the developed condition, the flood level difference mapping results described in Section 7.4.5 reflects the operation of the detention basins and confirm that there is the capacity to provide regional flood storage without affecting detention basin performance.

The developed condition flood surface and terrain information was also interrogated and a 1% AEP flood storage volume of approximately 9,600 m³ is available on site in developed condition. Therefore, there is no net loss of floodplain storage due to the proposed development.

7.4. Climate Change Assessment

The climate change guideline provided in the Australian Rainfall and Runoff (AR&R) 2019 Chapter 6 of Book1 has been used to understand the potential climate hazards surrounding the Subject site.

A six-step process is suggested in AR&R 2019 to incorporate climate change risks into the decision-making process and involve the estimation of design flood characteristics. Following the guideline, the site is within the catchment located in the East Coast South Natural Resource Management (NRM) Clusters (as presented in Figure 1.6.1 of AR&R 2019).

As a part of Step 3 there needs to be consideration of the “Purpose and Nature of the Asset or Activity and Consequences of its Failure”. AR&R 2019 states that the ‘purpose of the asset’ can refer to flow conveyance, improved safety, and reduced frequency of exposure and damage. The consequences of failure can be rated as either low, medium or high. The low consequence is defined as “some probability that asset performance will be impacted but the delivery of services will be only partially or temporarily compromised, or alternative sources of services (e.g. availability of different power sources) are readily available”. Given that the proposed developed floor level is above 1% AEP storm event, the consequence risk rating is therefore considered “low” for the subject site.

Application of Step 4 in the six-step process indicates for the 1% AEP event, the practitioner could consider the impact of the 0.5% and 0.2% AEP events to gain an understanding of the extent to which the risks of climate change may exceed the coping capacity of the facility to perform its intended function. The flood level, depth results for 0.5% AEP and 0.2% AEP in the existing and developed condition are provided in figure 7-9 to 7-12 in Appendix D.

Modelled peak flood levels for the 1% AEP, 0.5% AEP and 0.2% AEP events at the southern portion of the site are presented in Table 7-1. It is noted that the adopted lot level of 6.05 m AHD is 200 mm higher than 0.2% AEP flood level.

Table 7-1 – Flood Levels Comparison

Event	Flood Level (m AHD)
1%AEP	5.55
0.5%AEP	5.68
0.2%AEP	5.85

The 0.5% AEP flood level is around 0.13 m higher than the 1% AEP, whilst the 0.2% AEP flood level is only 0.30 m higher than the 1% AEP. These flood level differences are considered as a reasonable order of potential increases in peak flood levels that might eventuate from future climate change and associated increases in design rainfall intensities.

The incremental flood level impact in 0.5% AEP and 0.2% AEP events suggests low flood risk consequences to the site, particularly given that the FPL (i.e. 6.05 m AHD) for the proposed developemnt is greater than the 0.2 % AEP flood event.

Hence, it is concluded that the increases in flood levels are minimal and the exposure risk to the impacts of climate change is considered “low”.

Therefore, it is our view additional climate change considerations are not needed in support of this planning proposal. Furthermore, this approach is consistent with the EHG requirements from DPE for this development as a part of climate change assessment.

7.5. Flood Hazard Mapping

Hazard maps are useful to obtain an appreciation of the relative depth and velocity of floodwater within a locality. Flood hazard mapping has been prepared for the existing and developed conditions scenarios. Plate 7-3 below provides an overview of the velocity depth product corresponding with each of the H1 – H6 hazard categories which are further described in Pate 7-4.

The hazard zones consistent with the Australian Rainfall and Runoff Revision 2019 (ARR, 2019).

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)
H1	D*V ≤ 0.3	0.3	2.0
H2	D*V ≤ 0.6	0.5	2.0
H3	D*V ≤ 0.6	1.2	2.0
H4	D*V ≤ 1.0	2.0	2.0
H5	D*V ≤ 4.0	4.0	4.0
H6	D*V > 4.0	-	-

Plate 7-3 – ARR 2019 Hazard Vulnerability Threshold

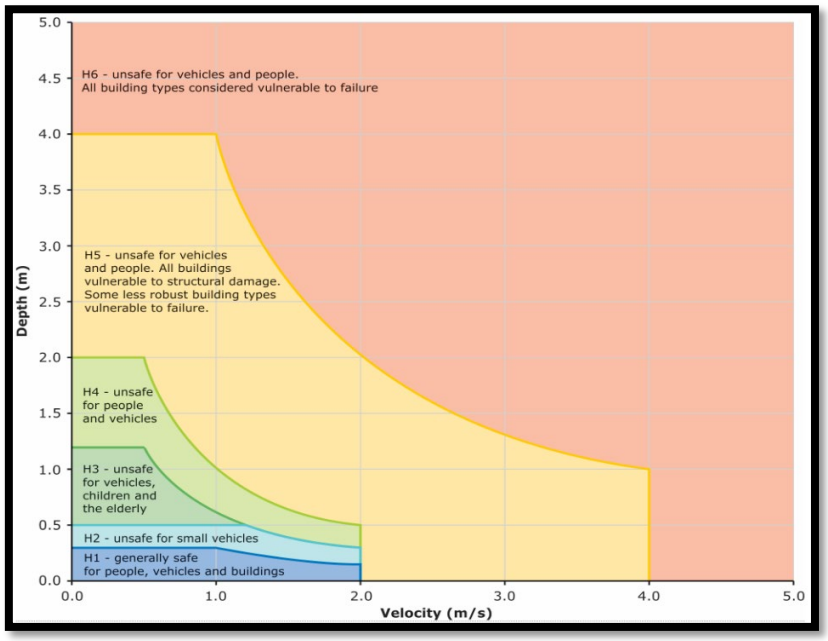


Plate 7-4 – ARR 2019 Hazard Categories

Existing condition flood hazard mapping for the 1% AEP flood event shown in Figure 7-13 in Appendix D indicates that flood hazard within the site and surrounds generally ranges from the H1 safe category to H3 (unsafe for children and the elderly) in the southwest portion of the site. Isolated high hazards (up to H5) are noted at the swale at M5 Highway corridor, south of the site which is unsafe for vehicles and people, with building subject to structural damage. High hazard is expected in dedicated drainage areas and can be managed via the use of appropriate flood warning signage.

Existing condition flood hazard mapping for the rarer 0.5% AEP, 0.2%AEP as climate change proxies along with the extreme PMF events are provided in figures 7-14 to 7-16, respectively, in Appendix D. In the PMF event, High hazard (H5) encompasses a large area of the south-western portion of the site.

Developed condition flood hazard mapping for 1% AEP flood event shown in Figure 7-17 in Appendix D indicates that, flood hazard within the site and surrounds is generally within the H1 safe category with hazard of H5 and H4 contained within the Basin 1 and Basin 2 respectively. Appropriate signage will be installed to mitigate this risk in high hazard (>H3) within the proposed detention basins. Furthermore, up to H5 hazard is seen at the swale at M5 Highway corridor, south of the site similar to existing condition in 1% AEP event.

