Location

Source: Allen Jack + Cottier Architects

Gateway South Concept Design Church Street, Parramatta

Response to Request for Additional Information – Referral Comments of October 2016

January 2017

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TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

1.1. Scope

SMEC has been engaged by Gateway Parramatta One P/L ABN 57607 553 565 (also referred to in this report as "Dyldam") to review the flooding and stormwater requirements for the proposed Gateway South Development at Church Street, Parramatta. After the original DA submission by Boyded Industries in 2014, Parramatta City Council (PCC) provided additional requirements to be addressed in further submissions. Following those comments, AECOM Consultants on behalf of Boyded Industries revised the concept design for the proposed Gateway South Development and submitted it to PCC on 4th September 2015. Following further submissions by Dyldam; PCC on 29 June 2016 issued an Assessment Report under Section 79C of the Environmental Planning an Assessment Act of 1979 seeking additional information. Dyldam provided a response to the S79C Report following which in October 2016, PCC sought further information from Dyldam on inter-alia flood related issues.

This report provides a response to the clarification inquiries from PCC dated October 2016. This report focusses on those inquiries and reference can be made to the SMEC report[1] and previous reports referred to in that document for background information.

[1] SMEC (July 2016) "Gateway South Concept Design Church Street, Parramatta
S79C Assessment Report: Flooding" Dyldam

2. FLOODING COMMENTS

The first two columns of Table 1 below give the comments made The Development Engineer in his "Request for Additional Information" of October 2016. SMEC's response to those comments are provided in the third column.

Table 1: Development Engineer Comments and SMEC responses

DA/706/2014 Consent Conditions #11 (1) Flood management.	*DA/738/2016 Responses by SMEC/Applicant and Council's assessment of responses*	SMEC Response January 2017
a) The three development sites, 1, 2 and 3, are subject to high hazard flooding from the Clay Cliff Creek main channel and from overland flow in the surrounding streets. Adequate precautions, satisfactory to Council, must be included in all developments in these sites to address the needs of public and occupant safety, emergency escape and refuge, prevention of ingress of flood waters and protection of property.	**SMEC Response:** Flood Emergency Management Strategy has been addressed in Appendix G of the DA documents dated September 2015. This document will be updated to include the recent changes and will be submitted on completion. **Council response:** Updated information and cited references on this are required to be submitted and form part of the current DA before assessment can be finalised.	**Updated information and cited references in relation to the Flood Emergency Management Strategy are provided as Appendix A of this document.**
b) For the purpose of this consent, the Flood Planning Level is defined as the predicted 1% AEP flood level (100 ARI) level plus 500mm arising from Clay Cliff Creek and the surrounding overland flow level, as obtained from the 'Cardno 2D flood model' for Clay Cliff Creek and environs, known as the '2007 model'. The Flood Planning level for each building may vary with the immediate terrain and built context. The Flood Planning Level must be re-determined for each Development Application for each individual building using the '2007 2D Cardno Flood model' (or approved alternative) adjusted for revised designs, building footprints, ground surface levels and so on.	**SMEC Response:** Using the 2007 2D Cardno Flood Model, it was shown in Appendix F of the DA documents dated September 2015 that the Flood Planning Level for this locality is 12.9 m. AHD. It was also demonstrated that the buildings and ground surfaces do not harm other land by diverting floodwaters and concentrating stormwater. There have been no significant changes to the overall layout since that submission. **Council response:** Council accepts 12.9m AHD as Flood Planning Level but updated information and cited references on this condition are required to be submitted and form part of the current DA before assessment can be finalised.	**Maybe re-word to "The 2007 2D Cardno model (XP SWMM) was adopted and revised to reflect the latest building design in re-determining the Flood Planning Level for each individual building.** **The report on these studies is presented as Appendix B to this document. Updated information and cited references are provided in that Appendix.**

DA/706/2014 Consent Conditions #11 (1) Flood management.	*DA/738/2016 Responses by SMEC/Applicant and Council's assessment of responses*	SMEC Response January 2017
Development Applications for individual sites within this concept DA must demonstrate that buildings and ground surfaces do not harm other land by diverting floodwaters and concentrating stormwater at least up to the Flood Planning Level. In addition Council requires additional flood protection measures to be taken to the level of the Probable Maximum Flood (or PMF) as follows and as may be determined for individual DAs. The PMF as derived from Council's adopted flood levels (Lower Parramatta River) and for the purposes of this Consent may be assumed to be for Site 1: 14.0m AHD and for Site 2: 14.2m AHD.	PMF flooding protection must be documented on DA drawings etc. This includes floodgates on driveways and elsewhere, flood doors etc. This should be done in consultation with Council.	**It is shown in Appendix B that the buildings and ground surfaces do not harm other land by diverting flood water or concentrating stormwater at the 1:100 year ARI Flood Level and at the PMF level.** **All building materials up to the PMF are flood compatible and possibly provide a list of materials for building components i.e. floors, walls etc.** **Appendix C provides documented information on floodgates provided to protect the basement areas up to the PMF level.**
c) All of the buildings, landscape and public domain areas subject to this consent shall be designed and built so as to cause no significant, alterations to the predicted flow patterns of floodwaters, at least up to 'Flood Planning Level' (the 1% Annual Exceedance Probability (AEP) event plus 500mm freeboard).	**SMEC Response:** Using the 2007 2D Cardno Flood Model, it was shown in Appendix F of the DA documents dated September 2015 that there were no alterations to the predicted flow patterns of floodwaters. There have been no significant changes to the overall layout since that submission. **Council response:** While this is generally accepted in principle, updated information and cited references on this are required to be submitted and form part of the current DA before assessment can be finalised.	**It is shown in Appendix B of this report that all of the buildings, landscape and public domain areas were re-assessed using the 2007 Cardno Model against thee 100 year ARI and PMF event and that there were no significant alterations to the predicted flow patterns.**

DA/706/2014 Consent Conditions #11 (1) Flood management.	***DA/738/2016 Responses by SMEC/Applicant and Council's assessment of responses***	**SMEC Response January 2017**
d) The minimum level of all habitable floors in all of the buildings shall be not less than the respective Flood Planning Levels (1% AEP event plus 500mm freeboard).	**SMEC Response:** Using the 2007 2D Cardno Flood Model, it was shown in Appendix F of the DA documents dated September 2015 that the Flood Planning Level for this locality is 12.9 m. AHD. All habitable floor levels are at or above this level thus fully meeting the PCC requirements. There have been no significant changes to the overall layout since that submission. **Council response:** This is acceptable.	**No further comment**
e) All basement car parks must be protected from ingress of floodwaters with a continuous floodproof bund (including crests on driveways, accessways and other openings) to a minimum level of the Flood Planning Level (1% AEP event plus 500mm freeboard). In addition, the basement car park for Site 1 shall be protected from the ingress of flood waters between the FPL (12.9m AHD) and the PMF (14.0m AHD) with additional driveway crest height and/or self-operating flood gates, and other means. In addition, the basement car park for Site 2 shall be protected from the ingress of flood waters between the FPL (12.9m AHD) and the PMF (14.2m AHD) with additional driveway crest height and/or self-operating flood gates, and other means.	**SMEC Response:** The basement car parks on Sites 1 and 2 are protected from ingress of floodwaters to the FPL of 12.9m AHD. In addition self-operating flood gates will be installed on sites 1 and 2 to prevent ingress of flood waters between the FPL and PMF. **Council response:** This must be documented on the drawings etc. in consultation with Council. Updated information and cited references on this are required to be submitted and form part of the current DA before assessment can be finalised.	**Updated conceptual drawings showing the self-operating flood gates for the basements of sites 1 and 2 are presented in Appendix C. In these drawings protection is provided against the ingress of flood waters to 14.0 m AHD in Site 1 and 14.2 m AHD in Site 2.** **Updated Information and cited references are provided in Appendix B and its Attachments.**
f) All building and landscape construction must be	**Council response:** Updated information and cited references	**The forces on the buildings from the moving waters included**

DA/706/2014 Consent Conditions #11 (1) Flood management.	*DA/738/2016 Responses by SMEC/Applicant and Council's assessment of responses*	SMEC Response January 2017
designed to be inundated and to resist the forces of moving floodwaters, water-borne debris and flotation, up to the Probable Maximum Flood (PMF) level.	on this are required to be submitted and form part of the current DA before assessment can be finalised.	**debris were calculated using AS 5100.2 as shown in Appendix C to this report.** **These forces were adopted by the Structural Engineers in the design of the buildings and the results of their analyses are presented separately in this submission.** **All landscape construction has been designed to resist the forces of moving flood waters.**
g) For the Site 2 building fronting Church Street, an underfloor flood passageway across the south east corner of this building between Lansdowne Street and Church Street must be provided. This must be generally in accordance with this Concept DA, but will be subject to Council's detailed approval with the individual building Development Application. The underside of this structure must be not less than 200mm below the Flood Planning Level for this building and higher if possible. The Plaza area in Site 2 fronting Lansdowne Street must be set at a level that allows the passage of floodwaters into this underfloor passageway. Detailed design of the plaza area and the Lansdowne and Church Street frontages must address this together with public safety and other aspects including flow from this structure across the footway. This design must be based on hydrodynamic	**SMEC Response:** The hydrodynamic flood flow modelling is currently in progress. **Council response:** Updated information, detailed designs and cited references on this are required to be submitted and form part of the current DA before assessment can be finalised.	**Detailed Drawings of the underfloor flood passageway are presented in Drawings DA-800-004 and DA-800-005 Turner in this submission.** **We have interpreted this requirement to mean that PCC require a 300 mm freeboard during the 1:100 year ARI flood event.** **The underside of this structure is at 12.65 m AHD whilst the highest level of the 1:100 year ARI flood level within the underfloor passageway is 12.385 m AHD.** **The minimum freeboard for the 1: 100 year ARI flood for the underfloor passageway is thus 265 mm which is within the acceptable limit for the free board.** **The Plaza area in Site 2 has been set at 11. 765 m AHD which is at**

DA/706/2014 Consent Conditions #11 (1) Flood management.	*DA/738/2016 Responses by SMEC/Applicant and Council's assessment of responses*	SMEC Response January 2017
overland flow flood modelling. In such design public safety must take precedence over minor flood affectation.		**the same level as the passage way and this allows the floodwaters to enter into this underfloor passageway as shown in drawings DA-800-004 and DA-800-005 Turner.** **Detailed hydraulic modelling of the plaza, underfloor passageway, and the Lansdowne and Church Street frontages was carried out as shown in Appendix B. It can be seen from this that the existing flood affectation of this locality has not been increased.**
h) For Site 1 an underfloor floodway is not required.	**Council response:** No action required.	**No further comment**
i) Individual DAs must include comprehensive safety and emergency access and egress plans for both occupants and the general public.	**SMEC Response:** Flood Emergency Management Strategy has been addressed in Appendix G of the DA documents dated September 2015. This document will be updated to include the recent changes and will be submitted on completion. **Council response:** Updated information and cited references on this are required to be submitted and form part of the current DA before assessment can be finalised.	**The Flood Emergency Management Strategy is presented in Appendix A**
j) For the Site 3 Park the proposed landscape design is not acceptable to Council, nor approved by this Consent, and a Development Application for this site will need to be substantially modified to incorporate the following responses to flood risk management and water sensitive urban design. The park design and construction should be completed to	**SMEC Response:** Site 3 will be designed in conjunction with Parramatta City Council and design consultants to advise a desired urban outcome without affecting or altering the flood waters flowing through Site 3. Further modelling of the entire proposal will be undertaken to inform this process.	**Flood Modelling was carried out using the layouts and ground surface levels shown in Drawings L-03-100 to L-03-801 (Oculus) and the report Site 3 Landscape Design Report (Oculus, July 2016).** **A compliance statement from Oculus dated Jan 2017 is presented in Appendix D of this report and provides a detailed**

DA/706/2014 Consent Conditions #11 (1) Flood management.		*DA/738/2016 Responses by SMEC/Applicant and Council's assessment of responses*	**SMEC Response January 2017**
	Council's satisfaction prior to the occupation of any of the buildings. The design must address the following to Council's satisfaction:	**Council response:** Updated information and cited references on this are required to be submitted and form part of a current DA before assessment can be finalised. This should be done in close consultation with Council.	**response to Council requirements.**
i.	The existing Clay Cliff Creek culvert should not be altered and any fencing around it should be constructed or reconstructed to Sydney Water requirements and specifications. Details of this, including the written approval of Sydney Water, are required to be submitted for Council approval with the Development Application for the park.	See above.	
ii.	In order not to divert floodwaters or reduce storage the finished surface levels of the park should not be significantly different from current surface levels (pre development) unless changes are justified to Council's satisfaction and such changes are shown not to increase flood hazards or displace floodwaters onto adjoining lands. This should be demonstrated to Council's satisfaction in any DA for the park site.	See above.	
iii.	The proposed kiosk amenities facility, half basketball court and play area are not approved by this Consent. Such may be the subject of a DA for the park but would be assessed on their merits at that time, particularly in terms of flood risk safety management and encouragement of use of the high hazard flood area in the park. Council currently considers such an application would not be	See above.	

DA/706/2014 Consent Conditions #11 (1) Flood management.	***DA/738/2016 Responses by SMEC/Applicant and Council's assessment of responses***	**SMEC Response January 2017**
supported because of the significantly increased risk to public safety but acknowledges that such facilities would be of value to the local communities and will review the risk and liability issues associated with this on receipt of a DA proposal.		
iv. Additional car parking must not be provided in or immediately adjacent to the park.	See above.	
v. The Landscape Design for Site 3 must be responsive to the likelihood of flash flooding and be such as to prevent or minimise harm to the public as well as scour and transport of debris. The design must be able to resist fast-moving floodwaters and is likely to include grass or other approved ground cover, shrubs and trees, appropriate park furniture, lighting and pathways. Council considers the use of planting acceptable in this floodway subject to appropriate species selection and Council's approval of the detailed landscape design.	See above.	

<u>Scope of required documentation</u>

The SMEC responses above on behalf of the Applicant include reference to documents including some that formed part of the concept DA. None of these have been submitted with this DA.

These are:

- *(AECOM, 2015), Gateway South Church Street Parramatta, - Appendix D Supplementary Flood*
- *Impact Report – Revised DA Document, Client: Boyded Industries Pty/Ltd.*
- *(AJ+C, 2015), Gateway South Parramatta Stage 1 DA Report. Allen Jack + Cottier Architects.*
- *(AECOM, 2014), Gateway South Church Street Parramatta, - Appendix L Concept Stormwater*
- *Management Plan – Original DA Document, Client: Boyded Industries Pty/Ltd.*
- *(AECOM, 2015), Gateway South Concept Development Application – Supplementary*
- *Information to Support Stormwater Management Plan, Client: Boyded Industries Pty/Ltd.*
- *Reference is also made twice in the above comments to "Flood Emergency Management Strategy Appendix G Sept 2015".*

The Applicant is therefore required to submit all documents on which this DA depends to form part of this DA. *(This does not include work and studies made and/or owned by Council.)*

All documentation associated with this project has been supplied as attachments to this report.

3. REFERENCES

(Parramatta City Council, July 2016), **Assessment Report –Mixed Use Development S79C – Environmental Planning and Assessment Act, 1979** – Kate Lafferty

(AECOM, 2015), **Gateway South Church Street Parramatta, - Appendix D Supplementary Flood Impact Report – Revised DA Document**, Client: Boyded Industries Pty/Ltd.

(AJ+C, 2015), **Gateway South Parramatta Stage 1 DA Report**. Allen Jack + Cottier Architects.

(SKM, 2005), **Lower Parramatta River Floodplain Risk Management Study and Plan Volume 1 Main Report**, Client: Parramatta City Council.

(SKM, 2005), **Lower Parramatta River Floodplain Risk Management Study and Plan Volume 2 Planning**, Client: Parramatta City Council.

(AECOM, 2014), **Gateway South Church Street Parramatta, - Appendix L Concept Stormwater Management Plan – Original DA Document**, Client: Boyded Industries Pty/Ltd.

(AECOM, 2015), **Gateway South Concept Development Application – Supplementary Information to Support Stormwater Management Plan,** Client: Boyded Industries Pty/Ltd.

APPENDIX A
Gateway South Concept Design Church Street, Parramatta:
Flood Emergency Response Strategy

January 2017

TABLE OF CONTENTS

TABLE OF FIGURES

1. INTRODUCTION

1.1. Scope

This Flood Emergency Response Strategy (the Strategy) outlines the procedure to follow in the event of a flood alarm being raised by building management. The strategy will describe the likely nature of the flood emergency and outline actions for the protection of residents, retail and office tenancy employees, guests, shoppers and general public within and in the vicinity of the site complex.

This document will form a part of a wider emergency management strategy developed by the building managers for a range of situations (including flooding, fire, terrorism etc.,) at a later date.

1.2. Site Location

The proposed Gateway South development consists of three sites where in Sites 1 and 2 it is proposed to develop the land with the construction of a mixed commercial and residential development and providing the third site (Site 3) as a public park. The proposed sites are situated along the Clay Cliff Creek with flows travelling from a west to east direction crossing Lansdowne Street, Early Street, and Church Street and ultimately discharging to the Parramatta River. The three sites are shown in Figure A.1 below. The catchment is within both the Cumberland Council and Parramatta City Council (PCC) Local Government Areas while the site is within the PCC LGA.

Figure A. 1: Proposed Site Locality (Source: AECOM, 2015)

The Gateway South complex will comprise of five buildings for residential and non-residential uses covering 14,287 square metres. The complex will also contain a public park, basement car parking (for public use as well as tenant usage) and car dealerships on the lower floors.

The finished floor elevation of the four main buildings within the Gateway South complex is 12.9 m AHD. The basement entry elevation for the two buildings in Site 1 in Early Street is 12.9 m AHD and protected to the PMF flood level of 14.0 m AHD with a concealed flood gate. The other two buildings in Site 2 have a basement entry elevation of 13.29 m AHD and are also protected to the PMF flood level of 14.2m AHD with a concealed flood gate.

2. NATURE OF THE FLOOD THREAT

2.1. Pattern of Flooding

The general pattern of flooding within the areas affected by the development is from west to east and arises in the Clay Cliff Creek that has a catchment area of approximately 3.2 square kilometres. The main flow path is a concrete channel that delivers flood flows from the Ollie Webb detention basin to Parramatta River in the east. Uncontrolled flooding arises when the capacity of this channel and its associated culverts are exceeded during major events.

The critical issue in flooding of this area is the extremely short warning times available to manage these events. The time to peak from the commencement of the rise of the flood hydrograph for a design flood event is in the order of 60 minutes, necessitating very rapid response times. Although the design flood event is based on a number of assumptions and every event will behave in a different fashion, the design flood event timings should be used as a first cut basis for management of flood events. It should be recognised though that there could be flood events that could respond faster than the design flood event and that needs to be incorporated into the management of the flood event.

On the other hand the duration of the flood event is also likely to be relatively short and most flooding from design flood events would have drained within a few hours. The cause of this sharp short flooding is the generally impervious nature of the catchment, the relatively short distance from the headwaters to the site and the relative steepness of the catchments. Flooding could be induced from various types of precipitation events such as widespread rainfall or thunderstorm activity over the catchment. The latter in particular could result in a flood event in the site without any significant rainfall elsewhere in metropolitan area thus reducing the likelihood of warnings from the Bureau of Meteorology.

It will also not be possible to estimate the magnitude of the flood (except in very broad terms) during the commencement of the event and consequently it will be necessary for Emergency Management to take a conservative view of flood events. The following sections provide an indication of the implications of floods of different frequencies (and consequently magnitudes) at different localities in the vicinity of the site to guide the management of emergencies.

Details of the site and localities together with the extent of the flood during a 100 year ARI event (also referred to as a 1% AEP flood event) is shown Figure A.2.

The lowest lying land in this locality is on Church Street between Early Street and Landsdowne Street and in Early Street and Lansdowne Street at their junctions with Church Street. Emergency flood management would need to focus on keeping people away from these locations as they can become hazardous even during relatively small flood events. People in the vicinity of these areas should be moved to the higher ground in Church Street to the north of its junction with Early Street or to the west of Early Street. There will be highly hazardous conditions on Landsdowne Street and areas around Site 3 and these areas should be avoided under most flood circumstances.

The buildings will be designed to withstand the forces generated by a PMF event and level 2 upwards would be completely safe for the duration of any flood event.

During (even a relatively small) flood event; there could be overflows from the channel on Site 3 and upstream of site 3 with flows moving rapidly and hazardously in a north easterly direction across the plaza and under the building in Site 2 to re-emerge on Church Street. There is a risk that people on the lower levels of the plaza could be trapped between by these fast moving waters on the flood screens surrounding the flood passageway in Site 2. People on the lower levels of the plaza and on Lansdowne Street need to be moved rapidly to higher ground during any flood event.

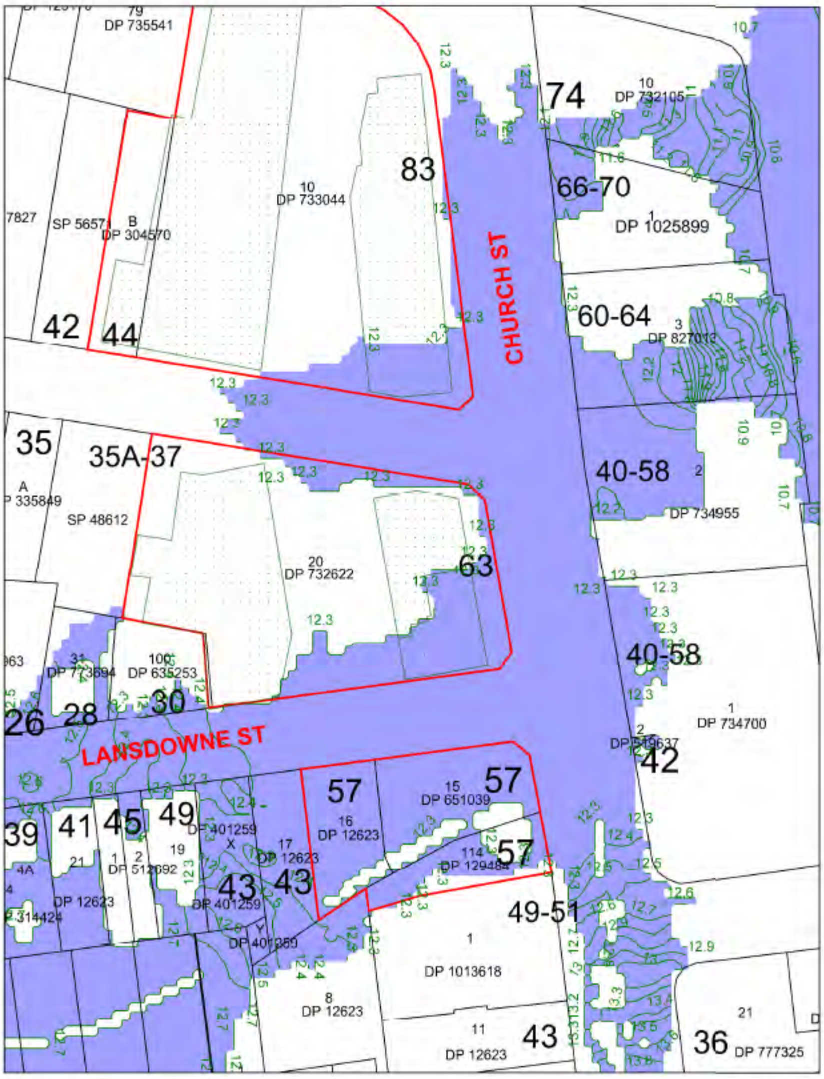

Figure A. 2: Flooding in the vicinity of the site (100 year ARI flood extent)

2.2. 5 year ARI flood event

A 5 year flood event has a 20% probability of occuring in any one year. During an event of this frequency, flood elevations will reach around 12.02 m AHD and depths will reach nearly 0.5 metres along Church Street and parts of Early and Landsdowne street creating a hazard zone in the vicinity of the site. During this event flood waters will enter the underfloor flood passageway under Site 2 and enter Church Street from the passageway.

There would be flooding along Landsdowne Street but the upper parts of Early Street would be relatively dry. The design flood could peak within 60 minutes and the design flood event would occur over a period of about 2.5 hours.

2.3. 10 year ARI flood event

A 10 year flood event has a 10% probability of occuring in any one year. During an event of this frequency, flood elevations will reach around 12.14 m AHD and depths will reach to 0.61 metres along Church Street and parts of Early and Landsdowne street creating a hazard zone in the vicinity of the site. During this event flood waters will enter the underfloor flood passageway under Site 2 and enter Church Street from the passageway.

There would be flooding along Landsdowne Street but the upper parts of Early Street would be relatively dry. The design flood could peak within 60 minutes and the design flood event would occur over a period of about 2.5 hours.

2.4. 20 year ARI flood event

A 20 year flood event has a 5% probability of occuring in any one year. During an event of this frequency, flood elevations will reach around 12.22 m AHD and depths will reach up to 0.70 metres along Church Street and parts of Early and Landsdowne street creating a hazard zone in the vicinity of the site. During this event flood waters will enter the underfloor flood passageway under Site 2 and enter Church Street from the passageway.

There would be flooding along Landsdowne Street but the upper parts of Early Street would be relatively dry. The design flood could peak within 60 minutes and the design flood event would occur over a period of about 2.5 hours.

2.5. 100 year ARI flood event

A 100 year flood event has a 1% probability of occuring in any one year. During an event of this frequency, flood elevations will reach around 12.39 m AHD and flood depths will reach up to 0.86 metres along Church Street and parts of Early and Landsdowne street creating a high hazard zone in the vicinity of the site.

There would be very serious flooding along Landsdowne Street but the upper parts of Early Street would be relatively dry. The design flood could peak within 60 minutes and the design flood event would occur over a period of about 2.5 hours.

During a 100 year event, flood waters will enter the floodway under Site 2 with flow depths of around 0.8 metres and a freeboard of 300 mm to the soffit of the slab and velocities of one m/s through the floodway.

2.6. Probable Maximum Flood (PMF) event

A PMF event has a very low probability of occuring in any one year but is nevertheless a real risk. The PMF provides the upperbound of the floods that could realistically occur at this site. During an event of this frequency, flood depths will approach 2 metres along Church Street and parts of Early and Landsdowne street creating a high hazard zone in the vicinity of the site. The flood could peak within 60 minutes and the design flood event would occur over a period of 2.5 hours.

During a PMF, flood waters will enter and overtop the floodway under Site 2 with velocities of 2.6 m/s through it. Council has specified that the PMF level to be considered at this site is 14.2 m AHD and under this scenario there will be 1.3 metres of water inside the building. Entry of water into the basements will be prevented by flood gates at the entry points.

3. PROCEDURES AND RESPONSIBILITIES

3.1. Review of Plans and Procedures

The strategy will be reviewed every twelve months along with the other emergency management plans and procedures. It will also be reviewed after a significant flood event or following changes to the flood management guidelines.

3.2. Facility Management Actions

The Flood Emergency Response strategy will provide an evacuation plan for all occupants of the building and in the vicinity to remain on the premises at a safe level until the flood abates as flood protection measures will be in place. The broad strategy envisages that all people at risk in the vicinity of the plaza will also be accommodated within the building above the level of the PMF.

Now and always

- Inform tenants, employees, customers and the public that flooding is a real risk
- Display the Flood Plan
- Encourage staff to participate in development & implementation of this plan
- Ensure WH&S procedures cover specific risks associated with floods
- Maintain an up to date list of emergency contact numbers for staff and services
- Train Facility Management staff and Emergency Control Organisation in flood procedures
- Incorporate flood awareness in Facility Management staff and tenant induction training
- Prepare an Emergency Kit
- When flooding is likely
- Inform Facility Management staff of Flood Watch or Severe Weather Warning
- Initiate control of car park access
- Warn all occupants of any likely impact on car park levels
- Ensure all evacuation routes are kept clear
- Keep radios tuned to local radio station
- Ensure retail and office tenants and residents are aware of Flood Watch or Severe Weather Warning
- During a flood
- Keep in contact with all occupants and keep them updated on the situation

After a flood

- Keep radio tuned to local radio station and keep listening for updates on forecast flood heights and timings
- Do not enter flood waters.
- Before reoccupying any area impacted by floodwater undertake a WH&S risk assessment
- Salvage and Business Resumption Plan (24 - 48 Hours)
- Removal of remaining floodwater, mud and debris from the plant by using wash down hoses, brooms, squeegees, mops, sump pumps and clean up supplies.

- Analyse all salvageable materials and equipment, begin discard/removal
- of all non-salvageable materials/equipment
- Remove sandbags, window boarding and other items used to protect building exterior.
- Cleaning/drying of all essential equipment (lubricate as needed).
- Dehumidify/dry all damp/moist areas.
- Preserve equipment/materials that might otherwise be lost.
- Reclaim any salvageable supplies/business operating equipment.
- Conduct safety walkthrough by the Safety Committee and other necessary building/utilities officials: Fire Department, Electric/Gas Utilities, Building Inspector, etc.

3.3. Safety Audit

The building proprietors, their operators, occupiers, lessors or their agents, ought to guarantee that leases not just cover the safety of occupants in a flood emergency, yet incorporate commitments for tenants to take an interest in emergency planning and evacuation exercises and acknowledge the authority of designated ECO Wardens in emergency situations.

The rent documentation for individual retail and office tenures should accommodate occupants to train their staff individuals in the Flood Emergency Response Strategy and maintenance of documentation to this impact.

A regular check of all safety and flood mitigation measures should be managed by building/facility management.

Flood plan to be implemented at all times: Building/Facility management must perform a flood risk assessment and come up with control measures to avoid or minimise the risk as shown below.

3.3.1. Low Risk

Generally, low risk flood scrutiny is categorised by blocked pits and pipes, and debris ponding and flooding around the site. It is for the most part illustrative of an occasion less than or equivalent to the 1 in 5 year ARI. This kind of flooding does not in general pose a threat to life and property, and a table of risk and control measures is sketched out below.

Risk	Control
Slip hazards from blockage of pits causing ponding	Take care moving around site.
Risk to property through water damage	Store objects sensitive to water inside or away from overland flow paths.

3.3.2. Moderate Risk

Moderate risk floods are similar to that of a low risk flood, except water is expected to be flowing on Church Street, Early Street and Lansdowne Street. This risk level is roughly categorised when water starts to overtop the kerbing near the Church Street entry to the sites. Risk to property and life is dramatically increased in this category due to the flow of water over footpaths and around the precincts. A table of risks and control measures is included below.

Risk	Control
Slip hazards from blockage of pits causing ponding	Take care moving around site.
Injury from crossing flowing water. Falls, floating objects.	Avoid pedestrian movement around the Lansdowne Street, Early Street and Church Street entry points. Avoid crossing flowing water on foot. Cross in vehicles to reach flood refuge and avoid egress from site. Move to, or remain inside buildings until directed or flood waters recede.

3.3.3. High Risk

High risk floods are larger in magnitude again compared to moderate risk floods. Due to velocities in the vicinity of the intersection of Church Street and Lansdowne Street these floods pose a high risk to property and life. Under no circumstance should anyone attempt to cross flood water by foot or in vehicles once water has reached the footpaths.

Risk	Control
Injury from crossing flowing water. Falls, submerged objects.	Avoid crossing flowing water on foot or in vehicles. Move to, or remain inside buildings until directed or flood waters recede. Avoid evacuation by foot or in vehicles from all entrances.
Inundation of floor level	Remain calm. Inundation in the order of 200-300mm at relatively low velocities around the precincts of some buildings. Take refuge in tenancies with a first floor.
Isolation due to flood waters	Remain calm at refuge point and wait for flood waters to recede.

3.4. Training

All personnel responsible for the management of the emergency evacuation plans will be trained as necessary. Building management will provide all floor levels with a map of the appropriate evacuation process in At least one person will be responsible for each floor of the building(s) to ensure all occupants are aware of the contact person will be made available on each floor (minimum) to be responsible for the occupants of that floor. All retail and commercial operators must undertake annual staff training drill to makes sure the systems are well understood and functional.

Staff from each tenancy should have flood awareness incorporated as part of their induction training.

This should include the following information;

- Flood behaviour and risks around the site as described above.
- Maximum water levels expected around the site.
- Location and access to first floor tenancies.
- Evacuation procedures, when applicable.

3.5. Emergency Control Organisation

An Emergency Control Organisation (ECO) that meets all the guidelines of Australian Standard (AS) 3745-2010 must be established so that site personnel understand all risks identified in the hazard assessment.

The ECO personnel will receive specific advice and training to understand their role in a flood emergency at the site.

Building management and security personnel will be equipped with two-way radios in order to carry out an effective evacuation, if necessary, or to inform occupants of the flood emergency and short term and longer term actions.

The Facility Manager will determine the necessary action for flood control procedures.

3.6. Tenancy training and evacuation procedures

Regular ECO training will be provided and facility management must ensure that ECO representatives/wardens are available within the complex so that all tenants have a representative available at all times during retail/office hours.

Each tenant will be required to have a copy of the evacuation strategy readily available in their stores/offices at all times. Building management must ensure all tenants regularly undertake annual staff training drills and that an induction for all new tenants covers information pertaining to site evacuations and procedures.

3.7. Stakeholders

The main stakeholders have been identified as:

- Parramatta City Council
- State Emergency Services
- Utility Authorities – Endeavour Energy; Jemena; Luminet; Optus; Sydney Water; Telstra
- Local residents
- Car dealerships
- Local businesses

3.8. Emergency contacts (TO BE FINALISED BY BUILDING MANAGEMENT)

Organisation/Contact person	Contact number
Fire, Police, Ambulance	000
SES	132 500
Electricity	
Gas	
Plumbing	
Glaziers	
Security	
SES Western Region Flood Information	www.floodsafe.com.au/sydney-western-region

APPENDIX B
Gateway South Concept Design Church Street, Parramatta: Flood Modelling

January 2017

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1. Scope

This Appendix covers two major requirements of PCC[1] in relation to flood modelling;

1. It updates the model runs undertaken in the Stage 1 concept DA using the 2007 2D Cardno flood model adjusted for revised designs, building footprints, ground surface levels etc., and assesses compliance against PCC requirements; and,
2. It examines in greater detail the operation of the underfloor flood passageway to assess any public safety concerns arising from this development.

[1] DA/738/2016 REQUEST FOR ADDITIONAL INFORMATION – REFERRAL COMMENTS

2. 2-D MODELLING UPDATE

2.1. Background

A detailed history of flood modelling at this location is presented in a number of reports[2,3,4,5] which have been reviewed and commented upon by SMEC[6,7] and by others.

The PCC approved model for this locality is the 2D XP SWMM model developed by Cardno in 2007 as a part of the Clay Creek Catchment Master Plan. We acknowledge with thanks Messrs. Paul Clark and Peter Siriani of Parramatta City Council for approving and expediting the use of this model by SMEC.

2.2. Model Changes

The following changes were introduced into the model supplied for the purposes of this study;

- The Digital Terrain Model of the post-development scenario was replaced with the most recent updates (supplied to SMEC by "at&l" following their drainage studies);
- The timestep was decreased from 0.5 s to 0.1 s to provide greater run stability on the advice of the software developers; and
- An updated model version (2014) was adopted which allowed the use of the significantly faster 64 bit processors adopted to reduce run times.

To maintain consistency and comparability with previous studies, a critical duration of two hours was maintained for all flood events.

In previous model runs, the areas around the buildings were made "inactive" in order that the change in flood plain storage at the sites were fully recognised in the model runs. During very large flood flows up to the PMF however (i.e. flood levels greater than the FPL), there is a flow path through the buildings and this pattern of flow needs to be recognised in emergency flood management. Thus the inactive areas in the previous model were re-structured as active. This change does not affect floods to the FPL.

2.3. Model Verification

Verification of the model was undertaken by comparing the model output results and maps against the published results presented by Cardno in the AECOM (September 2015) report. Figure B.1 (extracted from AECOM, 2015) of this Appendix shows specific locations in the vicinity of the proposed development where comparisons have been made. Flood levels[8] have been examined at these locations using the updated model for the pre-development scenario in Table B.1 and it can be seen that results are very close and verifies the model for the purposes of this study. Slight differences in levels could be attributed to updated ground levels arising from more accurate information being made available to SMEC.

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[2] AECOM (Sep 2015) "Gateway South, Church Street, Parramatta Revised Supplementary Flood Impact Report", Boyded Industries

[3] AECOM (Oct 2014) "Gateway South, Church Street, Parramatta Supplementary Flood Impact Report", Boyded Industries

[4] SKM (2005) "Lower Parramatta River Floodplain Risk Management Study and Plan", PCC

[5] Cardno (2007) "Clay Cliff Creek Catchment Master Drainage Plan", PCC

[6] SMEC (2015) "Gateway South Concept Design Church Street, Parramatta Review of Flooding and Stormwater Comments Clay Cliff Creek" Dyldam

[7] SMEC (2016) "Gateway South Concept Design Church Street, Parramatta S79C Assessment Report: Flooding" Dyldam

[8] Ground levels have also been updated using the new DTM

Table B. 1: Comparison of Flood Levels between AECOM (2015) and SMEC for Existing Scenario during 1% AEP flood event

Location	Ground Levels AECOM[9] (2015)	Ground Levels SMEC	Existing Situation 100 Year ARI flood AECOM[10] (2015) (no culvert blockage)	Existing Situation 100 Year ARI flood SMEC (no culvert blockage)
C1	12.51	12.50	-	-
C2	12.01	12/07	12.33	12.34
C3	11.70	11.65	12.33	12.34
C4	11.66	11.53	12.33	12.34
C5	11.89	11.70	12.36	12.37
C6	12.07	11.90	12.38	12.39
C7	12.34	12.28	12.42	12.39
E1	13.35	13.66	-	-
E2	12.74	13.01	-	-
E3	12.26		12.33	-
E4	11.67	11.71	12.33	12.34
E5	11.35	11.32	12.33	12.34
L1	12.20	12.30	12.46	12.52
L2	11.98	12.07	12.45	12.40
L3	11.72	11.70	12.41	12.41
L4	11.50	11.57	12.40	12.39
L5	11.63	11.60	12.38	12.38

Comparison of flood maps in terms of elevations, velocities and depths are presented in Figures B.2, B.3 and B.4. It can be noted in Figure B.2 that the updated DTM indicates a flow path to the north of Early Street from Church Street to the East which was not apparent in the previous modelling exercise.

[9] AECOM (2015) Appendix A Table 3
[10] AECOM (2015) Appendix A Table 4

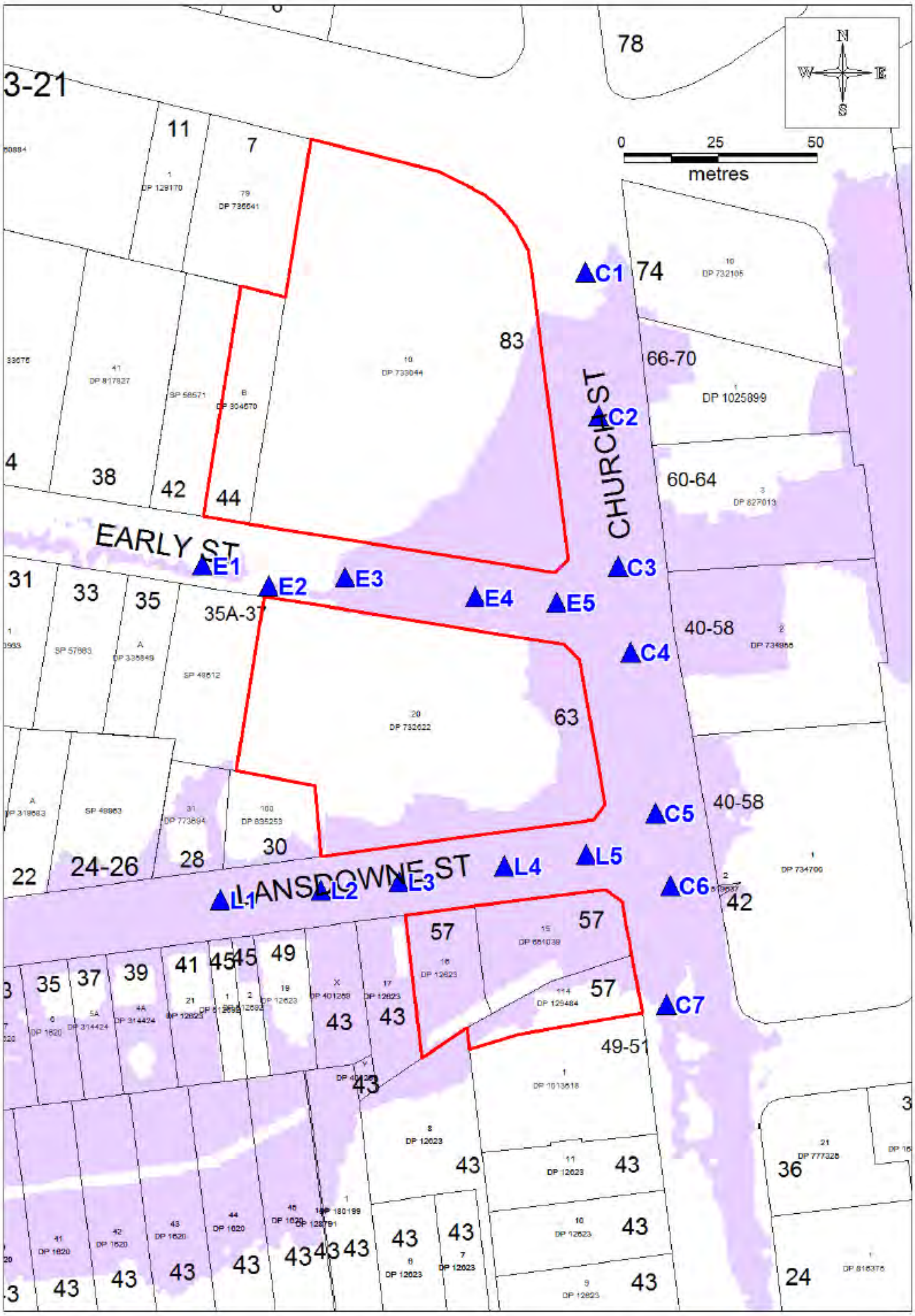


Figure B. 1: Location of comparison sites (from AECOM, 2015)

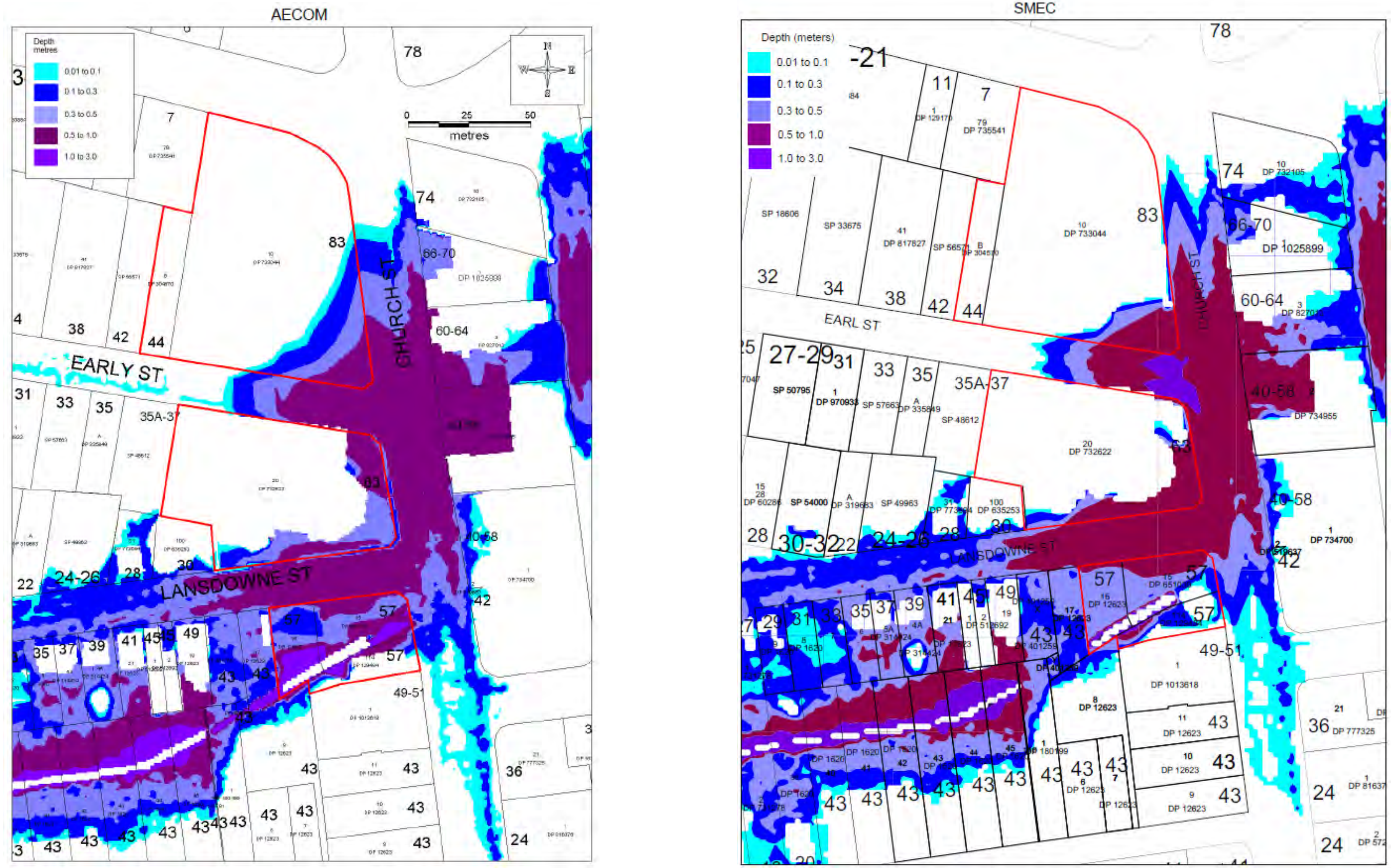


Figure B. 2: Comparison of depths between SMEC and AECOM models for 1% AEP event

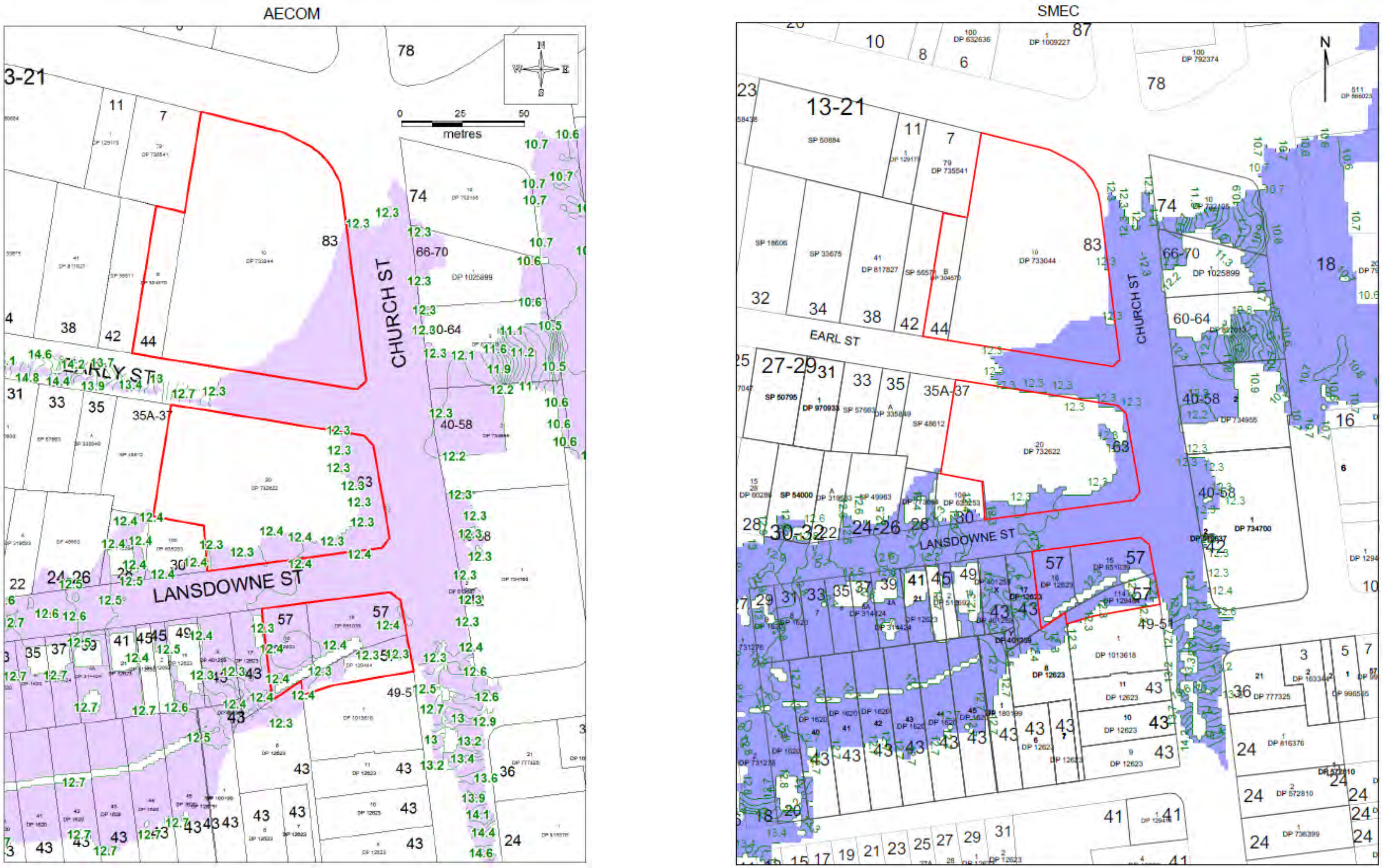


Figure B. 3: Comparison of elevations between SMEC and AECOM models for 1% AEP event

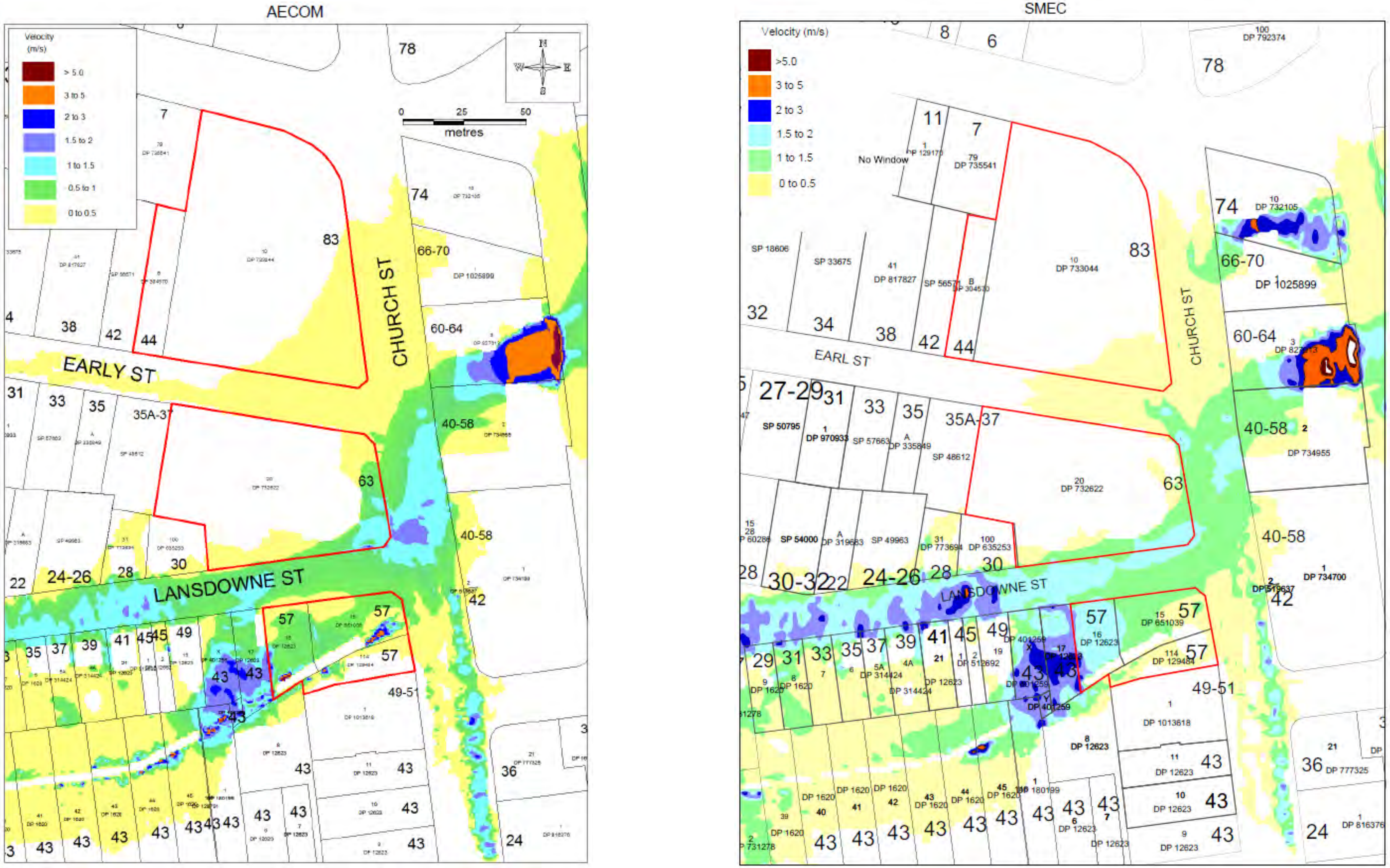


Figure B. 4: Comparison of velocity between SMEC and AECOM models for 1% AEP event

2.4. Model Results

2.4.1. 100 year ARI Flood Event

Flood elevations and afflux arising from the development for the 100 year ARI flood event are presented in Table B.2 and in Figure B.5. As presented previously[11] it can be seen that there is no afflux generated by this development and water levels actually reduce in Lansdowne Street and nearby private property. This reduction has been attributed to removal of existing buildings and maintenance of a flow path under Site 2.

Table B. 2: Flood Elevations 100 year ARI Flood Event

Location	100 Year ARI flood levels with no culvert blockage Post development scenario	Afflux arising from the proposed development
C1	-	-
C2	12.35	0.01
C3	12.35	0.01
C4	12.34	0.00
C5	12.38	0.01
C6	12.39	0.00
C7	12.38	-0.01
E1	-	-
E2	-	-
E3	-	-
E4	12.34	0.00
E5	12.34	0.00
L1	12.51	-0.01
L2	12.39	-0.01
L3	12.39	-0.02
L4	12.38	-0.01
L5	12.38	0.00

[11] AECOM (2014)

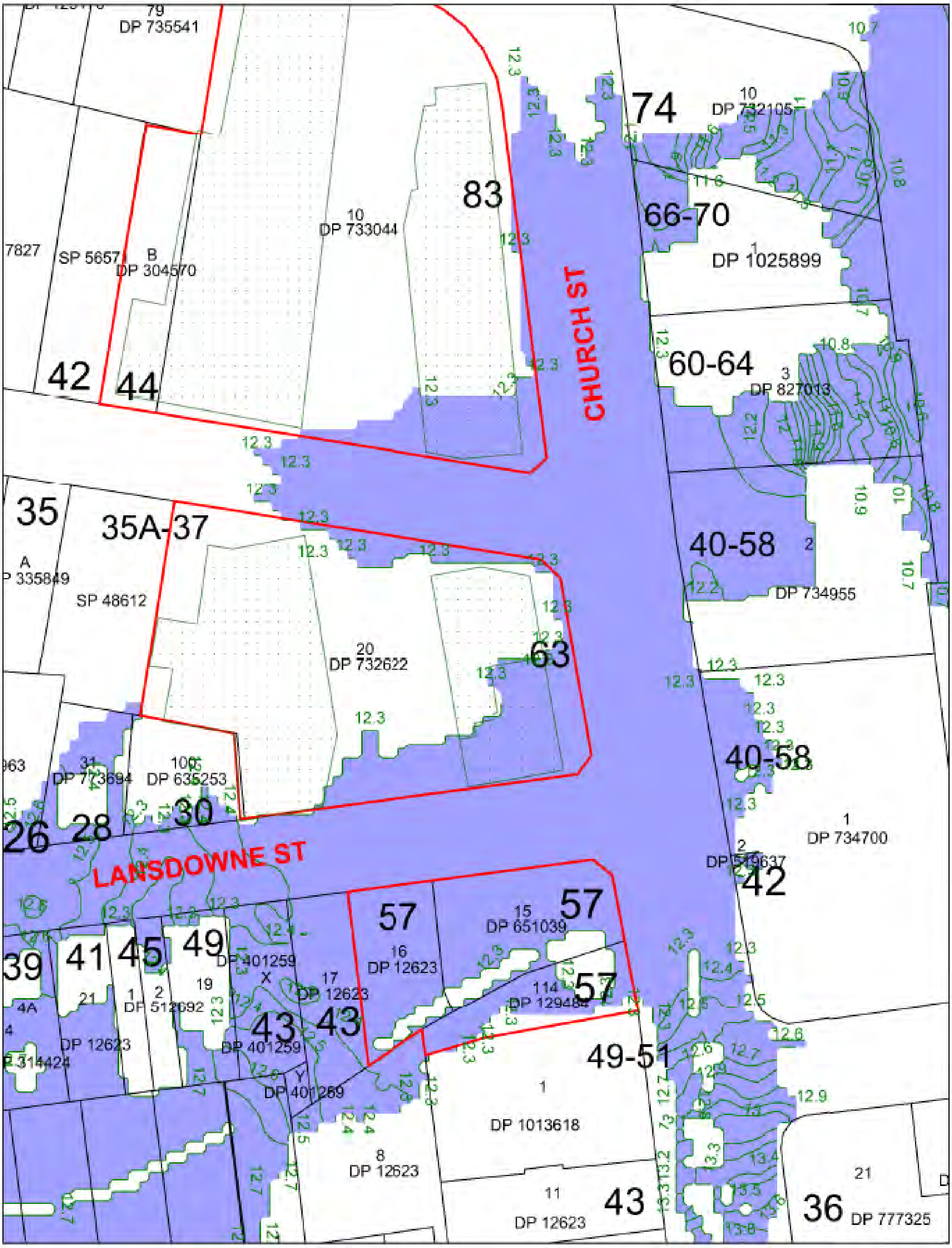


Figure B. 5:100 year ARI Post-Development Scenario: Flood Elevations

Figure B.5 shows the areal extent of flooding arising from a 100 year ARI flood event. It can be seen that the existing floods in Lansdowne Street, Church Street and a part of Earl Street has not been worsened, confirming the results in Table B.2. Afflux maps are shown in Figure B.14 which once again indicates the proposed buildings and ground surfaces do not harm other lands.

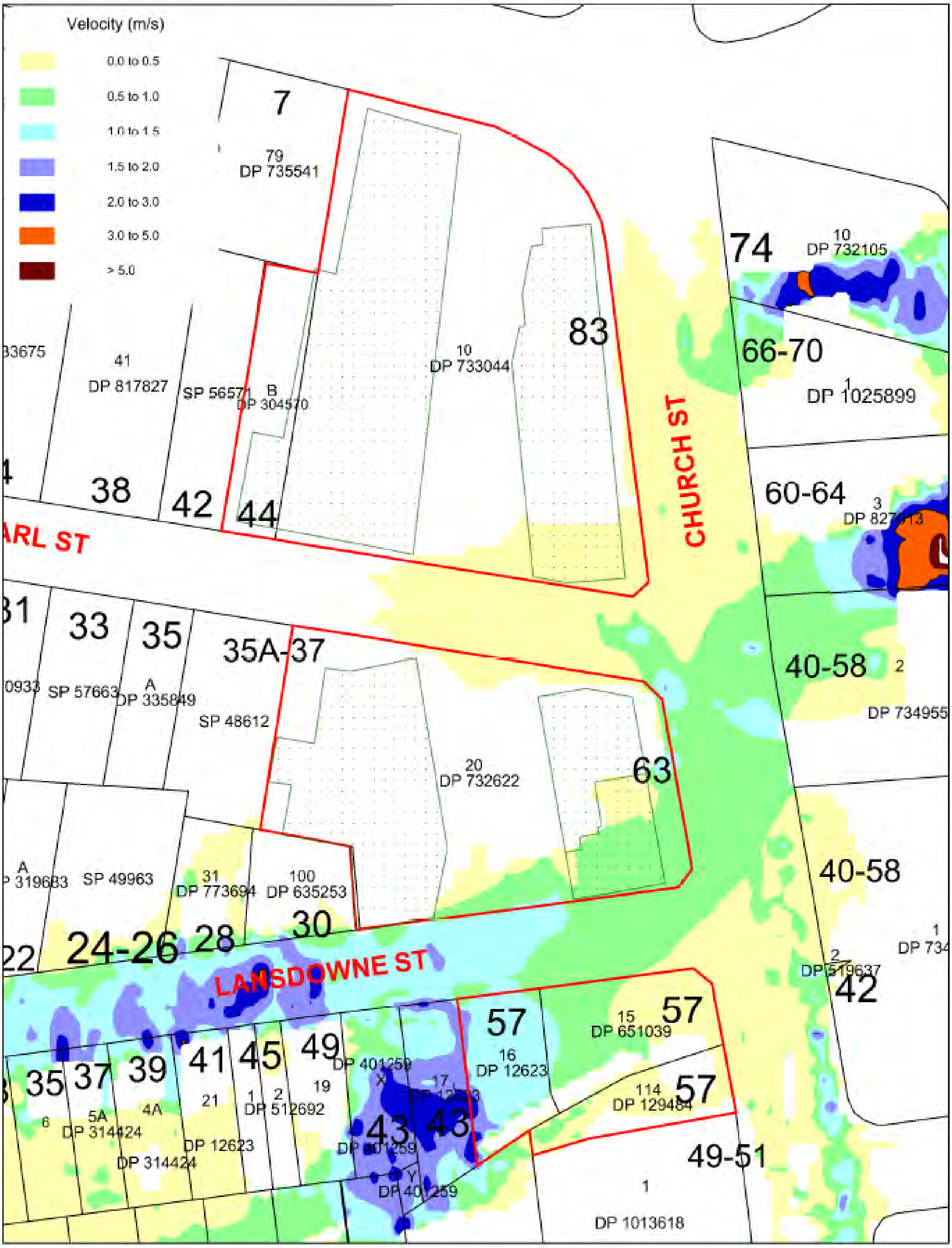


Figure B. 6: 100 year ARI Post-Development Scenario: Peak Velocities

The pattern of peak velocities under a 100 Year ARI flood event is shown in Figure B.6. It can be observed that high velocities are experienced along Lansdowne Street in particular and also to the immediate north of the channel. The flow direction is broadly in a north-easterly direction across site 2.

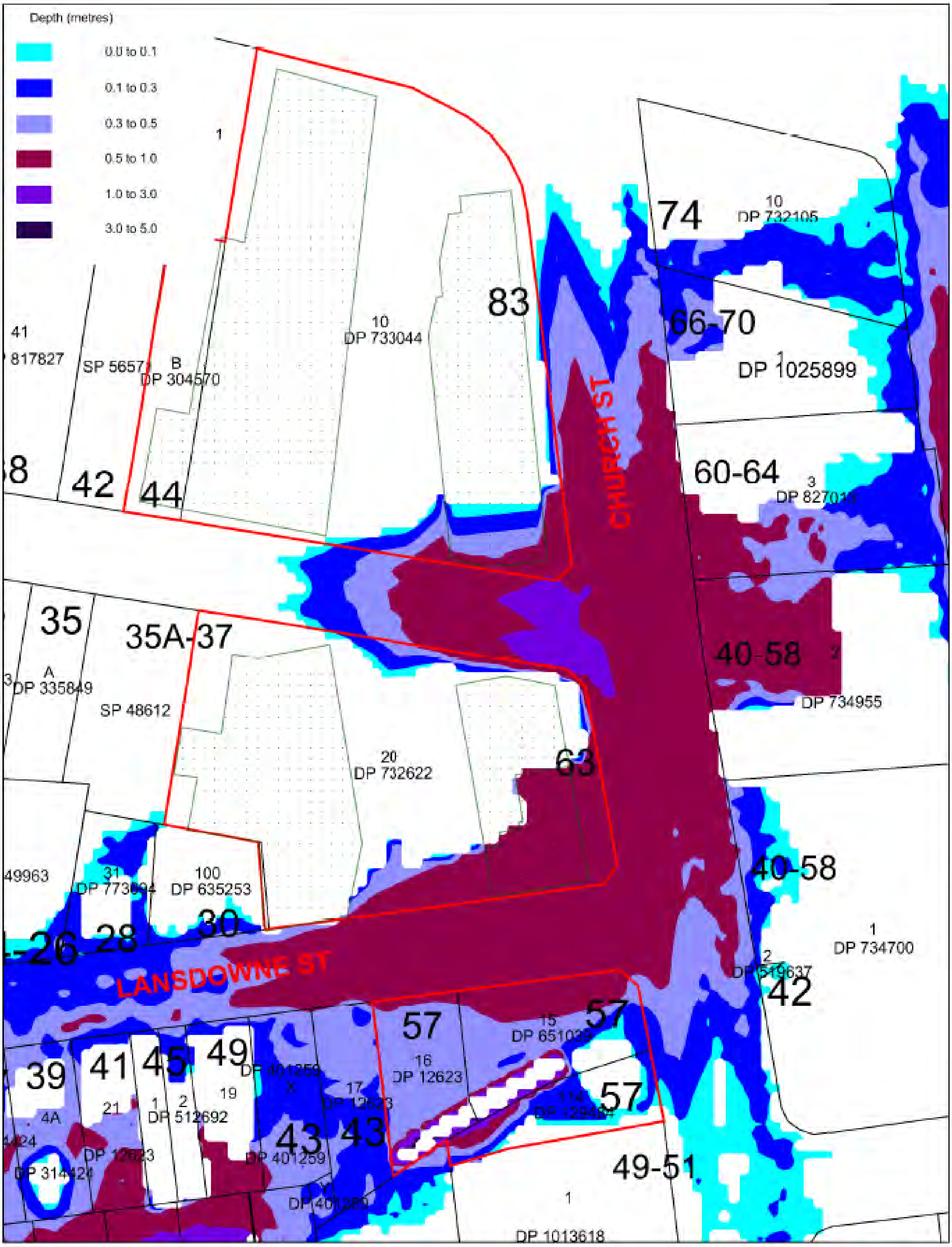


Figure B. 7: 100 year ARI Post-Development Scenario: Maximum Depth

Figure B.7 shows the maximum depth under the 100 year ARI flood event. It can be seen that flood depths are greatest along Church Street between Lansdowne Street and Early Street. This is due to the generally lower terrain levels in this area.

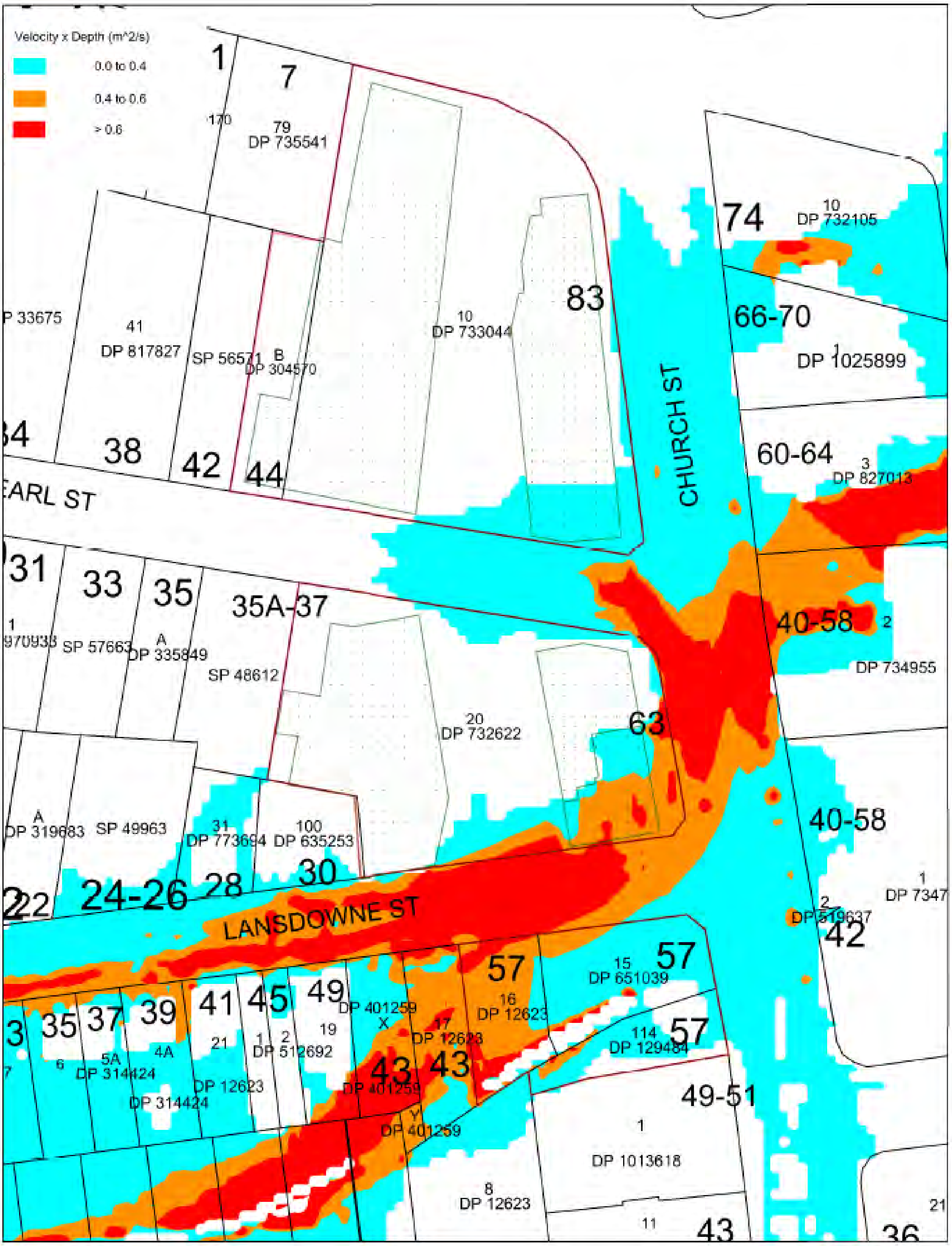


*Figure B. 8: 100 year ARI Post-Development Scenario: Depth * Velocity product*

The velocity * depth product during a 100 year ARI flood event is shown in Figure B.8. The guidelines[12] identify areas with a depth velocity product of greater than 0.4 as being hazardous to children and a depth velocity

[12] Australian Rainfall and Runoff Revision Project 10: Appropriate Safety Criteria for People, Stage 1 Report (Table 5) (April 2010)

product of greater than 0.6 of being hazardous to adults as well. Under these criteria, Lansdowne Street and Church Street face hazardous conditions in a 100 year ARI flood event.

It is also interesting to note though that only a small part of site 3 is affected by these condition; mostly because the flood flows have spilled upstream of the culvert on Church Street.

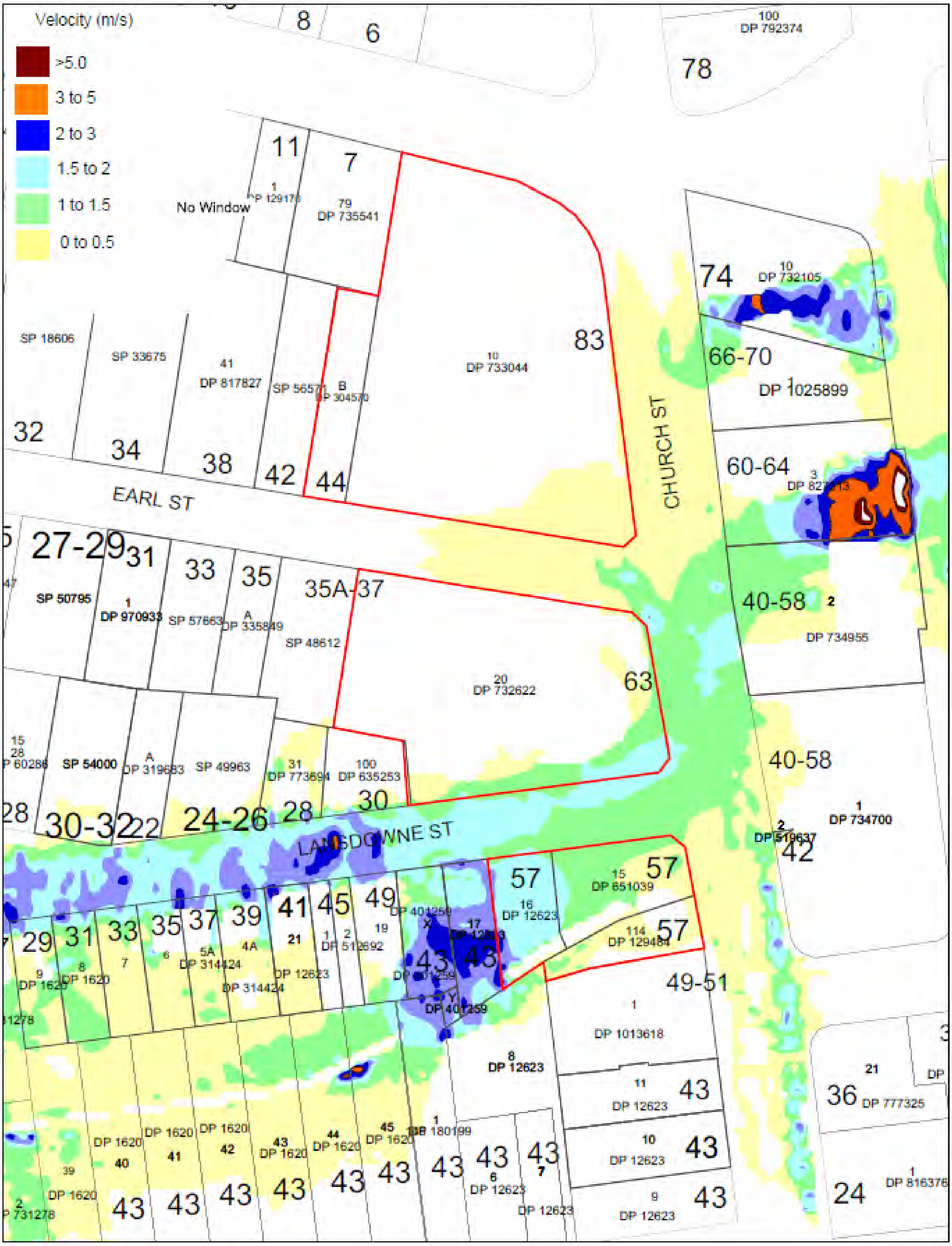


Figure B. 9: 100 year ARI Existing Scenario: Peak Velocities

Figures B.6 and B.9 show the peak velocity during a 100 year ARI event with the existing scenario and the proposed development. Figure B.10 shows the changes in velocity with this development. It can be observed that there are slight increases in the velocity along some sections of Lansdowne Street and Church Street and reductions elsewhere.

Figures B.8 and B.11 show the peak velocity depth product which is a representation of the flood hazard. Figure B.12 shows the change in hazard arising from this development. It indicates that there will be significant reductions in the velocity depth product following the proposed development, although there will also be slight increases in the vicinity of the underfloor floodway passage.

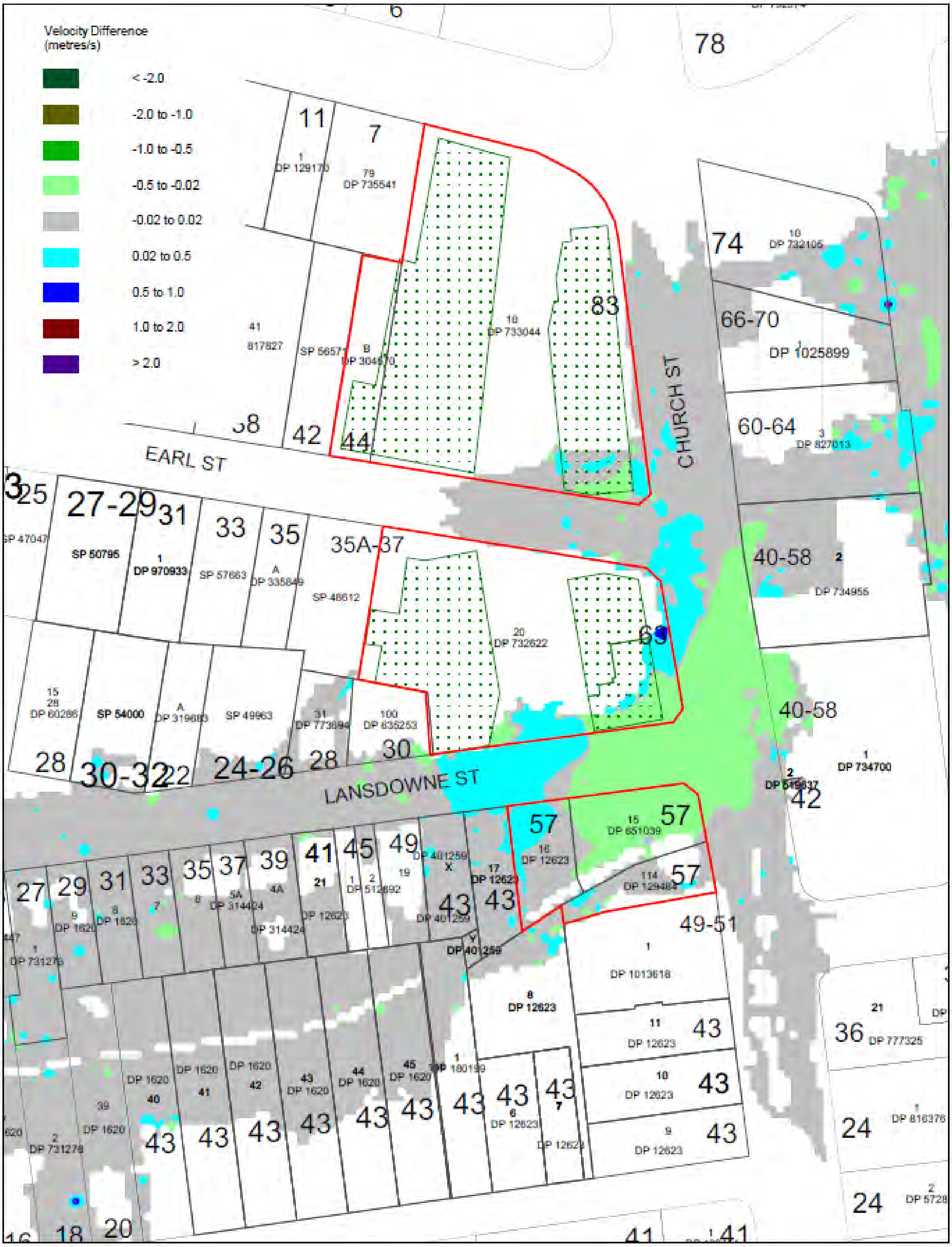


Figure B. 10: 100 year ARI 100y Peak Flood Velocity Difference - Post-Development Less Existing Scenario

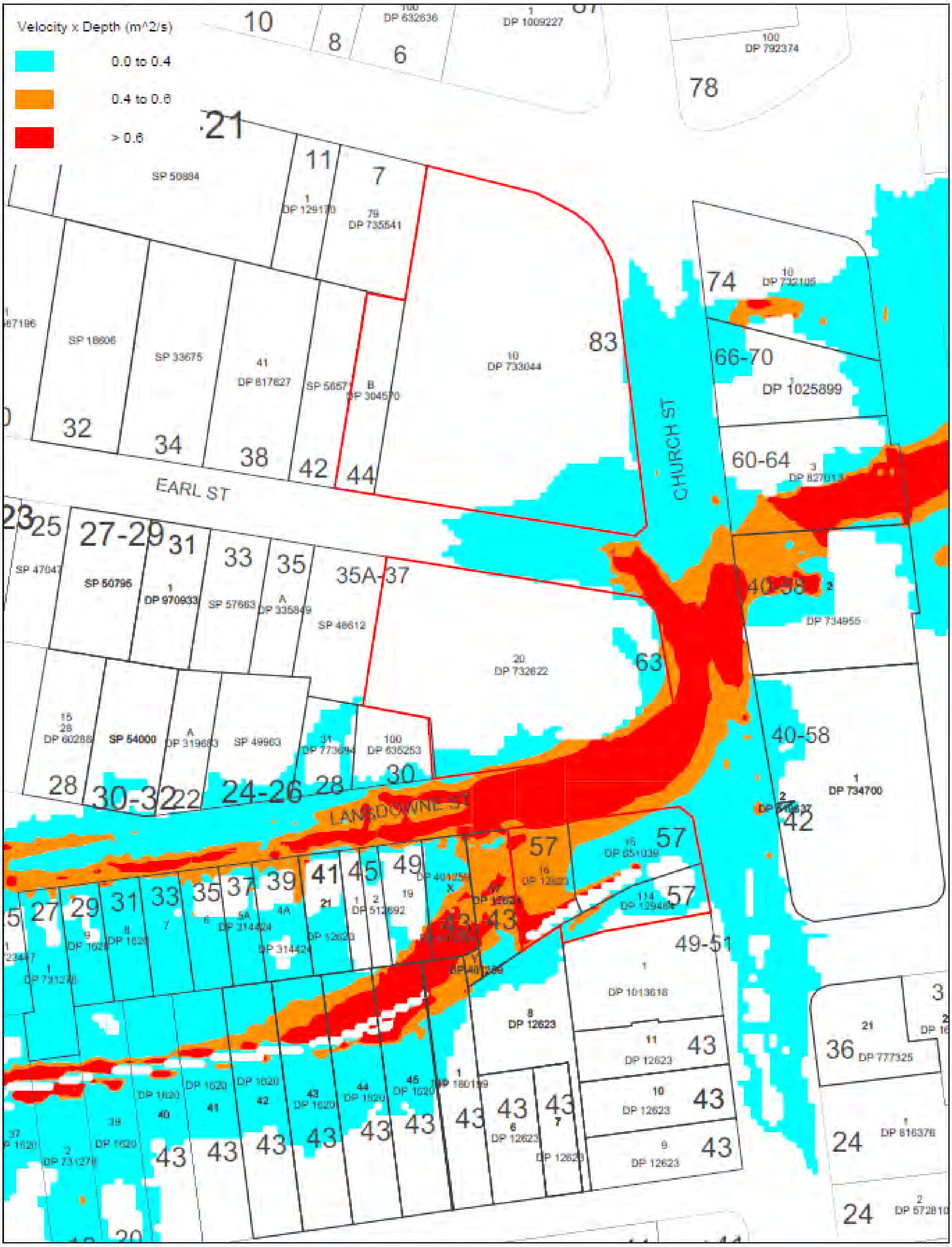


*Figure B. 11: 100 year ARI Existing Scenario: Depth * Velocity product*

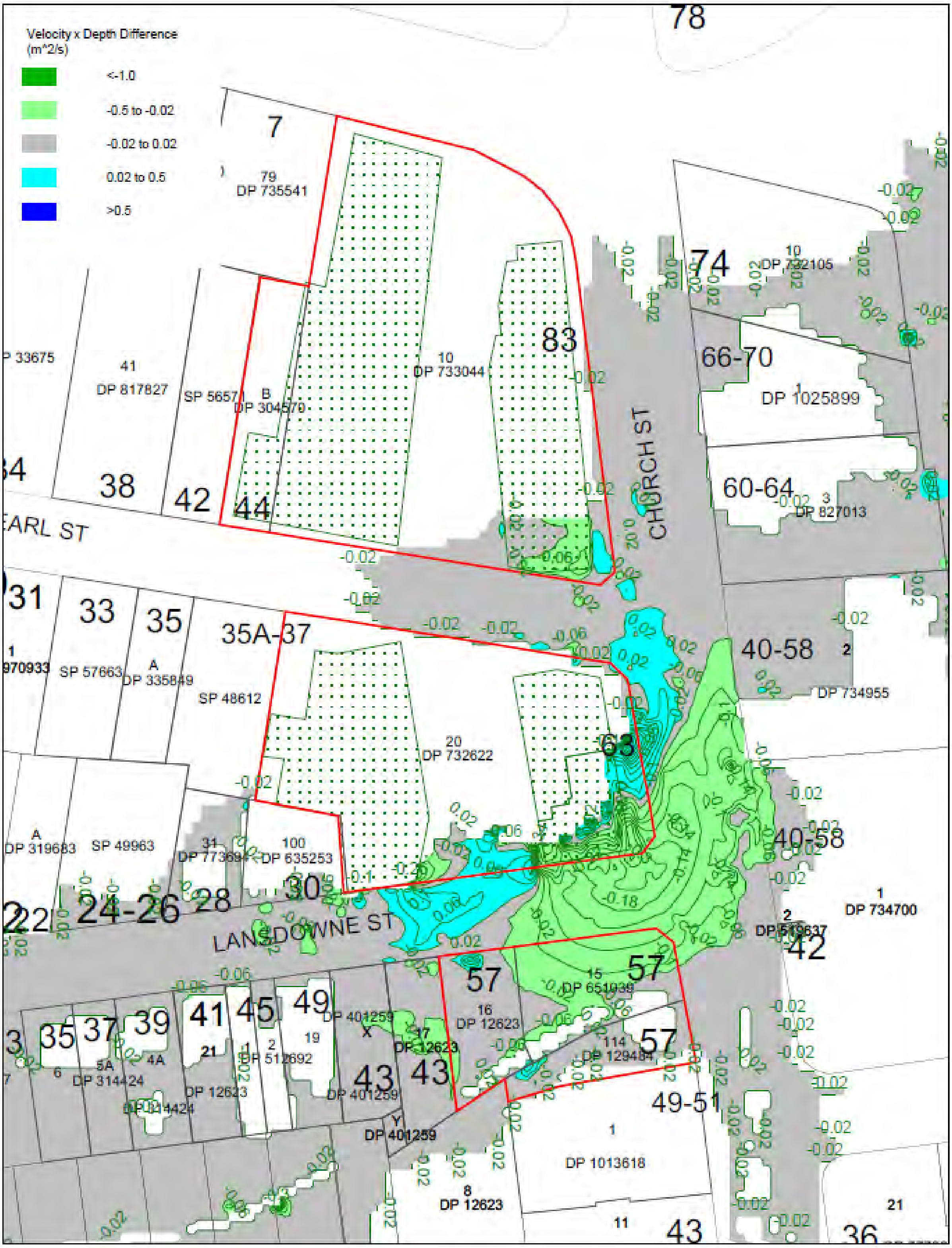


*Figure B. 12: 100y ARI Depth * Velocity product Difference - Post-Development Less Existing Scenario*

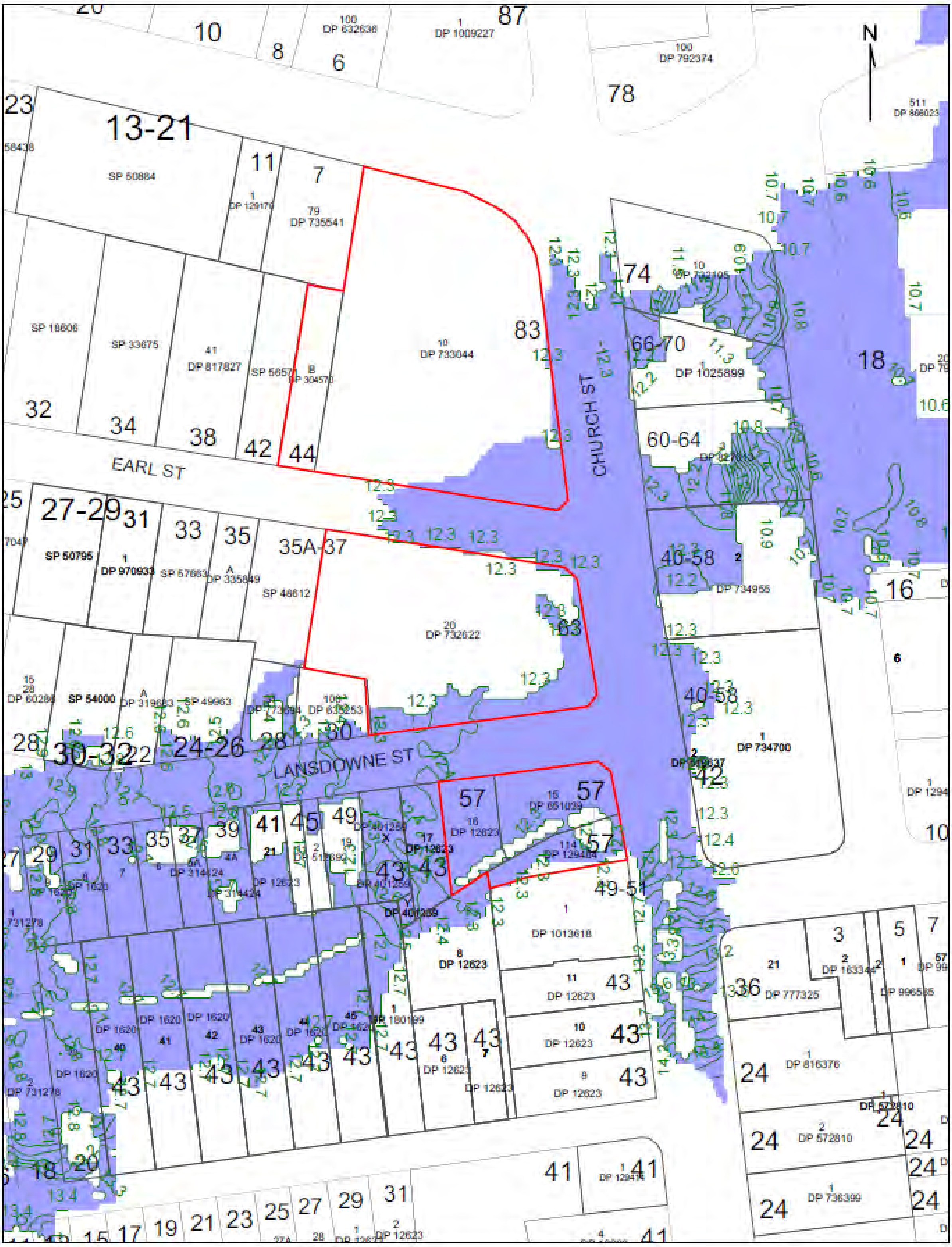


Figure B. 13: 100 year ARI Existing Scenario: Flood Elevations

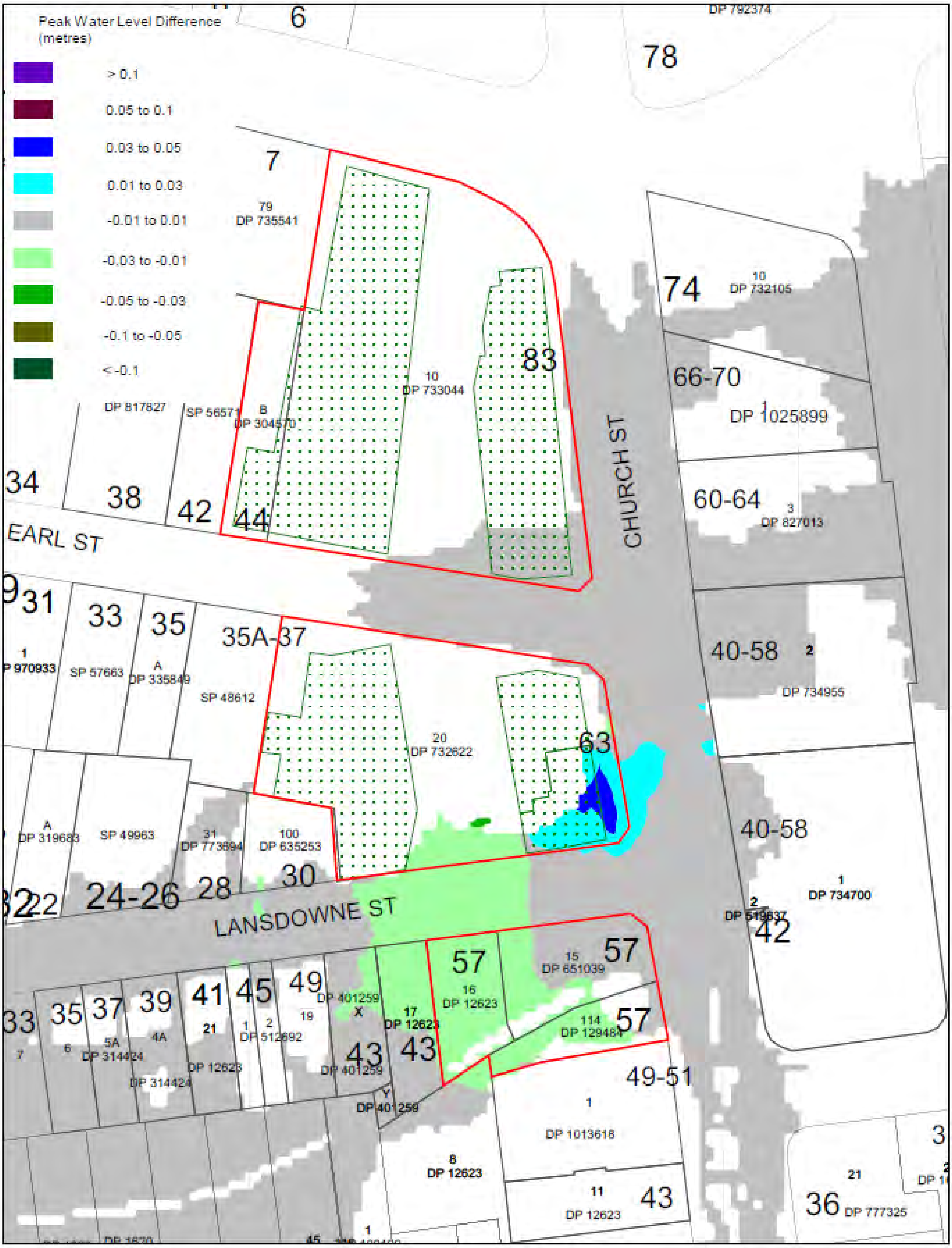


Figure B. 14: 100y ARI Flood Elevation Difference - Post-Development Less Existing Scenario

The flood planning levels were determined for each building and are shown in Table B.3

A FPL of 12.9 m AHD has been adopted for all its buildings.

Table B. 3: Food Planning levels for Each Building

Building	100 year ARI flood level	Minimum FPL
Building E + D	12.34	12.84
Building F	12.34	12.84
Building L	12.39	12.89
Building K	12.39	12.89

2.4.2. PMF Event

The flood behaviour of the site was also modelled under conditions of extreme flood (PMF) using the 2D XP SWMM 2007 model. A map of the maximum flood elevations.[13] arising from the PMF is shown in Figure B.15. It can be seen here that the maximum flood level generated by this model in the vicinity of the site is 13.36 m AHD. The PCC have however required that a flood level of 14.2 m AHD and14.0 m AHD be adopted for sites 2 and 1 respectively and those figures have been adopted in this report for design purposes.

Figures B.16 and B.17 show the peak velocities and the velocity-depth product on the site ain the post-development scenario. Figures B.18-B.20 show the changes in elevation, peak velocities and the velocity-depth product when compared against the existing scenario during a PMF event.

Once again it can be seen that there are no significant impacts arising from this development during a PMF event.

[13] It should be noted that there were model instabilities at these very high flows, but not in the vicinity of these project sites.