Developed condition flood hazard mapping for 0.5% AEP, 0.2%AEP as climate change proxies along with the PMF events are provided in figures 7-18 to 7-20, respectively, in Appendix D. The high flood hazard (>H3) is contained within detention basins for events up to the 0.2% AEP. In the PMF event, High hazard (H5) encompasses a large area of the south-western portion of the site, consistent with existing condition PMF hazard.

Based on the flood hazard results, there is no significant change to flood hazard external to the site for 1% AEP, 0.5% AEP up to PMF events in developed condition compared to existing condition.

7.6. FLOOD EVACUATION PLAN

The safe evacuation of people from flood-affected areas during a PMF event is a vital consideration for the planning of the proposed development. The proposed development must allow residents to be able to leave their homes during the Probable Maximum Flood (PMF) event and travel safely to higher ground. The flood evacuation routes must follow a continuous rising grade to a level above the PMF event for all residents. The proposed flood evacuation routes have been determined using the low flood risk precinct extent from the results of this study which represents PMF extents as shown in figures 7-5 and 7-7 in Appendix D. The result suggests that Bullecourt Avenue and Horsley Road are flood-free in PMF events and can be flood evacuation access points for the proposed development if required. It should be noted that an existing childcare facility in the north-west portion of the site is not affected by PMF flooding and therefore evacuation of the proposed development will not adversely impact this existing facility.

The flood evacuation routes identified for the proposed development is provided in Plate 7-5.

Plate 7-5 – Flood Evacuation Plan

Furthermore, the Canterbury Bankstown Flood Emergency Sub-plan 2021 prepared in accordance with the provisions of the State Emergency Service Act 1989 (NSW) outlines the multi-agency arrangements for the emergency management of flooding in the Canterbury-Bankstown Local Government Area (LGA). The community specific roles and responsibilities from sub-plan is summarised below:

- Preparedness
  - Understand the potential risk and impact of flooding.
  - Prepare homes and property to reduce the impact of flooding.
  - Understand warnings and other triggers for action and the safest actions to take in a flood.
  - Households, institutions and businesses develop plans to manage flood risks, sharing and practicing this with family, friends, employees and
  - neighbours.
  - Have an emergency kit; and
  - Be involved in local emergency planning processes.
- Recovery

- Assist with community clean-up if required and able to do so.
- Participate in After Action Reviews if required.

8. SUMMARY/CONCLUSION

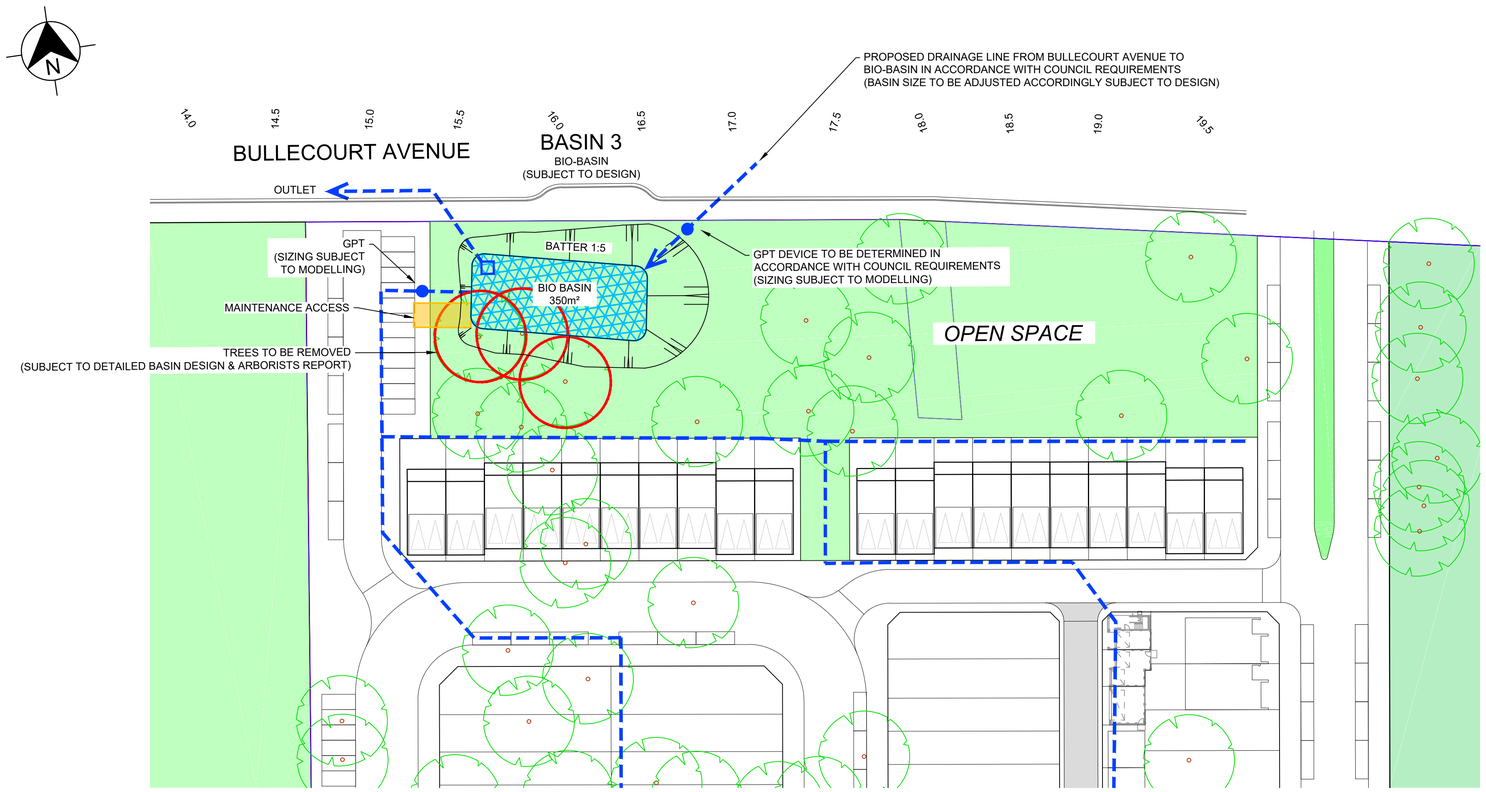
J. Wyndham Prince has been engaged by Mirvac to undertake a Flood and Risk Impact Assessment in support of a Planning Proposal to rezone approximately 19.62 ha of land at 2 and 2A Bullecourt Avenue, Milperra.

- Stormwater detention is not required for the north-western portion of the site due to the regrading of the site which has reduced the overall catchment discharging to the north-west. However, the southern portion of the site will require detention to ensure that developed condition flows are no greater than existing the condition. The investigation has determined that two (2) detention basins in the southern portion of the site with a combined 1% AEP detention volume of approximately 2,310 m³ will ensure that developed conditions flow are no greater than existing conditions flows external to the site.
- Four (4) Gross Pollutant Traps (GPTs) and three (3) bio-retention raingardens provide stormwater quality management for the proposed subdivision to ensure pollutant removal targets are met prior to discharge from the site. The bio-retention raingardens also ensure that developed conditions durations of stream forming flows are no greater than 3.5 – 5.0 times the duration of existing conditions stream forming flows.
- A frequency of inundation assessment was undertaken for the large southern detention Basin 1. For 95% of the modelled historic rainfall events, the assessment indicates that Basin 1 would hold water for less than 2.5 hours. Bureau of Meteorology data for the nearby Bankstown Airport indicates that, on average, rainfall events with a depth of >=1mm depth occur 85 days per annum. Therefore, the predominant use of the Basin 1 southern open space is for recreation.
- A flood assessment was undertaken using the hydraulic model that supported the Georges River Flood Study (BMT, 2020) to determine the flood risk and impact for storm events ranging from the 1% AEP to the PMF event.
- The regional 1% AEP flood level at the site is 5.55 m AHD in both the existing and developed condition. Freeboard of 0.5 m is required to finished floor levels and this the minimum floor levels for the proposed dwellings would be 6.05m AHD.
- Flood level difference mapping provided in Figure 7-12 in Appendix D indicates that there are no adverse flood level impacts external to the site.
- A climate change assessment was undertakn utilising the 0.5% AEP and 0.2% AEP events as proxies for 1% AEP climate change. 200 mm freeboard would still be available to the finished floor levels of proposed dwellings in the 0.2% AEP and therefore flood risk increases due to climate change are low.
- The site is affected by regional flooding in the 1% AEP event. The flood surface and terrain information have been interrogated for the existing and developed condition site. There is no net loss of floodplain storage due to the proposed development in the 1% AEP event.
- A flood evacuation plan is provided demonstrating that a continuous rising grade to areas above the PMF level can be achieved.

9. REFERENCES

1. BMT WBM Pty Ltd (2015). NSW MUSIC Modelling Guidelines
2. BMT WBM Pty Ltd (2018). TUFLOW User Manual
3. Bankstown Local Environmental Plan (LEP, 2015)
4. Bankstown Development Control Plan (DCP, 2015)
5. Botany Bay & Catchment Water Quality Improvement Plan (Sydney Metropolitan Catchment Management Authority, 2011)
6. Canterbury-Bankstown Council Development Engineering Standards (2006, as amended June 2009)
7. Draft Canterbury Bankstown Development Control Plan 2021 (DCP, 2021).
8. Georges River Flood Study (BMT, 2020)
9. Greater Metropolitan Regional Environmental Plan No.2 – Georges River Catchment (2020)
10. Liverpool City Council WSUD Technical Guidelines (Alluvium, 2016)
11. Willing & Partners Pty Ltd (1994). Runoff Analysis & Flow Training Simulation – Detailed Documentation and User Manual, Version 4.0
12. Willing & Partners Pty Ltd (1996). Runoff Analysis & Flow Training Simulation – Addendum Version 5.0
13. City of Canterbury Bankstown Council (2021) Canterbury Bankstown Flood Emergency Sub-plan

APPENDIX A – ENGINEERING PLAN



BASIN 3 PRELIMINARY LAYOUT PLAN
(INDICATIVE ONLY SUBJECT TO DESIGN)

TYPICAL BIO-BASIN PERCHED WITH OUTLET TO OSD
(INDICATIVE ONLY)

EXAMPLE BIO-BASIN INTEGRATED BETWEEN
ROADWAY AND PLAYGROUND AREA
(INDICATIVE ONLY)

1:500 (AT A1)
1:1000 (AT A3)

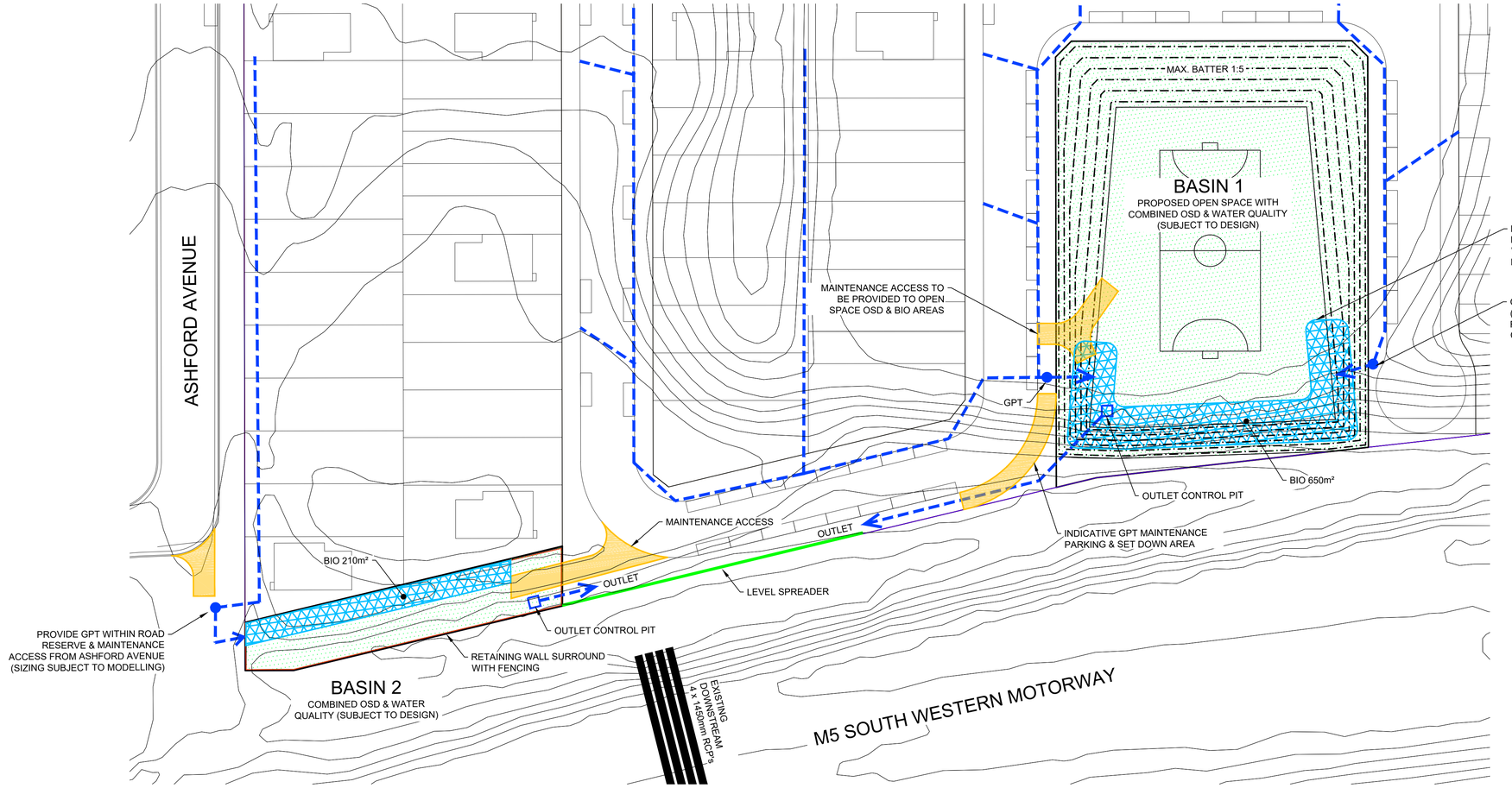
10 0 10 20 30 40 50
METRES

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300 **W** www.jwprince.com.au **E** jwp@jwprince.com.au