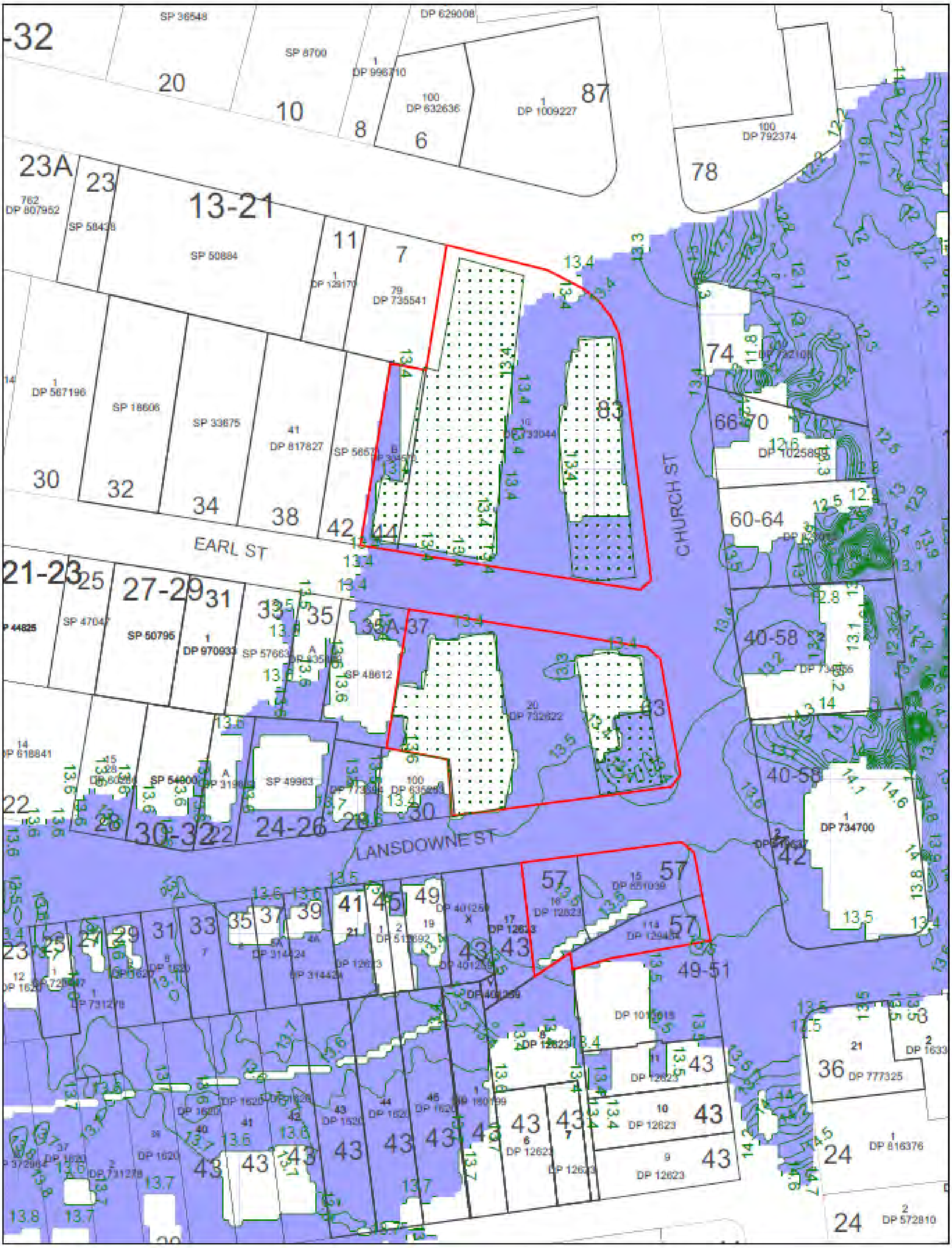


Figure B. 15: PMF Event Post-Development Scenario: Flood Elevations

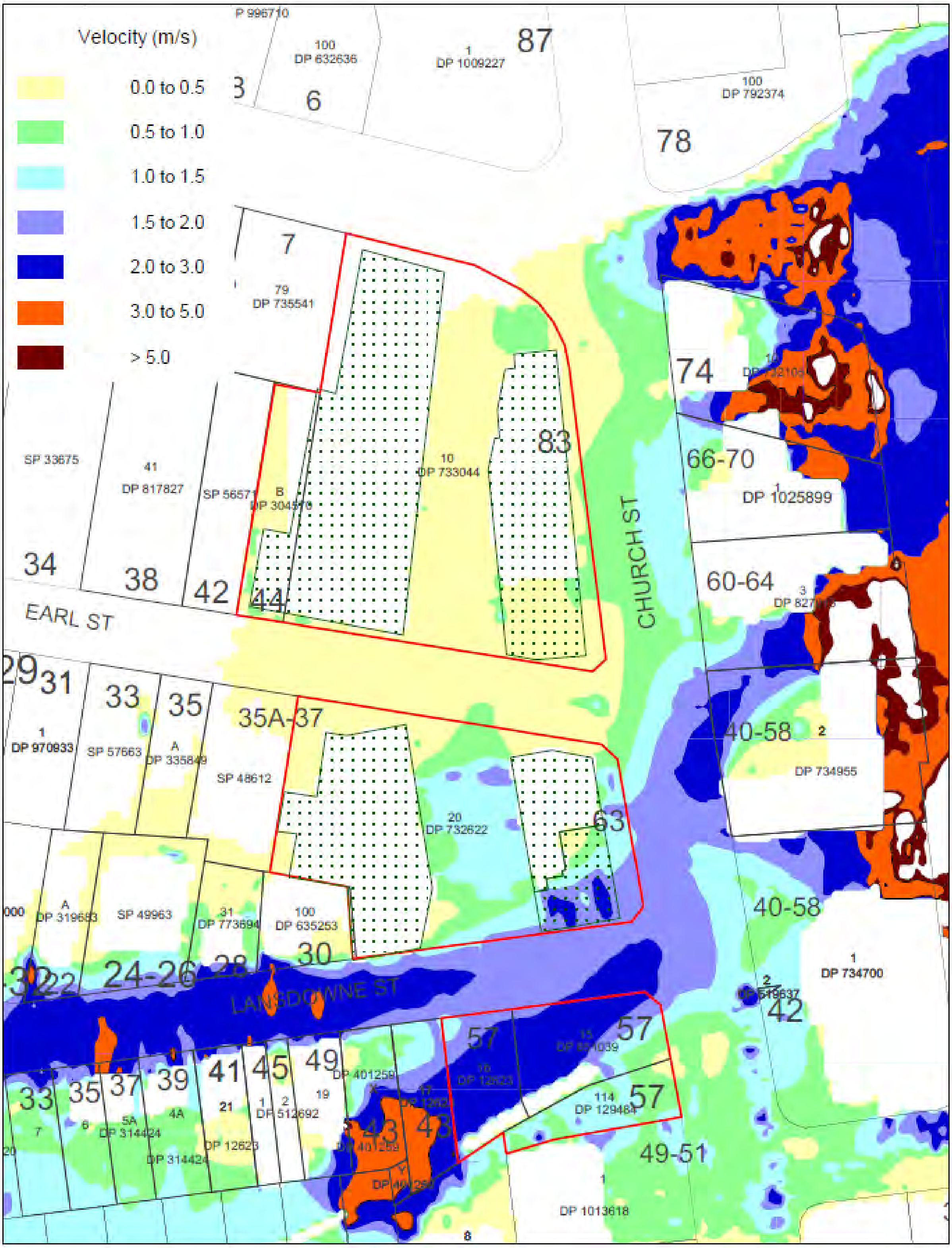


Figure B. 16: PMF Event Post-Development Scenario: Peak Velocities

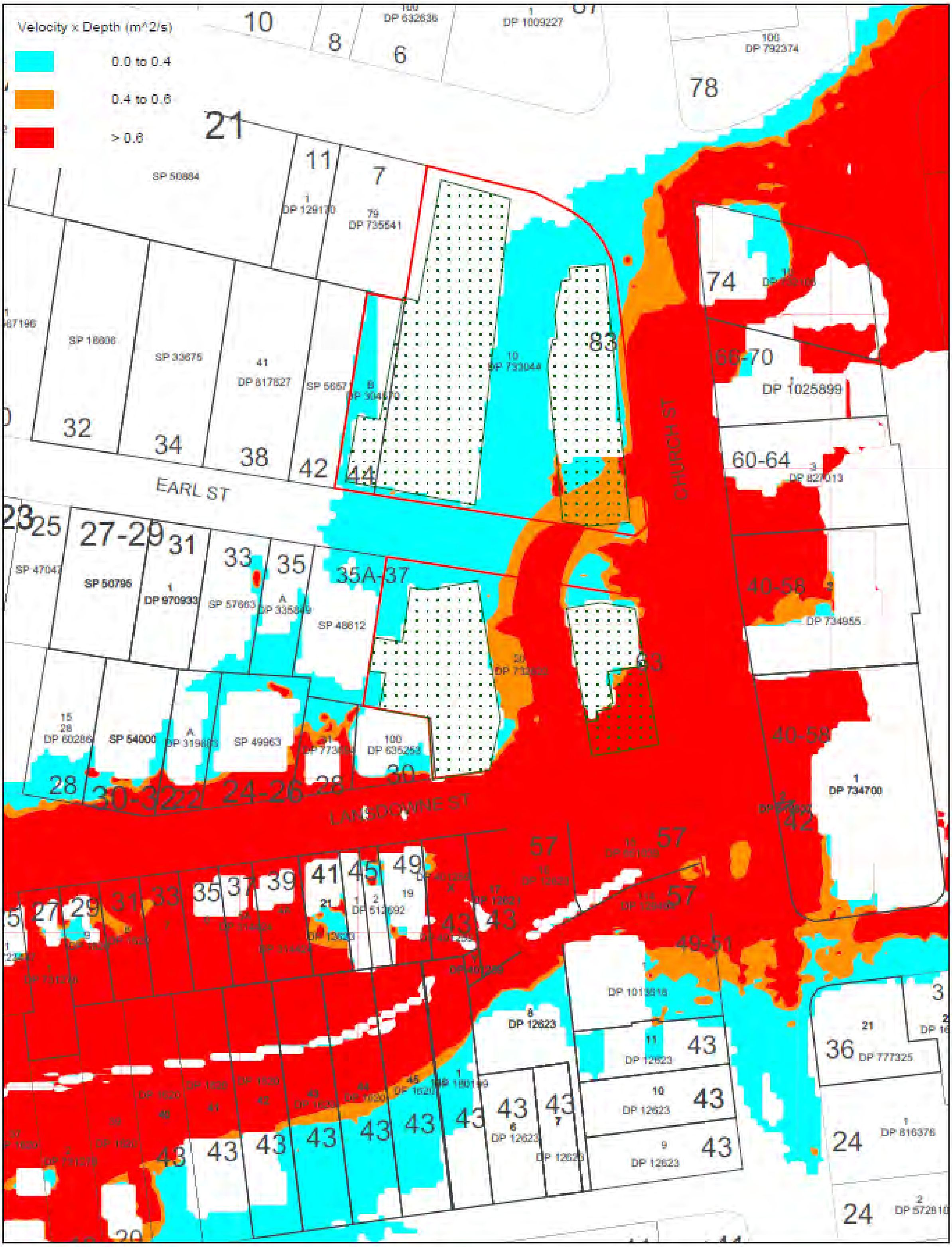


*Figure B. 17: PMF Event Post-Development Scenario: Depth * Velocity product*

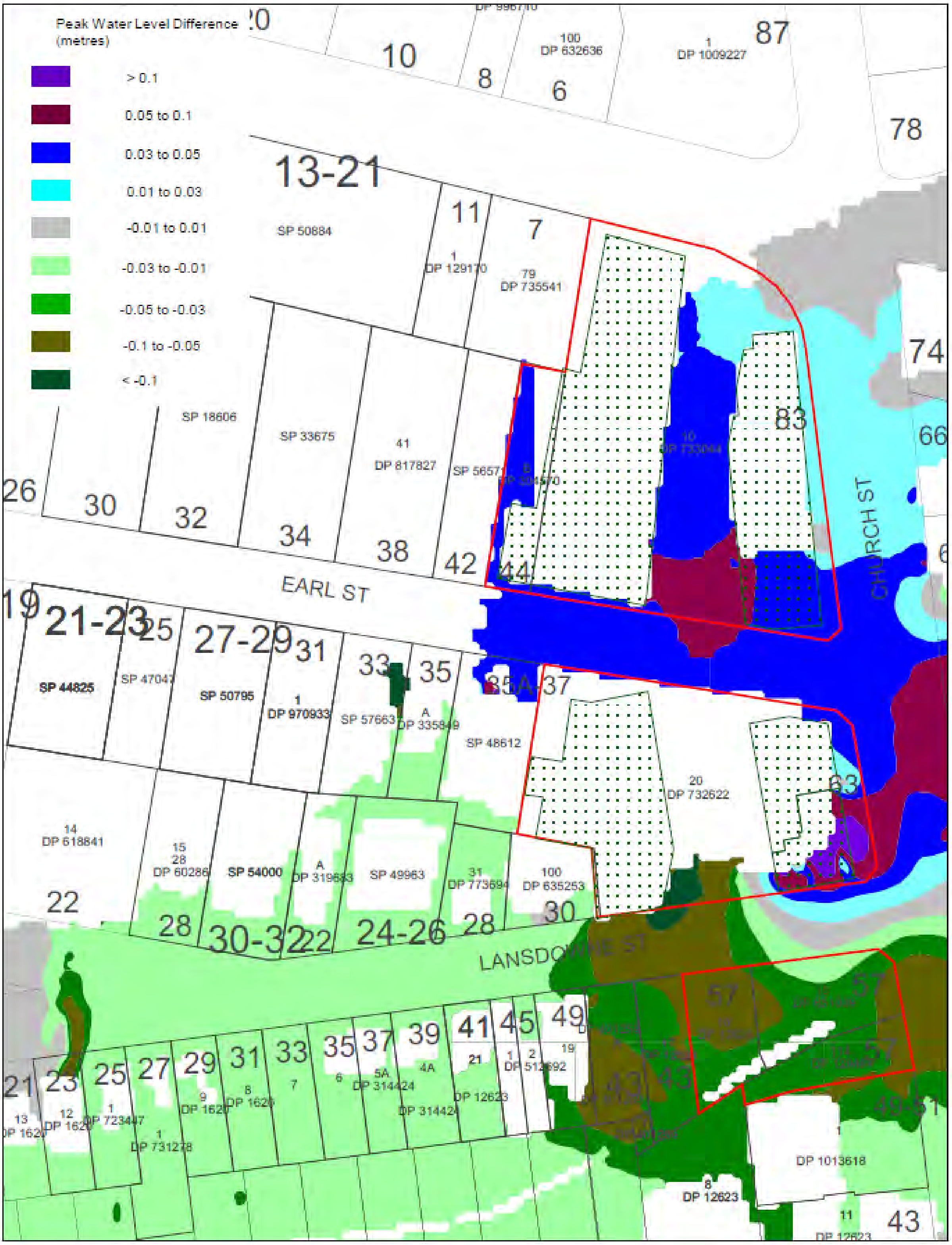


Figure B. 18: PMF Event Flood Elevation Difference - Post-Development Less Existing Scenario

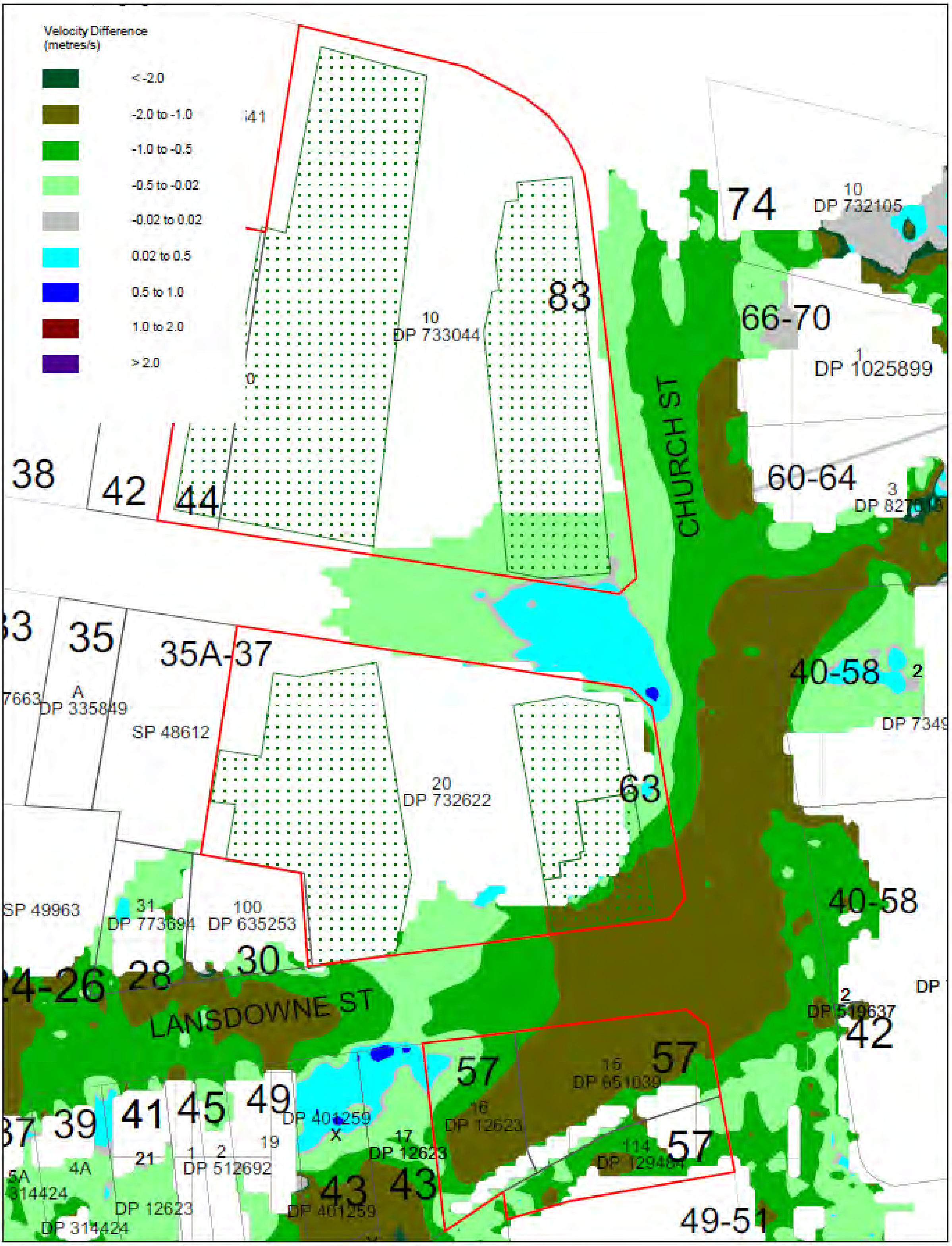


Figure B. 19: PMF Event Peak Flood Velocity Difference - Post-Development Less Existing Scenario

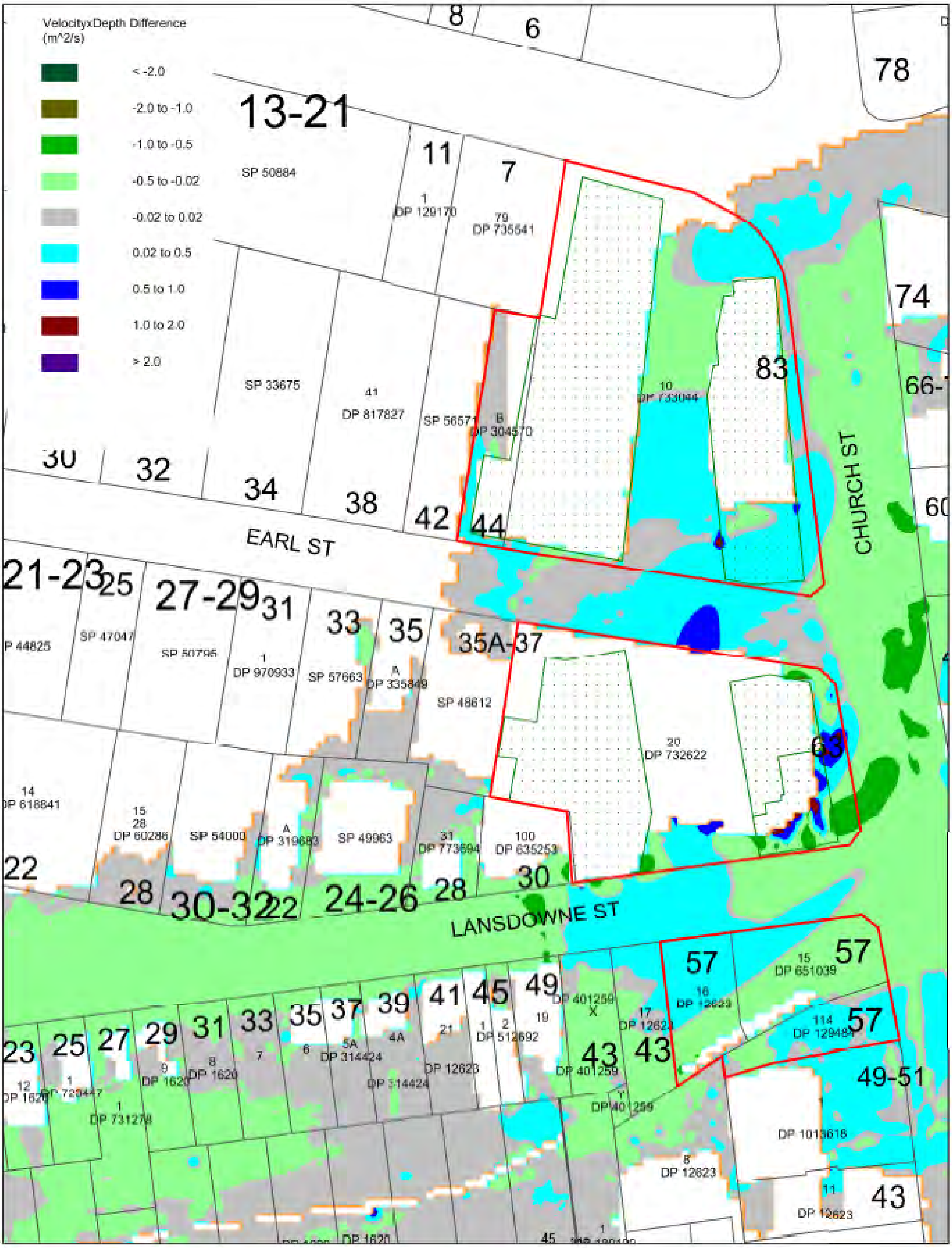


*Figure B. 20: PMF Event Depth * Velocity Difference - Post-Development Less Existing Scenario*

2.5. Conclusions

SMEC has undertaken extensive flood modelling in relation to the Gateway South development using the PCC preferred model (2007 Cardno 2D flood model). A number of enhancements were incorporated into this model to speed up run times and more accurately represent the behaviour of very high flows.

The model was verified against the results of previous studies[14] and found to be satisfactory.

An updated layout of buildings, plaza and flow paths was then incorporated into the model and flood studies carried out for the 100 year ARI flood event. The results were then used to re-determine the flood planning level for each building.

The model results confirm the previous findings that the proposed development does not result in significant adverse impacts to flood behaviour during a 100 year ARI flood event.

Flood studies were also undertaken during an extreme PMF event and once again it was shown that the proposed development does not result in significant adverse impacts to flood behaviour.

It can thus be concluded that the proposed buildings and ground surfaces do not harm other land by diverting floodwaters and concentrating stormwater during a 100 year ARI event, a PMF or floods in-between.

[14] AECOM (2014, 2015)

3. UNDERFLOW FLOOD PASSAGEWAY MODELLING

3.1. Underfloor Passageway Details

Details of the underfloor passageway as extracted from Drawings DA -800-004 and DA-800-005 Turner are presented in Figure B.21 to B.23 below.

It shows the structure as an open passageway under the building in Site 2 with an invert level of 11.765 m AHD and a soffit level of 12.65 m AHD. The main columns supporting the building have been assumed to have a diameter of around one metre and the passageway is protected against pedestrian entry by a floodway screen (grill).

The plaza level to the west of this structure is at 11.765 m AHD which allows free flow of water from the plaza into the passageway and out of it. The passageway discharges over its length into the footpath in Church Street and in effect replicates the existing situation of flows across Site 2.

3.2. Floodway Modelling

Detailed examination of the model results in the vicinity of the underfloor flood passageway and the surrounding areas was undertaken to check possible flood hazards arising from the construction of this structure.

Figures B.24 to B.26 show the detailed flow conditions through the passageway during a 100 year ARI flood event. It can be seen that during this event, the depth of water in the passageway is around 600 mm with velocities of around 1 m/s. The velocity depth product is shown in Figure B.26 and is compared against existing conditions in Figure B.27. It can be seen that the flood passageway as designed has not created any significant impact on the existing hazard condition at the site.

A sensitivity analysis was also carried out assuming fifty percent blockage of the grills surrounding the flood passageway to assess any significant changes in the flow patterns. The results of those runs are presented in Table B.4. It is seen that the major impact of the blocked grills is an increase in maximum flood depth by no more than 3 mm.

Figure B. 21: Floodway Elevation Details viewed from west (extract from Drawing DA -800 – 005 Turner)

Figure B. 22: Floodway Elevation Details viewed from east (extract from Drawing DA -800 – 005 Turner)

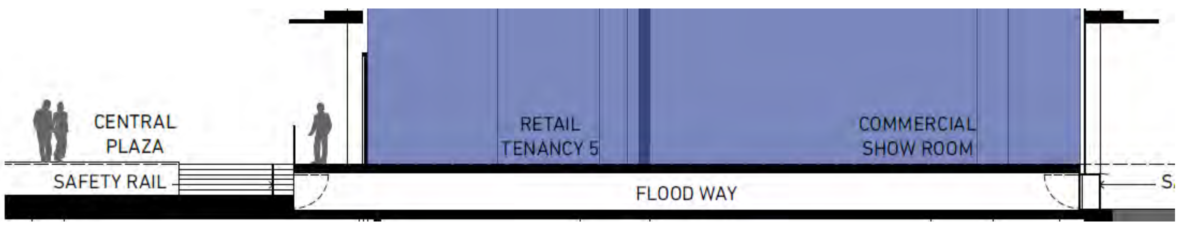


Figure B. 23: Floodway Elevation Details viewed from south (extract from Drawing DA -800 – 004 Turner)

Figure B. 24: 100 Year ARI flood flows through underfloor flood passageway: Depths

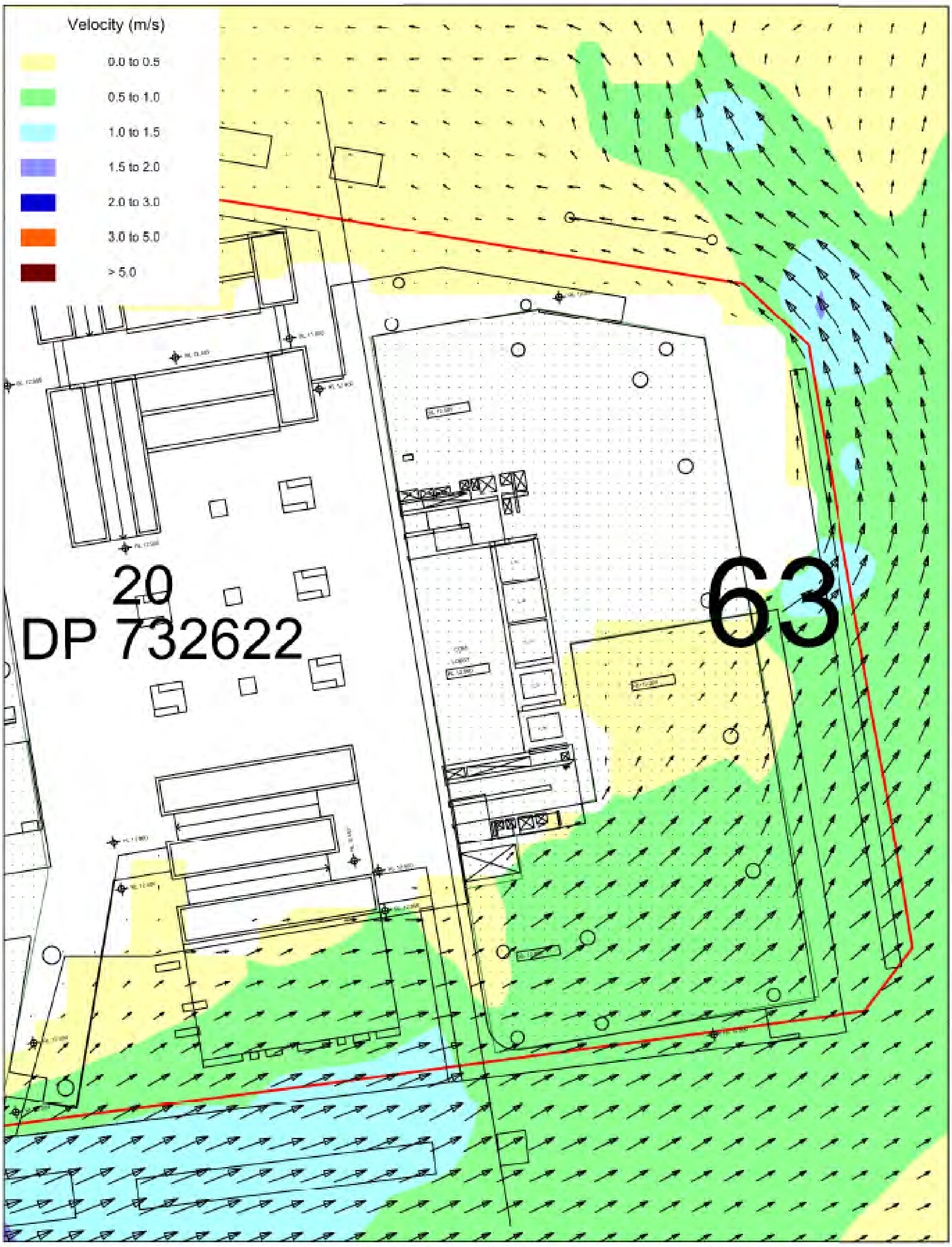


Figure B. 25: 100 Year ARI flood flows through underfloor flood passageway: Velocity (m/s) and Direction

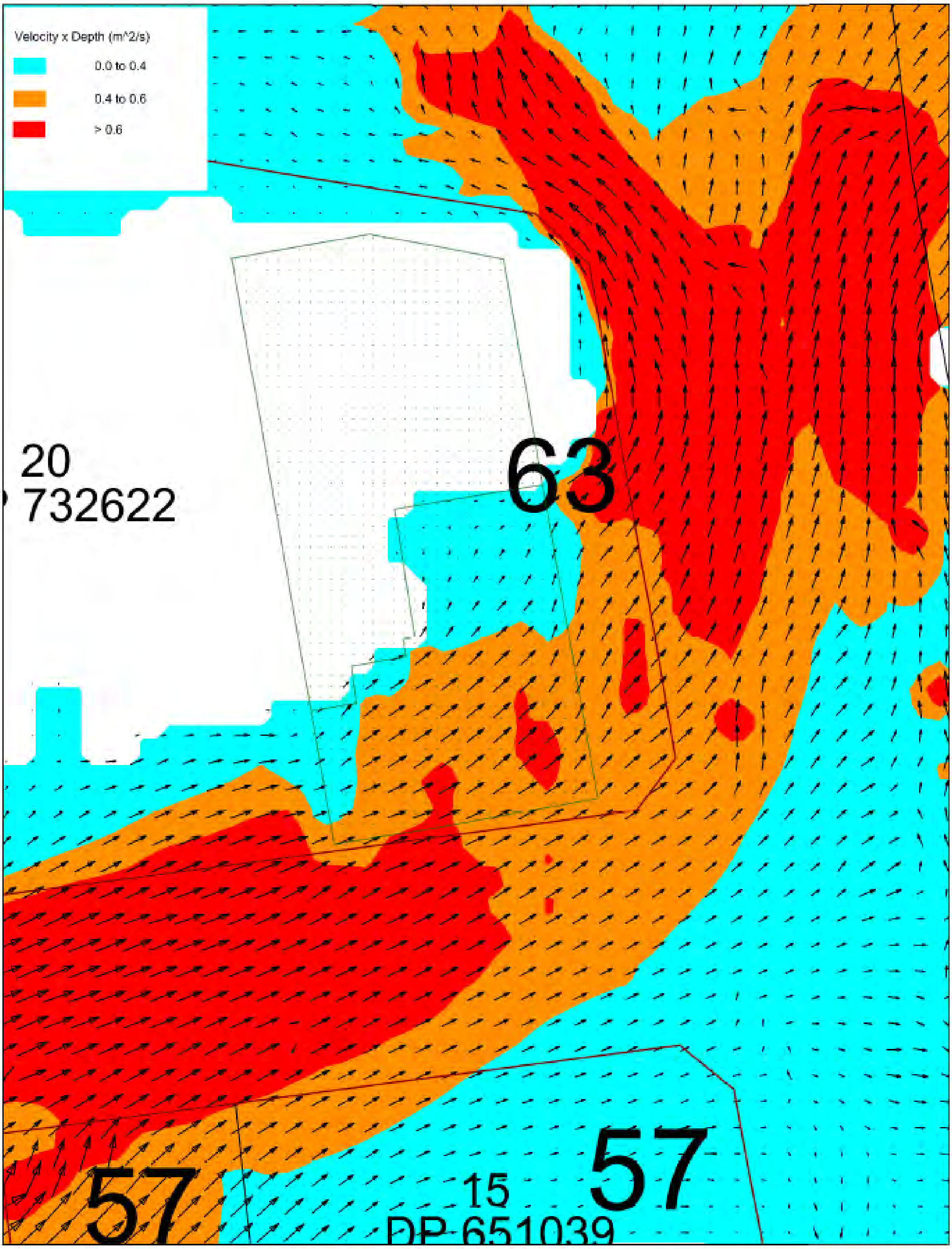


*Figure B. 26: 100 Year ARI flood flows through underfloor flood passageway: Depth * Velocity product*

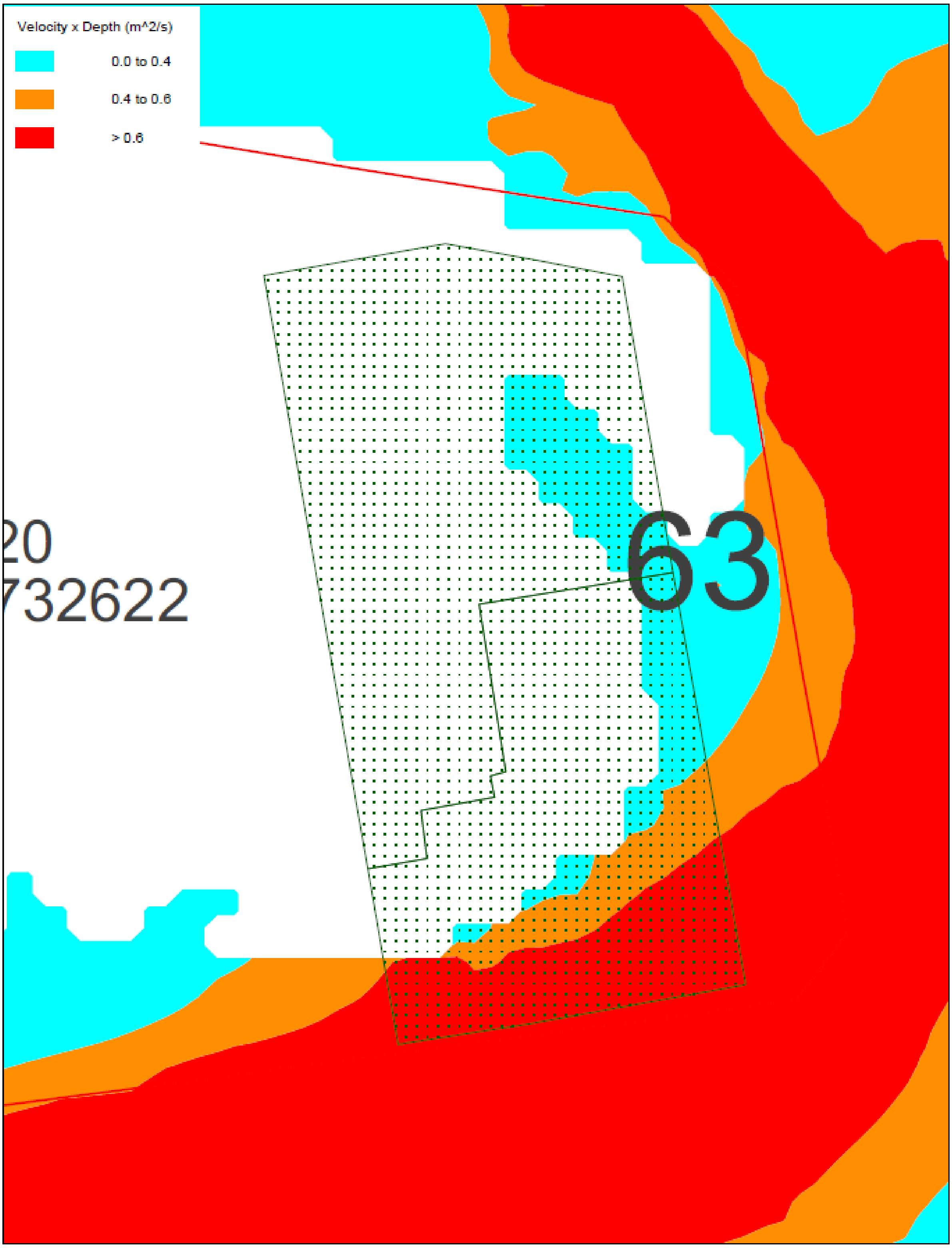


*Figure B. 27: 100 Year ARI flood flows through existing conditions: Depth * Velocity product*

*Table B. 4: Maximum Flood Depth, Velocity and Velocity*Depth Product in the vicinity of the site in Post Development Scenario under 0% and 50% blockage of the grills*

Location	Depth		Velocity		Velocity * Depth	
	0% Blockage	50% Blockage	0% Blockage	50% Blockage	0% Blockage	50% Blockage
L4	0.77	0.78	1.14	1.14	0.88	0.88
L5	0.83	0.83	0.72	0.76	0.60	0.63
C5	0.67	0.67	0.62	0.65	0.42	0.44
C6	0.48	0.48	0.28	0.30	0.14	0.14

3.3. Conclusions

It can be concluded that the underfloor flood passageway as designed effectively replicates the existing flood conditions in Site 2. The plaza area allows unimpeded access of flood flows into the flood passageway and the flood flows entering Church Street do not create any additional hazard.

APPENDIX C

Gateway South Concept Design Church Street, Parramatta: Aspects of Flood Design

January 2017

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1. Scope

This Appendix deals with issues arising from the flood studies documented in Appendices A and B. It looks at the design of the flood emergency management gates to be installed at the entrances to the basements of sites 1 and 2 as well as the estimation of forces on the buildings generated by the extreme floods that could affect it.

2. BASEMENT FLOOD GATES

PCC have specified that the entry to basements of Site 1 and 2 be protected against flooding to the PMF level. They have also specified the PMF level for Site 1 as 14.0 m AHD and for Site 2 as 14.2 m AHD.

SMEC propose the use of floatation type concealed flood gates to provide protection against flooding to the PMF level at these locations. This proposed concealed flood barrier is a self-actuating flood defence system that harnesses rising waters to automatically deploy a flood barrier.

Figures C.1 and C.2 presents the detail of the proposed gates. The flood gate is held in a cassette that is connected to a strip drain in front of the gate by a connection line. As flood levels rise outside the flood gate the water enters the cassette and raises the flood gate. As the flood waters recede, the water within the cassette can be removed either by pumping or through a siphon built into it.

Advantages of this system include;

- The gate is permanently installed below ground level at the isolation point and is ready for deployment when required;
- Rising water levels cause an automatic response, elevating the isolation barrier via floatation.
- Gate system retracts below pavement as water levels decrease.
- Low maintenance design; and
- Low aesthetic impact.

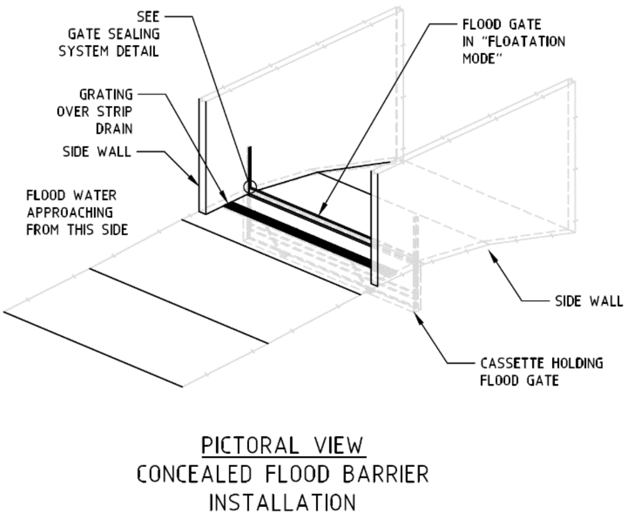


Figure C. 1: Pictorial View

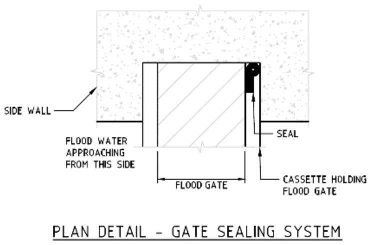


Figure C. 2: Gate Sealing System

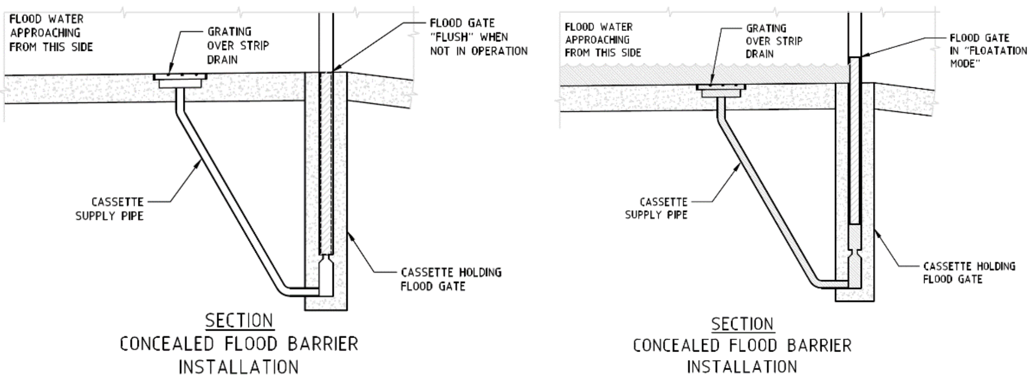


Figure C. 3: Gate Operation

2.1. Site 1

A concept design of the floodgate for site 1 is presented in Figure C.4 below. The gate will commence to rise when floodwaters approach a level of 12.9 m AHD (which is 500 mm above the 1% flood level) and the floodgate will provide protection to the PMF level of 14.0 m AHD. Further details of the structure are shown in Drawing DA-2101 AJ+C which forms a part of this submission. Full details of the proposed structure will be presented at the Construction Certificate stage.

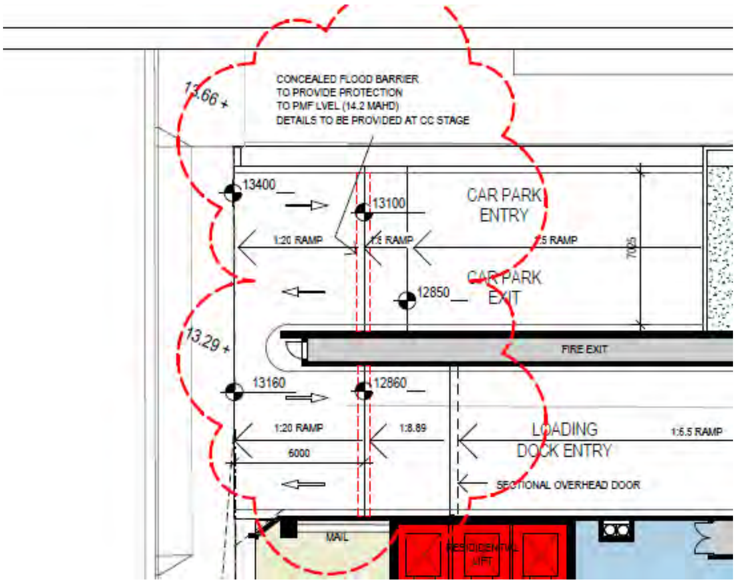


Figure C. 4: Site 1 Concept for floodgate to basement (extract from drawing DA-2101 AJ+C)

2.2. Site 2

A concept design of the floodgate for site 2 is presented in Figure C.5 and 6 below. The gate will commence to rise when floodwaters approach a level of 12.9 m AHD (which is 500 mm above the 1% flood level) and the floodgate will provide protection to the PMF level of 14.2 m AHD. Further details of the structure are shown in Drawing DA-800-003 Turner. As with Site 1, full details will be presented at the Construction Certificate stage.

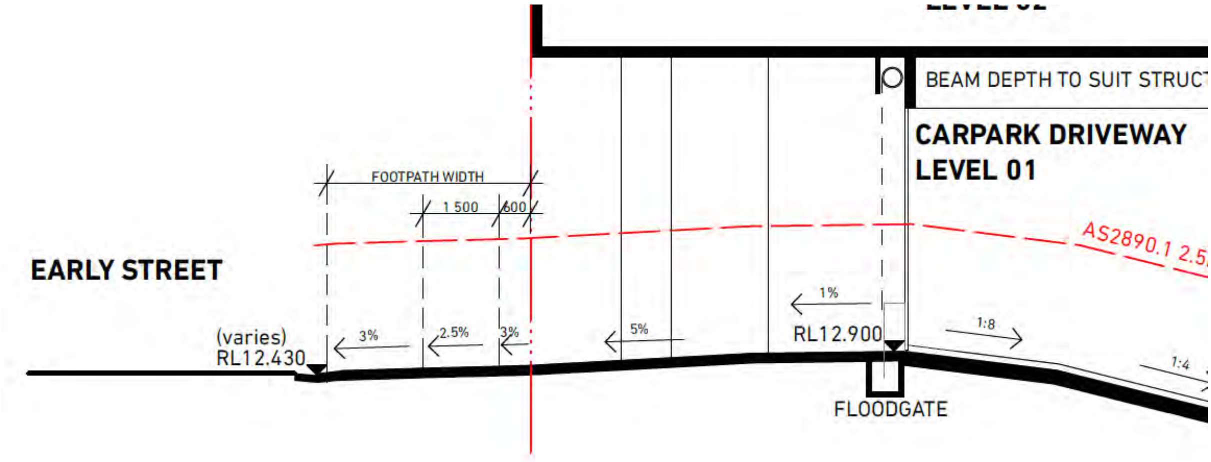


Figure C. 5: Site 2 concept for floodgate (extract from drawing DA-800-003 Turner)

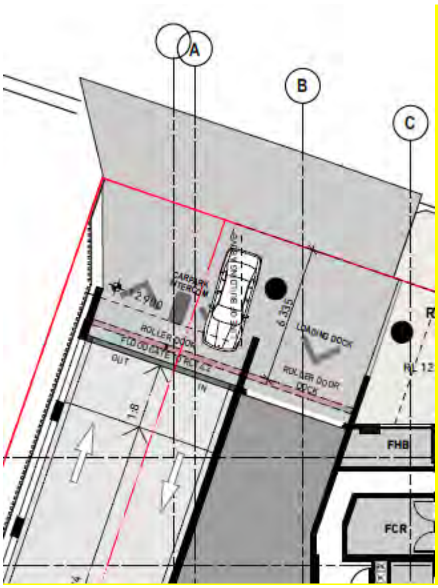


Figure C. 6: Site 2 concept for floodgate (extract from drawing DA-110-010 Turner)

3. FLOOD LOADINGS

3.1. Basis of Calculation

PCC have requested that the structural integrity of buildings in Site 2 be checked against loads arising from moving water, debris and buoyancy effects; during a major flood event. A worst case scenario would be the PMF condition with the water level at 14.2 m AHD within and outside the building and flows moving in a north easterly direction through the flood passageway under the building as well as through the building.

SMEC propose the use of AS5100.2 Bridge Design Loads to facilitate this response. The following forces have been considered as shown in Figure C.7 below;

1. Lateral drag forces on the columns arising from the moving water;
2. Vertical lift forces on the columns arising from the moving water;
3. Lateral drag forces on the slab which can be overtopped by up to 1300 mm;
4. Vertical lift forces on the slab from the moving water;
5. Lateral Forces from the moving water on the structure due to the build-up of a debris mat;
6. Lateral forces due to moving objects such as trees and cars impacting on the structure;
7. Vertical forces due to buoyancy and lift arising from the inundation
8. There is also an upward turning moment on the slab due to the effect of the moving water

The loadings on the structure are a function of the velocity. Details of flow velocities within the underfloor passageway during a PMF event are presented in Appendix B of this report.

3.2. Flood Loadings

Flood loadings are presented in Table C.1 below. Details of the calculations relating to these loadings are presented in Attachment 1 to this Appendix.

Table C. 1: Flood Loadings on structure from moving waters

Summary	3m/s	2m/s	1m/s	0.5m/s
FORCES (kN)				
Drag columns (Dc)	7.2	3.2	0.8	0.2
Lift columns (Lc)	10.4	4.6	1.2	0.3
Drag slab (Ds)	256.2	113.9	28.5	7.1
Lift slab (uplift) (Lsu)	81.0	36.0	9.0	2.3
Lift slab (down) (Lsd)	-270.0	-120.0	-30.0	-7.5
Debris (Db)	263.9	117.3	29.3	7.3
Log Impact (Li)	34.3	15.2	3.8	1.0
Buoyancy. (B)	88.3	88.3	88.3	88.3
MOMENT (kNm)				
Moment slab (Ms)	621.0	276.0	69.0	17.3

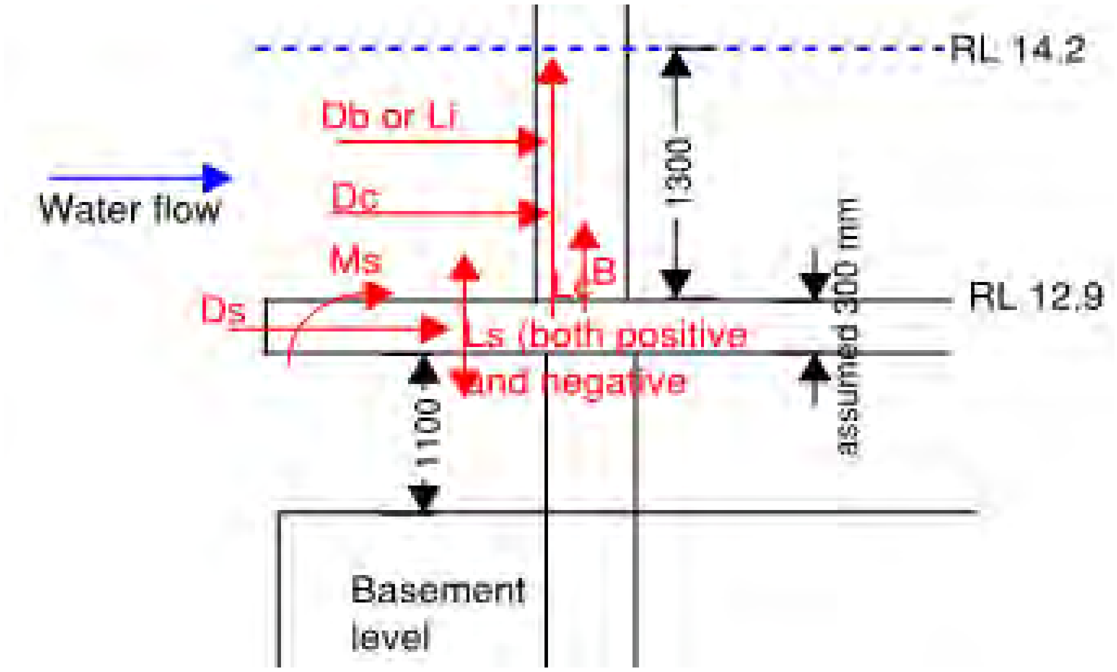


Figure C. 7: Loading Diagram

ATTACHMENT TO APPENDIX C

COMPUTATION SHEET

Project: Gateway South Church St Parramatta Flood Modelling
Project No.: 30012122 **Date:** 23/01/2017
Structure: **Designed By:** RAJ
Feature: Flood Loads **Reviewed by:**

Design Loads & Load Factors

Pier diamter = 1 m
Pier depth submerge(2.3 m
Vu = 3
Slab depth = 0.3 m

AS5100.2

Clause 15.3.1 Drag forces on piers

15.3.1(1) $F^*_{du} = 0.5 C_d V_u^2 A_d$

Cd = 0.7 (semi-circular pier nosing)
Ad = 2.3 m^2

F*du = 7.245 kN
Applied at the mid point of the flooded column.

Clause 15.3.2 Lift forces on piers

15.3.2(1) $F^*_{Lu} = 0.5 C_L V_u^2 A_L$

CL = 1 Assume worst case
AL = 2.3 m2
m^2
F*Lu = 10.35 kN
Applied at midpoint of the column

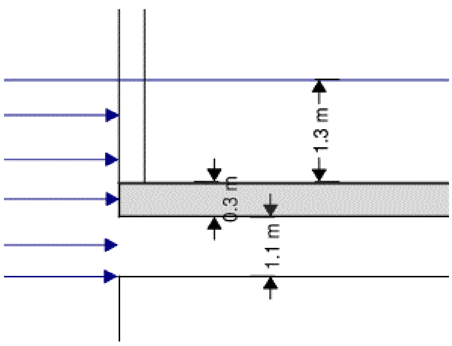
15.4.2 Drag Force on Slab

15.4.3(1) $F^*_{du} = 0.5 C_d V_u^2 A_s$

As = 2.25 m^2

$$S_r = \frac{d_{wgs}}{d_{sp}}$$

$$P_r = \frac{y_{gs}}{d_{ss}}$$



Sr = 4.333333
Pr = 0.6875
Cd = 3.3
F*du = 33.4125 kN
Applied at the mid point depth of the slab

	15.4.3 Lift force on slab
15.5.3(1)	$F^*_{Lu} = 0.5 C_L V_u^2 A_L$
	Assume worst case scenario for CL
	CL= 0.6
	-2
	Flu
	Assume AL = 7.5 m x 4 m (tributary area between columns)
	AL = 30 m^2
	FLu 81 kN
	-270 kN
	Applied to the underside of the slab (best to treat this as an area load to the tributary
	15.4.4 Moment on a superstructure
15.4.4(1)	$M^*_{gu} = 0.5 C_m V_u^2 A_s d_{sp}$
	dsp = 1.6 m
	Cm = 5
	M*gu = 81 kNm
	Applied at the soffit level at the centre-line of the slab.
	15.5 Forces due to debris
	Assume depth of debris mat = depth of water on columns
	Depth of debris mat= 2.3 m
	Length of debris mat is = 0.5 sum of adjacent spans
	Length = 7.5 m
15.5.4(1)	Drag due to debris
	$F^*_{du} = 0.5 C_d V_u^2 A_{deb}$
	V^2y 20.7
F15.5.4(A)	Cd = 3.4
	Adeb = 17.25 m^2
	F*du 263.925 kN
	Applied at mid height of the debris mat.
15.6	15.6 Forces due to log impact
	Assume a 2 t tree log impacting at the water level height.
	Kinetic Energy = $CWv^2/2g$
	C = Impact coefficient
AASHTO	C = 1.4 Conservative from AASHTO
2007	W = weight 2000 kg
3.14.7	KE = 1.284404 knm
	KE = R*y/2
	Where R is my reaction force and y is my displacement
	R = 2KE/y
	y = 0.075
	R = 34.25076 kN

Applied at the level of the flood.

AS5100.2
15.7 15.7 Effects due to buyoancy and lift.
Buoyancy = p x g x V
Assume tributary area 7.5 m x 4 m and a slab thickness of 0.3 m

Vslab =	9	m^3
p =	1000	kg/m^3
g =	9.81	m/s^2
Buoyancy = p x g x V	88.29	kN
	per column	

Applied at mid-depth of the slab.

SUMMARY acting on column

Drag piers	7.245	kN
Lift piers	10	kN
Drag superstructure	33	kN
Lift superstructure (uplift)	81	kN
Lift superstructure (down)	-270	kN
Moment superstructure	81	kNm
Debris	264	kN
Log Impact	34	kN
Buoyancy.	88	kN

SUMMARY	**3m/s**	**2m/s**	**1m/s**	**0.5m/s**
FORCES (kN)				
Drag columns (Dc)	7.2	3.2	0.8	0.2
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MOMENT (kNm)				
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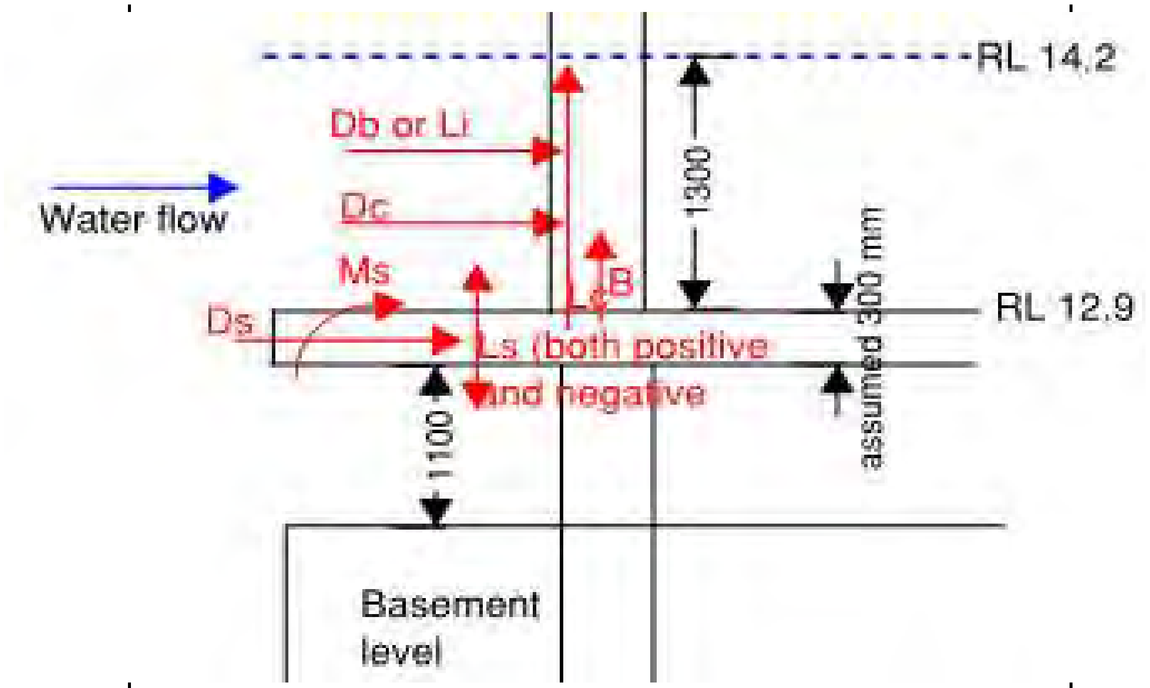

Use load cases combined to find the worst combinations.
Note: Debris loading and Log impact do not act concurrently.
For further reference please refer to the code references specified in the left column.

APPENDIX D
Gateway South Concept Design Church Street, Parramatta: Site 3 Compliance Statement

January 2017

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Scope

This Appendix deals with the PCC requirements for flood modelling of Site 3. It provides a statement from the designer (Oculus) asserting full compliance with PCC requirements.

2. COMPLIANCE STATEMENT

OCULUS

25 January 2017

Dyldam Pty Ltd
Level 1, 74 Macquarie Street
Parramatta NSW 2150

Attn. Chemaine Shehadeh

Re: Gateway South, Parramatta
Site 3 Landscape Design

Dear Sirs,

OCULUS confirms that the landscape design of the public park on Site 3 terrace has been designed in accordance with DA/706/2014 Consent Condition #11 (1) Flood Management (j) and with reference to Council's further responses dated 21.10.2016.

Specifically, we advise that in relation to this DA condition:

- Item j) (i): The existing Clay Cliff Creek culvert has not been altered and the existing fencing around it will be reconstructed to Sydney Water requirements and specifications;
- Item j) (ii): In order not to divert floodwaters or reduce storage, the finished surface levels of the park are not significantly different from current surface levels (pre development);
- Item j) (iii): The proposed kiosk amenities facility, half basketball court and play area are the subject of this DA for the park but we understand that Council will assess these items on their merits at that time, particularly in terms of flood risk safety management and encouragement of use of the high hazard flood area in the park. We understand that Council will review the risk and liability issues associated with this on receipt of this DA proposal;
- Item j) (iv): Additional car parking has not been provided in or immediately adjacent to the park.
- Item j) (v): The Landscape Design for Site 3 is responsive to the likelihood of flash flooding and has been designed to prevent or minimise harm to the public as well as scour and transport of debris. The design has considered the ability to resist fast-moving floodwaters and includes appropriately designed and selected planting, park furniture, lighting and pathways.

Yours faithfully,

Keith Stead, *Associate Director*

OCULUS
landscape architecture
urban design pty ltd

PO Box 307
Level 1
5 Wilson Street
Newtown NSW 2042

p 02.9.557.5533
f 02.9.519.8323
keith@oculus.info
www.oculus.info

acn 074.882.447
abn 34.074.882.447

DOCUMENT/REPORT CONTROL FORM

File Location Name:	I:\projects\30012122 – Gateway South Church St Parramatta Flood Modelling\010Flooding Assessment\
Project Name:	Gateway South Development- Church Street, Parramatta S79C Assessment Report : Flooding
Project Number:	30012122
Revision Number:	1

Revision History

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
1	31 January 2017	A Deen N Pannipitiya	C Katsoulas N Pannipitiya	A Deen

Issue Register

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Email:	amir.deen@smec.com	Website:	www.smec.com

Local People. Global Experience.

Reference Documents
Gateway South Concept Design
Church Street, Parramatta
Response to Request for Additional Information – Referral Comments of October 2016

January 2017

Location

Source: Allen Jack + Cottier Architects

Gateway South Concept Design Church Street, Parramatta Review of Flooding and Stormwater Comments

Clay Cliff Creek

Nov 2015

IMPORTANT NOTICE

This report is confidential and is provided solely for the purposes of flood assessment of Gateway South development for Gateway Parramatta One Pty Ltd (ABN 57607 553 565). This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ("SMEC") and Gateway Parramatta One under which SMEC undertook to perform a specific and limited task for Gateway Parramatta One. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than Gateway Parramatta One. Any other person who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that he or she acknowledges and accepts that he or she may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Scope

SMEC has been engaged by Gateway Parramatta One P/L ABN 57607 553 565 to review the flooding and stormwater requirements for the proposed Gateway South Development at Church Street, Parramatta. After the original DA submission by Boyded Industries in 2014, Parramatta City Council (PCC) provided additional requirements to be addressed in further submissions. Following those comments, AECOM Consultants on behalf of Boyded Industries revised the concept design for the proposed Gateway South Development and submitted it to PCC on 4th September 2015.

The current report provides a summary of the flooding and stormwater issues at the sites under consideration and queries raised by PCC with associated comments.

1.2. Site Location

The proposed Gateway South development consists of three sites where Sites 1 and 2 propose to develop the land with the construction of a mixed commercial and residential development and providing the third site (Site 3) as a public park. The proposed site is situated along the Clay Cliff Creek with flows travelling from a west to east direction crossing Lansdowne Street, Early Street, and Church Street and ultimately discharging to the Parramatta River. The three sites are shown in Figure 1 below. The catchment is within both the Holroyd City Council and Parramatta City Council Local Government Areas while the site is within the PCC LGA.

Figure 1: Proposed Site Locality

**Source (AECOM, 2015)*

2. FLOODING ISSUES

2.1. Pattern of Flooding

Flooding issues associated with this development have been the subject of two previous reports[1] which in turn were based upon flood investigations undertaken on behalf of Parramatta City Council[2].

The general pattern of flooding within the areas affected by the development is from west to east and arises in the Clay Cliff Creek that has a catchment area of approximately 3.2 square kilometres. The main flow path is a concrete channel that delivers flood flows from the Ollie Webb detention basin to Parramatta River in the east. Uncontrolled flooding arises when the capacity of this channel and its associated culverts are exceeded during major events.

The initial flood studies undertaken by SKM utilised a 1 dimensional model (MIKE 11) and estimated a 1% AEP flood level in Church Street in the vicinity of the development of around 12.9 m AHD. Subsequently PCC engaged Cardno to undertake drainage investigations in Clay Cliff Creek and they developed a more modern 2D model of flooding within this catchment using XP- SWMM software. These studies indicated that the 1% AEP flood levels in the vicinity of Church Street to be lower than those estimated by SKM and around 12.4 m AHD. These lower flood estimates have now been accepted by PCC (See Appendix A).

The PMF event under this modelling scenario was estimated as 12.9 m AHD. Furthermore it was estimated that 50% blockage of culverts would result in the 1%AEP flood increasing by 0.1 metres whilst 100% blockage of culverts would increase the flood level by 0.3 metres under the existing flood conditions..

AECOM using a revised Cardno model undertook a number of flood studies to finalise their investigations for the Gateway South Concept DA. They were able to achieve most of the PCC requirements by provision of a flow path during a 1% AEP flood event under the structures in Site 2. Details of their compliance with the requirements is presented in Table 1 of Section 4.

2.2. Summary of Review Conclusions

This review has examined the outcomes of the AECOM/Cardno modelling and flood investigations as reported against the PCC requirements as specified in their email correspondence. It can be concluded that although the AECOM/Cardno report has complied to a very significant extent with the PCC requirements, there were a number of points at which this conformance was incomplete. They include;

- Incomplete delivery of information requested;
- Blockage not considered in post development scenarios;
- Velocity depth product not always compliant with requirements; and
- The 20%AEP flood event not being modelled.

It needs to be recognised though that there were a number of discussions between AECOM and the PCC during the investigation phase and it is conceivable that some of these requirements may have been waived or modified by PCC.

[1] AECOM (2015) "Gateway South, Church Street, Parramatta Supplementary Flood Impact Report", Boyded Industries
AECOM (2014) "Gateway South, Church Street, Parramatta Supplementary Flood Impact Report", Boyded Industries

[2] SKM (2005) "Lower Parramatta River Floodplain Risk Management and Study", PCC
Cardno (2007) "Clay Cliff Creek Catchment Master Drainage Plan", PCC

3. REVIEW OF FLOODING COMMENTS

PARRAMATTA CITY COUNCIL (PCC) COMMENTS	AECOM/ CARDNO RESPONSE	SMEC COMMENTS
On 12 August 2011 Council advised in writing of the flood levels, flood contours, and flood hazard areas for these sites and their surrounds. These parameters include a predicted 1% AEP flood level in Church Street adjacent to Sites 1 and 2 of 12.9m AHD. It is Council's position that all of these parameters remain unchanged and the Concept Development Application now being assessed must demonstrate an effective response to them. This response includes effect risk management within and surrounding the development and ensuring no adverse impacts within the sites and on neighbouring properties and public lands. Council notes the submission of a flood model prepared by Cardno in 2011 which predicts a lower flood level and extent than those specified by Council. This was reviewed by Council and has not been accepted.	Refer AECOM letter to PCC dated 23 March 2015, which provided justification for use of the more recent 1D/2D flood modelling undertaken by Cardno, as well as the lower flood levels predicted for the sites. This was accepted by PCC in email correspondence dated 27 March 2015.	Email dated 27 March 2015 attached in Appendix 1. The 1%AEP flood level of 12.40mAHD has been accepted by PCC. AECOM/ Cardno XP-SWMM is a more detailed model than MIKE11 and is likely to provide more accurate results provided adequate methods, procedures and parameters and employed. Based on modelling by Cardno 2015, increases in flood levels are minimal. Increases in velocity of up to about 0.5 to 1.0 m/s on surrounding land. The revised XP-SWMM flood model which predicts a lower flood level by Cardno is based on the 2007 study with modifications. The results of the Cardno model have now been accepted by Council(See Appendix 1)

To progress this application it will be necessary to thoroughly review the design, particularly of the ground floor areas that lie within the 1% AEP and High Flood Hazard contours designated and advised by Council. While Council had discussed the possibility of a showroom elevated slab under which floodwaters might pass, on further examination this is not acceptable given its height above the street and consequent design impact on the public domain.	Design of the sites at ground level has been thoroughly reviewed and revised to address PCC's concerns in relation to residual flood hazard on the sites as well as potential off-site flood impacts. This has been done in consultation with PCC, including discussion of potential flood mitigation measures as well as adjustments to building footprints and plaza areas. Note that Site 2 has incorporated a suspended slab arrangement under which floodwaters can pass as this was considered the best outcome for the site, as discussed and agreed with Council at meeting 30 June 2015. This results in minor compromises both for the design impact on the public domain given height above street level, as well as a reduction in available building floor area.	Ground floor levels are above the accepted 1%AEP + freeboard level. Medium and High flood hazard exists in some areas on site and in surrounding areas. AECOM's revised concept design includes the use of an elevated slab and underfloor floodway that has been discussed and agreed by Council at a meeting on 30th June 2015.
The design review will require new flood modelling to demonstrate the amended design meets these requirements and parameters.	Additional flood modelling has been undertaken (refer Appendix A), the results of which are incorporated in this report.	Additional flood modelling was undertaken by AECOM in response to the PCC comments to address the critical issues raised. The additional flood modelling does not fully meet all the Council's requirements. There will be a need for further discussions with Council to resolve these issues.
Modelling to be at a sufficiently fine scale to enable detailed assessment of the DA. Previous broad scale 2D modelling was insufficient in this regard.	The 2m grid size adopted for the flood modelling is considered to be of appropriate resolution.	2m grid size is of appropriate resolution for a detailed flood assessment.

Detailed information must be provided of water levels, depths, velocities, directions of flow and flow volumes across the entire study area. The source of this information may be both 2D and 1D modelling as necessary, provided a sufficiently fine scale model is achieved with transparent inputs and assumptions and outputs that enable architectural details to be designed and assessed.	This report includes a summary of key findings in relation to existing flood conditions, flood impacts and relevant flood management measures. Note that detailed model results, as well as discussion of model inputs and assumptions, are presented in Cardno (2015) - refer Appendix A.	The AECOM report includes an Appendix with a detailed Hydraulic Modelling Report for review by PCC and includes maps of: 1%AEP - Existing and proposed maps of water level, depth, velocity, flow direction. (no volumes) - Tabulated water level sites (exist/post) - Hydrographs, locations of outputs - Proposed building footprints - Post scenario maps of Provisional Hazard - Post scenario maps of VxD product - Difference in water levels and velocities PMF - Post scenario maps of Depth and VD product No electronic model (hydrology/hydraulics) has been provided.
The applicant must provide cross sections of the various flow regimes modelled at locations as required by Council.	Flood model results have been presented in the form of maps showing the spatial variation of key flooding characteristics, including peak flood levels, depths, velocities and hazard. This is considered the most appropriate form of presentation given the nature of the floodplain and flood conditions of interest. Furthermore, Council has not advised of any particular locations where cross sections are required.	Cross sections of flow regimes have not been provided. ***AECOM could provide these sections on request.***

Details of the land surface / terrain survey and assumptions used in the model, pre- and post-development.	Relevant details and assumptions are included in Cardno (2015) – refer Appendix A.	Not all the Land surface/ terrain survey has been provided. Site Survey plan dated 19/12/2007 presented in report. Assumptions used in the model are discussed. Some model parameters have not been presented e.g. building outlines, roughness's. No pre versus post terrain model has been presented. ***AECOM could provide this information on request.***
The modelling must assume there is no benefit in flood level and flow reduction from the Ollie Webb Reserve detention basin.	The flow attenuation that occurs along Clay Cliff Creek as a result of the existing detention basin in Ollie Webb Reserve is included in the modelling for both existing and post-development conditions, and the effect of the basin is identical under both scenarios. This approach has been discussed and agreed verbally with PCC.	SMEC agrees that modelling Ollie Webb Reserve detention basin for existing and post scenarios does not model a benefit associated from the proposed development.
The modelling must assume there is no benefit in flood levels and flows, storage, and flows under Church Street from reconstructed park, channel and culvert inlet works in the Site 3 area. (Note all of these works are now deleted.)	As requested by PCC the existing trunk drainage system that traverses Site 3, comprising a concrete lined open channel and box culvert system, will be retained. Whilst the site will be extensively landscaped to replace the existing hardstand treatments, existing ground levels will remain substantially the same. This is reflected in the revised flood modelling presented in this report.	See also previous point The model is reported as having been revised with landscaping and no additional storage has been introduced.
Pre-development and post-development flood modelling is required for the situation when the main stormwater culvert under Church Street is: · fully functional · fully blocked · blocked to 50% capacity.	These blockage scenarios have been assessed and the results presented/discussed in this report.	Three blockage cases in pre-development have been included and reported in Table 4 of Appendix A. The post development scenarios reported in Table 6 of Appendix A however show the fully functional culvert only although it also presents results from 50% blockage of the grill structure ***The full blockage case needs to be modelled under the post-development scenario***

For a pre-development analysis the model may assume existing buildings on Sites 1 and 2 and surface levels as close as possible to predevelopment natural ground.	Pre-development analysis assumes present day conditions on these sites, including the buildings which currently occupy the sites.	AECOM modelling undertaken as per PCC requirement.
For post-development modelling there must be no flood storage assumed within sites 1, 2 or 3 to be consistent with the Concept DA design	New or compensatory flood storage has not been incorporated into the design on any of the sites.	AECOM method not to apply compensatory flood storage deemed appropriate, some storage exists associated with overland flows.
All street drainage pipelines must be assumed to be blocked in the 1% AEP flood event.	The minor piped drainage system has been modelled as fully blocked for all flood events.	AECOM modelling undertaken as per PCC requirement.
The applicant must model the flooding risk to the underground car park(s) and other basement facilities. In particular the entry/exit portals driveway levels must be set at 12.9m AHD plus 500mm freeboard as a minimum and any additional height that can be achieved.	Entry/exit to basement car parking incorporates flood protection to a minimum elevation of RL 12.9 m AHD, which is equivalent to the peak 100 year ARI flood level (ie. RL 12.4 m AHD) plus 0.5 m freeboard, as discussed and agreed with PCC. [Refer also response to Ref. 1 above re: peak flood levels]	Further to the revision of the 1%AEP flood level, the development now complies with the PCC requirement for driveway level of 1%AEP flood level plus 500mm freeboard. The model was not available for review in relation to the location and topography of proposed driveway levels.
Pedestrian areas must not be subject to flows with a depth velocity product greater than 0.4 m2/s for up to the 1% AEP event.	The revised plaza areas on Sites 1 and 2 generally achieve this criteria. It is noted that a small area of new plaza adjacent to Lansdowne St on Site 2 is subject to a residual depth-velocity product (ie. VxD) in the range 0.4 to 0.5 m2/s. All practical means have been explored to reduce both the area affected and VxD as far as practicable. Refer Section 3.3 for further discussion.	There are some areas in the plaza which have a depth velocity product greater than 0.4 ***AECOM indicate that they cannot fully comply with this PCC requirement.***
The outcomes of this process will require meaningful adjustment of the building footprints and design details at ground level to properly address flood behaviour and to ensure public safety and no adverse impacts.	Meaningful adjustment of the building footprints and design details at ground level for Sites 1 and 2 has been undertaken to address PCC concerns. This work has been done in consultation with PCC, to present and discuss results for various potential/interim layouts and to agree on a preferred way forward for resolving various design issues.	The revised design has been developed in order to meet all PCC's requirements based on various discussions and meetings.

For Site 3 the following key requirements apply: · Existing stormwater infrastructure (owned by Sydney Water) to remain as it is now. Flood analysis must assume the open Clay Cliff Creek stormwater channel and the box culvert under Church Street perform as they do now. · Landscape work in this lot to retain existing ground levels. · No flood storage including to compensate for loss of flood storage elsewhere in the development.	These requirements are reflected in the revised design (and flood modelling) for Site 3.	AECOM's revised design states that the Site 3 will be a public park dedicated to Council. The revised model maintains the existing stormwater channel and retains the existing ground levels. The report states that flood storage has not been assumed here for loss of storage elsewhere on the project.
Other issues in email of 12th March 2015		
Any flood analysis must assume that the open Clay Cliff Creek stormwater channel and the box culvert under Church Street perform as they do now		They have been reported as being modelled as specified by PCC
Such flood analyses must also analyse the situation where this culvert under Church Street is fully or partially blocked		Model runs under partial and complete blockage of the Church street culvert under the developed condition have not been presented ***As per previous comment; full blockage condition under post-development scenario has not been modelled***
It will be necessary to liaise with Sydney Water to determine their requirements for their stormwater channel and culvert		Liaison has been undertaken and reported upon.
Issues in email of 18th February 2015		
Prepare amended concept designs and support submission to address all of the above points		As per documents presented to PCC although not ALL the points raised were addressed

Relocate the footprints to the two building development sites westwards to remove their intrusion into the Clay Cliff Creek flow path. Alternatively or in combination with this revise the building footprints and landscaping to create flow-through areas (between ground level and the underside of the building slabs, beams etc). In these revisions provide for at least a 1% AEP (100 year ARI flood inundation and flood-path event plus 500mm freeboard		Finalised after discussions between PCC and AECOM
For the proposed Site 3 park and creek system and adjoining streets and lands, provide a detailed design, hydraulic analysis, water sensitive design and management system with costs and responsibilities, to address the physical form and management of low and high water flow regimes, safety, amenity, ecological values, landscape, recreation and compatibility between these various uses.		The proposal for site 3 has been modified to address these concerns
Provide a hydraulic analysis of the existing and proposed Clay Cliff Creek culvert system across Church Street, its capacity and proposed new inlet design and performance at the west of Church Street		No changes were proposed for the culvert system following discussions between AECOM and PCC
Relocate the supermarket to a floor level higher than the flood planning level (1% AEP flood level + 0.5 m freeboard).		Changes made to supermarket to address this issue
Demonstrate that all construction below the Probable Maximum Flood is of flood proof construction and use flood compatible building components.		All construction below 1% AEP flooding to be of flood compatible building components ***There is no mention of flood proof construction materials above 1% AEP flood level***
Demonstrate effective, practical fail safe methods to prevent ingress of floodwaters into the basement car parks for severe flooding events up to the Probable Maximum Flood		Proposals made by AECOM to demonstrate compliance with this requirement

Council requires certainty for consent purposes that the proposed works within Site S3 would be able to be implemented/constructed. The proposed final Site S3 architectural layouts are to be included in the hydraulic model to be investigated for flood impact assessment. The proposed modelled cross sections shall also be required to replicate the proposed architectural cross sections sufficiently. Subsequently, these modelled cross sections along the channel need to be constructed. Concept cross sections would not be acceptable for this hydraulic modelling assessment. The following information (as a minimum) would be required to be submitted for Council to assess any flooding impacts:		Site 3 proposed works have now been deleted and hence requirement is not relevant.
Detailed Site Survey Plan (1:200, AO/A1 size) covering all three sites (S1,S2 & S3) and adjoining properties along Church, Lansdowne and Early Street and the Great Western Highway		Some site survey information provided but not to the requirements of PCC stated here.
Plans showing Existing condition 100 year & 20 year Flood levels (not Flood Contours) with at least 25 meter intervals along the alignments of modelled Creek and overland flow-paths between Marsden Street and Parkes Street (downstream of Jubilee Park		20 year flood analysis not undertaken. Flood levels at 25 metre intervals not presented.
Plans showing Proposed condition 100 year & 20 year Flood levels (not just Flood Contours) at a minimum of 25 metre intervals along the alignments of the modelled Creek and overland flow-paths between Marsden Street and Parkes Street (downstream of Jubilee Park)		20 year flood analysis not undertaken. Flood levels at 25 metre intervals not presented.
Existing 100 year & 20 year Flood Inundation Extents Plan overlaid on the Detailed Site Survey Plan covering all three sites from Upstream of Site S3 to Jubilee Park Downstream.		100 year flood extent plan has been presented 20Year flood inundation extent plan was not presented.

Provide modelled 100 year & 20 year Flow Rates (both culverts and overland) flood levels and velocities (not just contours) just upstream of Church Street and at the Corner of Church & Lansdowne Street for Existing & Proposed Conditions on the Survey Plans		Information for the 100 year event has been presented but not the 20 year event.
Provide existing and proposed modelled Creek Cross sections covering 50 metres upstream of Site 3 (western Boundary of S3, Intermediate Two cross sections, Middle and just upstream of Church Street) then through the Site and up to the Great Western Highway at Church Street this to be plotted on A3 Sheets and Excel files. All Bridge crossings to be modelled and details to be submitted		Site 3 proposed works have now been deleted and hence requirement is not relevant
Amend the concept DA to fully comply with the Parramatta DCP 2011 (2.4.2.1 Design Principles) and provide a written review of this amended concept DA demonstrating that it that fully complies with the Parramatta DCP 2011 (2.4.2.1 Design Principles) or provide evidence that breach of these Design Principles will not cause adverse consequences to the public, to the environment, and to private land holders, business operators, NSW government agencies and Council		Amended by discussions between PCC and AECOM
Provide information in all flood calculations and modelling of flow rates, velocities, depths, water surface levels and hydrographs which show time from commencement of rainfall event to flood peaks		Information on flow rates, velocities, depths and levels have been presented for the 1%AEP event. There was also one set of hydrographs presented covering the "existing scenario" There was no information provided on the 5% (20 year) event.
Relocate the proposed supermarket to a higher level so that its finished floor levels are at least 0.5m above the 1% Annual Exceedance Probability Event (AEP) (= 1 in 100 year ARI).		Done
Show all internal finished floor levels to be at least 0.5m above the 1% Annual Exceedance Probability (AEP) Event		Done as per discussions with PCC

Provide equivalent physical volumetric compensation for any loss of flood storage arising from the development up to the 1% AEP event plus 0.5 m freeboard		Covered by flood modelling
Ensure and demonstrate that the amended development does not divert floodwaters onto adjoining lands, at least to a 1% AEP event, including not increasing volume, depth, and/or velocity of such waters		As per flood modelling, no diversions are reported
Amend designs to show flood-proofing of all basements to and below the Probable Maximum Flood levels		Basement entry level is at the estimated PMF level of 12.9 m AHD.
Show and specify flood-proof / flood compatible construction for all works below and up to Probable Maximum Flood levels		Flood compatible construction specified to the 1% flood level
Address the cumulative effects of floodwater diversions from the redevelopment of all private commercial property onto Church Street		Demonstrated by the modelling
Assess the alternatives of the present flood route and the use of an acquired 'greenlink' floodway along the existing culvert alignment as part of Council's Planning Framework for 'Auto Alley'. Also review a possible staged transition between the two situations		Not specifically covered in the report
Provide a detailed flood safety risk assessment, management plan and evacuation plan for Sites 1, 2 and 3 and surrounding streets		Plan provided
It is to be demonstrated (from the social equity point of view) within the heavily built up areas surrounding Site S3 that the proposed development does not WORSEN flood situation by diverting floodwaters onto adjoining lands, at least to a 1% AEP event, including increasing volume, depth, and/or velocity of such waters. Please also NOTE that flood modelling does not always consider all the features being present within the developed site		Modelling addresses the technical issues raised.

4. STORMWATER MANAGEMENT ISSUES

4.1. Design of the Stormwater Management System

The design of stormwater management on site was initially developed using the Upper Parramatta Catchment Trust methodology and parameters for on-site detention. The concept used was the provision of On-Site Detention (OSD) storage to reduce the magnitude of the flood peaks generated by the increased imperviousness both on the ground as well as in the vertical dimension arising from the construction of the high rise towers.

The major stormwater issues raised by PCC in their responses to the original DA submission were related to the lack of a Water Sensitive Urban design Strategy to address a relevant range of rainfall and stormwater events and stormwater discharges from the sites and the likely consequences for flooding and environmental factors in the vicinity. Issues raised included the interception by high buildings of wind-driven rainfall and the possibility of flooding from this water.

4.2. Summary of Review Conclusions

This review indicates that the development of the stormwater management system is still at a fairly early stage and would require substantial effort for completion in accordance with the PCC requirements.

There was insufficient information presented to enable a detailed check on the calculations supporting the estimation of the OSD requirements (including the wind-driven rainfall interception by the high buildings). Furthermore AECOM's view that the development of On-Site Detention would result in a worsening of the existing flood situation is not completely convincing on the information presented. Finally the PCC requirement for a Water Sensitive Urban Design strategy does not appear to be completely satisfied.

5. REVIEW OF STORMWATER COMMENTS

PARRAMATTA CITY COUNCIL (PCC) COMMENTS	AECOM RESPONSE	SMEC COMMENTS
Section 2, paragraph 2 and 3: "…Although this approach is that used in the UPRCT guideline for catchment wide application it is not sufficient for a development of this magnitude which should also be looked at on its merits and specific impacts caused by this development.	Preliminary verbal advice received from Council drainage engineers indicated that the development should be designed based on the Upper Parramatta River Catchment Trust (UPRCT) guidelines. Hence these were used in the preparation of the initial Conceptual Stormwater Management Plan.	Record of "preliminary verbal advice" to AECOM from PCC not found. It may also not be relevant in consideration of the updated AECOM report. Some discrepancies were noted by SMEC in the spreadsheets presented by AECOM, 2014 including level of orifice, freeboard to habitable floor level, possibly number of dwellings, rainfall intensity, possibly runoff coefficient. ***These discrepancies need to be checked and assessed against PCC requirements.***
"The potential volume of rainwater/stormwater draining from Sites 1 and 2 will be increased when wind-driven rainfall is intercepted by the high buildings. This must be allowed for in rainwater harvesting, on site detention, water sensitive urban design, water quality management and discharge designs. This is also complicated by the effects of down wash and rain shadow."	We agree that the potential rainwater / stormwater draining from Sites 1 and 2 will be increased when wind driven rainfall is intercepted by the high buildings. We have revised the estimated catchment areas for Sites 1 and 2 based on the AS/NZS 3500.3:2003 Plumbing and Drainage Part 3: Stormwater drainage (Section 3.4) which suggests that a 2v:1h maximum gradient of descent of wind-driven rain should be adopted for roof catchments (Figure 1).	AECOM states use of AS/NZS 3500.3:2003 Plumbing and Drainage for determining catchment areas, in coordination with UPRCT guideline, and DRAINS model. Wind driven rainfall accounted for in OSD. Rainwater Harvesting – no calculations found. Drainage designs only show drainage lines from OSD. No modelling found. ***AECOM's design was provided as a preliminary strategy and more detailed calculations will need to be developed for the next stage***

Section 2 paragraphs 5 and 6 "In addition this significant volume of stormwater being intercepted by this development and discharged from the sites is likely to cause local flooding in its own right. Or it may coincide with, and thereby amplify flood levels in Church Street and the immediate surrounds arising from Clay Cliff Creek.	A comparison has been made between the hydrographs for the 100 year Average Recurrence Interval (ARI) flood for a 2 hour storm event produced from the Clay Cliff Creek flood model (flood modelling conducted by Cardno in Flood Impact Assessment, 2015) and the local discharge from the site when for cases which include OSD and exclude OSD. The 2 hour duration storm event was chosen for this comparison as it was reported to produce the maximum flood levels in Clay Cliff Creek. The purpose of this comparison was to demonstrate that detaining stormwater on Gateway South development site using OSD has the potential to increase the flood levels on Church Street.	AECOM have tried to demonstrate that provision of OSD will result in a higher flood peak than without OSD. The method used by AECOM has not convincingly demonstrated that flooding is not amplified. The post development case (NO OSD) may still produce larger flooding when compared to the pre developed case. (AECOM only compared post-OSD and post no-OSD. It did not consider pre and post development). There are three discharge points shown and each may have individual impacts. Local runoff: The post runoff > pre runoff when there is no OSD. Impact on flooding at the different sites has not been compared. ***AECOM has not demonstrated that flooding discharging to the several discharge points does not amplify flooding due to the development. It will be necessary to provide for OSD in this development***.
There is a need for more information on the consequences and management of internally generated runoff and in particular how this would affect sites adjacent to the development sites."	For minor flood events, the local drainage network on-site that drains to Cliff Creek stormwater channel would require to be amplified to account for the increase in SSR requirements on site due to increase in catchment area from high rise buildings.	AECOM states the need to amplify drainage in minor events. Consequences of increased runoff on site and surrounds (adjacent to development) needs to be addressed. Where does the amplification of drainage apply – onsite and offsite? Inter-allotment drainage not shown. PCC comment does not focus on minor events only. ***There is a need for more investigation and design into the stormwater drainage system at the next stage***.

Section 2, paragraph 7: "Although much of this has been outlined in the concept DA documents so far submitted, the applicant will need to further develop response to the Water Sensitive Urban Design Objective and Design Principles outlined in the Parramatta DCP 2011 3.3.6 pp 64-74 and also in its Appendix Section 7 pp 460-1."	In accordance with the Parramatta Development Control Plan (DCP) 2011 – Water Sensitive Urban Design Guideline, the following strategy has been developed. The information provided below is in addition to the Gateway South Concept Development Application – Conceptual Stormwater Management Plan submitted in Oct, 2014.	***The AECOM response appears incomplete at this stage but could be a basis for possible future discussions and detail.***

6. REFERENCES

(AECOM, 2014), **Gateway South Church Street Parramatta, - Appendix D Supplementary Flood Impact Report – Original DA Document**, Client: Boyded Industries Pty/Ltd.

(AECOM, 2015), **Gateway South Church Street Parramatta, - Appendix D Supplementary Flood Impact Report – Revised DA Document**, Client: Boyded Industries Pty/Ltd.

(AJ+C, 2015), **Gateway South Parramatta Stage 1 DA Report**. Allen Jack + Cottier Architects.

(PCC, March 2015), **Email correspondence Parramatta City Council with AJ+C architects**.

(SKM, 2005), **Lower Parramatta River Floodplain Risk Management Study and Plan Volume 1 Main Report**, Client: Parramatta City Council.

(SKM, 2005), **Lower Parramatta River Floodplain Risk Management Study and Plan Volume 2 Planning**, Client: Parramatta City Council.

(AECOM, 2014), **Gateway South Church Street Parramatta, - Appendix L Concept Stormwater Management Plan – Original DA Document**, Client: Boyded Industries Pty/Ltd.

(AECOM, 2015), **Gateway South Concept Development Application – Supplementary Information to Support Stormwater Management Plan,** Client: Boyded Industries Pty/Ltd.

Appendix 1: Supporting Documents

From: Bartho, Nick <Nick.Bartho@aecom.com>
Sent: Friday, 27 March 2015 3:25 PM
To: Newman, Rachelle
Subject: FW: Adjusted flood modelling at Gateway Development Church Street Parramatta - DA/706/2014

FYI

Nick Bartho
Principal Engineer
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From: Paul Clark [mailto:PClark@parracity.nsw.gov.au]
Sent: Friday, 27 March 2015 2:34 PM
To: Brian.Mariotti@architectsajc.com; Bartho, Nick
Cc: Sue Weatherley; Mark Leotta; Anthony Newland; Robert Sutton; Katherine Lafferty
Subject: Adjusted flood modelling at Gateway Development Church Street Parramatta - DA/706/2014

Attention:
Brian Mariotti, Allen Jack and Cottier
Nick Bartho, AECOM

Dear Brian and Nick,

Thank you for your email of 25 March 2015 and attached letter.

Firstly Council advises that the matter of flood modelling levels and related issues was not resolved in the rezoning and planning process for the Gateway development and was deferred to Development Application Stage - which means it is to be finalised now.

With regard to precedent, Council has reviewed the application to which you refer (DA/455/2011) for 40-70 Church Street Parramatta.
Council notes that, after substantial consideration by Council's Catchment Team and an independent consultant (Bewsher Consulting) in 2011, Council did agree in January 2012 that the 'Cardno 2D flood model' for Clay Cliff Creek and environs, known as the '2007 model' was acceptable and sufficiently accurate for the purposes of development control for that development.

Council notes your request to use this Cardno 2D 2007 model (with any subsequent upgrades and refinements) as the basis for development control for the Gateway Development.

Council now wishes to advise that this request is reasonable and is acceptable subject to resolution of previously expressed concerns regarding flood hazard, velocities and depths, building footprints, floor levels, the free flow of floodwaters around (or through) the development, public safety, floodproofing and the like.

Would you please proceed on this basis. Please note the previously advised 1% AEP flood level of RL 2.9m AHD is superseded by this advice. Also please note Council requires you to remodel using the existing Site 3 levels and channel / culvert formation and not the opened up 'natural' channel and park as previously proposed.

If you require clarification please do not hesitate to contact me.

Regards

Paul Clark

Paul Clark | Senior Development Assessment Officer / Engineer | Development Services
Parramatta City Council
PO Box 32, Parramatta NSW 2124
☎ (02) 9806 5050

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DOCUMENT/REPORT CONTROL FORM

File Location Name:	I:\projects\30012122 – Gateway South Church St Parramatta Flood Modelling\010Flooding Assessment\
Project Name:	Gateway South Development- Church Street, Parramatta Review of Flooding and Stormwater Comments
Project Number:	30012122
Revision Number:	1

Revision History

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
1	30-10-2015	C. Koutsellis	A. Deen	B. Butturini

Issue Register

Distribution List	Date Issued	Number of Copies
Gateway Parramatta One Pty Ltd (ABN 57607 553 565)	30-10-2015	1
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SMEC Company Details

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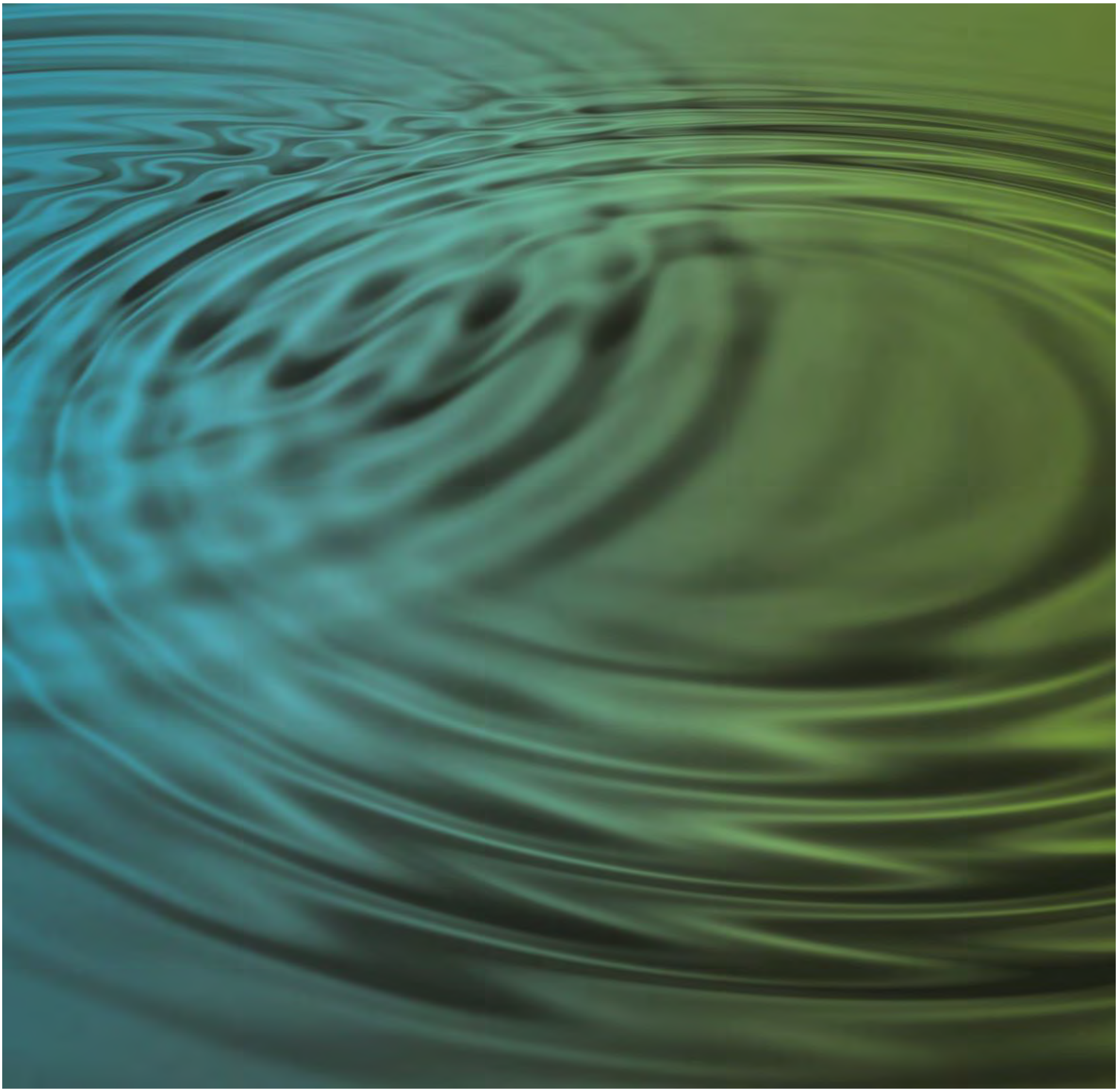
Boyded Industries Pty Ltd
03-Sep-2015

Gateway South, Church Street, Parramatta

Supplementary Flood Impact Report



Gateway South, Church Street, Parramatta

Supplementary Flood Impact Report

Client: Boyded Industries Pty Ltd

ABN: 92 000 092 464

Prepared by

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03-Sep-2015

Quality Information

Document Gateway South, Church Street, Parramatta

Ref p:\603x\60322150\4. tech work area\4.8 flooding\report\revised supplementary report - august 2015\final\60322150_gateway south_supplementary_flood_report_sep2015_v2.docx

Date 03-Sep-2015

Prepared by N. Bartho

Reviewed by B. Withnall

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	15-Oct-2014	Report for Development Application	R. Newman	Original signed
2	3-Sep-2015	Revised Report for Addendum #2 to SEE	R. Newman	

Table of Contents

Executive Summary

Introduction and Background

AECOM has been commissioned by Boyded Industries Pty Ltd to prepare a Supplementary Flood Impact Report for the Gateway South Concept Development Application (DA) DA/706/2014. Gateway South comprises the following three separate project sites:

- Site 1: 83 Church Street and 44 Early Street
- Site 2: 63 Church Street
- Site 3: 57 Church Street

The purpose of this Supplementary Flood Impact Report is to:

- Define existing flood behaviour in the vicinity of the project sites.
- Assess the impact of the proposed redevelopment on flood behaviour.
- Identify relevant flood management measures for the project sites.

Importantly, the Concept DA presented and assessed in this report reflects a design that has undergone revision since the original submission lodged with PCC in October 2014 in response to the flood mitigation measures proposed. The current site layout and building designs provide a considered response to a range of PCC concerns, and has been developed by the project team in consultation with PCC over the period March to June 2015. Further details of this consultation and agreed outcomes from this process are described herein.

Existing Flood Behaviour

Flood behaviour across the project sites was initially assessed in terms of existing flood data made available by PCC. However, this has been superseded by more detailed flood modelling undertaken by Cardno, utilising a 1D/2D hydraulic model based on the XP-SWMM software. Based on catchment-wide modelling originally undertaken for PCC in 2007, a refined version of the XP-SWMM model has been developed specifically for use in conjunction with the Gateway South development. This model was used to define existing flood behaviour in the vicinity of the project sites. The sensitivity of flood behaviour to culvert blockage scenarios and potential increases in design rainfall intensity as a result of future climate change was also assessed.

Figures showing detailed flood model results in terms of peak levels, depths and flow velocities are provided in Cardno (2015) in Appendix A, along with tabulated results for peak water levels and flow rates at key locations.

A peak 100 year average recurrence interval (ARI) flood level of approximately RL 12.4 m AHD was found to apply to all three sites, assuming ideal (ie. unblocked) flow conditions. For the PMF event, the peak flood level increases to RL 12.9 m AHD.

In the event that partial or complete blockage of the inlet of the culvert under Church Street were to occur, the following increases in peak 100 year ARI flood level adjacent to the three sites would occur:

- 0.1 m for 50% blockage. In this case the peak flood level would increase to RL 12.5 m AHD.
- 0.3 m for 100% blockage. In this case the peak flood level would increase to RL 12.7 m AHD.

Peak flood levels were found to be relatively insensitive to a climate change scenario based on an assumed 15% increase in design rainfall intensity, with a maximum increase in peak 100 year ARI flood level (ie. relative to present day climatic conditions) of about 40 mm in the vicinity of the project sites.

Preferred Post-Development Scenario

As requested by PCC in their comments on the October 2014 Concept DA submission, a design refinement process was undertaken to revise site layouts and building footprints for Sites 1 and 2. All options investigated assumed that existing ground levels and trunk drainage infrastructure on Site 3 was to remain unchanged, as directed by PCC. Several types of design modifications were considered, including changes to building footprints, extents and ground levels for proposed outdoor plaza areas, suspending slab arrangements within new buildings to crease underfloor floodway areas and on-site flood detention storage. Flood modelling was undertaken by Cardno for selected options to support this process.

The preferred option involved the following modifications to the October 2014 Concept DA submission:

Site 1

- Modification of Building F to incorporate an open forecourt area (at existing ground levels) at the south-eastern corner of the site.
- Expansion of the lowered plaza area (at street level) adjacent to Early Street.

Site 2

- Modification of Building L to incorporate a suspended ground floor slab over the southern portion of the site, forming an underfloor floodway to allow floodwaters to traverse the site as per present day conditions.
- Reconfiguration of the lowered plaza area (at street level) adjacent to Lansdowne Street to facilitate floodwaters accessing the underfloor floodway.

Site 3

- Proposed works on Site 3 to be limited to at-grade landscaping and planting only, with no significant changes to existing ground levels or trunk drainage infrastructure across the site.

Flooding Impacts

Detailed flood model results for post-development conditions are presented in Cardno (2015). Key findings in relation to off-site flooding impacts are as follows:

- Off-site flooding impacts for the 100 year ARI are generally negligible (ie. less than 10 mm). The one exception is a small area within the Church Street road reserve immediately adjacent to Site 2 that would experience an increase of about 30 mm.
- Off-site flooding impacts are relatively insensitive to partial blockage of the exclusion grill that would be required to prevent pedestrian access to the underfloor floodway area on Site 2, with a maximum increase in peak 100 year ARI flood levels in surrounding residential development of about 20 mm for the case where the grill was to experience a 50% blockage.

Flood Management Measures

Proposed on-site flood management measures include:

- Provision of appropriate minimum building floor levels. Minimum habitable ground floor levels for proposed commercial spaces on Sites 1 and 2 have been generally set at RL12.9 m AHD, equivalent to the peak 100 year ARI flood level plus 500 mm freeboard. A small area at the southern end of Building F on Site 1 has been set at RL 12.4 m AHD (ie. peak 100 year ARI flood level, excluding freeboard) to improve urban design outcomes, a compromise which has been discussed and agreed previously with PCC.
- Use of flood-compatible building components for all structures located below a minimum elevation of RL 12.9 m AHD, equivalent to the peak 100 year ARI flood level plus 500 mm freeboard.
- Protection of all entry/exit ramps to basement car parking to a minimum elevation of RL 12.9 m AHD, equivalent to the peak 100 year ARI flood level plus 500 mm freeboard.