WSU MILPERRA
PRELIMINARY BASIN 3 LAYOUT
INDICATIVE ONLY

Client: mirvac

110709-02-SK006
Rev B 14/04/23



BASINS 1 & 2 PRELIMINARY LAYOUT PLAN
(INDICATIVE ONLY SUBJECT TO DESIGN)

BIO-BASIN WITH ACCESS, SANDSTONE BLOCK WALLS & OPEN SPACE USE ADJOINING
(INDICATIVE ONLY)

PROPOSED HARD EDGING TO
RAINGARDEN - SANDSTONE BLOCK
WALL OR SIMILAR TO COUNCIL
REQUIREMENTS

GPT
(SIZING SUBJECT TO MODELLING)
RESTRICTED PARKING WITHIN
CULDESAC FOR GPT ACCESS

IEXAMPLE BIO-BASIN INTEGRATED BETWEEN
ROADWAY AND PLAYGROUND AREA
(INDICATIVE ONLY)

TYPICAL BIO-BASIN PERCHED WITH OUTLET TO OSD
(INDICATIVE ONLY)

1:500 (AT A1)
1:1000 (AT A3)
10 0 10 20 30 40 50
METRES

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300 W www.jwprince.com.au E jwp@jwprince.com.au

WSU MILPERRA
PRELIMINARY BASIN 1 & 2 LAYOUTS
INDICATIVE ONLY

Client: mirvac

110709-02-SK007
Rev B 14/04/23

APPENDIX B – MUSIC MODEL DATA

MUSIC MODELLING WORKSHEET

	Catchment Division							Node Inputs Catchment Split Road/Roof/Impervious/Pervious				
Catchment	**Total Catchment Area (ha)**	**R2 Lot Area (ha)**	**R2 No. Lots**	**Avg Lot Size (m^2)**	**Road Reserve Area (ha)**	**Active Open Space**	**Passive Open Space/RG**	**Road/Driveway (ha)**	**Roof (ha)**	**Other Impervious (ha)**	**Pervious Areas (ha)**	**Effective % Impervious**
Cat1a	3.394	1.476	88	168	1.416		0.502	1.493	0.738	0.272	0.892	73.7%
Cat1Byp	0.599	0.350	15	233	0.225	0.024		0.248	0.175	0.064	0.111	81.5%
Cat2	10.010	5.664	233	243	3.309	0.565	0.472	3.710	2.832	1.179	2.289	77.1%
Cat2Byp	0.127				0.127			0.121			0.006	95.0%
Cat3	2.640	2.427	82	296	0.110	0.036	0.066	0.347	1.214	0.389	0.690	73.9%
Existing Bullecourt Avenue	0.147				0.147			0.140			0.007	95.0%
Total	16.917											

		Urban Rational					0.1
	Cat. Area (ha)	**Flow Path Length (m)**	**Tc* (min)**	**%Imperv.**	**1yr Flow (m^3/s)**	**3mth Flow (m^3/s)**	**Weir Length**
Cat1a (GPT 3)	3.394	430	7.1	74%	0.462	0.240	4.5
Cat2 (GPT 1)	10.010	540	8.0	77%	1.323	0.688	12.8
Cat3 (GPT 2)	2.640	475	7.5	74%	0.352	0.183	3.4
Cat1Byp	0.599	140	5.0	82%	0.097	0.050	1.0

*Tc calculated based on Kinematic wave equation for a typical 370 m^2 lot plus flowpath travel time @ 2 m/s

= Adopted GPT High Flow Bypass

%Impervious	
R2 and R3 Lots	75%
Road	95%
Passive Open Space	10%
Active Open Space	50%
% Breakdown of lot area	
Roof	50%
Driveways	10%
Other Impervious	15%
Pervious Areas	25%

APPENDIX C – MUSIC-LINK REPORT

LIVERPOOL CITY COUNCIL

music@link

MUSIC-*link* Report

Project Details		Company Details	
Project:	WSU Milperra Rezoning	**Company:**	J. Wyndham Prince
Report Export Date:	19/04/2023	**Contact:**	Francis Lane
Catchment Name:	110709-02_MU03	**Address:**	Level 2/50 Belmore Street Penrith NSW 2750
Catchment Area:	16.917ha	**Phone:**	02 4720 3385
Impervious Area*:	148.3%	**Email:**	flane@jwprince.com.au
Rainfall Station:	67035 LIVERPOOL(WHITLAM		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1967 - 31/12/1976 11:54:00 PM		
Mean Annual Rainfall:	857mm		
Evapotranspiration:	1171mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Liverpool Clay Soil		
Scenario:	Liverpool Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Report	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	2.37%	Bio Retention Node	3	Urban Source Node	21
TSS	85.4%	Detention Basin Node	1		
TP	72.7%	GPT Node	4		
TN	51.3%	Generic Node	2		
GP	98.2%				

Comments

Pre-development node only in model for SEI assessment. Pollution reductions are not appliccable to this node.

Rainwater tanks excluded as requested by Council.