To cater for residual flood risk and emergency response, a detailed flood evacuation strategy and plan will need to be finalised in conjunction with future development of business planning and operational procedures for Gateway South. A preliminary strategy and framework has been prepared to guide this and support the current Concept DA submission.

1.0 Introduction

1.1 Overview

AECOM has been commissioned by Boyded Industries Pty Ltd to prepare a Supplementary Flood Impact Report for the Gateway South Concept Development Application (DA) DA/706/2014. Gateway South comprises the following three separate project sites (refer Figure 1):

- Site 1: 83 Church Street and 44 Early Street
- Site 2: 63 Church Street
- Site 3: 57 Church Street

Figure 1 Project site location

Source: AECOM, 2014

The proposed Concept Plan is for a high rise mixed use development across the subject three sites. The development comprises three buildings on Site 1 (of which the two towers are linked by a podium) and two buildings on Site 2 with residential and non-residential uses, basement car parking, and a public domain scheme. Site 3 will be a public park, to be dedicated to Parramatta City Council (PCC).

The Concept Plan does not seek approval for any construction or demolition works. Approval for any physical works will be the subject of future staged applications. Demolition of all existing building structures on site will be required to facilitate the future redevelopment. It is noted that the existing trunk drainage system which traverses Site 3 will be retained as part of the redevelopment as requested by PCC.

1.2 Background

The project site is located in the middle reaches of the Clay Cliff Creek catchment (refer Figure 2). Upstream of the project sites (ie. to the west), the catchment drains to a detention basin at Ollie Webb Reserve. From Ollie Webb Reserve flows are conveyed along a brick and concrete open channel that runs through the rear of residential properties from Marsden Street through to Site 3. From Site 3 a closed culvert system conveys flows further east, crossing under the railway line and ultimately discharging into Parramatta River at James Ruse Drive.

Due to the proximity of the project sites to Clay Cliff Creek, there is the potential for all three sites to experience mainstream flooding. Accordingly, PCC require that potential flood impacts and risks to the project are assessed as part of the DA process.

The following previous flooding investigations have been undertaken for the Gateway South development, firstly to support rezoning of the project sites in 2012, and subsequently to inform development of the initial Concept DA submitted in October 2014:

- *Gateway South, Church Street Parramatta – Flood Impact Report for Rezoning Application* (AECOM, 2012)
- *Gateway South, Church Street Parramatta – Supplementary Flood Impact Report* (AECOM, 2014)

1.3 Purpose

The purpose of this report is to:

- Define existing flood behaviour in the vicinity of the project sites.
- Assess the impact of the proposed redevelopment on flood behaviour.
- Identify relevant flood management measures for the project sites.

Importantly, the Concept DA presented and assessed in this report reflects a design that has undergone revision since the original submission lodged with PCC in October 2014 in response to the flood mitigation measures proposed. The current site layout and building designs provide a considered response to a range of PCC comments and concerns, and has been developed by the project team in consultation with PCC over the period February to July 2015. Further details of this consultation and agreed outcomes from this process are described in Section 1.7.

Due to their past experience of flood investigations in the Clay Cliff Creek catchment, and in particular for the Gateway South development, Cardno were engaged by AECOM to undertake flood modelling to inform development of the site layouts and building designs. A copy of the technical report produced by Cardno to document this work is included as Appendix A.

1.4 Existing Development on the Project Sites

The project sites contain disused buildings and hardstand areas that supported previous use for automotive services, car showrooms, sales areas, office space and workshop spaces. The following specific uses are noted for the lots:

- 44 Early Street is vacant of buildings and was largely used as a staff car park.
- 83 Church Street was used as a second hand car showroom until 2010. It contains vacant buildings in the west and a concrete forecourt.
- 63 Church Street was the main Heartland Parramatta office for new car sales and also contained a workshop in the west of the Lot. Waste disposal facilities and a plant room are located in the south-western portion of the Lot.
- 57 Church Street was the main sales area for second-hand car sales, however is now predominately used for storage and archiving.

AECOM

Legend

100 year ARI flood extents — Project Sites — Existing stormwater pipe or channel

Deep

Shallow

Gateway South Development
Clay Cliff Creek
Existing 100 year ARI flood extents
Source: Cardno hydraulic model (2014), LPMA Contour data

0 100 200 400 m

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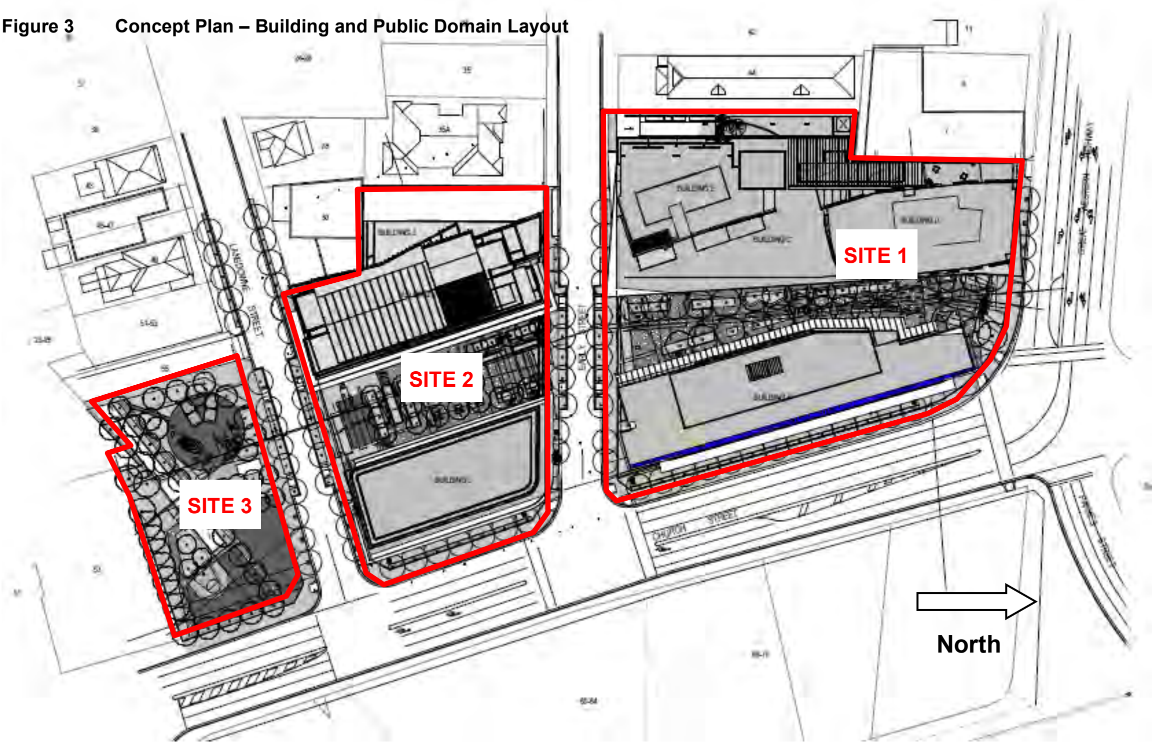
1.5 Proposed Concept Plan

The proposed building layout and public domain works are illustrated in Figure 3. A description of the proposed design concept of relevance to the flood assessment is provided below for each site.

Figure 3 Concept Plan – Building and Public Domain Layout



Source: Allen Jack + Cottier, 2015

Site 1

- The Concept Plan for Site 1 comprises two towers (Tower D and E) atop a podium (Podium C), and a non-residential building (Building F) fronting Church Street.
- Entry to and egress from the basement car parking is from Early Street.
- A pedestrian plaza separates the buildings and traverses Site 1 from north to south. The central part of the plaza is level (RL 12.90), with stairs, accessible ramps and landscape features at the northern and southern ends of Site 1 to connect to existing street levels.
- On the western side (away from Church Street) Podium 'C' comprises 2 storeys of non-residential uses. Basement 1 has been designed to allow for a future supermarket fit out. The ground floor has been designed to accommodate retail uses that front the pedestrian plaza. The loading dock is located on the western side of Podium C with access from Early Street and egress onto the Great Western Highway.

  Building C/D has a maximum height of 141.7 m (including podium). This height equates to 2 storeys of non-residential floor space beneath 40 storeys of residential floor space.

  Building C/E has a maximum height of 82 m (including podium). This height equates to 2 storeys of non-residential floor space beneath 21 storeys of residential floor space.
- On the eastern side (fronting Church Street) Building F has a maximum height of 45.1 m. The ground floor of Building F has been designed to accommodate a car showroom fronting Church Street. Vehicle access is provided from Early Street and pedestrian access from the plaza, Church and Early Streets. The lobby to the commercial offices (Levels 2-10) is provided on the western side of Level 1, fronting onto the pedestrian plaza.

Site 2

- The Concept Plan for Site 2 comprises a non-residential building fronting Church Street (Building L) and a mixed use building to the west of the site (Building J / K), separated by public open space.

- Entry to and egress from the basement car parking and loading dock is from Early Street.
- As with Site 1, a pedestrian plaza traverses Site 2 from north to south. The central part of the plaza is level (RL12.90), with stairs, accessible ramps and landscape features at the northern and southern ends of Site 2 to connect to existing street levels.
- On the western side (away from Church Street) Building J/K has a maximum height of 112.9 m. This height equates to 8 storeys of non-residential floor space beneath 23 storeys of residential floor space.
- On the eastern side (fronting Church Street) Building L has a maximum height of 45.1 m (or 40 m if the plant room is excluded). Building L has been designed to accommodate a ground floor car showroom fronting Church Street, with vehicle access from Early Street. Two retail tenancies are also located on Level 1. The lobby to the commercial offices (Levels 2-10) is provided on the western side of Level 1, fronting onto the pedestrian plaza.

Site 3

- Site 3 comprises designated open space in the form of a public park, to be dedicated to PCC. The open space concept design for Site 3 has been designed for passive and active spaces and includes a kiosk, watercourse, seating area, playground and half-basketball court. The Concept Plan includes provision for connection to the future laneway to the west of the site.
- As requested by PCC the existing trunk drainage system that traverses this site, comprising a concrete lined open channel and box culvert system owned by Sydney Water (SW), will be retained. Whilst the site will be extensively landscaped to replace the existing hardstand treatments, existing ground levels will remain substantially the same.

Note that proposed building floor levels and basement car park protection levels are described in Section 3.4.

1.6 Methodology

The approach adopted for this Supplementary Flood Impact Assessment, which updates earlier work undertaken as part of the original Concept DA submission in October 2014 (as documented in AECOM, 2014), involved the following broad tasks:

- **Define Existing Flooding Conditions**

  A truncated version of the XP-SWMM flood model previously developed by Cardno (as reported in Cardno, 2014) was created to improve model reliability in a more recent version of the XP-SWMM software. This model is a good reflection of present day catchment conditions, and incorporates site survey last updated in September 2014. Checks were undertaken by Cardno to ensure that flood behaviour predicted by the truncated version of the model compared closely to that of the previous model. Appendix A provides further details of the flood model development process.

  The truncated flood model was then used to define existing flooding conditions in the vicinity of the project sites. Sensitivity analyses were undertaken to assess the impact of the following scenarios on 100 year ARI flooding conditions:

  - 50% and 100% blockage of the inlet of the culvert crossing under Church Street; and
  - climate change scenario based on an assumed 15% increase in design rainfall intensity.

  Section 2.2 provides an overview of existing flood conditions, with further details provided in Appendix A.

- **Investigate Design Refinement Options and Assess Flood Impacts for the Preferred Post-Development Scenario**

  Investigation of several design refinement options for buildings and plaza areas on Sites 1 and 2 were undertaken in response to PCC comments on the October 2014 Concept DA submission. Section 1.7 provides further details in relation to key issues and concerns raised by PCC.

  Section 3.2 provides a summary of the options that were investigated, including presentation of interim Cardno model results that were provided for comparative purposes to inform assessment of options.

  Section 3.3 provides an overview of flooding conditions and impacts associated with the preferred post-development scenario, with further details provided in Appendix A.

- **Identify Key Flood Management Measures**

  Finally, key flood management measures were identified in terms of:

  - minimum building floor levels
  - minimum protection levels for basement car parking
  - requirements for flood-compatible building materials
  - flood evacuation planning, to cater for residual flood risk issues.

  These measures were then incorporated into the revised architectural designs that have been prepared for the project sites.

1.7 Consultation with Council and Sydney Water

Throughout development of the Concept DA, several meetings have been held with PCC's floodplain management officers as well as Sydney Water's land and waterways team. The outcomes of those discussions have informed this Supplementary Flood Impact Assessment.

1.7.1 Prior to October 2014 Concept DA Submission

Key points discussed in early meetings prior to October 2014 included:

- Both PCC and Sydney Water reinforced the need to minimise potential off-site flood impacts.
- Both PCC and Sydney Water indicated they would be supportive of a concept to naturalise the existing concrete-lined channel and culvert on Site 3, subject to appropriate design.

These key points were considered to be addressed within the October 2014 Concept DA submission.

1.7.2 Post October 2014 Concept DA Submission

In February 2015, a detailed set of comments on the October 2014 Concept DA submission were received from PCC, which included a range of flooding and site stormwater management and water sensitive urban design (WSUD) issues. *[Note that site stormwater management and WSUD issues are not dealt with in the current report, but are addressed in a separate letter report by AECOM.]*

The comments in relation to flooding issues were further clarified by email correspondence from PCC dated 12 March 2015. Table 1 identifies the issues raised in detail and provides comment on how the revised Concept DA now addresses these issues.

Following investigation of several design refinement options for buildings and plaza areas on Sites 1 and 2, a meeting was held with PCC on 30 June 2015. The purpose of this meeting was to present and discuss interim findings in terms of off-site flood impacts and residual flood risks associated with the various options, in order to reach in-principle agreement with PCC regarding the preferred approach to modifying the design of proposed buildings and open plaza areas to resolve the outstanding flood issues. The updated architectural plans are consistent with the agreed outcomes of this meeting, key elements of which comprised:

Site 1

- Modification of Building F to incorporate an open forecourt area (at existing ground levels) at the south-eastern corner of the site.
- Expansion of the lowered plaza area (at street level) adjacent to Early Street.

Site 2

- Modification of Building L to incorporate a suspended ground floor slab over the southern portion of the site, forming an underfloor floodway to allow floodwaters to traverse the site as per present day conditions.
- Reconfiguration of the lowered plaza area (at street level) adjacent to Lansdowne Street to facilitate floodwaters accessing the underfloor floodway.

Refer to Section 3.3 for further discussion of these modifications and changes to post-development flood conditions and impacts.

Table 1 Response to PCC Comments of 12 March 2015

Ref.	Key Issue Raised by Council	Response
1	On 12 August 2011 Council advised in writing of the flood levels, flood contours, and flood hazard areas for these sites and their surrounds. These parameters include a predicted 1% AEP flood level in Church Street adjacent to Sites 1 and 2 of 12.9m AHD. It is Council's position that all of these parameters remain unchanged and the Concept Development Application now being assessed must demonstrate an effective response to them. This response includes effect risk management within and surrounding the development and ensuring no adverse impacts within the sites and on neighbouring properties and public lands. Council notes the submission of a flood model prepared by Cardno in 2011 which predicts a lower flood level and extent than those specified by Council. This was reviewed by Council and has not been accepted.	Refer AECOM letter to PCC dated 23 March 2015, which provided justification for use of the more recent 1D/2D flood modelling undertaken by Cardno, as well as the lower flood levels predicted for the sites. This was accepted by PCC in email correspondence dated 27 March 2015.
2	To progress this application it will be necessary to thoroughly review the design, particularly of the ground floor areas that lie within the 1% AEP and High Flood Hazard contours designated and advised by Council. While Council had discussed the possibility of a showroom elevated slab under which floodwaters might pass, on further examination this is not acceptable given its height above the street and consequent design impact on the public domain.	Design of the sites at ground level has been thoroughly reviewed and revised to address PCC's concerns in relation to residual flood hazard on the sites as well as potential off-site flood impacts. This has been done in consultation with PCC, including discussion of potential flood mitigation measures as well as adjustments to building footprints and plaza areas. Note that Site 2 has incorporated a suspended slab arrangement under which floodwaters can pass as this was considered the best outcome for the site, as discussed and agreed with Council at meeting 30 June 2015. This results in minor compromises both for the design impact on the public domain given height above street level, as well as a reduction in available building floor area.
3	The design review will require new flood modelling to demonstrate the amended design meets these requirements and parameters	Additional flood modelling has been undertaken (refer Appendix A), the results of which are incorporated in this report.
4	Modelling to be at a sufficiently fine scale to enable detailed assessment of the DA. Previous broad scale 2D modelling was insufficient in this regard.	The 2m grid size adopted for the flood modelling is considered to be of appropriate resolution.
5	Detailed information must be provided of water levels, depths, velocities, directions of flow and flow volumes across the entire study area.	This report includes a summary of key findings in relation to existing flood conditions, flood impacts and relevant flood management measures. Note

Ref.	Key Issue Raised by Council	Response
	The source of this information may be both 2D and 1D modelling as necessary, provided a sufficiently fine scale model is achieved with transparent inputs and assumptions and outputs that enable architectural details to be designed and assessed.	that detailed model results, as well as discussion of model inputs and assumptions, are presented in Cardno (2015) – refer Appendix A.
6	The applicant must provide cross sections of the various flow regimes modelled at locations as required by Council.	Flood model results have been presented in the form of maps showing the spatial variation of key flooding characteristics, including peak flood levels, depths, velocities and hazard. This is considered the most appropriate form of presentation given the nature of the floodplain and flood conditions of interest. Furthermore, Council has not advised of any particular locations where cross sections are required.
7	Details of the land surface / terrain survey and assumptions used in the model, pre- and post- development.	Relevant details and assumptions are included in Cardno (2015) – refer Appendix A.
8	The modelling must assume there is no benefit in flood level and flow reduction from the Ollie Webb Reserve detention basin.	The flow attenuation that occurs along Clay Cliff Creek as a result of the existing detention basin in Ollie Webb Reserve is included in the modelling for both existing and post-development conditions, and the effect of the basin is identical under both scenarios. This approach has been discussed and agreed verbally with PCC.
9	The modelling must assume there is no benefit in flood levels and flows, storage, and flows under Church Street from reconstructed park, channel and culvert inlet works in the Site 3 area. (Note all of these works are now deleted.)	As requested by PCC the existing trunk drainage system that traverses Site 3, comprising a concrete lined open channel and box culvert system, will be retained. Whilst the site will be extensively landscaped to replace the existing hardstand treatments, existing ground levels will remain substantially the same. This is reflected in the revised flood modelling presented in this report.
10	Pre-development and post development flood modelling is required for the situation when the main stormwater culvert under Church Street is: • fully functional • fully blocked • blocked to 50% capacity.	These blockage scenarios have been assessed and the results presented/discussed in this report.
11	For a pre-development analysis the model may assume existing buildings on Sites 1 and 2 and surface levels as close as possible to predevelopment natural ground.	Pre-development analysis assumes present day conditions on these sites, including the buildings which currently occupy the sites.
12	For post-development modelling there must be no flood storage assumed within sites 1, 2 or 3 to be consistent with the Concept DA design	New or compensatory flood storage has not been incorporated into the design on any of the sites.

Ref.	Key Issue Raised by Council	Response
13	All street drainage pipelines must be assumed to be blocked in the 1% AEP flood event.	The minor piped drainage system has been modelled as fully blocked for all flood events.
14	The applicant must model the flooding risk to the underground car park(s) and other basement facilities. In particular the entry/exit portals driveway levels must be set at 12.9m AHD plus 500mm freeboard as a minimum and any additional height that can be achieved.	Entry/exit to basement car parking incorporates flood protection to a minimum elevation of RL 12.9 m AHD, which is equivalent to the peak 100 year ARI flood level (ie. RL 12.4 m AHD) plus 0.5 m freeboard, as discussed and agreed with PCC. *[Refer also response to Ref. 1 above re: peak flood levels]*
15	Pedestrian areas must not be subject to flows with a depth velocity product greater than 0.4 m^2s^{-1} for up to the 1% AEP event.	The revised plaza areas on Sites 1 and 2 generally achieve this criteria. It is noted that a small area of new plaza adjacent to Lansdowne St on Site 2 is subject to a residual depth-velocity product (ie. VxD) in the range 0.4 to 0.5 m^2/s. All practical means have been explored to reduce both the area affected and VxD as far as practicable. Refer Section 3.3 for further discussion.
16	The outcomes of this process will require meaningful adjustment of the building footprints and design details at ground level to properly address flood behaviour and to ensure public safety and no adverse impacts.	Meaningful adjustment of the building footprints and design details at ground level for Sites 1 and 2 has been undertaken to address PCC concerns. This work has been done in consultation with PCC, to present and discuss results for various potential/interim layouts and to agree on a preferred way forward for resolving various design issues.
16	For Site 3 the following key requirements apply: • Existing stormwater infrastructure (owned by Sydney Water) to remain as it is now. Flood analysis must assume the open Clay Cliff Creek stormwater channel and the box culvert under Church Street perform as they do now. • Landscape work in this lot to retain existing ground levels. • No flood *storage* including to compensate for loss of flood storage elsewhere in the development.	These requirements are reflected in the revised design (and flood modelling) for Site 3.

2.0 Existing Flood Behaviour

2.1 Background

Previous studies and flood maps prepared by or on behalf of PCC for the broader Clay Cliff Creek catchment were initially reviewed as part of the flood assessment. While Council's flood mapping is appropriate for definition of the broader floodplain in a regional context, review of the information as it relates to the project sites identified limitations in its ability to appropriately define flood behaviour at a local level of detail. The 1D modelling approach that forms the basis of PCC's flood mapping, based on the results of the *Lower Parramatta River Flood Study Review* (SKM, 2005), is limited in its capabilities to model the distribution of flows and flow patterns in an urban floodplain such as this, where complex and multiple overland flowpaths are influenced by localised topographic features and building outlines. Given the broad scale modelling on which PCC's mapping is based there is a lack of specific detail that will influence flood behaviour on a local scale.

Due to the above, more detailed flood modelling has been undertaken to better define the nature of flooding conditions in the vicinity of the project sites. Cardno were engaged by AECOM to undertake this flood modelling because of their past experience in the catchment. At the permission of PCC, the XP-SWMM 1D/2D hydraulic model established for the *Clay Cliff Creek Catchment Master Drainage Plan* (Cardno, 2007) was used as the basis, with further model development undertaken by Cardno to establish a suitable level of detail to assess flood behaviour and impacts associated with the Gateway South development.

Cardno (2015), included as Appendix A, provides further details of the flood model development process as well as background information relevant to past flood investigations in the catchment.

2.2 Existing Flood Behaviour

Key aspects of existing 100 year ARI flood conditions relevant to the project sites are shown in Figure 2 and Figure 4.

Figures showing more detailed flood model results for the 100 year ARI in terms of peak levels, depths and flow velocities are provided in Appendix A, along with tabulated results for peak water levels and flow rates at key locations. A summary of key findings is discussed below.

A peak 100 year ARI flood level of approximately RL 12.4 m AHD was found to apply to all three sites, assuming ideal (ie. unblocked) flow conditions. For the PMF event, the peak flood level increases to RL 12.9 m AHD.

In the event that partial or complete blockage of the inlet of the culvert under Church Street were to occur, the following increases in peak 100 year ARI flood level adjacent to the three sites would occur:

- 0.1 m for 50% blockage. In this case the peak flood level would increase to RL 12.5 m AHD.
- 0.3 m for 100% blockage. In this case the peak flood level would increase to RL 12.7 m AHD.

Peak flood levels were found to be relatively insensitive to a climate change scenario based on an assumed 15% increase in design rainfall intensity. The maximum increase in peak 100 year ARI flood level (ie. relative to present day climatic conditions) was approximately 0.04 m in the vicinity of the project sites.

It is noted that these relatively minor increases in peak flood levels would be accommodated within a typical 0.5 m freeboard allowance when determining appropriate minimum building floor levels.

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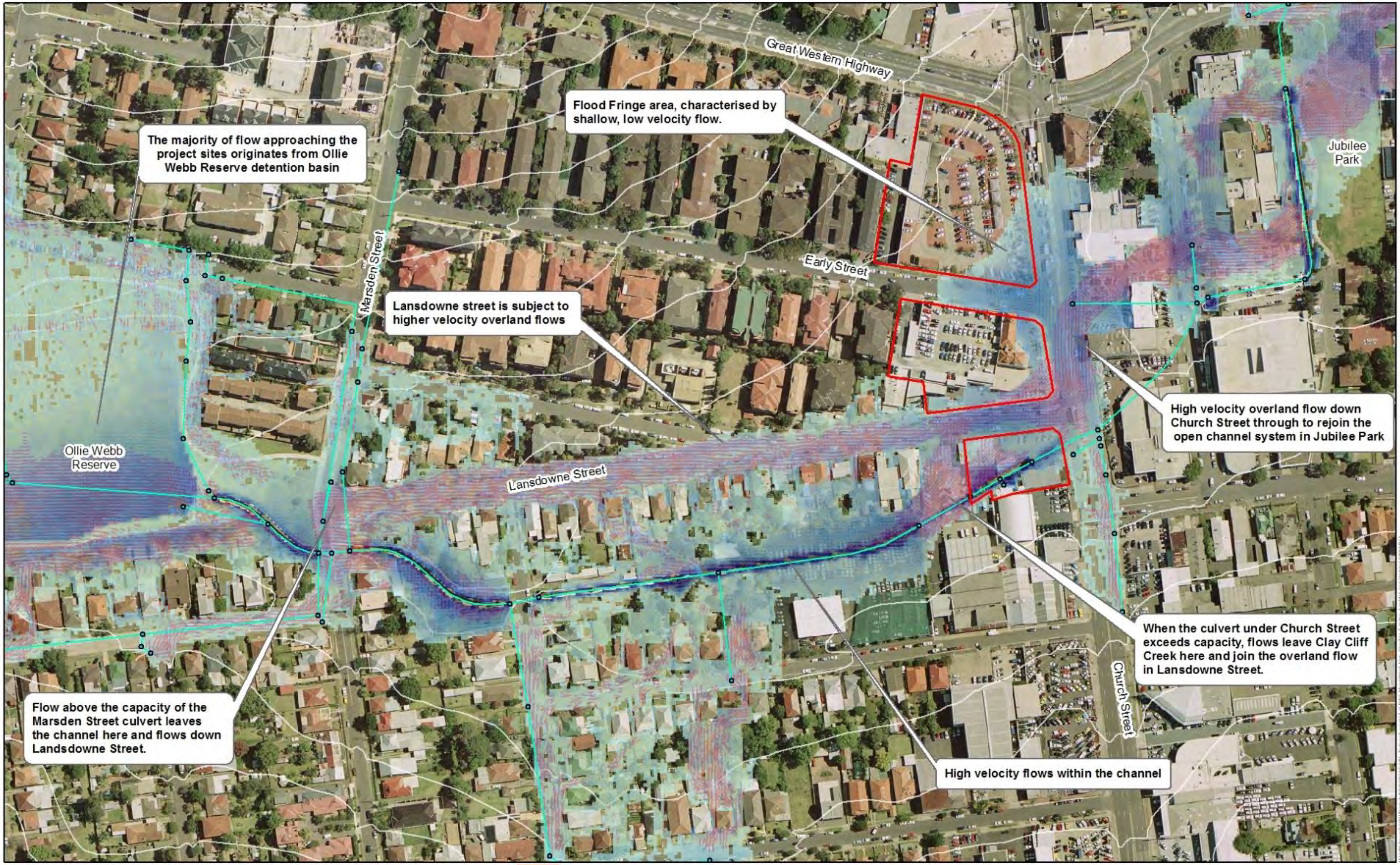

100 year ARI flood extents
Deep
Shallow

Flow velocity
Less than 2m/s
2 to 4 m/s
Greater than 4m/s

Stormwater network
Existing stormwater pipe or channel

Contour interval: 2m

Project Sites

0 25 50 100 m

Gateway South Development
Clay Cliff Creek
Overview of existing flood behaviour
Source: Cardno hydraulic model (2014), LPMA Contour data

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3.0 Post-development Flood Behaviour and Proposed Flood Management Measures

3.1 Background

Investigation of several design refinement options for buildings and plaza areas on Sites 1 and 2 were undertaken in response to PCC comments on the October 2014 Concept DA submission. Section 3.2 provides a summary of the options that were investigated, including presentation of interim model results that were provided by Cardno for comparative purposes to inform assessment of options.

Section 3.3 provides an overview of flood behaviour and impacts associated with the preferred post-development scenario, with further details included in Appendix A.

Section 3.4 describes key design elements and management measures that have been incorporated into the revised architectural designs to comply with PCC requirements and to minimise residual flood risk on the project sites.

3.2 Investigation of Design Refinement Options

As requested by PCC in their comments on the October 2014 Concept DA submission, a design refinement process was undertaken to revise site layouts and building footprints for Sites 1 and 2. All possible options investigated assumed that existing ground levels and trunk drainage infrastructure on Site 3 was to remain unchanged, as dictated by PCC.

The type of design modifications investigated included the following, as discussed and agreed with PCC:

1. Reductions to building footprints.
2. Reductions to proposed ground levels across public domain / plaza areas, and/or enlargement of these areas at lowered elevation.
3. Provision of suspended slab arrangements within new buildings to create underfloor floodway areas.
4. Provision of on-site flood detention storage within underground tanks located within new basement areas.
5. Allowing floodwaters to enter new buildings.

Whilst numerous potential options involving one or more of the above were explored, Table 2 describes the key options that were considered to be the most practical and feasible to incorporate.

Whilst not reported in Cardno (2015), flood modelling was undertaken to assist this process by determining relative flood impacts for each option listed in Table 2, which includes a summary of key findings. Figures showing preliminary flood model results referred to in Table 2 are included in Appendix B for reference.

Table 2 Summary of Design Refinement Options

Option	Description	Summary of Key Findings
A	October 2014 Concept DA Submission, plus: • Site 3 modified to retain existing ground levels and trunk drainage infrastructure.	• Sites 1 and 2 – unacceptable flood impacts remain. • Refer Figure B1.
B	As per Option A above, plus: • Site 1 – open forecourt added at south eastern corner of site. • Sites 1 and 2 – lowered plaza areas extended.	• Resolves offsite impacts for Site 1. • Offsite impacts remain for Site 2. • Refer Figure B2.
C	As per Option B above, plus: • Site 1 – underfloor floodway added. • Site 2 – no change.	• Resolves offsite impacts for Site 1. • Offsite impacts remain for Site 2. • Refer Figure B3.
D	As per Option B above, plus: • Site 1 – no change. • Site 2 – underfloor floodway added.	• Resolves offsite impacts for Site 1. • Offsite impacts remain for Site 2. Underfloor floodway area not sufficient. • Refer Figure B4.
E	As per Option D above, plus: • Site 1 – no change. • Site 2 – underfloor floodway extended as required to mitigate off-site impacts.	• Resolves offsite impacts for Sites 1 and 2. • Refer Figure B5.

As noted previously, the above findings were presented and discussed with PCC on 30 June 2015. Consistent with **Option E** in Table 2, the following modifications were incorporated into the architectural designs for proposed buildings and public domain areas:

Site 1

- Modification of Building F to incorporate an open forecourt area (at existing ground levels) at the south-eastern corner of the site.
- Expansion of the lowered plaza area (at street level) adjacent to Early Street.

Site 2

- Modification of Building L to incorporate a suspended ground floor slab over the southern portion of the site, forming an underfloor floodway to allow floodwaters to traverse the site as per present day conditions. The proposed configuration of this floodway is shown on several architectural drawings contained in Appendix C.
- Reconfiguration of the lowered plaza area (at street level) adjacent to Lansdowne Street to facilitate floodwaters accessing the underfloor floodway.

Site 3

- Proposed works on Site 3 to be limited to at-grade landscaping and planting only, with no significant changes to existing ground levels or trunk drainage infrastructure across the site.

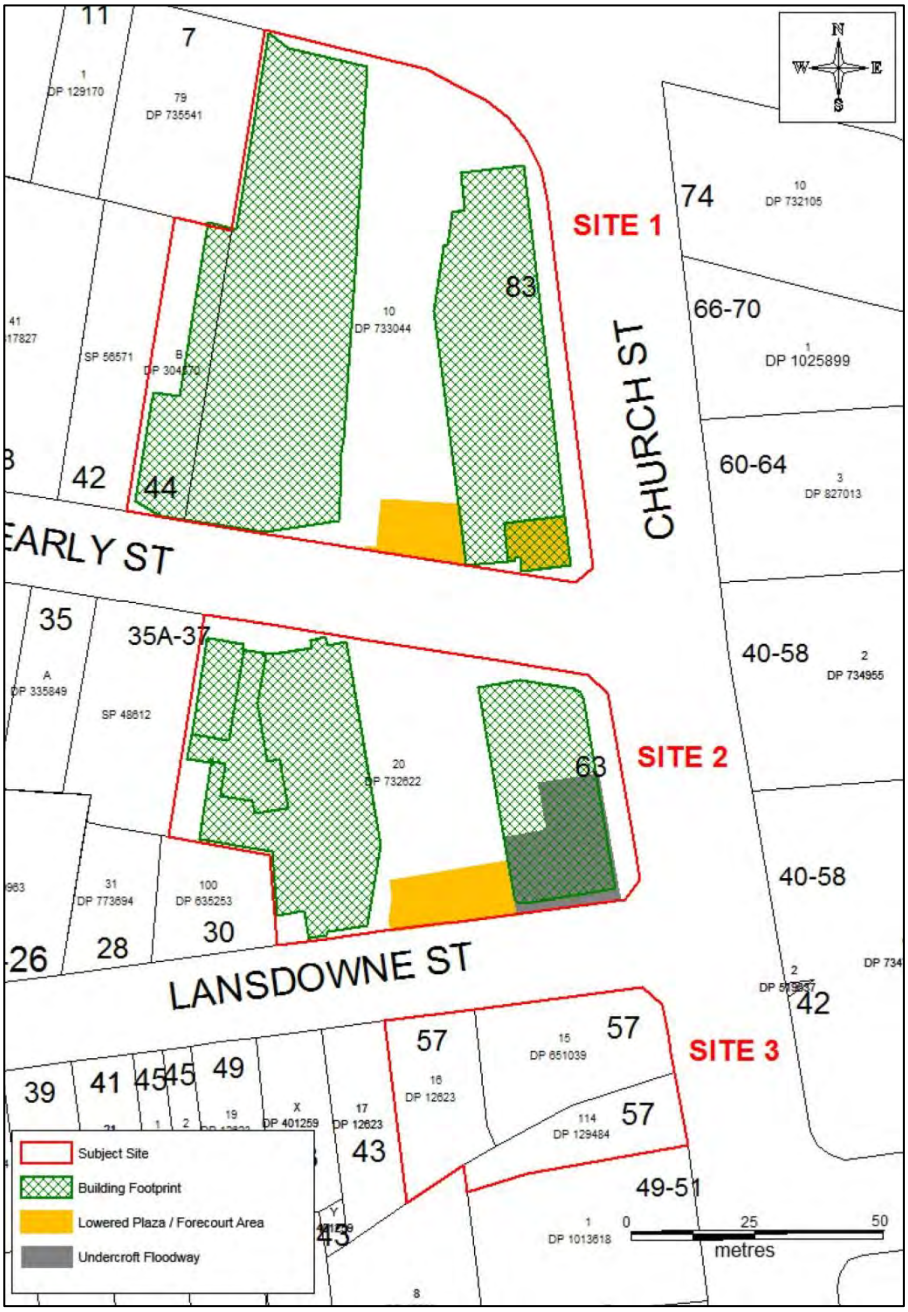
Section 3.3 describes post-development flood behaviour and impacts associated with this preferred option.

3.3 Post-Development Flood Behaviour for Preferred Option

Details in relation to flood model development for the preferred option, as well as figures showing detailed flood model results for the post-development scenario and resulting flood impacts, are included in Appendix A. The following provides a summary of key findings, with extracts from selected figures in Cardno (2015) provided for ease of reference.

Figure 5 shows the layout of the key flood design elements for Sites 1 and 2 (refer previous section) as modelled, the location and extent of which were sourced from updated architectural drawings for the sites.

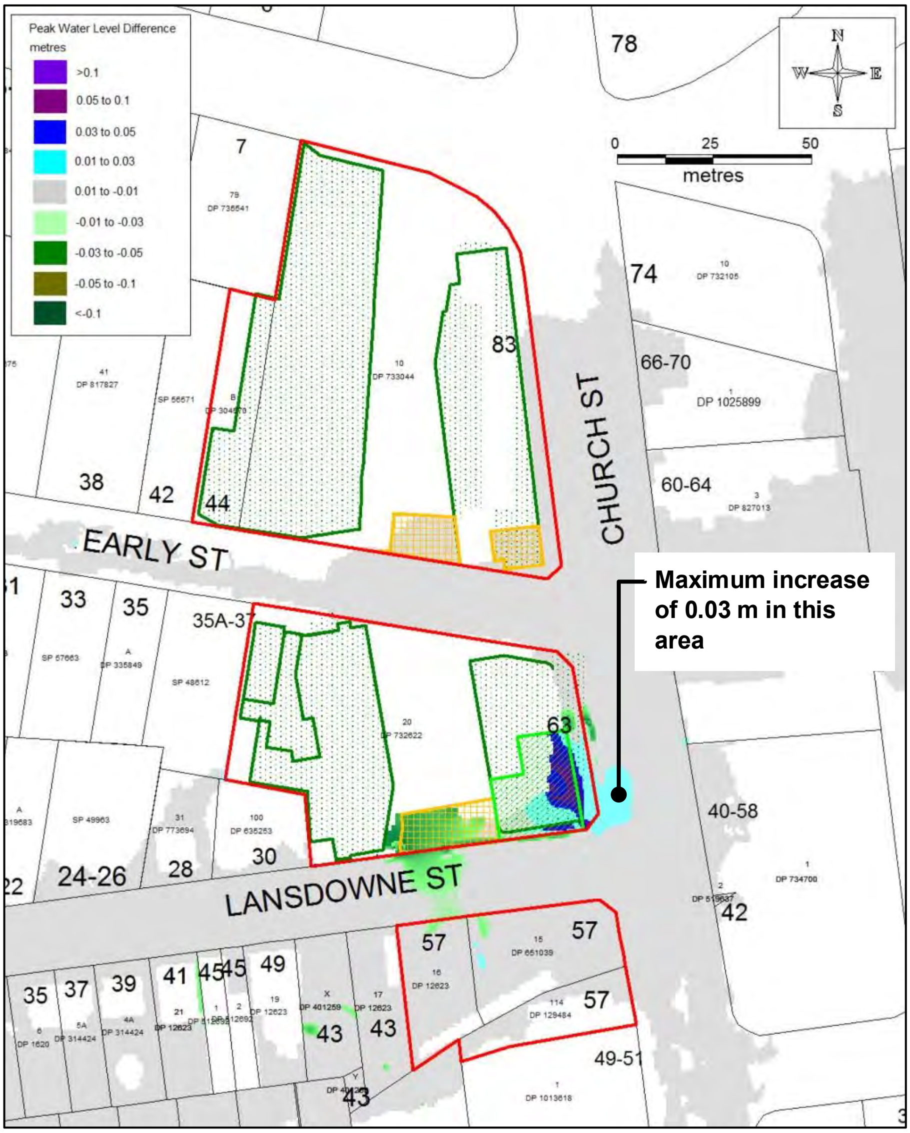
Figure 5 Proposed changes to buildings and plaza areas



(Source: Cardno, 2015)

Figure 6 shows differences in peak 100 year ARI flood levels, which demonstrates that off-site flood impacts are generally negligible (ie. less than 0.01 m). The one exception is a small area within the Church Street road reserve immediately adjacent to Site 2 that experiences an increase in peak 100 year ARI flood level of approximately 0.03 m.

Figure 6 Relative flood level impacts - 100 year ARI event

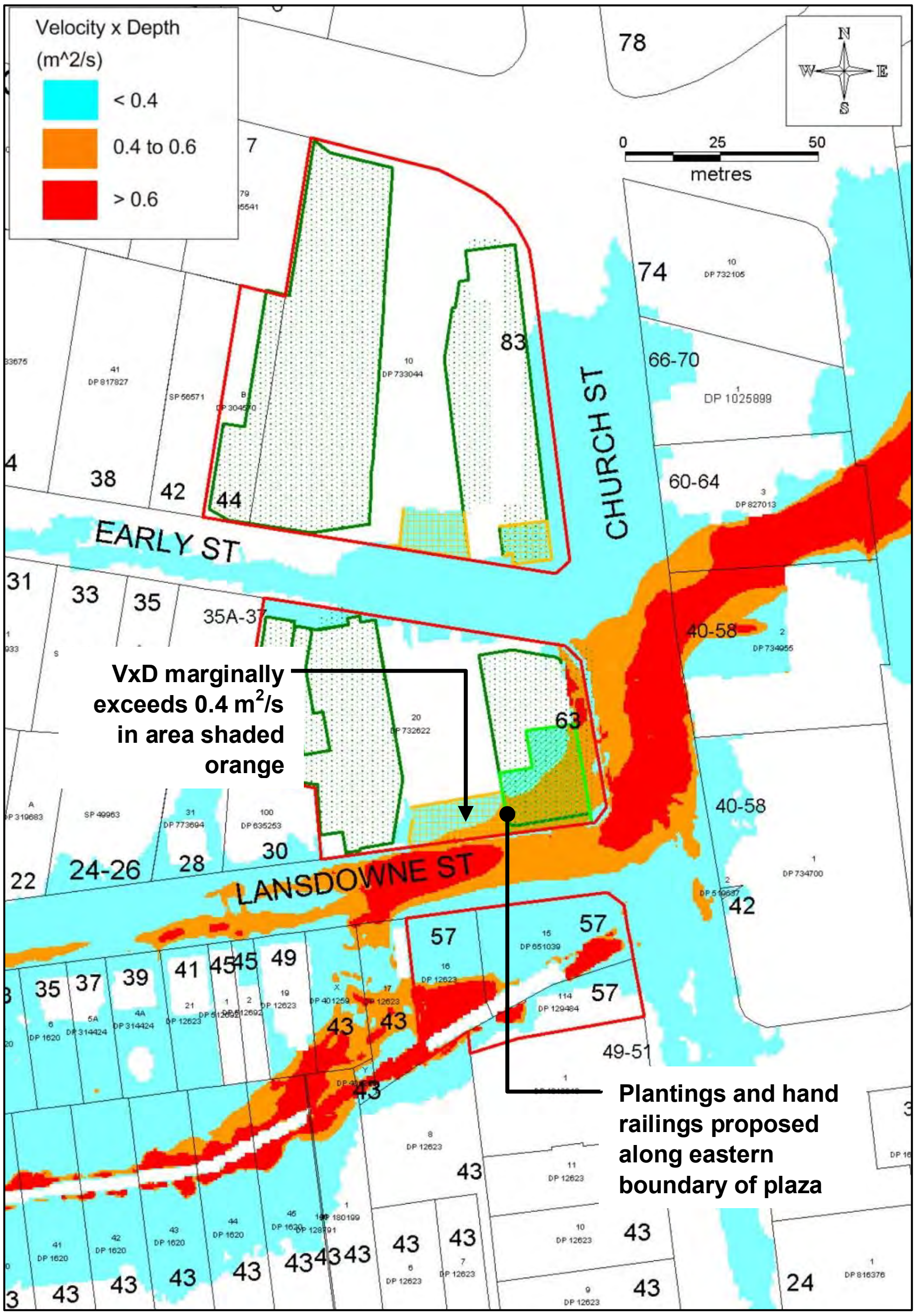


(Source: Cardno, 2015)

A sensitivity analysis was undertaken to assess the impact of a partial blockage of the security grills, required to prevent pedestrian access to the underfloor floodway area on Site 2, which may occur as a result of debris conveyed in floodwaters. This partial blockage scenario assumed 50% blockage of the total waterway area along the western (upstream) and southern sides of the underfloor floodway area, which is considered conservative. Under these conditions off-site flood impacts for the 100 year ARI as a result of the Gateway South development were still shown to be relatively minor, with a maximum increase of 0.02 m adjacent to existing residential development along Clay Cliff Creek immediately upstream of Site 3.

PCC has indicated a desired maximum VxD of 0.4 m^2/s in pedestrian areas for events up to the 100 year ARI. The modified pedestrian accessible plaza areas on Sites 1 and 2 generally satisfy this criteria, however it is noted that a small area of new plaza adjacent to Lansdowne Street on Site 2 is subject to a residual VxD in the range 0.4 to 0.5 m^2/s (refer Figure 7 for location). It is not considered practical to further reduce this VxD due to the proposed underfloor floodway located adjacent to this area. As discussed with PCC at the meeting of 30 June 2015, design of this plaza area has therefore incorporated features to increase pedestrian safety, including plantings and hand railings along the eastern boundary of the plaza (refer Figure 7).

Figure 7 Post-development velocity-depth product - 100 year ARI event



(Source: Cardno, 2015)

3.4 Proposed Flood Management Measures

The following sections outline key proposed flood management measures in terms of:

- minimum building floor levels
- requirements for flood-compatible building materials
- minimum protection levels for basement car parking
- flood evacuation planning, to cater for residual flood risk issues.

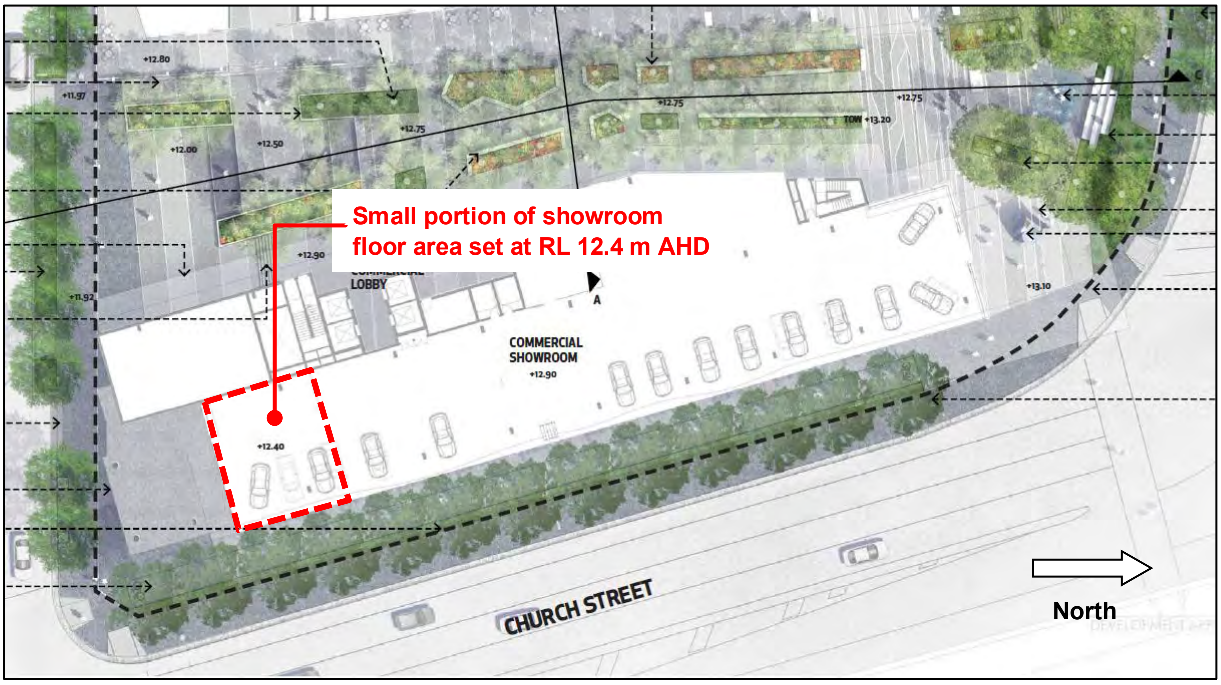
Where relevant these measures have been incorporated into the revised architectural designs that have been prepared for the project sites.

3.4.1 Minimum Building Floor Levels

Minimum habitable ground floor levels for proposed commercial spaces on Sites 1 and 2 have been generally set at RL 12.9 m AHD, which correspond to the peak 100 year ARI flood level (RL 12.4 m AHD) plus 0.5 m freeboard.

The one exception to this is the southern end of Building F on Site 1. Whilst the majority of the proposed car showroom floor area has been set at RL 12.9 m AHD, the floor ramps down to a minimum elevation of RL 12.4m AHD at the very southern end. Figure 8 shows the proposed extent of this lower floor area. This has been done to better integrate the showroom area with the external public domain areas, as well as to facilitate vehicle access into the showroom via Early Street.

Figure 8 Site 1 building floor area set at 100 year ARI flood level



(Source: AJ+C, 2015)

This approach specifically for car showroom areas as part of Gateway South has previously been discussed and agreed with PCC, noting that the revised building designs presented in the current Concept DA have a much reduced footprint at this lower elevation than the previous October 2014 Concept DA submission.

3.4.2 Building Components and Structural Soundness

PCC requires that all building components and structures located below the 100 year ARI flood level plus 0.5 m freeboard (ie. RL 12.9 m AHD) are flood-compatible, and consider the additional loadings imposed by the presence of floodwaters.

This requirement will require particular consideration for above-floor level components of the proposed car showroom area that will be set at RL 12.4 m AHD in Building F on Site 1 (refer Section 3.4.1). For all other building locations on Sites 1 and 2, this requirement only applies to below ground floor level components.

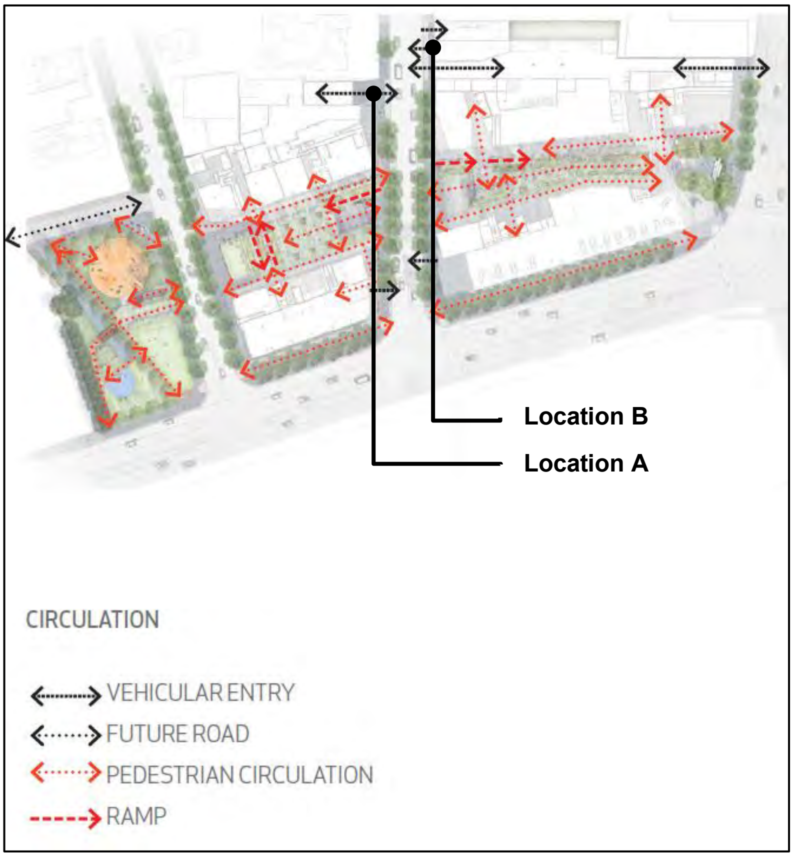
This issue will require further consideration during subsequent detailed design stages for the development.

3.4.3 Basement Car parking

Entry/exit ramps down to basement car parking on Sites 1 and 2 incorporates flood protection to a minimum elevation of RL 12.9 m AHD, which is equivalent to the 100 year ARI flood level (RL 12.4 m AHD) plus 0.5 m freeboard (and also coincidentally the PMF level), as discussed and agreed with PCC. Relative to existing footpath levels, this elevation is approximately (refer Figure 9 for locations):

- 0.1 to 0.4 m above the existing footpath level along the southern side of Early Street (Location A);
- At existing footpath level along the northern side of Early Street (Location B).

Figure 9 Protection of basement car parking ramps



(Source: AJ+C, 2015)

Note that no basement access would be provided off Lansdowne Street.

3.4.4 Emergency Evacuation

As requested by PCC at the meeting of 30 June 2015, a flood evacuation plan has been prepared to address residual flood risk issues associated with the revised Concept DA. The plan, entitled "*Flood Emergency Response Strategy - Gateway South Parramatta"* has been developed by First 5 Minutes Pty Ltd (2015). Key elements of the strategy include:

- Site Overview
- Objectives
- Establishment of an Emergency Control Organisation
- Training and auditing requirements
- Site maintenance and facility management
- Flood response procedures
- Emergency contacts

It is anticipated that the specific format and details presented in this document will need to be finalised in conjunction with the future development of business planning and operational procedures for Gateway South.

4.0 References

AECOM (2014), *Gateway South, Church Street Parramatta – Supplementary Flood Impact Report*, prepared for Boyded Industries Pty Ltd.

AECOM (2012), *Gateway South, Church Street Parramatta – Flood Impact Report*, Rezoning Application, prepared for Heartland Group.

AJ+C (2015). *Gateway South Parramatta, Stage 1 – DA Report*, prepared by Allen Jack+Cottier dated 21 August 2015.

Cardno (2015), *Gateway South, Church Street Parramatta – Flood Impact Assessment*, prepared for AECOM, 14 August 2015.

Cardno (2014), *57-83 Church Street Parramatta – Flood Impact Assessment*, prepared for AECOM, 16 October 2014.

Cardno (2007), *Clay Cliff Creek Catchment Master Drainage Plan.*

First 5 Minutes (2015). *Flood Emergency Response Strategy – Gateway South Parramatta*.

SKM (2005). *Lower Parramatta River Flood Study Review*.

Appendix A

Cardno (2015) Hydraulic Modelling Report

Gateway South, Church Street Parramatta

Flood Impact Assessment

59915016

Prepared for
AECOM

14 August 2015

Cardno
Shaping the Future

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Document Information

Prepared for	AECOM
Project Name	Flood Impact Assessment
File Reference	59915016 R001 GatewaySouth ChurchSt V2.docx
Job Reference	59915016
Date	14 August 2015
Version Number	2

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
1	16/10/2014	Issue	Tina Fang	Andrew Reid
2	14/08/2015	Issue	Tina Fang	Andrew Reid

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background

Cardno was commissioned by AECOM to undertake flood modelling of the proposed Gateway South redevelopment at 57-83 Church Street and 44 Early Street, Parramatta to assess changes to flood behaviour in a 100 year Average Recurrence Interval (ARI) event. This report documents the inputs, methodology and results of the flood modelling for the subject site.

A number of studies have previously been completed in the catchment, including:

- Clay Cliff Creek Catchment Master Drainage Plan by Cardno in July 2007. The aim of the study for Parramatta City Council was to prepare a Drainage Master Plan, identifying overland flow problem areas, surcharging locations due to insufficient pipe capacity and pit inlet capacity, and localised flooding with areas for improvement. Cardno completed this Master Drainage Plan in 2007 and City of Parramatta approved use of the XP-SWMM model for flood modelling in this study.
- Lower Parramatta River Floodplain Risk Management Study by SKM in August 2005.
- Lower Parramatta River – Flood Study by SKM in March 2005. The Lower Parramatta River Flood Study (LPRFS) provided a complete review and updating of flood level information in the tidal section of Parramatta River, between the Charles Street weir and Ryde Road Bridge. The Flood Study provided the base data for the subsequent Floodplain Risk Management Study (FRMS).
- Clay Cliff Creek Catchment Flood Study by Dalland & Lucas in 1992. This report was commissioned by Parramatta City Council in order to develop a Flood Mitigation Plan for the catchment.

The findings of the previous studies were reviewed and further detailed flood modelling of the site, catchment and existing drainage system has been undertaken.

This Version 2 of the Report is an update of the 2014 assessment to support further design development that has occurred following the 2014 concept Development Application submission.

1.2 Objectives

The objectives of this study were to:

- Identify flood behaviour in a 100 year ARI event for the site locality at existing pre-development conditions;
- Investigate several design refinement options in response to Council comments on the previous 2014 Concept DA submission;
- Identify flood extent, depth and velocity for the 100 year ARI event for the site locality for the preferred post-development scenario; and
- Evaluate potential changes in flood behaviour of the post-development scenario compared to the existing conditions, probable maximum flood event inundation and flood sensitivity to climate change and potential blockage scenarios.

1.3 Input Data

The following information was used to inform the study:

- Gateway South site survey by Dunlop Thorp & Co, dated 19th December 2007 (Appendix B);
- Additional survey detail for Site 2 and Site 3, received 17th September 2014;
- Trivett site survey by Hard and Forester, dated 1st October 2009;

- Flood advice from Council, dated 18th August 2011 (Appendix C);
- Ollie Webb Reserve Detention Basin Design Drawings by Cardno, dated 29th March 2007; and
- Clay Cliff Creek Catchment – Master Drainage Plan, Cardno 2007.

2 Site Location

The site comprises three neighbouring sites (Numbers 57, 63 and 83 Church Street, and 44 Early Street) fronting Church Street in Parramatta as shown in Figure 1. All three sites are used for car sales with the majority of the site area being used for car parking with small buildings. The Clay Cliff Creek canal is located on the southern boundary of number 57 and flows in a west to east direction. Overland flowpaths exist over the creek canal, in Lansdowne Street and further downstream through the centre of the Trivett car dealership site.

Figure 1 - Aerial View of Proposed Gateway South Development Site (Source: Nearmap [dated 11 July 2015])

3 Existing Flood Behaviour

3.1 Lower Parramatta River Flood Study 2005

The Lower Parramatta River Flood Study (LPRFS) completed by SKM in 2005 estimated the flood levels shown in Table 1. This Study included a broad scale MIKE-11 model of the catchment that covers the Clay Cliff Creek floodplain. The MIKE-11 model was calibrated according to available historical data in the catchment.

Table 1 - Flood levels estimated in the 2005 Flood Study

MIKE-11 Cross Section & Location	CH 133, CH 55, CH 450, CH 498 (in Church Street)	CH 1230 (over the Clay Cliff Creek canal upstream)	CH 357 (Lansdowne Street upstream of site)
20 year ARI	12.52 -12.54	12.80	12.54
100 year ARI	12.89 -12.91	12.99	12.89
PMF	13.84 – 14.10	14.40	14.22

Source: Council Flood Map (Appendix C)

It can be seen that the flood levels in Church Street are consistent for all cross sections thus there is a broad level pool that has a flood level consistent with Anderson Street. This indicates that overland flow is arriving at Church Street and Anderson Street and being withheld before draining either into the Clay Cliff Creek canal opening in Anderson Street or behind the Marriott Hotel and Carpark. The results of the MIKE-11 model are representative of a broad scale overland flow study. Cross sections of the MIKE-11 model are several hundred metres apart and would not represent the overland flowpaths and floodplain storage areas in detail.

3.2 Clay Cliff Creek Drainage Masterplan 2007

In 2007 Cardno completed a masterplan for drainage in the Clay Cliff Creek catchment using a 1D/2D XP-SWMM model. The Study used the same hydrological input data to the 2005 study and catchment data available from Council's GIS, which is considered to be similar to that used in 2005. The 1D sections for the Clay Cliff Creek canal were imported to the XP-SWMM model directly from the MIKE-11 model. A downstream condition for the XP-SWMM model was also imported directly using the results of the MIKE-11 model. Results of the XP-SWMM model were validated using the results of the MIKE-11 model and those reported in the LPRFS (Cardno 2007).

However more detailed pit and pipe data was made available by Council for inclusion into the 2007 model. The 2007 model included 1D elements for road kerbs and all pits and pipes greater than and including 450mm. The 2D component of the XP-SWMM model included a 2m grid cell generated from a DTM that was established using Council ALS.

Table 2 - Flood Levels Estimated in the 2007 Drainage Master Plan (m AHD)

Location	Church Street	Anderson Street
20 year ARI	12.17	10.65
100 year ARI	12.28	10.73

Source: Cardno 2007

Results in Table 2 show that the 2007 Study predicts 100 year ARI levels in Church Street that are approximately 0.6m lower than the 2005 LPRFS. The MIKE-11 model of the 2005 Study predicted level pooling in Church Street and Anderson Street most likely caused by a hydraulic control downstream. Whilst levels in Anderson Street are similar for both studies the following are considered to explain the cause of flood level differences in Church Street:

- Modelling of the floodplain using 2D grid cell in XP-SWMM that would provide greater detail in representing overland flowpaths and floodplain storage. The MIKE-11 model is limited to interpolation of floodplain topography between the 1D cross sections.
- Greater detail in the drainage system to include the drainage system from Council's GIS data for all pipes greater than or equal to 450mm;
- Inclusion of 1D kerbs and building footprints; and
- Detailed roughness zones for roads, parks and building lots.

The 2007 study and its results have been accepted by Council and are considered to provide a more detailed estimation of flood levels for the Clay Cliff Creek floodplain. The 2007 study identifies a number of drainage improvement options, such as the Ollie Webb Reserve Retarding Basin that has been constructed.

3.3 Update of the 2007 Flood Model for 2014 Concept DA Submission

Cardno updated our previous 1D/2D XP-SWMM model prepared for Council for the Clay Cliff Creek catchment in 2007. The following changes in the catchment were incorporated to update to 2014 the original model that was created in 2007:

- Update to the geometry of the Clay Cliff Creek canal according to the ground survey;
- Update of the drainage system geometry according to the ground survey of both 57-83 Church Street and the Trivett site; and
- Proposed development layout of 57-83 Church Street received from AECOM (discussed in Section 4.2).

The DTM was updated in the vicinity of the subject site using the supplied survey. Pits, pipes and the Clay Cliff Creek canal were updated in the model as 1D elements. Flows that exceeded the capacity of the 1D element were conveyed as overland flows across the 2D model terrain.

Council advised acceptance of the use of this model for the purpose of flood assessment for the Gateway South development, thus superseding the design flood levels from their original advice (Appendix C) and SKM 2005.

3.4 Truncated Model for Current Concept DA Submission

A truncated version of the 2014 model was created in XP-SWMM to improve model reliability in a more recent version of the software. The models were generated and run using XP-SWMM2013 (Last Update Jan., 2013 Interface Version: 2012 Engine Version 12.0 Data File Version: 12.5), coupled with Tuflow Build: 2012-05-AE-iSP-w32. Attributes of pits and pipes, open channel sections and other stormwater drainage structures, ground surface levels, and surface roughness as previously modelled was extracted from the XP-SWMM 2d model and used in setting up the truncated 1D/2D model of the study area. Inflow hydrographs from runoff and conduit flows upstream of Marsden Street were extracted and input to the truncated model. Similarly, flow hydrographs of nodes within the model extent and the modelled water level at the downstream boundary were input from the previous modelled results.

The truncated model layout is shown in Figure 2 and nearby trunk drainage is shown in Figure 3. All local street drainage pipelines were modelled as 100% blocked, that is excluding the trunk drainage culvert and open channel along the main branch of Clay Cliff Creek which were modelled as open.

This truncated flood model was verified to the previous model and was determined to be suitable for this flood assessment. Minor increases (of up to 0.03 m) to peak flood levels result for the truncated model in the 100 year ARI event as listed in Table 3 for reference locations on adjacent streets shown in Figure 8.

Table 3 – Peak Flood Levels (m AHD) of Previous and Current Models

Reference	DTM Ground Elevation	WL October 2014	WL May 2015
C1	12.51	n/a	n/a
C2	12.01	12.25	12.28
C3	11.70	12.25	12.28
C4	11.66	12.24	12.28
C5	11.89	12.30	12.32
C6	12.07	12.33	12.34
C7	12.34	12.41	12.40
E1	13.35	n/a	n/a
E2	12.74	n/a	n/a
E3	12.26	n/a	12.28
E4	11.67	12.25	12.28
E5	11.35	12.25	12.28
L1	12.20	12.41	12.43
L2	11.98	12.41	12.43
L3	11.72	12.37	12.38
L4	11.50	12.36	12.37
L5	11.63	12.34	12.35

4 Flood Modelling Results

4.1 Pre-Development Scenario

The flood model was run of the existing scenario for the 100 year ARI critical duration event of 120 minutes.

Modelled results for the pre-development scenario are shown in the following figures:

- Figure 4 – Existing Scenario Peak Flood Depth 100y ARI;
- Figure 5 – Existing Scenario Peak Water Level 100y ARI;
- Figure 6 – Existing Scenario Peak Velocity 100y ARI; and
- Figure 7 – Existing Scenario Peak Velocity Arrows 100y ARI.

In general, stormwater runoff from west of the site is conveyed eastward to Church Street. Flow is conveyed along Clay Cliff Creek and across the adjacent properties fronting Lansdowne Street and Dixon Street. Lansdowne Street is also an overland flowpath in a 100 year ARI event as flow moves towards Church Street. A small proportion of flow is conveyed overland along Early Street. Runoff ponds on Church Street near the subject site as the existing culvert under Church Street does not have capacity to convey all flows.

Peak 100 year ARI modelled flood levels are listed in Table 4 for reference locations shown on Figure 8. Also listed in Table are peak water levels for three pre-development scenario conditions to evaluate model sensitivity:

- 50% blockage of the culvert crossing under Church Street;
- 100% blockage of the culvert crossing under Church Street; and
- Climate change scenario for additional rainfall intensity.

The climate change assessment was based on an assumed 15% increase in design rainfall which yields a 12% increase in 100 year ARI flood flows. Results indicate a maximum increase of 0.11 m in peak water on Church Street for the 50% blockage condition, 0.30 m for the 100% blockage condition, and 0.04m for the climate change condition.

Table 5 lists peak flowrates for overland and conduit flows at reference locations shown on Figure 9. Flow time-series graphs for Line 3 (just upstream of the subject site) and Line 1 (downstream of Church Street) are shown in Figure 10.

Table 4 – Peak Flood Levels (m AHD) for the Pre-Development Scenario

Reference	0% Blocked	50% Blocked	Difference to 0% Blocked	100% Blocked	Difference to 0% Blocked	Climate Change	Difference to 0% Blocked
C1	n/a	n/a	n/a	12.64	n/a	n/a	n/a
C2	12.33	12.44	0.11	12.64	0.30	12.37	0.04
C3	12.33	12.44	0.11	12.63	0.30	12.37	0.04
C4	12.33	12.44	0.11	12.62	0.30	12.37	0.04
C5	12.36	12.47	0.11	12.67	0.30	12.40	0.04
C6	12.38	12.49	0.11	12.68	0.30	12.42	0.04
C7	12.42	12.50	0.08	12.69	0.27	12.43	0.02
E1	13.37	13.37	0.00	13.37	0.00	13.36	0.00
E2	12.76	12.76	0.00	12.76	0.00	12.76	0.00
E3	12.33	12.44	0.11	12.63	0.30	12.37	0.04
E4	12.33	12.44	0.11	12.63	0.30	12.37	0.04
E5	12.33	12.44	0.11	12.63	0.30	12.37	0.04
L1	12.46	12.54	0.09	12.71	0.25	12.49	0.03
L2	12.45	12.53	0.08	12.70	0.26	12.48	0.03
L3	12.41	12.51	0.10	12.69	0.29	12.44	0.04
L4	12.40	12.50	0.11	12.69	0.29	12.43	0.04
L5	12.38	12.49	0.10	12.68	0.29	12.42	0.04

Table 5 – Peak Overland and Culvert Flows

Reference	Overland Flow (m^3/s)	Culvert Flow (m^3/s)
Line 1	16.4	14.7
Line 2	0.0	n/a
Line 3	21.8	12.8
Line 4	6.3	n/a
Line 5	15.5	12.8
Line 6	0.8	n/a

4.2 Post-Development Scenario

4.2.1 Proposed Development

The proposed development drawings received from AECOM comprise multi-storey residential buildings with commercial and retail units on the ground floor on Sites 1 and 2 (shown on Figure 11). Site 3 is to be converted to open space with ground elevations essentially unchanged as per Council’s request.

Flood modelling of several design layouts was undertaken to refine the concept to mitigate and manage flood behaviour. Site 1 includes a lowered plaza area with an elevation of about 12.0 m AHD to match back into existing footpath levels, and a forecourt (within the eastern building footprint) to existing ground levels (about 11.45-11.90 m AHD). Site 2 includes a lowered plaza area with an elevation of 11.7 m AHD, and an undercroft floodway (within the eastern building footprint) which has an elevation of 11.7 m AHD. The purpose of the floodway is to allow floodwaters that presently flow across Site 2 to continue across to Church Street under post-development conditions.

4.2.2 Model Results – 100y ARI

Results for the modelled 100 year ARI event are shown in the following figures:

- Figure 12 – Post-Development Scenario Peak Flood Depth 100y ARI;
- Figure 13 – Post-Development Scenario Peak Water Level 100y ARI;
- Figure 14 – Post-Development Scenario Peak Flood Velocity 100y ARI;
- Figure 15 – Post-Development Scenario Peak Flood Velocity Arrows 100y ARI;
- Figure 16 – Post-Development Scenario Provisional Hazard 100y ARI; and
- Figure 17 – Post-Development Scenario Velocity-Depth Product 100y ARI.

Peak flood levels for the post-development scenario at reference locations (shown on Figure 8) are listed in Table 6. Provisional hazard was assessed during the 100 year ARI event, this has been determined using the methods outlined in the NSW Floodplain Development Manual Appendix L.

A sensitivity scenario was modelled assuming 50% blockage of the grilles that will prevent access into the undercroft flowpath of Site 2. This blockage was modelled on the western and southern face of the undercroft, in combination with four structural columns (two on Lansdowne Street frontage and two on Church Street frontage) modelled as one grid cell each (2m by 2m).

Table 6 - Peak Flood Levels (m AHD) for the Post-Development Scenario

Reference	Post-Development	Difference to Pre-Development	Scenario – Safety Grille	Difference to Pre-Development
C1	n/a	n/a	n/a	n/a
C2	12.33	0.00	12.33	-0.01
C3	12.33	0.00	12.33	0.00
C4	12.33	0.00	12.32	-0.01
C5	12.37	0.01	12.37	0.01
C6	12.38	0.00	12.39	0.01
C7	12.42	0.00	12.42	0.00
E1	13.36	0.00	13.36	0.00
E2	12.76	0.00	12.76	0.00
E3	12.33	0.00	12.32	-0.01
E4	12.33	0.00	12.32	-0.01
E5	12.33	0.00	12.32	-0.01
L1	12.45	-0.01	12.46	0.01
L2	12.44	-0.01	12.46	0.01
L3	12.40	-0.01	12.42	0.01
L4	12.39	-0.01	12.41	0.01
L5	12.38	0.00	12.40	0.01

Figures 18 and 19 show the difference at post-development compared to pre-development for peak water level and peak velocity in the 100 year ARI event respectively. The post-development scenario results in a maximum increase to peak water level of 0.03 m on Church Street at the kerbline adjacent to Site 2. Modelling of the grille blockage scenario shows a maximum increase to peak water level of maximum 0.02m on Lansdowne Street, and similarly a maximum 0.02m increase on properties just upstream of Site 3. Some reductions in flood velocity post-development in a 100 year event occur, but increases are less than 0.1 m/s on private property and 0.2 m/s on the roads.

4.2.3 Model Results – PMF

The flood model was modified to represent the Probable Maximum Flood (PMF) event by adjusting the inflow hydrographs and downstream boundary to the PMF modelling from the Clay Cliff Creek catchment model.

Results for the modelled PMF event (60 minute critical duration) are shown in the following figures:

- Figure 20 – Post-Development Scenario Peak Flood Depth PMF; and
- Figure 21 – Post-Development Scenario Velocity-Depth Product PMF.

Peak flood levels at reference locations (shown on Figure 8) are listed in Table 7. Modelling indicates that in a PMF event the plaza areas between the buildings on Site 1 and Site 2 are inundated. However, the main plaza areas (excluding the lowered area fronting Lansdowne Street) have a velocity-depth product less than 0.4 m^2/s.

Table 7 - Peak Flood Levels (m AHD) for the PMF Post-Development Scenario

Reference	Post-Development 100y ARI	Post-Development PMF
C1	n/a	12.87
C2	12.33	12.87
C3	12.33	12.87
C4	12.33	12.86
C5	12.37	12.91
C6	12.38	12.91
C7	12.42	12.92
E1	13.36	13.38
E2	12.76	12.87
E3	12.33	12.87
E4	12.33	12.86
E5	12.33	12.86
L1	12.45	12.96
L2	12.44	12.95
L3	12.40	12.92
L4	12.39	12.92
L5	12.38	12.91

5 Summary

Modelling of flood behaviour in the vicinity of the subject was undertaken based on a refined model of the regional Clay Cliff Creek system. Pre-development and post-development conditions were modelled including for several scenarios of trunk culvert blockage and climate change. Flood behaviour for these cases for these cases is summarised in the report, listing peak flood levels for evaluation of building floor and entry levels, and showing that only minor off-site impacts result post-development, including:

- Less than 0.01 m increase in surrounding properties, and
- Up to 0.03 m increase in the adjoining road reserve.

6 References

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APPENDIX A
FIGURES

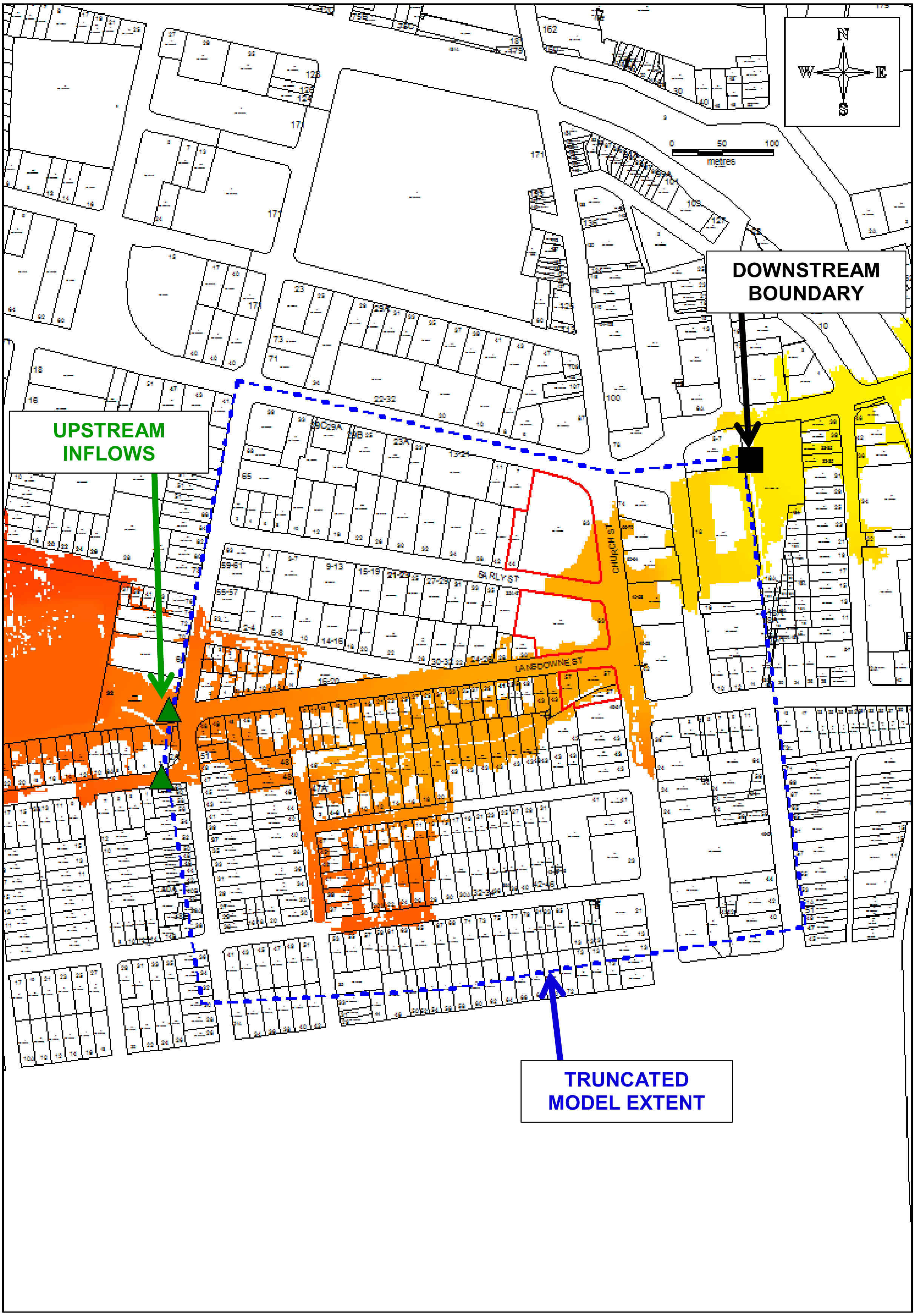


Figure 2 – Model Extent (Showing Flood Extents of the 2014 Flood Model)

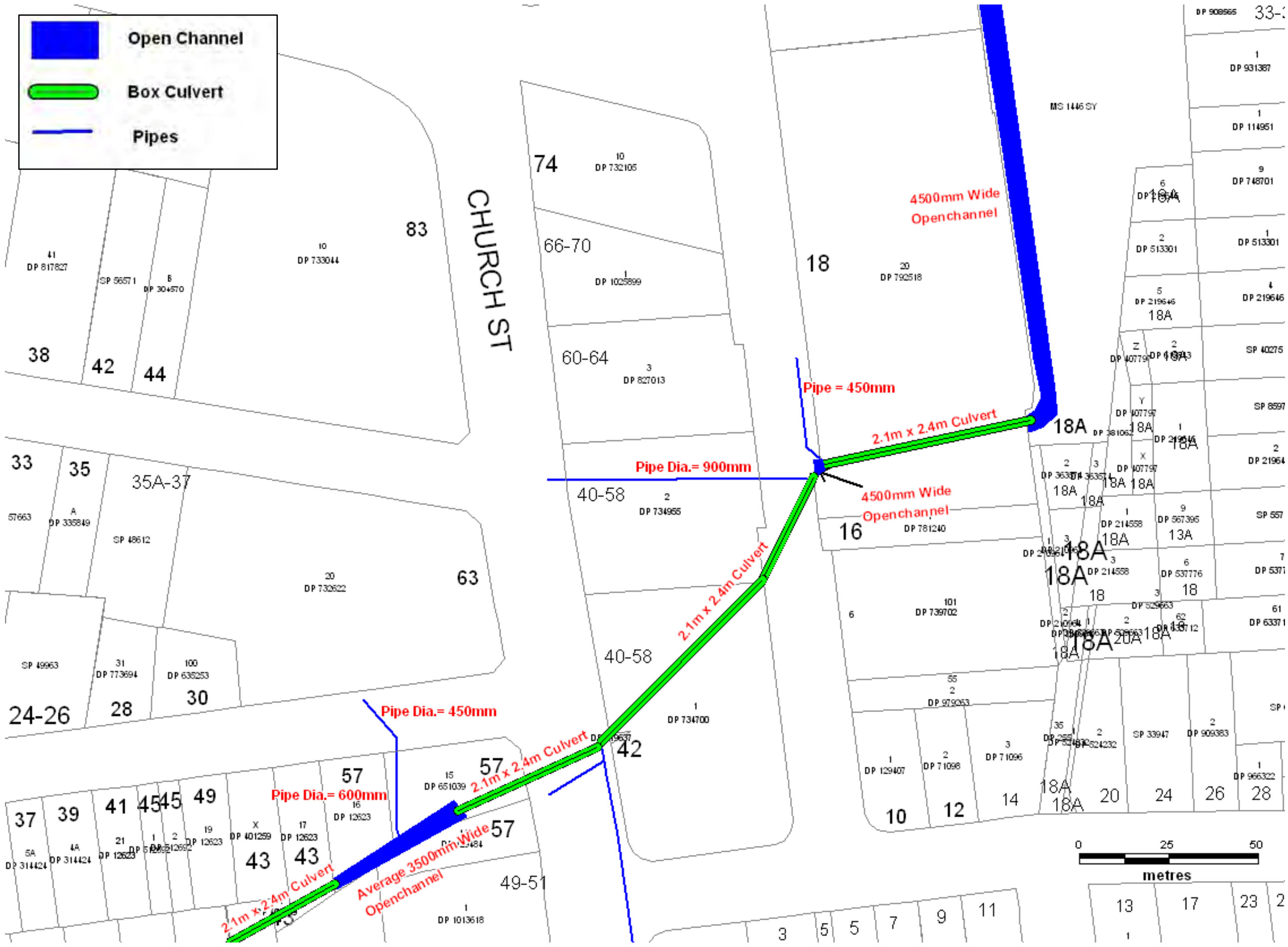


Figure 3 – Existing Drainage Layout

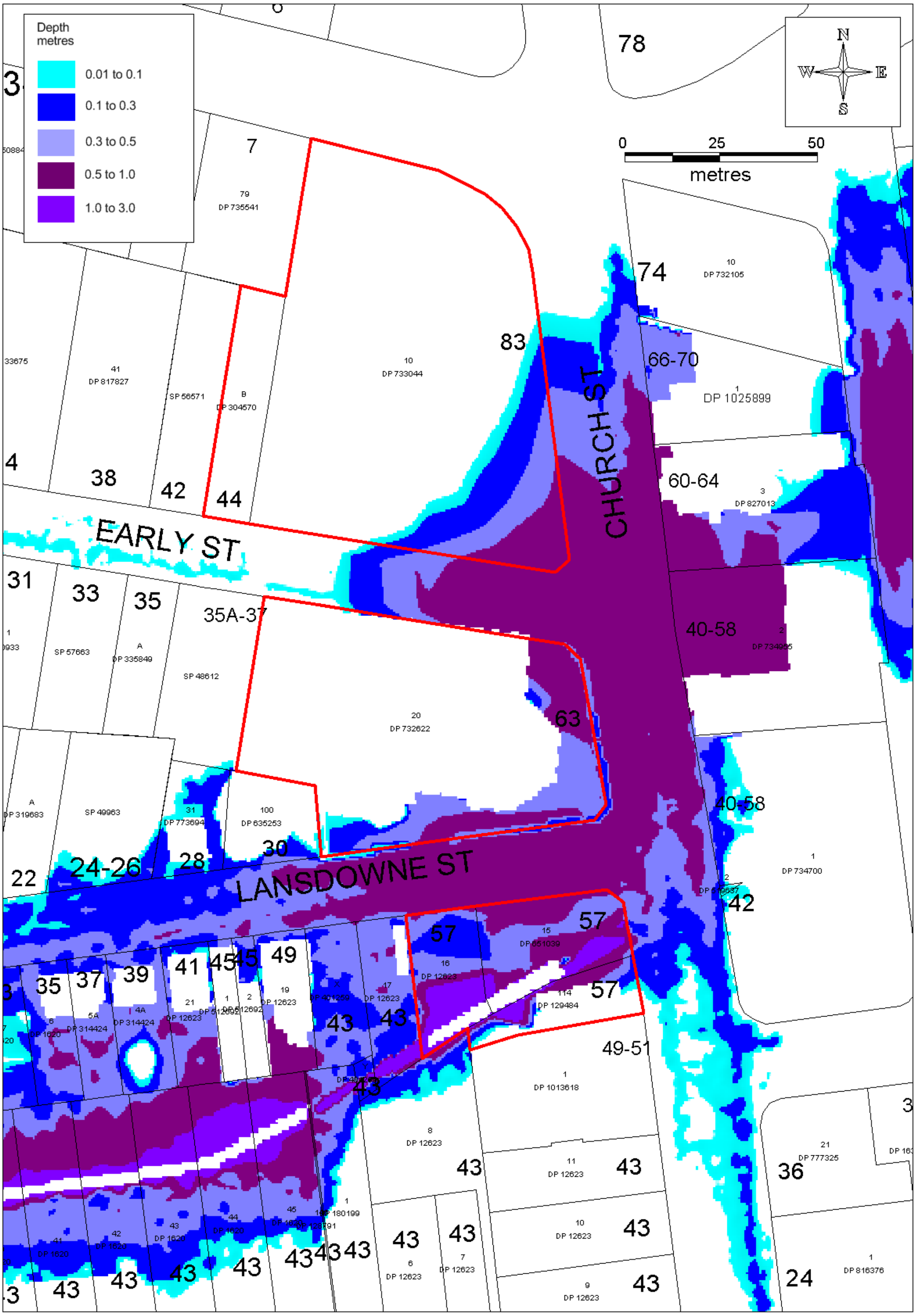


Figure 4 – Existing Scenario Peak Flood Depth 100y ARI

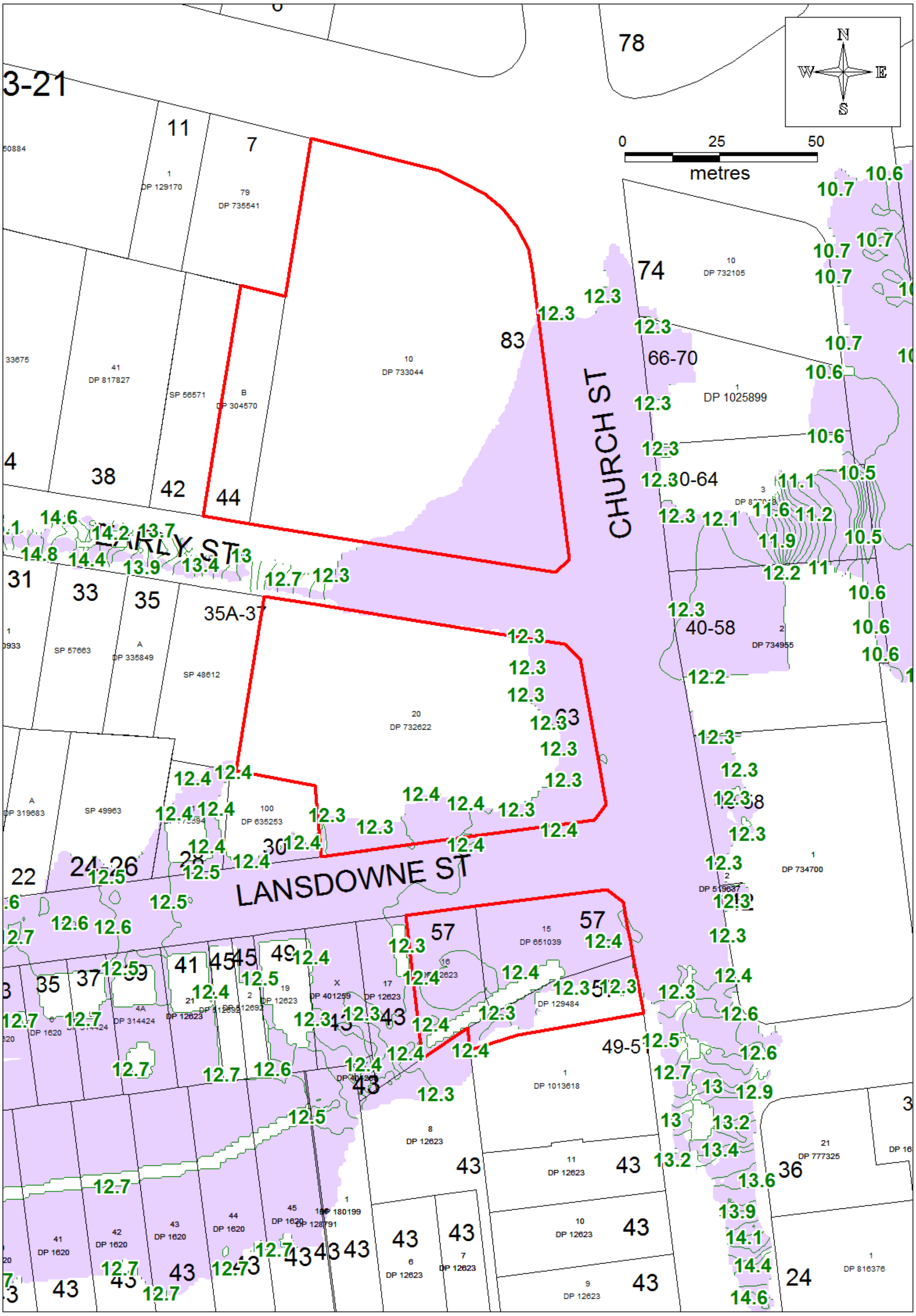


Figure 5 – Existing Scenario Peak Water Level 100y ARI

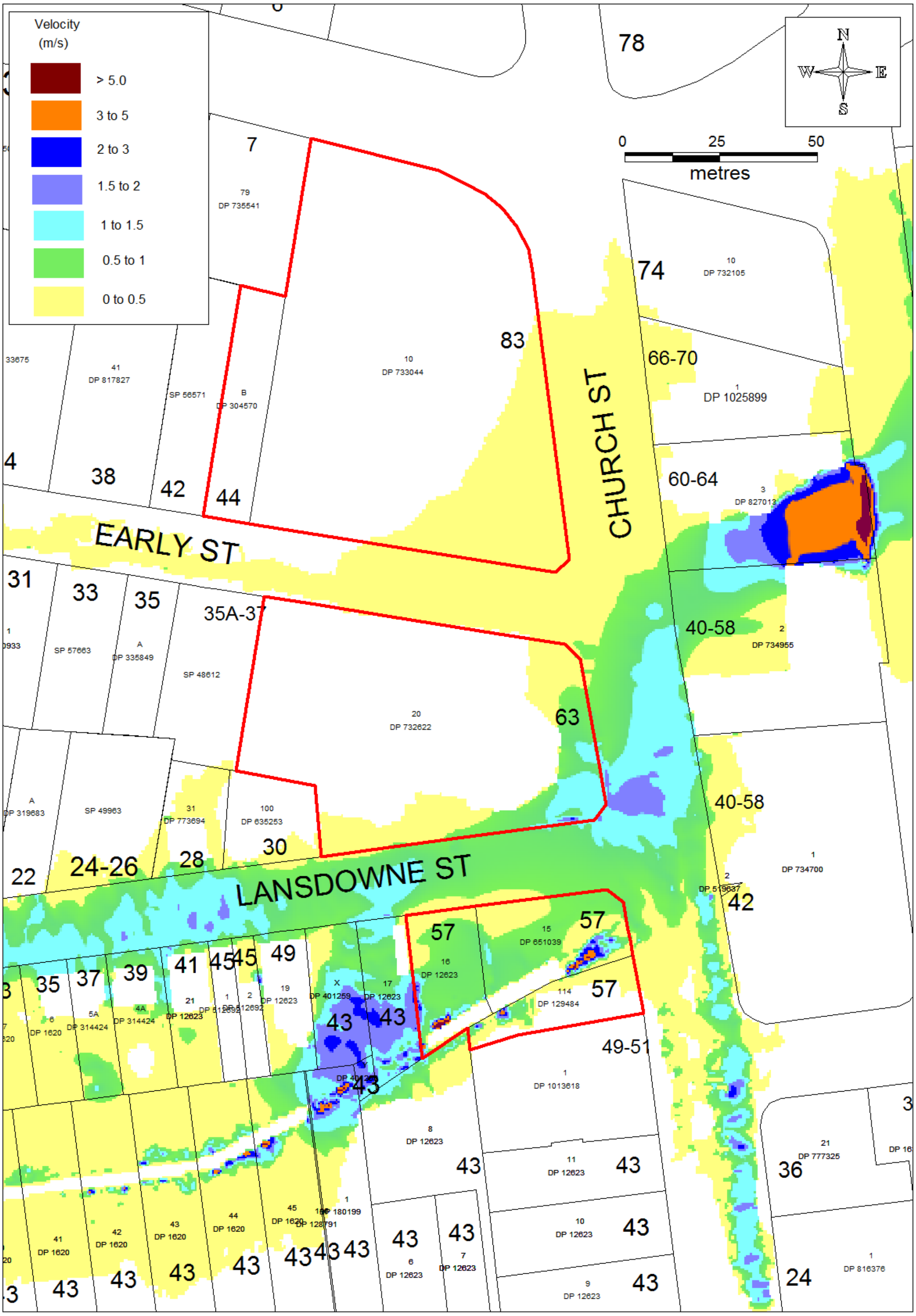


Figure 6 – Existing Scenario Peak Velocity 100y ARI

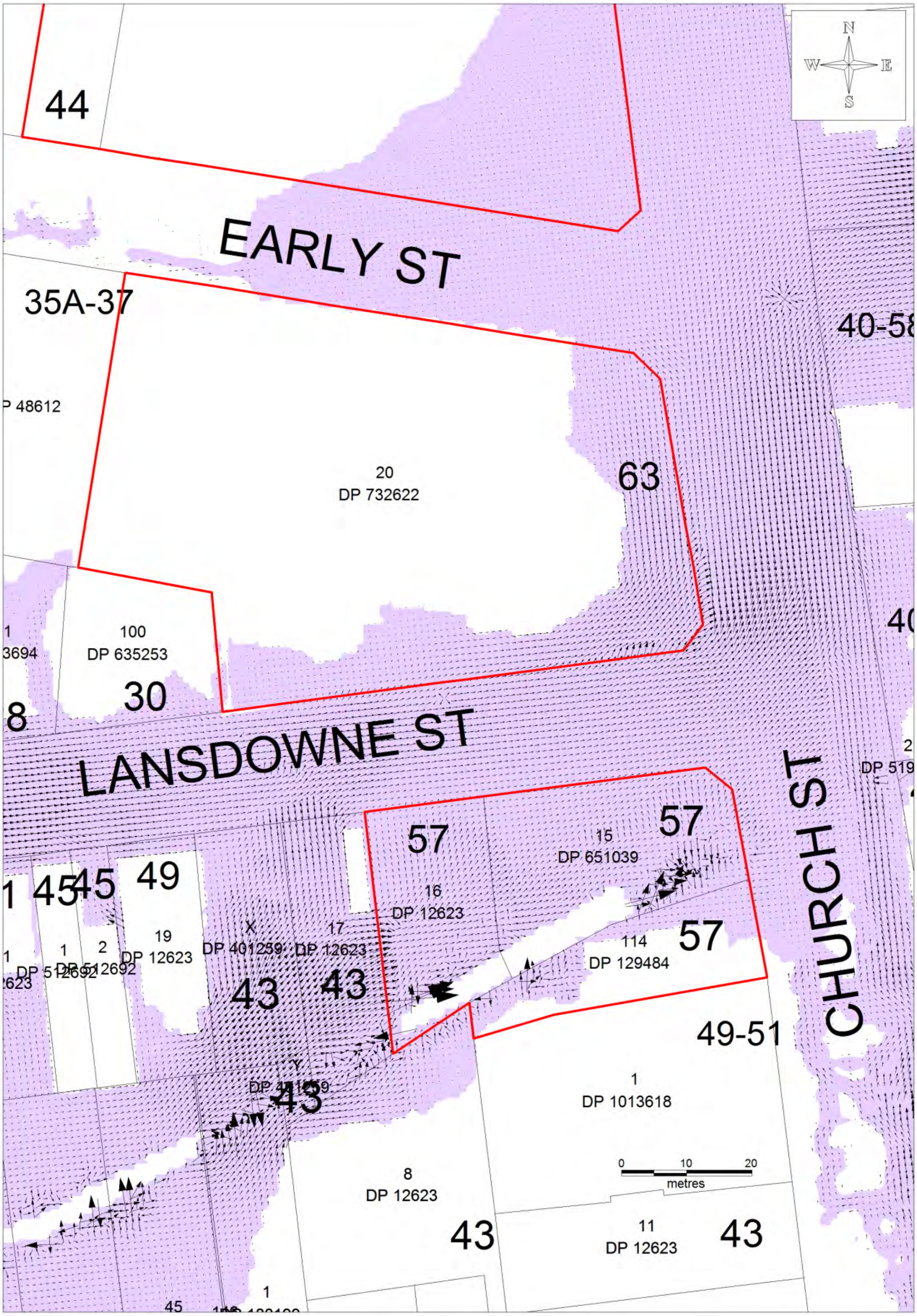


Figure 7 – Existing Scenario Peak Velocity Arrows 100y ARI

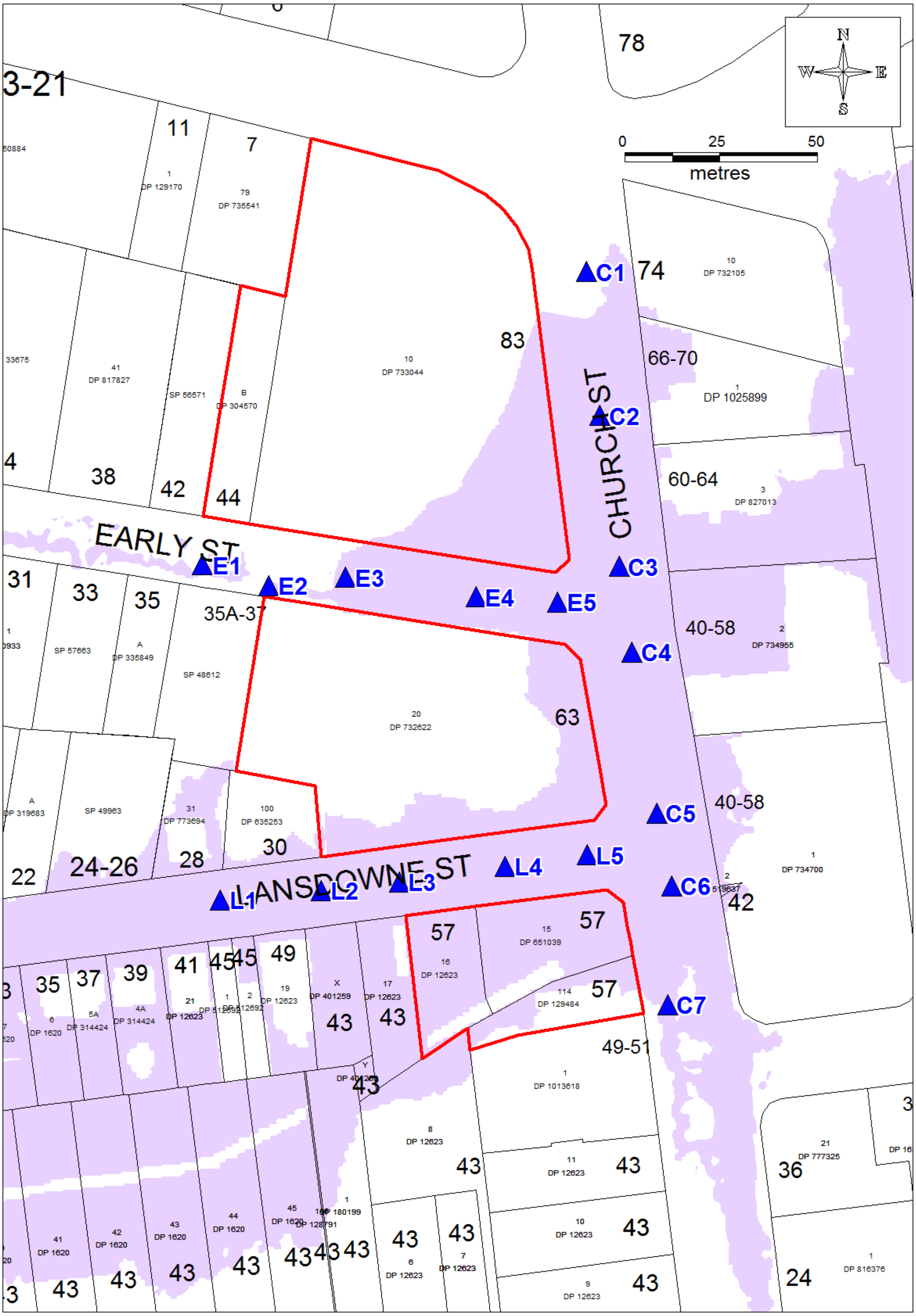


Figure 8 – Existing Scenario Water Level Reference Location 100y ARI

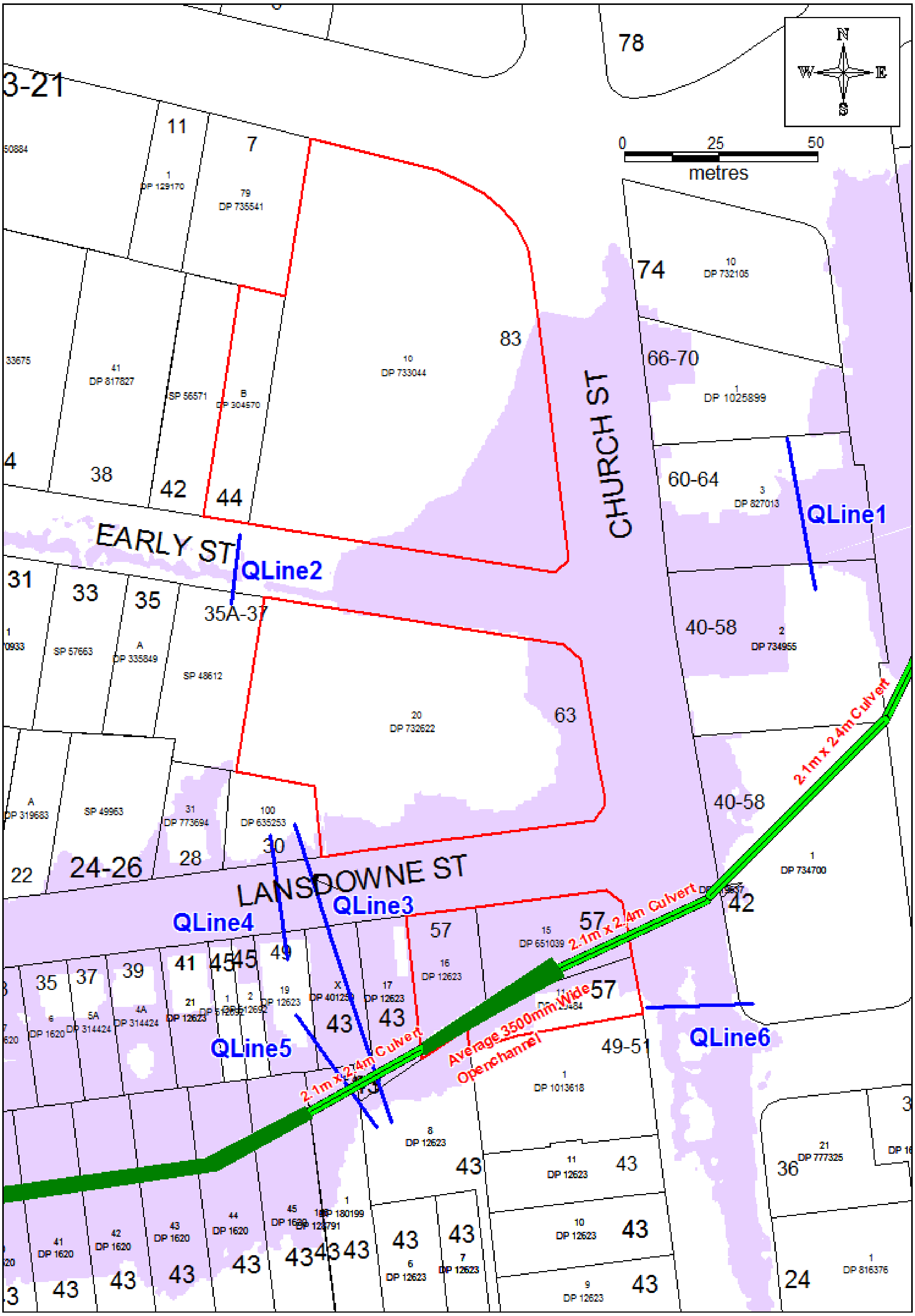


Figure 9 – Existing Scenario Flow History Line Reference Location 100y ARI

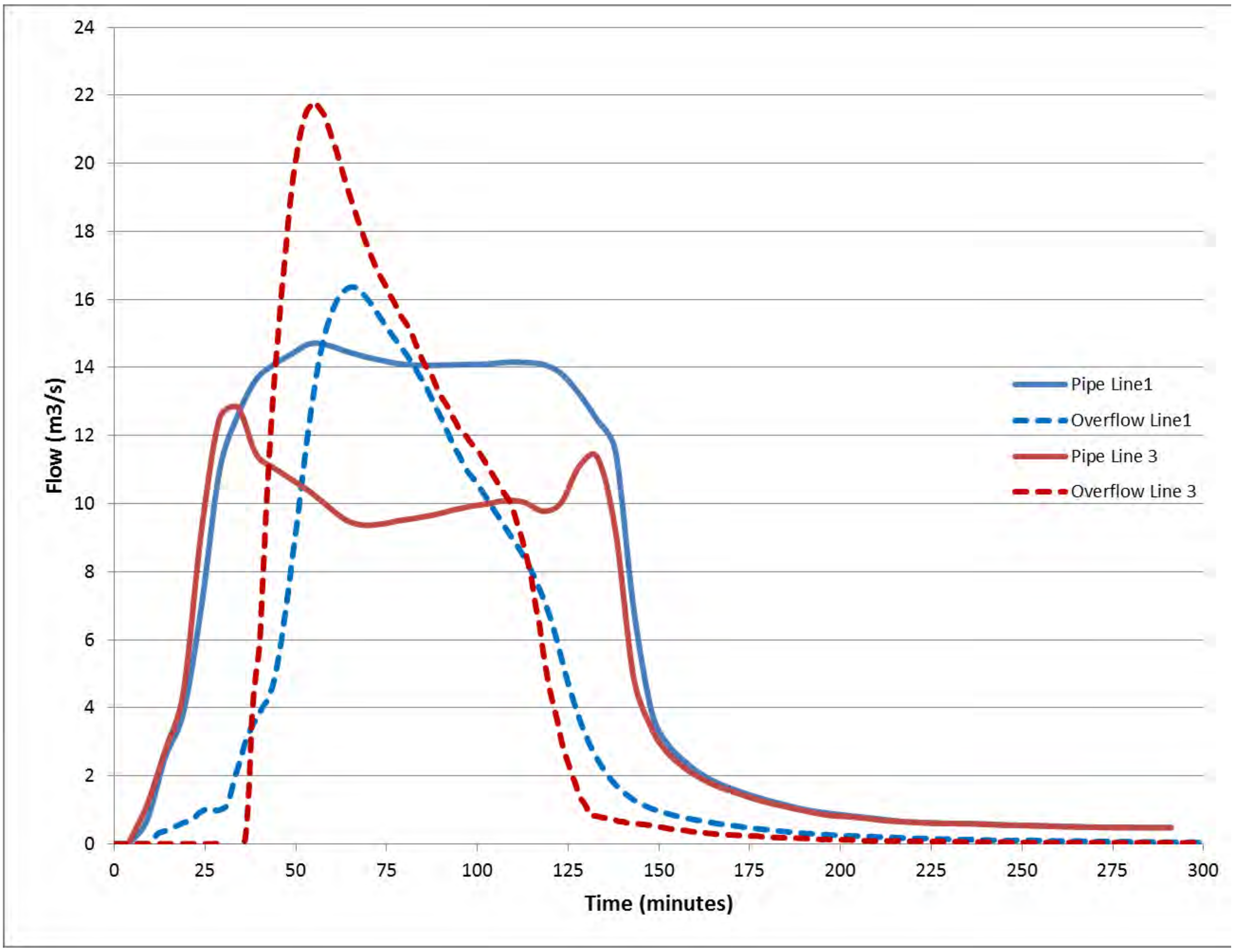


Figure 10 – Existing Scenario Flow Time Series Graphs 100y ARI

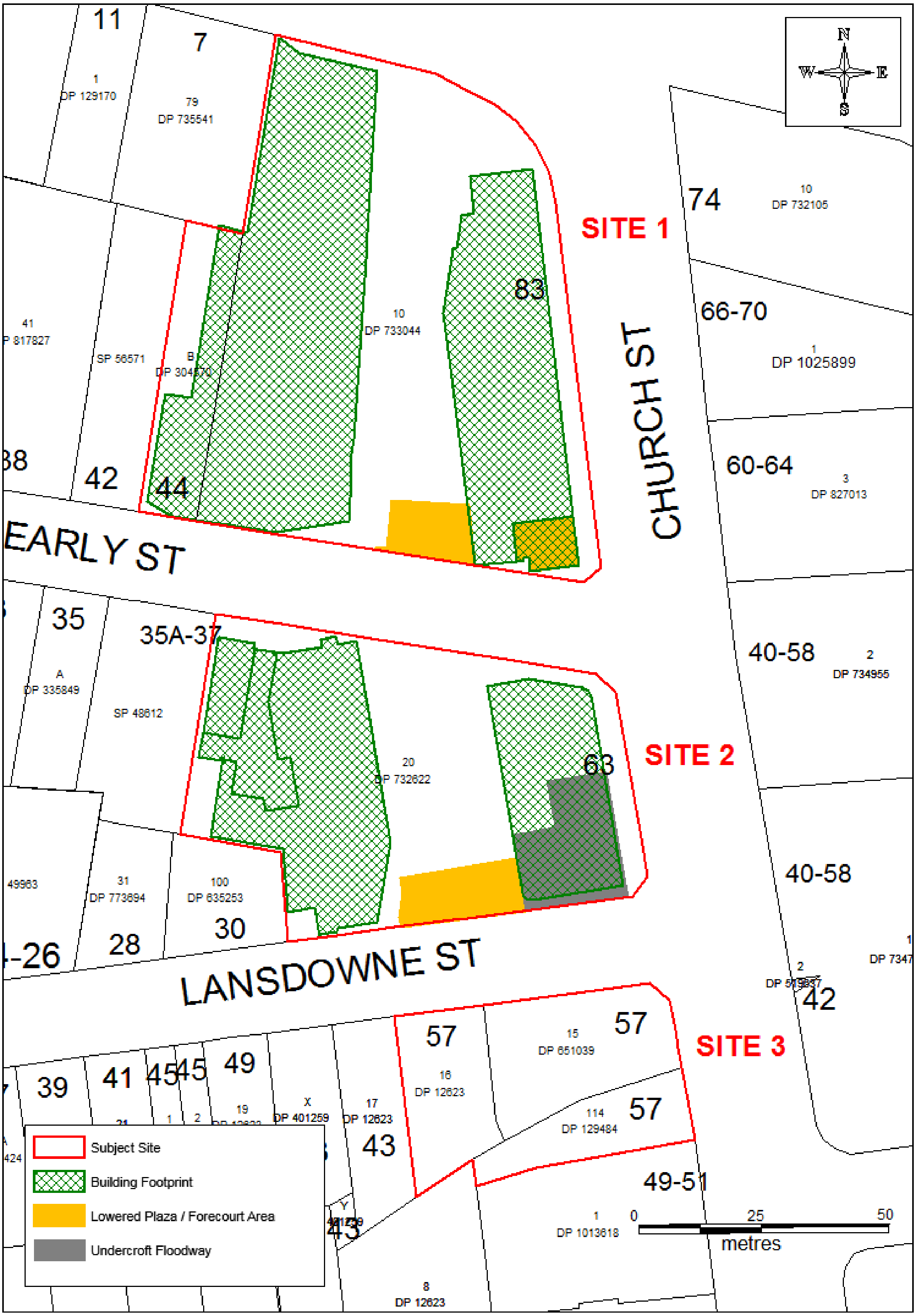


Figure 11 – Proposed Scenario Layout

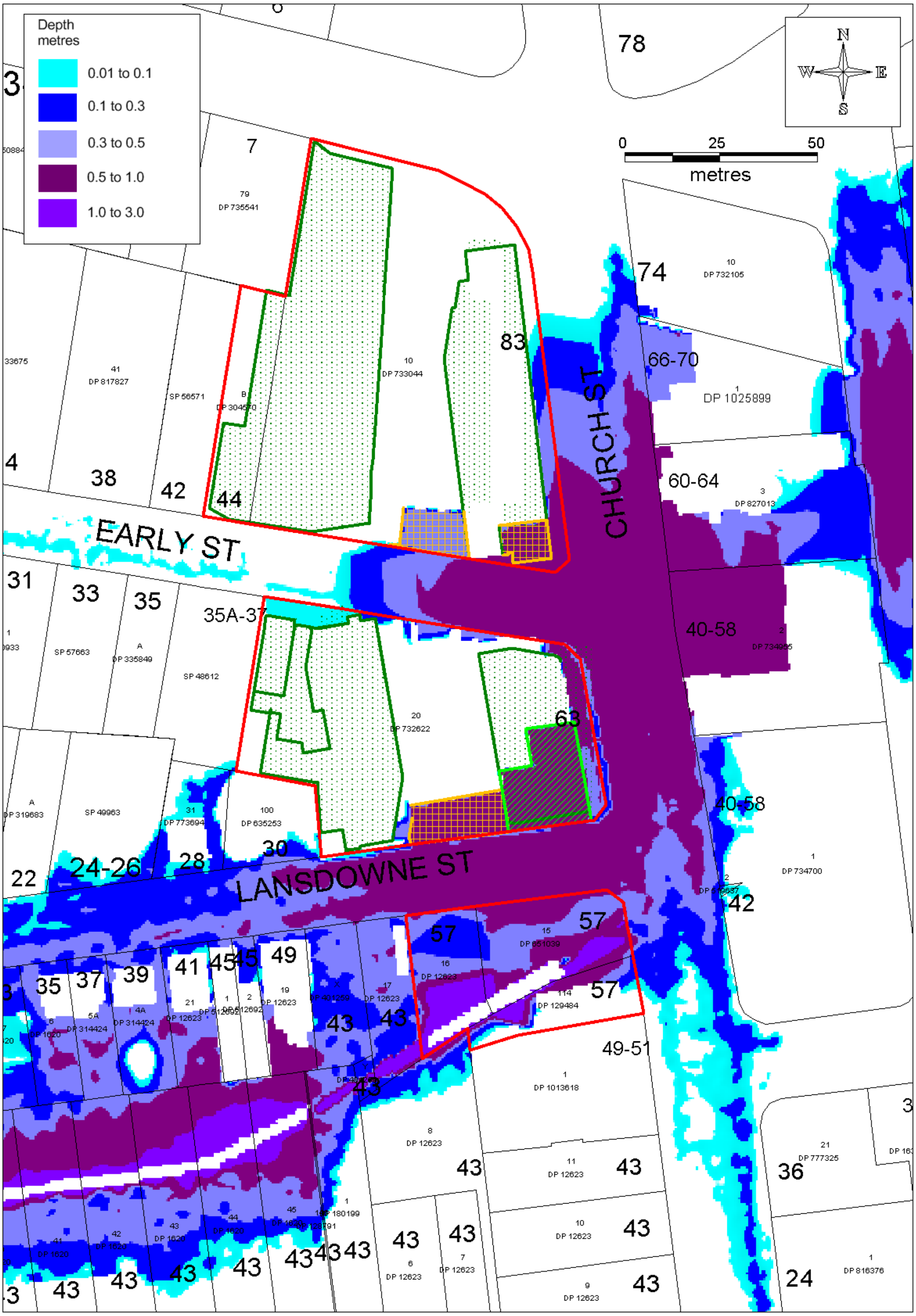


Figure 12 – Post-Development Scenario Peak Flood Depth 100y ARI

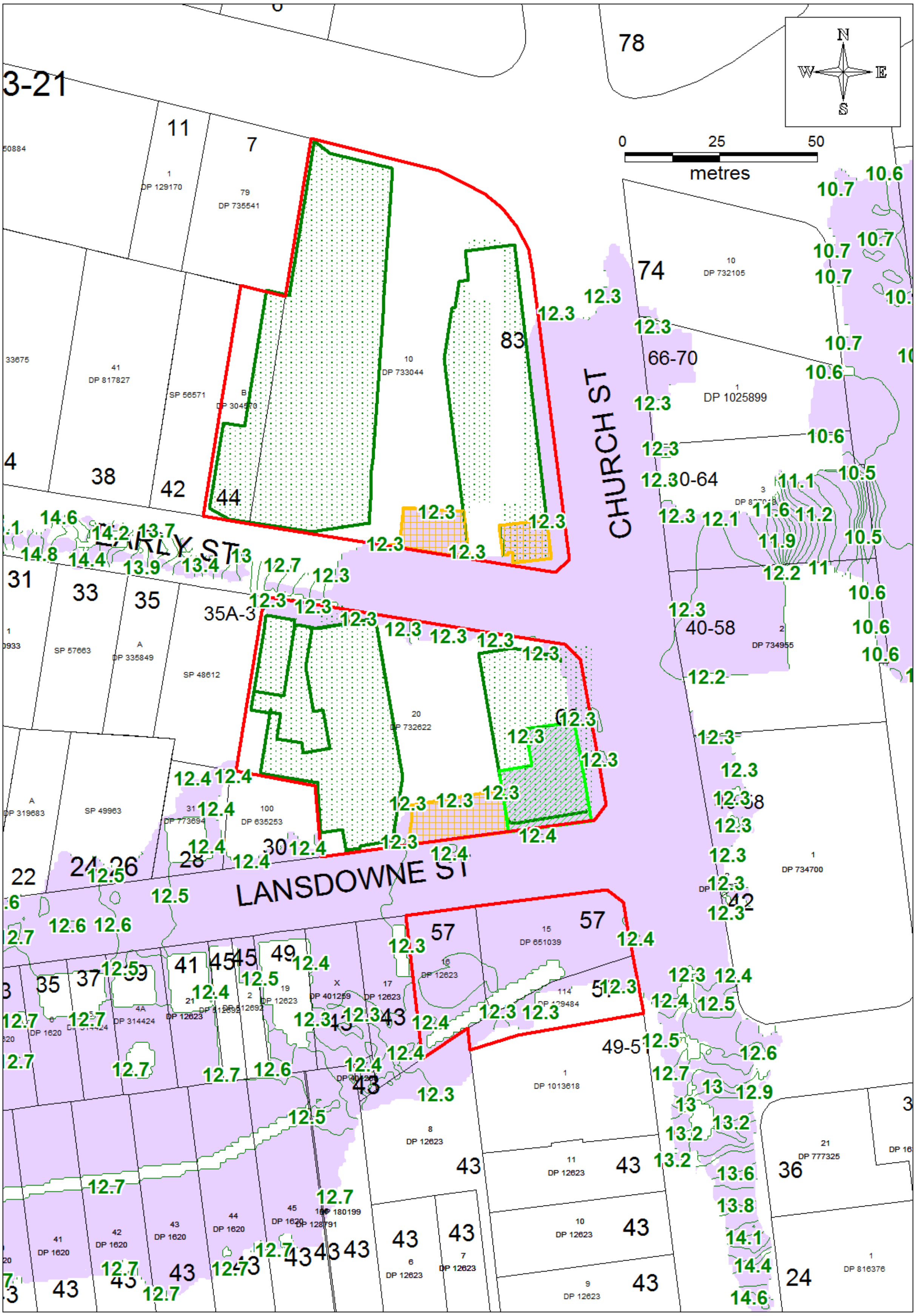


Figure 13 – Post-Development Scenario Peak Water Level 100y ARI

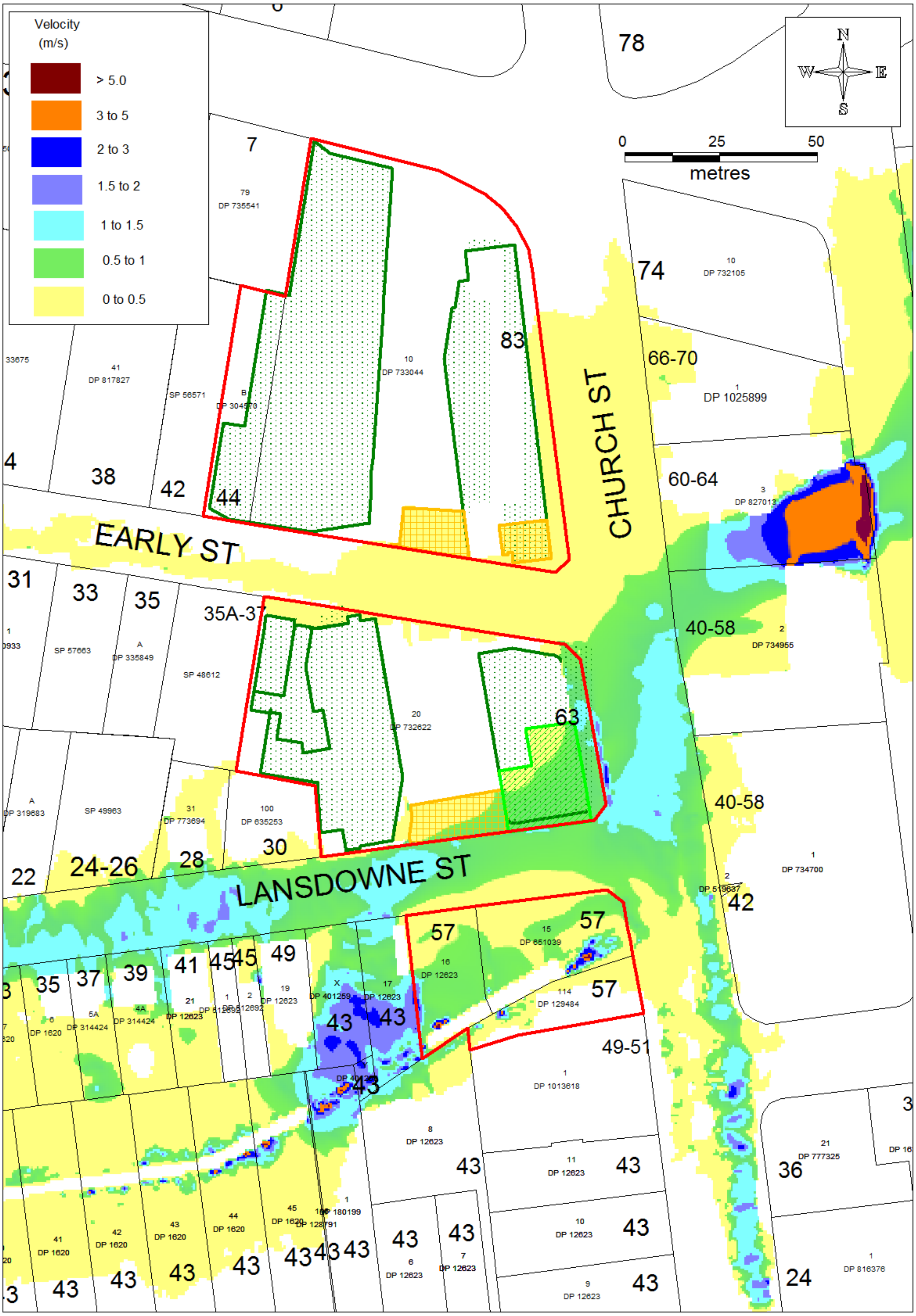


Figure 14 – Post-Development Scenario Peak Flood Velocity 100y ARI

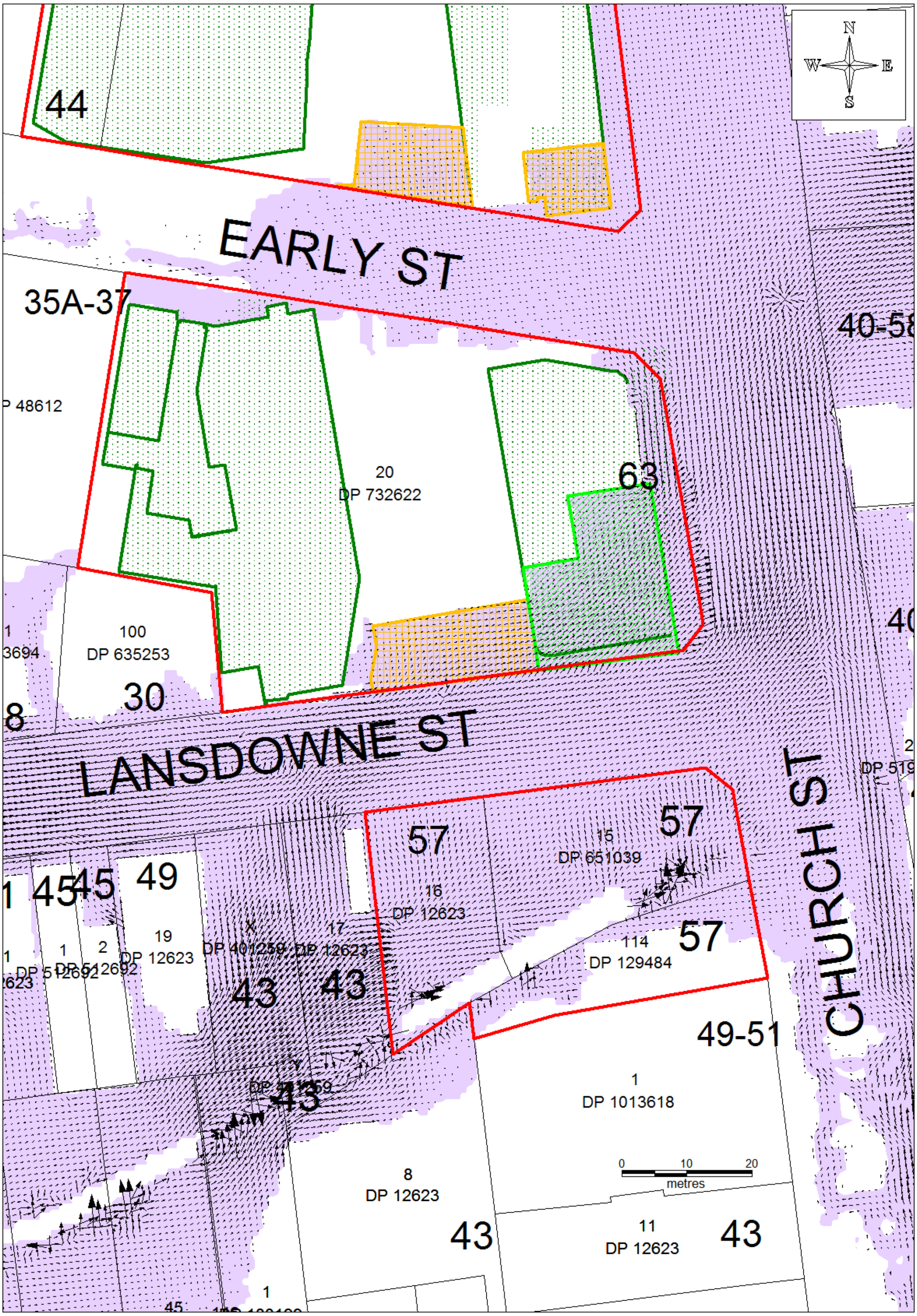


Figure 15 – Post-Development Scenario Peak Flood Velocity Arrows 100y ARI

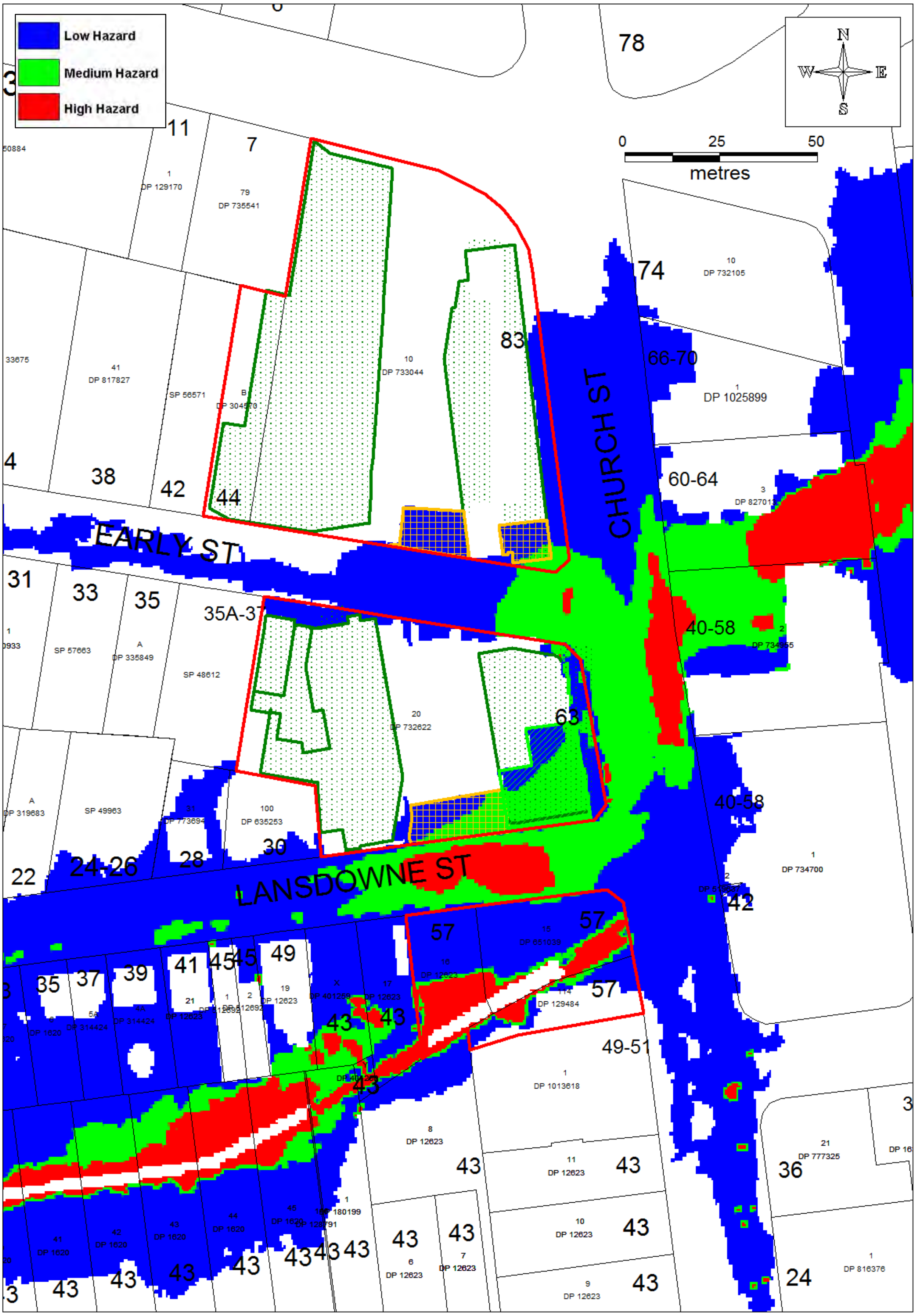


Figure 16 – Post-Development Scenario Provisional Hazard 100y ARI

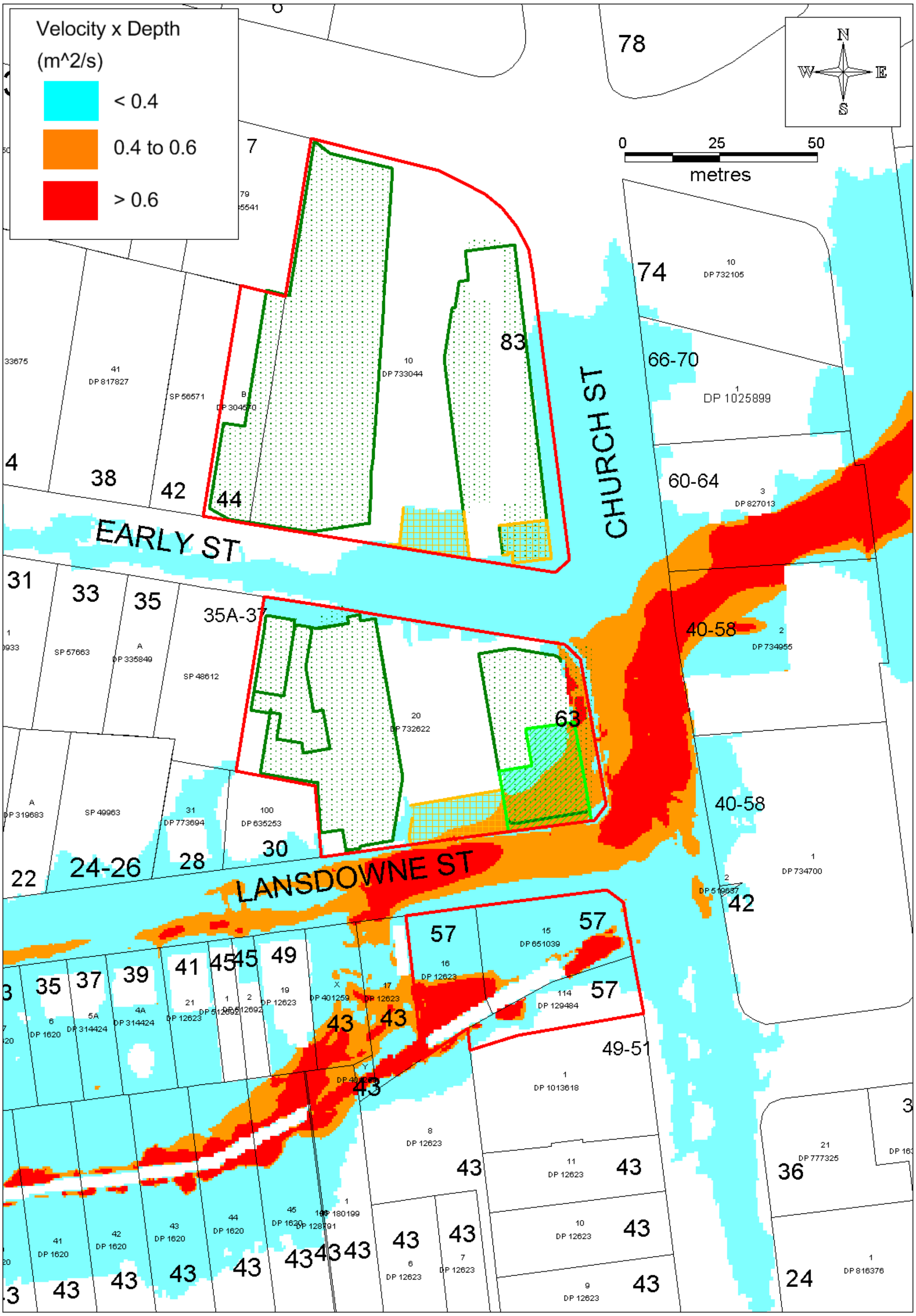


Figure 17 – Post-Development Scenario Velocity-Depth Product 100y ARI

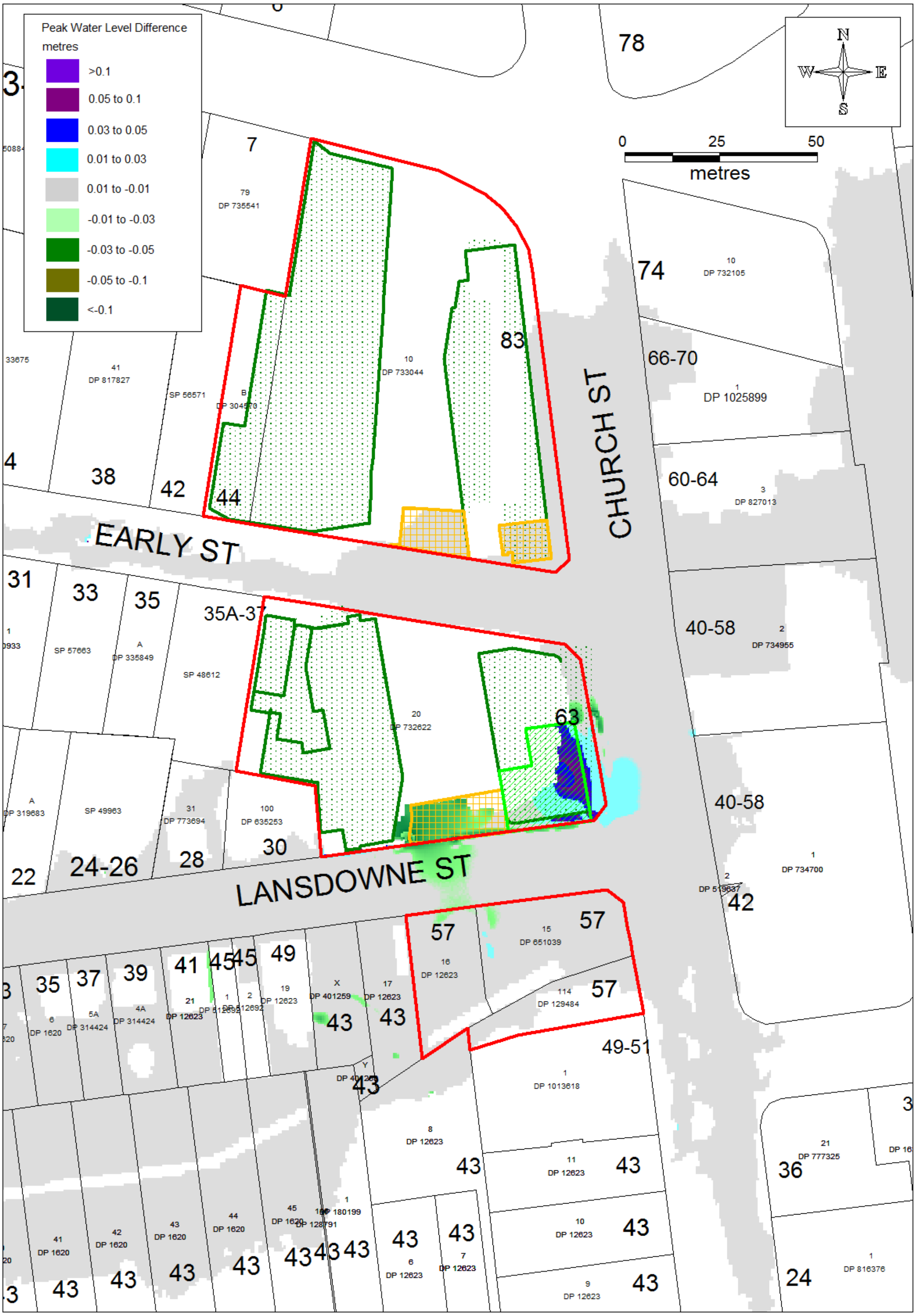


Figure 18 – Peak Water Level Difference 100y ARI - Post-Development Less Existing Scenario

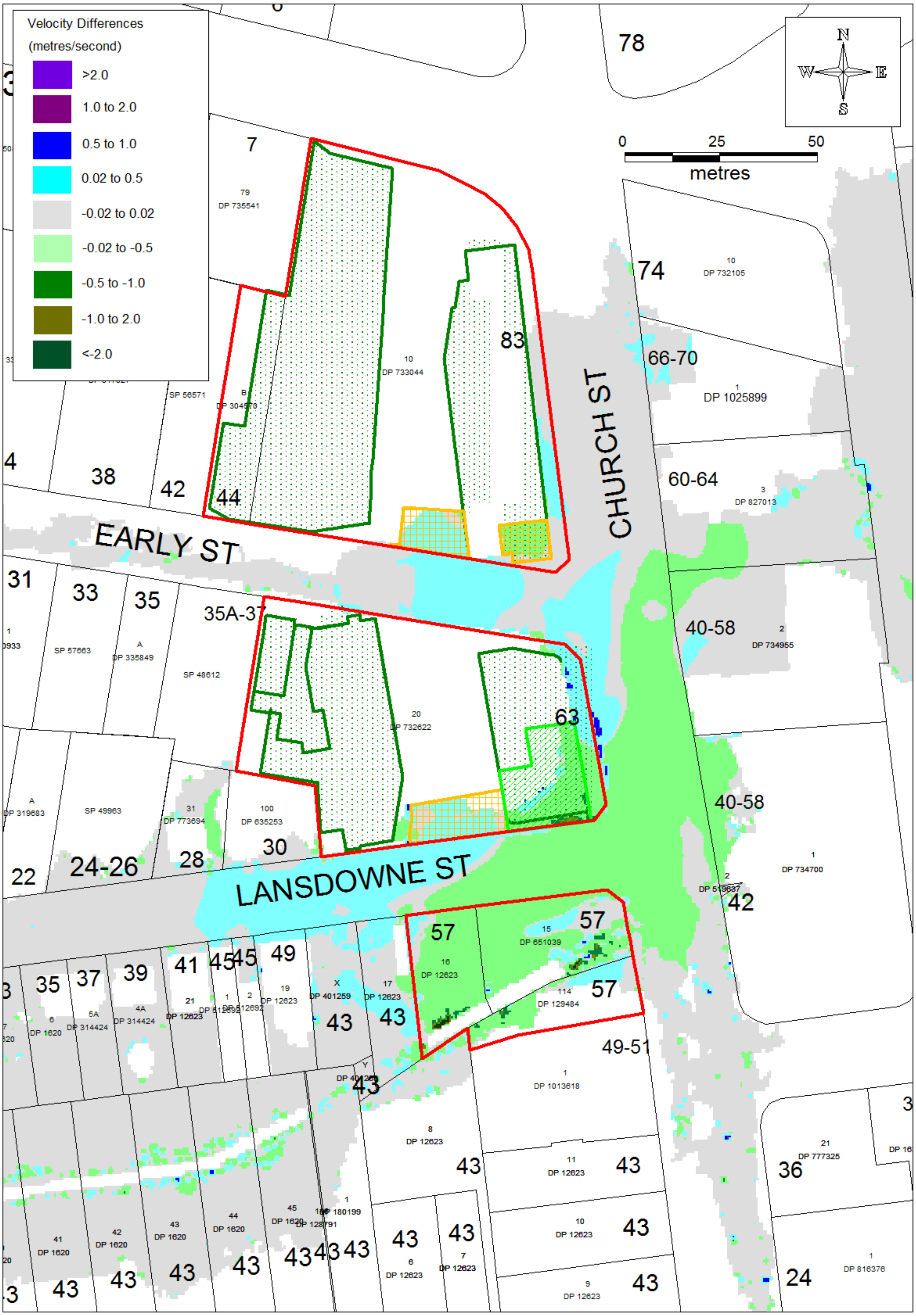


Figure 19 – Peak Flood Velocity Difference 100y ARI - Post-Development Less Existing Scenario

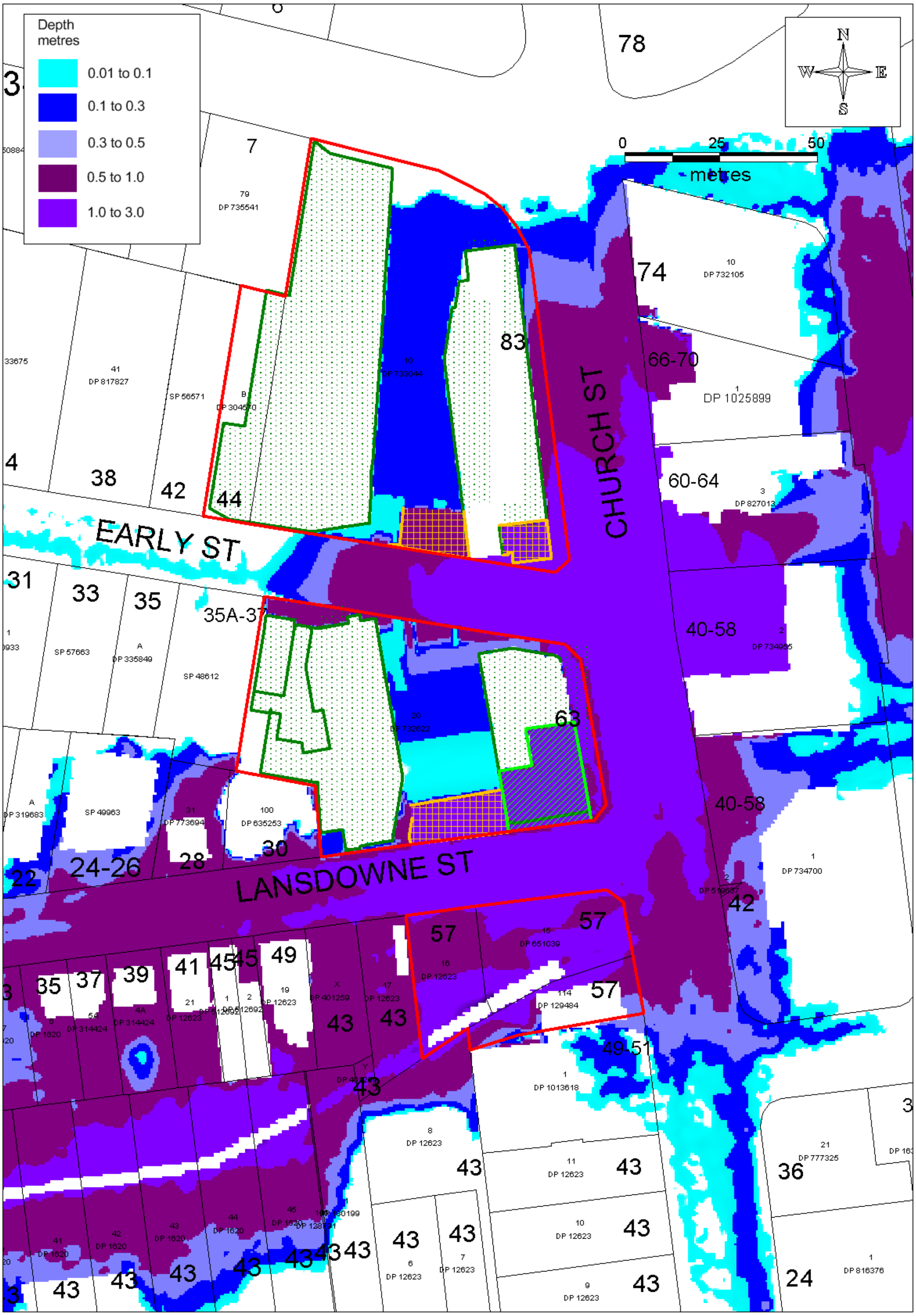


Figure 20 – Post-Development Scenario Peak Flood Depth PMF

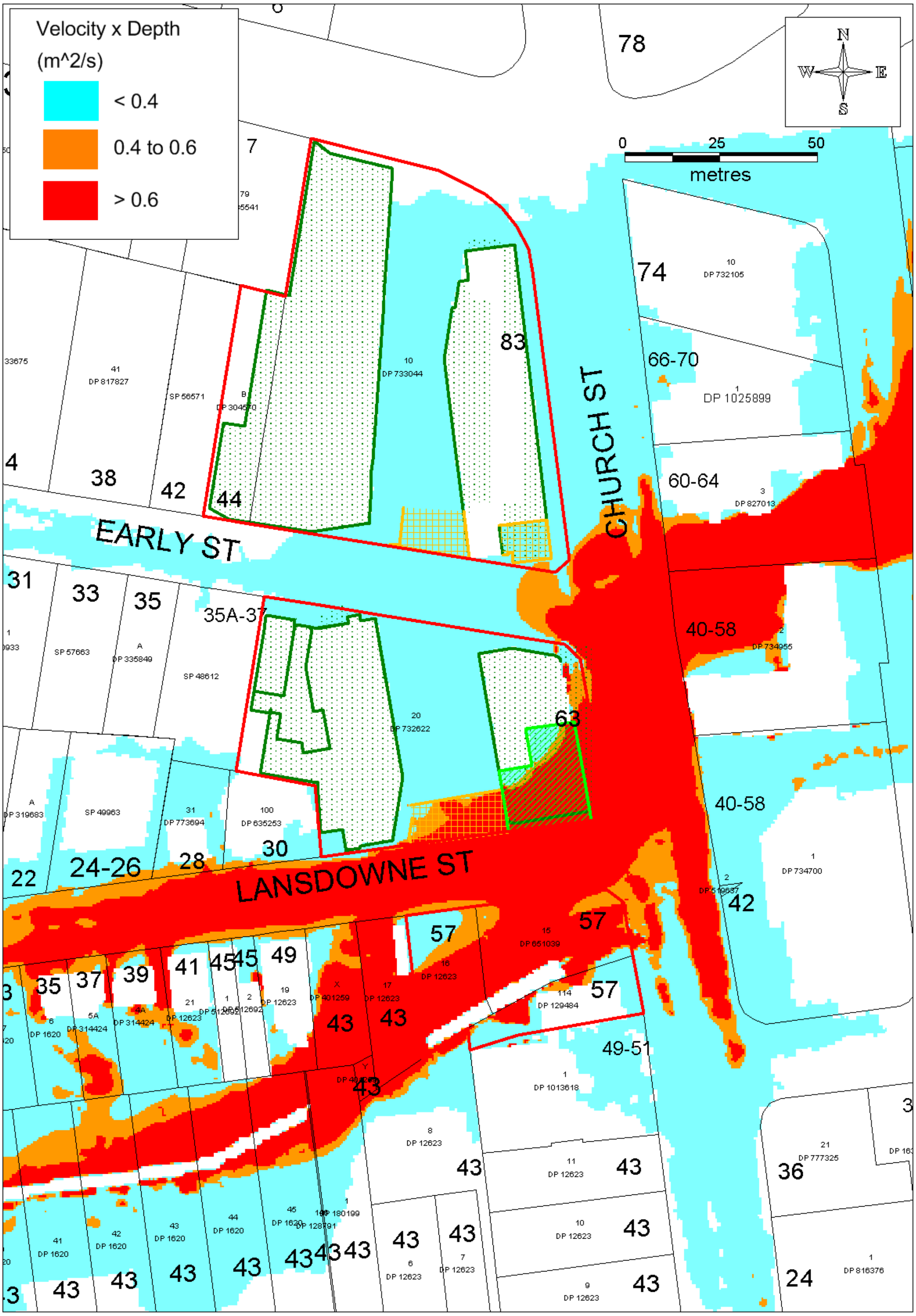
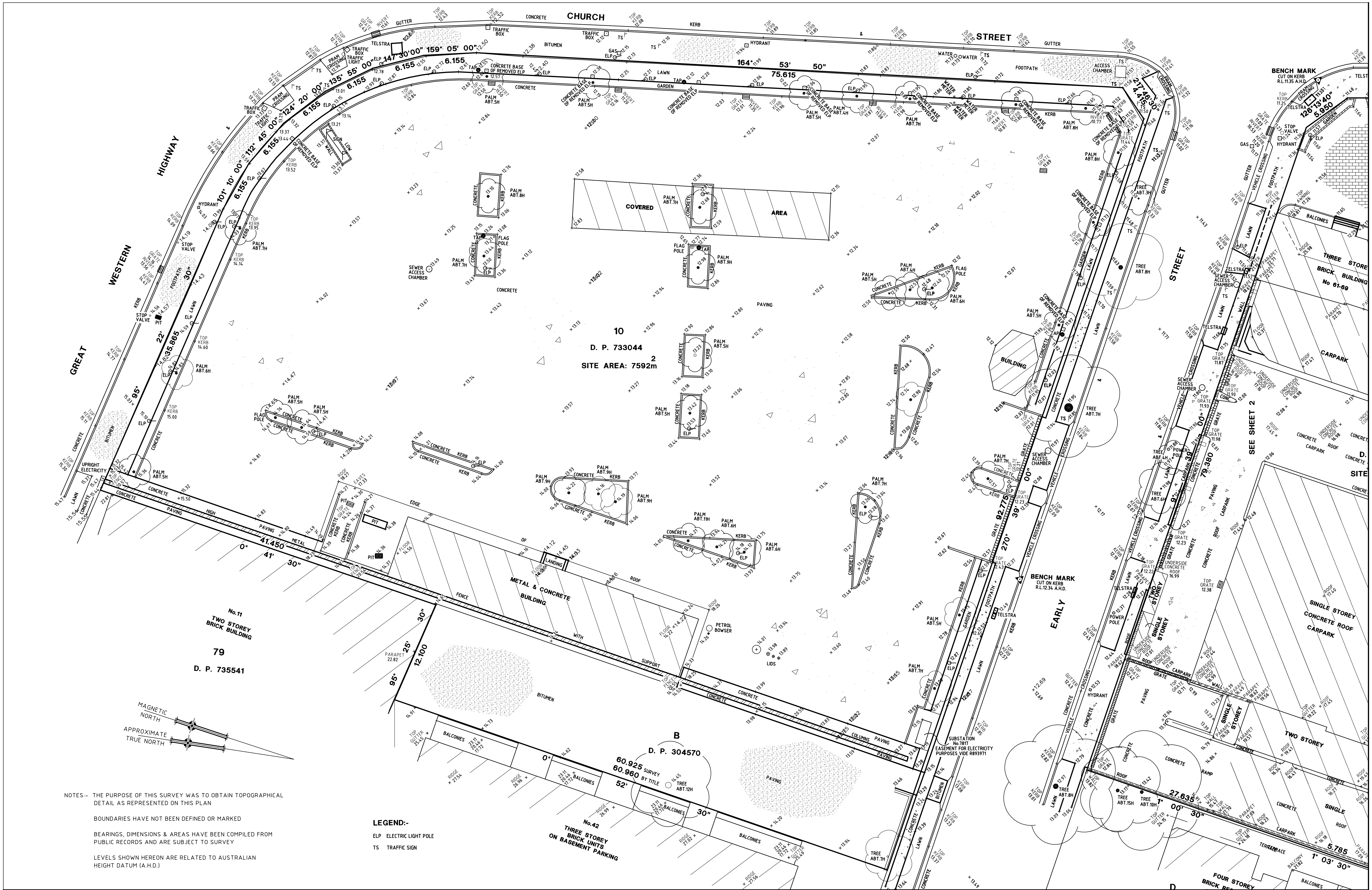


Figure 21 – Post-Development Scenario Velocity-Depth Product PMF

APPENDIX B
SITE SURVEY



NOTES:- THE PURPOSE OF THIS SURVEY WAS TO OBTAIN TOPOGRAPHICAL DETAIL AS REPRESENTED ON THIS PLAN

BOUNDARIES HAVE NOT BEEN DEFINED OR MARKED

BEARINGS, DIMENSIONS & AREAS HAVE BEEN COMPILED FROM PUBLIC RECORDS AND ARE SUBJECT TO SURVEY

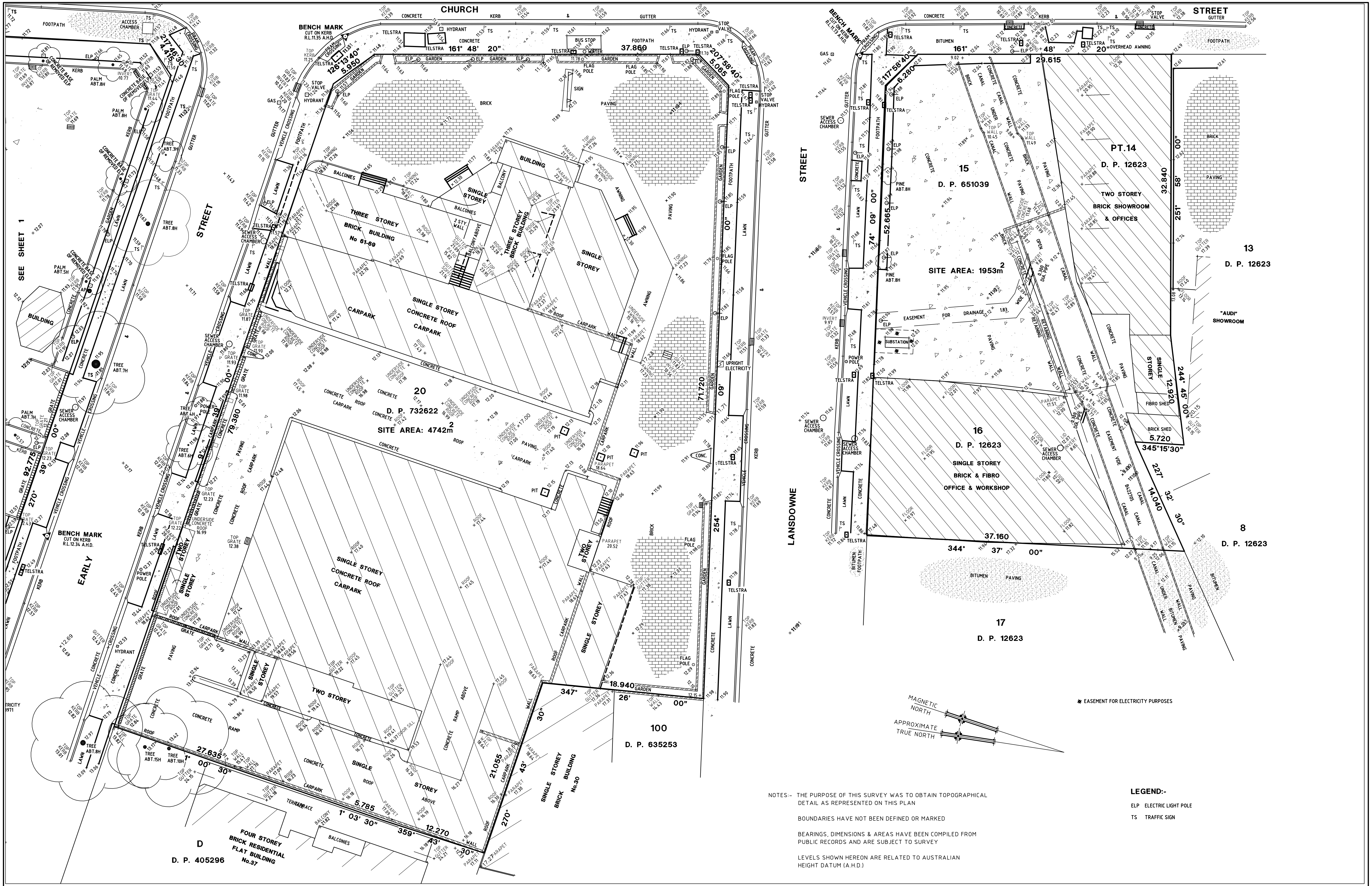
LEVELS SHOWN HEREON ARE RELATED TO AUSTRALIAN HEIGHT DATUM (A.H.D.)

LEGEND:-

ELP ELECTRIC LIGHT POLE

TS TRAFFIC SIGN

AMENDMENTS:	DRAWN: W.B.S	CLIENT: ROSSFIELD BOYDED GROUP	TITLE: PLAN OF LAND COMPRISED IN CERTIFICATES OF TITLE 14/12623, 16/12623, 15/651039, 20/732622, 10/733044 AND B/304570 AT PARRAMATTA L.G.A. PARRAMATTA	DUNLOP THORPE & CO. PTY. LTD.	REDUCTION RATIO 1:200	SIZE A1
	SURVEYED: R.O.			SURVEYORS ABN 74 003 512 150	LEVEL DATUM A.H.D.	
	DESIGNED:			447 KENT STREET SYDNEY 2000 PHONE (02) 9283 6677 FAX (02) 9283 6633	DATE 19-12-2007	
				DX 988 SYDNEY Email : dunthor@ozemail.com.au	SHEET 1 OF 2 SHEETS	
					REFERENCE No. 16434	



NOTES:- THE PURPOSE OF THIS SURVEY WAS TO OBTAIN TOPOGRAPHICAL DETAIL AS REPRESENTED ON THIS PLAN

BOUNDARIES HAVE NOT BEEN DEFINED OR MARKED

BEARINGS, DIMENSIONS & AREAS HAVE BEEN COMPILED FROM PUBLIC RECORDS AND ARE SUBJECT TO SURVEY

LEVELS SHOWN HEREON ARE RELATED TO AUSTRALIAN HEIGHT DATUM (A.H.D.)

LEGEND:-

ELP ELECTRIC LIGHT POLE

TS TRAFFIC SIGN

AMENDMENTS:	
DRAWN:	W.B.S
SURVEYED:	R.O.
DESIGNED:	
CLIENT:	ROSSFIELD BOYDED GROUP

TITLE:

PLAN
OF LAND COMPRISED IN CERTIFICATES OF TITLE 14/12623, 16/12623, 15/651039, 20/732622, 10/733044 AND B/304570
AT PARRAMATTA
L.G.A. PARRAMATTA

DUNLOP THORPE & CO. PTY. LTD.
SURVEYORS
447 KENT STREET
SYDNEY 2000
DX 988 SYDNEY
ABN 74 003 512 150
PHONE (02) 9283 6677
FAX (02) 9283 6633
Email : dunthor@ozemail.com.au

REDUCTION RATIO	1:200
SIZE	A1
LEVEL DATUM	A.H.D.
DATE	19-12-2007
SHEET 2 OF 2 SHEETS	
REFERENCE No. 16434	

APPENDIX C
COUNCIL FLOOD ADVICE

Parramatta City Council
Main Office: 30 Darcy Street, Parramatta, NSW, 2150
Postal Address: PO Box 32, Parramatta, NSW, 2124
Council Customer Service Telephone No: 9806 5050
Council Fax No: 9806 5917
Catchment Management Section: Ground Floor, 1A Civic Place, Parramatta
Email Address: council@parracity.nsw.gov.au

RECEIVED IN RECORDS 16 AUG 2011

Flood Enquiry Application

Applicant to fill in

Property Details

Address	House No.: 57, 63, 83	*This form applies for up to three adjoining sites. A separate Flood Enquiry form and fee will be required for more than 3 or separate lots.*
	Street: Church Street	
	Suburb: Parramatta	Postcode:
	Are you the owner of this property? ☐ Yes ☒ No	

Applicant Details

Name	Family Name (or Company Name): AECOM	
	Given Name:	
	OR Company Contact Person: Greg Burgon	
Contact Details	Suburb:	Postcode:
	Home Phone:	Office Phone:
	Mobile:	Fax:
	Email: greg.burgon@aecom.com	Date: 12·8·11

How would you like this information to be provided to you? ***(Please tick)***

☐ Collection ☐ Posted ☒ Emailed ☐ Faxed

Reason for Enquiry ***(Please tick)***

☒ Proposed Re-development of Property	☐ Alterations and Additions to existing Dwelling
☐ Purchase of Property	☐ Property Valuation
☐ Flood drainage investigation	☐ Subdivision
☐ Change of Use within an Existing Development	☐ Owner Enquiry
☐ Other (please specify):	

Property Type ***(Please tick)***

Residential (Single residential dwelling and / or granny flat)	☐ $171.30
Development Duplex (Includes other residential such as dual occupancies, multi-unit housing and residential flat building)	☐ $234.10
Commercial (Including industrial and mixed use)	☒ $411.10

Disclaimer: Flood levels and flood extent lines are based on current information held by Council. Council does not accept responsibility for the accuracy of this information. Any pipe sizes and location of pits and pipe lines should be confirmed by site investigation.
The flood levels shown on the back of this form are only an approximate guide and have been derived using the current computer simulated model.
The information provided in this document is presented in good faith to assist the public in understanding Council's drainage requirements that apply within the Parramatta Local Government Area. It is the responsibility of each individual using this information to undertake their own checks and confirm this information prior to its use.
Parramatta City Council, its agents and employees are not liable (whether by reason of negligence, lack of care or otherwise) to any person for any damage or loss whatsoever which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement, or advice referred to above.

Customer Acknowledgement
I hereby acknowledge that I have read and understood the above Disclaimer:

Signature	[signature]	**Date**	12·8·11

Office Use Only – RC 682

Amount	Receipt No.	Date	Accepted by:
$ 411.10	3429736	15/8/11	Hasna

Refer to back of this form for level information issued:

SCANNED 16 AUG 2011 PCC

Flood Enquiry Information Issued *(To be completed by Council Officer)*

Mainsteam Flooding

Is the property affected by mainstream flooding?	☑ Yes
	☐ No

Flood Levels	Closest Cross sections: (*Please refer to Flood Study*): Refer to table on flood map.	
☑ 1:20 Year ARI	m AHD	**Comments:** Council is currently updating the Lower Parramatta River catchment Study. Flood levels in this area may change.
☑ 1:100 Year ARI	m AHD	
☑ PMF	m AHD	
☑ Refer to flood maps provided for detailed flood levels.		

The above flood level information is obtained from the following flood study report:

Lower Parramatta River Floodplain Risk Management Study, Flood study Review, Final, March 2005 (SKM).

Note: Flood inundation can be verified by detail survey to AHD undertaken by a Registered Surveyor.

Local Flooding *(Please tick)*

Is the property located within a Hatched Grey Area? *Properties located within a **Hatched Grey Area** are subjected to flooding from the local catchment.*	☐ Yes ☑ No
Is the property located within a Grey Area? *Properties located within a **Grey Area** are subjected to additional site drainage controls to manage flooding in the local catchment.*	☐ Yes ☑ No
Is the property affected by overland stormwater run-off from the local catchment?	☑ Yes ☐ No

Note: *You are required to contact Council's Development Service Engineer for any details and requirements relating to development that is affected by local flooding.*

Additional Recommended Actions *(Please tick)*

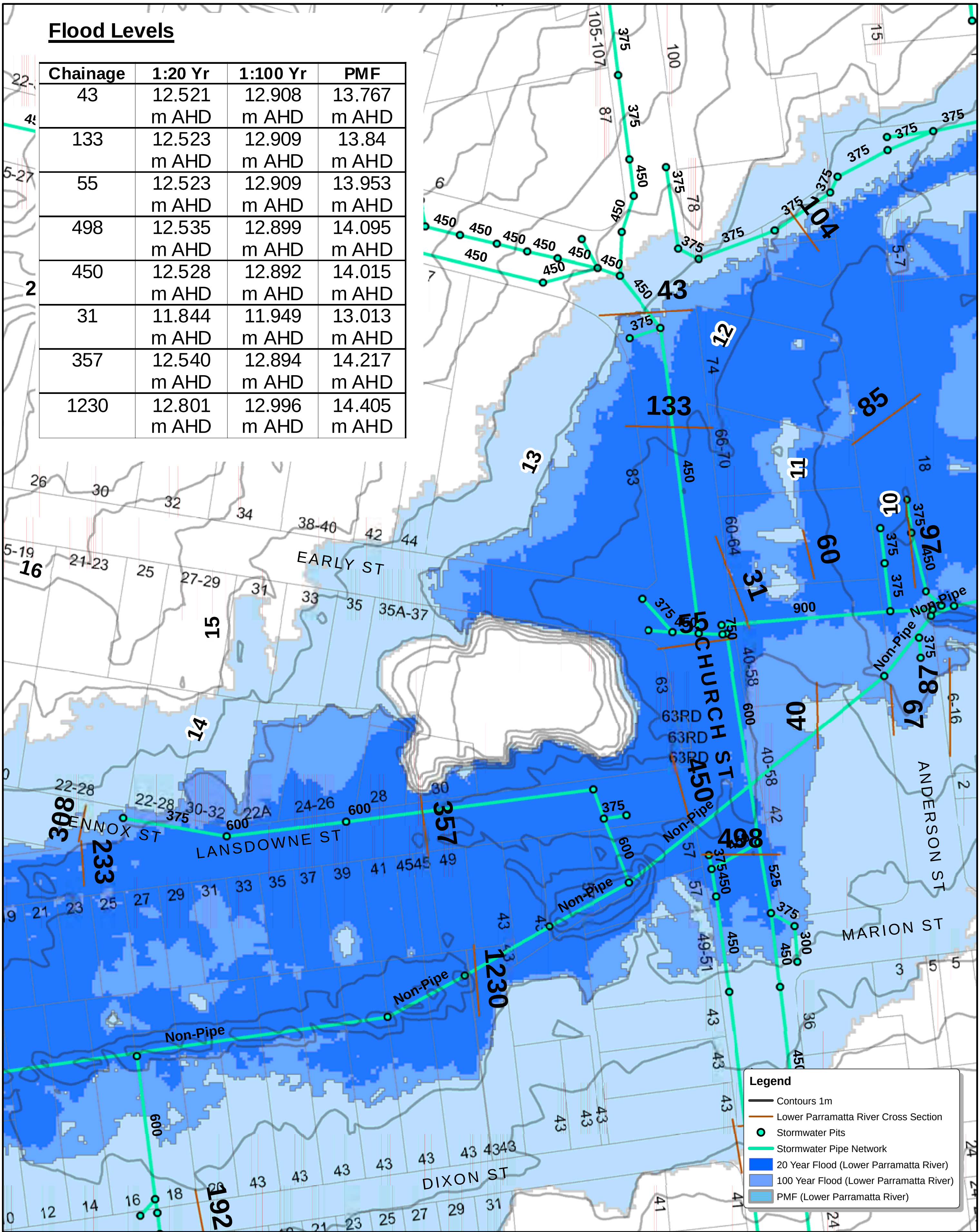
☑	The Applicant needs to discuss the proposal to re-develop this site with Council's Town Planner and Development Services Engineer.
☑	The Applicant needs to contact Council's Town Planner and organise a prelodgement meeting to discuss any proposal to redevelop this property.
☑	The applicant needs to refer to Council's Local Floodplain Risk Management policy for details relating to developing a land affected by flooding.

Definitions: (As per NSW Floodplain Development Manual dated April 2005)

1. **AHD** – a common national surface level datum approximately corresponding to mean sea level.
2. **ARI** – the long term average number of years between the occurrences of a flood as big as or larger than, the selected event.
3. **PMF** – is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation.
4. **AEP** – Annual Exceedance Probability is the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage.

Flood Levels

Chainage	1:20 Yr	1:100 Yr	PMF
43	12.521 m AHD	12.908 m AHD	13.767 m AHD
133	12.523 m AHD	12.909 m AHD	13.84 m AHD
55	12.523 m AHD	12.909 m AHD	13.953 m AHD
498	12.535 m AHD	12.899 m AHD	14.095 m AHD
450	12.528 m AHD	12.892 m AHD	14.015 m AHD
31	11.844 m AHD	11.949 m AHD	13.013 m AHD
357	12.540 m AHD	12.894 m AHD	14.217 m AHD
1230	12.801 m AHD	12.996 m AHD	14.405 m AHD

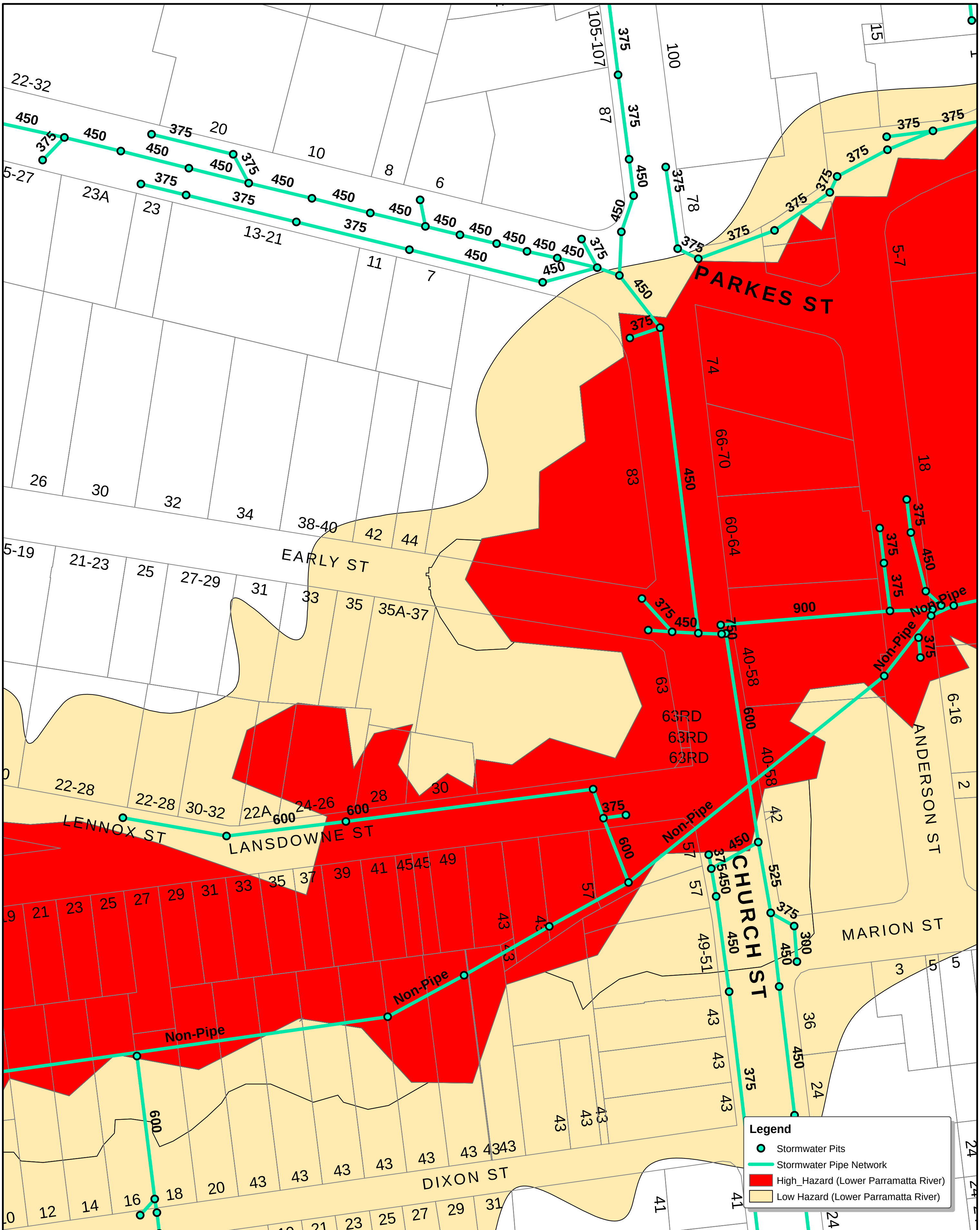


Parramatta City Council Flood Map

1:1,750

N

Printed 18/08/2011



PARRAMATTA CITY COUNCIL

Parramatta City Council Flood Map

1:1,750

N

Printed 18/08/2011

DISCLAIMER: Flood levels and flood extent lines are based on current information held by Council. Council does not accept responsibility for the accuracy of this Information. Any pipe sizes and location of pits and pipe lines should be confirmed by site investigation.

The flood levels provided are only an approximate guide and have been derived using the current computer simulated model.

The information provided on this document is presented in good faith. It is the responsibility of each individual using this information to undertake their own checks and confirm this information prior to its use.

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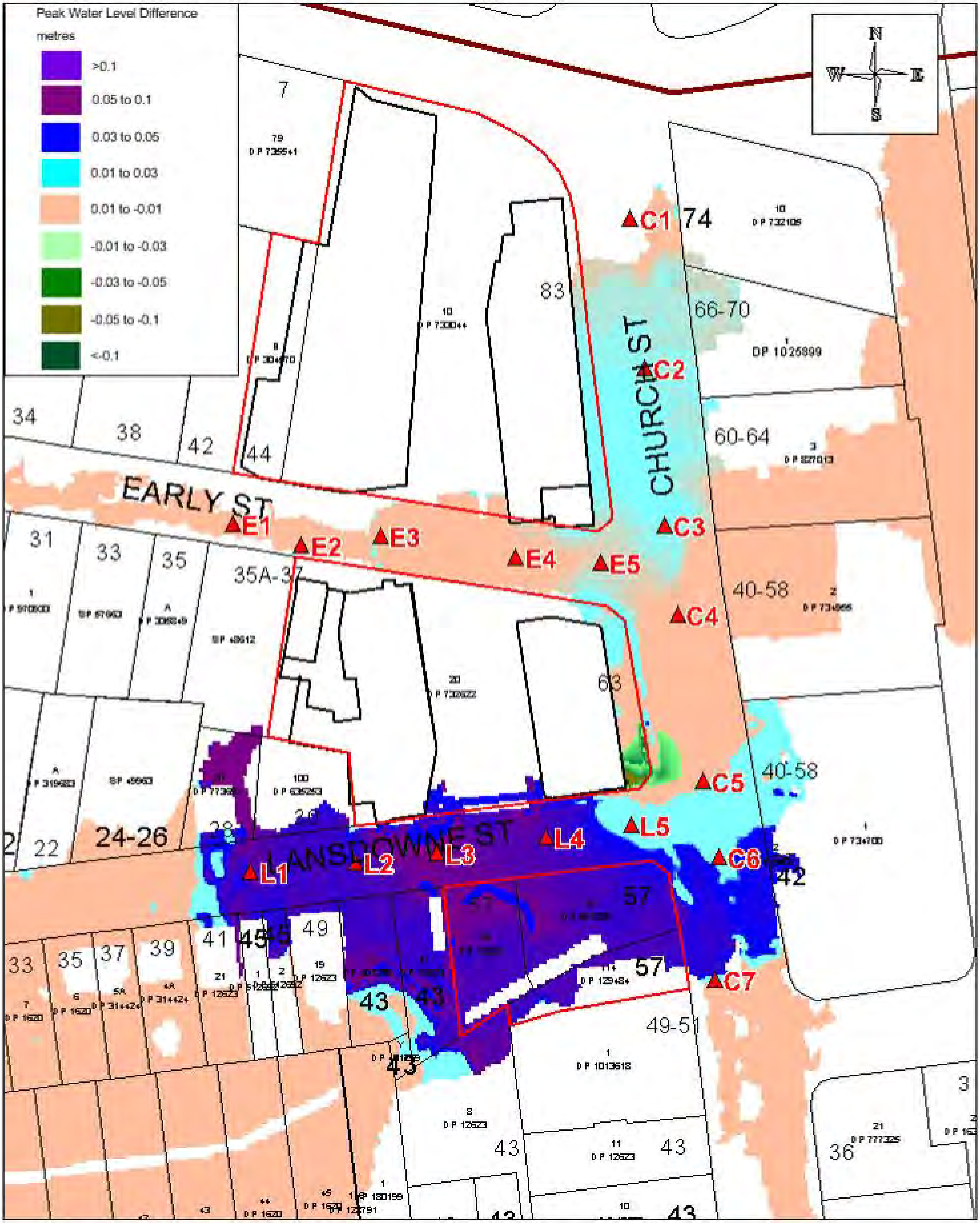
Appendix B

Preliminary Flood Model Results for Design Refinement Options



Legend

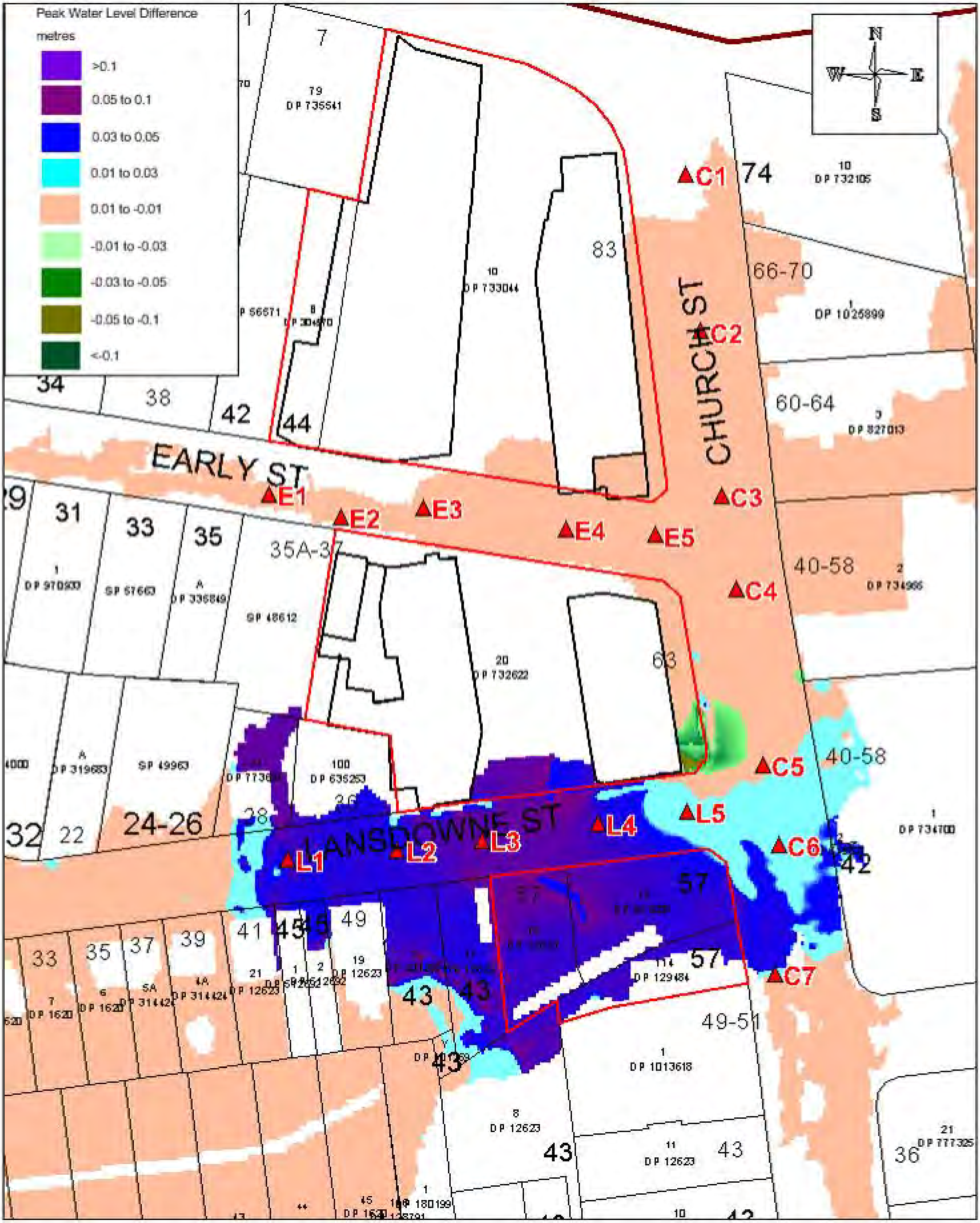
Site Boundary

Proposed Building Outlines

Reference Level

Figure B1

Figure - 100y Water Level Difference
Scenario A - 0% Blockage
Preliminary 25 May 2015



Legend

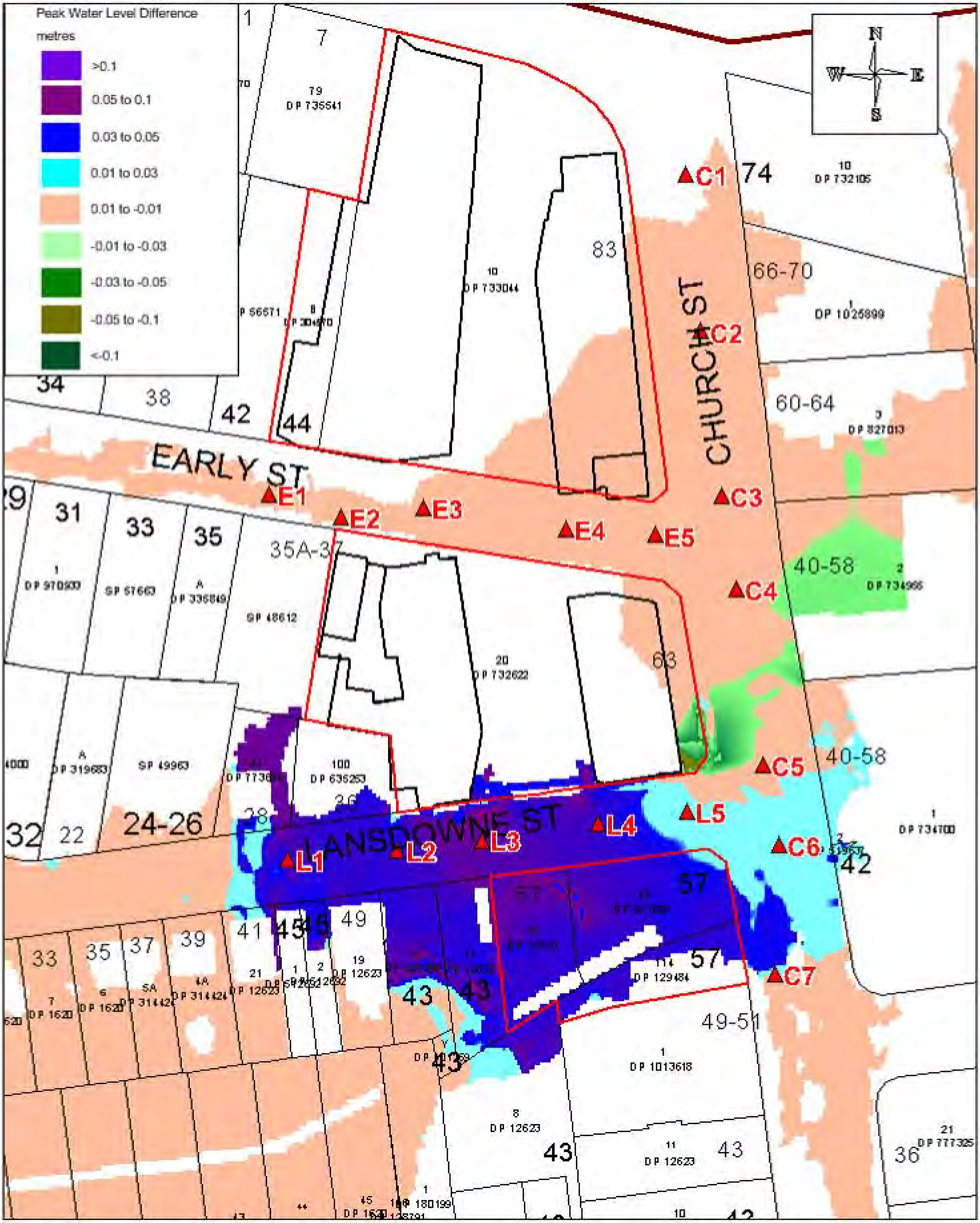
Site Boundary

Proposed Building Outlines

Reference Level

Figure B2

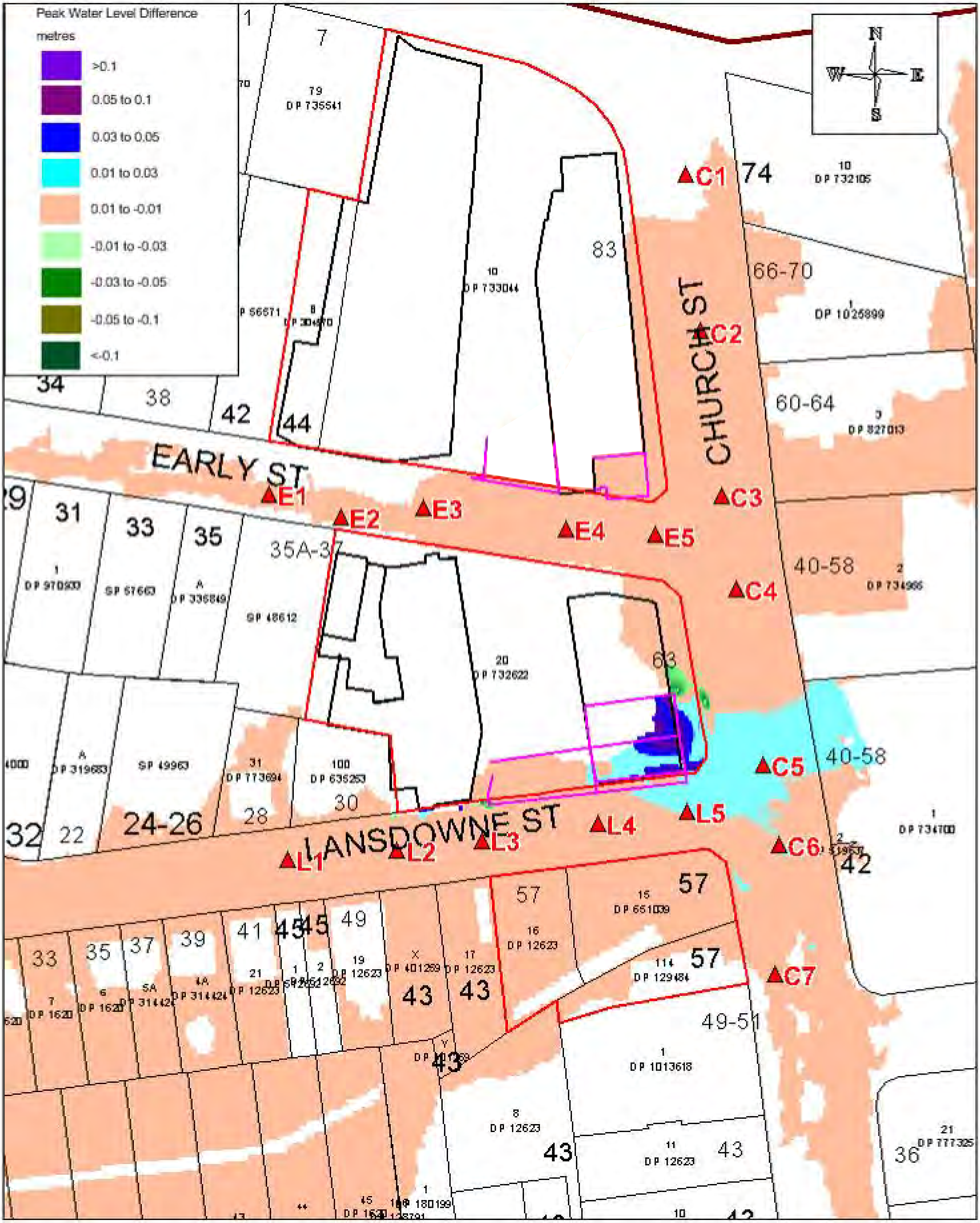
Figure - 100y Water Level Difference
Scenario B - 0% Blockage
Preliminary 25 May 2015



Legend
Site Boundary
Proposed Building Outlines
Reference Level

Figure B3

Figure - 100y Water Level Difference
Scenario C - 0% Blockage
Preliminary 25 May 2015



Legend
Site Boundary
Proposed Building Outlines
Reference Level

Figure B4

Figure - 100y Water Level Difference
Scenario D - 0% Blockage
Preliminary 29 May 2015

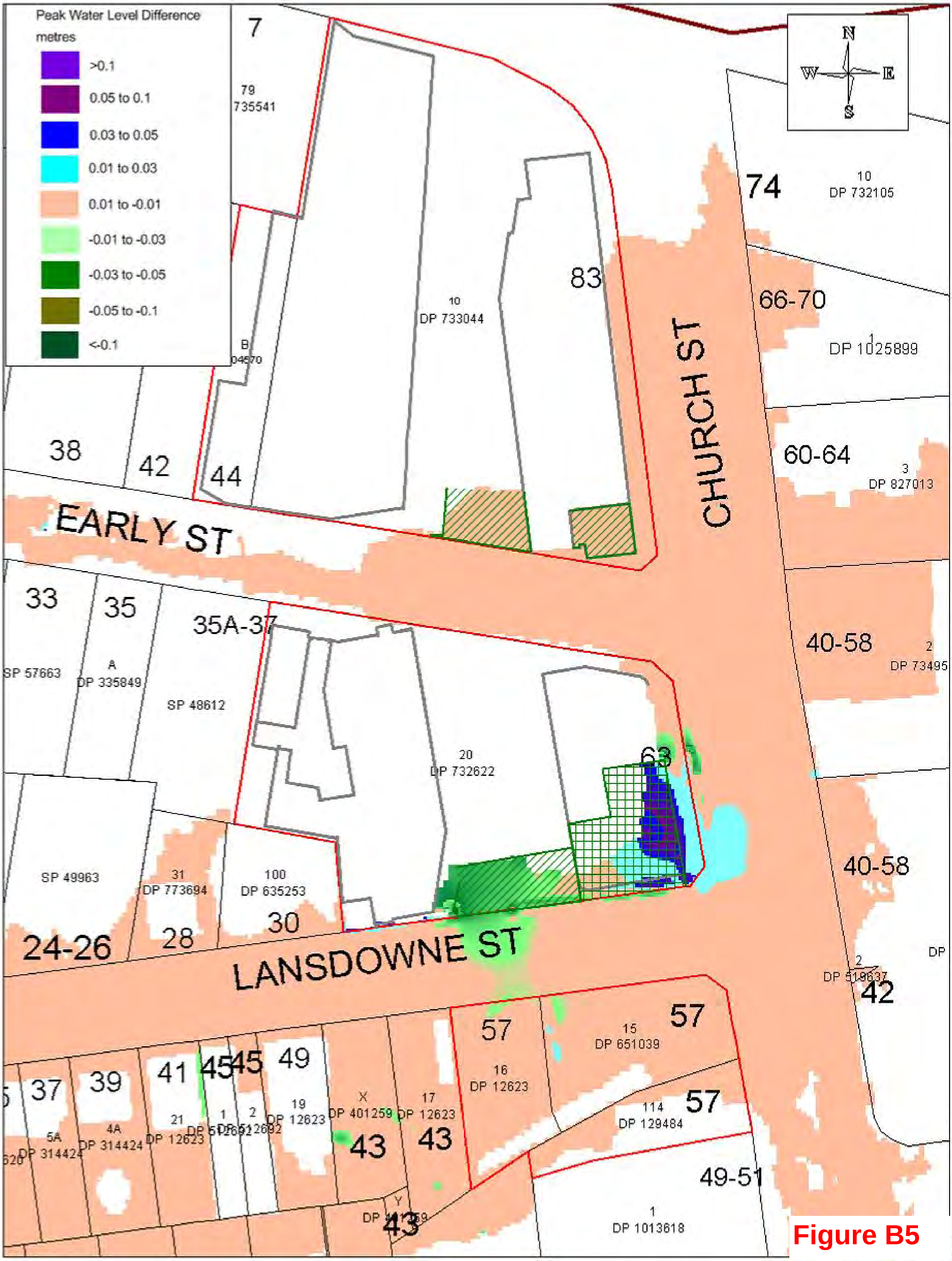


Figure B5

Figure - 100y Water Level Difference
Scenario E - 0% Blockage
Preliminary 18 June 2015

Appendix C

Drawings Showing Details of Proposed Underfloor Floodway for Building L on Site 2

Floodway beneath showroom - extent shown dotted

Floodway beneath showroom - extent shown dotted

NOTES

DLCS Quality Endorsed Company ISO 9001:2008, Registration Number 20476
Nominated Architect: Nicholas Turner 6695, ABN 86 064 084 911

CLIENT
Boyded Industries
℅ Caverstock Group Pty Ltd

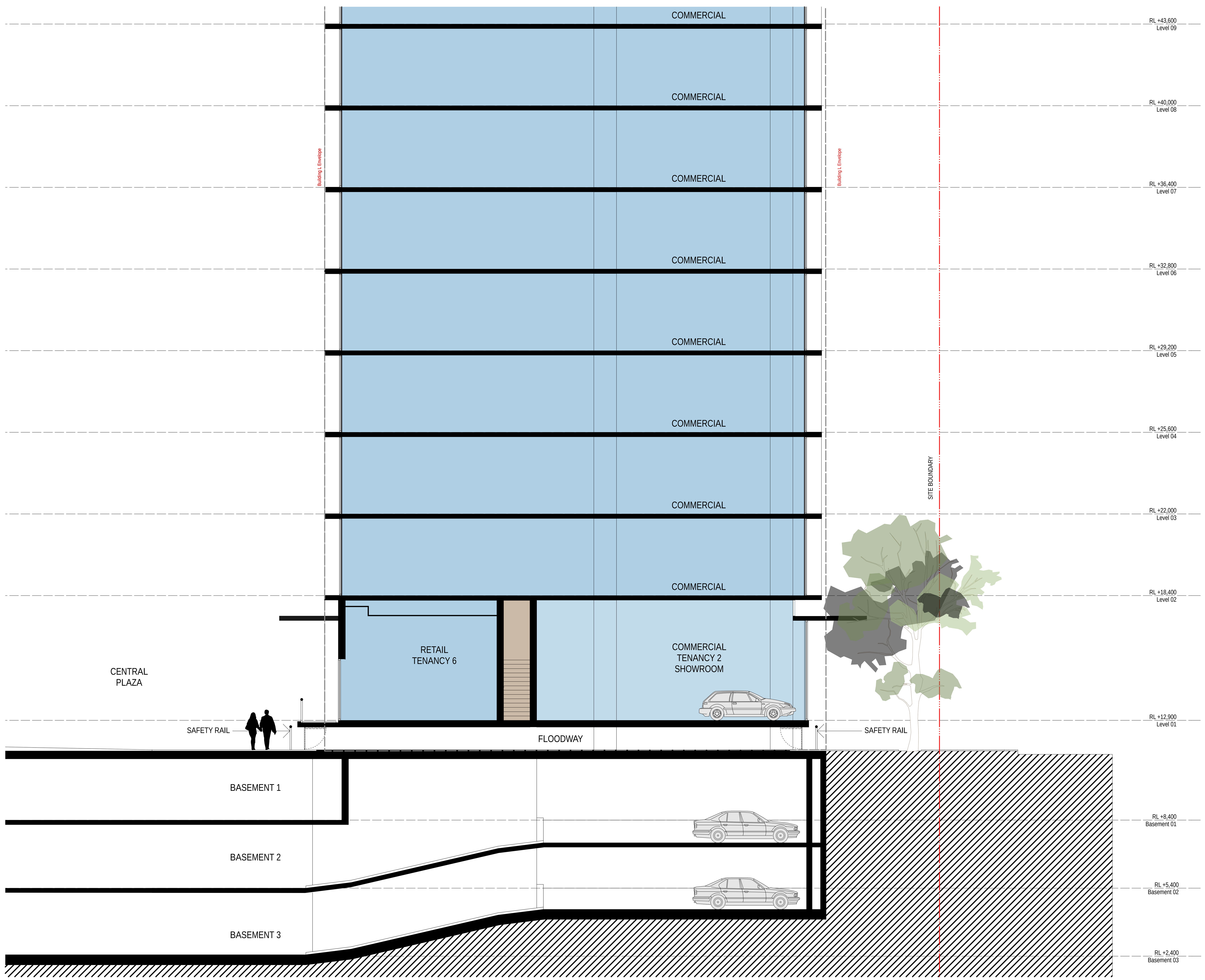
Rev.	Date	Approved by	Revision Notes
G	30.07.15	SC	Minor Amendments & Clarifying Information
A	14.10.14	SC	Development Application

Project Title
Gateway South Parramatta
63 Church Street

Drawing Title
SUPPLEMENTARY DRAWINGS
Floodway Layout

Scale: 1:200 @ A1, 50% @ A3
Project No.: 13079
Drawn by: SC
North
Status: For Information
Dwg No.: DA-800-099
Rev: G

turner.
Level 1, 410 Crown Street
Surry Hills NSW 2010
Australia
T +61 2 8668 0000
F +61 2 8668 0088
turnerstudio.com.au



Rev.	Date	Approved by	Revision Notes
G	30.07.15	SC	Minor Amendments & Clarifying Information
A	14.10.14	SC	Development Application

NOTES

DLCS Quality Endorsed Company ISO 9001:2008, Registration Number 20476
Nominated Architect: Nicholas Turner 6695, ABN 86 064 084 911

CLIENT
Boyded Industries
℅ Caverstock Group Pty Ltd

Project Title
Gateway South Parramatta
63 Church Street

Drawing Title
SUPPLEMENTARY DRAWINGS
Floodway Detail Section

Scale
1:100 @ A1, 50% @ A3

Project No.
13079

Drawn by
SC

North

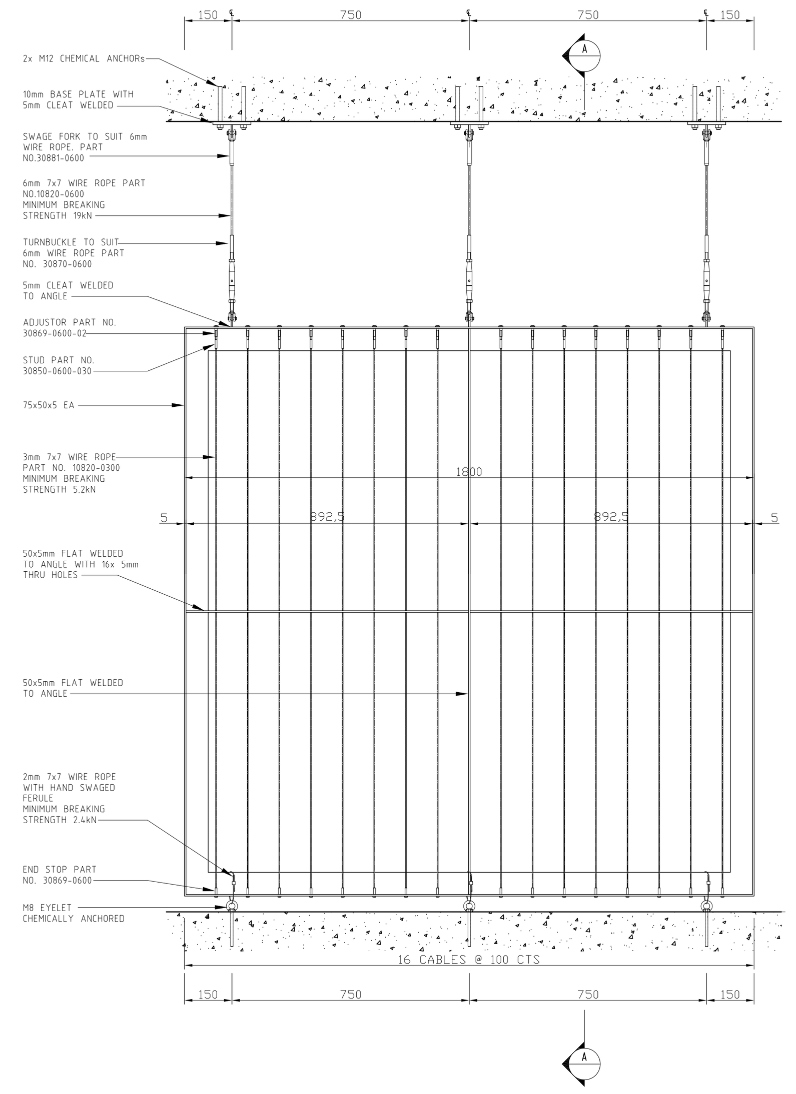
Status
For Information

Dwg No.
DA-800-050

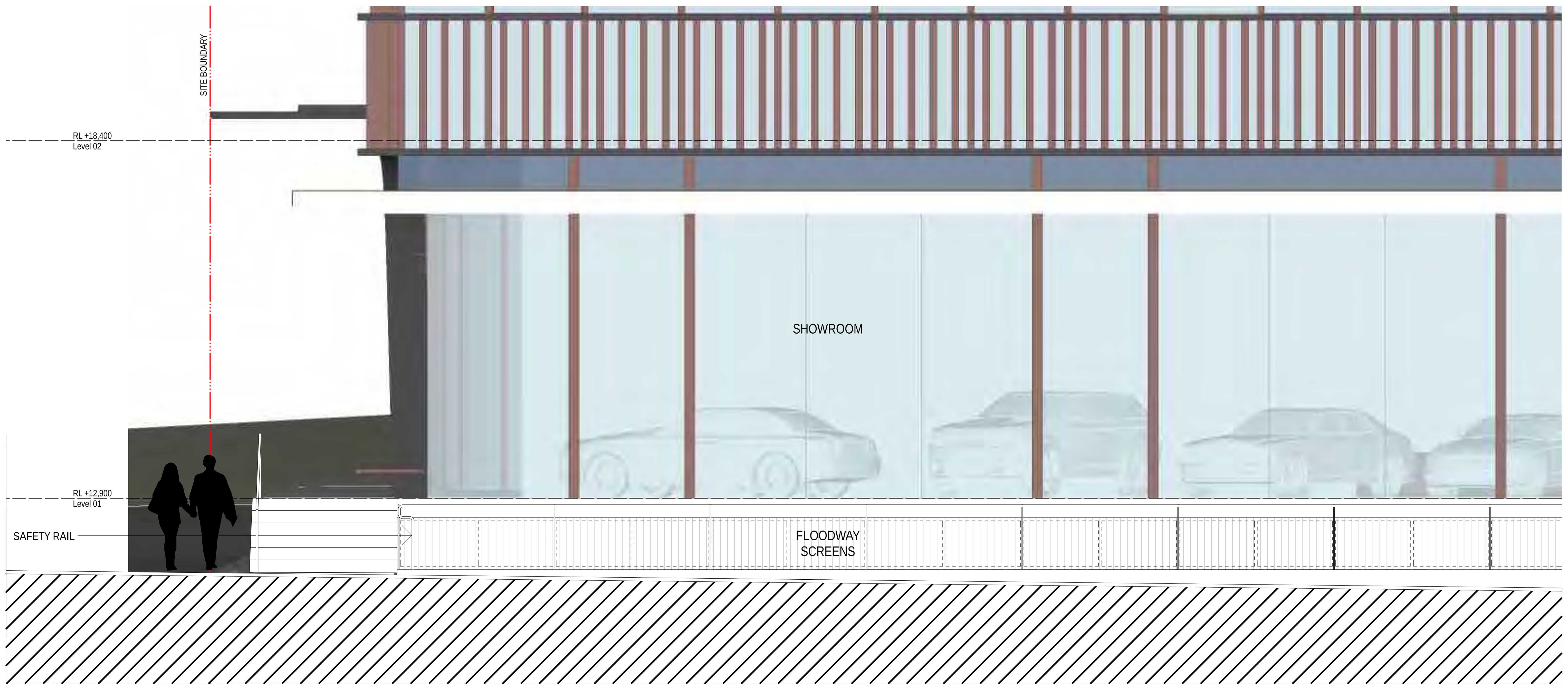
Rev
G

turner
Level 1, 410 Crown Street
Surry Hills NSW 2010
Australia
T +61 2 8668 0000
F +61 2 8668 0088
turnerstudio.com.au

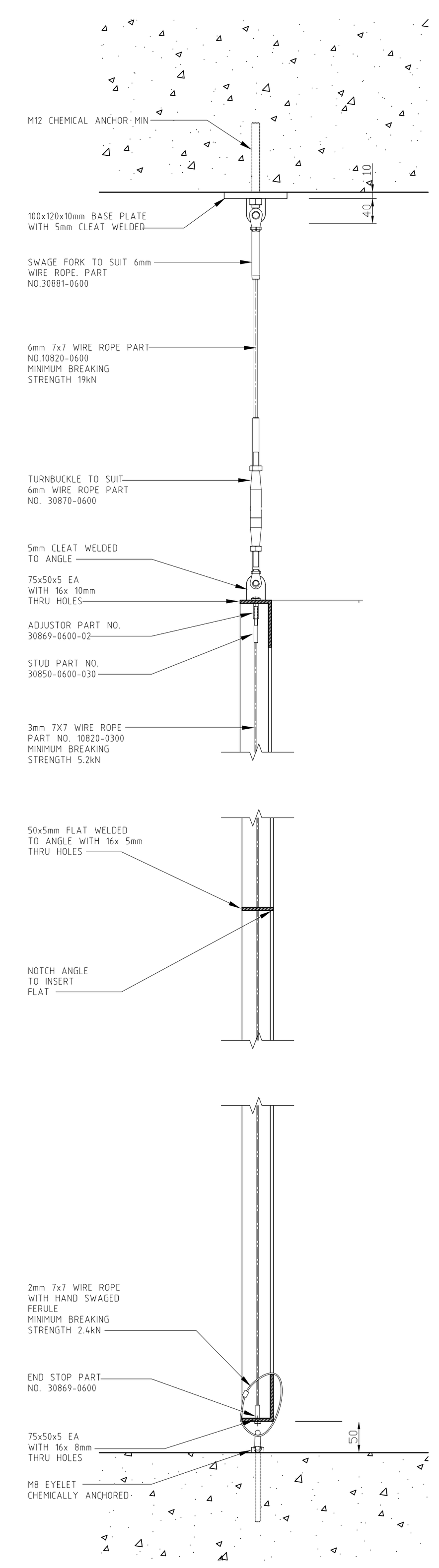
1 Central Plaza Floodway Detail Elevation 1:50



3 Frame Elevation 1:20



2 Central Plaza Floodway Detail Elevation 1:50



4 Frame Section AA 1:20

CLIENT
Boyded Industries
% Caverstock Group Pty Ltd

Project Title
Gateway South Parramatta
63 Church Street

Drawing Title
SUPPLEMENTARY DRAWINGS
Floodway Detail Elevations and Section

Rev.	Date	Approved by	Revision Notes
G	30.07.15	SC	Minor Amendments & Clarifying Information
A	14.10.14	SC	Development Application

Scale	Project No.	Drawn by	North
1:50 @ A1, 50% @ A3	13079	SC	
Status	Dwg No.	Rev	
For Information	DA-800-051	G	

turner
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turnerstudio.com.au

FLOOD EMERGENCY RESPONSE STRATEGY

Gateway South Parramatta

Developed by First 5 Minutes Pty Ltd

Document issued 17th August 2015

Gateway South Parramatta

Concept drawing

Site Overview

There are two sites either side of Early Street in Parramatta.