LIVERPOOL CITY COUNCIL

music@link

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention 1 - 650m²	Exfiltration Rate (mm/hr)	0	None	0
Bio	Bioretention 1 - 650m²	Hi-flow bypass rate (cum/sec)	0	None	100
Bio	Bioretention 1 - 650m²	Orthophosphate Content in Filter (mg/kg)	0	55	30
Bio	Bioretention 1 - 650m²	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention 1 - 650m²	Total Nitrogen Content in Filter (mg/kg)	1	800	600
Bio	Bioretention 2 - 210m²	Exfiltration Rate (mm/hr)	0	None	0
Bio	Bioretention 2 - 210m²	Hi-flow bypass rate (cum/sec)	0	None	100
Bio	Bioretention 2 - 210m²	Orthophosphate Content in Filter (mg/kg)	0	55	30
Bio	Bioretention 2 - 210m²	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention 2 - 210m²	Total Nitrogen Content in Filter (mg/kg)	1	800	600
Bio	Bioretention 3 - 350m²	Exfiltration Rate (mm/hr)	0	None	0
Bio	Bioretention 3 - 350m²	Hi-flow bypass rate (cum/sec)	0	None	100
Bio	Bioretention 3 - 350m²	Orthophosphate Content in Filter (mg/kg)	0	55	30
Bio	Bioretention 3 - 350m²	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention 3 - 350m²	Total Nitrogen Content in Filter (mg/kg)	1	800	600
Detention	Detention Basin	% Reuse Demand Met	None	None	0
GPT	Vortex Style GPT	Hi-flow bypass rate (cum/sec)	None	99	0.05
GPT	Vortex Style GPT	Hi-flow bypass rate (cum/sec)	None	99	0.24
GPT	Vortex Style GPT	Hi-flow bypass rate (cum/sec)	None	99	0.688
GPT	Vortex Style GPT	Hi-flow bypass rate (cum/sec)	None	99	0.183
Post	Post-Development Node	% Load Reduction	None	None	92.3
Post	Post-Development Node	GP % Load Reduction	90	None	99.4
Post	Post-Development Node	TN % Load Reduction	45	None	92.8
Post	Post-Development Node	TP % Load Reduction	65	None	94.1
Post	Post-Development Node	TSS % Load Reduction	85	None	95.7
Pre	Pre-Development Node	% Load Reduction	None	None	80.6
Pre	Pre-Development Node	TN % Load Reduction	45	None	82.5
Pre	Pre-Development Node	TP % Load Reduction	65	None	80.8
Urban	Bullecourt Pervious [0.007 ha]	Area Impervious (ha)	None	None	0
Urban	Bullecourt Pervious [0.007 ha]	Area Pervious (ha)	None	None	0.007
Urban	Bullecourt Pervious [0.007 ha]	Total Area (ha)	None	None	0.007
Urban	Bullecourt Roads [0.14 ha]	Area Impervious (ha)	None	None	0.14
Urban	Bullecourt Roads [0.14 ha]	Area Pervious (ha)	None	None	0
Urban	Bullecourt Roads [0.14 ha]	Total Area (ha)	None	None	0.14
Urban	Cat1a Imervious [0.272 ha]	Area Impervious (ha)	None	None	0.272
Urban	Cat1a Imervious [0.272 ha]	Area Pervious (ha)	None	None	0
Urban	Cat1a Imervious [0.272 ha]	Total Area (ha)	None	None	0.272
Urban	Cat1a Pervious [0.892 ha]	Area Impervious (ha)	None	None	0
Urban	Cat1a Pervious [0.892 ha]	Area Pervious (ha)	None	None	0.892
Urban	Cat1a Pervious [0.892 ha]	Total Area (ha)	None	None	0.892

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Cat1a Road/Driveway [1.493 ha]	Area Impervious (ha)	None	None	1.493
Urban	Cat1a Road/Driveway [1.493 ha]	Area Pervious (ha)	None	None	0
Urban	Cat1a Road/Driveway [1.493 ha]	Total Area (ha)	None	None	1.493
Urban	Cat1a Roof [0.738 ha]	Area Impervious (ha)	None	None	0.738
Urban	Cat1a Roof [0.738 ha]	Area Pervious (ha)	None	None	0
Urban	Cat1a Roof [0.738 ha]	Total Area (ha)	None	None	0.738
Urban	Cat1Byp Impervious [0.064 ha]	Area Impervious (ha)	None	None	0.064
Urban	Cat1Byp Impervious [0.064 ha]	Area Pervious (ha)	None	None	0
Urban	Cat1Byp Impervious [0.064 ha]	Total Area (ha)	None	None	0.064
Urban	Cat1Byp Pervious [0.111 ha]	Area Impervious (ha)	None	None	0
Urban	Cat1Byp Pervious [0.111 ha]	Area Pervious (ha)	None	None	0.111
Urban	Cat1Byp Pervious [0.111 ha]	Total Area (ha)	None	None	0.111
Urban	Cat1Byp Roads [0.248 ha]	Area Impervious (ha)	None	None	0.248
Urban	Cat1Byp Roads [0.248 ha]	Area Pervious (ha)	None	None	0
Urban	Cat1Byp Roads [0.248 ha]	Total Area (ha)	None	None	0.248
Urban	Cat1Byp Roof [0.175 ha]	Area Impervious (ha)	None	None	0.175
Urban	Cat1Byp Roof [0.175 ha]	Area Pervious (ha)	None	None	0
Urban	Cat1Byp Roof [0.175 ha]	Total Area (ha)	None	None	0.175
Urban	Cat2 Byp Roads [0.121 ha]	Area Impervious (ha)	None	None	0.121
Urban	Cat2 Byp Roads [0.121 ha]	Area Pervious (ha)	None	None	0
Urban	Cat2 Byp Roads [0.121 ha]	Total Area (ha)	None	None	0.121
Urban	Cat2 Impervious [1.179 ha]	Area Impervious (ha)	None	None	1.179
Urban	Cat2 Impervious [1.179 ha]	Area Pervious (ha)	None	None	0
Urban	Cat2 Impervious [1.179 ha]	Total Area (ha)	None	None	1.179
Urban	Cat2 Pervious [2.289 ha]	Area Impervious (ha)	None	None	0
Urban	Cat2 Pervious [2.289 ha]	Area Pervious (ha)	None	None	2.289
Urban	Cat2 Pervious [2.289 ha]	Total Area (ha)	None	None	2.289
Urban	Cat2 Roads/Driveway [3.710 ha]	Area Impervious (ha)	None	None	3.71
Urban	Cat2 Roads/Driveway [3.710 ha]	Area Pervious (ha)	None	None	0
Urban	Cat2 Roads/Driveway [3.710 ha]	Total Area (ha)	None	None	3.71
Urban	Cat2 Roof [2.832 ha]	Area Impervious (ha)	None	None	2.832
Urban	Cat2 Roof [2.832 ha]	Area Pervious (ha)	None	None	0
Urban	Cat2 Roof [2.832 ha]	Total Area (ha)	None	None	2.832
Urban	Cat2Byp Pervious [0.006 ha]	Area Impervious (ha)	None	None	0
Urban	Cat2Byp Pervious [0.006 ha]	Area Pervious (ha)	None	None	0.006
Urban	Cat2Byp Pervious [0.006 ha]	Total Area (ha)	None	None	0.006
Urban	Cat3 Impervious [0.389 ha]	Area Impervious (ha)	None	None	0.389
Urban	Cat3 Impervious [0.389 ha]	Area Pervious (ha)	None	None	0
Urban	Cat3 Impervious [0.389 ha]	Total Area (ha)	None	None	0.389
Urban	Cat3 Pervious [0.690 ha]	Area Impervious (ha)	None	None	0

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Cat3 Pervious [0.690 ha]	Area Pervious (ha)	None	None	0.69
Urban	Cat3 Pervious [0.690 ha]	Total Area (ha)	None	None	0.69
Urban	Cat3 Road/Driveway [0.347 ha]	Area Impervious (ha)	None	None	0.347
Urban	Cat3 Road/Driveway [0.347 ha]	Area Pervious (ha)	None	None	0
Urban	Cat3 Road/Driveway [0.347 ha]	Total Area (ha)	None	None	0.347
Urban	Cat3 Roof [1.214 ha]	Area Impervious (ha)	None	None	1.214
Urban	Cat3 Roof [1.214 ha]	Area Pervious (ha)	None	None	0
Urban	Cat3 Roof [1.214 ha]	Total Area (ha)	None	None	1.214
Urban	Existing Site [16.770 ha]	Area Impervious (ha)	None	None	0
Urban	Existing Site [16.770 ha]	Area Pervious (ha)	None	None	16.77
Urban	Existing Site [16.770 ha]	Total Area (ha)	None	None	16.77

Only certain parameters are reported when they pass validation

LIVERPOOL CITY COUNCIL

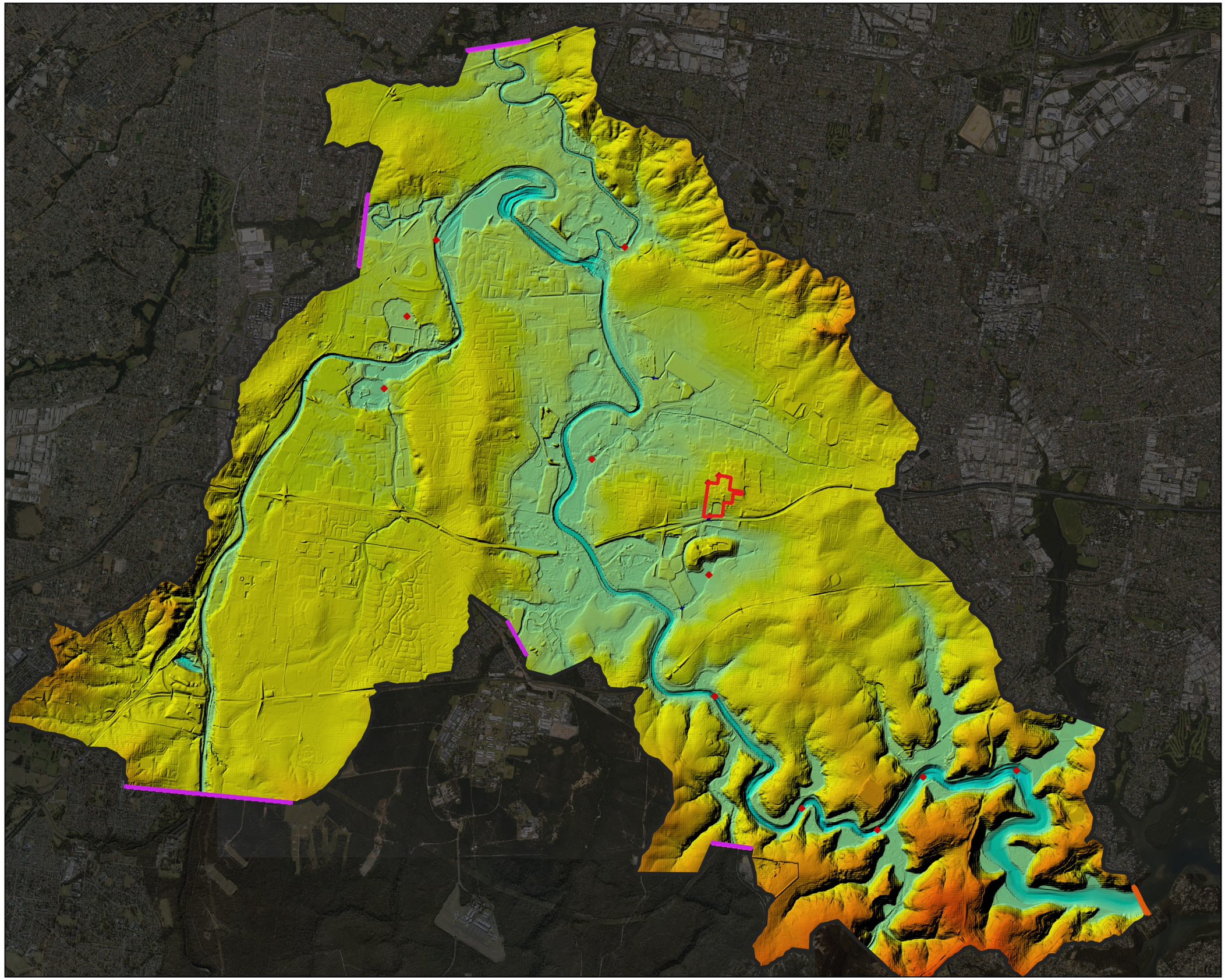
music@link

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Pre	Pre-Development Node	GP % Load Reduction	90	None	0
Pre	Pre-Development Node	TSS % Load Reduction	85	None	78.6

Only certain parameters are reported when they pass validation

APPENDIX D – FIGURES



J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Terrain Elevation (m AHD)

- <= 0
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- > 60

TUFLOW Elements

- Model Boundary
- Inflow Location
- Upstream Inflow Locations
- Downstream Boundary
- Drainage Network