Site 1 - 533 apartments in two buildings. 40 floors and 21 floors on podium with commercial/retail of 22,615m² and 634 cars underground.

Site 2 - 231 apartments over 22 floors with car park for 273 cars under and commercial/retail of 16,484m².

The site is for a high rise mixed use development across three sites; comprising 5 buildings for residential and non-residential uses, basement car parking, and a public park.

The proposed site features two 10-storey commercial towers fronting Church Street with car dealerships on the ground floor, and residential and mixed use towers at the rear.

The residential section has a 43-storey and 23-storey apartment block, and a 31-storey mixed use commercial and residential tower.

There will be flood alarms installed in the Plazas near Lansdowne Street and Early Street. Boom gates and warning signs will be installed at the car park entry points. If cars have to be moved from the site during the project they will be directed by Security personnel away from the site and up Early Street.

Note 1: The basements entry/exits are above the 100 year flood level plus freeboard.

Note 2: Whilst the basements are "tanked" to above the ground water level, the street level is in effect largely waterproofed and flooding will be a surface effect.

Note 3: Any water intrusion through the basement walls would be covered by the basement drainage system.

Objective

The objective of the Flood Emergency Response Strategy is to provide for the safety of shoppers, retail and office tenancy staff and residents from the proposed premises during significant flood conditions (i.e. 100 year ARI).

Evacuation Strategy

The proposed 100 year ARI Flood Emergency Response Strategy is to allow members of the public, retail and office staff and residents to:

1. Remain on the premises until the flood abates as they are protected from the 1:100 year flood; or
2. Access the assembly area in the Northern Plaza.

Emergency Control Organisation

An Emergency Control Organisation (ECO) meeting the guidelines of Australian Standard (AS) 3745-2010 must be established for the site to deal with all risks identified in the hazard assessment. This will include managing floor impact on the site.

The ECO is to receive specific instruction on their role in a flood impact on the site buildings or their precincts.

Facility Management staff members and Security personnel will have two way radios in order to remain in constant contact with each other and the Facility Manager during the flood control procedures.

ECO personnel would also control safe pedestrian evacuation from the shops and or offices.

Training

All Emergency Control Organisation (ECO) personnel are to receive specific instruction in their roles and responsibilities at least annually.

ECO Wardens should be nominated in each tenancy with a Chief Warden nominated for the complex. This should be arranged so that one Warden per tenancy is present at all times during retail/office hours. These Wardens should be appropriately trained in emergency management procedures for the site including flooding.

Such training should occur during employment inductions and is to include the following;

- Flood behaviour and risks around the site.
- Maximum water levels expected around the site.
- Location and access to first floor tenancies.
- Evasion and evacuation procedures, when applicable.
- Activation and use of the Emergency Warning and Intercommunication System (EWIS).
- How to conduct a tenant specific or complex wide flood response drill.
- Contact numbers and website for the Bureau of Meteorology.
- Contact number for the SES.

Staff Training

All retail and commercial operators will be required to have a copy of the evacuation strategy readily available in their stores/offices at all time and undertake annual staff training drills to ensure all systems are understood and operational.

Staff from each tenancy should have flood awareness incorporated as part of their induction training.

This should include the following information;

- Flood behaviour and risks around the site as described above.
- Maximum water levels expected around the site.
- Location and access to first floor tenancies.
- Evasion and evacuation procedures, when applicable.

Audit

The building owners, their agents, occupiers, lessors or their representatives, should ensure that leases not only cover the safety of occupants in an emergency, but include obligations for occupants to participate in emergency planning and evacuation exercises and acknowledge the authority of designated ECO Wardens in emergency situations.

The lease documentation for individual retail and office tenancies shall provide for tenants to instruct their staff members in the Flood Emergency Response Strategy and retention of documentation to this effect.

Low Risk

Low risk flood behaviour is categorised by blocked pits and pipes, and nuisance ponding and flooding around the site. It is generally representative of an event less than or equal to the 1 in 5 year ARI. This type of flooding poses low risk to life and property, and a table of risks and control measures is outlined below.

Risk	Control
Slip hazards from blockage of pits causing ponding	Take care moving around site.
Risk to property through water damage	Store objects sensitive to water inside or away from overland flow paths.

Moderate Risk

Moderate risk floods are similar to that of a low risk flood, except water is expected to be flowing on Church Street, Early Street and Lansdowne Street. This risk level is roughly categorised when water starts to overtop the kerbing near the Church Street entry to the sites. Risk to property and life is dramatically increased in this category due to the flow of water over footpaths and around the precincts. A table of risks and control measures is included below.

Risk	Control
Slip hazards from blockage of pits causing ponding	Take care moving around site.
Injury from crossing flowing water. Falls, floating objects.	Avoid pedestrian movement around the Lansdowne Street, Early Street and Church Street entry points. Avoid crossing flowing water on foot. Cross in vehicles to reach flood refuge and avoid egress from site. Move to, or remain inside buildings until directed or flood waters recede.

High Risk

High risk floods are larger in magnitude again compared to moderate risk floods. Due to velocities in the vicinity of the intersection of Church Street and Lansdowne Street these floods pose a high risk to property and life. Under no circumstance should anyone attempt to cross flood water by foot or in vehicles once water has reached the footpaths.

Risk	Control
Injury from crossing flowing water. Falls, submerged objects.	Avoid crossing flowing water on foot or in vehicles. Move to, or remain inside buildings until directed or flood waters recede. Avoid evacuation by foot or in vehicles from all entrances.
Inundation of floor level	Remain calm. Inundation in the order of 200-300mm at relatively low velocities around the precincts of some buildings. Take refuge in tenancies with a first floor.
Isolation due to flood waters	Remain calm at refuge point and wait for flood waters to recede.

Facility Management Actions

Now and always

- Inform tenants that flooding is a real risk
- Display your Flood Plan
- Encourage staff to participate in development & implementation of this plan
- Ensure WH&S procedures cover specific risks associated with floods
- Maintain an up to date list of emergency contact numbers for staff and services
- Train Facility Management staff and Emergency Control Organisation in flood procedures
- Incorporate flood awareness in Facility Management staff and tenant induction training
- Prepare an Emergency Kit

When flooding is likely

- Inform Facility Management staff of Flood Watch or Severe Weather Warning
- Initiate control of car park access
- Warn all occupants of any likely impact on car park levels
- Ensure all evacuation routes are kept clear
- Keep radio tuned to local radio station
- Ensure retail and office tenants and residents are aware of Flood Watch or Severe Weather Warning

During a flood

- Keep in contact with all occupants and keep them updated on the situation

After a flood

- Keep radio tuned to local radio station and keep listening for updates on forecast flood heights and timings
- Do not enter flood water.
- Before reoccupying any area impacted by floodwater undertake a WH&S risk assessment

Emergency Calls

Fire, Police, Ambulance	"Zero-Zero-Zero" (000)
SES	132 500
Electricity	
Gas	
Plumbing	
Glaziers	
Security	

Web Sites

Bureau of Meteorology - NSW	http://www.bom.gov.au/nsw/index.shtml
Parramatta Forecast	http://www.bom.gov.au/nsw/forecasts/parramatta.shtml
State Emergency Service (SES)	http://www.ses.nsw.gov.au/
SES Western Region Flood Information	http://www.floodsafe.com.au/sydney-western-region
Live Traffic NSW	https://www.livetraffic.com/desktop.html#mapview

Sydney Mean Monthly Rainfall

Summer	
December	78
January	103
February	117
Autumn	
March	131
April	127
May	123

Winter	
June	128
July	98
August	82
Spring	
September	69
October	77
November	83

Figure 1 – Site 1 & Site 2 Plan

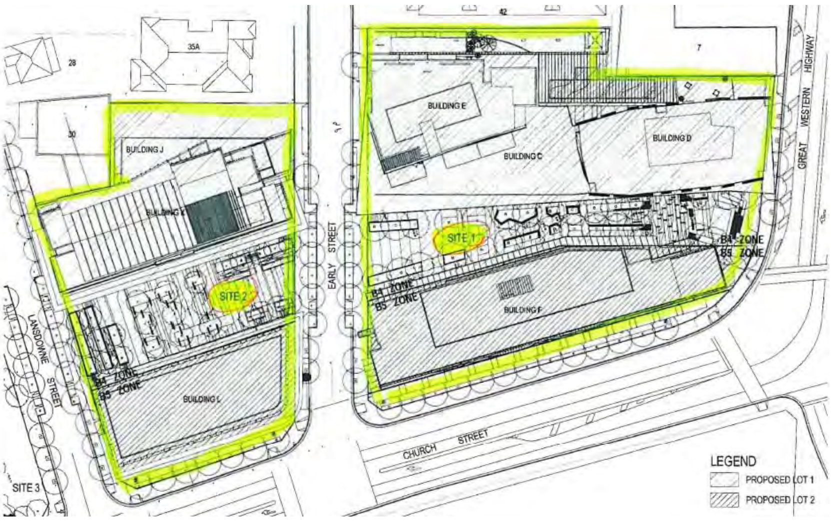

Figure 2 – Building Level Use

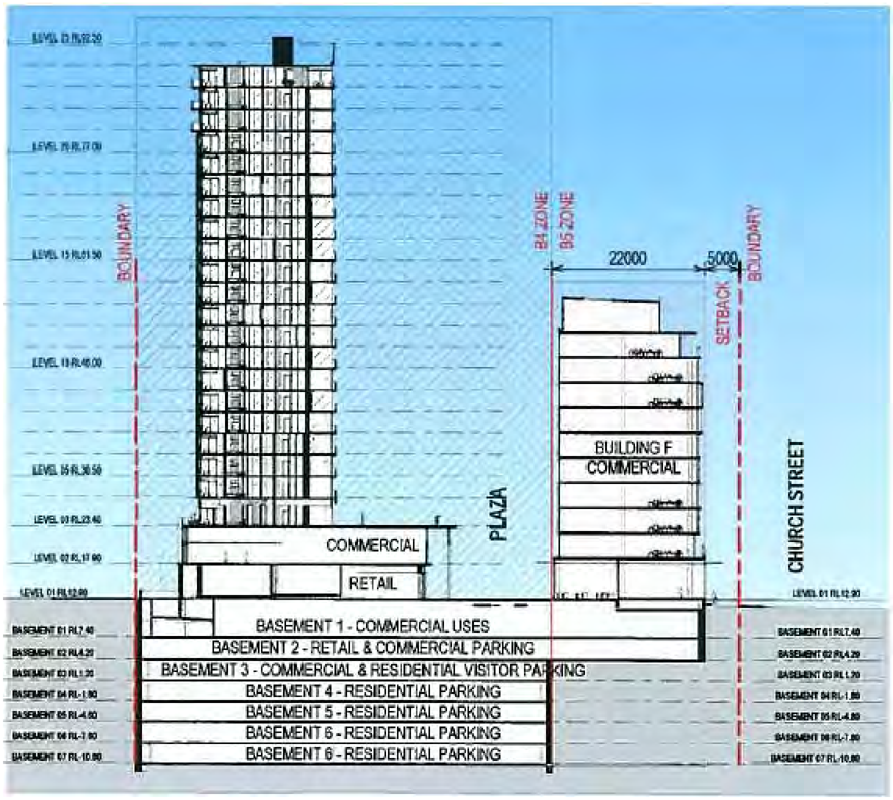

Figure 3 – 100 year Velocity x Depth Scenario E Nil Blockages

Parramatta C Flood Matrix Index

On the information available at the date if issue of this document the development complied with all of the following:

Floor Level	
1	All floor levels to be equal to or greater than the 20 year *ARI flood level* plus *freeboard.*
2	Habitable floor levels to be equal to or greater than the 100 year *ARI flood level* plus *freeboard.*
3	All floor levels to be equal to or greater than the *PMF* level plus *freeboard.*
4	Floor levels to be equal to or greater than the *100 year ARI flood level plus freeboard.* Where this is not practical due to compatibility with the height of adjacent buildings, or compatibility with the floor level of existing buildings, or the need for access for persons with disabilities, a lower floor level may be considered. In these circumstances, the floor level is to be as high as practical, and, when undertaking alterations or additions no lower than the existing floor level.
5	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 subfloor space is not to be enclosed.
Building Components & Method	
1	All structures to have *flood compatible building components* below the 100 year ARI *flood* level plus *freeboard.*
2	All structures to have *flood compatible building components* below the *PMF*.
Structural Soundness	
1	Engineers report to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year ARI *flood* plus *freeboard.*
2	Engineers report to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF level.
Flood Affectation	
1	Engineers report required to certify that the development will not increase *flood affectation* elsewhere, having regard to: (I) loss of flood storage; (ii) changes in flood levels, flows and velocities caused by alterations to flood flows; and (iii) the cumulative impact of multiple potential developments in the vicinity.
2	The impact of the development on flooding elsewhere to be considered having regard to the three factors listed in consideration 1 above.

Car Parking and Driveway Access	
1	The minimum surface level of open spaces or carports shall be as high as practical, but no lower than 0.1m below the 100 year ARI flood level. In the case of garages, the minimum surface level shall be as high as practical, but no lower than the 100 year ARI flood level.
2	The minimum surface level of open parking spaces or carports shall be as high as practical, but no lower than 0.3m above the 20 year ARI flood level.
3	Garages capable of accommodating more than 3 motor vehicles on land zones for urban purposes, or enclosed car parking, must be protected from inundation by floods equal to or greater than the 100 year ARI flood. Ramp levels to be no lower than 0.5m above the 100 year ARI flood level.
4	The driveway providing access between the road and parking spaces shall be as high as practical and generally rising in the egress direction.
5	The level of the driveway providing access between the road and parking spaces shall be no lower than 0.2m below the 100 year ARI flood level.
6	Enclosed car parking and car parking areas accommodating more than 3 vehicles, with a floor below the 100 year ARI flood level, shall have adequate warning systems, signage, exits and evacuation routes.
7	Restraints or vehicle barriers to be provided to prevent floating vehicles leaving a site during a 100 year ARI flood.
Evacuation	
1	Reliable access for pedestrians required during a 20 year *ARI peak flood.*
2	Reliable access for pedestrians and vehicles required to a publicly accessible location during the *PMF peak flood.*
3	Reliable access for pedestrians and vehicles is required from the site to an area of refuge above the PMF level, either on site (eg. second storey) or off site.
4	Applicant to demonstrate the development is consistent with any relevant *flood evacuation strategy* or similar plan.
5	Applicant to demonstrate that evacuation in accordance with the requirements of this DCP is available for the potential development resulting from the subdivision.
6	Adequate flood warning is available to allow safe and orderly evacuation without increased reliance upon SES or other authorised emergency services personnel.

Management and Design	
1	Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this the relevant FRMS and FRMP
2	Site Emergency Response Flood plan required where the site is affected by the 100 year ARI flood level, (except for single dwelling-houses).
3	Applicant to demonstrate that area is available to store goods above the 100 year *flood* level plus *freeboard.*
4	No storage of materials below the 100 year *ARI flood level.*
Notes	
i.	*Freeboard* equals an additional height of 500mm.
ii.	The relevant environmental planning instruments (generally the Local Environmental Plan) identify development permissible with consent in various zones in the LGA. Notwithstanding, constraints specific to individual sites may preclude Council granting consent for certain forms of development on all or part of a site. The above matrix identifies where flood risks are likely to determine where certain development types will be considered "unsuitable" due to flood related risks.
iii.	Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.
iv.	Any fencing that forms part of a proposed development is subject to the relevant Flood Effects and Structural Soundness planning considerations of the applicable land use category.
v.	Development within the floodplain may be subject to the Foreshore Building Line objectives of the LEP and REP
vi.	Terms in italics are defined in the glossary of this policy. Development types are specified in each land use category. These development types are generally as defined within Environmental Planning Instruments applying to the local government area.

AJ+C
ALLEN JACK+COTTIER

GATEWAY SOUTH PARRAMATTA

STAGE 1 - DA REPORT

26 AUGUST, 2015

GATEWAY SOUTH PARRAMATTA

STAGE 1 - DA REPORT

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26 AUGUST, 2015

AERIAL

CHURCH STREET

CHURCH STREET

PLAZA

AJ+C, Turner and Oculus have prepared this design report to accompany a Stage 1 Development Application for 57, 63 and 83 Church Street and 44 Early Street, Parramatta on behalf of Dyldam.

The application has been prepared following a design excellence competition conducted by the Heartland Group in accordance with the Parramatta City Council Competitive Design Policy.

AJ+C and Turner were jointly awarded the project, with AJ+C appointed as coordinating architect. Oculus were appointed as public domain and landscape architects.

This Stage 1 Development Application incorporates the ideas, concepts and building forms presented in the winning competition submissions.

In this submission, our key strategies were generated in response to the competition objectives in the Brief and the aims of Parramatta LEP and DCP:

- Enhance the quality of the public domain by reducing the scale of the buildings adjacent to the linear plaza
- Provide solar access to the residential accommodation, the linear plaza and new park by locating and shaping the towers appropriately
- Represent elements of Parramatta's natural and cultural heritage in the public spaces and buildings through reference to the meeting of the waters – fresh water meets salt water at Parramatta
- Reference the site's status as a meeting / crossing place between residential areas to the south and Parramatta's retail / commercial / cultural core to the north.
- Provide a range of housing, employment and recreational spaces that accommodate the needs of Parramatta residents, workers and visitors
- Improve pedestrian access to the city and street level amenity by providing a series of high quality, activated pedestrian ways connecting the 3 sites

We began by modelling and analysing a 'default scheme' generated by the Voluntary Planning Agreement (VPA) envelopes and generating responses to this theoretical design.

We created a more pedestrian friendly, lower scaled street wall along the western edge of the plaza by dividing the residential/retail buildings on the western half of the sites into 2 basic elements; a well-defined 2 storey retail / commercial podium, with the residential towers set back above.

We created a continuous colonnade along the western side and a continuous awning along the eastern side of the plaza to provide a protected and inviting all-weather pedestrian environment. Combined with tree planting along the plaza, these protect the outdoor spaces from downdrafts from the surrounding buildings and the prevailing winds. The colonnade is scaled to accommodate outdoor dining areas.

The residential towers have been located and shaped to provide midwinter lunchtime (1pm) sunlight to 15% of the plaza and 21% of the park, compared to 14% and 0% for the VPA massing at the same time.

The setback from the commercial buildings on Church Street also increased the amenity of the residential accommodation by increasing allowed solar access to the lower levels of the residential towers. The resulting podium roof provides opportunities for more landscaped open space within the site for residential common areas.

The architectural expression of the scheme reflects this bipartite division, with the curtain wall cladding of the northern residential tower subtly undulates to reference water with two coloured glazing types to represent the meeting of fresh and salt water. The podium expression features variously shaped columns to reference the historical open woodland that existed on the site before settlement and visually extend the small 'forest' of native trees running through the plaza.

We devoted the western setback zones on sites 1 & 2 to landscaped open space, to respect the amenity of existing residential buildings next door.

Location

ANALYSIS

01 LOCATION AND CONTEXT

The Sites are located at the corner of the Great Western Highway and Church and are part of the Auto Alley Precinct, identified in the LEP as a special character area. Adjoining land uses include other car dealerships to the south and opposite on Church Street, with primarily 3-4 storey walk-up apartments to the west. Immediately north of the sites are various mixed-use developments including high-density residential, commercial shop-fronts facing Church Street, and towards the rail line is Westfield Shopping Centre.

Presently the Sites have low-rise 1-2 storey buildings for the purposes of car showrooms, sales and servicing. The northern parcel of land within the Site is more than 80% open hardstand that is currently vacant.

02 SOLAR ACCESS + MICROCLIMATE

The sites are aligned with Church Street, which runs roughly north-south, with the Great Western highway, Early Street and Landsdowne Street running roughly east-west between the three sites.

The site orientation provides good solar access throughout the day.

Prevailing winds are predominately westerly, north westerly and south westerly.

As the surrounding area to the west and south is predominantly flat with low scale buildings, the site is relatively exposed to winds from these directions.

North

North - west

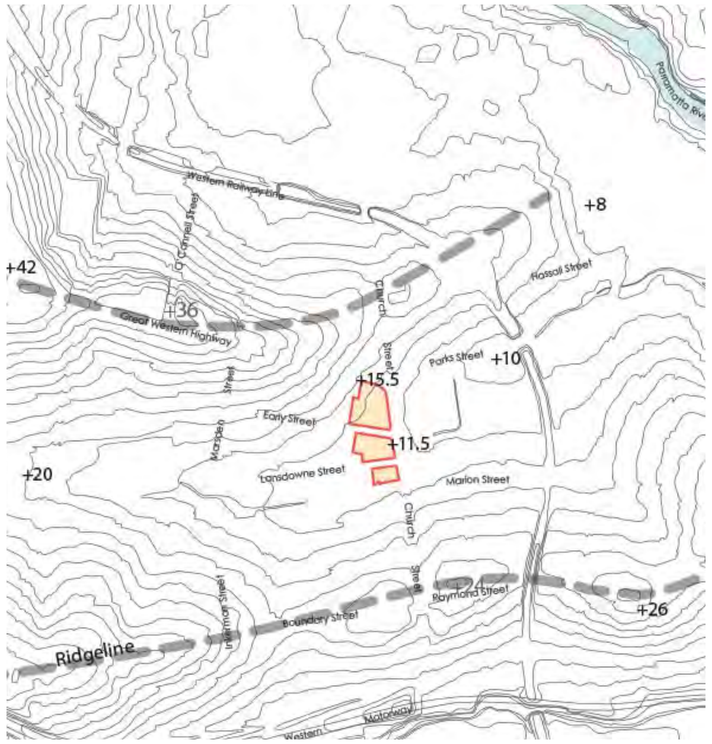
West

East

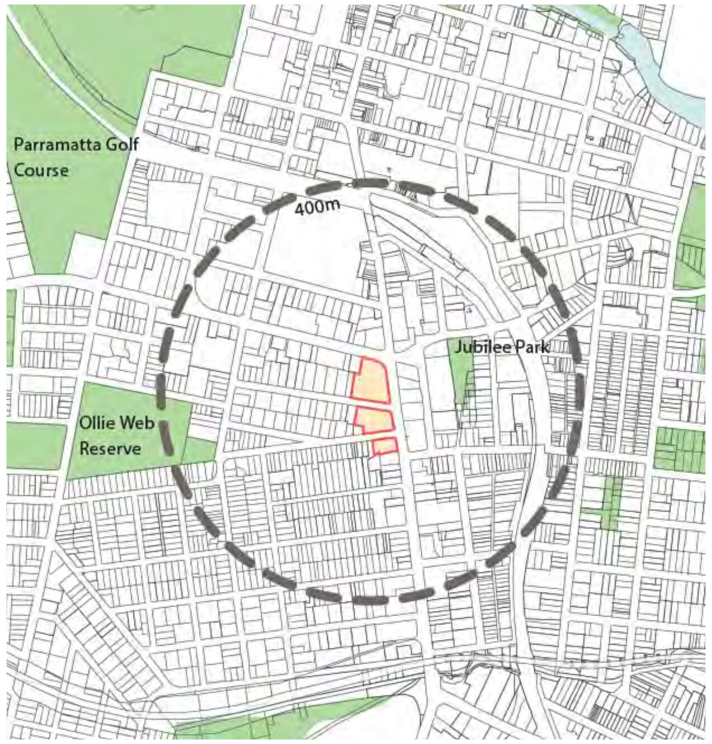
03 VIEWS

The sites have potential views east towards Sydney CBD, west towards the Blue Mountains and north towards the Parramatta CBD, River, Government House and parklands.

The photographs ont he left show potential views from level 37 - approximately 118m.



Topography



Open space

04 TOPOGRAPHY + FLOODING

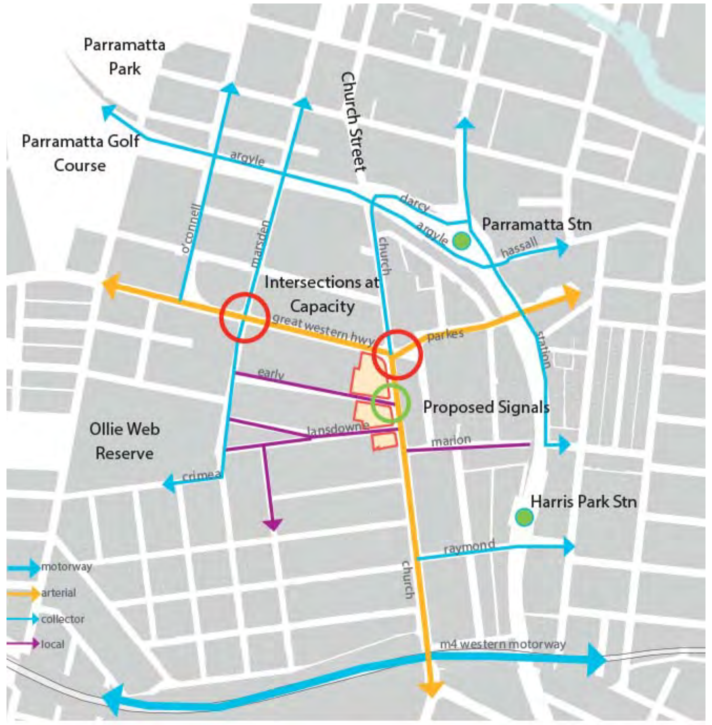
The sites are located on the gentle slopes of the Clay Cliff Creek valley and fall generally to the east and south, ranging from RL +15.5m at the Great Western Highway to RL +11.5m at the Landsdowne / Church Street corner. The southern parcel has an open drain culvert that transitions into a covered culvert.

Local high points include Mays Hill at approximately +42m, 1 km to the west.

Detailed flood modelling indicates that sites 1 and 2 are subject to low to medium hazard flooding on the margins of the northern and middle parcel. Site 3, having a culvert running through it, is subject to high-hazard flooding.

05 OPEN SPACE

The Site is within 400m of local parks Ollie Web Reserve and Jubilee Park, and within 800m of Parramatta Park and Parramatta River.



Traffic

Public transport

Pedestrian

Cycling

06 VEHICULAR TRANSPORT AND ACCESS

The Sites front the arterial roads of Church Street to the east and the Great Western Highway to the north. Two local streets separate the 3 parcels of land comprising the site: Early Street and Lansdowne Street. The existing signalised intersections of Church St / Great Western Hwy and Great Western Highway / Marsden Street are near to capacity.

Opportunity exists to provide a new signalised intersection at Early / Church for right-turn exit into Church Street to provide an alternate vehicular exit from the site and avoid the Great Western Hwy.

Preliminary discussions with RMS have indicated that while vehicular access to the site from the Great Western Highway would not be acceptable, limited vehicular egress from the site to the Great Western Highway may be acceptable.

The Site is located on a strategic bus corridor along Church Street and the Great Western Hwy. Local bus routes provide access to surrounding suburbs with several bus stops located immediately adjacent to the site.

07 PEDESTRIAN / CYCLING ACCESS + AMENITY

The Sites are within 400m walking catchments of both Parramatta Station and Harris Park. Also within walking distance is Westfield, Ollie Web Reserve and Jubilee Park. Existing intersections of Church / Great Western Hwy and Church / Marion provide signalised pedestrian crossings across Church Street to access the City Centre and train stations.

Church Street is a 6-lane arterial road with limited attraction for pedestrians. It is a car-dominated environment with poor streetscape definition and lack of activation and built form address. The local streets of Early and Lansdowne are somewhat more pleasant with street trees and grass verges, but lack pedestrian activation.

The Site adjoins an off-road cycle route on the western side of Church Street. An on-road cycleway existing along Lansdowne Street.

KEY URBAN DESIGN + DEVELOPMENT PRINCIPLES

The following key urban design and development principles were established as part of the Urban Design Study (AECOM, 2012) undertaken for the Planning proposal, rezoning and design excellence competition for the subject sites.

These principles have been realised in the proposed concept design as follows:

01 SOUTHERN GATEWAY TO CITY CENTRE

- Enhance the arrival experience to the City Centre from the South.
- Create a place with a strong identity.

The concept design reinforces the "gateway" location and provides a distinct sense of arrival from the south to the Parramatta city centre through the scale, form, and architectural design of the development.

The northern entry to the linear plaza has been widened to create a distinct entry space by rotating the northern tower and podium westwards, and decreasing the footprint of building F at ground level.

The design acknowledges the local identity by referencing the river in the form and materials of the building facades and in the public domain.

A strong identity will be created through the land use mix, architectural design, and the landscape and public domain elements that connect all three sites.

The pedestrian plaza and park on Site 3 will contribute to creating a strong community identity for the precinct.

The pedestrian plaza for Sites 1 and 2 provides places for people to linger, congregate and for events to be hosted.

The park for Site 3 will provide areas for both passive and active recreation.

02 TRANSIT ORIENTED DEVELOPMENT

- Bring economic vitality to local shops by increasing residential development in the heart of the city.
- Promote public transport by locating development within walking distance to rail and strategic bus corridors.
- Reduce car dependence for all trip types by focusing development close to the City Centre and utilising existing transport infrastructure.

The residential component of the development (60% of the total GFA) will support the economic viability of the retail uses and the viability of local businesses beyond the subject sites.

The site is in proximity to existing high-quality rail and bus transit connections, being located approximately 500metres from Parramatta Station and 400metres from Harris Park Station.

The pedestrian plaza linking all three sites, and the future cycle path along Church Street will encourage a walkable and cycle friendly environment.

The mix of residential, retail and employment uses on the sites will contribute towards reducing car dependence, as many new employment areas, shops and services will be on the doorstep.

03 MIXED USE DEVELOPMENT

- Provide new jobs to increase activity in the City Centre.
- Differentiate the retail experience and offerings with speciality shops and new format automotive retail.
- Locate apartment living in close proximity to local retail to support local jobs.
- Reduce car dependence for daily shopping needs.

40% of the total GFA of the development will be provided for non-residential uses. Details of specific tenants and retail types would be provided for future DAs.

The concept design captures the benefits of location between the Parramatta CBD and surrounding residential areas to create opportunities for a variety of economically viable retail areas along the new public domain on street level as well as in the lower ground level.

Modern retail car showrooms have been designed for the ground floor of Building L on Site 1 and Building F on Site 2, fronting Church Street, maintaining the historic link with the Auto Alley precinct and providing a distinct identity and high visibility from Church Street.

The commercial and retail uses on lower ground level will support the local residential population for the southern Parramatta CBD. This will contribute towards reducing car dependence for daily shopping needs.

04 REINFORCE THE STREET EDGE

- Activate the street edge by locating shop fronts and entrances at street level.
- Provide address and identity to Church Street with quality built form.
- Upgrade Church Street to improve the visual character, landscape and micro-climate.

The concept design provides sheltered, activated edges along the full site frontage of Church St and the linear plaza, with residential and commercial lobbies opening directly off the plaza which will perceptually expand the public realm beyond the building line.

Ground floor retail uses on Sites 1 and 2 will contribute towards activating the pedestrian plaza and frontages along Church Street. Awnings and colonnades along the retail frontages will provide a high level of pedestrian amenity and opportunities for outdoor dining.

The landscape scheme will improve the visual character and microclimate along Church Street. The car showrooms on the ground floor of Buildings L and F will contribute towards activating this part of Church Street, with continuous awnings along the frontage of each site.

The concept design retains and updates the Auto Alley character of Church Street by locating distinctive showroom spaces on ground floor along Church Street, with contemporary commercial spaces above.

05 INCREASE DENSITY

- Increase residential development in the City Centre to provide economic vitality and enhancement to the public domain.
- Provide higher density residential development in close proximity to existing transport and social infrastructure.
- Provide a range of apartment dwellings.

The residential component of the development (60% of the total GFA) will support the economic viability of the development and activation of the public domain by bringing new residents to the city centre and contributing to a lively 7 day a week character for the city centre.

The density of development is considered appropriate for the location of the subject precinct – within the southern part of the Parramatta CBD and within proximity to existing high-quality rail and bus transit connections.

The apartment mix of the development will provide a range of studio, 1, 2 and 3 bed apartments, and has been based on market advice from Knight Frank.

06 TRANSFORM THE PUBLIC DOMAIN

- Enhance the public domain into high quality streets, lanes and plazas to support a vibrant and walkable centre.
- Provide ample shade and protection from undesirable climatic conditions in the public domain.
- Provide more street tree planting to mitigate the effects of the urban heat island.

The public domain and landscape scheme will establish a new benchmark for the public domain by providing new, high quality through site links and park.

The design features awnings and colonnades providing pedestrian amenity and opportunities for outdoor dining along the public domain.

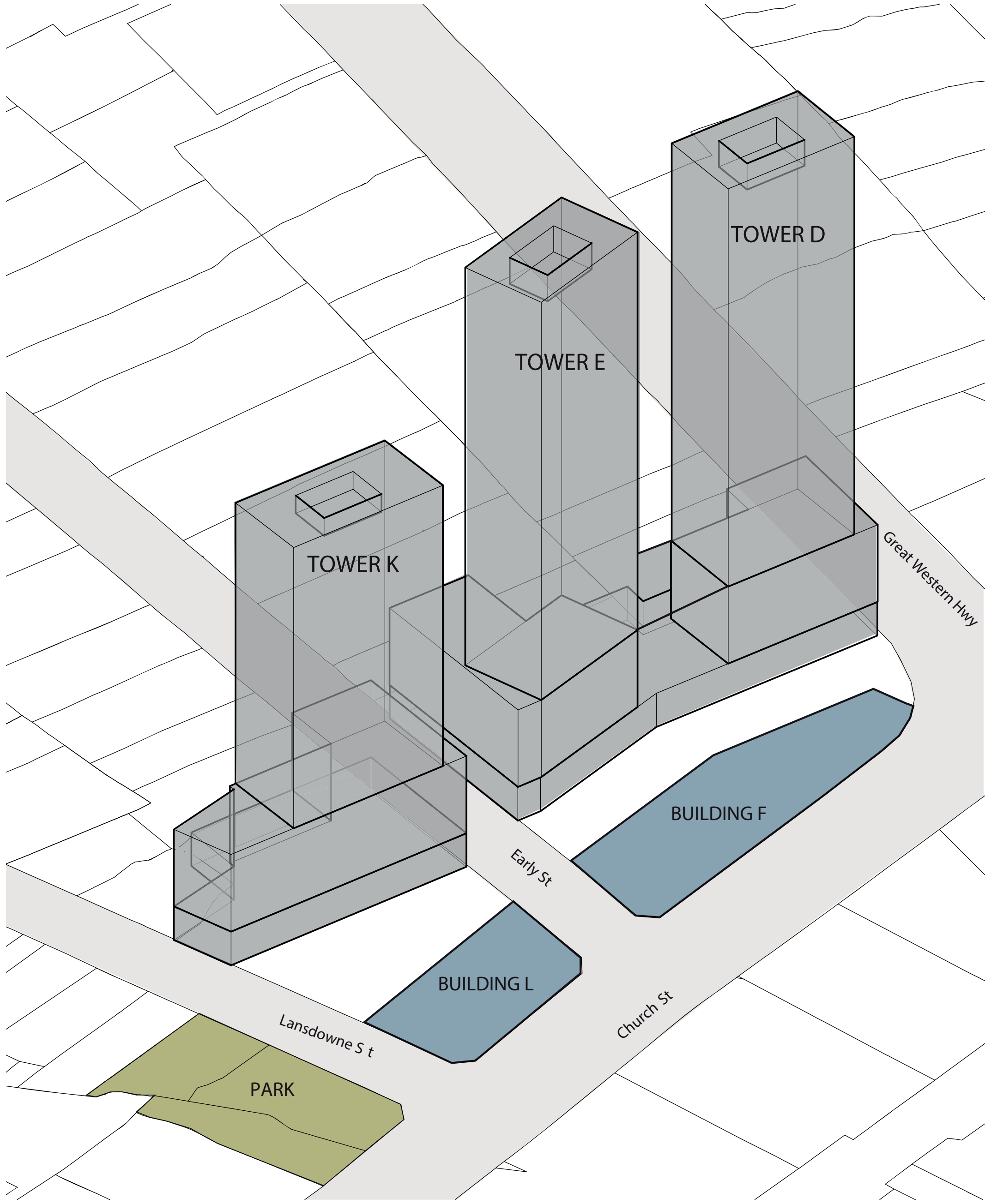
The scheme addresses the key environmental factors to create a comfortable environment. Key considerations have been to mitigate the impacts of wind, maximise solar access and provide appropriate shaded areas in the pedestrian plaza open space areas.

The design proposes groves of trees along the Plaza and street tree planting along the Great Western Highway, Church, Early and Landsdowne Streets.

MASSING AND BUILT FORM

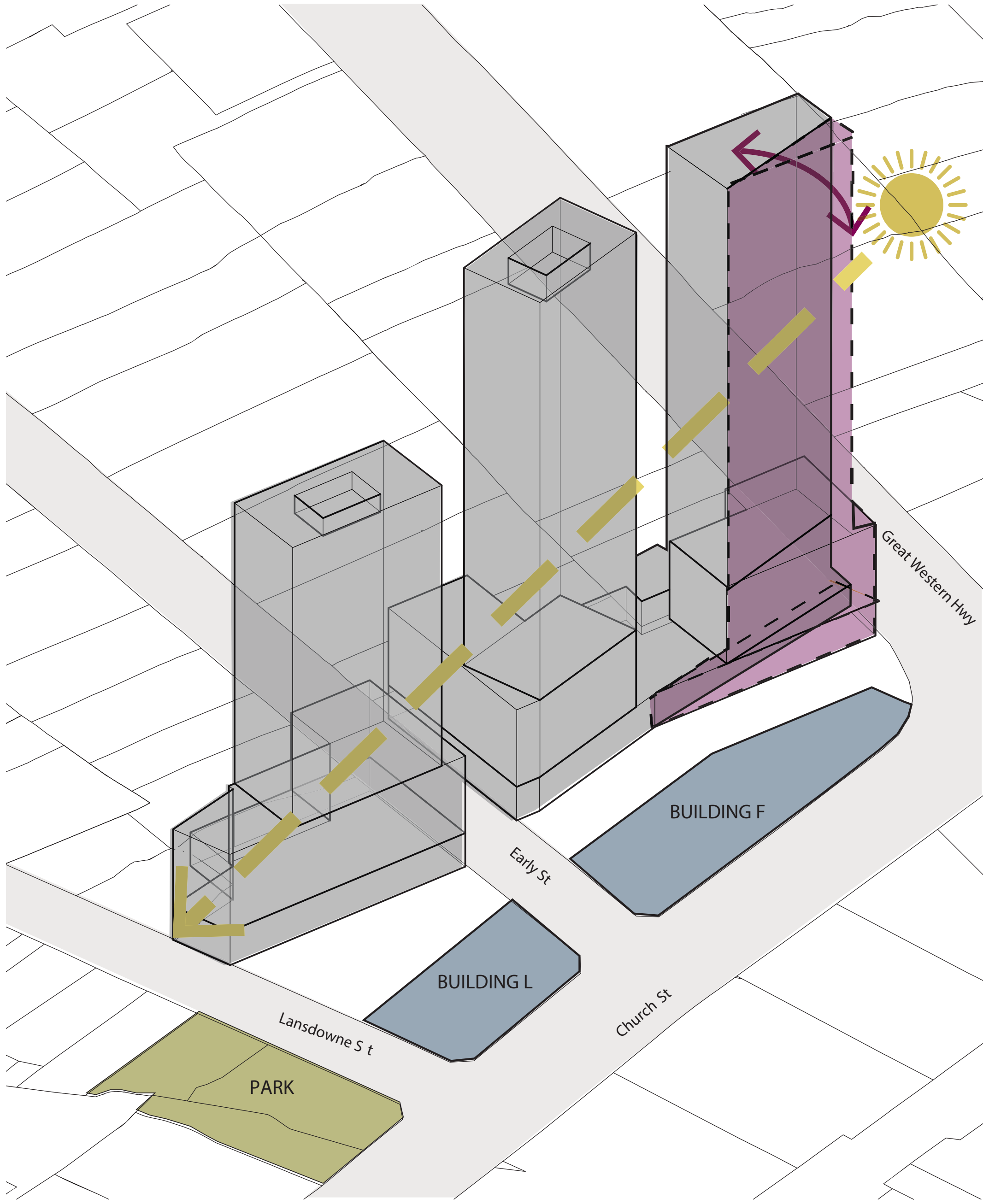
01 VPA MASSING

We began by modelling and analysing the 'default scheme' generated by the Voluntary Planning Agreement (VPA) envelopes and generating responses to this theoretical design.



02 ROTATE NORTHERN TOWER & PODIUM

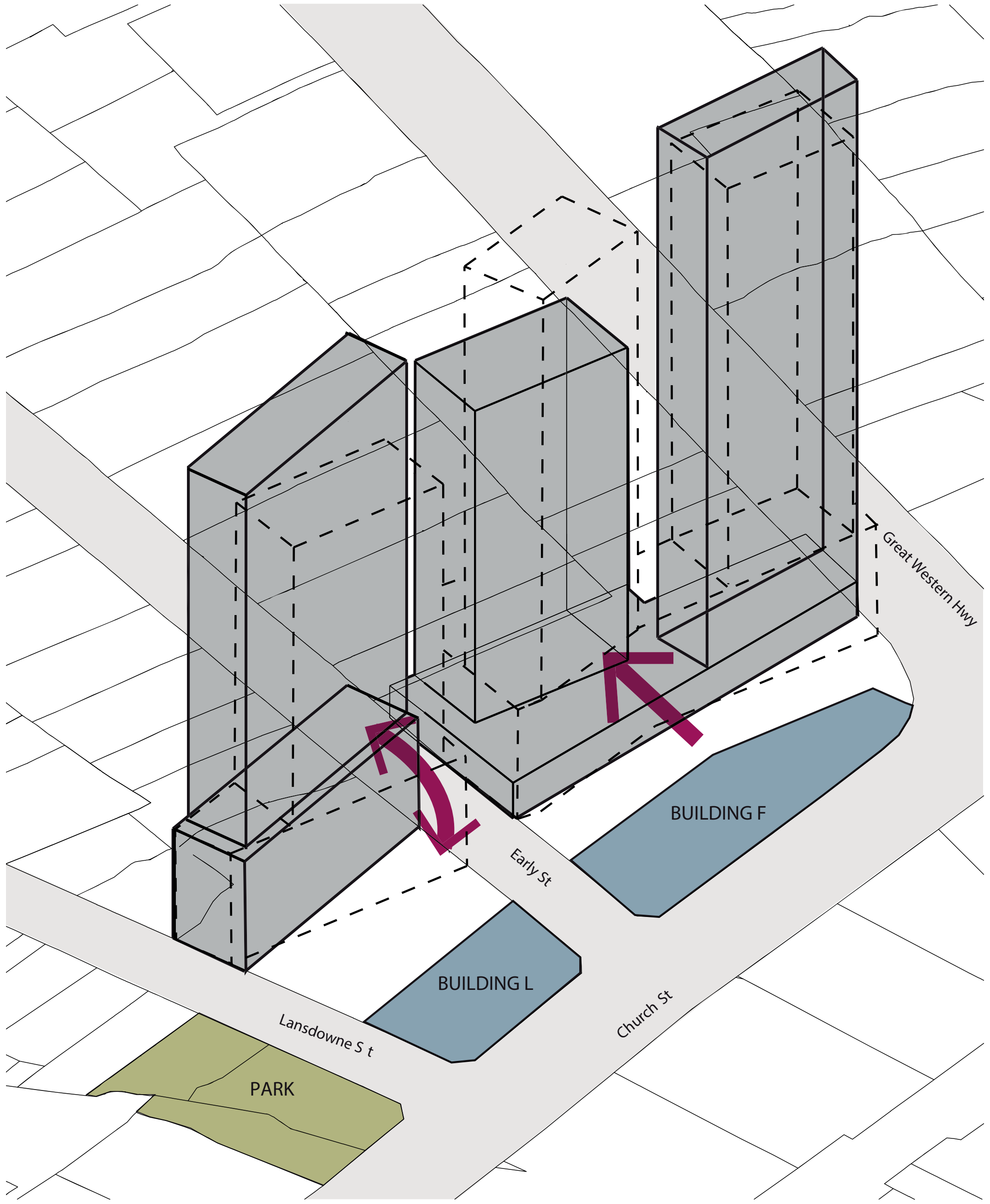
We rotated tower D and the northern podium closer to a north-south alignment to increase the width of the plaza at the northern site entry and improve solar access to the public domain and apartments.



03 TOWERS LOCATIONS

We pushed the middle tower back from the podium line to reduce the visual bulk of the building when viewed from the plaza.

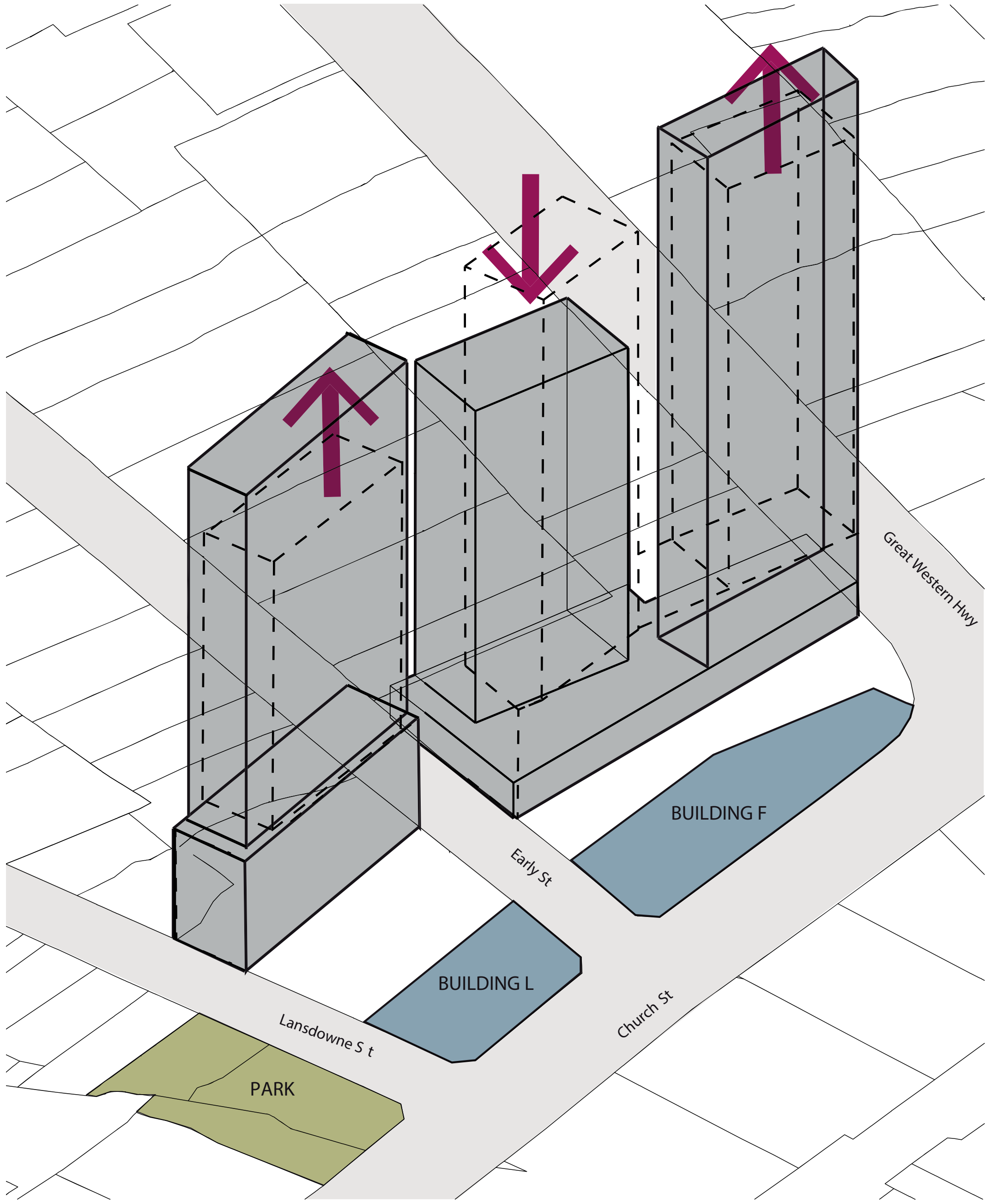
We rotated the southern tower and podium closer to a north-south alignment to allow more solar access to the public domain and apartments.



04 TOWER HEIGHTS

In response to the competition jury's comments, we manipulated the building heights to create a more varied skyline and make the northern tower more prominent.

Tower D was raised slightly, tower E was lowered significantly and tower K was raised slightly.

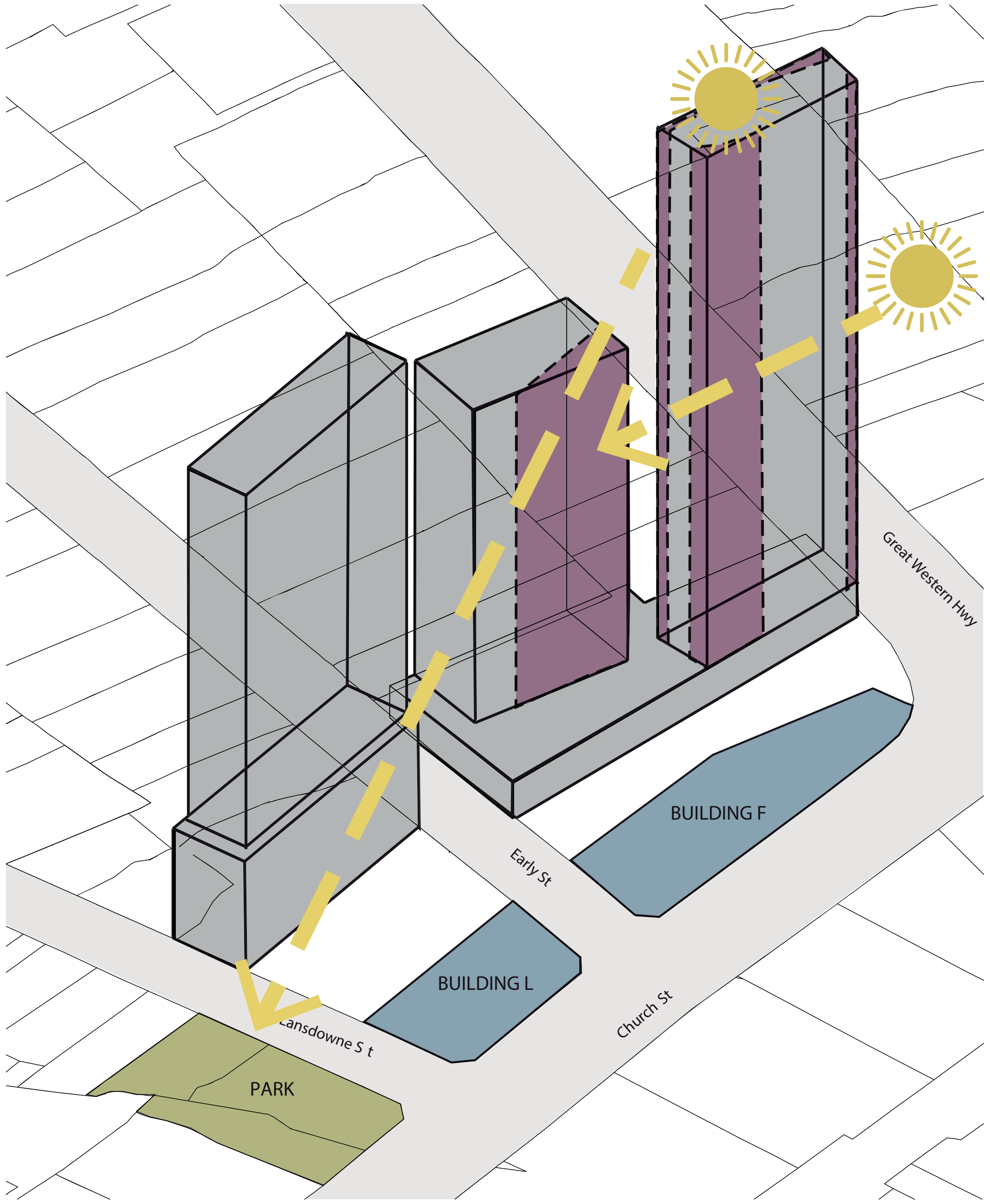


05 TOWER FORMS

We shaped and deflected the towers to further improve solar access to the public domain and apartments.

Tower D evolved into a more elliptical shape to increase solar access around the corners, while tower E was chamfered to follow the alignment of tower K, increase building separation and solar access between towers D and E.

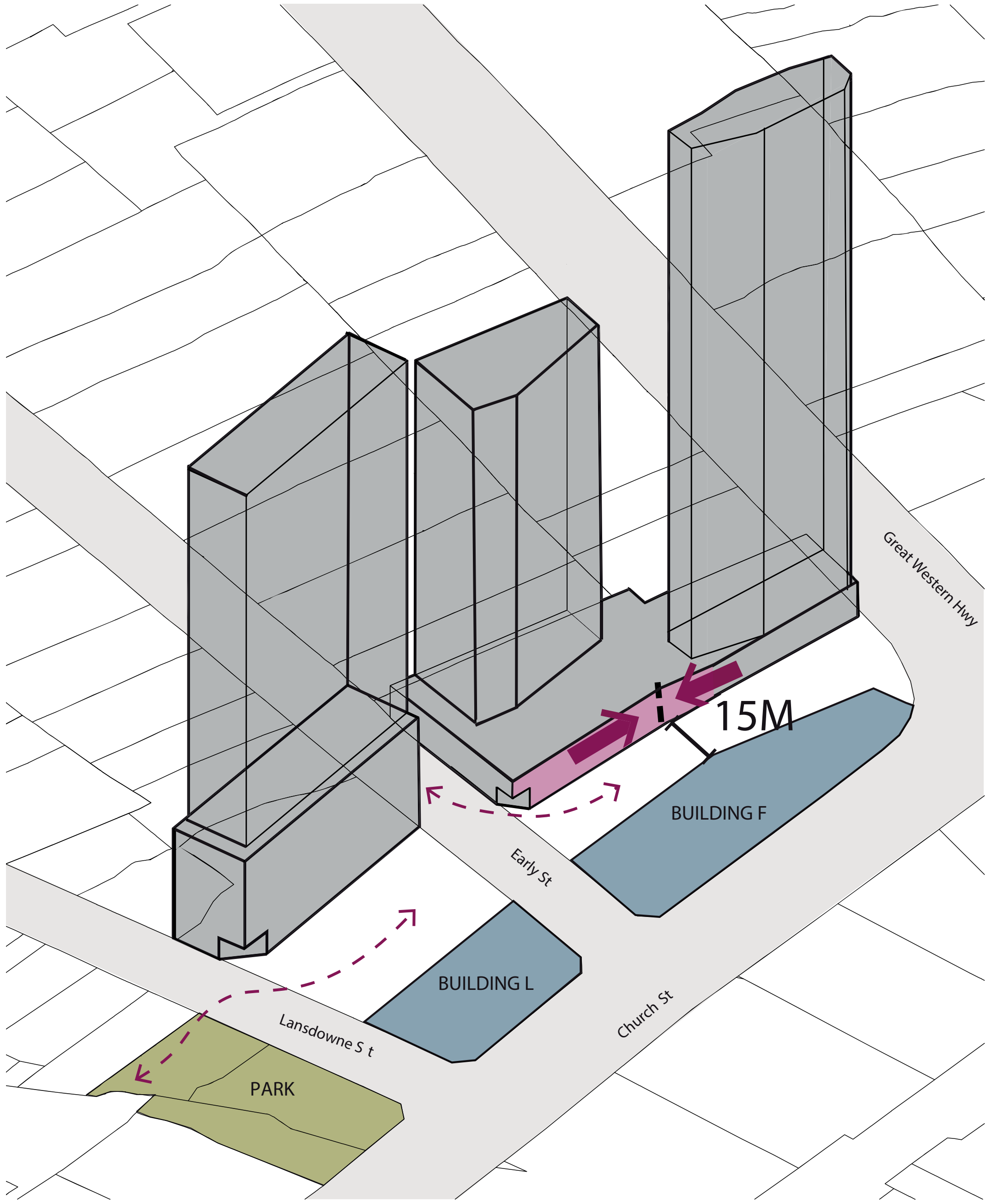
This greatly improved solar access to the plaza and park around lunchtime by letting the sun in around and between the towers.



06 PODIUM FORMS

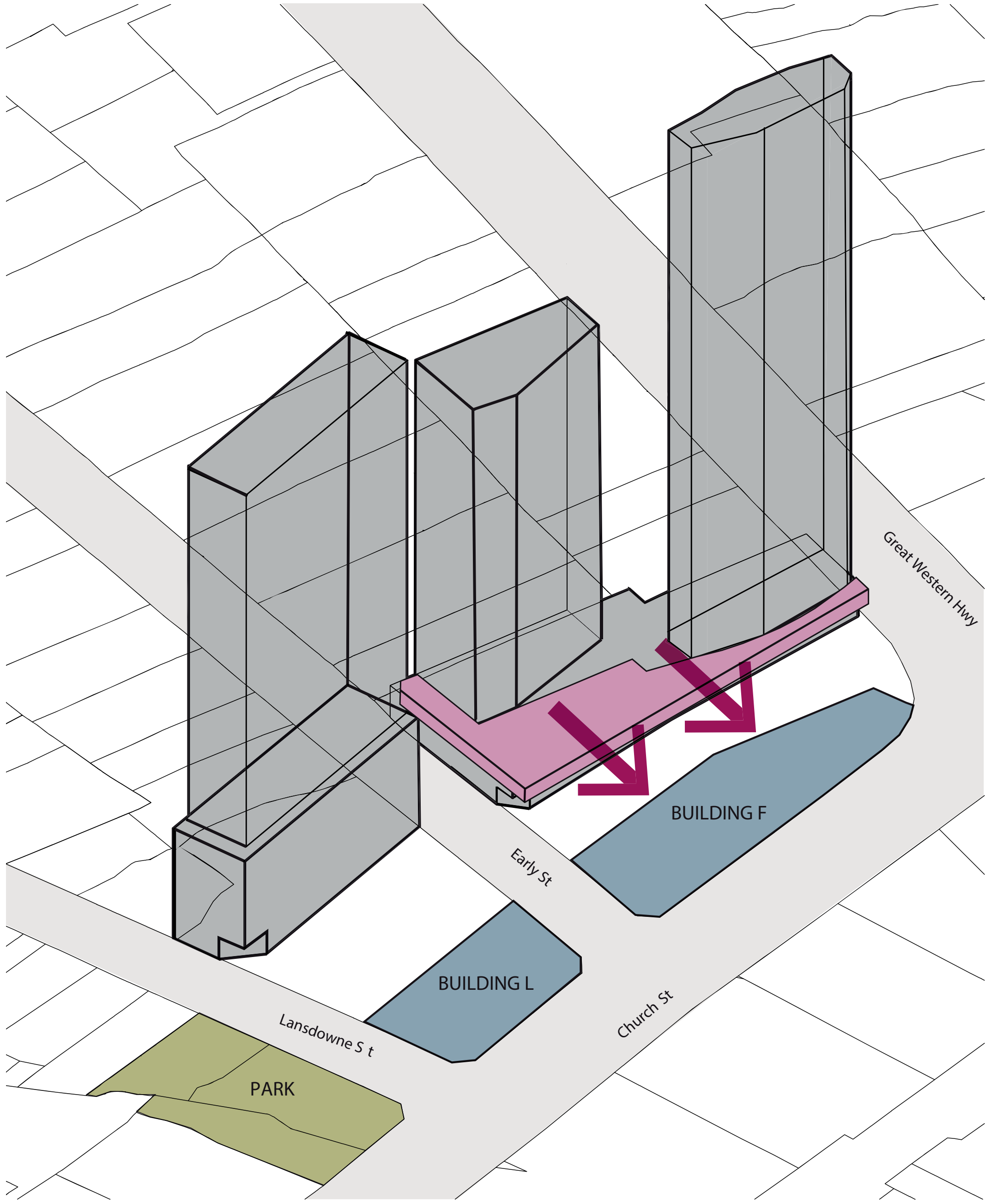
We manipulated the podium line on ground floor to maintain the minimum 15m width of the Plaza stipulated in the VPA.

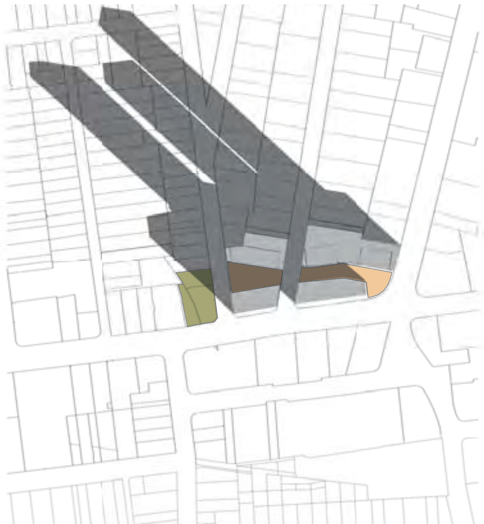
The podium corners were chamfered at ground floor level to improve visual and pedestrian connectivity between the future public street to the south and the site 2 plaza in response to the design jury's comments at pre-DA stage. The site 1 corners were also chamfered to improve connectivity between Early Street and the site 1 plaza.



07 COLONNADE

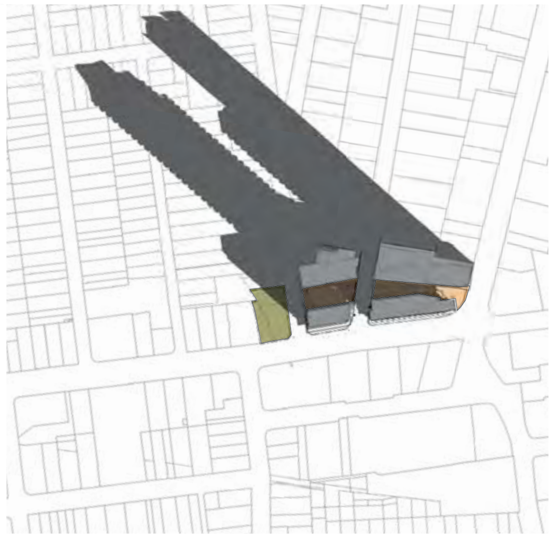
The upper level of site 1 podium was extended to create a double height colonnade along the site 1 plaza frontage.





% Linear Plaza Overshadowed = 76%
% Clay Cliff Park Overshadowed = 18%

VPA SHADOW MIDWINTER 9AM



% Linear Plaza Overshadowed = 82%
% Clay Cliff Park Overshadowed = 16%

PROPOSED SHADOW MIDWINTER 9AM

% Linear Plaza Overshadowed = 46%
% Clay Cliff Park Overshadowed = 49%

VPA SHADOW MIDWINTER 12NOON

% Linear Plaza Overshadowed = 49%
% Clay Cliff Park Overshadowed = 53%

PROPOSED SHADOW MIDWINTER 12NOON

% Linear Plaza Overshadowed = 86%
% Clay Cliff Park Overshadowed = 100%

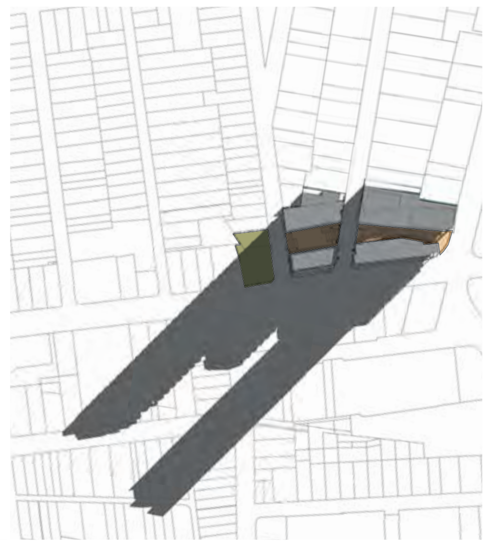
VPA SHADOW MIDWINTER 1PM

% Linear Plaza Overshadowed = 85%
% Clay Cliff Park Overshadowed = 79%

PROPOSED SHADOW MIDWINTER 1PM

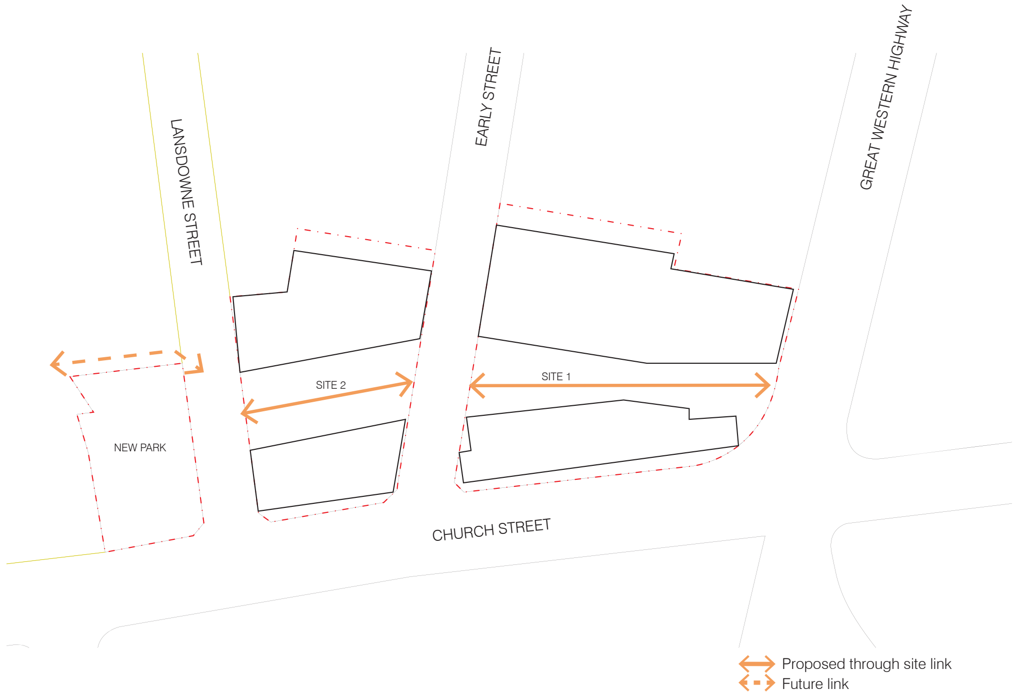
% Linear Plaza Overshadowed = 95%
% Clay Cliff Park Overshadowed = 90%

VPA SHADOW MIDWINTER 3PM

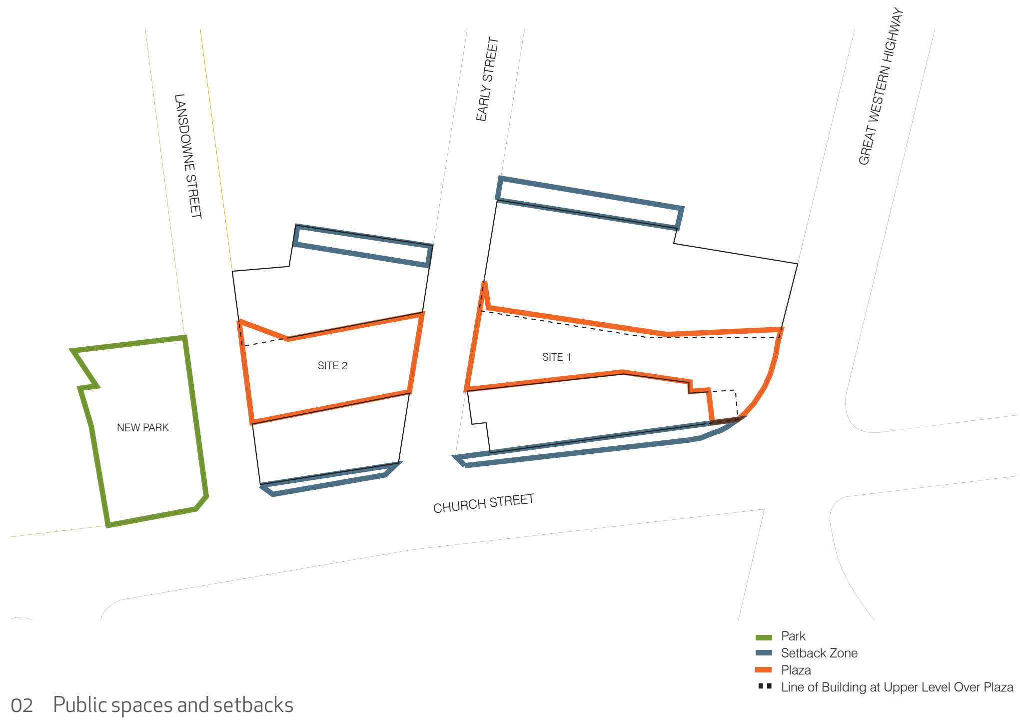


% Linear Plaza Overshadowed = 95%
% Clay Cliff Park Overshadowed = 83%

PROPOSED SHADOW MIDWINTER 3PM



01 Through site links



02 Public spaces and setbacks

03 Pedestrian access

04 Vehicular access

URBAN DESIGN

01 THROUGH SITE LINKS

A continuous through site link connects the Great Western Highway / Church Street corner at the northern end of site 1 to the site 3 park, with provision for future connection to the projected new public street to the south.

02 PUBLIC SPACES AND SETBACKS

A publicly accessible thoroughfare (plaza) is provided to sites 1 and 2 which is at least 15m wide at ground level. The area of the plaza is as follows:

- Site 1: minimum 1600m^2
- Site 2: minimum 1350m^2

5m setbacks are provided to the Church Street frontage of sites 1 and 2 to allow for future road widening.

6m setbacks are provided to the western edge of sites 1 and 2 to provide a buffer zone between the new development and existing residential areas.

03 PEDESTRIAN ACCESS

Residential, retail and commercial lobbies open directly off the plaza and surrounding street frontages which will activate the public domain both day and night.

04 VEHICULAR ACCESS

Residential, retail and commercial parking entries and exits are located off Early Street; driveways are proposed to be grouped to minimise the impact on pedestrian amenity.

To reduce truck movement in Early Street, loading access to site 1 has been separated, with the entry located off Early Street and exit proposed to the Great Western highway. Loading entry and exit to site 2 is located off Early Street.

PUBLIC DOMAIN DESIGN STATEMENT URBAN FABRIC

This document sets forth the guiding principles for the landscape and external public and communal spaces for the development of Gateway South, Parramatta. The proposed landscape treatment is integrated within the development's ground floor plazas, private podium gardens, a new park and the interfaces with both existing streetscapes and the new commercial streetscape.

The master plan exploits the site's location between the Parramatta CBD and surrounding residential areas to create opportunities for economically viable retail areas along the new public domain on street level as well as in the first basement level.

The design provides commercial space above the retail level suitable for a variety of purposes such as a child care centre, gym or office suites with good exposure to street frontages and access to natural light. The commercial building on Church Street has been planned as a flexible space suitable for a variety of uses. The master plan provides well oriented residential accommodation with appropriate setbacks from the commercial buildings and other residential buildings.

The proposed design locates the built form to maximize solar access and visual connections to the new linear plaza and park, despite the predominant scale of the proposal and the location of the tall buildings north of the park.

The proposed buildings are arranged to form a sequence of spaces along the public domain linear plaza; a wider 'gateway' space at the northern end with flanked by the taller buildings, giving it an 'urban' feel, continuing southwards with a gradual increase in width and reduction in scale to the park at the southern end which has a lower-scaled, suburban feel.

The linear plaza visually extends across both Early and Lansdowne Streets, with pedestrian crossings and reduced road widths to suggest pedestrian priority and calm traffic. Tree planting at these points creates thresholds between the commercial areas along Church Street and the residential areas to the west. The proposal provides sheltered, activated edges along the full site frontage of Church St and the linear plaza, with residential and commercial lobbies opening directly off the plaza and expanding the perception of the public realm beyond the building line.

DESIGN OBJECTIVES

The key design objectives of the public domain design for Gateway South include:

- Responding to the broader context and the future changes to Auto Alley Precinct and Parramatta including the potential Clay Cliff Creek parklands and changes to the local transport network.
- Creating a high quality and distinctive character suitable for the site, the precinct and Parramatta.
- Provide memorable but human-scaled public spaces at ground level.
- Provide an equally successful environment for both day-time and night-time use of the publicly accessible spaces.
- A well-considered and sensitive design that helps to integrate the buildings with the proposed public spaces on the site and with the surrounding public domain.
- Maximising opportunities for ecologically sustainable design.
- Provide integrated design with building footprints which minimises offsite flooding impacts and considers residual flood risk to public domain users
- Helping to integrate pedestrian, bicycle, vehicle and public transport

STREETSCAPE

The treatment of the streetscapes surrounding and between the sites aims to:

- Enhance and reinforce Church St as Parramatta's main street and major north-south connection for vehicles, pedestrians and views, and responding to Church Street's role as "Auto Alley", celebrating car culture including potential new public art;
- Reinforce Great Western Highway as a major gateway to the city, with the corner of Great Western Highway and Church St designed as a "Gateway" with the potential for a large scale artwork;
- Connect with the "Church St South" precinct immediately north of the site;
- Allow for a new pedestrian crossing of Church St at Early St to connect the potential chain of parks to the east;
- Accommodate the future connection to the south-west of the park on Site 3;
- Allow for the proposed future widening and cycleway along Church St;
- Reinforce north-south pedestrian movement through the site between the park on Site 3, Site 2 and Site 1 across Early and Lansdowne Streets.
- New street tree planting along Church St, Great Western Highway, Early St & Lansdowne St;
- Great Western Highway, Church St, Early St & Lansdowne St to have "Primary treatment" paving.

Well connected and good looking streets and public spaces will contribute to the Parramatta's pedestrian and environmental amenity and provide the location for important social activities including sitting, people watching, window shopping, outdoor dining and resting. Improving public domain design will provide many benefits for the city by supporting sustainable travel and equitable access, health and well being, public safety and social engagement.

Church Street along the front of Sites 1 and 2 will include a 5m wide dedication zone to allow for future road widening and acquisition by RMS including a 3.5m road widening to cater for an upgrade to the Church St & Great Western Highway intersection, and a 1.5m zone for cycle way & footpath. We have also allowed for the cycleway to continue along the Church St frontage of Site 3 (park). Due to the future road widening, tree planting is proposed to be located outside of this setback to enable trees to be provided in advance of the widening works. The street trees would be located within a planted verge which will help separate the footpath and cycleway from the road.

The 5m dedication zone would also provide flexibility if the preferred route option for the Western Sydney Light Rail Network affects the section of Church Street in Auto Alley and also for an accessible bus stop on Church Street. We have also allowed for a potential traffic light system at the Early intersection with Church Street including a new pedestrian crossing across Church Street to link with the potential future park on the opposite side of the street, which forms part of the Clay Cliff Creek chain of parks.

The streetscape treatment of the Great Western Highway will provide wide footpaths paved from boundary line to kerb with the introduction of new street tree planting for shade and amenity. The two major streets (Church St and Great Western Highway) would include appropriate street furniture provision in the form of litter bins, bicycle racks etc, although seating will generally be located on quieter side streets and in the public domain spaces within the sites.

New street tree planting and paving is also proposed for Early and Lansdowne Streets but with the trees located in a grass verge to the back of the kerb with paved footpaths to the site boundaries. Generous pedestrian crossings are proposed on both streets where the north-south pedestrian link crosses to provide easy and safe pedestrian access between the three sites. These crossings would include carriageway narrowing and pram ramps. In the future when pedestrian numbers would be expected to be higher, consideration should be given to upgrading these crossings as marked pedestrian crossings or raised 'wombat style' crossings with appropriate traffic signage.

All public domain streetscape works would be designed with "Primary treatment" paving in accordance with Parramatta City Council's Public Domain Guidelines (Parramatta City Council - Urban Design Unit August 2011).

SITE 1 & 2 PUBLIC DOMAIN

The public domain which forms part of Sites 1 and 2 will primarily consist of the north-south pedestrian walkway and plaza spaces which will serve as the primary pedestrian connection through the site, linking the two development sites with the park on Site 3 to the south and to the Great Western Highway and "Church St South" precinct to the north. These public domain spaces will also provide access to the residential and commercial lobbies. The design of these spaces has been based around providing permeable spaces with strong north-south accessibility but also east-west cross connections. They are also intended to provide a range of different spaces for possible events, gathering, seating, outdoor dining etc as an extension of the "Church St South" entertainment to the north. The design and positioning of the buildings maximise solar access into this space, with good sun penetration around the middle of the day but also some sun in the afternoon.

Whilst the Site 1 and 2 public domain will act as a north-south pedestrian link and essentially forms a single space, a range of different secondary spaces will be created within it using tree planting, changes in level and planters. These will have different functions, with the main circulation zones being provide along the east and west edges against the buildings and under the protection of awnings, and the main gathering spaces in the centre. There would be outdoor seating/dining opportunities along the west edge of the public spaces with the main event/gathering/communal seating spaces located towards the middle. There is the opportunity for a weekend market concept using the plaza spaces and this could be extended across Early St by means of a temporary road closure.

The public domain is generally paved with low planting provided at changes in level and clear stemmed trees throughout. A double row of trees is proposed down the whole length of the Site 1 and 2 public space to create a strong visual link through the space to the park on Site 3, as well as provide amenity, shade, wind protection. These will be supplemented by low planting to help define different spaces and provide interest. A range of opportunities will be included for public seating including bench type seating, seating edges and seating steps.

The plaza spaces have generally been set at RL 12.9 AHD, 0.5m above the 100 year flood level with a series of ramps, steps and terracing to connect back to street level. The raised level has been set back from Lansdown and Early street into the plaza spaces to minimise offsite flooding impacts.

PODIUM AND ROOF GARDENS GENERALLY

The design of both Site 1 and Site 2 podium and roof gardens would take account of the design principles contained within SEPP 65. The design of these podium areas will aim to create highly usable spaces but also spaces that are attractive whether seen from within or when viewed from above. To this end, strong and simple geometries would be used with bold patterning in the ground plane treatment and with the planting.

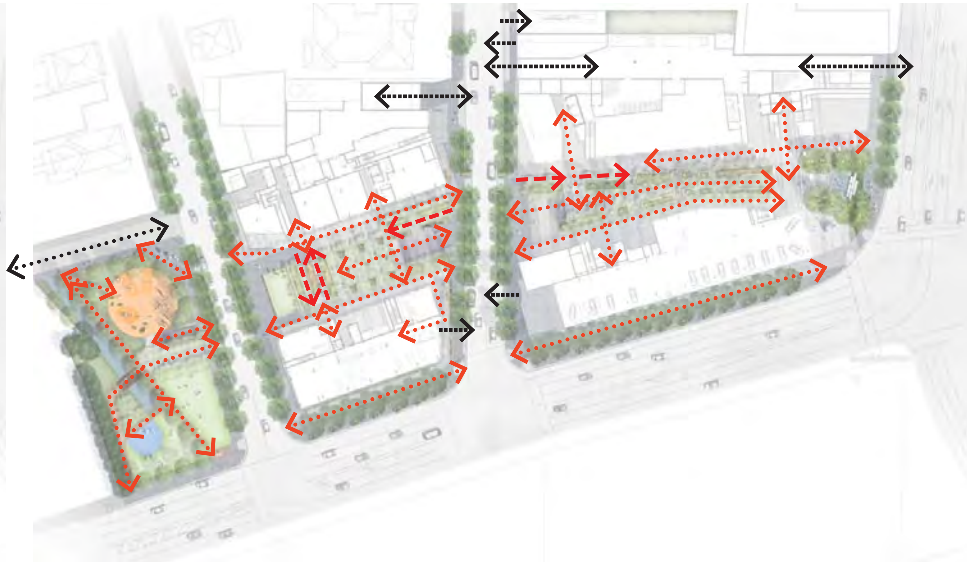
Paving treatments would include pavers for main pathways, terraces, and other heavily used areas. Select areas would have timber decks. Non trafficable areas could be paved in feature pebbles or gravel.

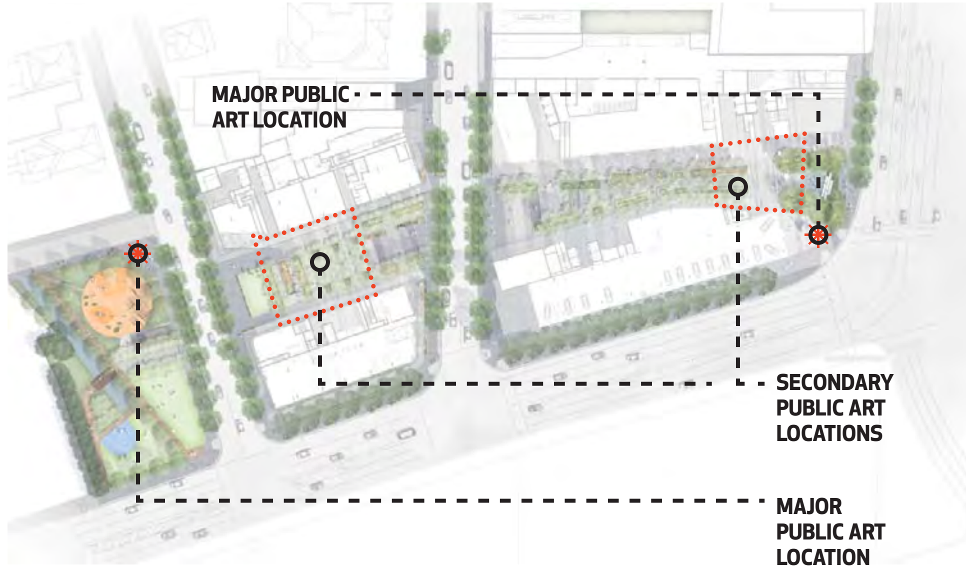
Shade is a key requirement of podium gardens and whilst the residential towers will provide shade at certain times of day, this will be supplemented in key areas by covered areas and tree planting. BBQ areas could be provided for both commercial and residential podium gardens with table settings. Seating would be located throughout the podium gardens, carefully grouped to promote social interaction whilst allowing for privacy, and sensibly located to provide an outlook.

Planting and lawn areas will typically be raised with adequate soil depth, drainage and irrigation essential requirements. Planting will include small trees as well as shrubs with all plant species selected to be suitable for the available soil depth, degree of sun or shade, and level of exposure. The species palette should aim to provide year-round interest in plant form, foliage colour and texture, and flowering.

Lighting shall aim to provide adequate lighting for main pathways and spaces but without over-lighting or creating glare issues for adjacent apartments. Lighting will typically be low level lighting using bollards or wall mounted lights.

PUBLIC DOMAIN PRINCIPLES





LANDSCAPE SPACES

01 ENTRY SPACE + WATER PLAY
02 LEVEL PLAZA WITH PLANTING
03 LANDSCAPE STAIRS / RAMP TRANSITION SPACE
04 NORTH FACING PARK PLAZA
05 PLAYSPACE
06 OPEN LAWN
07 EXISTING CATCHMENT CHANNEL
08 ACTIVE RECREATION

CIRCULATION

VEHICULAR ENTRY
FUTURE ROAD
PEDESTRIAN CIRCULATION
RAMP

PUBLIC ART STRATEGY

PUBLIC DOMAIN PRINCIPLES

WSUD

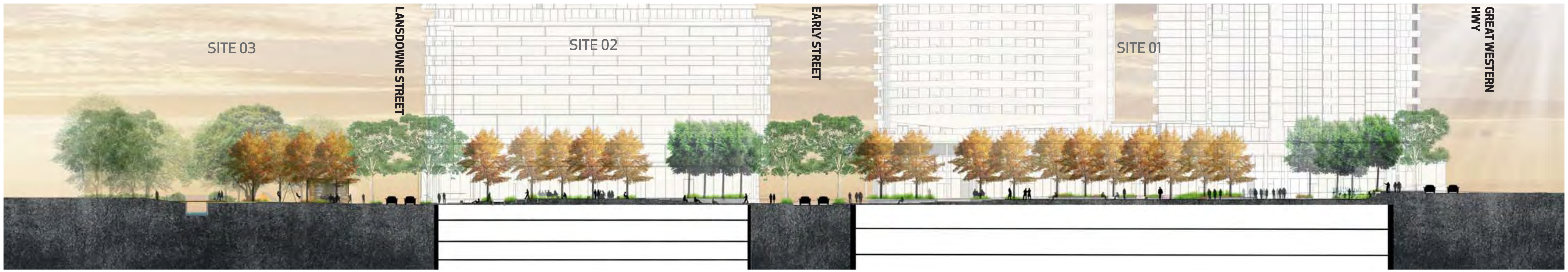
- SWALES
- TREE PIT (NEAR BUILDING)
- TREE PIT (NEAR ROAD)
- RAINGARDEN
- INFILTRATION

TREE PLANTING

- FEATURE
- SMALL FEATURE
- BUFFER
- STREET TREE

MASS PLANTING

- FEATURE
- VERGE PLANTING
- BUFFER
- TURF



SECTION AA 1:750 @ A3

SCALE 1:750 0 5M 10M 20M

NORTH

WATER SENSITIVE URBAN DESIGN (WSUD)

A Water Sensitive Urban Design Strategy (WSUD) has been developed for the site and closely integrated with the landscape design. This will include the following key measures:

- Rainwater tanks collecting rainwater from roofs etc and storing this for reuse in irrigation;
- Planted swales to collect and detain surface water located along Church St and parts of Early and Lansdowne Sts;
- Biofiltration rain gardens located on either side of Early and Lansdowne Sts in blisters either side of pedestrian crossings;
- Tree pits with passive irrigation located adjacent to the kerb along Early and Lansdowne Sts;
- Tree pits with passive irrigation located within paved areas in Site 2 and the park (Site 3);
- Infiltration areas located within the main lawn areas of the park (Site 3).

TREES

Species	Common Name
Angophora floribunda	Rough-barked Apple
Eucalyptus tereticornis	Forest Red Gum
Melaleuca styphelioides	Prickly Paperbark

GRASSES/SEDGES/RUSHES

Species	Common Name
Carex appressa	Tall Sedge
Carex irversa	Knob Sedge
Eleocharis sphacelata	Tall Spike Rush
Ficinia nodosa	Knobby Club Rush
Juncus usitatus	Common Rush
Lomandra longifolia	Tanika
Poa labillardieri	Large Tussock Grass





PUBLIC ART STRATEGY

The Gateway South precinct offers an opportunity to create a connected series of major public artworks to mark key points in the precinct, enrich the public domain and interpret and communicate the natural and social history of the area.

The principles of our concept public art strategy were established in response to Parramatta Council's Civic Improvement Plan (CIP); with the aim of contributing to a high quality urban design and public domain character for Parramatta city centre by:

1. Facilitating the interpretation, conservation and articulation of the heritage of Parramatta through the telling of legible historical and contemporary stories;
2. Creating 'places' through the integration of art and interpretive material into the fabric of the city centre in ways to reflect, respond and give meaning to the city's unique environment, history and culturally diverse society;
3. Enabling public art to reflect and engage with community aspirations, create discussion, interest and awareness, and foster relationships between people and place; and
4. Identifying sites for public artworks that are both city scaled and pedestrian scaled

The CIP identifies two relevant sites to the proposed development:

5. A Gateway large scale artwork at the intersection of Church Street and the Great Western Highway to be read by vehicular traffic.
6. Large scale works along Church Street celebrating the Auto Alley identity and car culture

Further, this concept public art strategy identifies a number of other opportunities for public art:

7. A major artwork located in the park on Site 3, which celebrates the key landscape restoration idea behind the park and the broader Clay Cliff Creek Parklands. This artwork could be located near the park entry off Lansdowne St and could help to terminate the vista through the central plaza space of Sites 1 and 2; and
8. A number of smaller scale artworks throughout the development, potentially along the linear Plaza connecting the three sites.

The design concept for the design excellence competition winning scheme was the "meeting of the waters"; the point on Parramatta River at which the fresh river water meets the salty harbour water. This has been interpreted not only in the façade and design of the buildings, but also in the public domain. Alongside the car culture themes identified in the CIP, these concepts will form the basis of a detailed public art strategy to be submitted in the next stage development applications.

The integration of art and design within the Gateway South precinct should create a distinctive environment, aid orientation, and assist in the articulation of the spaces critical to the creation of places. Art will reinforce the experience of the place and invite rest, recreation and enjoyment. Works of art will enrich the experience of visitors, invite curiosity about Parramatta's history from pre-settlement times, and encourage the wider public to enjoy the newly enhanced spaces. Art will define the future of the place assist in identifying the neighbourhood and build a sense of ownership and community.

The detailed public art strategy will refine the locations and themes identified in this report. In a staged process, a list of artists will be assembled for consideration. The process will involve consultation with the Parramatta City Council and other authorities as appropriate.

- The precinct presents a range of unique opportunities for public art to add to the place, including the interpretation of the water and car culture themes through;
- Play elements;
- Aerial views i.e. looking down onto the site from the proposed towers both from within this project and from future projects along Auto Alley;
- Street furniture;
- Educational/environmental;
- Heritage & archaeological interpretation (Natural, Indigenous and Non Indigenous);
- Lighting: catenary lighting, in ground lighting, interactive lighting, architectural lighting;
- Building facades;
- Ephemeral and temporary works.

PUBLIC DOMAIN MATERIALS

The public domain streetscape materials would be designed in based on the “Primary treatment” paving in accordance with Parramatta City Council’s Public Domain Guidelines. Within the sites, the public domain materials would seek to complement the streetscape materials but would incorporate greater variety and richness.

The paving within the plaza spaces and park would be precast concrete pavers with brick paver detailing. The same treatment would be adopted for ramps and steps. Special areas would have a different paving treatment such as the events/performance area at the north end of Site 1 and the smaller gathering space at the north end of Site 2. These could include brick paving or timber decking. Planter and terrace walls would be insitu concrete with brick detailing. Seats would be hardwood timber on steel frames with concrete bases again with brick detailing.

All final material selections will be heavily informed by maintenance considerations for the landscape and the use of robust user friendly materials and multi-purpose furniture. All aspects of detailing, material choice and vegetation densities will be tested against an understanding of their life cycle, prevailing site conditions, longevity and durability.

SURFACES




ELEMENTS

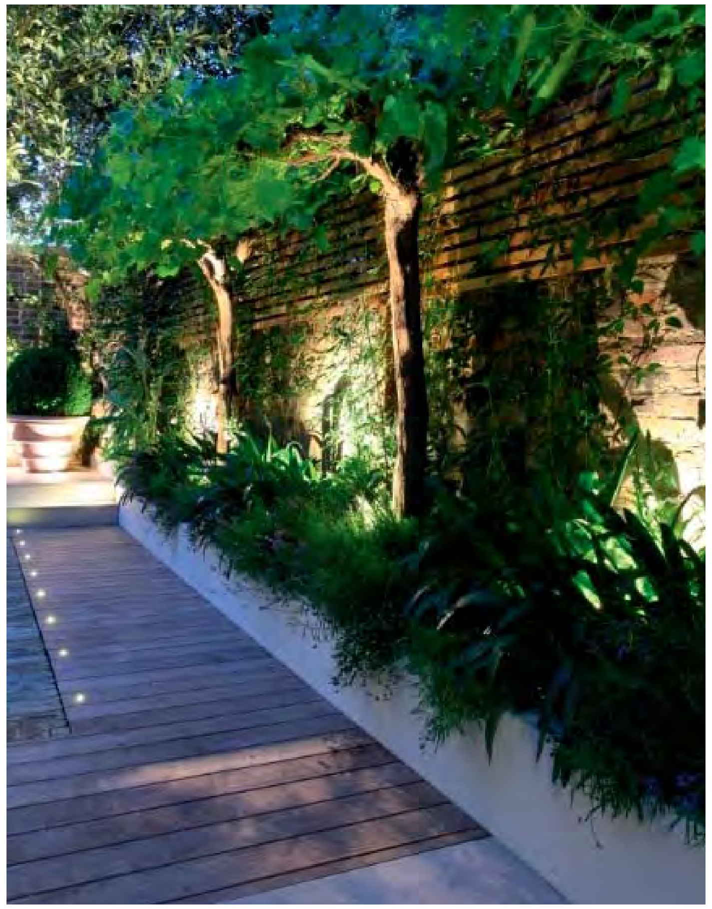


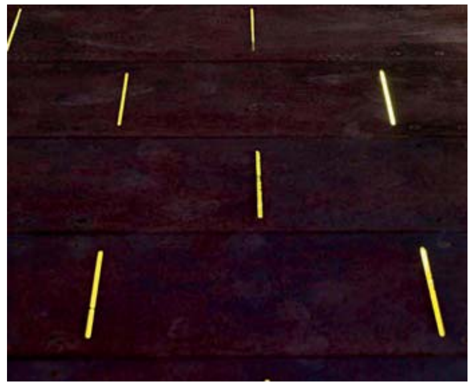

FURNITURE

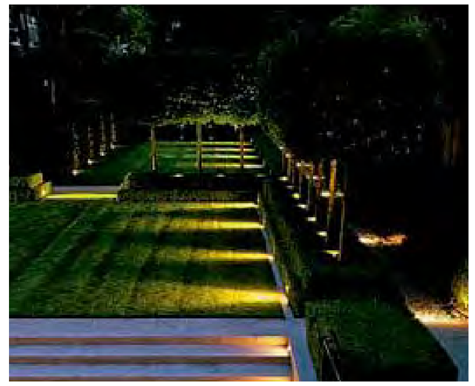


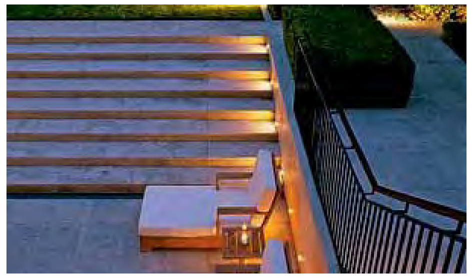

LIGHTING

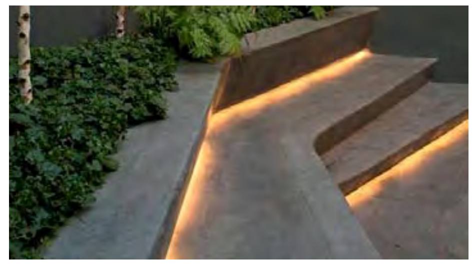
Public domain lighting will be designed to meet relevant Australian standards and to provide a suitable level of lighting for public safety and security without over-lighting spaces. Within the main plaza space through Sites 1 and 2, this would consist of either a catenary lighting system or a limited number of tall mast lighting with directional spot lights to minimise the impact at ground level. In additional to general lighting, there would also be opportunities for feature lighting of elements including the water feature, walls, steps, seating elements and trees. The park lighting would include pedestrian pole lighting, supplemented by feature lighting.











PLANTING STRATEGY

The planting strategy for the public domain will include street tree, feature, buffer/screen and riparian planting. Street tree planting species would be in accordance with Council's requirements. The predominant tree planting through the public plaza space in Sites 1 and 2 will consist of medium sized, hardy, deciduous trees of approximately 12m mature height with clear stems. At the ends of the plaza space, small evergreen trees will be used for wind amelioration and as a buffer to the streets. Mass planting species will be tough, hardy species suitable for their specific locations and selected to provide interest in their foliage and flowers. Tree species within the park would be predominantly native species.

TREES SITE 01 +02

Image	Species	Common Name
01	Acer buergeranum	Trident maple
02	Melia azedarach	Persian lila
03	Ulmus parvifolia	Chinese Elm
04	Waterhousia floribunda	Weeping lilly pilly
05	Flindersia australis	Crows Ash

TREES SITE 03 PARK

Image	Species	Common Name
06	Angophora floribunda	Rough-barked apple
	Eucalyptus haemastoma	Scribbly Gum
07	Ficus rubiginosa	Port Jackson Fig
	Melaleuca decora	Paper Bark
08	Tristaniopsis laurina	Water Gum

STREET TREES

Image	Species	Common Name
	Corymbia Maculata	Spotted Gum
	Lophostemon confertus	Brush Box


01


02


03


04


05


06


07


08

CENTRAL PLAZA PLANTS

The central plaza will help contribute to the local biodiversity and wildlife habitat by increasing the bio-mass and diversity of the site through planting and bold forms that can be managed and maintained. Plants have been selected that can tolerate low water to reduce maintenance requirements, and that are a suitable size as not to obstruct views to the retail frontages. There will be sufficient soil depths including the provision of deeper soil zones on, under and at the edges of the podium structure.

SHRUBS

Image	Species	Common Name
01	Alpinea caerulea	Native ginger
02	Doryanthes palmeri	Spear Lily
03	Cyathea cooperi	Australian Tree fern
04	Anemone x hybrida	Wind Flower
05	Philodendron Xanadu	Xanadu
06	Aspidistra elatior	Cast iron plant
07	Molineria recurvata	Palm Grass
08	Clivea minata	Kaffir lily
09	Festuca glauca	Blue festuca
10	Hebe pimeleloides	Hebe ' Quicksilver'
11	Lomandra longifolia	Lomandra Lime Wave
12	Myroporum parvifolium	Creeping Boobialla
13	Teucrium fruticans	Blue Germander
14	Westringia mundii	Coastal Rosemary

VINES AND CLIMBERS

Image	Species	Common Name
15	Pandorea jasminoides	Lady Di Bower of beauty
16	Cissus antartica	Kangaroo vine


01


02


03


04


05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11


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14


15


16

PARK PLANTS

The planting within the Park will feature native planting to reduce the need for maintenance and irrigation. Within the playground the planting will be more diverse, non allergenic and a variety of flowering colours.

SHRUBS AND GROUNDCOVERS

Image	Species	Common Name
01	Acacia cognata	Lime Light Acacia
02	Banksia spinulosa	Banksia Candlesticks
03	Blechnum cartilagineum	Gristle Fern
04	Callistemon citrinus	Crimson Bottlebrush
05	Dianella caerulea	Blue Flax Lily
06	Doryanthes excelsa	Gymea Lily
07	Grevillea speciosa	Red Spider Flower
08	Hardenbergia violacea	False Sarsaparilla
09	Hibbertia scandens	Golden Guinea Flower
10	Isopogon anemonifolius	Broad-leaved Drumsticks
11	Leucopogon juniperus	Bearded Heath
12	Pandorea pandorana	Wonga Wonga Vine
13	Teucrium fruticans	Blue Germander
14	Westringia mundii	Coastal Rosemary

ROOF TERRACE PLANTS

The roof terrace will utilise predominantly native, sun loving plants that can tolerate low water to reduce maintenance requirements. Plants have been selected that will not obstruct district views. There will be sufficient soil depths and planter box dimensions to enable suitable mass planting and trees to be grown over podiums.

SHRUBS AND GROUNDCOVERS

Image	Species	Common Name
01	Acacia cognata	Lime Light Acacia
02	Agave attenuata	Agave
03	Artemisia 'Powis Castle'	Mounded Artemisia
04	Campanula poscharskyana	Serbian Bellflower
	Cistus x purpureus	Pink Rock Rose
05	Correa alba	White Correa
	Dianella caerulea	Blue Flax Lily
06	Echeveria 'Blue Curls'	Hens and Chicks
07	Eremophila nivea	Silky Eremophila
08	Gazania tomentosum	Gazania
09	Kalanchoe luciae	Flapjacks
	Hebe pimeleloides	Hebe ' Quicksilver'
10	Lomandra longifolia	Lime Wave
11	Sedum 'Autumn Joy'	Sedum
12	Senecio mandraliscae	Blue Chalk Sticks
13	Pennisetum alopecuroides	Fountain Grass
14	Teucrium fruticans	Blue Germander
15	Westringia mundii	Coastal Rosemary
16	Myroporum parvifolium	Creeping Boobialla

SITE 01 PLAZA SPACE

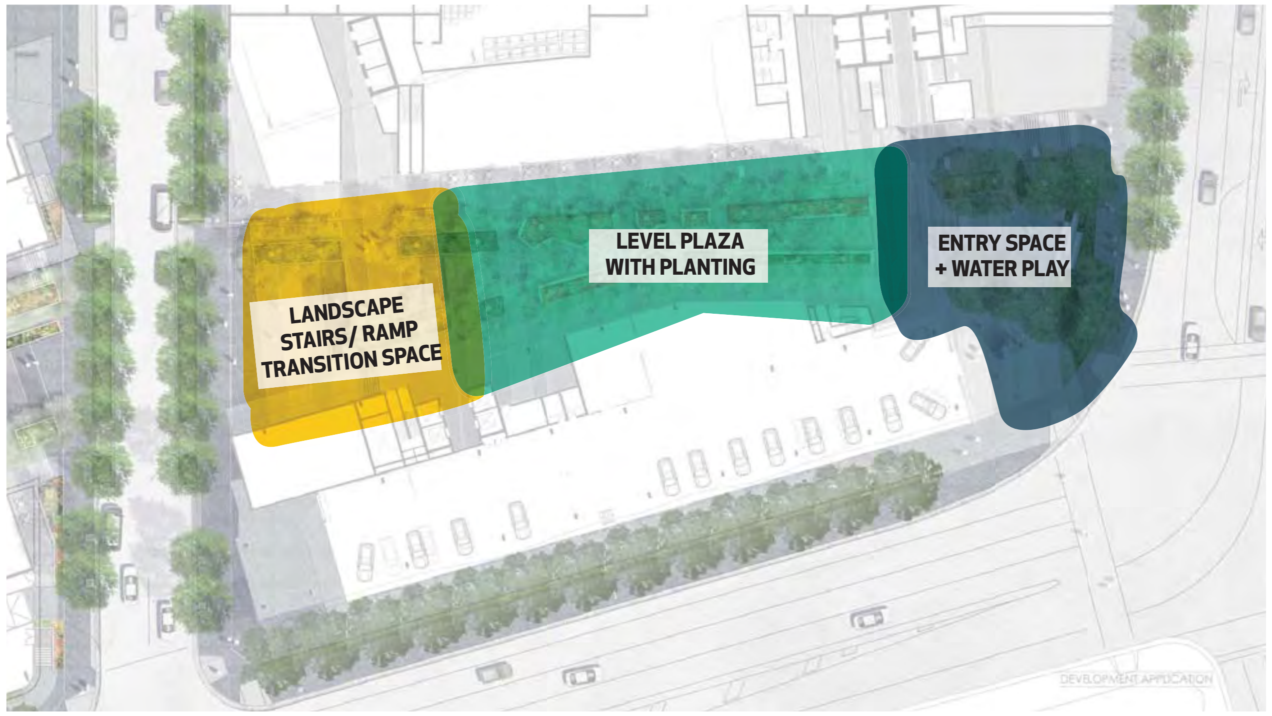
At the interface between the Site 1 plaza and the Great Western Highway, there is a change in level of up to 1.7m, reducing to zero towards Church St. A broad flight of stairs has been provided down into the plaza for pedestrians heading east along the GWH. A series of terraces then take up this level change including both planting and seating, with the latter focused on an events/performance space. The upper level of these terraces provides planting against the GWH to provide both visual/physical separation and some degree of noise attenuation for the plaza space from the road.

The northern part of the Site 1 public plaza includes an interactive water feature which provides feature, a play opportunity for children and can also help to mitigate against the traffic noise from the GWH. This water feature is intended to comprise a series of jets in the paving which can be turned off to allow events to take place. An events/performance space can be accommodated when the water feature is turned off with seating provided by the terraces to the north and other seating elements on the other three sides of the space. This space would have a different paving treatment to the surrounding plaza and would include power and water supplies.

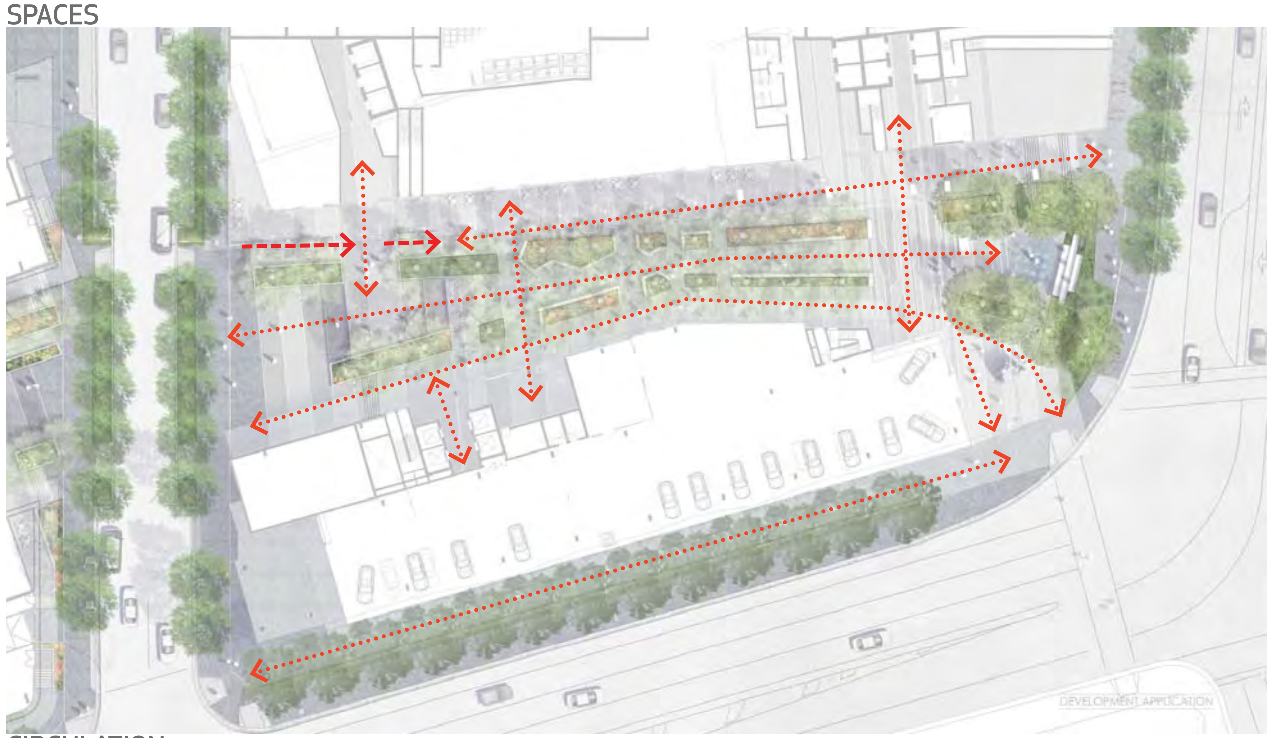
Adjacent to the entries to the commercial and residential lobbies in the centre of the Site 1 public space, there is a break in the tree planting to reinforce the building entries and aid with way finding. A series of flush skylights have been incorporated into the paving above the Retail Mall, along with four raised skylights attached to the end of planters. Strong east-west connectivity across the plaza has been provided through the creation of gaps in the planters.

To the south of this, the double row of trees continues with seating beneath. Adjacent to Early St, the plaza terraces down to street level in the centre with a flight of stairs against the building on the west side and a ramp on the east side providing disabled access.

Planters are generally recessed into the slab to minimise raised elements within the plaza space. Some planters are raked up to form seating edges facing into the centre of the plaza with the planters sloping down to meet the plaza level elsewhere.

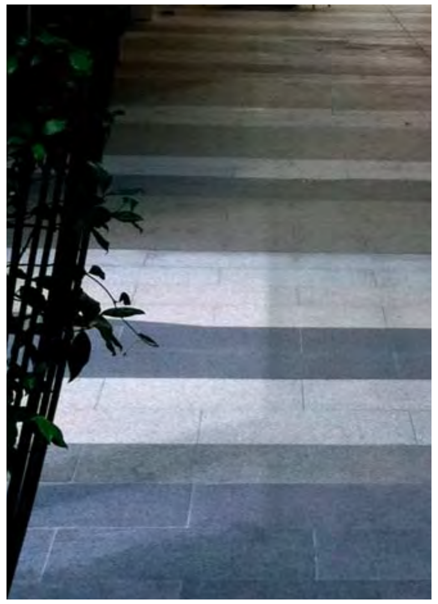


SPACES



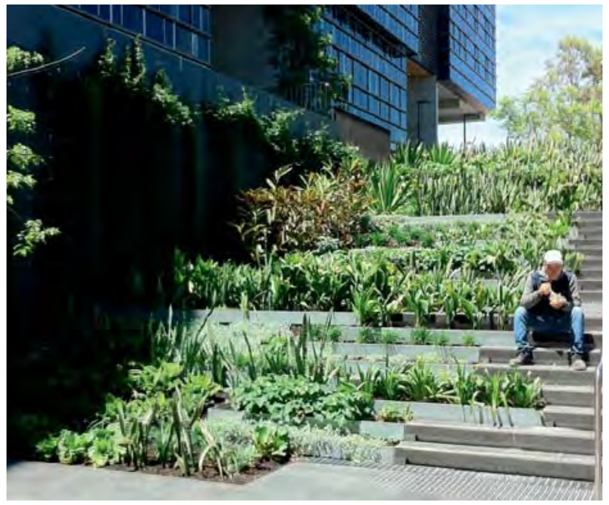
CIRCULATION

New Acton - Active retail edge



Georges Terrace - Paving detail retail edge

Saitama Plaza, Japan - tree lined courtyard



Central Park - Planted stairway

Tree uplighting

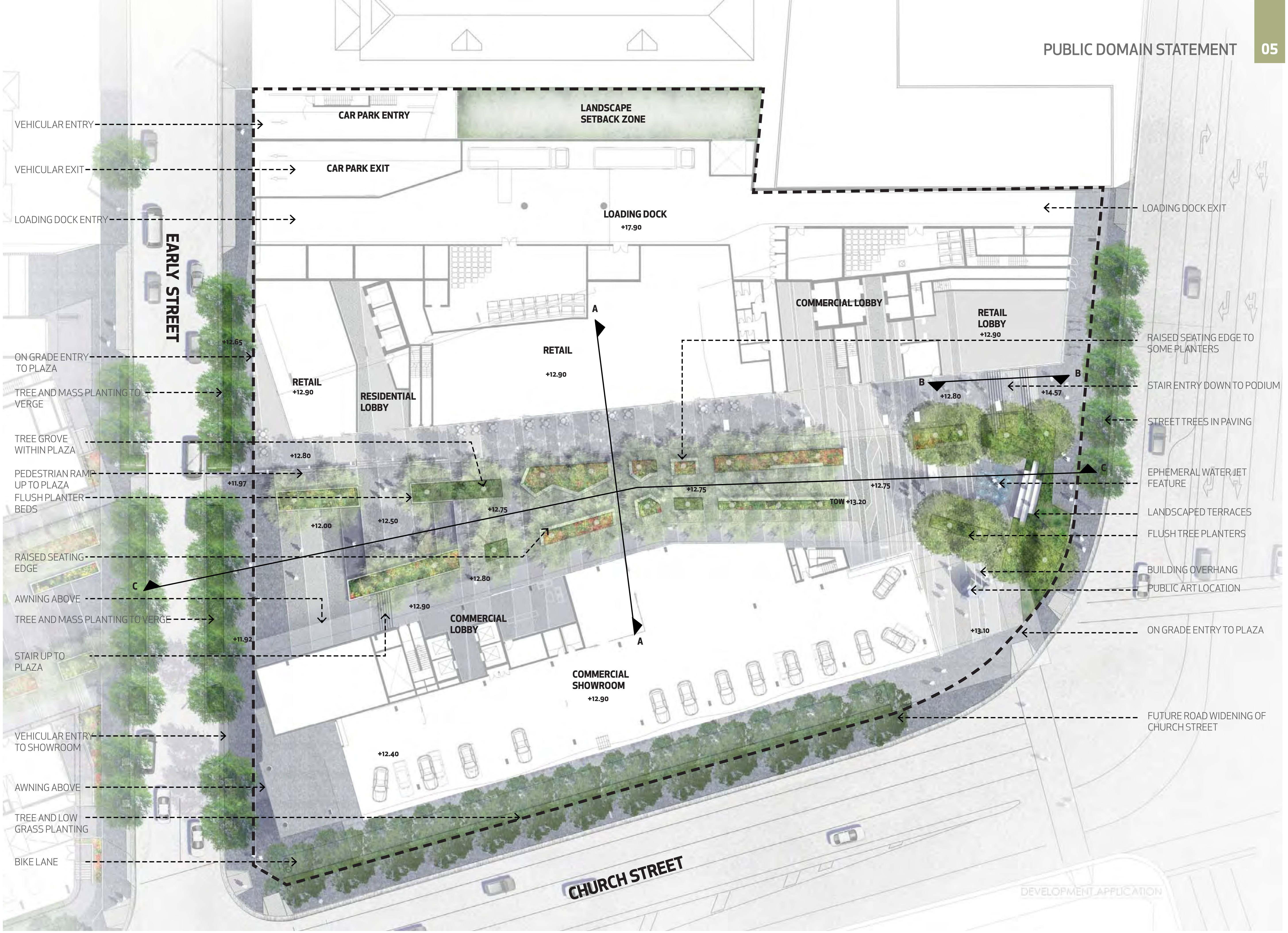
Raised planting beds

University of Sydney - Skylights

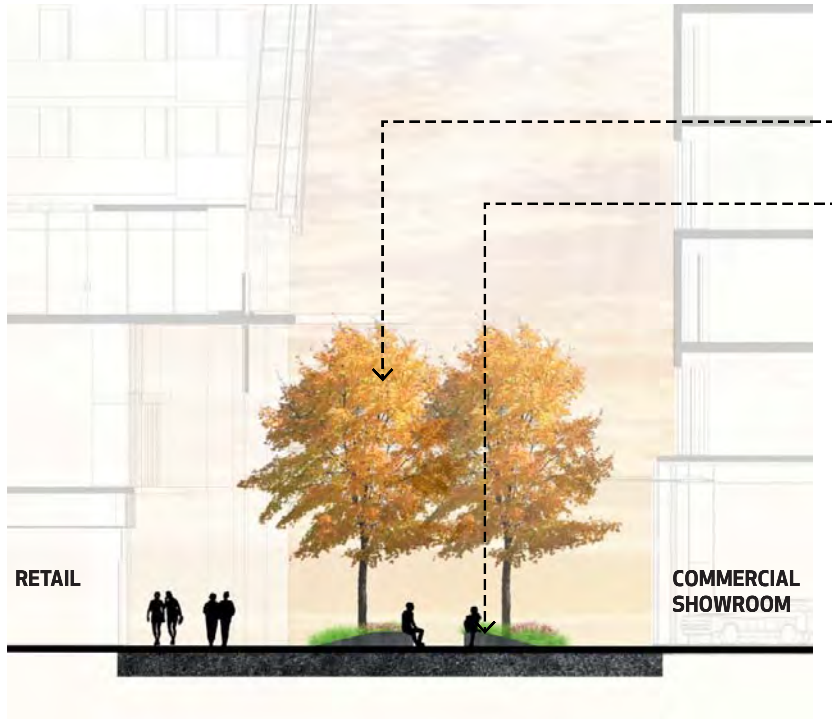
Seating walls

Balgowlah - Custom furniture

Rouse Hill Town Centre - Water feature

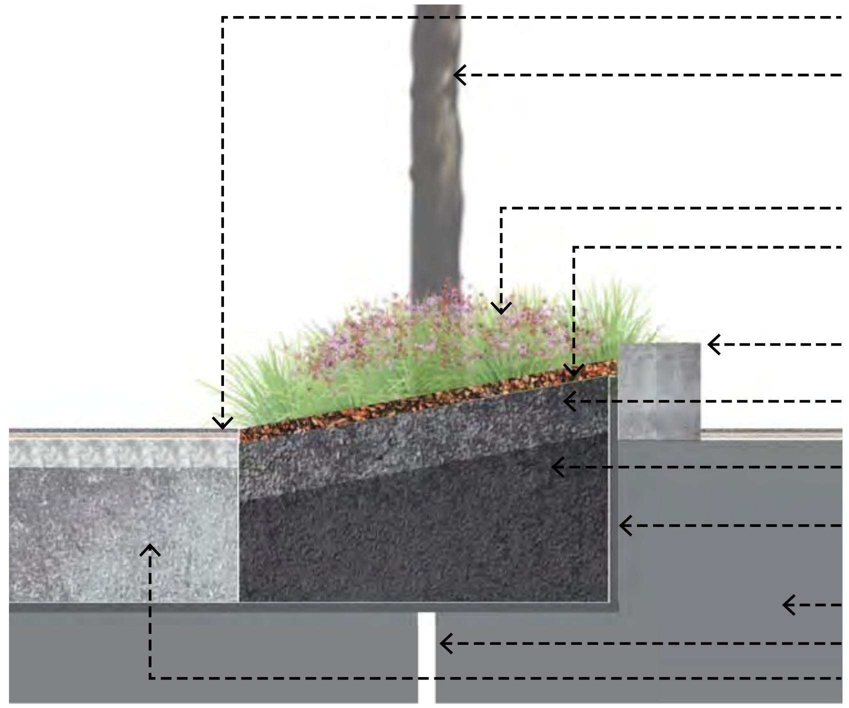


SITE 01 PLAZA PLAN

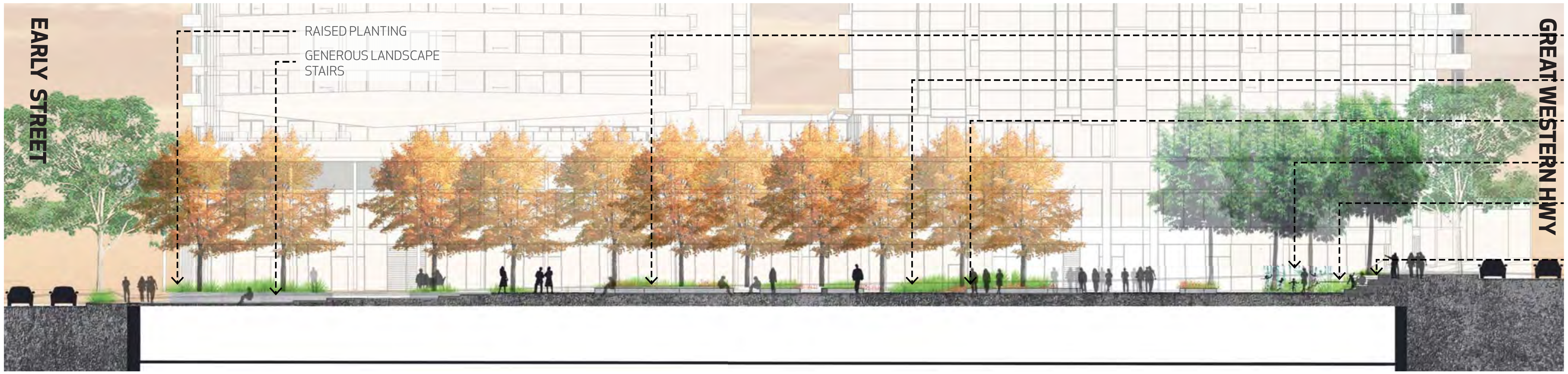


SECTION AA 1:250 @ A3

SECTION BB 1:250 @ A3



DETAIL MOUNDED PLATING WITH SEAT EDGE 1:40 @ A3



SECTION CC 1:350 @ A3

SITE 1 PODIUM

The podium associated with the Site 1 residential buildings is located on level 3 at the base of the two residential towers. The landscape podium will include communal facilities including a pool, spa, sauna, gym and covered BBQ area. These facilities will be located between the two towers on the west side of the podium for solar access. The pool and spa will be surrounded by timber pool decks with lounges and raised platforms for sitting and sunbathing. Privacy planting will be provide along the north and west sides of the pool area as well as pool fencing/gates (in accordance with Australian Standards). The area at the south end of the pool will be paved and will extend under the covered BBQ area to provide a flexible and durable area for small events.

To the east of this, three 'outdoor rooms' have been created with long bench seating allowing small groups or individuals to occupy each space. One of these is located adjacent to the gym and provides an outdoor spill-out area, whereas the other two would be for more informal gatherings.

The south east part of the podium adjacent to private apartments/terraces will be planted as a non-publicly accessible green roof to provide privacy and an outlook for these apartments.

CHARACTER IMAGES


Custom timber furniture

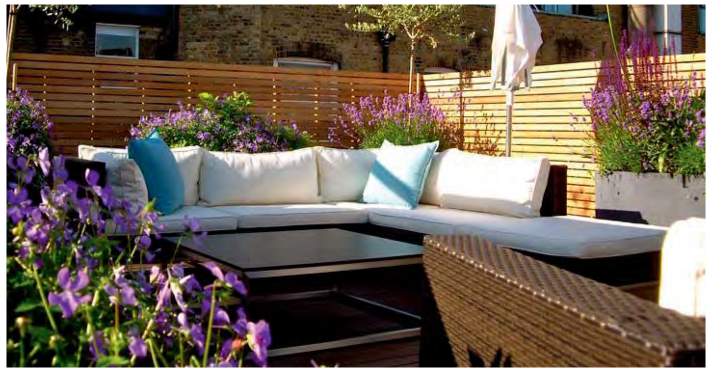

Movable lounges


Custom timber furniture


Lounge seating

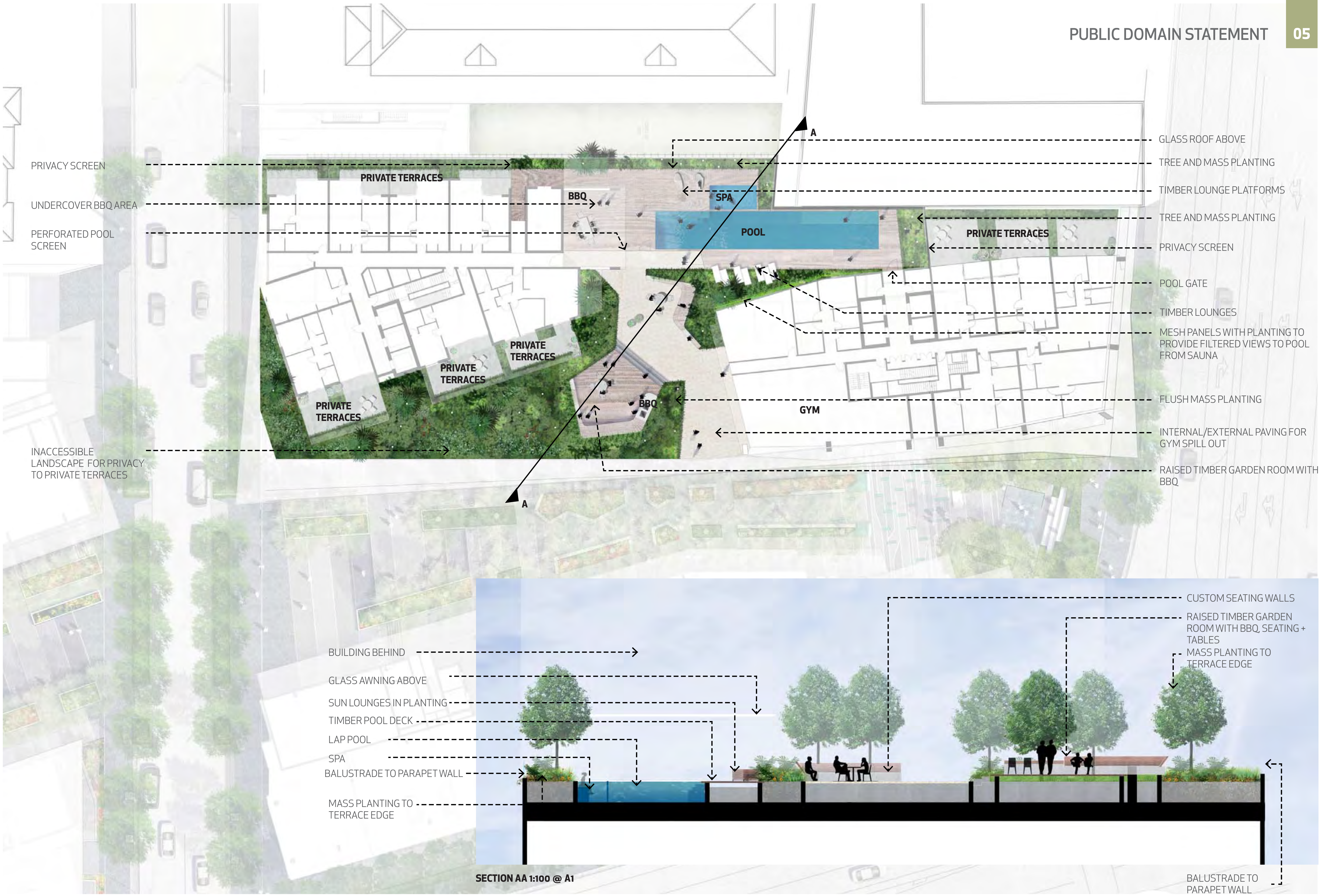

Raised timber platforms


Mesh green walls


Lounge seating


Lush planting


Lush planting

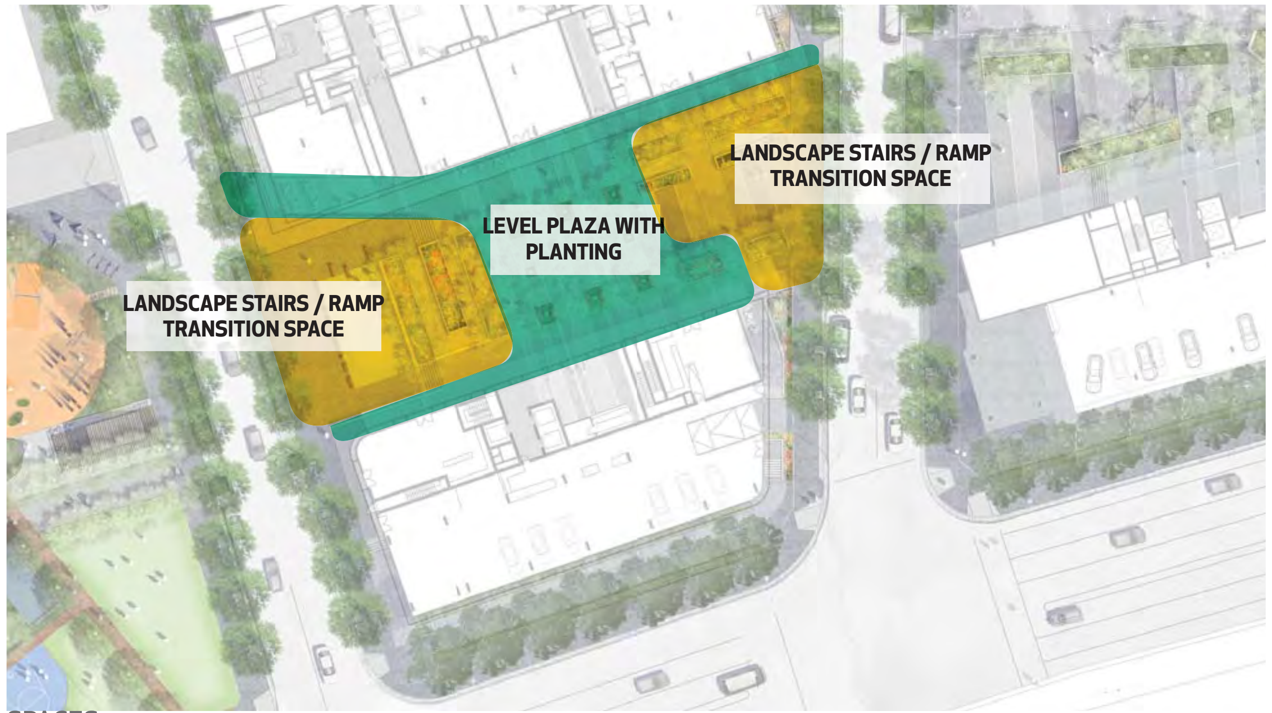


SECTION AA 1:100 @ A1

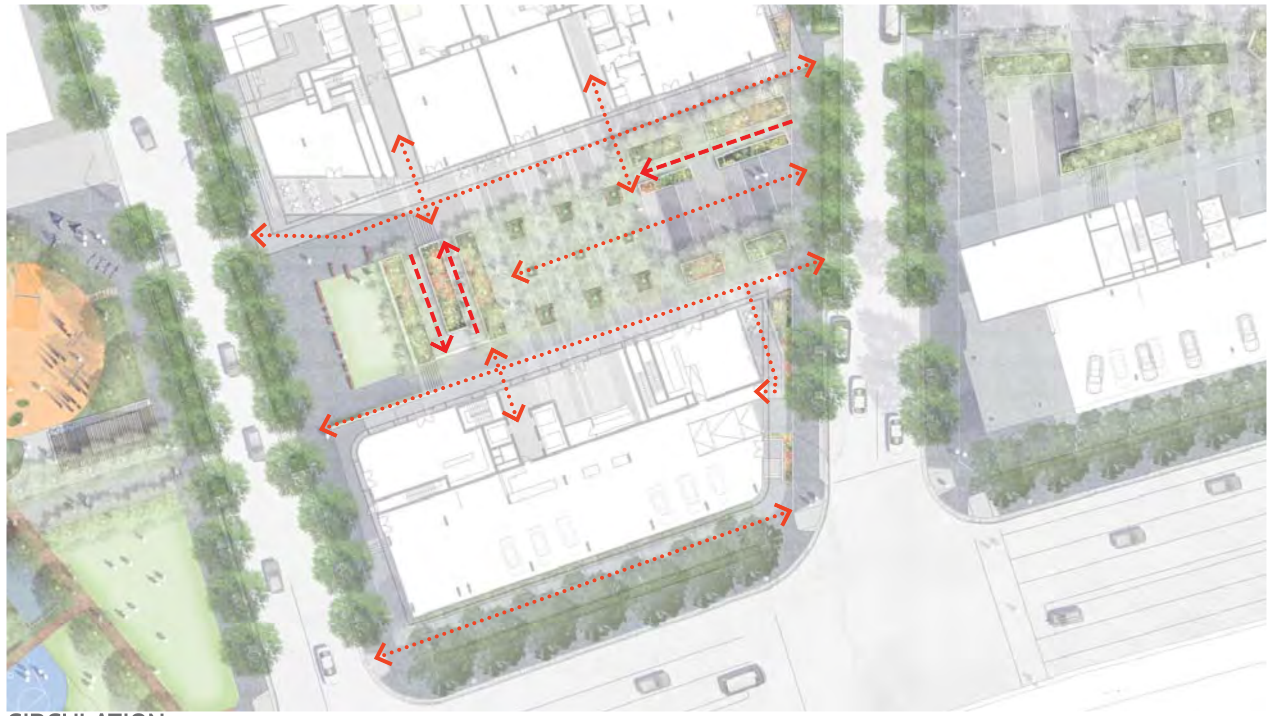
SITE 2 PLAZA SPACE

At the north end of the Site 2 plaza space facing north onto Early St, a space has been formed by the change in level with landscape terraces looking onto a contained space which can function both as a secondary events space and a smaller scale gathering or outdoor seating space. Either side of this, there is a flight of stairs against the building on the east and west side and a ramp providing disabled access.

The central level part of the Site 2 plaza includes a number of seating elements beneath the tree canopy. This terraces down to the Lansdowne St level, with a switchback ramp integrated with planters and flights of stairs against the buildings on either side. The public space through Site 2 will allow pedestrian access by a variety of means using both stairs and ramps, and using a variety of routes with more direct continuous routes along the east and west edges against the buildings and more meandering routes through the centre of the space. Strong east-west connectivity across the plaza has also been provided in the centre of the space beyond the level changes down to street level. Planters are recessed into the slab to avoid raised elements within the central plaza space, with raised planters only associated with the stairs and ramps at either end.



SPACES

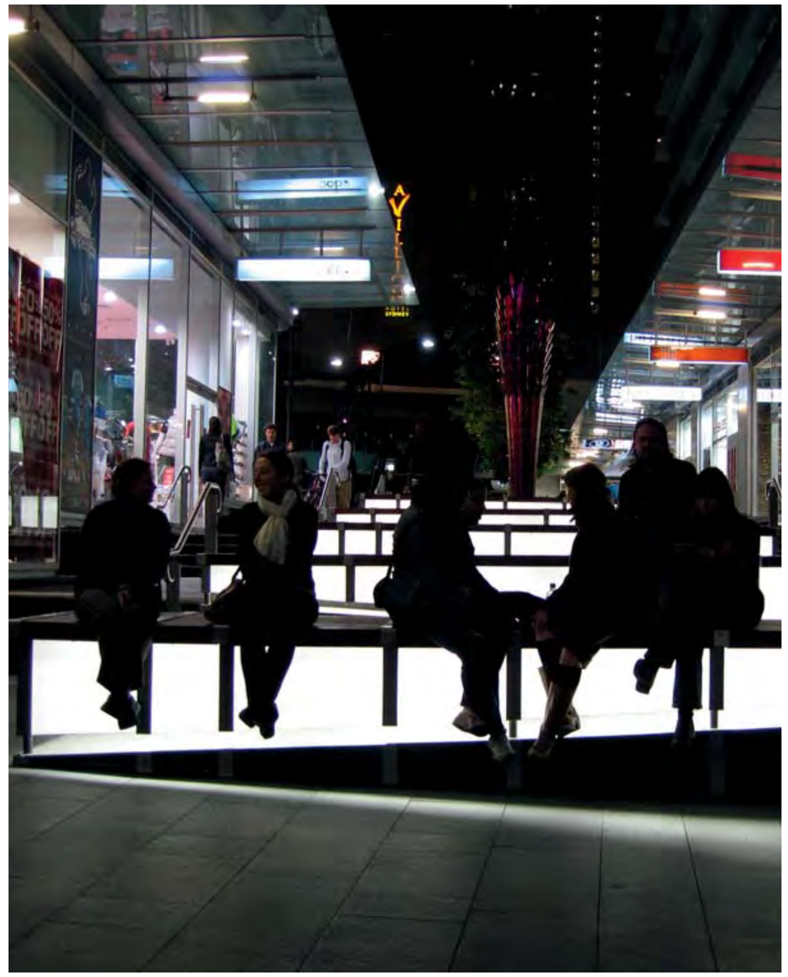


CIRCULATION

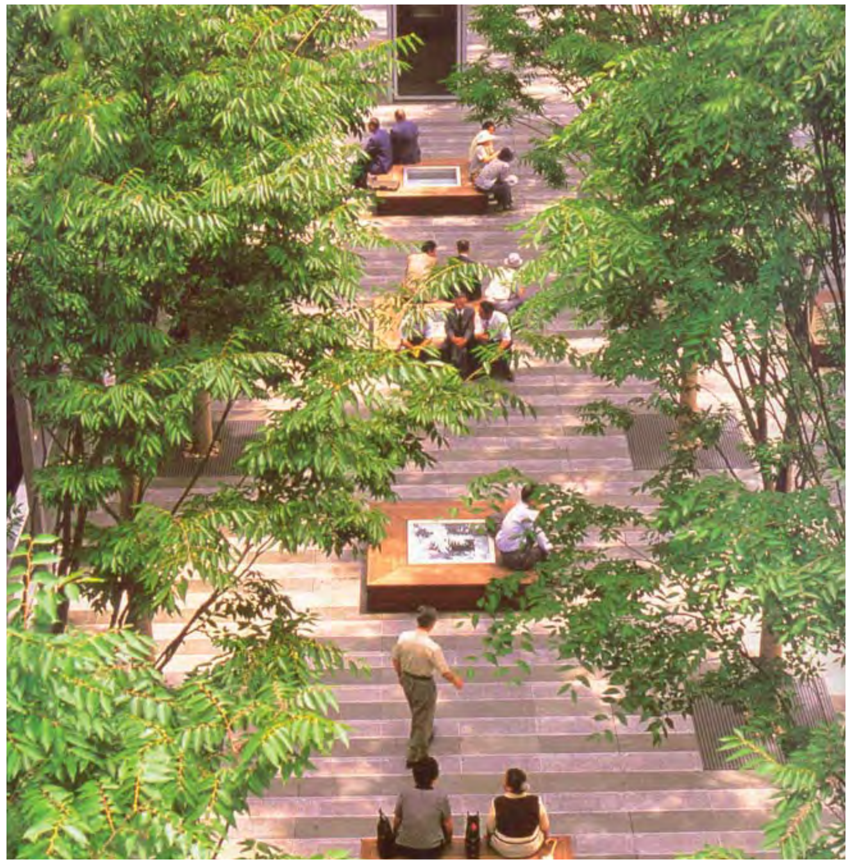
One Central Park - Courtyard

One Central Park - Integrated seating + planter bed

New Acton - Active retail edge



World Square - switch back ramp and seating



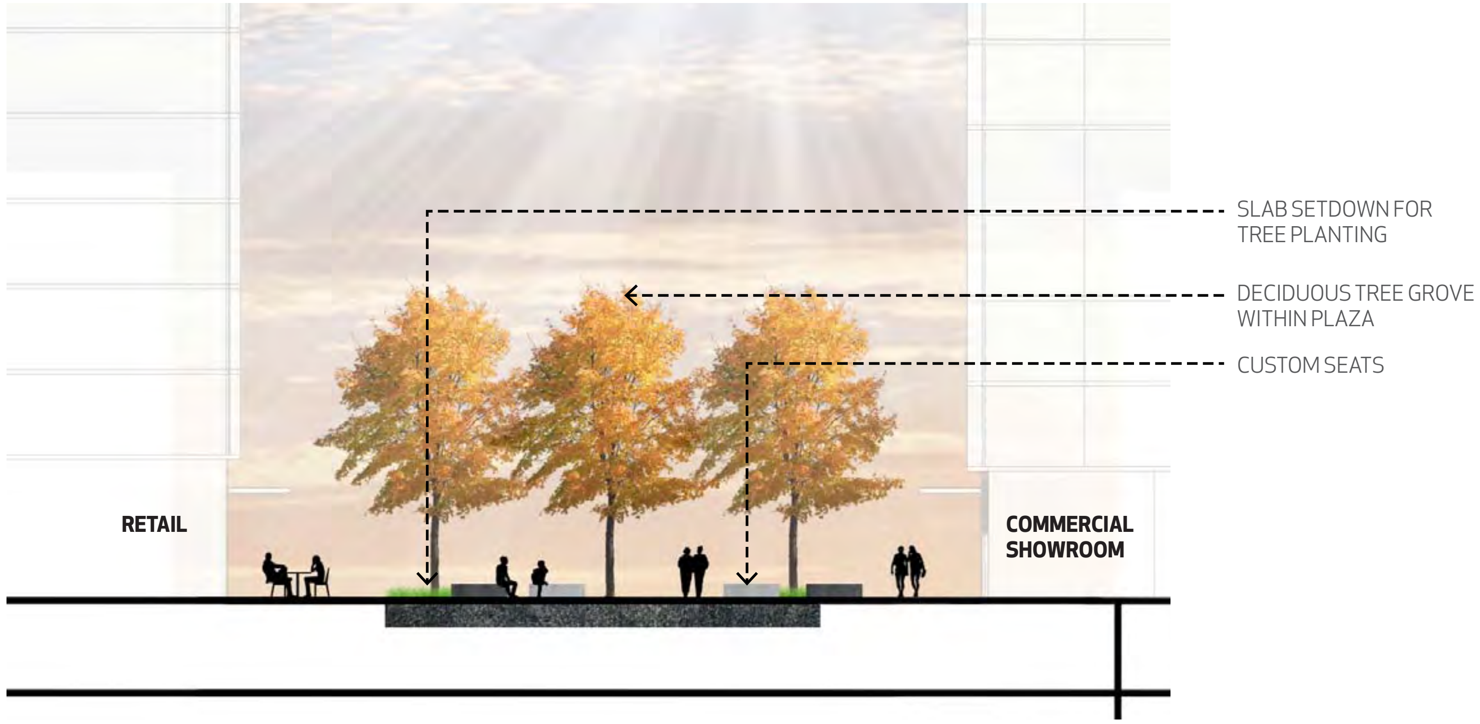
Saitama Plaza, Japan - Courtyard

Berges du Rhone - Seating steps

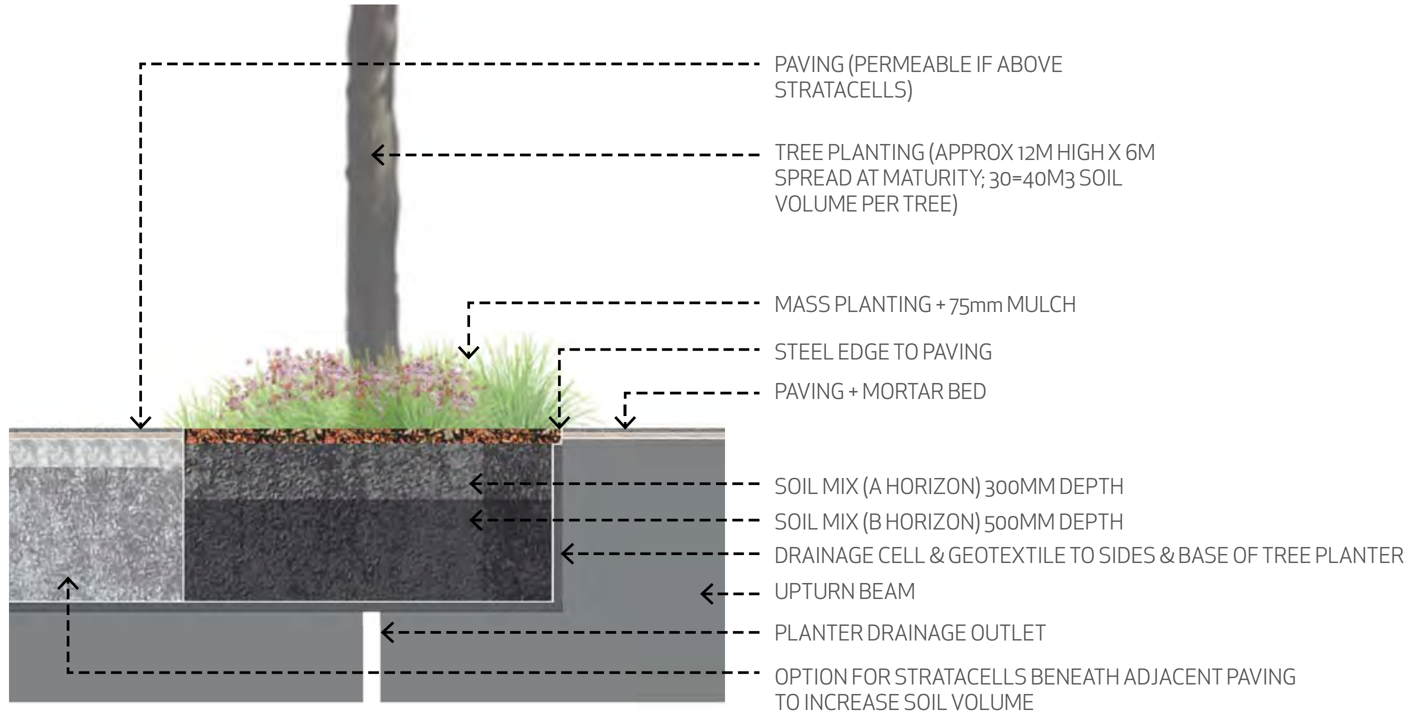
Planting

Lighting integrated within seating elements

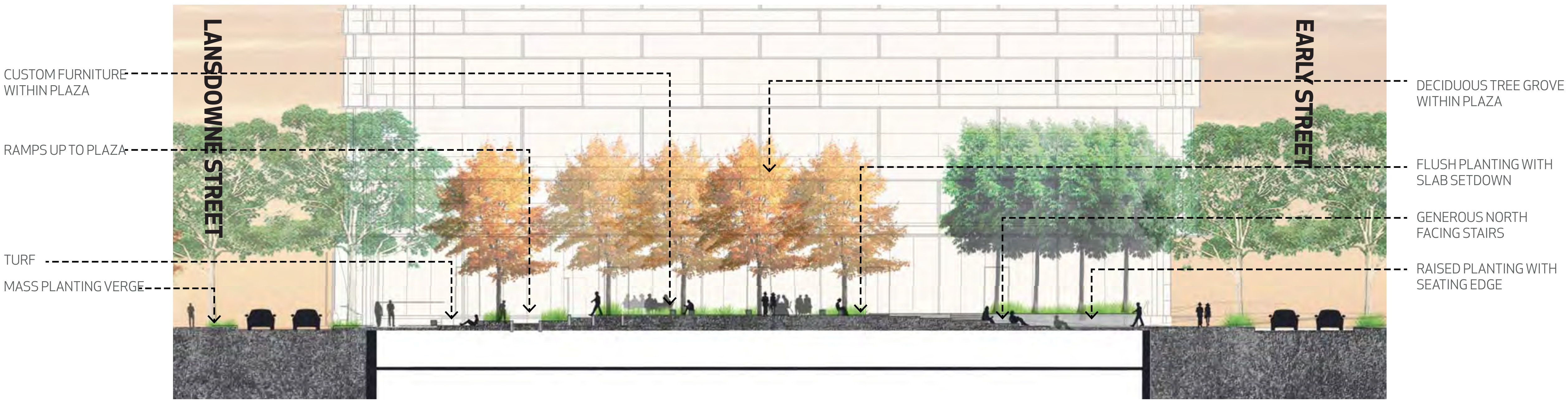
SITE 02 PLAZA PLAN



SECTION AA 1:250 @ A3



DETAIL PLATING SETDOWN



SECTION BB 1:350 @ A3

SITE 2 PODIUM & ROOFTOP

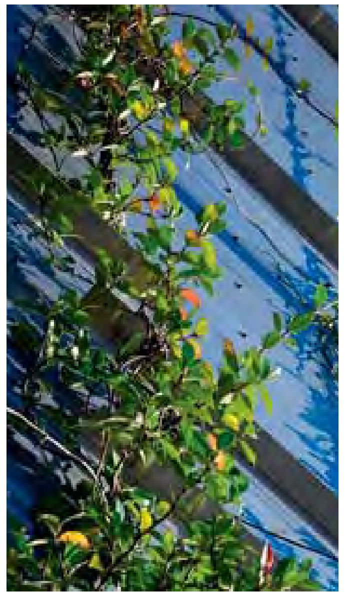
The main communal facilities for the Site 2 residential tower are located on the roof top. This includes the pool which is located in the north east part of the podium partly under a building overhang. The pool has been pushed to the edge of the podium to maximise solar access to the pool itself and create a usable pool deck on one side. A canopy attached to the building provides further shade to the pool deck. The pool deck continues around the north end of the pool with raised timber lounges and privacy planting. The pool deck will have pool fencing/gates in accordance with Australian Standards.

The north west part of the podium receives good sun and two outdoor spaces have been created here, linked to the pool deck, with raised seating platforms and edge planting for privacy and shelter.

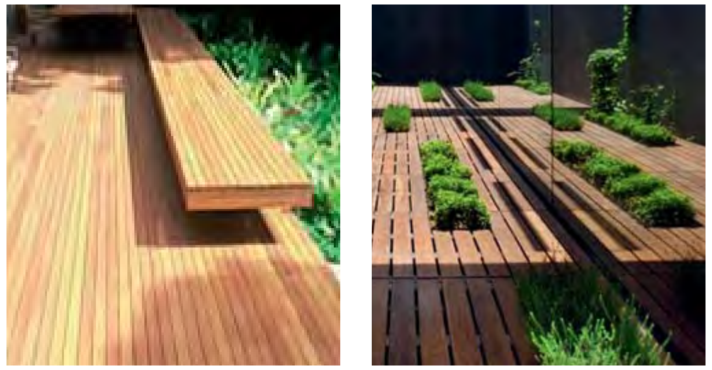
At the south end of the podium, two further outdoor spaces have been created, with paved terraces and perimeter planting. One of these will act as a spill-out area for the gym, whilst the other will be more of a quiet seating area.

The level 3 podium of Site 2 is located on the west side of the tower and will serve the adjacent commercial offices. This area has been designed as a series of break-out spaces for the commercial tenant(s). A larger paved area has been created at the entry point with fixed seating and opportunity for outdoor meetings and social gatherings. This main space leads to three smaller spaces which would act as smaller meeting rooms or gathering spaces. These could have either fixed or movable furniture and the southern space is proposed to have a pergola structure for shade. All of these areas will be contained within planting, particularly to the podium edges for privacy and shelter including small shade trees.

CHARACTER IMAGES

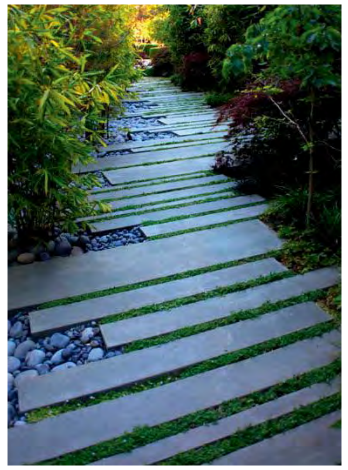

Climbers


Planting in Decking


Decking Details

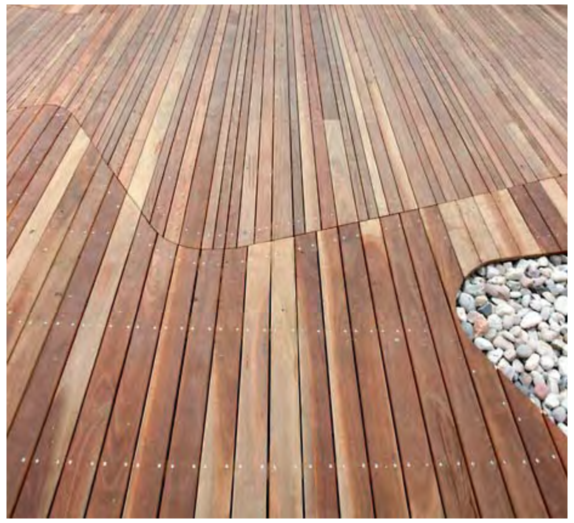

Platforms Over Decking


Lounge Seating


Paving Details


Lush Planting


Lush Planting


Timber detail

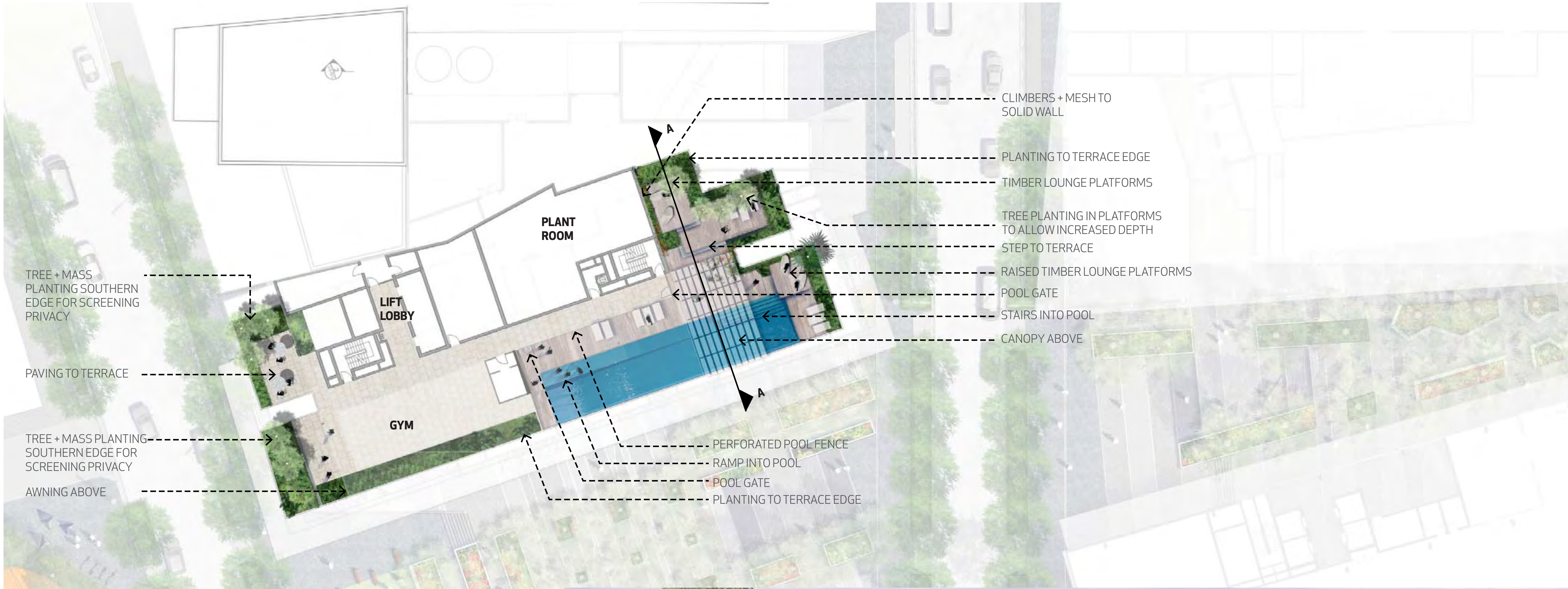

Platforms Over Decking

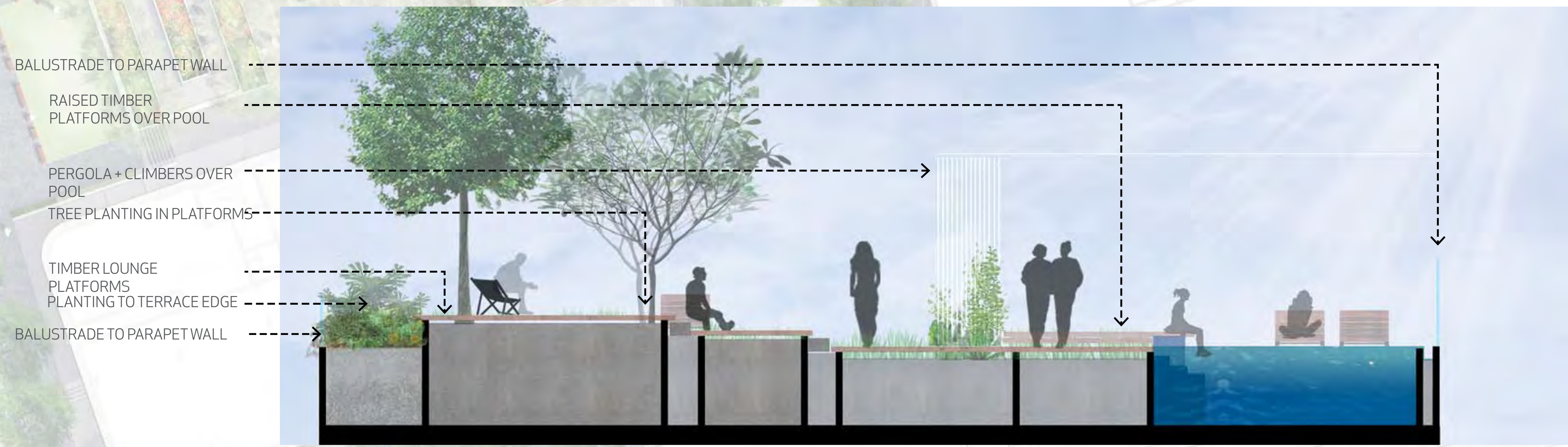
SECTION AA 1:50 @ A1

SCALE 1:400 0 2M 4M 10M

NORTH

SITE 02 PODIUM PLAN + LANDSCAPE SECTION





SECTION AA 1:50 @ A1

SCALE 1:400 0 2M 4M 10M

NORTH

SITE 02 ROOF PLAN + LANDSCAPE SECTION

SITE 3 PUBLIC PARK

The design of the Site 3 Park builds on the broader work already undertaken as part of the Design Parramatta project by GAO Landscape Architecture, Parramatta City Council Landscape Architecture, Equatica and Lightwell for the Clay Cliff Creek Parklands. The new parklands were designed to accommodate intermittent flooding of Clay Cliff Creek, reduce the 'heat island' effect, create a recreational focus and the potential for kitchen gardens while providing urban habitat. The revitalised parks would become part of a sequence of existing parklands, including Parramatta Park, Ollie Webb Reserve and the river banks, ringing the city centre. These would be linked together to create a four kilometre green 'armature' to assist with cooling and civilising the city centre.

The Urban Park on Site 3 occupies the whole site and totals 1,953 sqm. It has been designed to terminate the north-south public open space through Sites 1 and 2. The design intent is for the park to contribute to improving the quality of the city centre's stormwater; strengthen the landscape experience for those approaching the city centre; and offer the opportunity to form part of a larger open space network that would improve pedestrian and cycle links through and around the city centre.

A paved plaza area at the north-west corner of the park would connect with the pedestrian crossing on Lansdowne St, bringing people into the park. This would then connect into the future laneway to the west, linking with the residential areas to the south, and also via a bridge crossing across the storm water catchment channel to the south east part of the park. A small building/structure/shelter would activate this space, and would provide the opportunity for public toilets and possibly a kiosk.

The western part of the park would be the main children's play zone within the park. This zone would be located furthest away from Church St and adjacent to the potential toilet/kiosk building.

The play area would provide a range of age appropriate play opportunities that encourage users to:

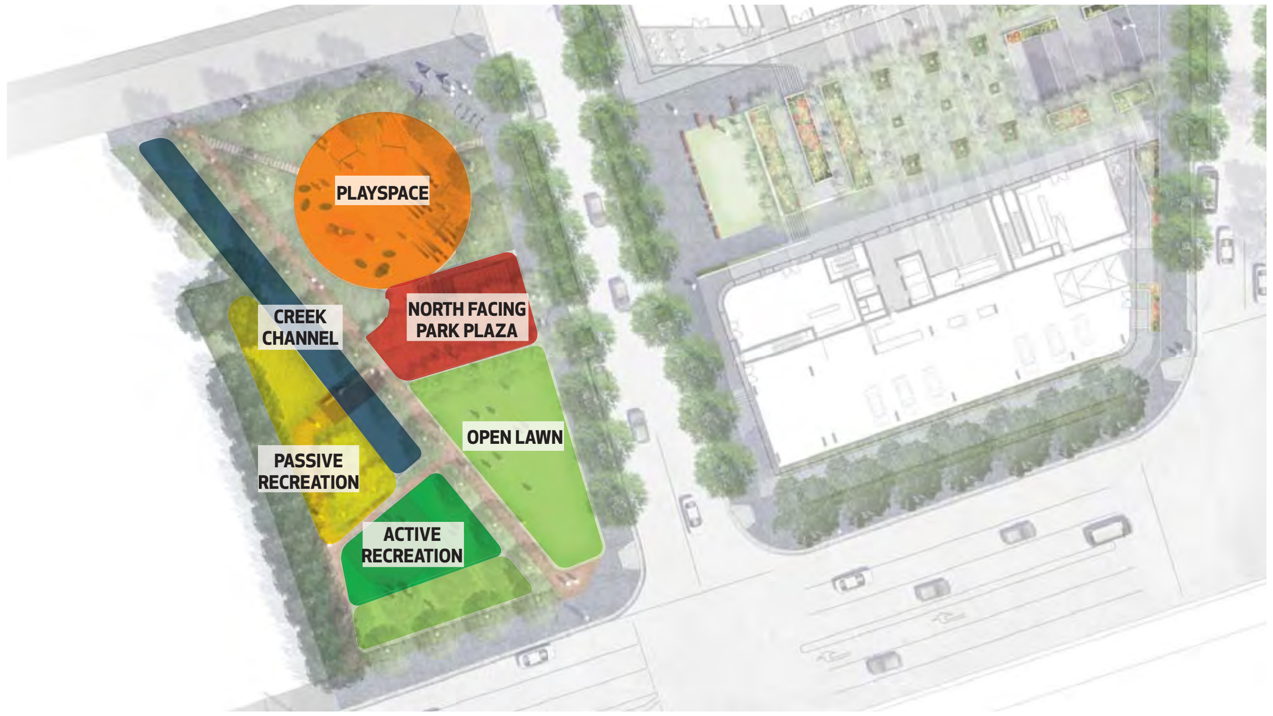
- be inventive, spontaneous and independent;
- develop the five senses;
- encourage social interaction;
- play independently in the peace and quiet; and
- be active and develop physically and mentally;

Around the perimeter of the playspace a vegetated buffer provides a physical and visual barrier to the adjacent streets. The existing creek channel, culvert and trunk drainage components through the park is to be retained and protected with balustrades and with additional buffer planting on either side to ensure there is no direct access for the safety of playing children.

The eastern part of the park would be largely open with a basketball half court and gently sculpted lawn areas making the most of the good solar access.

The southern side of the creek channel is vegetated for screening adjacent properties with larger planting masses creating opportunities for quiet, shaded seating pockets. A pathway connects Church St to the bridge across the creek line and the rest of the park and plaza.

The existing levels have been maintained across the site so as not to alter flood conveyance and storage characteristics with exception to minor landscape treatments such as the sculpting of turf and garden beds.



SPACES

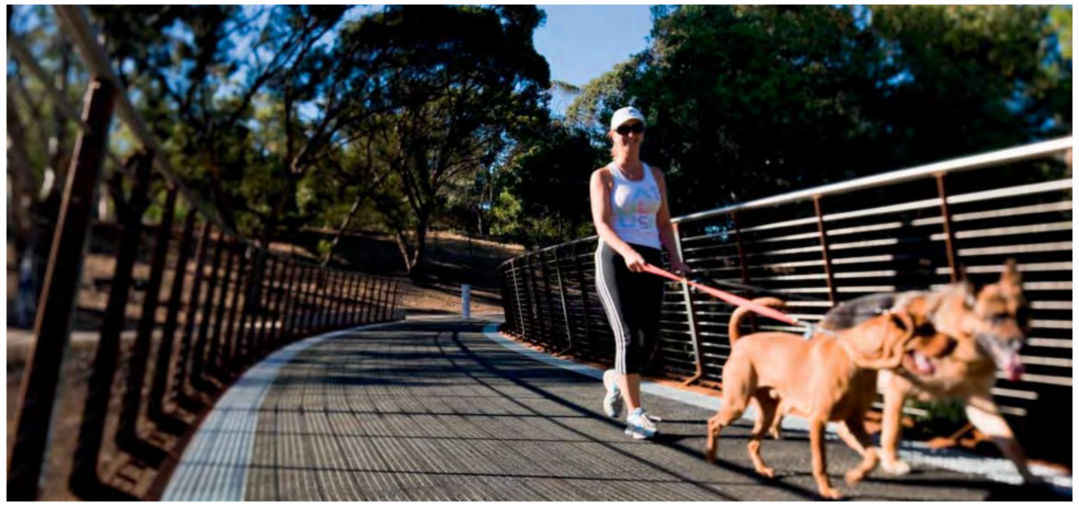
CIRCULATION

SCALE 1:400 0 2M 4M 10M


Darling Quarter - Mound Slide


Box Hill Gardens, Basketball Court


Buluk Park - Open Grass Area


Boardwalk over canal


Rouse Hill - Shade structure


Sydney Park - Kiosk


Lizard Log Park - Environmental play


Rouse Hill - Lawn amphitheatre


Rouse Hill - Timber Crossing

SECTION AA 1:250 @ A3

SITE 01

01 STREET LEVEL / PODIUM (BUILDINGS B + C)

The lower 2 levels of the mixed use buildings have been expressed as a podium with a strong horizontal datum to create an appropriately scaled pedestrian environment to the streets and plaza. This primary awning element becomes deeper at the building corners to signal the entry to the site and create wider protected areas where pedestrian flows are likely to be higher.

The tower expression is clearly separated from the podium expression to reinforce this horizontal datum and allow each building element to

A continuous colonnade along the three building frontages creates a protected pedestrian environment connecting the Great Western Highway, the plaza and Early Street. The colonnade is scaled to allow for outdoor dining.

The nature of the buildings above the podium is reflected by the size and materiality of the columns along the colonnade, creating a changing and expressive environment along the colonnade, inspired by a grove of trees with thicker and thinner trunks reflecting the species, age and size of the trees.

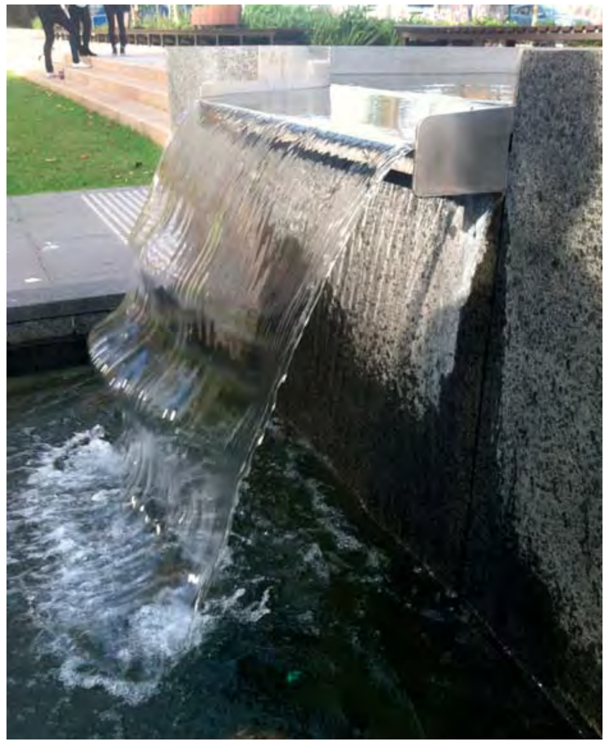
The columns supporting tower D are scaled to express the height and size of the building above, with robust materials such as concrete and metal cladding.

Where tower E is set back from the line of the podium, the columns express this change and are commensurately slenderer.

The podium facade behind the colonnade is extensively glazed in keeping with the anticipated retail and commercial uses, allowing good visual connections and promoting an active streetfront.

Secondary awning elements within this façade emerge and project at various points along the podium to provide variety to the façade, mark the entries to the site, provide a degree of sunshading (at the northern end), and mark the transition in scale between street and plaza.

Combined with the variable primary awning line and colonnade, these emerging secondary awning elements create a waving effect, further expressing the 'meeting of the waters' theme found in the public domain and tower facades.



02 NORTHERN TOWER (BUILDING D)

The northern residential tower has been scaled, shaped and clad to create a distinctive landmark element at the CBD end of the site, in keeping with its role as a gateway to the new Auto Alley precinct.

The façade is clad in rippling ribbons of curtain wall glass to express Parramatta's location at the 'meeting of the waters' where the fresh river water meets the salty water of Sydney harbour.

Accordingly, the glass pattern and colour changes from top to bottom; with vertical, light coloured glazing at the top, being the calm 'headwaters' of the river, darkening in colour and steadily increasing in wave pitch towards the bottom of the tower, representing the deeper, rougher waters of the harbour and ocean beyond.

Responding to the findings of a preliminary wind study, all balconies at the top of the building are glazed wintergardens to protect them from wind and ensure they are useable at all times. This reinforces the appearance of smooth, calm water at the upper levels, with balconies gradually becoming fully open lower down the tower.

Preliminary thermal modelling of typical west and north-west facing units undertaken in response to design jury comments indicate that these comply with BASIX.

The rippling glazed ribbons are separated by strips of vertical glazing which accommodate the opening window elements providing natural ventilation to internal spaces. These elements also clearly separate the individual glazed ribbons both visually and constructionally, simplifying the detailing of the angled façade and avoiding awkward junctions between the angled elements.

The façade projects beyond the building line at the top and sides.

Tower E west

Tower E east

03 CENTRAL TOWER (BUILDING E)

The central residential tower has been scaled to sit between the two taller and more prominent residential towers at the northern (building D) and southern (building K) ends of the site.

The building form of the central tower was generated by sun angles to the plaza and park around lunch time, which led to the eastern elevation being angled to the north-west, closely following the orientation of the southern tower on site 2.

Accordingly, the design of this tower expresses its role as a transition element between the taller towers, with architectural elements relating to the other buildings.

The eastern façade has strongly expressed horizontal spandrels and balcony upstands similar to the southern tower, but these are angled and shaped to express a transition to the rippling façade elements of the northern tower.

The western façade represents the relationship between the three towers, being composed of shorter horizontal elements towards the south representing the southern tower, balanced against a 'tower' element at the northern end of the building representing the northern tower
This façade has prominent vertical blade elements to provide shading to the west facing apartment windows, similar to those proposed for the southern tower.

04 CHURCH STREET BUILDING NORTH (BUILDING F)

Along with the northern residential tower and podium, the northern church street building will form the northern entry to the site.

The design has a strong horizontal articulation to delineate the various functions intended for the building; car showrooms on the ground floor and commercial space to the upper 9 floors. The top floor and plant room are set back to reinforce the horizontal expression of the building, lower the visual bulk of the building and allow solar access to the lower floors of the northern residential tower opposite.

The ground floor car showroom is expressed as an independent glass box with alternating frameless glass and expressed mullions to maximise visibility from the street. This design has been replicated on site 2 to create a unified presence to the car showrooms across the 2 sites.

The northern end of the showroom is level with the plaza at the Church Street / Great Western Highway corner and is one of the major entry points to the showroom. The southern end is approximately 1 metre above street level due to the fall in the existing street level and the required minimum floor level generated by the 100 year flood level. Access at this end is via internal stair and ramp. There are other entries to the west, off the plaza, and east, off Church Street.

The upper level façade features a series of vertical fins to the north, east and south elevations, which provide shading from low angled sun and lend expression to the facade. The depth of these fins varies along the length of the building to create a subtle rippling effect when viewed obliquely from Church Street. This rippling effect ties into the 'meeting of the waters' theme expressed in the design of the public domain and northern tower, connecting the buildings and open spaces into a family of designed elements.

South east aspect

SITE 02

01 DEVELOPMENT PROGRAMME

The programme for GSP Site 2 is accommodated in two buildings orientated north-south, a 10-storey building on Church Street and a 32-storey building to the west of the site.

The Church Street building [Building L] contains retail, showroom and commercial uses. The western building [Bldg I, J & K] contains retail and commercial uses on the ground and podium levels with residential apartments in the tower.

Common residential facilities including a gymnasium and pool are located on the roof level of Tower K. Beneath the buildings and podium is basement parking over 4 subterranean levels.

Building plant and services are located on the ground level, basement and on the roofs of the buildings.

On Tower K the roof plant is housed in the architectural roof feature zone. Vehicles enter the site from Early Street either to the car-parking ramp to the basement or the ground level loading dock.

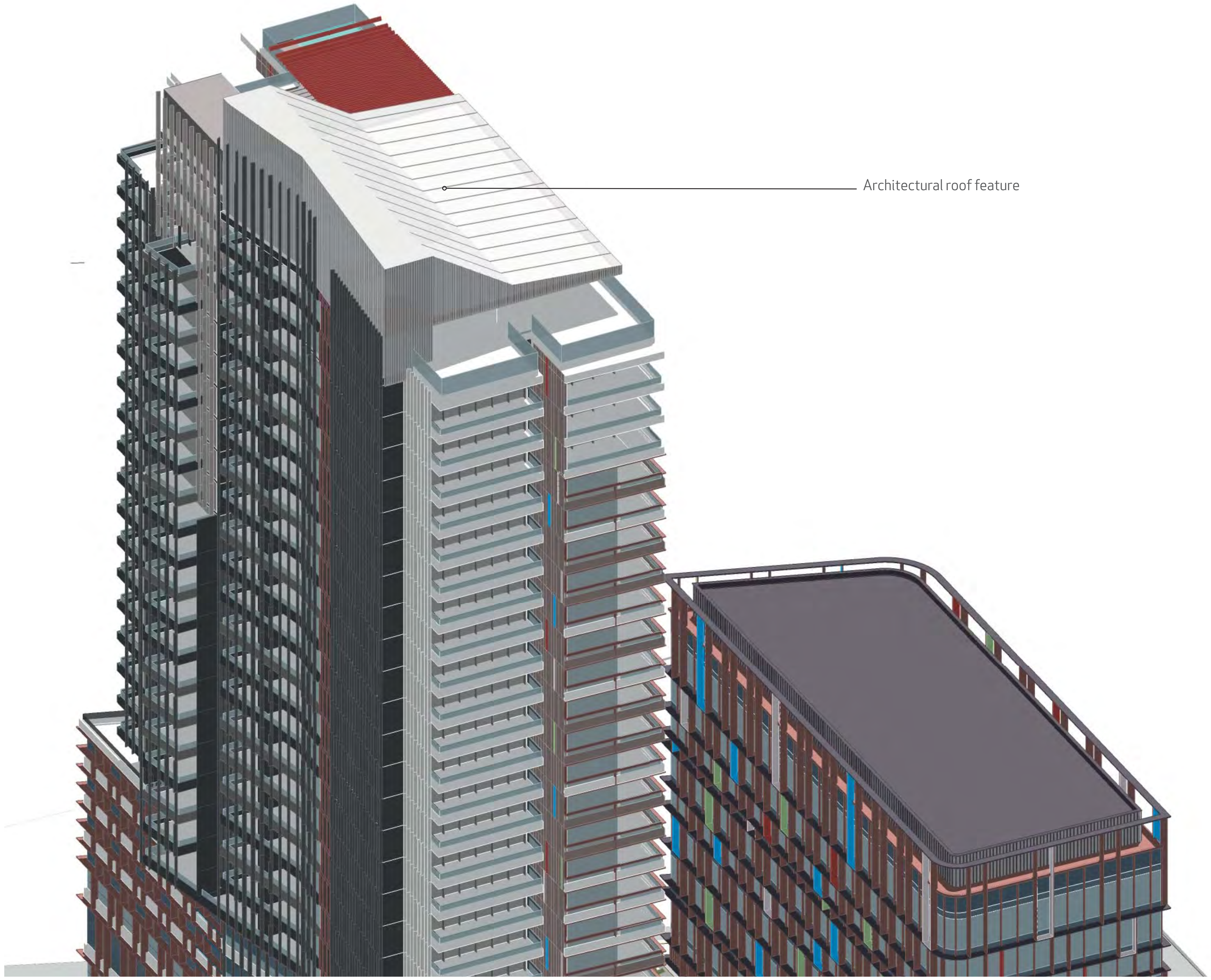
Lower floors and public domain - south east aspect

02 DESIGN CONCEPT

The design concept for GSP Site 2 is based on the organisation of the programme, the interrelationships between the different forms, the public domain and the context.

On the ground floor, the programme is predominantly retail with car showrooms on Church Street and lobbies for the residential and commercial components. These active uses are designed to work with the public domain in the centre of the site assisting this area to be lively and activated. Other uses, such as services and vehicle entrances are located to the west of the site where activation is less of a concern. There are also connections to lobbies and the public space from Early and Lansdowne Streets. The upper floors of the Church Street building [Bldg L] and the podium of the western building [Bldg J] are commercial levels. Residential levels are located above.

Further information regarding the building programme is shown in the architectural documentation. Refer also to the landscape report by Oculus Landscape Architecture and Urban Design for information regarding the public domain.



Upper floors - south west aspect

03 DESIGN CONCEPT - CHARACTERISATION

The characterisation follows the programme of the building using a common element, in this case a aluminium frame curtain wall system, modified to respond to the conditions of the particular use inside. At the base of the western building [Bldg I], the curtain wall is spaced to respond to the requirements of a shopfront, with a larger interval between mullions and a frameless transom detail. Directly above the retail level, on the public elevations, there is a generous awning providing cover for pedestrians.

For the commercial levels above, the curtain wall system is modified with a different transom interval to allow for a opaque spandrel and services area. The commercial levels also amend the mullion position on alternate levels, which forms a macro horizontal 'brick' pattern over the elevation. On facades exposed to western sun, the mullions are increased in intensity to assist in reducing solar heat gain in the afternoon.

Above, for the residential levels of the tower, the curtain wall system is adapted into a floor-to-floor system with a tighter mullion and transom pattern to allow for the integration of opening sashes, sliding door elements and balustrades. The adapted system also facilitates with addressing SEPP65 criteria for cross ventilation and solar access. At high level, the window system is complemented with projecting balconies. On the western facade the thermal performance of the residential facade is assisted by the integration of a vertical fin-shading matrix.

The Church Street building [Bldg L] is similar to the western building, but has a alternate series of variations based on its particular spatial programme and environmental requirements. At the base of the building, the retail levels use a similar system as the western building with the exception of the showroom on Church Street, which uses a semi-frameless glazing system for improved visibility. Like the western building an awning over the retail level provides cover for pedestrians. The commercial levels above adopt a curtain wall system deployed in a vertically orientated pattern. As the western building provides shading from the afternoon sun, the pattern of the curtain wall does not require aspectual variation or additional shading to address solar heat gain.

Refer to the architectural documentation for further detail concerning the building characterisation and the location of the different architectural elements.

North east aspect

04 DESIGN CONCEPT - COLOUR PALETTE

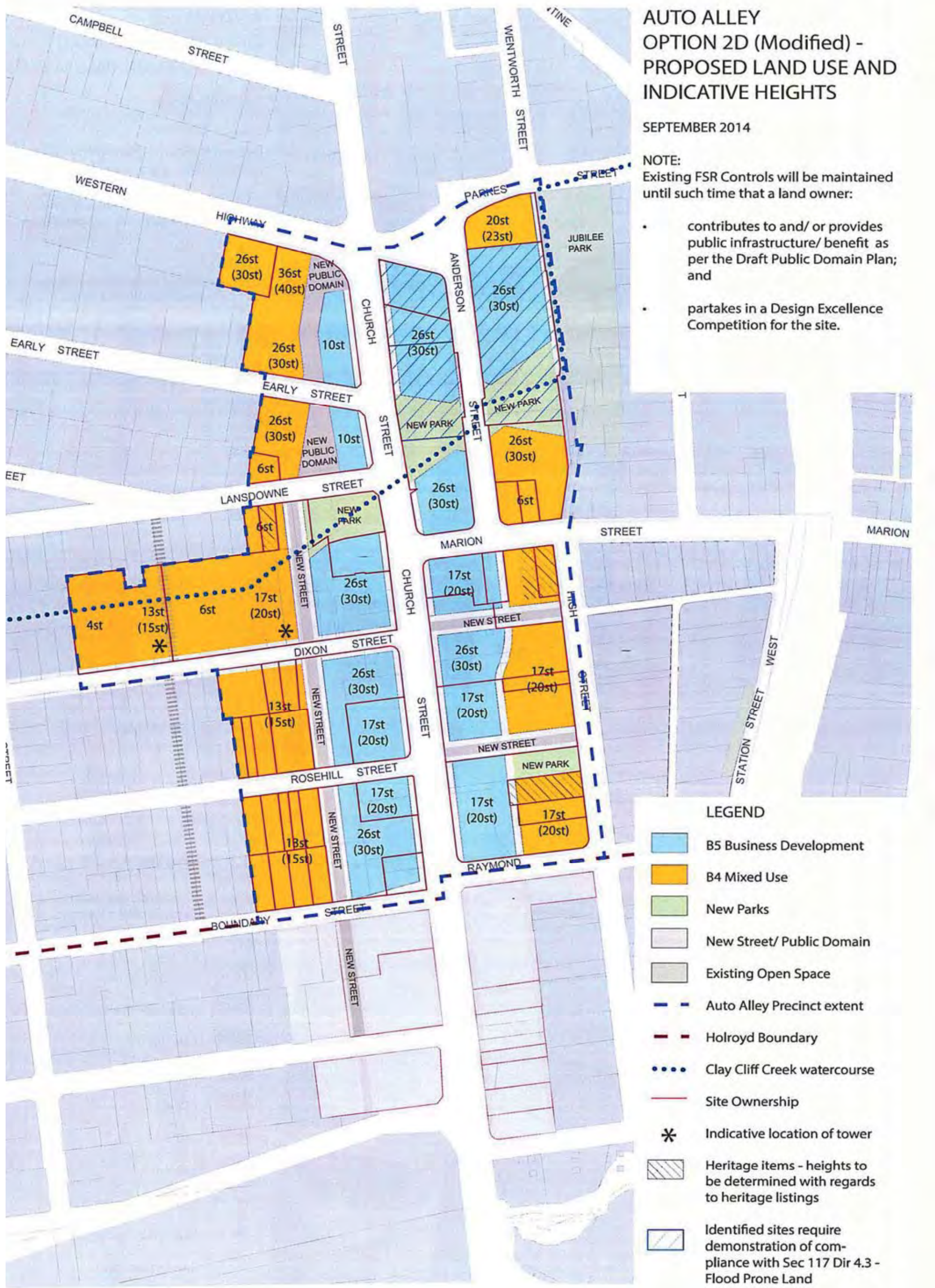
A contextual referent colour palette is applied over the aluminium framed curtain wall system in order to visually articulate the facade and express connections to the local and wider Parramatta location. Two palette systems are utilised, one concerned with the immediate context and the other with the wider city context. Each palette uses a series of colours based from the colours found in or expressive of the particular context. The intensity and frequency of the various referential hues varying based on the direction to the particular context. The coloured cladding panels are finished with a mirror finish to further emphasise the reflection of context.

The first palette references the immediate context drawing tones from the Parramatta CBD, the Harris Park Indian culture and the automotive environment of Auto-Alley. This palette is applied to the lower levels, where the connection to the immediate context is more tangible.

The second palette references the city context and responds to the vistas visible at high level - the Blue Mountains, the Sydney skyline and Parramatta River and Parklands. The second palette is applied to the higher parts of the development.

Further information regarding the colour palette and its implementation on the building is presented in the architectural documentation.

04 DESIGN CONCEPT - PERSPECTIVES



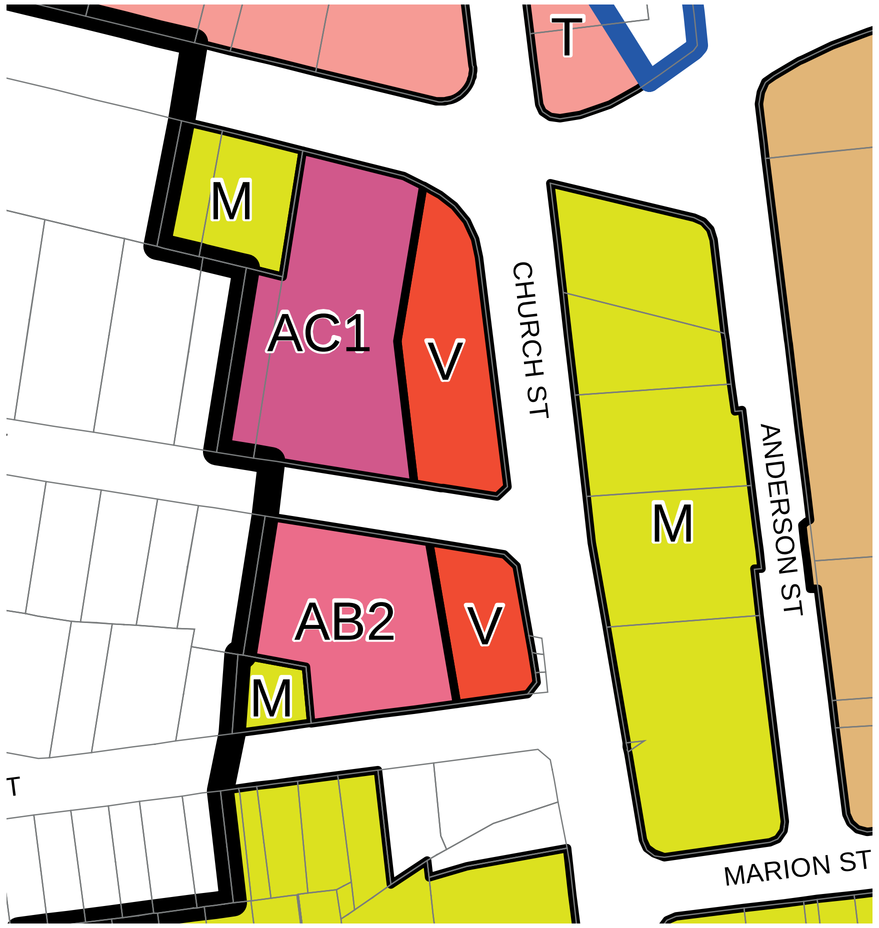
SITE 01 + 02

01 CONTEXT

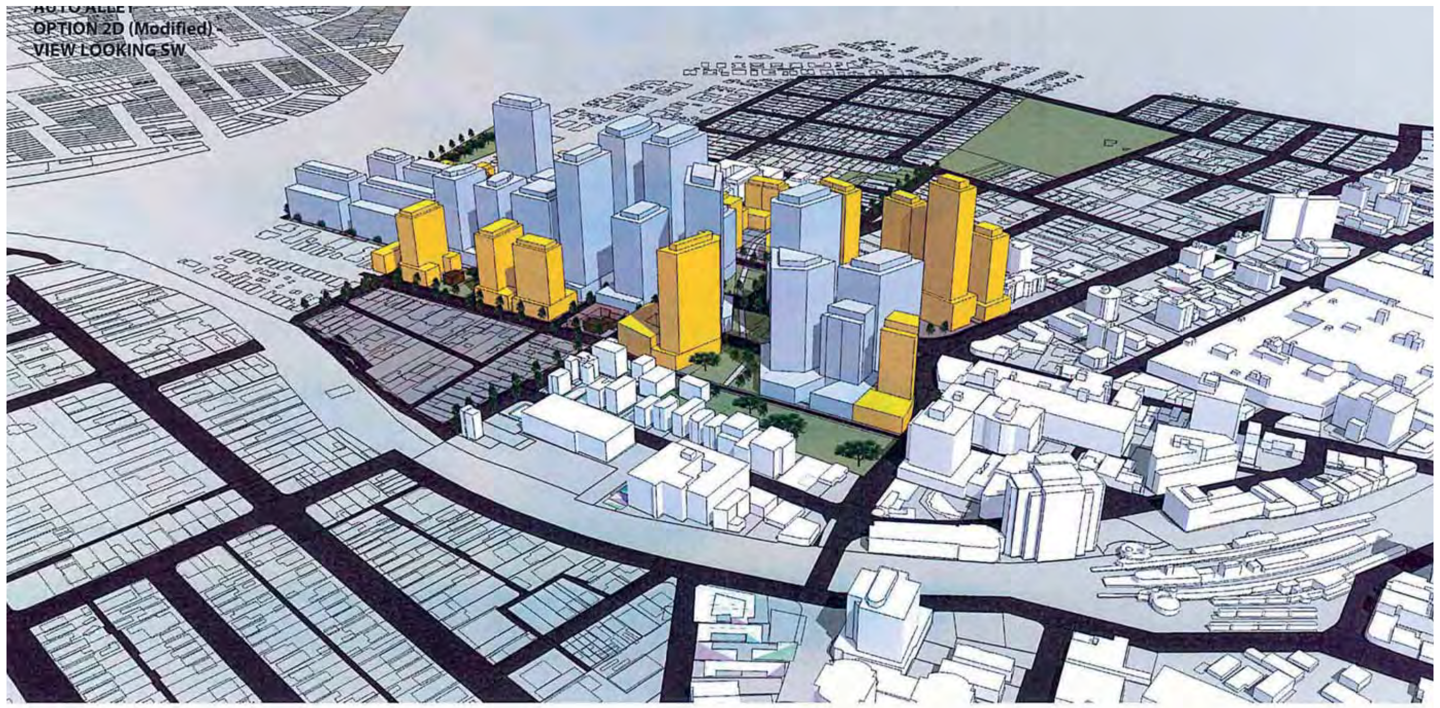
This area is undergoing significant change and as such Parramatta City council has a suite of site specific planning controls to direct the urban grain, texture, built form and public realm – this is known as the Auto Alley, which strongly define the future character, scale and context, and constitutes the framework which needs to be addressed when considering 'context' within SEPP65.

In addition to these precinct wide objectives, the DCP allows for certain scale and height across the site. The winning competition entry departs slightly from these built form controls. This said, the proposed building massing achieves the goals and objectives of the DCP and where departures are sought, they are done so to improve the project and public domain outcomes. These departures to the DCP were endorsed by the Competition Panel.

The proposed design is the first stage in the establishment of the desired future character of the area. It will form a transition between the new commercial core of Auto Alley and surrounding residential areas, and will thereby contribute to the quality and identity of the area.