0 600 1,200 1,800 m

Scale at A3 **1:50000**

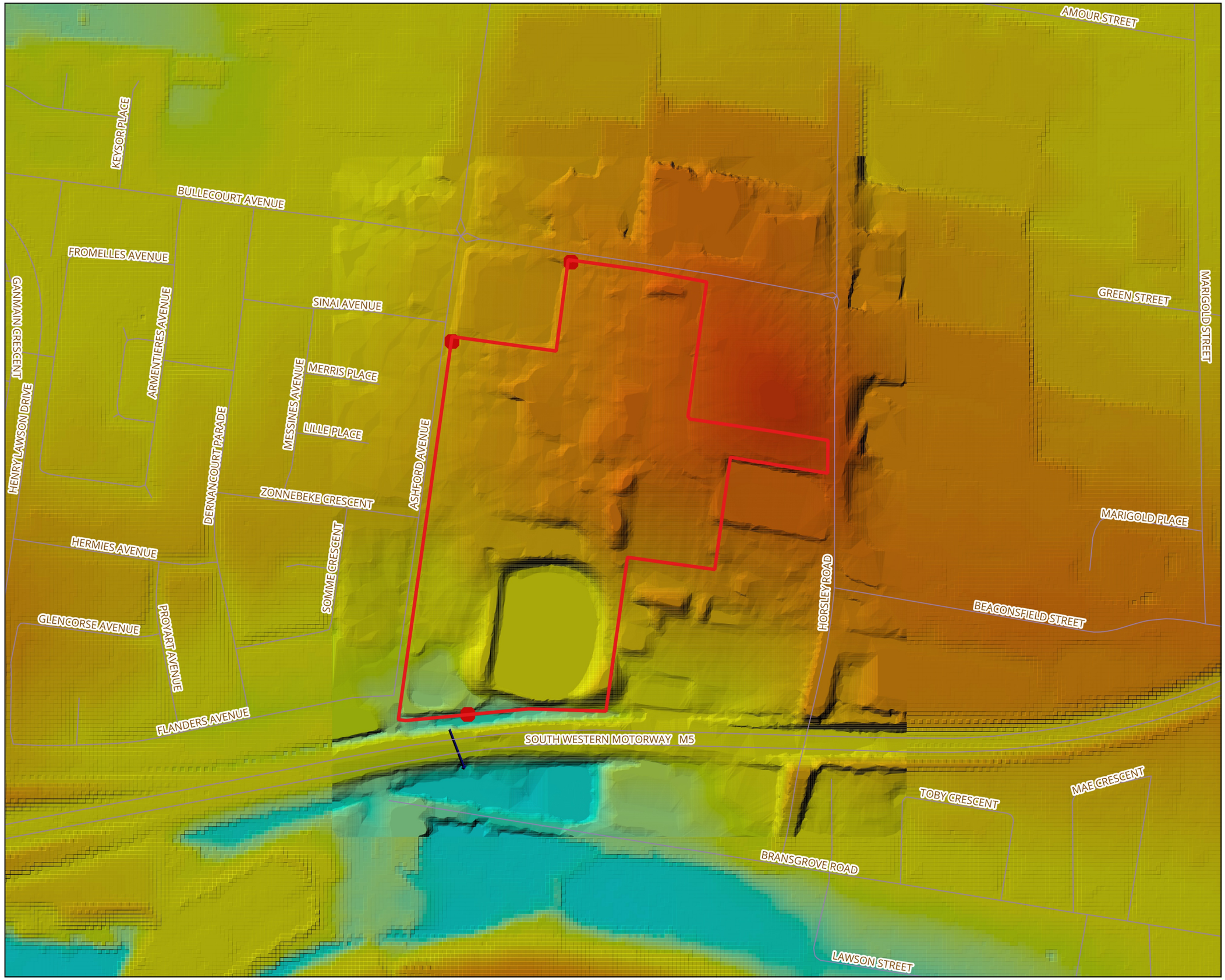
Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-1**

Existing Terrain and TUFLOW Elements

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	



J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Terrain Elevation (m AHD) Site

- <= 0
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- > 20

TUFLOW Elements

- Inflow Location
- Drainage Network

0 50 100 150 m

Scale at A3 **1:4500**

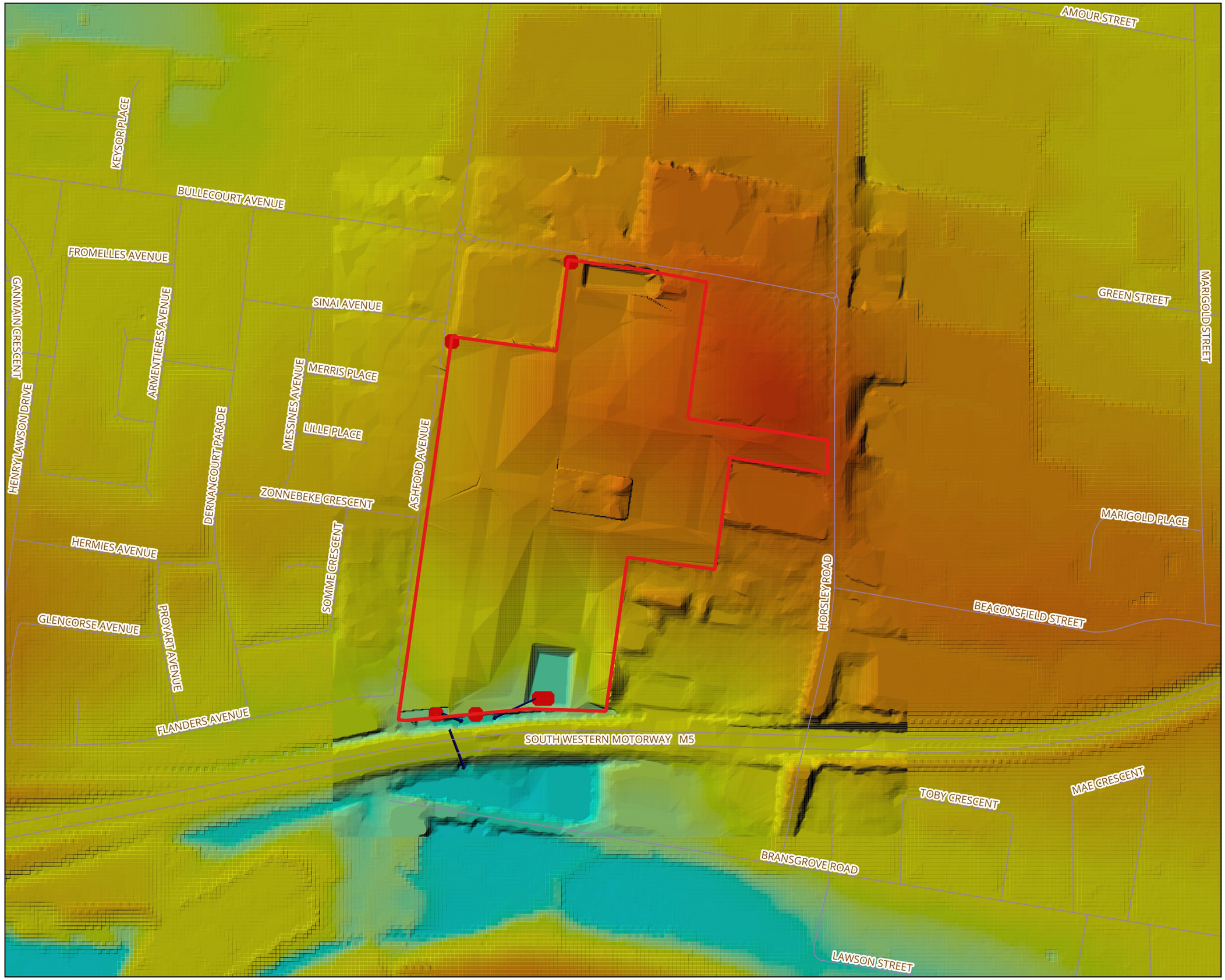
Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-2**

Existing Terrain and TUFLOW Elements (Site)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	



J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Terrain Elevation (m AHD) Site

- <= 0
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- > 20

TUFLOW Elements

- Inflow Location
- Drainage Network

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-3**

Developed Terrain and TUFLOW Elements (Site)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- Flood Level 1m Intervals
- Flood Level 0.1m Intervals