Parramatta City Centre LEP Height of Buildings Map 2007 as amended



Parramatta City Centre Auto Alley Strategic Planning

02 SCALE

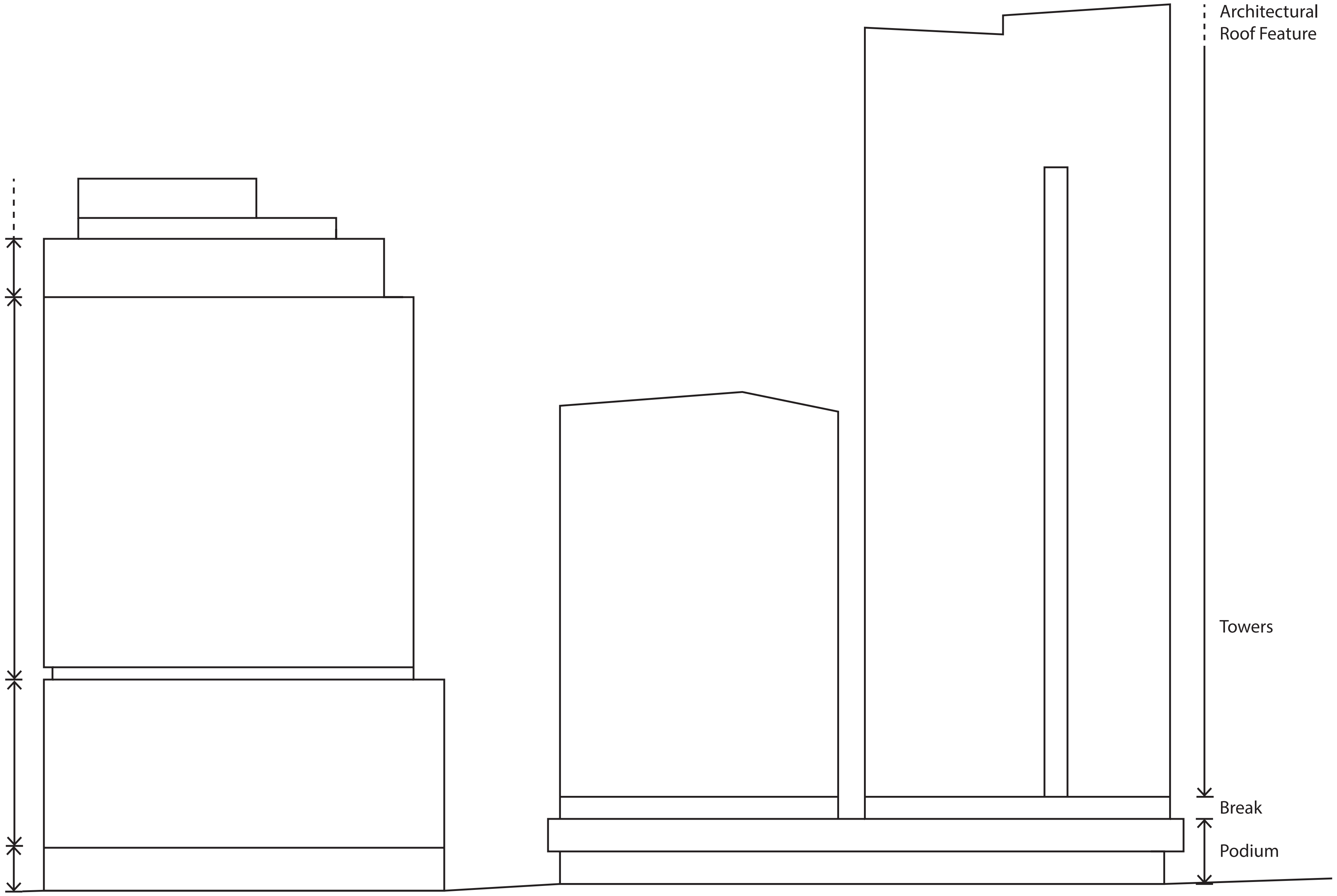
The proposed bulk and height complies with the parameters of the VPA and achieves the scale identified for the desired future character of the area.

The treatment of the retail / commercial podium scale creates a transition from the predominant 12m (3-4 storey) height of the surrounding residential areas, up to the projected larger scale of the new Auto Alley commercial core and the CBD to the north.

KEY

G	7
K	10
M	12
O	15
P	18
R	21
S	24
T	28
U	34
V	36
W	40
Y	54
AA1	60
AA2	72
AB1	80
AB2	90
AC1	118
AC2	120
AG	200
	Refer to Cl 29E

Parramatta City Centre LEP Height of Buildings Map 2007 as amended



03 BUILT FORM

The proposed built form creates a well-defined public domain, establishes a new high quality streetscape to Church Street and improves the existing character of Early Street and Landsdowne Street streetscapes, and provides high quality internal amenity and outlook from the new buildings.

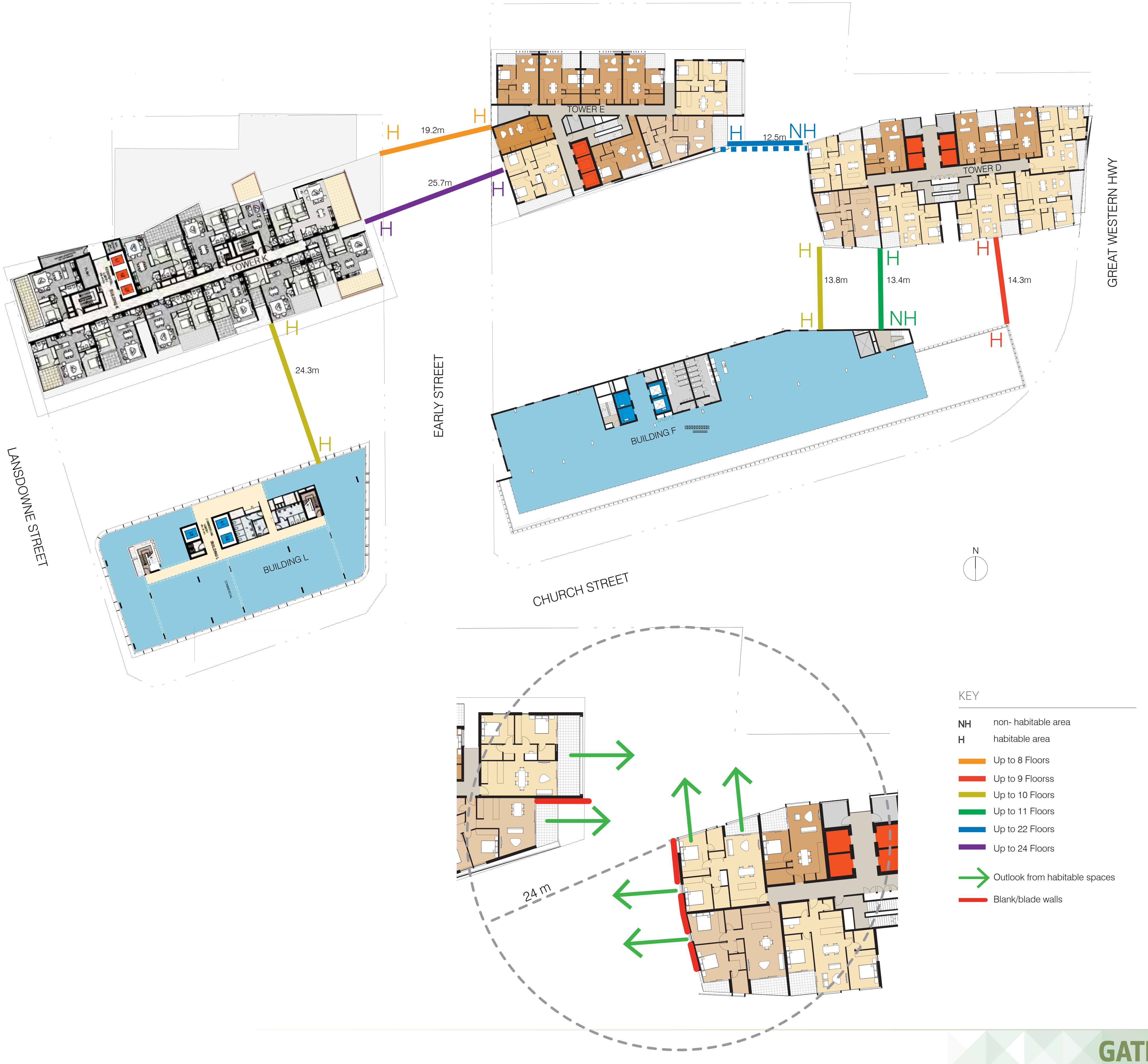
The variation in height across the 3 residential towers and consequent additional height of the northern tower responds to the competition jury's recommendations, creating a varying skyline and an iconic expression at the northern end of the precinct.

The building forms are articulated horizontally, with a clear break between the upper residential towers and the lower levels, which establish a datum which respects the existing local streetscape and reflects the retail and commercial functions with extensive glazing behind a colonnade.

The buildings are also articulated vertically, with the residential towers being expressed as a series of vertical elements which celebrate the buildings' height, capped with expressive architectural roof features.

The proposed floor to floor and ceiling heights comply with the SEPP65 guidelines.

Floor / Use:	Storey height	Min. floor to ceiling height
L1 (Ground floor) retail	5m	3.3m
L1 (Ground floor) showroom	6m	5m
Level 2 commercial	5.5	3.3m
Residential floors above L3	3.1m	2.7m



KEY

NH	non- habitable area
H	habitable area
	Up to 8 Floors
	Up to 9 Floorss
	Up to 10 Floors
	Up to 11 Floors
	Up to 22 Floors
	Up to 24 Floors
	Outlook from habitable spaces
	Blank/blade walls

03 BUILT FORM / BUILDING SEPARATIONS

SEPP65 PRINCIPLES 03 BUILT FORM

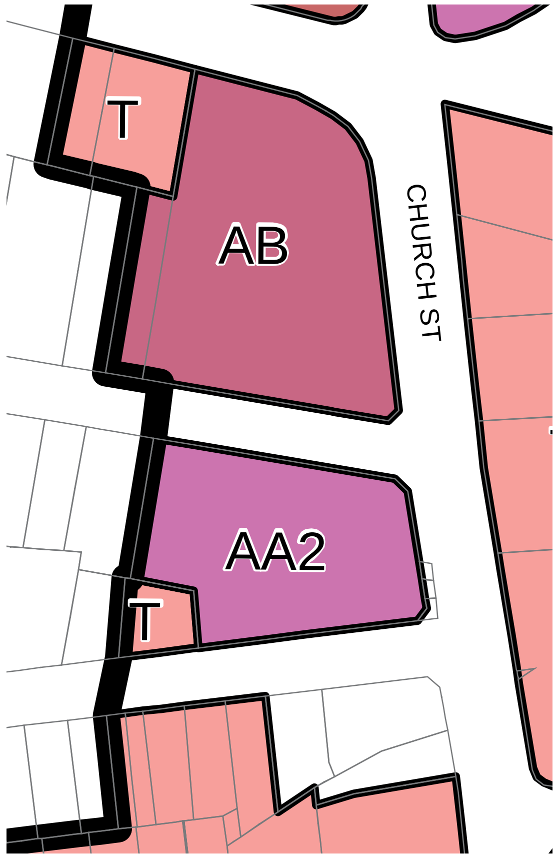
Building separation distances are generally compliant with the RFDC rules of thumb.

The separation between towers D and E is 12.5m at one point as shown in diagram below.

This has been addressed in a number of ways as shown in diagram below and is therefore considered acceptable.

The design allows sufficient solar access to the public realm, provides appropriate outlook from and ensures adequate privacy between habitable spaces in the two buildings through the following measures:

1. Buildings D and E are offset in plan so that they are not directly opposite each other. This allows outlook and views from the habitable rooms in each tower and allows solar access between the buildings to the plaza and park around lunchtime in midwinter. This also allows solar access to neighbouring properties to the west in the morning in midwinter; these properties have full solar access from approximately midday onwards in midwinter.
2. The habitable spaces in the southwest corner of building D closest to building E face westwards, therefore do not directly overlook building E to the southwest.
3. South facing bedrooms in building D have vertically proportioned 'slot' windows that direct outlook southwards, and restrict westward outlook where this would lead to overlooking of habitable spaces in building E.
4. North facing balconies in building E are provided with blade walls to direct outlook northwards, and restrict eastward outlook where this would lead to overlooking of habitable spaces in building D to the northeast.
5. The habitable spaces in the northeast corner of building E face north and eastwards. The façade of building D immediately to the northeast has no windows therefore there is not direct overlooking into habitable spaces in building E.



Parramatta City Centre LEP Floor Space Ratio Map 2007 as amended

Parramatta City Centre Auto Alley Strategic Planning

04 DENSITY

The proposed density complies with the density parameters of the VPA and therefore with stated desired future density of the area.

The proposed FSR for site 1 is 8.28:1, including the provision of a 15% bonus subject to achieving design excellence as per Parramatta City council competitive design process.

The unit mix and apartment size is:

Apartment Tpe	Mix	Min. size
Studio	3.0%	40m²
1 Bedroom	42.9%	50m²
2 Bedroom	49.0%	70m²
3 Bedroom	5.1%	90m²

KEY

- B 0.4
- F 0.6
- S1 1.5
- S2 1.52
- T 2
- V 3
- W 3.5
- X1 4
- X2 4.2
- AA1 6
- AA2 6.4
- AB 7.2
- AC 8
- AE 10

Parramatta City Centre LEP Floor Space Ratio Map 2007 as amended

05 RESOURCES

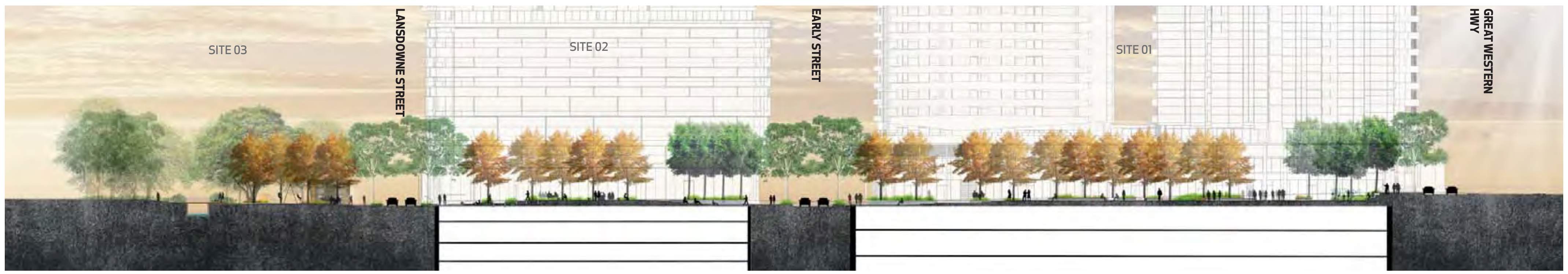
The proposal utilizes a range of passive design features such as good orientation, cross ventilation to achieve resident comfort without relying on powered heating, cooling or ventilation.

Solar access to living areas and private open spaces and the number of cross ventilated apartments comply with the SEPP65 guidelines.

Extensive landscaped podium rooves are proposed which will help minimise the 'urban heat island' effect, and can be irrigated from captured rainwater.

In response to comments from the design excellence jury at the pre-DA meeting, thermal modelling was carried out on two typical west and north-west facing apartments in building D. The design of these apartments were shown to comply with BASIX.

BCA Section J and BASIX compliance for the non-residential and residential buildings will be subject to detail design and assessment at Stage 2 DA.

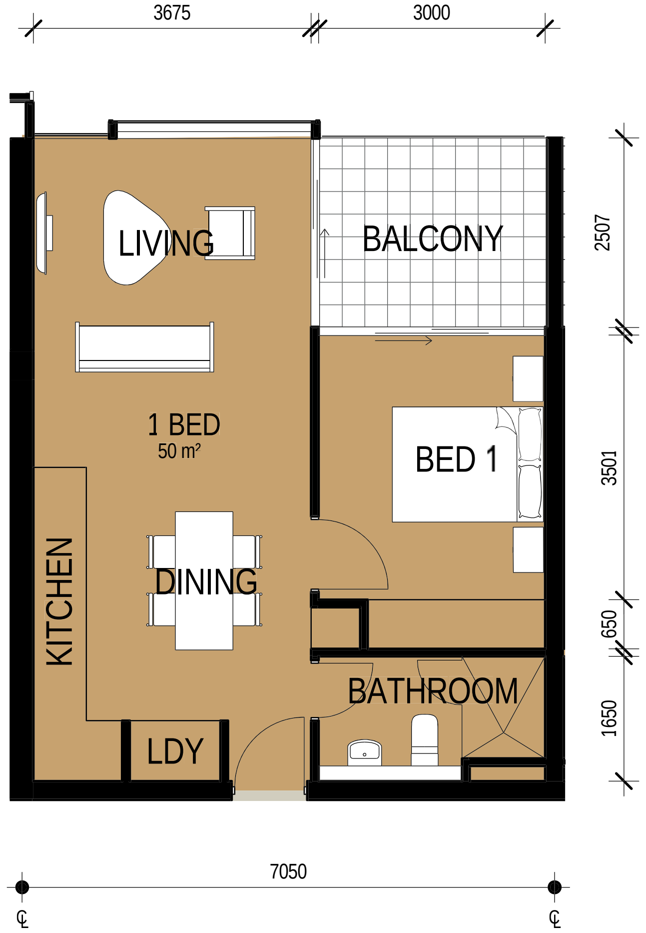


SECTION AA 1:750 @ A3

06 LANDSCAPE

The proposed landscape design builds on the existing site's natural and cultural features by utilizing water sensitive urban design (WSUD), recognizing the flood zone, using native plant species and referencing local geo-graphical and cultural heritage.

The proposed public spaces establishes a first stage in the transition to the desired future character of the area and optimises useability and equitable access by providing easy grade transitions across the site and respects neighbours' amenity through the establishment of landscaped setback zones to the west of the site.



Typical 1 bed apartment

Typical 2 bed apartment

07 AMENITY

The proposed design optimises amenity through providing appropriate access to views, outlook, sunlight and natural ventilation, and providing visual and acoustic privacy between residential and commercial / retail areas. The design provides appropriate indoor and outdoor space, meets the brief requirements for room dimensions and shapes, efficiency and provision of service areas.

Balconies

Each apartment, with the exception of studios, has been provided with private open space which is directly accessible from internal living areas, complies with the SEPP65 size guidelines, being at least 2m deep, and functionally planned to provide opportunities for indoor/outdoor living.

Cross ventilation

The number of cross ventilated apartments complies with the required 60% SEPP65 guideline.

Solar access

The number of apartments receiving 2 hours of solar access on 21 June between the hours of 9am and 3pm complies with the required 70% SEPP65 guideline.

Southerly aspect

The number of single aspect, south facing apartments is less than the 10% SEPP65 guideline.

Apartment depth

Single aspect apartments are less that 8m deep, and kitchens are within 8m of a window, measured to the face of the rear cabinet.

Access corridors

Residential corridors are naturally lit and ventilated.

08 SAFETY

The project will provide an equally successful environment for both day-time & night-time use of the public spaces.

The proposed design contributes to a safe and secure public domain by placing "eyes on the street" overlooking the public and communal spaces, maximising activity on streets and public areas, and providing clear, safe ac-cess points to the three sites and to each building.

Active uses on ground floor are arranged along both sides of the plaza and along the adjacent street frontages, with vehicular entries, servicing and plant areas restricted to discrete zones on Early Street and the Great Western Highway.

Pedestrian entries to the buildings are located on either side of the plaza and along the adjacent street frontages, providing further activation to the surrounding public domain.

The proposed public spaces cater for desired recreational uses through provision of colonnades, awnings, informal seating, children's play areas, safe and accessible grade transitions, clear definition between public and private spaces.

Daytime activation will be provided by the existing desire lines across the site between residential areas to the CBD. This existing flow of people would be augmented by the new residents, workers and destination elements of the proposal, including the commercial uses and park.

The retail areas along the linear plaza are envisaged as restaurants and cafes, both to extend the 'eat street' of Church Street south and to serve workers and residents in the proposed development. These would provide good night time activation, along with the proposed landscape design at the northern end which includes water features, lighting and artwork.

The colonnade along the linear plaza will provide all weather outdoor dining opportunities and, combined with proposed tree planting, good visual privacy between the new "eat street" and the residential areas above.

KEY

Passive surveillance at ground floor active frontages
Passive surveillance at upper floor

09 SOCIAL DIMENSIONS

The project includes a substantial amount of public domain area, non-residential floorspace and communal outdoor areas for the apartments. This mix of landuses can cater for a wide variety of potential functions and activities throughout the day both during the week and on weekends.

The apartment mix was developed after a detailed review of the DCP guidelines and research into a number of factors, including discussions with property advisory agents, potential site investors and also based on our residential development experience as project architects. This advice will ensure an appropriate and economically sustainable dwelling mix considering likely buyer/tenant interest, current market conditions and affordability.

Good transport links and the presence of a wide range of services in the local area will further contribute to the attractiveness and quality of the project.

10 AESTHETICS

The proposed design composes building elements, textures, materials and colours to reflect the use, internal design and structure of the development, responds to the environment and represents the geographical and cultural heritage of Parramatta.

The design establishes a new benchmark in the transition to the desired future character of the area

North aspect

SITE 01

DESIGN CONCEPT VERIFICATION

Pursuant to Clause 50 (1A) of the Environmental Planning and Assessment Regulation 2000, I hereby declare that I am a qualified designer, which means a person registered as an architect in accordance with the Architects Act 2003 as defined by Clause 3 of the Environmental Planning and Assessment Regulation 2000.

I directed the design of the residential flat development stated above and I confirm that the design achieves the design quality principles set out in Part 2 of the State Environmental Planning Policy No 65 - Design Quality of Residential Flat Development.

Michael Heenan
Allen Jack+Cottier
Principal, CEO Design
Architect 5264 (NSW)

SITE 02

DESIGN CONCEPT VERIFICATION

Stephen Cox of Turner has directed the design of GSP Site 2 and is qualified as a registered architect under the Architects Act 2003.

Revision H

	SITE 1																								
	Building D								Building E																
	Studio	1 Bed	2 Bed	3 Bed	GFA	Adaptable	Solar (70% required)	x-vent (60% required)	Studio	1 Bed	2 Bed	3 Bed	GFA	Adaptable	Southerly aspect	Solar (70% required)	x-vent (60% required)	Site 1 apartment totals	Site 1 residential mix	Residential GFA	Residential NSA	Adaptable	Southerly aspect	Solar (70% required)	x-vent (60% required)
	1	1	2	3					1	1	2	3													
B1																									
1 (G)					77								53							130					
2																									
3			3		227				1	5	1		461	1	1	5	4	10		688		1	1	5	4
4		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
5		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
6		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
7		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
8		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
9		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
10		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
11		6	4		700	1	8	6	1	5	3		610	1	1	6	5	19		1310		2	1	14	11
12		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
13		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
14		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
15		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
16		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
17		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
18		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
19		3	6		700	1	7	6	1	5	3		610	1	1	6	5	18		1310		2	1	13	11
20		3	6		700	1	7	6		4	1	2	600	1	1	4	5	16		1300		2	1	11	11
21		3	6		700	1	7	6		4	1	2	600	1	1	4	5	16		1300		2	1	11	11
22		3	6		700	1	7	6		4	1	2	600	1	1	4	5	16		1300		2	1	11	11
23		3	6		700	1	7	6		4	1	2	600	1	1	4	5	16		1300		2	1	11	11
24		3	6		700	1	7	6										9		700		1	0	7	6
25		3	6		700	1	7	6										9		700		1	0	7	6
26		3	6		700	1	7	6										9		700		1	0	7	6
27		3	6		700	1	7	6										9		700		1	0	7	6
28		3	6		700	1	7	6										9		700		1	0	7	6
29		3	6		700	1	7	6										9		700		1	0	7	6
30		3	6		700	1	7	6										9		700		1	0	7	6
31		3	6		700	1	7	6										9		700		1	0	7	6
32		3	6		700	1	7	6										9		700		1	0	7	6
33		3	6		700	1	7	6										9		700		1	0	7	6
34		3	6		700	1	7	6										9		700		1	0	7	6
35		3	6		700	1	7	6										9		700		1	0	7	6
36		3	6		700	1	7	6										9		700		1	0	7	6
37		3	6		700	1	7	6										9		700		1	0	7	6
38		1	2	4	700	1	5	4										7		700		1	0	5	4
39		1	2	4	700	1	5	4										7		700		1	0	5	4
40		1	2	4	700	1	5	4										7		700		1	0	5	4
41		1	2	4	700	1	5	4										7		700		1	0	5	4
42		1	2	4	700	1	5	4										7		700		1	0	5	4
SUBTOTAL	0	131	201	20	27,604	39	271	224	17	101	53	8	12,674	21	21	117	104			**40,278**		60	21	388	328
SITE SUBTOTAL		352				11.1%	77.0%	63.6%			179			11.7%	11.7%	65.4%	58.1%					11.3%	4.0%	73.1%	61.8%
TOTAL							531																		
TOTAL AREA																									
Mix																									
Studio	0								17									17	3.2%						
1B		131								101								232	43.7%						
2B			201								53							254	47.8%						
3B				20								8						28	5.3%						
PARKING																									
Residential total						531																			
Adaptable						53.1																			
Non adaptable						478																			
Visitor total						106																			
Visitor accessible						1.1																			
Visitor non accessible						105																			
Non residential total																									
Non resi accessible																									
Non resi non acc																									
PARKING TOTAL						**637**																			
Motorbikes						13																			
Bike parking						265.5																			

								SITE 2																						
								Building K																						
	Building A	**Building B**	**Building C**	**Building F retail**	**Building F commercial**	**Site 1 Total GFA**	**Site 1 mix**	Studio	1 Bed	2 Bed	3 Bed	Site 2 Residential GFA	Adaptable	Southerly aspect	Solar	x-vent	Site 2 apartment totals	**Building I**	**Building J**	**Building L retail**	**Building L commercial**	**Site 2 Total GFA**	**Site 2 mix**	Residential GFA total	Non-Residential GFA total	**Total Apartments**	**Adaptable**	**Southerly aspect**	**Solar % (70% required)**	**x-vent % (60% required)**
								1	1	2	3																			
B1	5200																													
1 (G)		974		1231								20						557	78	184	622			150						
2			2650		1166														1053		840			0						
3			526		1387														1075		840			688		**10**				
4					1387														1075		840			1310		**19**				
5					1387														1075		840			1310		**19**				
6					1387														1075		840			1310		**19**				
7					1387														1075		840			1310		**19**				
8					1387														1075		840			1310		**19**				
9					1387			1	4	6		838	1	0	8	9	11				840			2148		**30**				
10					1129			1	4	6		848	1	0	8	9	11				840			2158		**30**				
11								1	4	6		848	1	0	8	9	11							2158		**30**				
12								1	4	6		848	1	0	8	9	11							2158		**29**				
13								1	4	6		848	1	0	8	9	11							2158		**29**				
14								1	4	6		848	1	0	8	9	11							2158		**29**				
15									5	6		857	1	0	9	9	11							2167		**29**				
16									5	6		857	1	0	9	9	11							2167		**29**				
17									5	6		857	1	0	9	9	11							2167		**29**				
18									5	6		857	1	0	9	9	11							2167		**29**				
19									5	6		857	1	0	9	9	11							2167		**29**				
20									5	6		857	1	0	9	9	11							2157		**27**				
21									5	6		857	1	0	9	9	11							2157		**27**				
22									5	6		857	1	0	9	9	11							2157		**27**				
23									5	6		857	1	0	9	9	11							2157		**27**				
24									5	6		857	1	0	9	9	11							1557		**20**				
25									5	6		857	1	0	9	9	11							1557		**20**				
26									3	4	2	789	1	0	9	9	9							1489		**18**				
27									3	4	2	789	1	0	9	9	9							1489		**18**				
28									3	4	2	789	1	0	9	9	9							1489		**18**				
29									3	4	2	789	1	0	6	7	9							1489		**18**				
30									4	1	3	715	2	0	5	6	8							1415		**17**				
31																	0							700		**9**				
32																								700		**9**				
33																								700		**9**				
34																								700		**9**				
35																								700		**9**				
36																								700		**9**				
37																								700		**9**				
38																								700		**7**				
39																								700		**7**				
40																								700		**7**				
41																								700		**7**				
42																								700		**7**				
SUBTOTAL	5200	974	3176	1231	12004	Target 62,862		6	95	119	11	**18,396**	23	0	185	193		557	7581	184	8182	Target 34,901			58,674		**83**	**21**	**573**	**521**
SITE SUBTOTAL			**22,585**			**62,863**			231				10.0%	0.0%	80.1%	83.5%				**16,504**		**34,900**					**10.9%**	**2.8%**	**75.2%**	**68.4%**
TOTAL					Site 1 FSR	**8.28 :1**															Site 2 FSR	**7.36 :1**		**58,674**	**39,089**	**762**		**97,763**		
TOTAL AREA		0.00%			vs target FSR	8.28 :1													0.00%		vs target FSR	7.36 :1						max= 97,763 m2		
Mix							**resi**										Site 2						**resi**		Totals	Mix	Site	Area	FSR	
Studio							**64.1%**	6									2.6%						**52.7%**		23	3.02%	1	7,592	8.28 :1	
1B							**non-res**		95								41.1%						**non-res**		327	42.91%	2	4,742	7.36 :1	
2B							**35.9%**			119							51.5%						**47.3%**		373	48.95%	3	1,953	0.00 :1	
3B											11						4.8%								39	5.12%	Total	14,287	6.8428 :1	
																												resi	**non-res**	
PARKING																												**60.0%**	**40.0%**	
Residential total						531			231																	762				
Adaptable						53.1			23.1																	76.2				
Non adaptable	1/30m2	1/30m2	1/200m	1/30m2	1/200m	478			208									1/30m2	1/200m	1/30m2	1/200m					686				
Visitor total						106			46																	152				
Visitor accessible						1.1			0.9																	2				
Visitor non accessible									45																	150				
Non residential total	173	32	16	41	60	323												19	38	6	41	104				426				
Non resi accessible	3.5	0.6	0.3	0.8	0.6	5.9												0.4	0.8	0.1	0.4	1.7				7.5				
Non resi non acc	170	32	16	40	59	317												18	37	6	41	102				419				
PARKING TOTAL			**323**			**960**			**277**											**104**		**381**				**1341**				
Motorbikes			6			19			6											2		8				27				
Bike parking	26	4.87	15.88	6.155	60	378			115.5									3	37.91	0.92	41	198				576				

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21 August 2015

Kieran Turner
Boyded Industries Pty Ltd
18-20 Chicago Ave
Blacktown NSW 2148

Dear Kieran

Gateway South Concept Development Application
Supplementary Information to Support Stormwater Management Plan

We provide the following response to Parramatta City Council's report *"DA/706/2014 – Gateway South Matters to be Addressed & Additional Information to be Submitted"* dated Feb, 2015, in particular the Catchment & Engineering Comments described in Section 2.

Stormwater Management

Section 2, paragraph 2 and 3:

"…Although this approach is that used in the UPRCT guideline for catchment wide application it is not sufficient for a development of this magnitude which should also be looked at on its merits and specific impacts caused by this development.

The potential volume of rainwater/stormwater draining from Sites 1 and 2 will be increased when wind-driven rainfall is intercepted by the high buildings. This must be allowed for in rainwater harvesting, on site detention, water sensitive urban design, water quality management and discharge designs. This is also complicated by the effects of down wash and rain shadow."

Preliminary verbal advice received from Council drainage engineers indicated that the development should be designed based on the Upper Parramatta River Catchment Trust (UPRCT) guidelines. Hence these were used in the preparation of the initial Conceptual Stormwater Management Plan.

We agree that the potential rainwater / stormwater draining from Sites 1 and 2 will be increased when wind driven rainfall is intercepted by the high buildings. We have revised the estimated the catchment areas for Sites 1 and 2 based the AS/NZS 3500.3:2003 Plumbing and Drainage Part 3: Stormwater drainage (Section 3.4) which suggests that a 2v:1h maximum gradient of descent of wind-driven rain should be adopted for roof catchments (Figure 1).

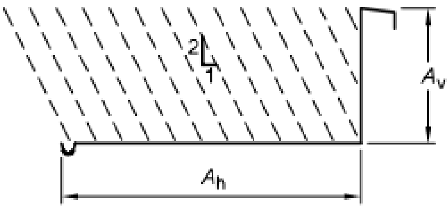

Figure 1 Vertical wall with a flat roof

In order to calculate the maximum catchment area, the worst case scenario for wind driven rainfall intercepted by the high buildings, would be to consider rainfall is intercepted from the east face of the site (Church St) and parts of the south face of the site (Early St and Lansdowne St). New catchment areas were calculated using the surface area of the East face and South face of buildings and roof areas of all the buildings. Table 1 provides the revised estimated catchment areas for Sites 1 (Catchments 1A and 1B) and 2 (Catchments 2A and 2B).

Table 1 Revised estimated catchment areas for Sites 1 and 2

	Catchment 1A	Catchment 1B	Catchment 2A	Catchment 2B
Area (m^2)	9,400	3,500	2,950	6,000

The revised catchment areas in Table 1 have been applied to the methodology for estimating On-Site Stormwater Detention (OSD) and Rainwater Reuse volumes defined in the Upper Parramatta River Catchment Trust (UPRCT) guidelines. With consideration being given to the area bypassing the OSD, the revised OSD volumes for Sites 1 and 2 are provided in Table 2 for discussion purposes only.

On-Site Detention Calculation Sheet as specified in the UPRCT guidelines was used to re-calculate the OSD volumes. As discussed in *Section 3.1 Design Criteria – Conceptual Stormwater Management Plan for Gateway South,* Total Site Storage Requirement (SSR) parameter of 245m^3/ha and Total Permissible Site Discharge (PSD) of 235L/sec/ha were used in the recalculations. Updated SSR and PSD requirements are shown in Table 3

Table 2 Revised OSD and RWT volumes

	Catchment 1A	Catchment 1B	Catchment 2A	Catchment 2B
OSD Volume (m^3)	230	86	73	147
RWT Volume (m^3)[1]	90	40	50	20

Table 3 Updated SSR and PSD requirements

	Catchment 1A	Catchment 1B	Catchment 2A	Catchment 2B
SSR (m^3)	230	86	73	147
PSD (L/sec)	178	67	56	114

Section 2 paragraphs 5 and 6

"In addition this significant volume of stormwater being intercepted by this development and discharged from the sites is likely to cause local flooding in its own right. Or it may coincide with, and thereby amplify flood levels in Church Street and the immediate surrounds arising from Clay Cliff Creek.

There is a need for more information on the consequences and management of internally generated runoff and in particular how this would affect sites adjacent to the development sites."

The Gateway South development is located near the Clay Cliff Creek Catchment and this area is prone to flooding.

A preliminary DRAINS model was prepared for the site to compare the effectiveness of OSD storage given the proximity to Clay Cliff Creek. In should be noted, by adopting the PSD requirements from UPRCT guidelines in the DRAINS model, the calculated OSD volume exceeds the calculated SSR for the development site.

A comparison has been made between the hydrographs for the 100 year Average Recurrence Interval (ARI) flood for a 2 hour storm event produced from the Clay Cliff Creek flood model (flood modelling conducted by Cardno in *Flood Impact Assessment, 2015*) and the local discharge from the site when for cases which include OSD and exclude OSD. The 2 hour duration storm event was chosen for this comparison as it was reported to produce the maximum flood levels in Clay Cliff Creek. The purpose of this comparison was to demonstrate that detaining stormwater on Gateway South development site using OSD has the potential to increase the flood levels on Church Street.

Figure 2 and Figure 3 show the hydrographs in the following scenarios:

- Peak flows for overland flows entering the site in the 100 year flood during the 2 hour storm event, which is the critical duration for maximum flood levels (Figure 2 – red line)
- Peak discharge from the local Gateway South development site adopting the OSD listed in Table 2 (Figure 2 and Figure 3 –purple line)
- Peak discharge from the local Gateway South development site without adopting OSD (Figure 2 and Figure 3 – blue line)

Figure 2 compares the 100 year flood hydrograph in the stormwater channel with respect to having OSD and excluding OSD. Figure 2 shows, during the 100 year ARI flood for a 2 hr storm event, peak flow occurs at 55

[1] In accordance with the original design

minutes (solid line). Figure 3 shows, the peak discharge from the local Gateway South development occurs at 40 minutes (dashed line). By comparing the time of occurrence of the peak flows in Figure 2 and Figure 3, it can be observed that the peak flow in the local catchment occurs prior to the peak flow in the Cliff Creek stormwater channel.

As shown in Figure 3, by not providing OSD, the peak discharge from the Gateway South development site discharges prior to the arrival of peak flows from Clay Cliff Creek. By adopting OSD, the local site discharge will continue to flow at higher rates even after the peak flow discharge and subsequently coincide with the arrival of peak discharge from Clay Cliff Creek thus resulting in a higher cumulative discharge from the site to Church St.

Therefore, by including provisions for OSD at the Gateway South development site, higher peak flows will be discharged into Clay Cliff Creek during the peak storm event.

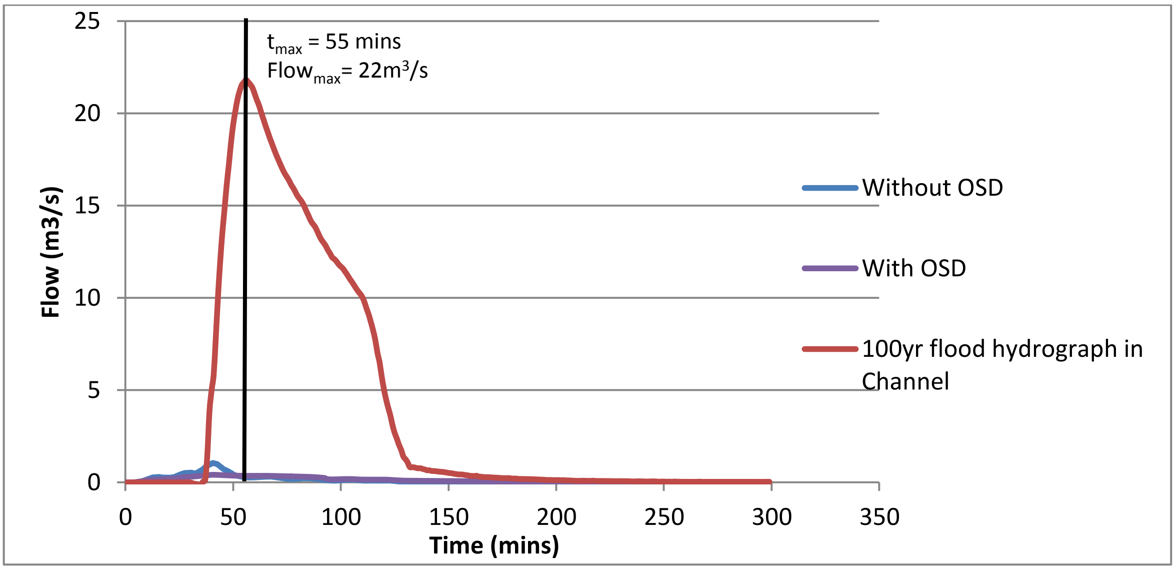

Figure 2: Comparison of hydrographs (peak flood levels in the channel and Gateway South development with and without OSD)

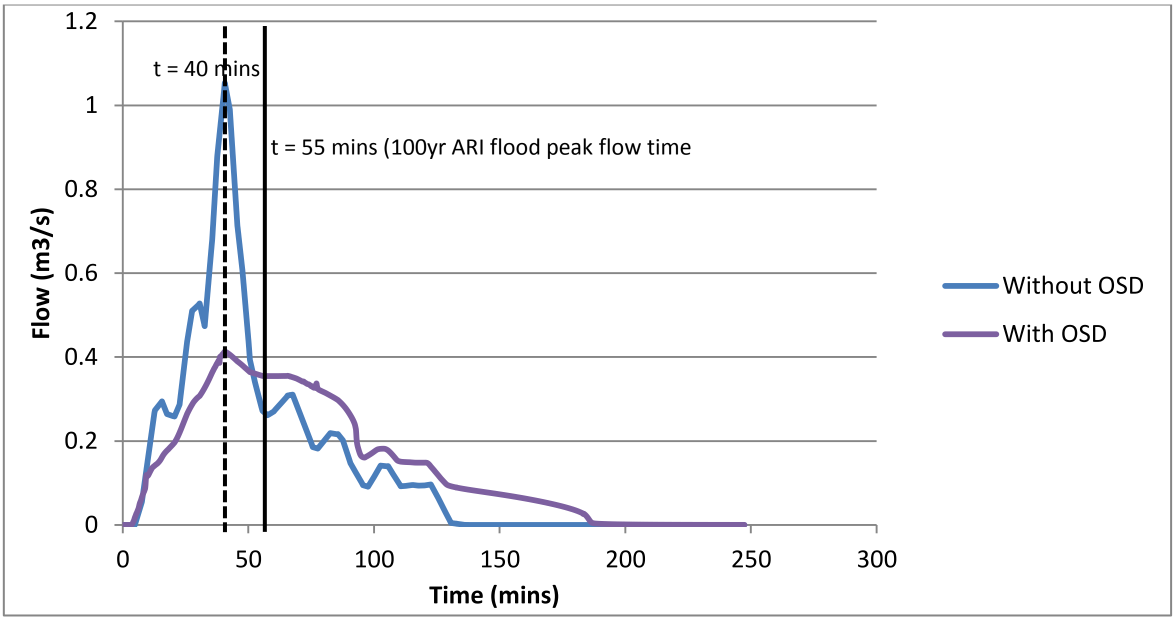

Figure 3: Comparison of hydrographs with and without OSD

For minor flood events, the local drainage network on-site that drains to Cliff Creek stormwater channel would require to be amplified to account for the increase in SSR requirements on site due to increase in catchment area from high rise buildings.

AECOM

Water Sensitive Urban Design

Section 2, paragraph 7:

"*Although much of this has been outlines in the concept DA documents so far submitted, the applicant will need to further develop response to the Water Sensitive Urban Design Objective and Design Principles outlines in the Parramatta DCP 2011 3.3.6 pp 64-74 and also in its Appendix Section 7 pp 460-1.*"

In accordance with the Parramatta Development Control Plan (DCP) 2011 – *Water Sensitive Urban Design Guideline*, the following strategy has been developed. The information provided below is in addition to the *Gateway South Concept Development Application – Conceptual Stormwater Management Plan* submitted in Oct, 2014.

Water Sensitive Urban Design Strategy for Gateway South Concept Development Application

1. **Background information**

The Gateway South project is located across Nos 57, 63 and 83 Church Street, and 44 Early Street, Parramatta. A Flood Impact Report for the Gateway South (57, 63 and 83), Church Street Parramatta has been prepared by AECOM in June, 2012.

2. **Site context**

The site is located adjacent to the Clay Cliff Creek catchment (Figure 4). As stated in the Flood Impact Report (AECOM, 2012) stormwater flows from Ollie Webb Reserve (west of the development site) towards Church St (east of the development site) and discharges to Parramatta River. A closed stormwater culvert runs underneath 57 Church Street extending under the railway line before discharging to Parramatta River. Due to the proximity of the development site to Clay Cliff Creek, the site is likely to be affected by severe storm events (100 year ARI flood).

Figure 4 Clay Cliff Creek

Source: AECOM, 2011

3. **Proposed development**

The following details were provided in the "*Gateway South Concept Development Application – Conceptual Stormwater Management Plan*":

Site 1 - Two buildings of mixed use retail, commercial and residential (42 floors and 23 floors), a third building containing retail and commercial (10 floors) with provision for a major supermarket and underground carpark.

Site 2 - Two buildings of mixed use retail, commercial and residential (31 floors), a third building containing retail and commercial (10 floors) with provision for a supermarket and underground carpark.

Site 3 - A designated open space which will be dedicated to Parramatta City Council.

Refer to Figure 5 for an indicative project site layout.

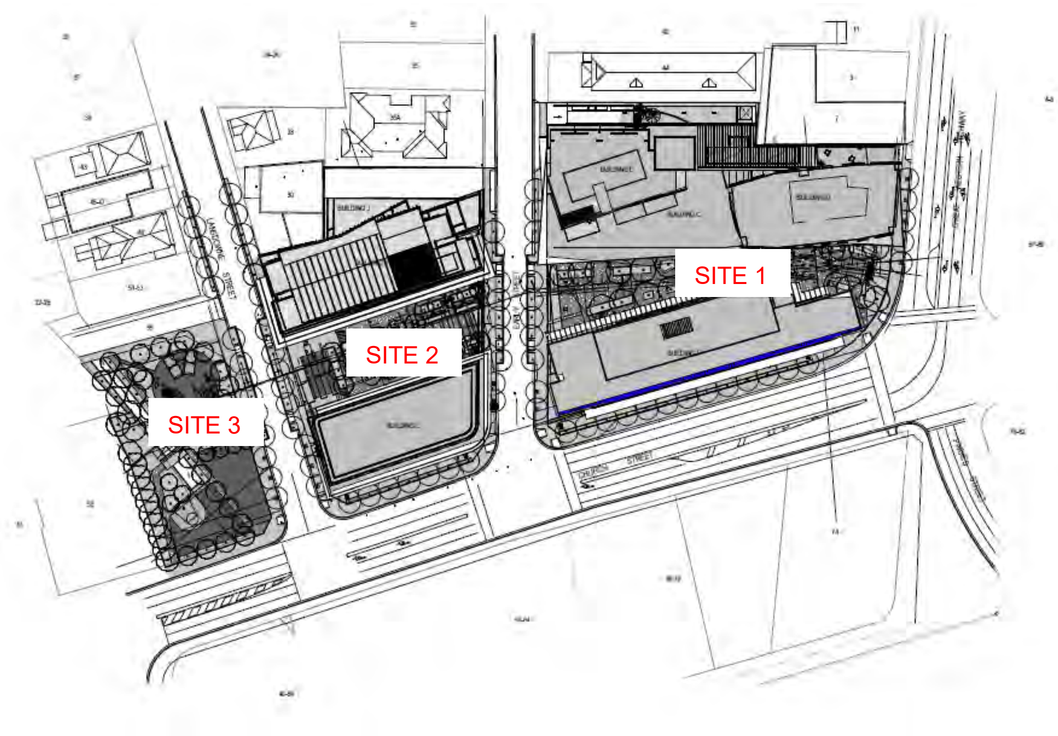

Figure 5 Indicative Project Site Layout

(Source: Allen Jack + Cottier, 2014)

4. WSUD objectives

The following details were provided in the "*Gateway South Concept Development Application – Conceptual Stormwater Management Plan*":

The WSUD requirements for the proposed development are generally defined in Parramatta City Council's (PCC) Development Control Plan 2011 (DCP) and include pollutant load reduction targets. An extract of the DCP is provided below for reference purposes.

Gross Pollutants (GP)	*90% reduction in the post development mean annual load of GP*
Total Suspended Solids (TSS)	*85% reduction in the post development mean annual load of TSS*
Total Phosphorus (TP)	*60% reduction in the post development mean annual load of TP*
Total Nitrogen (TN)	*45% reduction in the post development mean annual load of TN*
Hydrocarbons, motor oils, oils and grease	*No visible oils for flows up to 50% of the one-year ARI peak flor specific for service stations, depots, vehicle body repair workshops, vehicle repair stations, vehicle sales or hire premises, car parks associated with retails premises, places of worship, tourist and visitor accommodation, registered clubs and pubs.*

Water Quality Modelling

A simplistic MUSIC was prepared to estimate the potential percentage reduction in pollutant load that could be achieved using the implemented WSUD elements above. Results of the MUSIC model are presented in Table 4.

Table 4: MUSIC results

	Sources	Residual Load	% reduction
Flow (ML/yr)	15.5	13.8	10.8
Total Suspended Solids (kg/yr)	3.09E+03	362	88.3
Total Phosphorus (kg/yr)	6.09	3.01	50.7
Total Nitrogen (kg/yr)	44.3	26.1	41
Gross Pollutants (kg/yr)	371	0	100

Comparing the results of the MUSIC model in Table 4 and the water quality targets discussed above, compliance with Parramatta City Council's reduction targets for removal of gross pollutants and total suspended solids has been achieved. It can also be observed that the Parramatta City Council's water quality targets for removal of total phosphorus and total nitrogen have not been achieved. Removal of phosphorous and nitrogen from surface runoff typically requires either infiltration and/or bio treatment in the form of bio-retention basins etc. Given the constraints on achieving the water quality targets described above due to the limited green space available in sites 1 and 2, we do not believe that the target reductions for total nitrogen and total phosphorous can be achieved.

5. Constraints and opportunities

Flooding is a major constraint for the development as the site is located adjacent to the Clay Cliff Creek.

The footprint of the development is located very close to the receiving waters, providing little opportunity to install bio-retention facilities between the development and the discharge point;

Opportunities in the development site include significant roof areas that can be used to harvest rainwater for reuse. This can be used to supplement non potable water uses including toilet flushing and landscape watering. Site 3 is a dedicated open space, which includes landscaped zones for passive infiltration. These opportunities have been incorporated into the Water Sensitive Urban Design Strategy.

6. Best planning practices

As this development application is currently in concept stages, a detailed capital and life-cycle cost of infrastructure can be provided at a later stage to provide a detailed assessment of best planning practices that can be used on site. This is will determined in consultation with PCC and due consideration will be given to Council's maintenance and asset management practices.

7. Water conservation

Rainwater tanks will be incorporated into the proposed design to capture rainfall from roof areas. This will be treated and reticulated through the buildings as non-potable water, which will reduce potable water demand on site.

8. Stormwater management

As this development application is currently in concept stages, a concept stormwater management strategy has been developed to address the stormwater management requirements on site. At this stage, only indicative sizing, location and configuration of rainwater tanks are known.

9. Integration with urban design

The following WSUD measures will be integrated into the design of Gateway South development. Typical details have been provided in Appendix A for discussion purposes.

- Vegetated swales near the foot paths – this will complement the existing road levels and reduce runoff from the footpaths
- Tree pits – will be integrated into the public domain works
- Raingarden – will be used along the footpath to capture runoff and remove sediments from runoff
- Infiltration – will be predominately used in Site 3 and assist in reducing runoff from site

- Vegetated filter strips – act as buffer zones near the foot paths to reduce runoff and filter sediments through vegetation
- Rainwater tanks – privately maintained landscaping will be irrigated by rainwater harvested from roof areas and reused for non-potable use such as toilet flushing

In conclusion, we have demonstrated the following:

- There is an increase in stormwater draining from Site 1 and 2 due to the wind-driven rainfall intercepted by high buildings. However, during severe flood events (100 year ARI flood), it be seen from Figure 2 and Figure 3 higher peak flows will be discharged to the stormwater by including OSD. Increase in flows during minor flood events will be accounted for, by amplifying the local drainage system to Cliff Creek stormwater channel.
- Water Sensitive Urban Design measures have been incorporated into the design of the Gateway South development.

Kind regards

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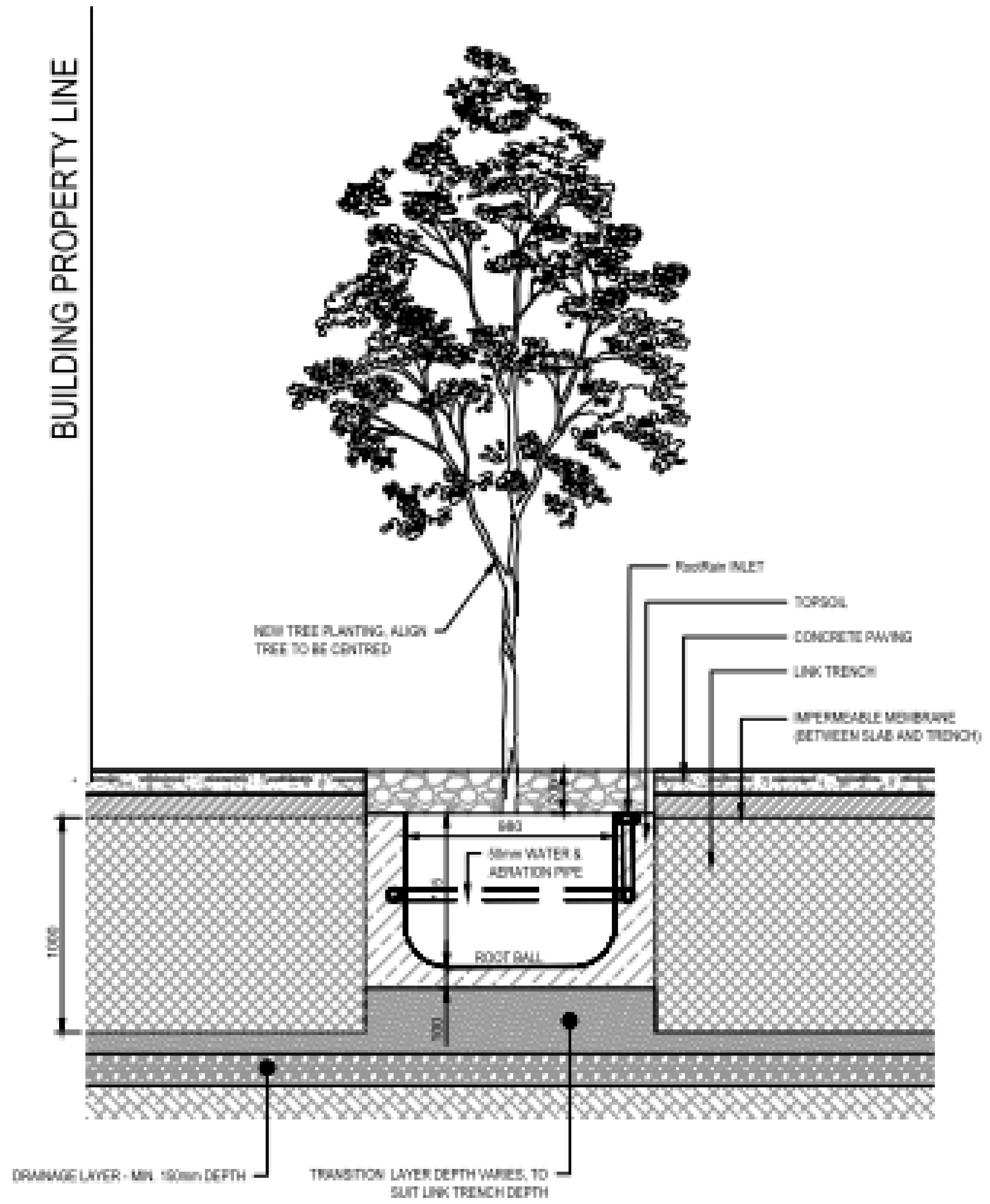
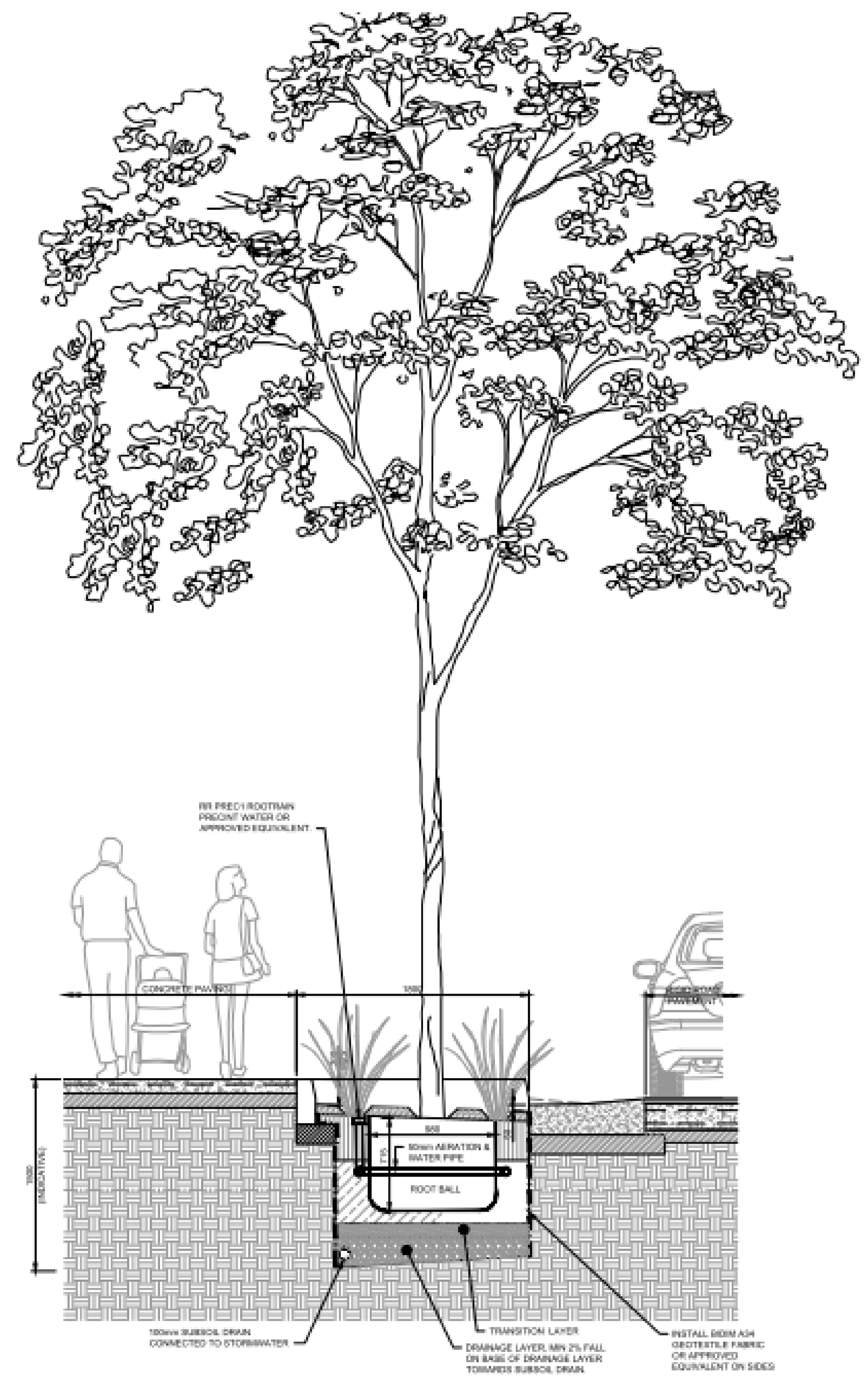
Appendix A – WSUD Strategies to be applied on Gateway South Development


A - SWALES
B - TREEP PIT (NEAR BUILDING)
C - TREE PIT (NEAR ROAD)
D - RAINGARGEN
E - INFILTRATION
F - VEGETATED FILTER STRIP

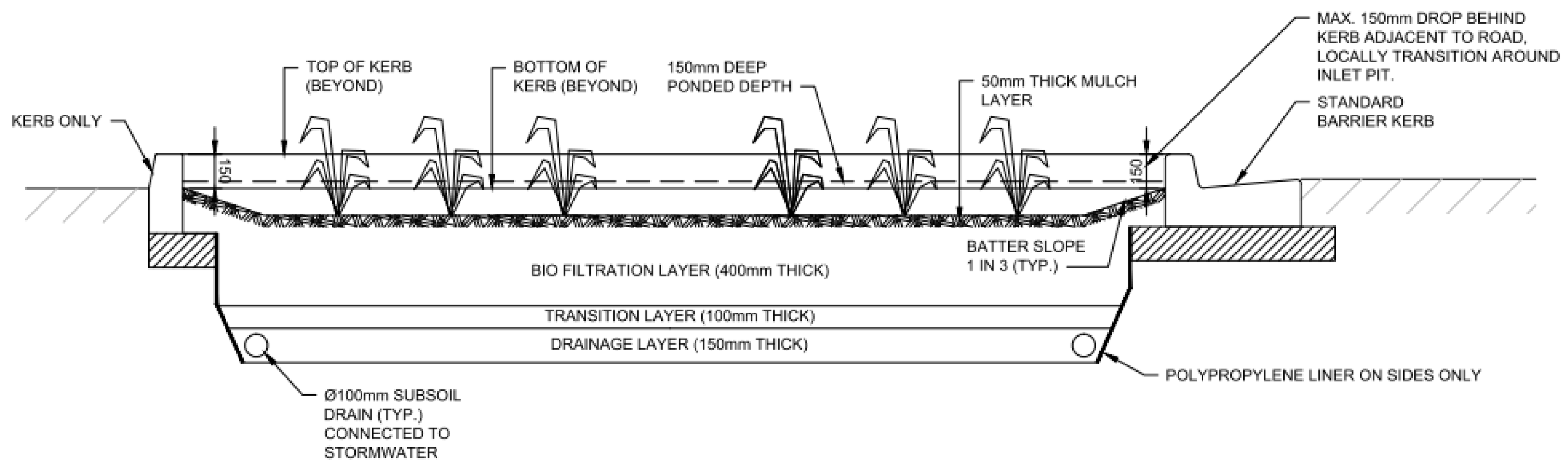
(A) SWALE - TYPICAL SECTION



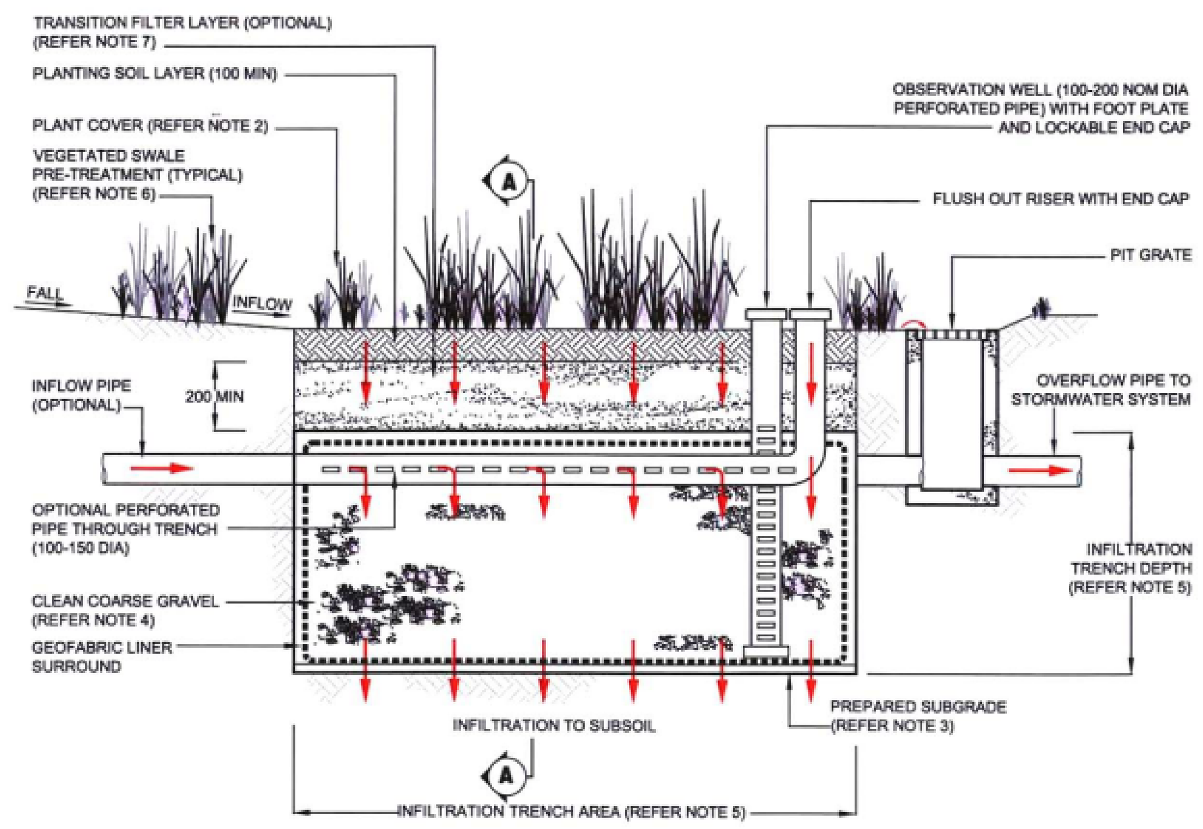
(B) TREE PIT WITH PASSIVE IRRIGATION (NEAR BUILDING) - TYPICAL SECTION



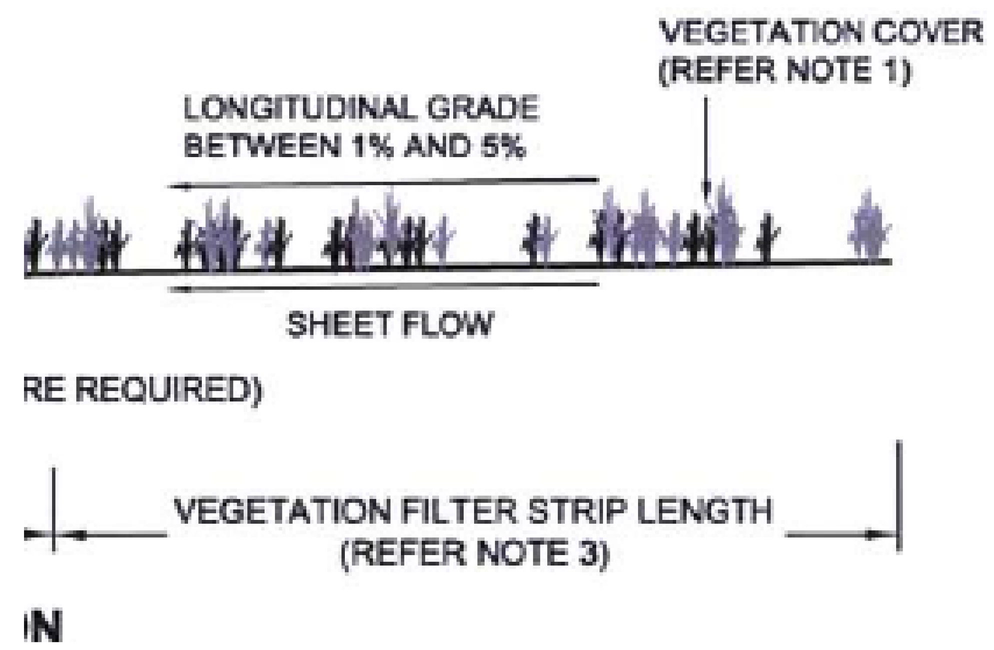
(C) TREE PIT WITH PASSIVE IRRIGATION (NEAR ROAD) - TYPICAL SECTION



(D) RAINGARDEN - TYPICAL SECTION



(E) INFILTRATION - TYPICAL SECTION



(F) VEGETATED FILTER STRIP - TYPICAL SECTION

Local People. Global Experience.

Location

Source: Allen Jack + Cottier Architects

Gateway South Concept Design Church Street, Parramatta S79C Assessment Report: Flooding

July 2016

IMPORTANT NOTICE

This report is confidential and is provided solely for the purposes of flood assessment of Gateway South development for Gateway Parramatta One Pty Ltd (ABN 57607 553 565). This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ("SMEC") and Gateway Parramatta One under which SMEC undertook to perform a specific and limited task for Gateway Parramatta One. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than Gateway Parramatta One. Any other person who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that he or she acknowledges and accepts that he or she may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Scope

SMEC has been engaged by Gateway Parramatta One P/L ABN 57607 553 565 (also referred to in this report as "Dyldam") to review the flooding and stormwater requirements for the proposed Gateway South Development at Church Street, Parramatta. After the original DA submission by Boyded Industries in 2014, Parramatta City Council (PCC) provided additional requirements to be addressed in further submissions. Following those comments, AECOM Consultants on behalf of Boyded Industries revised the concept design for the proposed Gateway South Development and submitted it to PCC on 4th September 2015. Following further submissions by Dyldam; PCC on 29 June 2016 issued an Assessment Report under Section 79C of the Environmental Planning an Assessment Act of 1979.

This report provides a response to the requirements specified for flood related issues in the above Assessment Report.

1.2. Site Location

The proposed Gateway South development consists of three sites where Sites 1 and 2 propose to develop the land with the construction of a mixed commercial and residential development and providing the third site (Site 3) as a public park. The proposed site is situated along the Clay Cliff Creek with flows travelling from a west to east direction crossing Lansdowne Street, Early Street, and Church Street and ultimately discharging to the Parramatta River. The three sites are shown in Figure 1 below. The catchment is within both the Cumberland City Council and Parramatta City Council Local Government Areas while the site is within the PCC LGA.

Figure 1: Proposed Site Locality (*Source: AECOM, 2015)*

2. FLOODING ISSUES

2.1. Pattern of Flooding

Flooding issues associated with this development have been the subject of two previous reports[1] which in turn were based upon flood investigations undertaken on behalf of Parramatta City Council[2].

The general pattern of flooding within the areas affected by the development is from west to east and arises in the Clay Cliff Creek that has a catchment area of approximately 3.2 square kilometres. The main flow path is a concrete channel that delivers flood flows from the Ollie Webb detention basin to Parramatta River in the east. Uncontrolled flooding arises when the capacity of this channel and its associated culverts are exceeded during major events.

The initial flood studies undertaken by SKM utilised a 1 dimensional model (MIKE 11) and estimated a 1% AEP flood level in Church Street in the vicinity of the development of around 12.9 m AHD. Subsequently PCC engaged Cardno to undertake drainage investigations in Clay Cliff Creek and they developed a more modern 2D model of flooding within this catchment using XP- SWMM software. These studies indicated that the 1% AEP flood levels in the vicinity of Church Street to be lower than those estimated by SKM and around 12.4 m AHD.

AECOM using a revised Cardno model undertook a number of flood studies to finalise their investigations for the Gateway South Concept DA. They were able to achieve the PCC requirements by provision of a flow path under the structures in Site 2.

SMEC has reviewed the modelling undertaken during the previous studies and noted their compliance with PCC requirements.

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[1] AECOM (2015) “Gateway South, Church Street, Parramatta Supplementary Flood Impact Report”, Boyded Industries
AECOM (2014) “Gateway South, Church Street, Parramatta Supplementary Flood Impact Report”, Boyded Industries

[2] SKM (2005) “Lower Parramatta River Floodplain Risk Management and Study”, PCC
Cardno (2007) “Clay Cliff Creek Catchment Master Drainage Plan”, PCC

3. REVIEW OF FLOODING COMMENTS

The flood issues in the Assessment Report are covered by the Development Engineer who comments that (pg. 23);

"The Applicant has responded positively and constructively to Council's engineering concerns.

A 2D/1D flood study by Cardno ('the Cardno 2007 Study') clarified the relevant flood levels, depths and velocities around the site and revised flood planning levels and strategy were agreed with Council. Amended architectural drawings showed an appropriate treatment concept, especially at ground level, to accommodate flood waters as necessary, while retaining a suitable street frontage and public safety. Special attention has been given to flood proofing the basement car parks and evacuation/emergency response systems…….

CONCLUSION

The Concept DA proposal satisfies the requirements of Council's controls and can be supported, subject to special conditions of consent, and noting that there will be further detailed assessments and requirements for each of the individual sites and their respective DA's."

Further comments are provided under the section **"Development of Flood Prone Land"** (pg. 64)

"All three development sites are subject to high hazard flooding from the Clay Cliff Creek main channel and from overland flow in the surrounding streets. The applicant has satisfactorily addressed the flooding in terms of habitable levels above flooding and protection of the basements from flooding. Council's Development Engineer has assessed the application and advises that adequate precautions, satisfactory to Council, must be included in all developments in these sites to address the needs of public and occupant safety, emergency escape and refuge, prevention of ingress of flood waters and protection of property within the future development applications."

3.1. Detailed Comments

3.1.1 Flood Emergency Management (11 (1) (a)):

PCC Requirement: The three development sites (being Site 1, 2 and 3) are subject to high hazard flooding from the Clay Cliff Creek main channel and from overland flow in the surrounding streets. Adequate precautions, satisfactory to Council, must be included in all developments in these sites to address the needs of public and occupant safety, emergency escape and refuge, prevention of ingress of flood waters and protection of property.

Response: Flood Emergency Management Strategy has been addressed in Appendix G of the DA documents dated September 2015. This document will be updated to include the recent changes and will be submitted on completion.

3.1.2 Flood Planning Level (11(1) (b))

PCC Requirement: For the purpose of this consent, the Flood Planning Level is defined as the predicted 1% AEP flood level (100 ARI) level plus 500mm arising from Clay Cliff Creek and the surrounding overland flow level, as obtained from the 'Cardno 2D flood model' for Clay Cliff Creek and environs, known as the '2007 model'. The Flood Planning level for each building may vary with the immediate terrain and built context. The Flood Planning Level must be re-determined for each Development Application for each individual building using the '2007 2D Cardno Flood model' (or approved alternative) adjusted for revised designs, building footprints, ground surface levels and so on. Development Applications for individual sites within this concept DA must demonstrate that buildings and ground surfaces do not harm other land by diverting floodwaters and concentrating stormwater at least up to the Flood Planning Level.

Response: Using the 2007 2D Cardno Flood Model, it was shown in Appendix F of the DA documents dated September 2015 that the Flood Planning Level for this locality is 12.9 m. AHD. It was also demonstrated that the buildings and *ground surfaces do not harm other land by diverting floodwaters and concentrating stormwater. There have been no significant changes to the overall layout since that submission.*

3.1.3 Alterations to predicted flow patterns (11(1)(c))

PCC Requirement: All of the buildings, landscape and public domain areas subject to this consent shall be designed and built so as to cause no significant, alterations to the predicted flow patterns of floodwaters, at least up to 'Flood Planning Level' (the 1% Annual Exceedance Probability (AEP) event plus 500mm freeboard).

Response: Using the 2007 2D Cardno Flood Model, it was shown in Appendix F of the DA documents dated September 2015 that there were no alterations to the predicted flow patterns of floodwaters. There have been no significant changes to the overall layout since that submission.

3.1.4 Minimum level of all habitable floors (11(1)(d))

PCC Requirement: The minimum level of all habitable floors in all of the buildings shall be not less than the respective Flood Planning Levels (1% AEP event plus 500mm freeboard).

Response: Using the 2007 2D Cardno Flood Model, it was shown in Appendix F of the DA documents dated September 2015 that the Flood Planning Level for this locality is 12.9 m. AHD. All habitable floor levels are at or above this level thus fully meeting the PCC requirements. There have been no significant changes to the overall layout since that submission.

3.1.5 Basement Car Parks (11 (1) (e))

PCC Requirement: All basement car parks must be protected from ingress of floodwaters with a continuous flood proof bund (including crests on driveways, access ways and other openings) to a minimum level of the Flood Planning Level (1% AEP event plus 500mm freeboard). In addition, the basement car park for Site 1 shall be protected from the ingress of flood waters between the FPL (12.9m AHD) and the PMF (14.0m AHD) with additional driveway crest height and/or self-operating flood gates, and other means. In addition, the basement car park for Site 2 shall be protected from the ingress of flood waters between the FPL (12.9m AHD) and the PMF (14.2m AHD) with additional driveway crest height and/or self-operating flood gates, and other means.

Response: The basement car parks on Sites 1 and 2 are protected from ingress of floodwaters to the FPL of 12.9m AHD. In addition self-operating flood gates will be installed on sites 1 and 2 to prevent ingress of flood waters between the FPL and PMF.

3.1.6 Underfloor Flood Passageway 11(1)(g)

PCC Requirement: For the Site 2 building fronting Church Street, an underfloor flood passageway across the south east corner of this building between Lansdowne Street and Church Street must be provided. This must be generally in accordance with this Concept DA, but will be subject to Council's detailed approval with the individual building Development Application. The underside of this structure must be not less than 200mm below the Flood Planning Level for this building and higher if possible. The Plaza area in Site 2 fronting Lansdowne Street must be set at a level that allows the passage of floodwaters into this underfloor passageway. Detailed design of the plaza area and the Lansdowne and Church Street frontages must address this together with public safety and other aspects including flow from this structure across the footway. This design must be based on hydrodynamic overland flow flood modelling. In such design public safety must take precedence over minor flood affectation.

Response: The hydrodynamic flood flow modelling is currently in progress.

3.1.7 Safety and emergency management (11 (1) (i))

PCC Requirement: Individual DAs must include comprehensive safety and emergency access and egress plans for both occupants and the general public.

Response: Flood Emergency Management Strategy has been addressed in Appendix G of the DA documents dated September 2015. This document will be updated to include the recent changes and will be submitted on completion

3.1.8 Site 3 Park (11 (1) (j))

PCC Requirement: For the Site 3 Park the proposed landscape design is not acceptable to Council, nor approved by this Consent, and a Development Application for this site will need to be substantially modified to incorporate the following responses to flood risk management and water sensitive urban design. The design must address the following to Council's satisfaction:

i. The existing Clay Cliff Creek culvert should not be altered and any fencing around it should be constructed or reconstructed to Sydney Water requirements and specifications. Details of this, including the written approval of Sydney Water, are required to be submitted for Council approval with the Development Application for the park.

ii. In order not to divert floodwaters or reduce storage the finished surface levels of the park should not be significantly different from current surface levels (pre development) unless changes are justified to Council's satisfaction and such changes are shown not to increase flood hazards or displace floodwaters onto adjoining lands. This should be demonstrated to Council's satisfaction in any DA for the park site.

iii. The proposed kiosk amenities facility, half basketball court and play area are not approved by this Consent. Such may be the subject of a DA for the park but would be assessed on their merits at that time, particularly in terms of flood risk safety management and encouragement of use of the high hazard flood area in the park. Council currently considers such an application would not be supported because of the significantly increased risk to public safety but acknowledges that such facilities would be of value to the local communities and will review the risk and liability issues associated with this on receipt of a DA proposal.

iv. Additional car parking must not be provided in or immediately adjacent to the park.

Response: Site 3 will be designed in conjunction with Parramatta City Council and design consultants to advise a desired urban outcome without affecting or altering the flood waters flowing through Site 3. Further modelling of the entire proposal will be undertaken to inform this process.

4. REFERENCES

(Parramatta City Council, July 2016), **Assessment Report –Mixed Use Development S79C – Environmental Planning and Assessment Act, 1979** – Kate Lafferty

(AECOM, 2015), **Gateway South Church Street Parramatta, - Appendix D Supplementary Flood Impact Report – Revised DA Document**, Client: Boyded Industries Pty/Ltd.

(AJ+C, 2015), **Gateway South Parramatta Stage 1 DA Report**. Allen Jack + Cottier Architects.

(SKM, 2005), **Lower Parramatta River Floodplain Risk Management Study and Plan Volume 1 Main Report**, Client: Parramatta City Council.

(SKM, 2005), **Lower Parramatta River Floodplain Risk Management Study and Plan Volume 2 Planning**, Client: Parramatta City Council.

(AECOM, 2014), **Gateway South Church Street Parramatta, - Appendix L Concept Stormwater Management Plan – Original DA Document**, Client: Boyded Industries Pty/Ltd.

(AECOM, 2015), **Gateway South Concept Development Application – Supplementary Information to Support Stormwater Management Plan,** Client: Boyded Industries Pty/Ltd.

DOCUMENT/REPORT CONTROL FORM

File Location Name:	I:\projects\30012122 – Gateway South Church St Parramatta Flood Modelling\010Flooding Assessment\
Project Name:	Gateway South Development- Church Street, Parramatta S79C Assessment Report : Flooding
Project Number:	30012122
Revision Number:	1

Revision History

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
1	28 July2016	A Deen	C Katsoulas	A. Butturini

Issue Register

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Gateway Parramatta One Pty Ltd (ABN 57607 553 565)	28 July 2016	1
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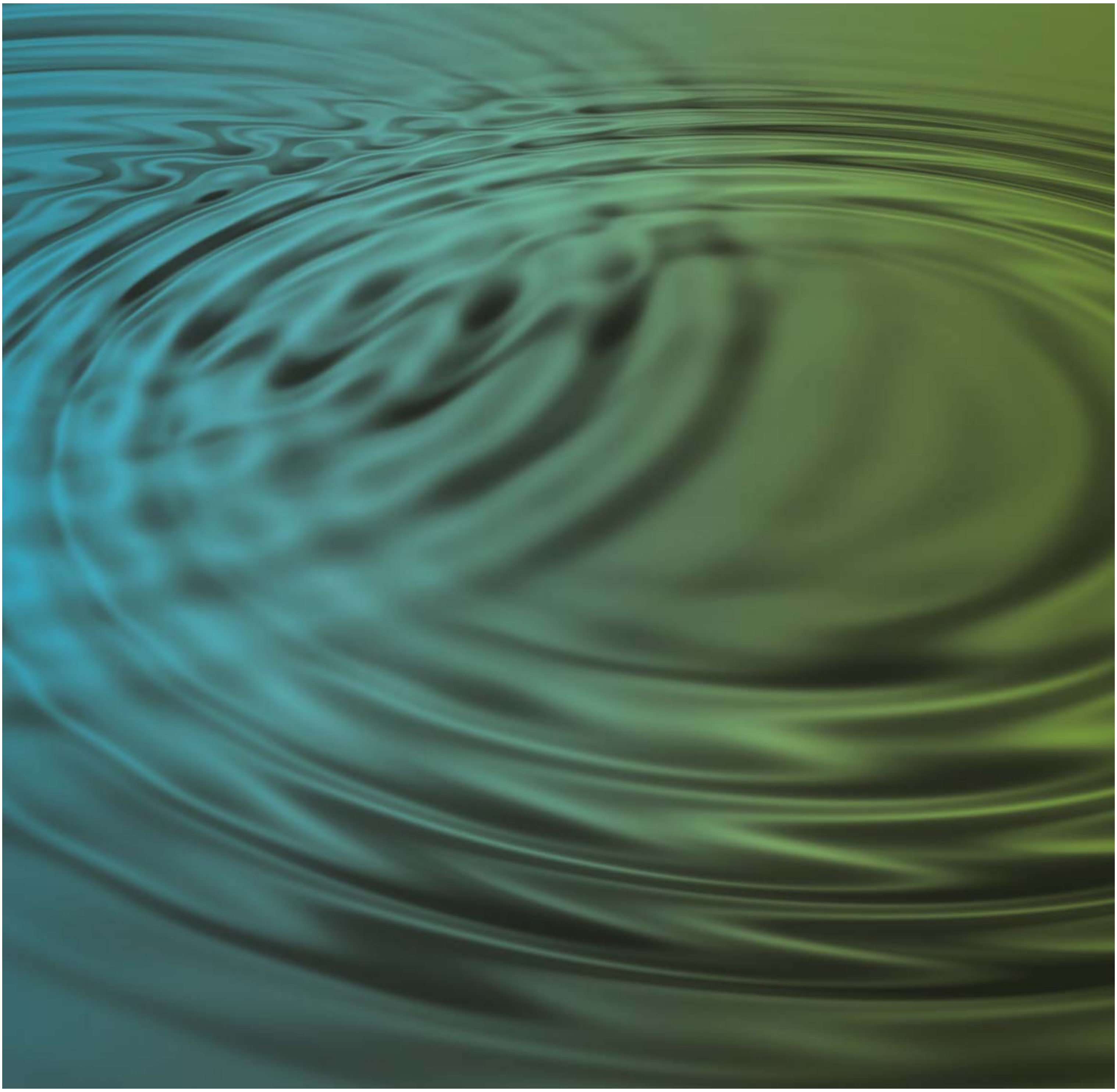
Appendix D

Flood Impact Assessment

Boyded Industries Pty Ltd
16-Oct-2014

Gateway South, Church Street, Parramatta

Supplementary Flood Impact Report



Gateway South, Church Street, Parramatta

Supplementary Flood Impact Report

Client: Boyded Industries Pty Ltd

ABN: 92 000 092 464

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16-Oct-2014

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

Quality Information

Document	Gateway South, Church Street, Parramatta
Ref	p:\603x\60322150\4. tech work area\4.8 flooding\report\60322150_gateway south - flood impact report_v03_for_verification confirmation.docx
Date	16-Oct-2014
Prepared by	D. Kennewell
Reviewed by	N. Bartho

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	15-Oct-2014	Report for Development Application	R. Newman	

Table of Contents

Executive Summary

In support of the Concept Development Application submission for 57, 63 and 83 Church Street and 44 Early Street (referred to as “the project site”), a flood impact assessment has been carried out to identify key flood related constraints and opportunities associated with the future development.

The project site is identified as being flood prone in the Flood Prone Land maps of Parramatta City Council LEP 2007.

Flood behaviour across the project site has been defined based on a review of existing Council information and supplemented with additional, more detailed flood modelling. This included updating the hydraulic model with relevant changes that have occurred since it was established in 2007. Of particular note is the demolition of the building at 57 Church Street. Using this information it has been possible to gain a comprehensive appreciation of existing flood behaviour across the project site in order to identify potential flood risks and outline relevant measures and controls that will need to be incorporated into the future redevelopment.

Flood management objectives and development controls

As part of this impact assessment, development controls have been identified as they relate to the three sites and the type of development proposed in the Concept Plan. Key flood planning controls include:

- Setting flood planning levels for habitable buildings, entries to basement carparks and evacuation routes.
- Managing flood affectation to surrounding development by ensuring adequate floodplain storage and floodways are incorporated into the development layout.
- Identifying key emergency evacuation requirements commensurate with the scale and nature of development proposed.

In applying these controls there are a range of opportunities that exist for effective well integrated floodplain management solutions.

Potential flood impacts

The assessment identified potential flood impacts requiring mitigation measures in the following areas:

- Minimum floor levels to set new habitable areas above the surrounding flood levels.
- External building components subject to flood waters
- Building footprints within the existing 100 year ARI flood extent, potentially creating offsite impacts if not managed
- Basement carparking potentially subject to flooding

Flood management measures

A suitable range of flood management measures are available to manage potential flood impacts of the project.

The proposed management measures include:

- The dedication of 57 Church Street as open space and compensatory flood storage
- All structures below the 100 year ARI flood level with 0.5m freeboard are to have flood compatible building components.
- Generally retail would be situated above the 100 year ARI flood level plus 0.5m freeboard.
- Provision of adequate signage, warning systems, exits and evacuations routes.

Subject to the adoption of the flood management measures proposed in this report, the flood characteristics of the site do not present an impediment to future development of the site.

1.0 Introduction

AECOM has been commissioned by Boyded Industries Pty Ltd to prepare a supplementary Flood Impact Report to accompany a Concept Development Application for the following precinct (the project site):

- Site 1 (northern) - 83 Church Street and 44 Early Street;
- Site 2 (central) - 63 Church Street; and
- Site 3 (southern) - 57 Church Street.

Refer to **Figure 1** for the location of the project site.

The proposed Concept Plan is for a high rise mixed use development across the subject three sites. The development comprises three buildings on Site 1 (of which the two towers are linked by a podium) and two buildings on Site 2 with residential and non-residential uses, basement car parking, and a public domain scheme. Site 3 will be a public park, to be dedicated to Council.

The Concept Plan does not seek approval for any construction or demolition works. Approval for any physical works will be the subject of future staged applications. Demolition of all existing structures on site will be required to facilitate the future redevelopment.

This flood impact assessment identifies key flood constraints and opportunities relevant to the proposed Concept Plan and future redevelopment of the project site.

Figure 1 Project site location

Source: AECOM, 2011

1.1 Existing Development on the site

The project site is largely vacant, however contains former car dealerships and administration / office buildings. The majority of the project site consists of impervious hardstand or roof areas.

1.2 Proposed Concept Plan

The proposed building layout and public domain works are illustrated in Figure 2. A description of the proposed design concept of relevance to the flood assessment is as follows:

Site 1

- There are 7 levels of basement, including 6 levels of car parking and 1 basement supermarket. Car park entry and egress is from Early Street.
- On the western side of Site 1 Building B/C (podium) comprises 2 storeys of non-residential uses. The ground floor has been designed to accommodate retail uses that front the pedestrian plaza.
- Building C/D has a maximum height of 141.7 metres (including podium, plant room and lift overruns that are included in the architectural roof features). Levels 3-42 have been designed for residential floor space.
- Building C/E has a maximum height of 82 metres (including podium, plant room and lift overruns that are included in the architectural roof features). Levels 3-23 have been designed for residential floor space.
- On the eastern side (fronting Church Street) Building F has a maximum height of 45.1 metres (including plant infrastructure and roof feature). The Concept Plan shows ground floor retail uses (and car showroom), and 9 levels of commercial floor space.
- A pedestrian plaza traverses Site 1 from north to south. The central part of the plaza is level (RL12.90), with stairs, accessible ramps and landscape features at the northern and southern ends of Site 1 to connect to existing street levels.

Site 2

- 3 levels of Basement car parking, accessed from Early Street.
- On the western side of Site 2 Building J/K has a maximum height of 112.85m. Levels 1-8 have been designed for non-residential floor space. Level 9-30 have been residential for residential floor space.
- On the eastern side (fronting Church Street) Building L comprises 10 storeys of non-residential uses and has a maximum height of 44.26m (including plant infrastructure and roof feature).
- Building L has been designed to accommodate a ground floor car showroom fronting Church Street, with vehicle access from Early Street.
- A pedestrian plaza traverses Site 1 from north to south. The central part of the plaza is level (RL12.90), with stairs, accessible ramps and landscape features at the northern and southern ends of Site 2 to connect to existing street levels.

Site 3

A designated open space which will likely be dedicated to Parramatta City Council. This would involve replacement of the enclosed culvert on the site with a section of naturalised open channel.

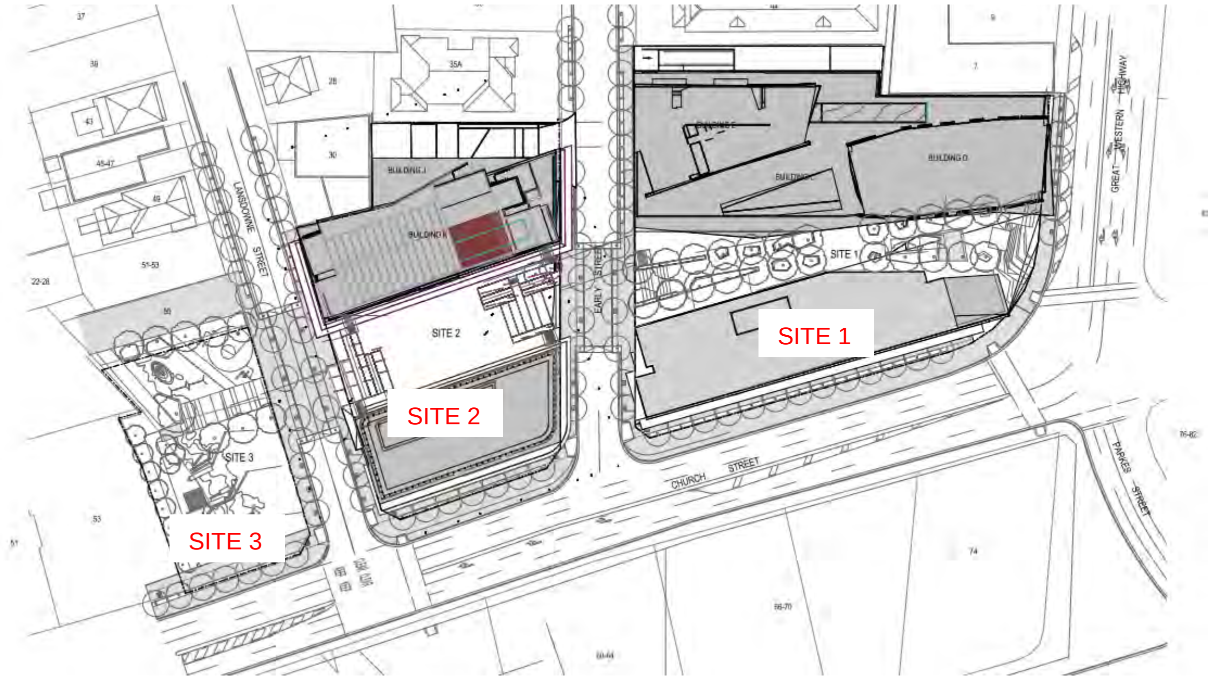

Figure 2 **Concept Plan - Building Layout**

(Source: Allen Jack + Cottier, 2014)

1.3 Background and methodology

The project site is located in the middle reaches of the Clay Cliff Creek catchment (refer Figure 3). Upstream (west of the project site), the catchment drains to a detention basin at Ollie Webb Reserve. From Ollie Webb Reserve flows are conveyed along a brick and concrete open channel that runs through the rear of residential properties from Marsden Street through to 57 Church Street. At 57 Church Street a closed culvert system conveys flows further east, under the railway line to ultimately discharge into Parramatta River at James Ruse Drive.

Sydney Water owns the trunk drainage system of Clay Cliff Creek.

Due to the proximity of the project site to Clay Cliff Creek, there is the potential for all three parcels of land to experience flooding. Accordingly, Council require that potential flood impacts and risks to the project site are assessed as part of the development.

In the Flood Impact Report (AECOM 2012) prepared to support the rezoning of the land, detailed flood modelling was undertaken. This work defined Flood Risk Precincts, assessed climate change sensitivity and summarised the history of flood investigations within the catchment.

Key tasks in this supplementary assessment, as presented in the following sections of this report, involved:

- Update of the “existing case” XPSWMM model. The model was built in 2007. Since this time the building immediately west of 57 Church Street has been demolished. Changes were also made to the model to more appropriately replicate the hydraulic behaviour of the concrete fencing on the south eastern boundary of 63 Church Street. For further details refer to the Cardno (2014) Hydraulic Modelling report in Appendix A.

- Update of the “proposed case” XPSWMM model. The proposed building footprints and the terrain model for the proposed open space park were then incorporated in the model to establish the “proposed case”.

- A comparison of these two hydraulic models was then used to inform the impacts and mitigation measures presented in this report.

Using existing flood information, supplemented with more detailed flood modelling undertaken for this assessment, it has been possible to gain a comprehensive appreciation of flood behaviour across the project site in order to determine key flood constraints and opportunities.

1.4 Consultation with Council and Sydney Water

Meetings were held with Parramatta Council's floodplain management officers, and Sydney Water's waterways team. The outcomes of those discussions have informed this flood impacts assessment.

Key points discussed in these meetings included:

- Both Parramatta Council and Sydney Water reinforced the need to minimise potential off-site flood impacts.
- Both Parramatta Council and Sydney Water indicated they would be supportive of a concept to naturalise the existing concrete culvert on Site 3, subject to appropriate design.

Legend

1% AEP flood extents Project Area — Existing stormwater pipe or channel

Deep

Shallow

Gateway South Development
Clay Cliff Creek
Existing 1% AEP flood extents
Source: Cardno hydraulic model (2014), LPMA Contour data

0 100 200 400 m

N

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Fig. **3**

2.0 Defining Flood Behaviour

In order to identify key flood impacts and risks to the project site it is necessary to quantify existing flood behaviour.

Previous studies and flood maps prepared by or on behalf of Council for the broader Clay Cliff Creek catchment were reviewed as part of the flood assessment. While Council's flood mapping is appropriate for definition of the broader floodplain (in a regional context), review of the information as it relates to the project site has identified limitations in its ability to appropriately define flood behaviour at a local level of detail. The one dimensional modelling approach that forms the basis of Council's flood maps is limited in its capabilities to model the distribution of flows in an urban floodplain such as this, where complex and multiple overland flowpaths are influenced by localised topographic features and building outlines. Given the broad scale modelling on which Council's mapping is based there is a lack of specific detail that will influence flood behaviour on a local scale.

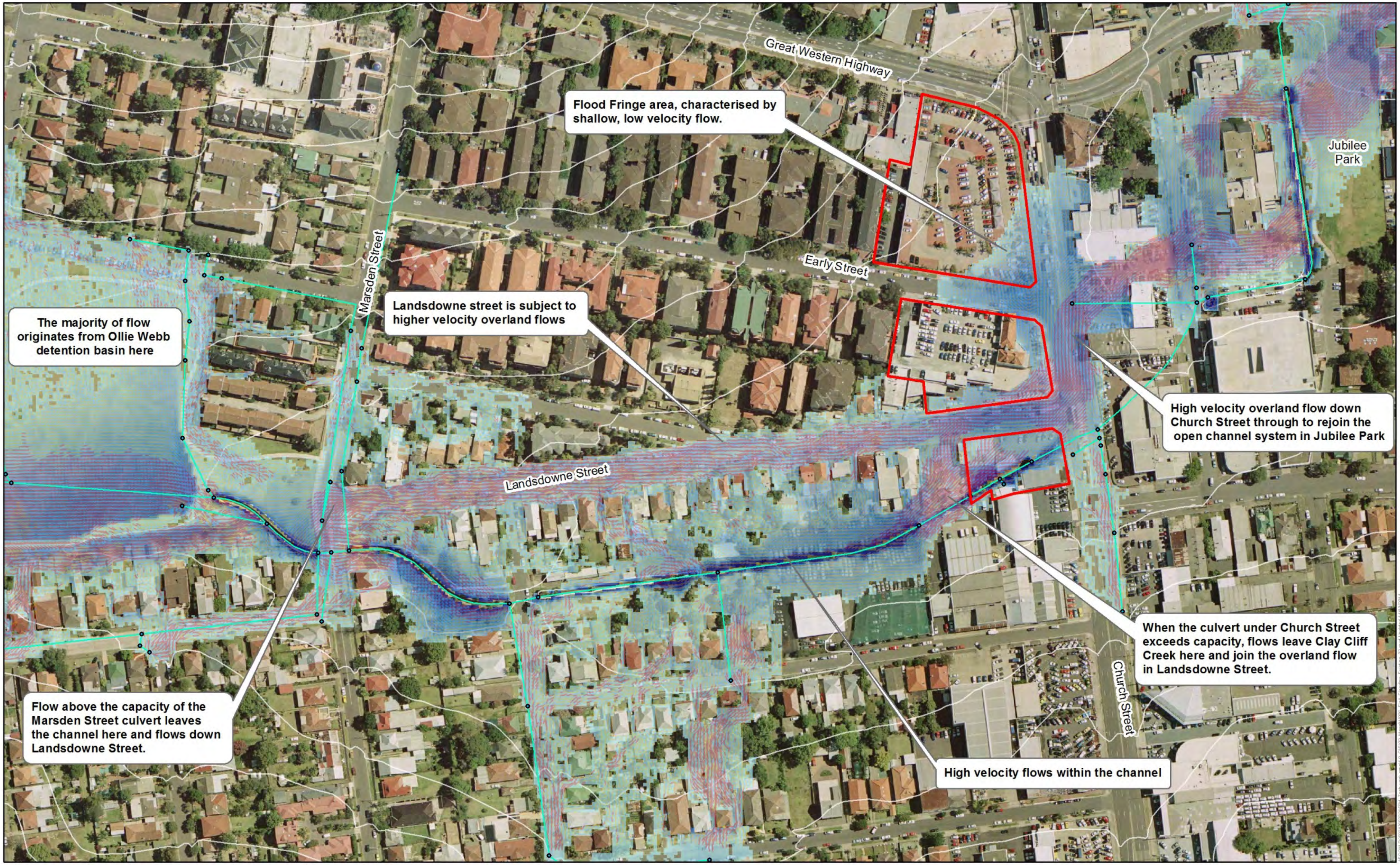
Due to the identified limitations of the Council Flood Mapping (2005), more detailed flood modelling has been undertaken to better quantify flood behaviour across the project site. Of particular relevance to the proposed development application, results of this detailed flood modelling show that the project site is primarily located within low and medium flood risk precincts as defined under Council's Local Floodplain Risk Management Policy. Under Council's Policy, residential and commercial development is permitted within these flood risk precincts, provided appropriate development controls are applied to manage the risk of flooding.

Because of their past experience in the catchment, Cardno were commissioned to undertake detailed flood modelling of the project site required for this flood impact study. At the permission of Parramatta Council the XPSWMM 1D/2D model established for the Clay Cliff Creek Catchment Master Drainage Plan was used as the basis, with added detail and assessment undertaken to meet the above requirements.

2.1 Existing Flood Behaviour

Existing flood behaviour is explained in depth in the Lower Parramatta River Flood Study (SKM, March 2005) and the Clay Cliff Creek Catchment Masterplan (Cardno, July 2007), and a summary of the existing work done is presented in Appendix A – Cardno (2014)

Key aspects of the flood behaviour relevant to the project site are shown in Figure 3 and Figure 4.



100 year ARI flood extents
- Deep
- Shallow

Flow velocity
- Less than 2m/s
- 2 to 4 m/s
- Greater than 4m/s

Stormwater network
- Existing stormwater pipe or channel

Contour interval: 2m

0 25 50 100 m

N

Gateway South Development
Clay Cliff Creek
Existing flood behaviour
Source: Cardno hydraulic model (2014), LPMA Contour data

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Fig. **4**

3.0 Potential flood impacts and management measures

Proposed flood management measures are shown in Figure 5.

Council's flood planning requirements are set out in the Local Floodplain Risk Management Policy (2005). The policy has been prepared with regard to the New South Wales Government's Floodplain Development Manual (2005) to ensure the type and nature of development is commensurate to the level of flood risk. The policy sets out different floodplain management requirements according to low, medium and high flood risk precincts.This assessment has been prepared with consideration of the Policy.