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-4**

1% AEP Flood Level and Depth
Existing Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- Flood Level 1m Intervals
- Flood Level 0.1m Intervals

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-5**

PMF Flood Level and Depth
Existing Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- **Flood Level 1m Intervals**
- **Flood Level 0.1m Intervals**

0 50 100 150 m

Scale at A3 **1:4500**

Job Title

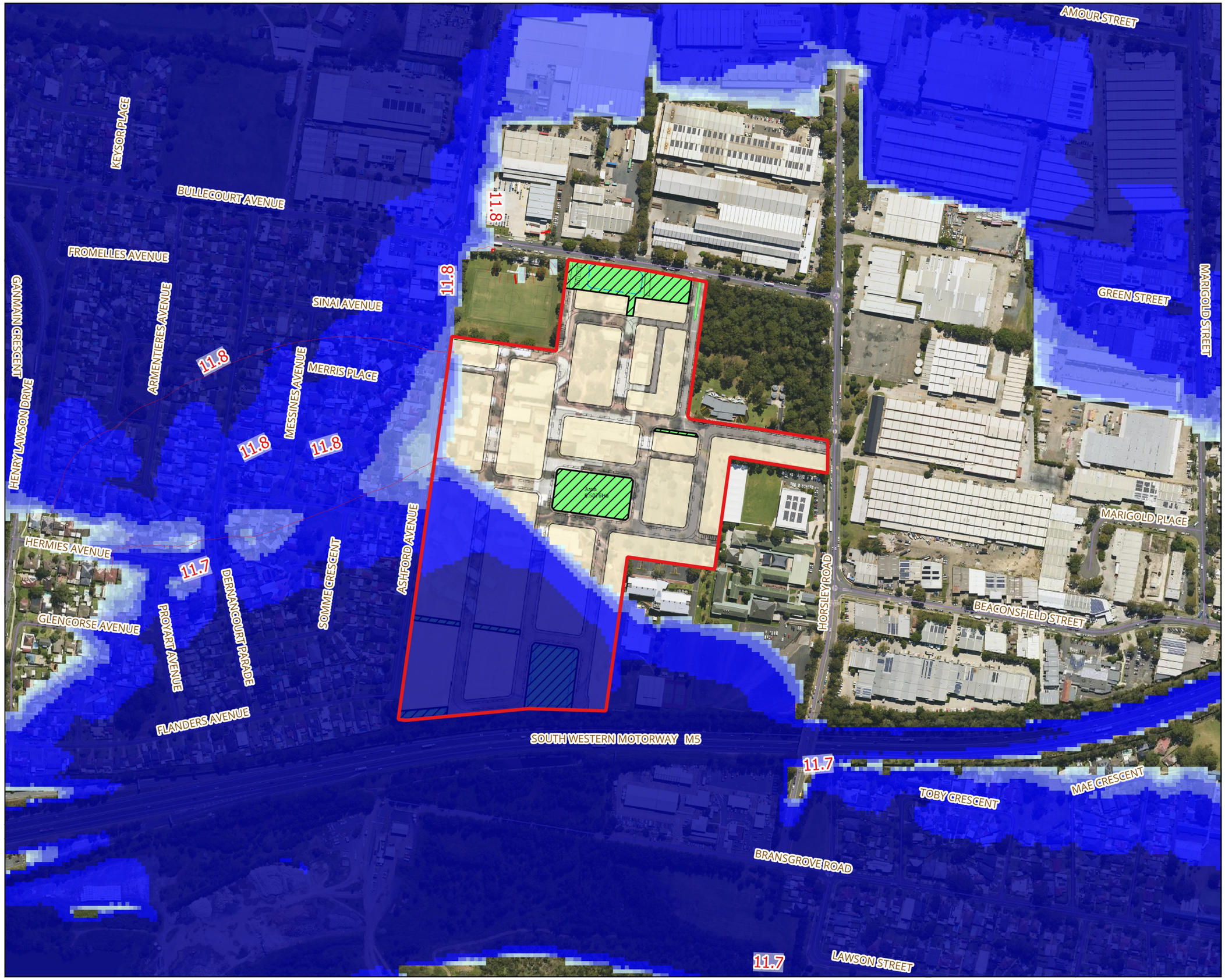
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-6**

1%AEP Flood Level and Depth
Developed Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	



J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- Flood Level 1m Intervals
- Flood Level 0.1m Intervals

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. 7-7
PMF Flood Level and Depth
Developed Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Flood Level Difference (m)

- <= -1.00
- -1.00 - -0.50
- -0.50 - -0.30
- -0.30 - -0.15
- -0.15 - -0.08
- -0.08 - -0.04
- -0.04 - -0.02
- -0.02 - 0.02
- 0.02 - 0.04
- 0.04 - 0.08
- 0.08 - 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- >1
- Areas that were flood affected and are now flood free in modelled event
- Areas that were flood free and are now flood affected in modelled event

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-8**
1% AEP Flood Level Difference

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- Flood Level 1m Intervals
- Flood Level 0.1m Intervals

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-9**

0.5% AEP Flood Level and Depth
Existing Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- Flood Level 1m Intervals
- Flood Level 0.1m Intervals

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-10**

0.2% AEP Flood Level and Depth
Existing Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- **Flood Level 1m Intervals**
- **Flood Level 0.1m Intervals**

0 50 100 150 m

Scale at A3 **1:4500**

Job Title

WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-11**

0.5% AEP Flood Level and Depth
Developed Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Depth Pallete

Band 1

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0
- >3

Flood Levels (m)

- Flood Level 1m Intervals
- Flood Level 0.1m Intervals

0 50 100 150 m

Scale at A3 **1:4500**

Job Title

WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-12**

0.2% AEP Flood Level and Depth
Developed Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-13**
1% AEP Flood Hazard
Existing Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-14**

0.5% AEP Flood Hazard
Existing Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-15**

0.2% AEP Flood Hazard
Existing Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-16**
PMF Flood Hazard
Existing Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-17**
1%AEP Flood Hazard
Developed Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-18**

0.5% AEP Flood Hazard
Developed Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-19**

0.2% AEP Flood Hazard
Developed Condition
(Climate change Scenario)

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	

Note: The hazard map prepared has been processed using the waterRIDE tool so insignificant differences in the flood extent can be seen.

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

Legend

- Site Boundary

Flood Hazard

- Generally safe for vehicles, people and buildings
- Unsafe for small vehicles
- Unsafe for vehicles, children and the elderly
- Unsafe for vehicles and people
- Unsafe for vehicles and people All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- Unsafe for vehicles and people All building types considered vulnerable to failure

0 50 100 150 m

Scale at A3 **1:4500**

Job Title
WSU Millperra
Flood and Risk Impact Assessment

Job No. **110709**

Figure No. **7-20**

PMF Flood Hazard
Developed Condition

Issue	Date	By	Checked	Approved
A	28/04/2023	AZ	SL	