3.1 Minimum Floor Levels

Potential Impact

Flood inundation above building floor levels can result in significant financial costs to restore property and manage health impacts. Flood waters are can often contain pathogens.

Management Measures

Design Flood Levels applicable to the sites are summarised in the table below.

Event	Flood Level (mAHD)
100 year ARI	12.4

Floor levels for this Concept Development Application have been set in recognition of the flood levels pre-development (as outlined in AECOM 2012). Subject to confirmation at detail design, and future discussions with Council, there may be potential to adopt a lower flood planning level at the site, taking into consideration the minor reduction in flood levels along Church Street predicted in this assessment.

The lowest habitable floor level (for residential and commercial premises) would need to be equal to or greater than the 100 year ARI plus 0.5m freeboard.

Based on the modelling undertaken as part of this study, this suggests that the minimum habitable floor level be set at RL 12.9mAHD, which would be approximately 0.3m to 1.2m above existing footpath level in Church Street, 0.2m to 1.4m above footpath level in Early Street and 0.8m to 1.1m above footpath level in Lansdowne Street.

Commercial car showrooms would be at the 100 year ARI flood level of 12.4m AHD.

3.2 Building Components and Structural Soundness

Potential Impact

High velocity flood waters can place significant dynamic pressure on building structures, potentially leading to failure. Deep flood waters can place significant hydrostatic pressure on building components that are subject to flood waters on only one side. This can lead to collapse without warning, resulting in significant risk to life and restoration costs.

Management Measures

All structures are to have flood compatible building components below the 100 year ARI flood level plus 0.5m freeboard.

Generally retail would be situated above the 100 year ARI flood level plus 0.5m freeboard.

It is proposed to locate commercial car showrooms at the 100 year ARI flood level, incorporating flood compatible materials in areas less than 0.5m above the flood level.

Flood depths across the project site are typically less than 0.9m in the 100 year ARI event (except for the planned open space on 57 Church Street) and floodwaters are generally relatively slow moving. No issues with these requirements are foreseen that would not normally be addressed during the development process.

3.3 Offsite flood impacts

Potential Impact

The redevelopment must not increase the flood affectation of surrounding development with regard to floodplain storage, flood levels, flows or velocities.

A portion of the proposed development footprint is located within the 100 year ARI flood extents. Building in this area could, if not appropriately mitigated, increase flood levels within Church Street and Lansdowne Street, by reducing floodplain storage and conveyance from Lansdowne Street to Church Street.

Management Measures

To offset potential impacts due to the building footprints being situated in the 100 year ARI flood extent, it is proposed to incorporate the following measures into the proposed open space at 57 Church Street:

- compensatory flood storage to offset the building footprint impacts
- improved conveyance along the naturalised reach of Clay Cliff Creek,
- a more hydraulically efficient inlet to the culvert under Church Street,
- and to reduce the risk of blockage relative to the existing culvert inlet, by reducing velocities at the inlet and providing a smoother transition from open channel to culverted flow.

At 63 and 83 Church Street the detailed flood modelling shows that the 100 year ARI flood would inundate the eastern perimeter of the two parcels. Flood depths are less than 0.8m and typically slow moving. The nature of flooding is more flood fringe than providing significant flow conveyance. Consequently it is feasible to minimise impacts on adjacent properties by providing compensatory flood storage.

Hydraulic modelling (Appendix A – Cardno 2014) indicates the project would result in a minor reduction in flood levels along Landsdowne, Early and Church Streets. These reductions are predominately within road reserve areas and are limited to between 0.02m and 0.10m.

Management measures and the resulting flood impact are shown in Figure 5 and Figure 6.

Residual Impacts

Hydraulic modelling (Appendix A – Cardno 2014) indicates that during the 100 year ARI flood event there would be minor, localised water level impacts downstream, as shown in Figure 6. Appendix A describes these impacts as being due to numerical instabilities in the hydraulic model and as such not significant. These impacts are limited to roads and opens space areas already subject to flooding. The water level impact is limited to between 0.02m and 0.05m.

3.4 Basement Carparking

Potential Impact

Flood waters entering underground basements pose a very significant risk to life. This can also result in significant remediation and clean up costs.

Management Measures

Council's Local Floodplain Risk Management Policy requires that entries to basement carparks are located at or above the 100 year ARI flood level or greater. Based on modelling undertaken as part of this study, and the recommendations of the AECOM Flood Impact report (2012), ramps to basement carparks will need to be set at a minimum level of 12.9mAHD which is approximately 0.3m - 1.2m above existing footpath level in Church Street, 0.2m – 1.4m above existing footpath level in Early Street and 0.8m – 1.1m above existing footpath level in Lansdowne Street.

It will also be necessary to provide adequate signage, warning systems, exits and evacuations routes. These measures will need to be incorporated into the Flood Evacuation Strategy and Emergency Response Plan.

3.5 Emergency Evacuation

Potential Impact

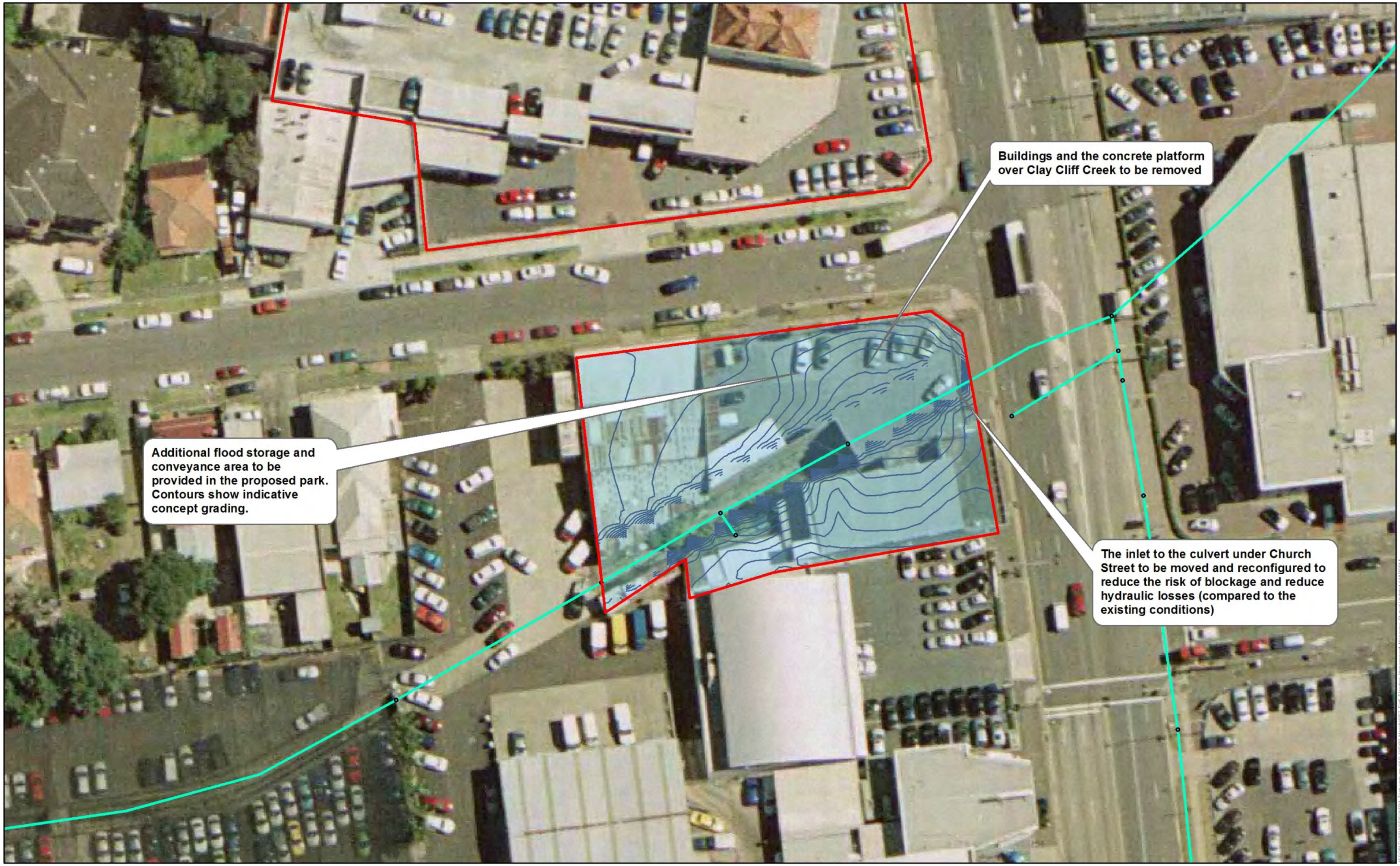
Human contact with flood waters should be avoided. Flood waters often contain pathogens, fast moving objects, have low visibility and can relocate hazardous objects where they are not expected by evacuees.

Considering the proposed commercial landuse for lower-floor areas of the proposal, flood evacuation to higher ground is not expected to be restrictive.

Management Measures

In accordance with Council's Local Floodplain Risk Management Policy, a Flood Evacuation Strategy and Emergency Response Plan will need to be developed for the project site. The plan will need to identify evacuation routes to publicly accessible locations during a PMF flood.

The plan will also need to identify safe and reliable access to an area of refuge above the PMF level, either on site (a second storey) or off site. The project site adjoins land in Early Street and the Great Western Highway which is above the PMF level and could be used as flood free refuge points. Fire stairs may be used to evacuate basement areas. Confirmation of safe evacuation routes would be developed in future stages of the project.



Legend

Project Area

Proposed_park_area

0.2m proposed contour

Stormwater pits

Existing stormwater junction

Stormwater pipes and channels

Existing stormwater pipe or channel

0 10 20 40 m

N

Gateway South Development
Clay Cliff Creek
Flood management measures
Source: Cardno hydraulic model (2014), LPMA Contour data

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Fig. **5**

Gateway South Development
Clay Cliff Creek
Flood Impact Assessment
Source: Cardno hydraulic model (2014), LPMA Contour data

0 25 50 100 m

N

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Fig. **6**

4.0 Conclusion

A supplementary flood impact assessment has been carried out to identify key flood opportunities and constraints associated with the proposed development of three contiguous parcels of land at 57, 63 and 83 Church Street and 44 Early Street Parramatta.

Detailed hydraulic modelling has been undertaken to better quantify flood behaviour for the site and immediate surrounds. The results of the current study, as well as previous investigations flood investigations at the rezoning stage (AECOM Flood Impact report 2012) show that the site is located primarily within low and medium flood precincts but that there will be no impediment to develop the land, provided suitable flood management measures are in place. Residential, commercial and retail development are permitted under Council's Local Floodplain Risk Management Policy providing appropriate development controls are applied to minimise flood risks.

Relevant flood planning controls have been outlined in this report as they relate to the proposed redevelopment and flooding characteristics of the project site. These flood planning controls, with associated opportunities and constraints, are to form the basis for criteria placed upon future development to ensure that flooding is adequately managed in accordance with Council's flood related policies.

Floor levels for this Concept Development Application have been set in recognition of the predicted flood levels pre-development (as outlined in AECOM 2012). Subject to confirmation at detail design, and future discussions with Council, there may be potential to adopt a lower flood planning level at the site, taking into consideration the minor reduction in flood levels along Church Street predicted in this assessment.

References

AECOM (2012), Gateway South, Church Street Parramatta, *Flood Impact Report*, Rezoning Application, prepared for Heartland Group.

Appendix A

Appendix A - Cardno (2014) Hydraulic Modelling report

57-83 Church Street Parramatta

Flood Impact Assessment

59915016

Prepared for
AECOM

16 October 2014

Cardno®
Shaping the Future

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Document Information

Prepared for	AECOM
Project Name	Flood Impact Assessment
File Reference	59915016 R001 57-83ChurchSt V1.docx
Job Reference	59915016
Date	16 October 2014
Version Number	1

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
1	16/10/2014	Issue	Tina Fang	Andrew Reid

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background

Cardno was commissioned by AECOM to undertake flood modelling of the proposed redevelopment at 57-83 Church Street, Parramatta to assess changes to flood behaviour in a 100 year Average Recurrence Interval event. This report documents the inputs, methodology and results of the flood modelling for the existing conditions.

A number of studies have previously been completed in the catchment, including:

- Clay Cliff Creek Catchment Master Drainage Plan by Cardno in July 2007. The aim of the study for Parramatta City Council was to prepare a Drainage Master Plan, identifying overland flow problem areas, surcharging locations due to insufficient pipe capacity and pit inlet capacity, and localised flooding with areas for improvement. Cardno completed this Master Drainage Plan in 2007 and City of Parramatta approved use of the SWMM model for flood modelling in this study.
- Lower Parramatta River Floodplain Risk Management Study by SKM in August 2005.
- Lower Parramatta River – Flood Study by SKM in March 2005. The Lower Parramatta River Flood Study (LPRFS) provided a complete review and updating of flood level information in the tidal section of Parramatta River, between the Charles Street weir and Ryde Road Bridge. The Flood Study provided the base data for the subsequent Floodplain Risk Management Study (FRMS).
- Clay Cliff Creek Catchment Flood Study by Dalland & Lucas in 1992. This report was commissioned by Parramatta City Council in order to develop a Flood Mitigation Plan for the catchment.

The findings of the previous studies were reviewed and further detailed flood modelling of the site, catchment and existing drainage system has been undertaken.

1.2 Objectives

The objectives of this study were to:

- Identify flood behaviour in a 100 year ARI event for the site locality at existing conditions;
- Identify flood extent, depth and velocity for the 100 year ARI event for the site locality for the proposed post-development conditions; and
- Evaluate the potential changes in flood behaviour of the post-development scenario compared to the existing conditions.

1.3 Input Data

The following information was used to inform the study:

- 57-83 Church Street survey by Dunlop Thorp & Co, dated 19th December 2007 (Appendix B);
- Trivett site survey by Hard and Forester, dated 1st October 2009;
- Flood advice from Council, dated 18th August 2011 (Appendix C);
- Ollie Webb Reserve Detention Basin Design Drawings by Cardno, dated 29th March 2007; and
- Clay Cliff Creek Catchment – Master Drainage Plan, Cardno 2007.

2 Site Location

The site comprises three neighbouring lots (numbers 57, 63 and 83) fronting Church Street in Parramatta as shown in Figure 1. All three sites are used for car sales with the majority of the site area being used for car parking with small buildings. The Clay Cliff Creek canal is located on the southern boundary of number 57 and flows in a west to east direction. Overland flowpaths exist over the creek canal, in Lansdowne Street and further downstream through the centre of the Trivett car dealership site.

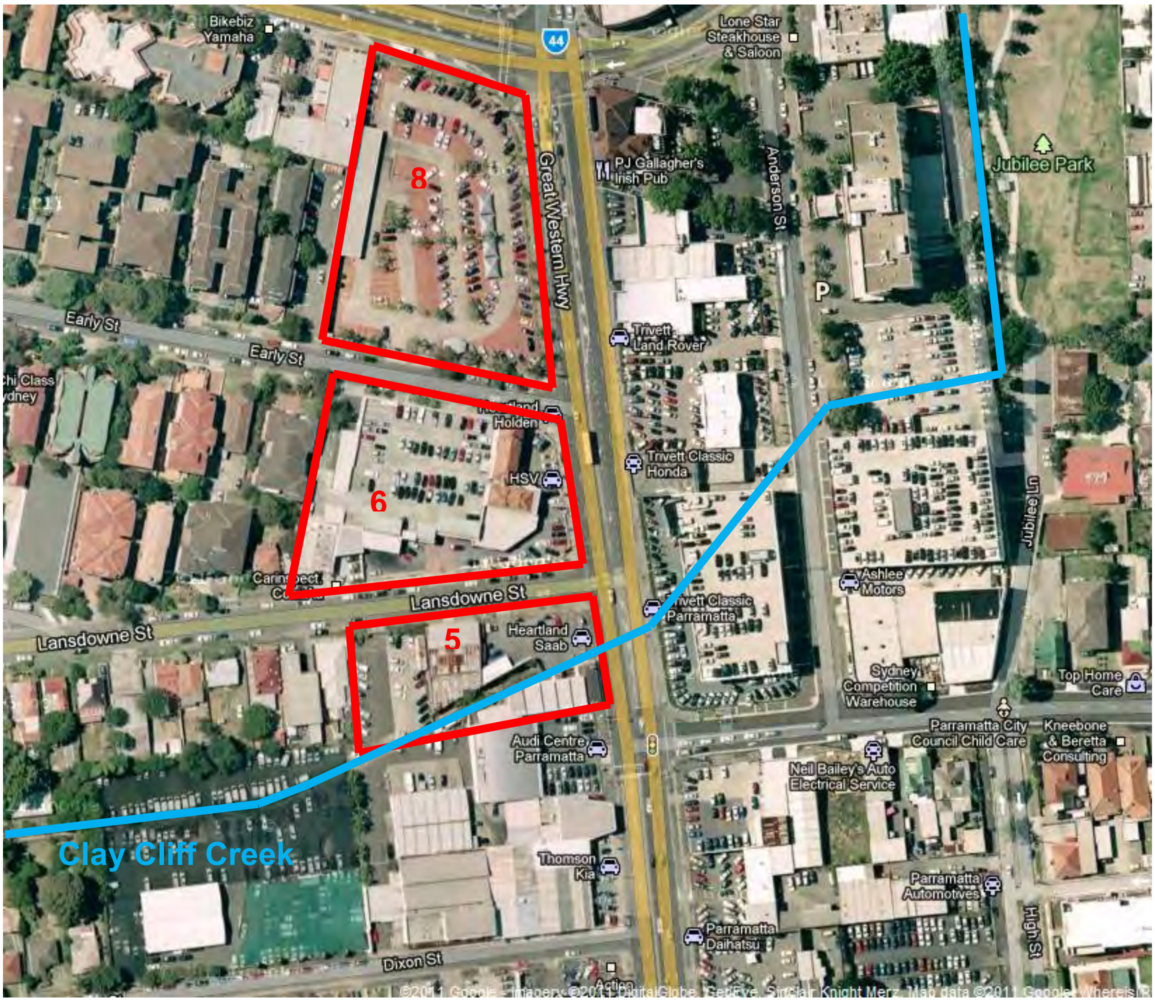

Figure 1 - Aerial View of 57-83 Church Street Parramatta

(Source: Google Maps, accessed 16rd November 2011)

3 Existing Flood Behaviour

3.1 Lower Parramatta River Flood Study 2005

The Lower Parramatta River Flood Study (LPRFS) completed by SKM in 2005 estimated the flood levels shown in Table 1. This Study included a broad scale MIKE-11 model of the catchment that covers the Clay Cliff Creek floodplain. The MIKE-11 model was calibrated according to available historical data in the catchment.

Table 1 - Flood levels estimated in the 2005 Flood Study

MIKE-11 Cross Section & Location	CH 133, CH 55, CH 450, CH 498 (in Church Street)	CH 1230 (over the Clay Cliff Creek canal upstream)	CH 357 (Lansdowne Street upstream of site)
20 year ARI	12.52 -12.54	12.80	12.54
100 year ARI	12.89 -12.91	12.99	12.89
PMF	13.84 – 14.10	14.40	14.22

Source: Council Flood Map (Appendix C)

It can be seen that the flood levels in Church Street are consistent for all cross sections thus there is a broad level pool that has a flood level consistent with Anderson Street. This indicates that overland flow is arriving at Church Street and Anderson Street and being withheld before draining either into the Clay Cliff Creek canal opening in Anderson Street or behind the Marriott Hotel and Carpark. The results of the MIKE-11 model are representative of a broad scale overland flow study. Cross sections of the MIKE-11 model are several hundred metres apart and would not represent the overland flowpaths and floodplain storage areas in detail.

3.2 Clay Cliff Creek Drainage Masterplan 2007

In 2007 Cardno completed a masterplan for drainage in the Clay Cliff Creek catchment using a 1D/2D XP SWMM model. The Study used the same hydrological input data to the 2005 study and catchment data available from Council's GIS, which is considered to be similar to that used in 2005. The 1D sections for the Clay Cliff Creek canal were imported to the XP SWMM model directly from the MIKE-11 model. A downstream condition for the XP SWMM model was also imported directly using the results of the MIKE-11 model. Results of the XP SWMM model were validated using the results of the MIKE-11 model and those reported in the LPRFS (Cardno 2007).

However more detailed pit and pipe data was made available by Council for inclusion into the 2007 model. The 2007 model included 1D elements for road kerbs and all pits and pipes greater than and including 450mm. The 2D component of the XP SWMM model included a 2m grid cell generated from a DTM that was established using Council ALS.

Table 2 - Flood Levels Estimated in the 2007 Drainage Master Plan (m AHD)

Location	Church Street	Anderson Street
20 year ARI	12.17	10.65
100 year ARI	12.28	10.73

Source: Cardno 2007

Results in Table 2 show that the 2007 Study predicts 100 year ARI levels in Church Street that are approximately 0.6m lower than the 2005 LPRFS. The MIKE-11 model of the 2005 Study predicted level pooling in Church Street and Anderson Street most likely caused by a hydraulic control downstream. Whilst levels in Anderson Street are similar for both studies the following are considered to explain the cause of flood level differences in Church Street:

- Modelling of the floodplain using 2D grid cell in XP-SWMM that would provide greater detail in representing overland flowpaths and floodplain storage. The MIKE-11 model is limited to interpolation of floodplain topography between the 1D cross sections.
- Greater detail in the drainage system to include the drainage system from Council's GIS data for all pipes greater than or equal to 450mm;
- Inclusion of 1D kerbs and building footprints; and
- Detailed roughness zones for roads, parks and building lots.

The 2007 study and its results have been accepted by Council and are considered to provide a more detailed estimation of flood levels for the Clay Cliff Creek floodplain. The 2007 study identifies a number of drainage improvement options, such as the Ollie Webb Reserve Retarding Basin that has been constructed.

3.3 Current Flood Modelling for 57-83 Church Street

Cardno modelled flood behaviour of the 100 year ARI storm event for existing and post-development conditions. This has been undertaken by updating of our previous 1D/2D XPSWMM model prepared for Council for the Clay Cliff Creek catchment in 2007.

The following changes in the catchment were incorporated into the model since when it was created in 2007:

- Inclusion of the Ollie Webb Reserve detention basin ground levels and hydraulic structures;
- Update to the geometry of the Clay Cliff Creek canal according to the ground survey;
- Generation of a local 1m grid of the topography for the site using the ground survey of both 57-83 Church Street and the Trivett site;
- Update of the drainage system geometry according to the ground survey of both 57-83 Church Street and the Trivett site; and
- Proposed development layout of 57-83 Church Street received from AECOM, including the proposed construction of a park at 57 Church Street (shown in the drawings in Appendix D).

The DTM was updated in the vicinity of the subject site using the supplied survey. Pits, pipes and the Clay Cliff Creek canal were updated in the model as 1D elements. Flows that exceeded the capacity of the 1D element were conveyed as overland flows across the 2D model terrain to assess the extent, depth and provisional hazard of overland flows.

Provisional hazard was assessed during the 100 year ARI event, this has been determined using the methods outlined in the NSW Floodplain Development Manual Appendix L.

4 Flood Modelling Results

4.1 Existing Scenario

The XP-SWMM flood model was run for the existing scenario for the 100 year ARI event (critical duration of 120 minutes). Peak modelled depths are shown in Figure 3 and peak water levels are shown in Figure 4. Results show that ponding occurs within Church Street, Lansdowne Street and in private property adjacent to the open channel.

4.2 Post-Development Scenario

The flood model of the existing scenario was modified to incorporate the proposed development of 57, 63 and 83 Church Street. Results for the modelled 100 year ARI event are shown in the following figures:

Figure 5 – Peak flood depth;

Figure 6 – Peak water level;

Figure 7 – Peak flood velocity; and

Figure 8 – Provisional hazard.

Peak velocities within the site are modelled as less than 1 m/s. A peak velocity of up to 2 m/s occurs at two discrete locations within Church Street and Lansdowne Street. In a 100 year ARI event, high provisional hazard is shown within the proposed park at 57 Church Street and in two locations in Lansdowne Street and Church Street.

Differences between the post-development scenario and the existing scenario of the modelled peak water levels are shown in Figure 9. Similarly, Figure 10 shows the differences for the peak velocity.

The proposed development shows significant reductions to peak water levels in Church Street, Lansdowne Street and nearby private property. It is considered that this results partly from the removal of existing buildings and the construction of additional flood storage in the park at 57 Church Street. Increases to peak water level are shown downstream of Church Street, notably on Anderson Street. These increases result from instabilities in the 1D/2D connections of the XP-SWMM model, noting these have been corrected in the vicinity of the site (from Inkerman Street to Church Street). In Anderson Street, the peak water level increase is generally up to 0.03m within an area currently inundated in a 100 year event up to about 0.9m. Thus, the model results are considered suitable for the purposes of this assessment.

Generally, a velocity difference of up to 0.3m/s occurs on the roads in the vicinity of the site, and up to 0.6m/s at an isolated location at 43 Lansdowne Street.

4.3 Summary

The model results indicate that the proposed development at 57, 63 and 83 Church Street do not result in a significant adverse impact to flood behaviour in the 100 year ARI event.

5 References

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DECCW 2007, *Floodplain Risk Management Guideline*, Practical Consideration of Climate Change, NSW Department of Environment & Climate Change, October.

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Westra, S, 2011, *Implications of Climate Change on Flood Estimation*, Engineers Australia, discussion paper for the Australian Rainfall and Runoff Climate Change Workshop no.2, February.

NSW Government (2005). *Floodplain Development Manual.*

Flood Impact Assessment

APPENDIX A
FIGURES

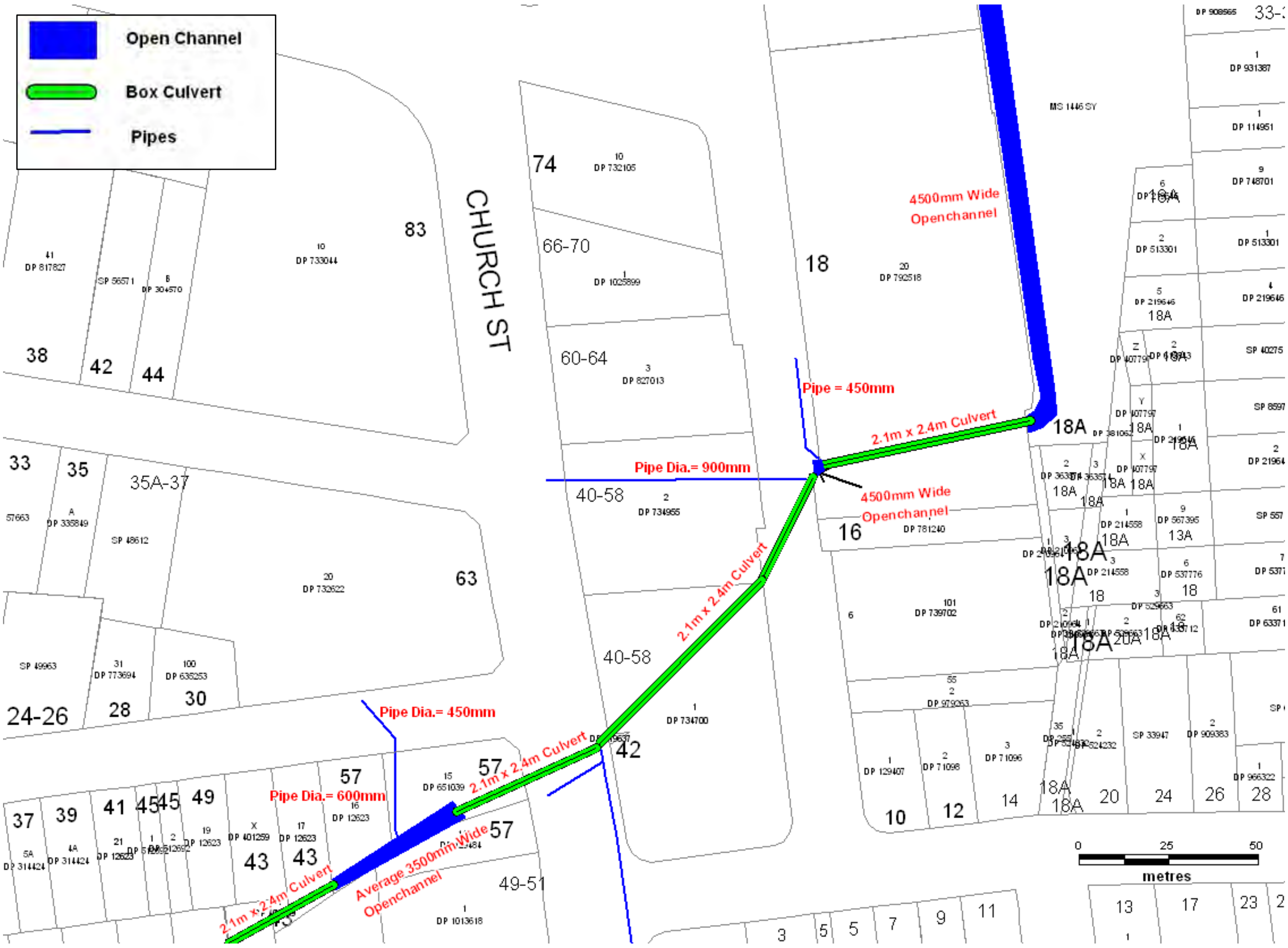

Figure 2 – Existing Drainage Layout

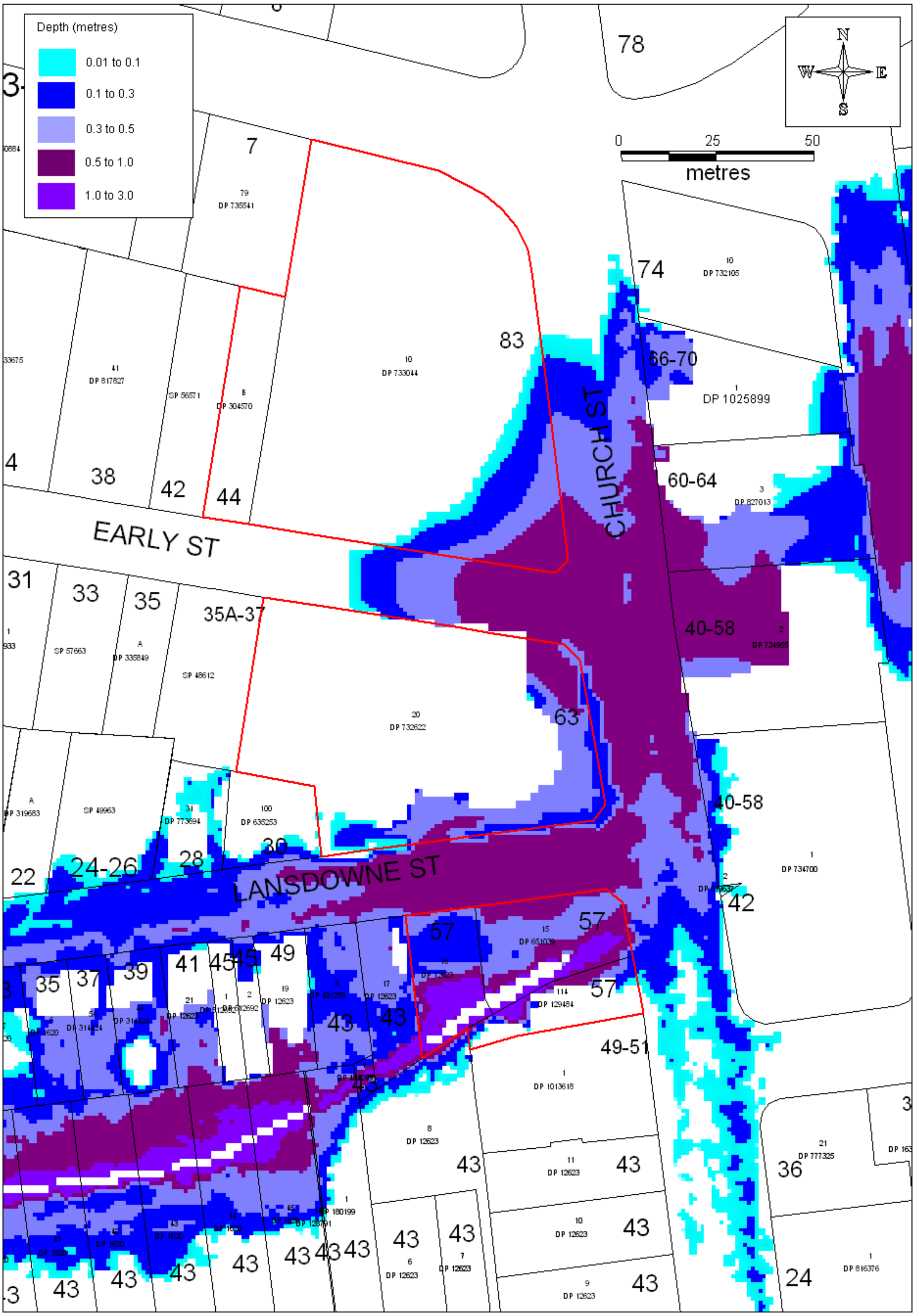

Figure 3 – Existing Scenario Peak Flood Depth 100y ARI

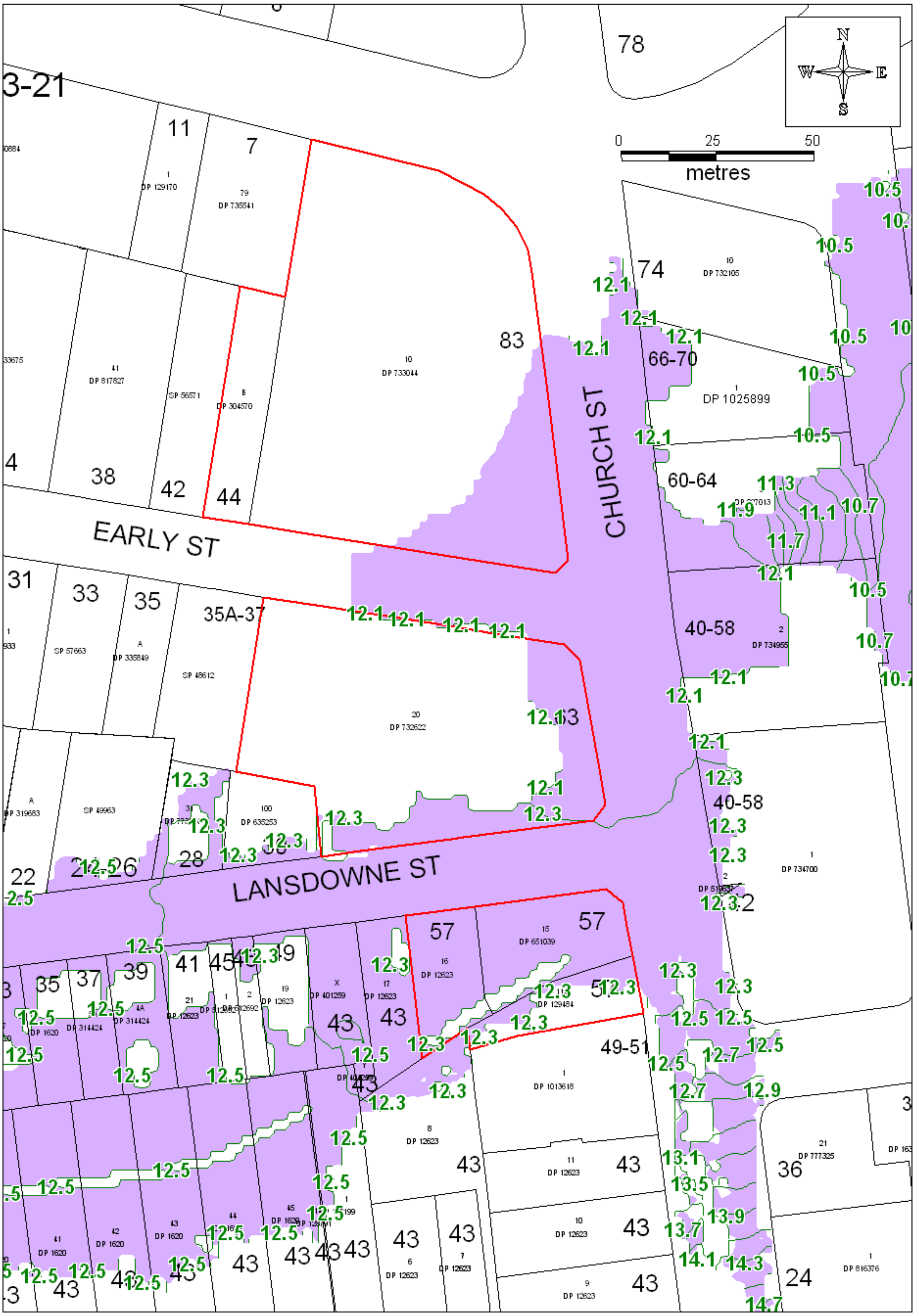

Figure 4 – Existing Scenario Peak Water Level 100y ARI

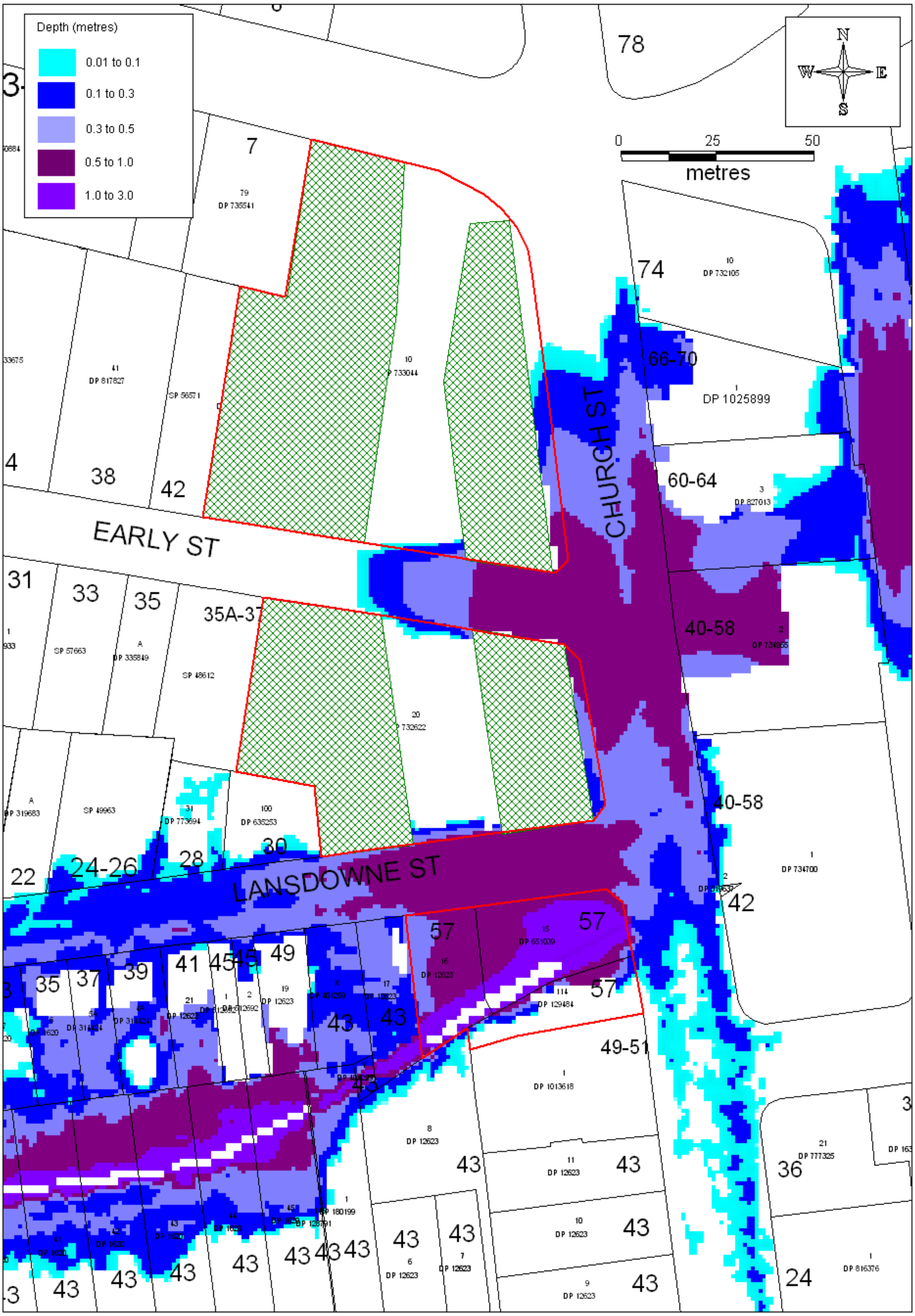

Figure 5 – Post-Development Scenario Peak Flood Depth 100y ARI

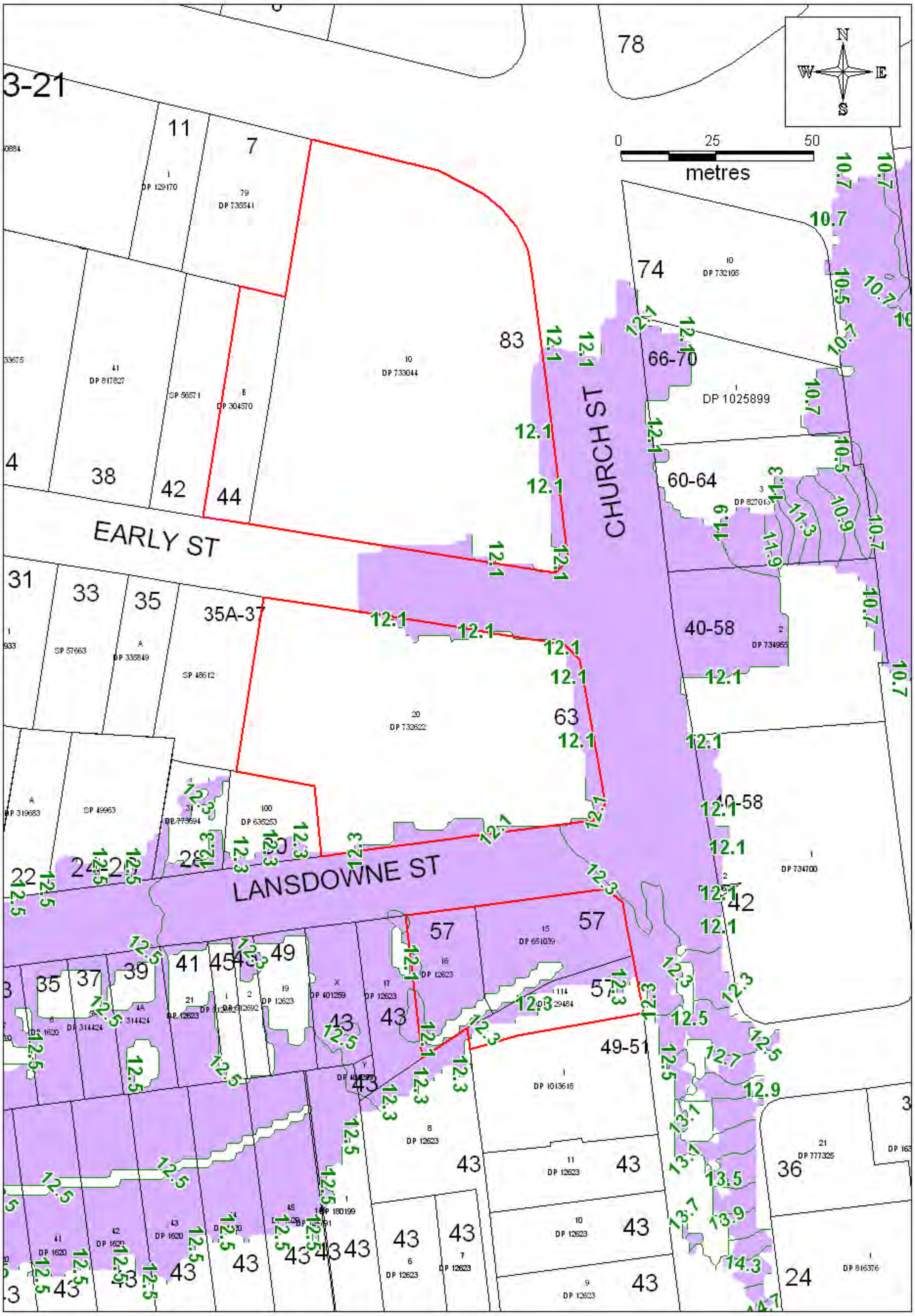

Figure 6 – Post-Development Scenario Peak Water Level 100y ARI

Figure 7 – Post-Development Scenario Peak Flood Velocity 100y ARI

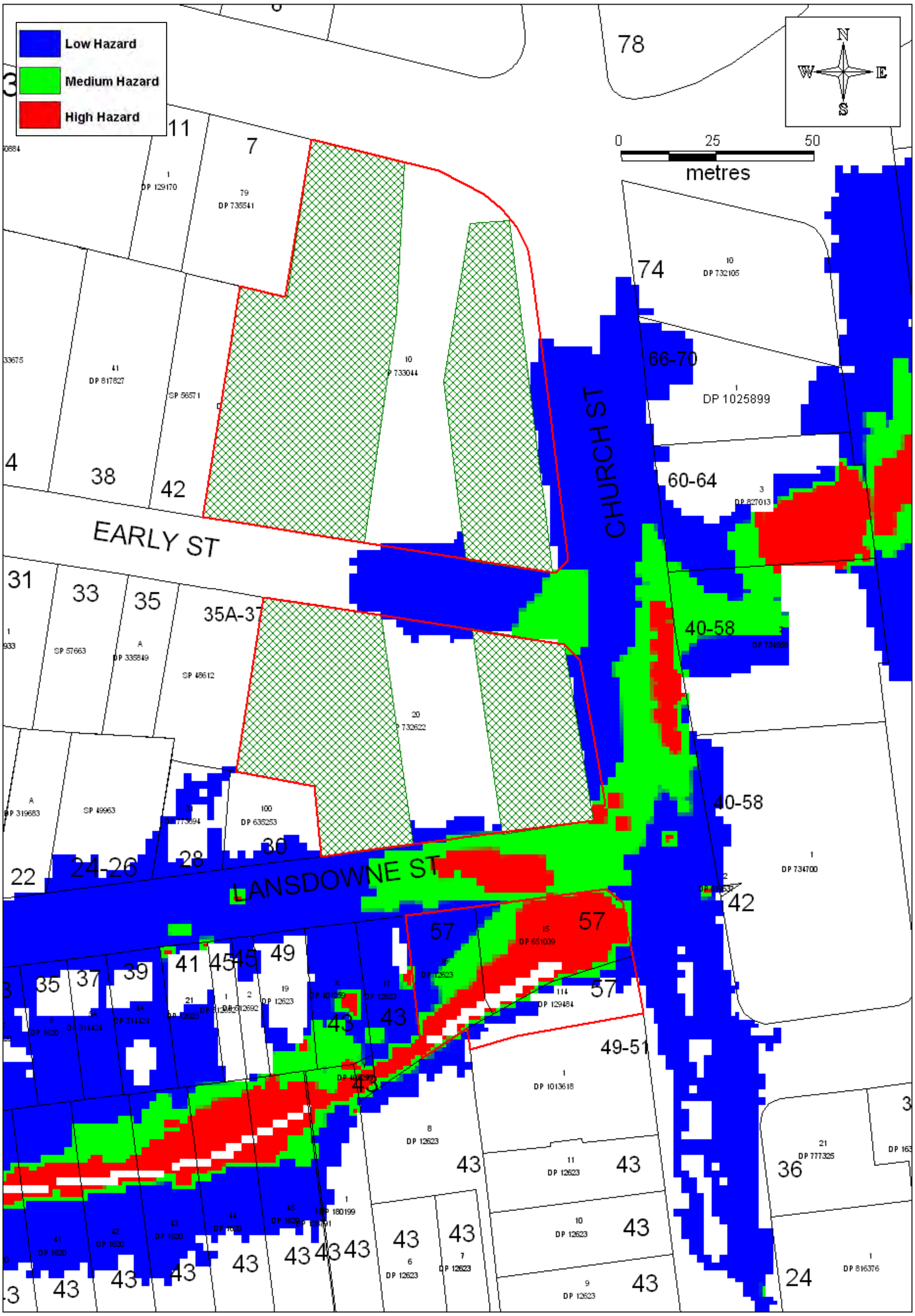

Figure 8 – Post-Development Scenario Provisional Hazard 100y ARI

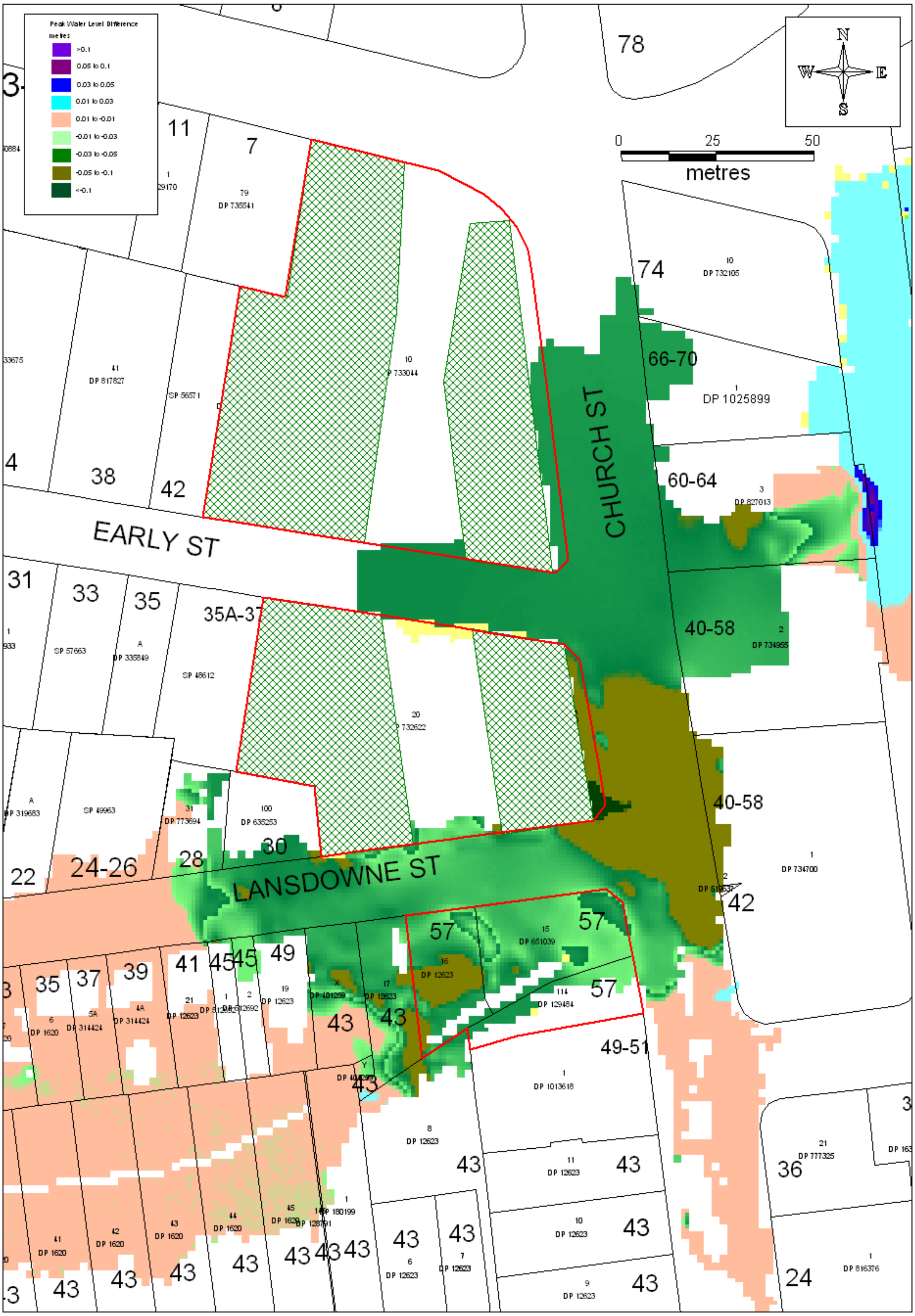

Figure 9 – Peak Water Level Difference 100y ARI - Post-Development Less Existing Scenario

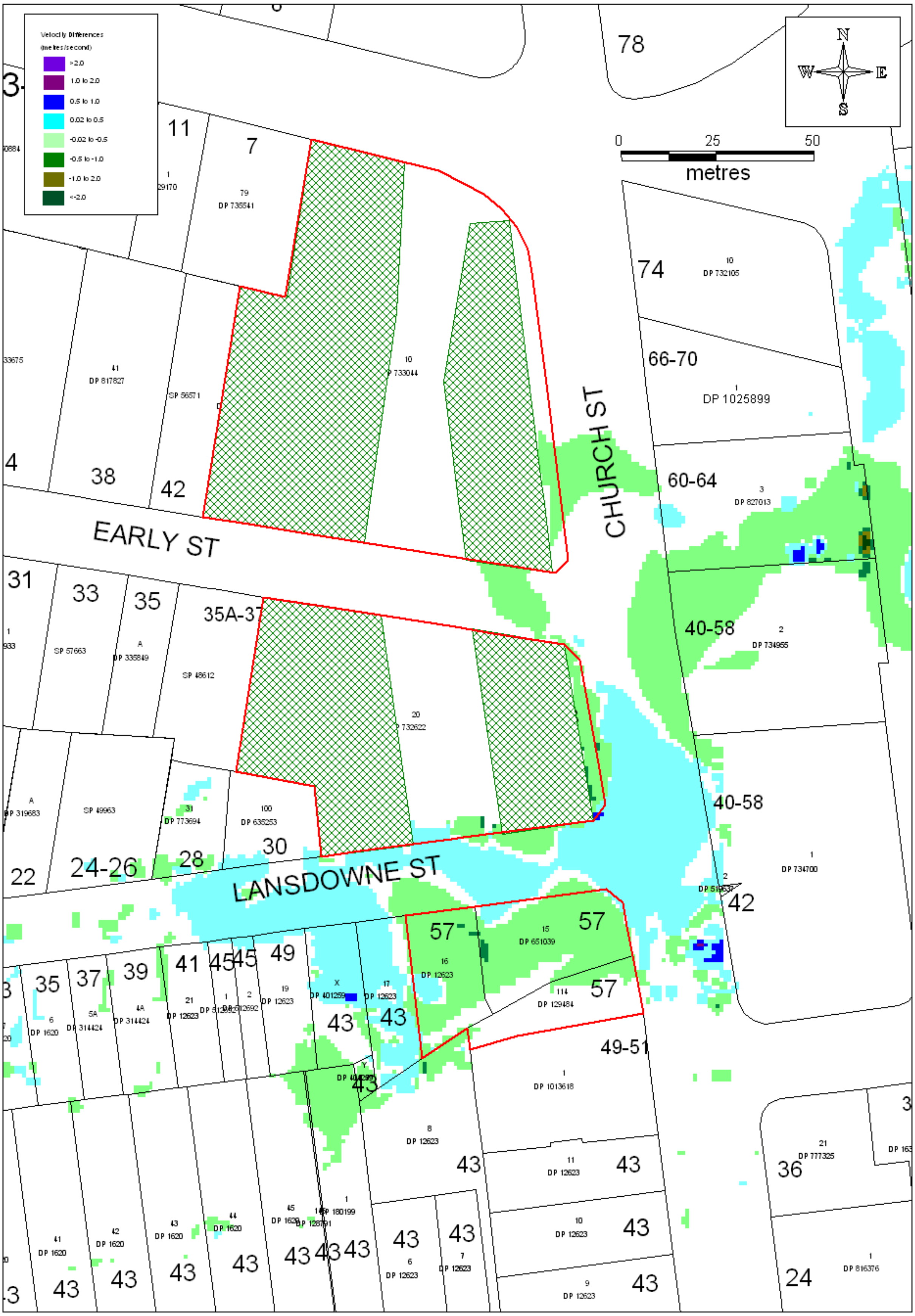

Figure 10 – Peak Flood Velocity Difference 100y ARI - Post-Development Less Existing Scenario

Flood Impact Assessment

APPENDIX B
SITE SURVEY

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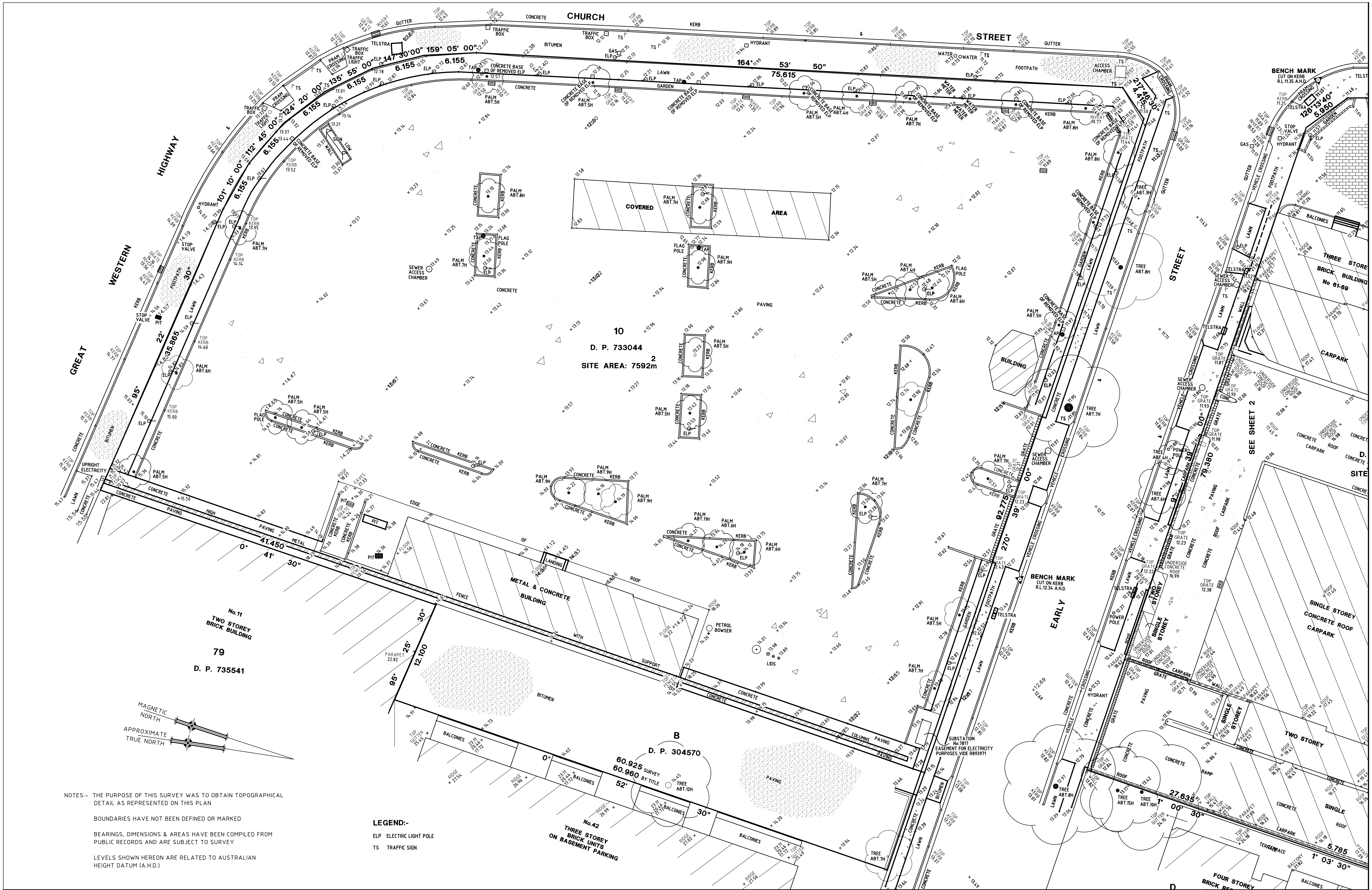


NOTES:- THE PURPOSE OF THIS SURVEY WAS TO OBTAIN TOPOGRAPHICAL DETAIL AS REPRESENTED ON THIS PLAN

BOUNDARIES HAVE NOT BEEN DEFINED OR MARKED

BEARINGS, DIMENSIONS & AREAS HAVE BEEN COMPILED FROM PUBLIC RECORDS AND ARE SUBJECT TO SURVEY

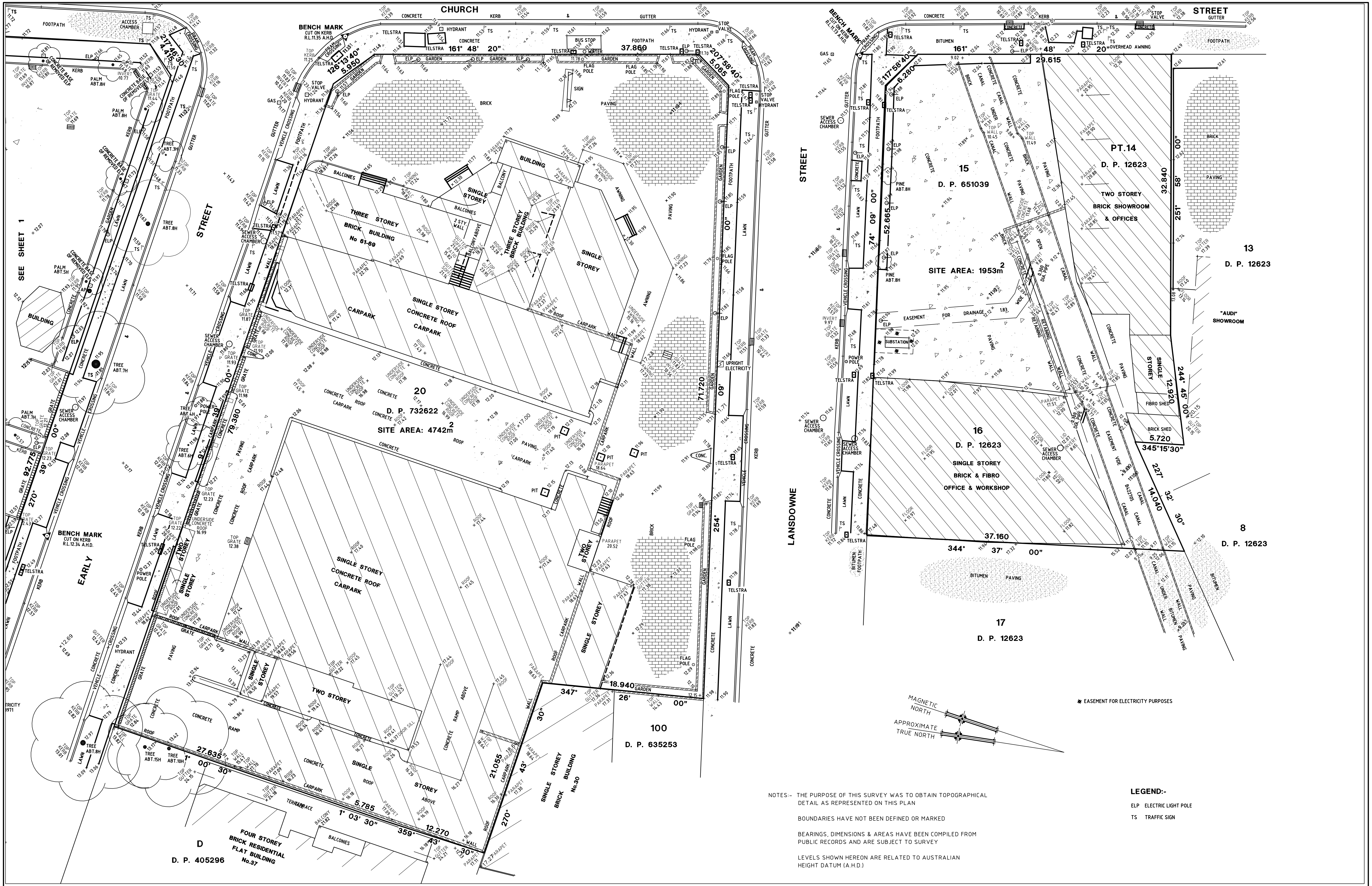
LEVELS SHOWN HEREON ARE RELATED TO AUSTRALIAN HEIGHT DATUM (A.H.D.)

LEGEND:-

ELP ELECTRIC LIGHT POLE

TS TRAFFIC SIGN

AMENDMENTS:	DRAWN: W.B.S	CLIENT: ROSSFIELD BOYDED GROUP	TITLE: PLAN OF LAND COMPRISED IN CERTIFICATES OF TITLE 14/12623, 16/12623, 15/651039, 20/732622, 10/733044 AND B/304570 AT PARRAMATTA L.G.A. PARRAMATTA	DUNLOP THORPE & CO. PTY. LTD.	REDUCTION RATIO 1:200 SIZE A1
	SURVEYED: R.O.			SURVEYORS ABN 74 003 512 150	LEVEL DATUM A.H.D.
				447 KENT STREET PHONE (02) 9283 6677	DATE 19-12-2007
	DESIGNED:			SYDNEY 2000 FAX (02) 9283 6633	SHEET 1 OF 2 SHEETS
				DX 988 SYDNEY Email : dunthor@ozemail.com.au	REFERENCE No. 16434



NOTES:- THE PURPOSE OF THIS SURVEY WAS TO OBTAIN TOPOGRAPHICAL DETAIL AS REPRESENTED ON THIS PLAN

BOUNDARIES HAVE NOT BEEN DEFINED OR MARKED

BEARINGS, DIMENSIONS & AREAS HAVE BEEN COMPILED FROM PUBLIC RECORDS AND ARE SUBJECT TO SURVEY

LEVELS SHOWN HEREON ARE RELATED TO AUSTRALIAN HEIGHT DATUM (A.H.D.)

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	SURVEYED: R.O.		
	DESIGNED:		

DUNLOP THORPE & CO. PTY. LTD.
SURVEYORS
447 KENT STREET
SYDNEY 2000
DX 988 SYDNEY
ABN 74 003 512 150
PHONE (02) 9283 6677
FAX (02) 9283 6633
Email : dunthor@ozemail.com.au

REDUCTION RATIO 1:200	SIZE A1
LEVEL DATUM A.H.D.	
DATE 19-12-2007	
SHEET 2 OF 2 SHEETS	
REFERENCE No. 16434	

APPENDIX C
COUNCIL FLOOD ADVICE

Parramatta City Council
Main Office: 30 Darcy Street, Parramatta, NSW, 2150
Postal Address: PO Box 32, Parramatta, NSW, 2124
Council Customer Service Telephone No: 9806 5050
Council Fax No: 9806 5917
Catchment Management Section: Ground Floor, 1A Civic Place, Parramatta
Email Address: council@parracity.nsw.gov.au

RECEIVED IN RECORDS 16 AUG 2011

Flood Enquiry Application

Property Details

Address	House No.: 57, 63, 83	*This form applies for up to three adjoining sites. A separate Flood Enquiry form and fee will be required for more than 3 or separate lots.*
	Street: Church Street	
	Suburb: Parramatta	Postcode:
	Are you the owner of this property? ☐ Yes ☒ No	

Applicant Details

Name	Family Name (or Company Name): AECOM	
	Given Name:	
	OR Company Contact Person: Greg Burgon	
Contact Details	Suburb:	Postcode:
	Home Phone:	Office Phone:
	Mobile:	Fax:
	Email: greg.burgon@aecom.com	Date: 12.8.11

How would you like this information to be provided to you? *(Please tick)*

☐ Collection ☐ Posted ☒ Emailed ☐ Faxed

Reason for Enquiry *(Please tick)*

☒ Proposed Re-development of Property	☐ Alterations and Additions to existing Dwelling
☐ Purchase of Property	☐ Property Valuation
☐ Flood drainage Investigation	☐ Subdivision
☐ Change of Use within an Existing Development	☐ Owner Enquiry
☐ Other (please specify):	

Property Type *(Please tick)*

Residential (Single residential dwelling and / or granny flat)	☐ $171.30
Development Duplex (Includes other residential such as dual occupancies, multi-unit housing and residential flat building)	☐ $234.10
Commercial (Including industrial and mixed use)	☒ $411.10

Disclaimer: Flood levels and flood extent lines are based on current information held by Council. Council does not accept responsibility for the accuracy of this information. Any pipe sizes and location of pits and pipe lines should be confirmed by site investigation.
The flood levels shown on the back of this form are only an approximate guide and have been derived using the current computer simulated model.
The information provided in this document is presented in good faith to assist the public in understanding Council's drainage requirements that apply within the Parramatta Local Government Area. It is the responsibility of each individual using this information to undertake their own checks and confirm this information prior to its use.
Parramatta City Council, its agents and employees are not liable (whether by reason of negligence, lack of care or otherwise) to any person for any damage or loss whatsoever which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement, or advice referred to above.

Customer Acknowledgement

I hereby acknowledge that I have read and understood the above Disclaimer:

Signature		**Date**	12.8.11

Office Use Only – RC 682

Amount	Receipt No.	Date	Accepted by:
$ 411.10	3429736	15/8/11	Hasna

Refer to back of this form for level information issued.

SCANNED 16 AUG 2011 PCC

Flood Enquiry Information Issued *(To be completed by Council Officer)*

Mainsteam Flooding

Is the property affected by mainstream flooding?			☑ Yes ☐ No
Flood Levels	Closest Cross sections: (*Please refer to Flood Study*): Refer to table on flood map.		
☑ 1:20 Year ARI	m AHD	**Comments:** Council is currently updating the Lower Parramatta River catchment Study. Flood levels in this area may change.	
☑ 1:100 Year ARI	m AHD		
☑ PMF	m AHD		
☑ Refer to flood maps provided for detailed flood levels.			
The above flood level information is obtained from the following flood study report:			
Lower Parramatta River Floodplain Risk Management Study, Flood study Review, Final, March 2005 (SKM).			

Note: Flood inundation can be verified by detail survey to AHD undertaken by a Registered Surveyor.

Local Flooding *(Please tick)*

Is the property located within a Hatched Grey Area? *Properties located within a **Hatched Grey Area** are subjected to flooding from the local catchment.*	☐ Yes ☑ No
Is the property located within a Grey Area? *Properties located within a **Grey Area** are subjected to additional site drainage controls to manage flooding in the local catchment.*	☐ Yes ☑ No
Is the property affected by overland stormwater run-off from the local catchment?	☑ Yes ☐ No
***Note:** You are required to contact Council's Development Service Engineer for any details and requirements relating to development that is affected by local flooding.*	

Additional Recommended Actions *(Please tick)*

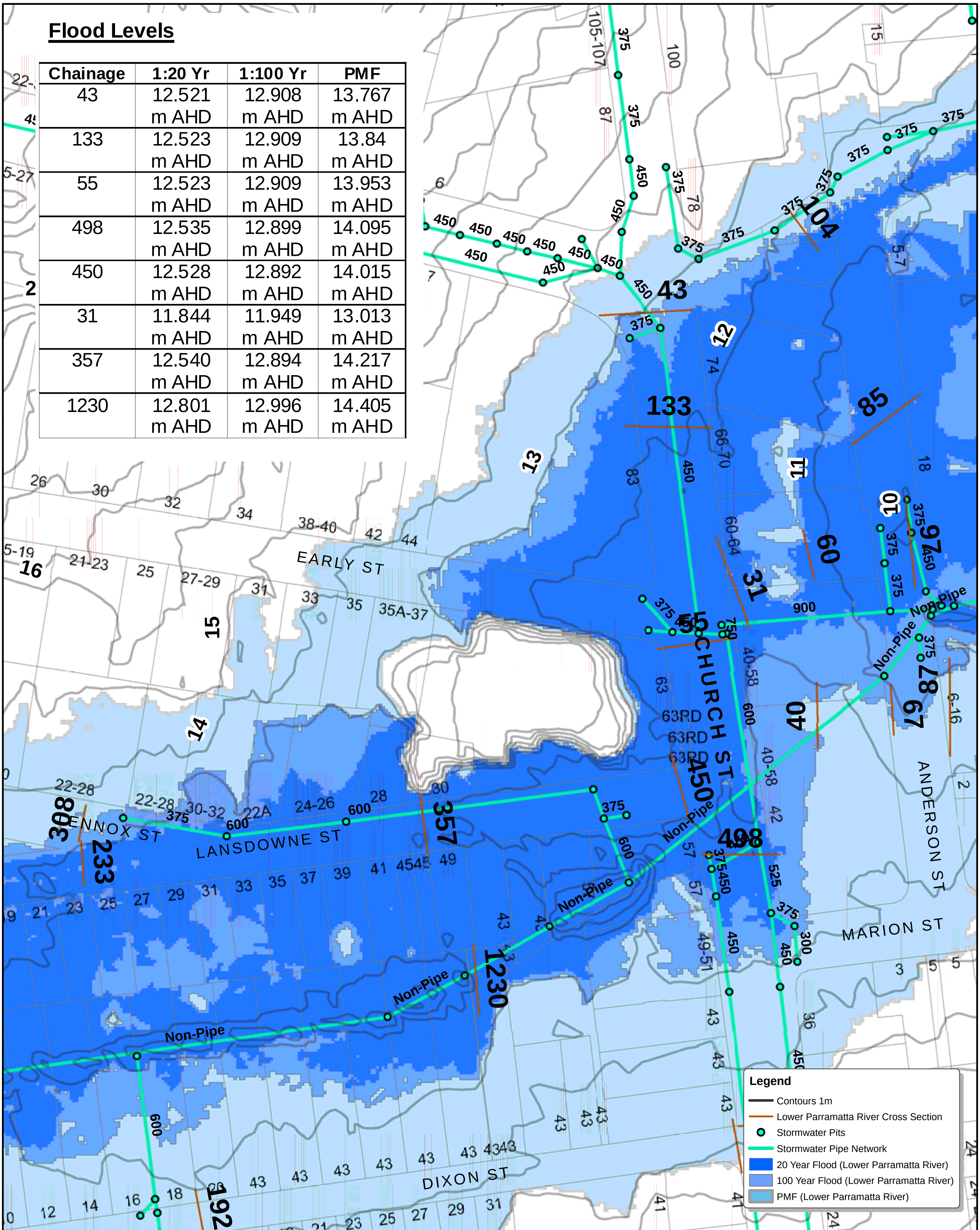
☑	The Applicant needs to discuss the proposal to re-develop this site with Council's Town Planner and Development Services Engineer.
☑	The Applicant needs to contact Council's Town Planner and organise a prelodgement meeting to discuss any proposal to redevelop this property.
☑	The applicant needs to refer to Council's Local Floodplain Risk Management policy for details relating to developing a land affected by flooding.

Definitions: (As per NSW Floodplain Development Manual dated April 2005)

1. **AHD** – a common national surface level datum approximately corresponding to mean sea level.
2. **ARI** – the long term average number of years between the occurrences of a flood as big as or larger than, the selected event.
3. **PMF** – is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation.
4. **AEP** – Annual Exceedance Probability is the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage.

Flood Levels

Chainage	1:20 Yr	1:100 Yr	PMF
43	12.521 m AHD	12.908 m AHD	13.767 m AHD
133	12.523 m AHD	12.909 m AHD	13.84 m AHD
55	12.523 m AHD	12.909 m AHD	13.953 m AHD
498	12.535 m AHD	12.899 m AHD	14.095 m AHD
450	12.528 m AHD	12.892 m AHD	14.015 m AHD
31	11.844 m AHD	11.949 m AHD	13.013 m AHD
357	12.540 m AHD	12.894 m AHD	14.217 m AHD
1230	12.801 m AHD	12.996 m AHD	14.405 m AHD

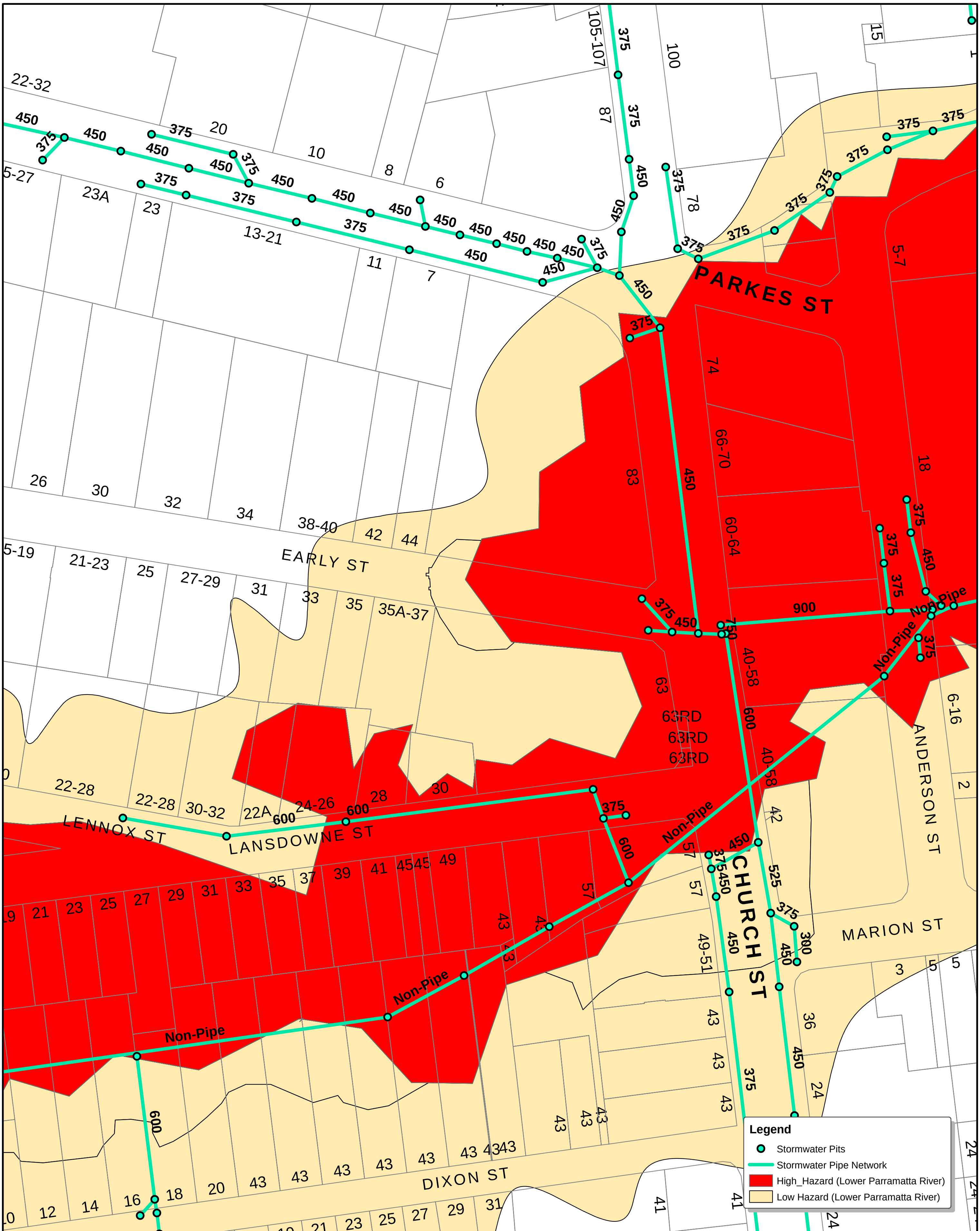


Parramatta City Council Flood Map

1:1,750

N

Printed
18/08/2011



Parramatta City Council Flood Map

1:1,750

N

Printed
18/08/2011

APPENDIX D
PROPOSED DEVELOPMENT OF PARK

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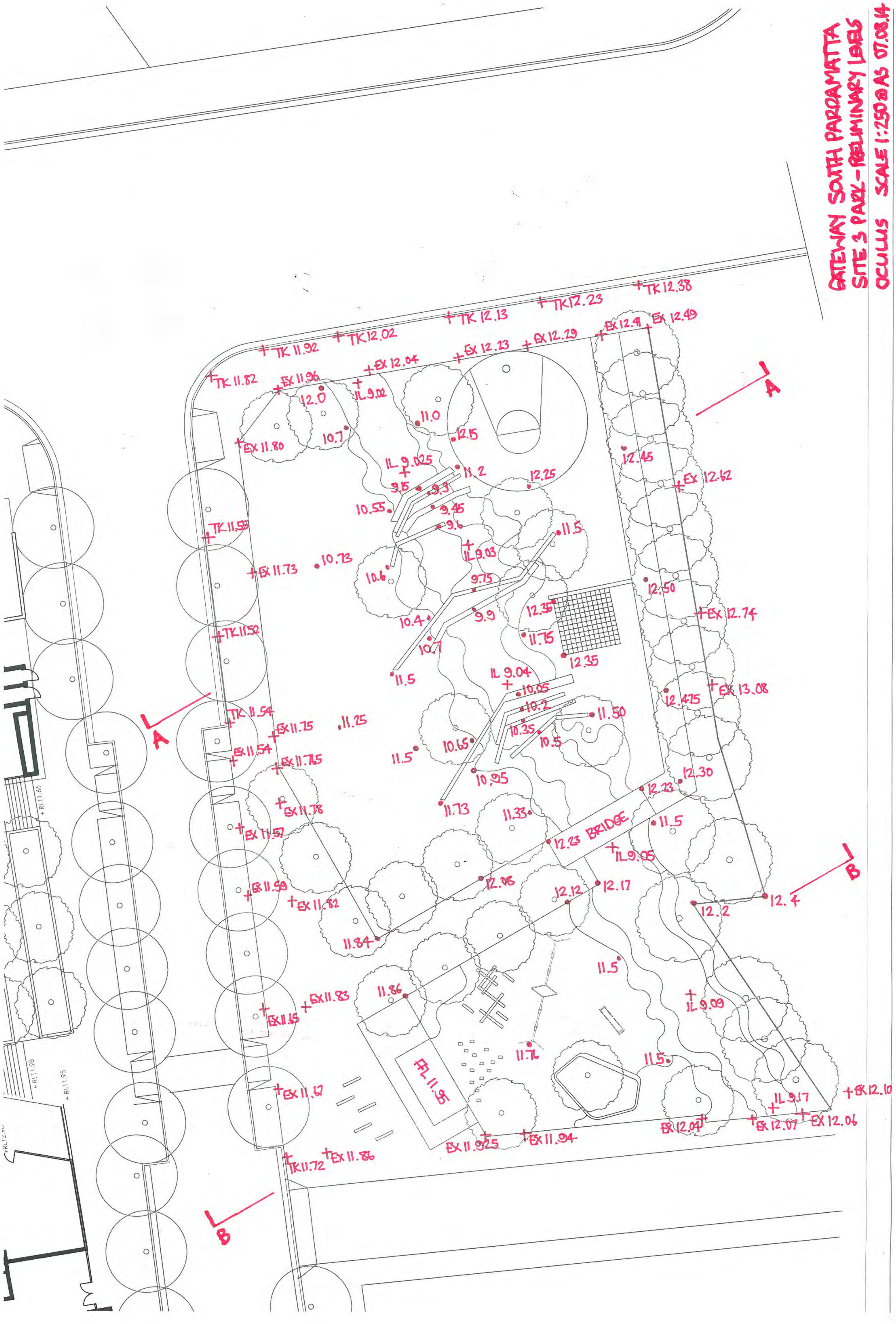
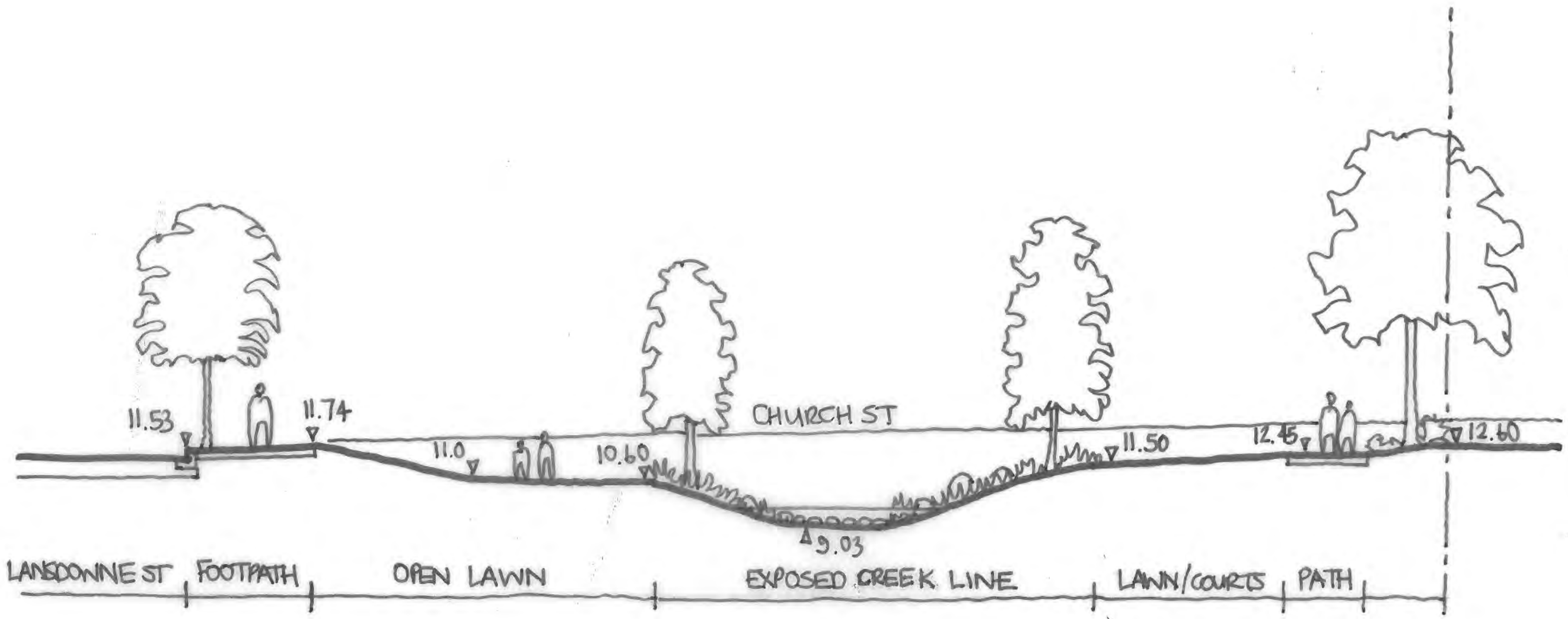
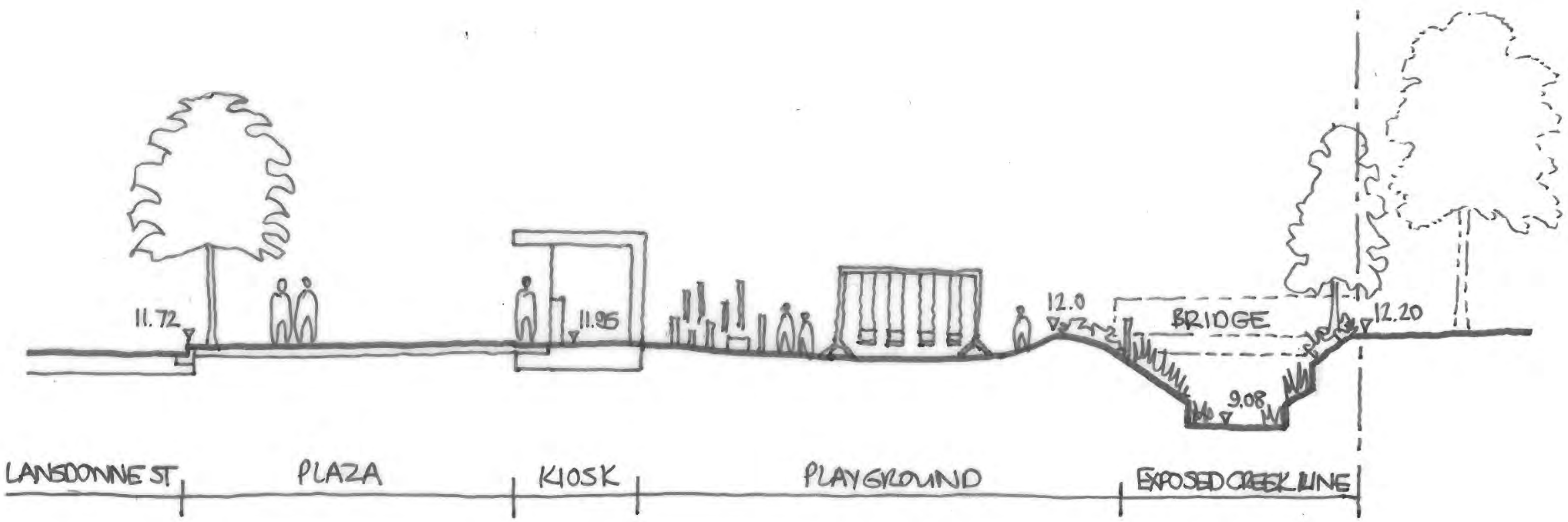


GATEWAY SOUTH PARRAMATTA
SITE 3 PARK - PRELIMINARY LEVELS
OCULUS SCALE 1:250 @ A3 07.08.14
TK 11.92
TK 12.02
TK 12.13
TK 12.23
TK 12.38
TK 11.82
EX 11.96
EX 12.04
EX 12.23
EX 12.29
EX 12.41
EX 12.49
12.0
IL 9.02
11.0
12.15
10.7
EX 11.80
IL 9.025
11.2
12.25
12.45
EX 12.62
9.15
9.3
10.55
9.45
9.6
TK 11.53
11.5
EX 11.73
10.73
IL 9.03
10.6
9.75
12.50
12.35
10.4
9.9
11.75
EX 12.74
TK 11.52
10.7
12.35
11.5
IL 9.04
10.05
10.2
12.425
EX 13.08
TK 11.54
EX 11.75
11.25
10.35
11.50
10.65
10.5
EX 11.54
EX 11.75
11.5
10.95
12.30
12.23
EX 11.78
11.73
11.33
11.5
12.23 BRIDGE
EX 11.57
IL 9.05
12.06
12.12
12.17
EX 11.59
EX 11.82
12.2
12.4
11.84
11.5
11.86
EX 11.83
EX 11.65
IL 9.09
FFL 11.95
11.76
11.5
EX 11.67
IL 9.17
EX 12.10
EX 12.04
EX 12.07
EX 12.06
EX 11.925
EX 11.94
TK 11.72
EX 11.86
A
B
+RL11.66
+RL11.98
+RL11.95





GATEWAY SOUTH PARRAMATTA
SITE 3 PARK – PRELIMINARY SECTIONS
OCULUS SCALE 1:200 @ A3 07.08.14

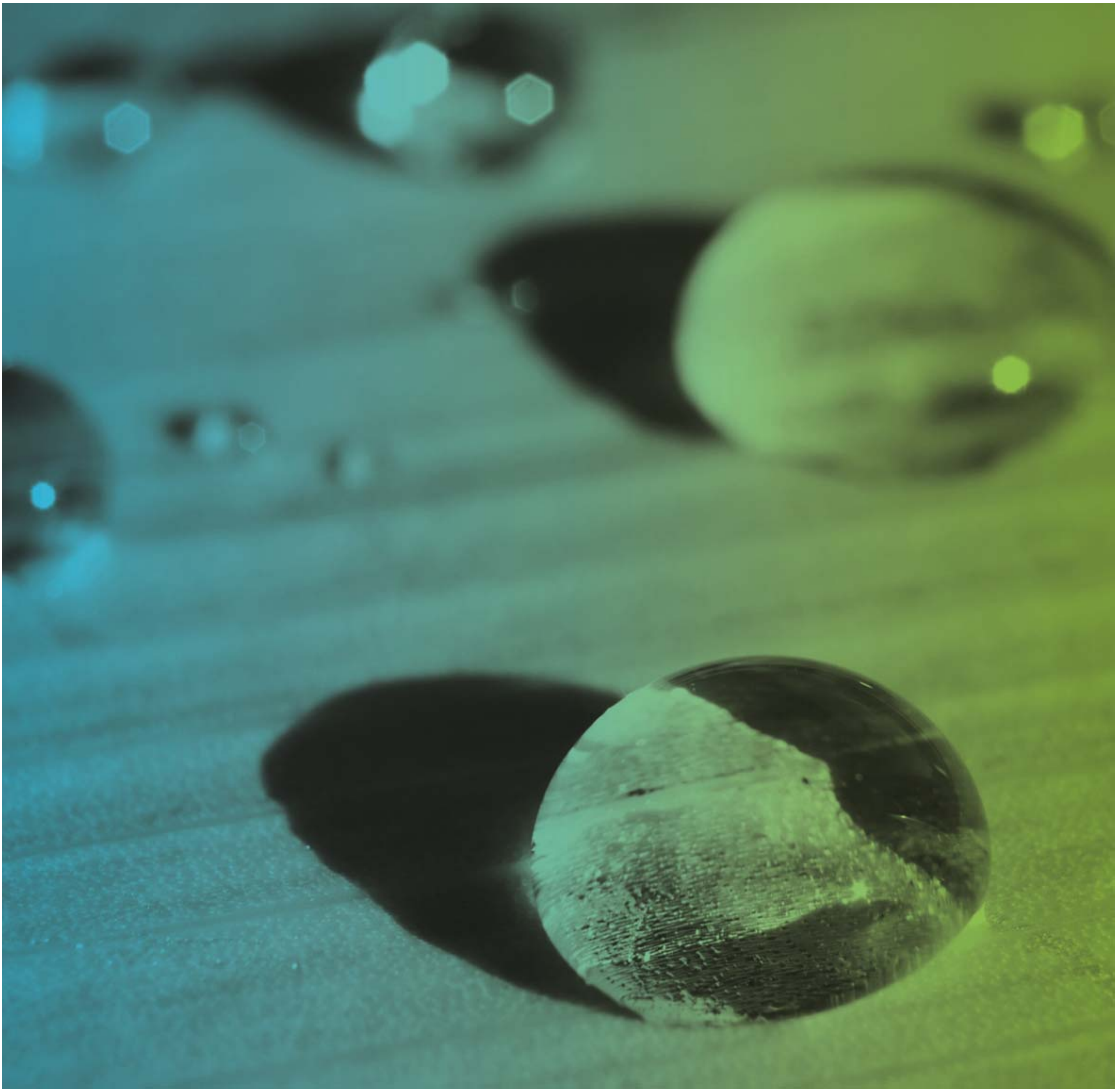
Appendix L

Concept Stormwater Management Plan

Boyded Industries Pty Ltd
14-Oct-2014
Doc No. CI001

Gateway South Concept Development Application

Conceptual Stormwater Management Plan



Gateway South Concept Development Application

Conceptual Stormwater Management Plan

Client: Boyded Industries Pty Ltd

ABN: 92 000 092 464

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 925

14-Oct-2014

Job No.: 60322150

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

Quality Information

Document	Gateway South Concept Development Application
Ref	60322150
Date	14-Oct-2014
Prepared by	Nathan Mitchell
Reviewed by	Luke Chipperfield

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
DRAFT	08-Aug-2014	Draft For Information Only - yet to be verified	-	
A	19-Aug-2014	For Information Only	Carlos Frias	
B	14-Oct-2014	For Information Only	Rachelle Newman	

Table of Contents

Executive Summary

This conceptual report estimates and provides commentary on the minimum requirements for managing stormwater drainage within the Gateway South project site in Parramatta. The project site encompasses the following sites:

Site 1 – 83 Church Street and 44 Early Street;

Site 2 – 63 Church Street; and

Site 3 – 57 Church Street.

The project site is located within the Clay Cliff Creek Catchment, which is prone to flooding under extreme rainfall events.

The methodology and procedure described in the Upper Parramatta River Catchment Trust (UPRCT) *On-Site Stormwater Detention Handbook* (Fourth edition, 2005) has been used to estimate the requirements relating to Onsite Stormwater Detention (OSD), Site Storage Requirements (SSR) and Permissible Site Discharge (PSD) rates.

Four local catchment areas within the project site have been delineated in an attempt to estimate the OSD requirements and limit the site area by passing the OSD tanks. The estimated OSD and PSD requirements for the project are:

Site Number	Sub catchment Area	Site Storage Requirement (m3)	Permissible Site Discharge (L/sec)
1	1A	135	65
	1B	54	27
2	2A	75	37
	2B	41	20

As Site 3 is nominated as a park and is located immediately adjacent to the Clay Cliff Creek truck drainage line, it has not been considered in estimating the OSD requirements for the development.

Rainwater reuse tanks will be incorporated into the development however no credit of the rainwater tank volume to offset the OSD Site Storage Requirement has been considered as there is a possibility that the rainwater tank could be full at the start of a major storm event.

Water Sensitive Urban Design (WSUD) elements will be considered as part of the stormwater management plan and may include Gross Pollutant Traps, OSD tanks, Silt and Grease arrestors in the car park and permeable surfaces in outdoor areas. These controls will attempt to reduce pollutant loads on and adverse impacts on downstream infrastructure.

Refer to the Flood Impact Report for the Gateway South, Church Street Parramatta prepared by AECOM 2014 which discusses the key flood related constraints and opportunities associated with the development. It also discusses the flood management objectives, potential flood impacts and potential flood mitigation measures for the project.

1.0 Background

1.1 Purpose of Document

AECOM Australia Pty Ltd has been commissioned by Boyded Industries Pty Ltd to prepare a Conceptual Stormwater Management Plan to support an initial Concept Proposal for the proposed Gateway South project in Parramatta. The Gateway South project is located across No.s 57, 63 and 83 Church Street, and 44 Early Street, Parramatta (herein referred to as "the project site")

The purpose of this Conceptual Stormwater Management Plan is to estimate the potential On-site Stormwater Detention requirements and identify opportunities and constraints for discharge of stormwater from the Site.

1.2 Scope of Works

The scope of works detailed within this report includes:

- Opportunities for managing the onsite stormwater drainage;
- Estimation of the potential volume of Onsite Stormwater Detention (OSD) required;
- Opportunities for Water Sensitive Urban Design (WSUD) elements which could be developed during future design stages;
- Commentary on Flood Plain Management; and
- A description of overland flow paths within the site.

1.3 Key Assumptions

The following key assumptions are employed throughout this report:

- The Site is located within the middle reaches of the Clay Cliff Creek catchment.
- The methodology for calculating the minimum OSD storage requirements defined in the Upper Parramatta River Catchment Trust's "*On-site Stormwater Detention Handbook*" (4th Edition, December 2005) is applicable to the Site.
- Based on preliminary discussions with Parramatta City Council Development Officers, the preferred method of Site stormwater discharge is via a direct connection to the underground drainage system within the existing road network. Pending the internal Site drainage design, this may require the extension and / or amplification of Council's road drainage system in the vicinity of the project site.

1.4 Reference documents

The following documents have been reviewed in the preparation of this Stormwater Management Plan:

- Upper Parramatta River Catchment Trust On-Site Stormwater Detention Handbook
- Upper Parramatta River Catchment Trust Calculation Sheet
- Parramatta City Council's Development Control Plan (DCP) 2011
- Parramatta City Council Local Floodplain Risk Management Policy
- Flood Impact Assessment by AECOM, 2012

2.0 Introduction

2.1 Site Location

The site is located on the corner of the intersection of Great Western Hwy and Church St, Parramatta and has a street address which encompasses 57, 63 and 83 Church St, and 44 Early St, Parramatta.

The site is broken into three separate sites which are divided by Early Street and Lansdowne Street. Refer to Figure 1 below clarification.

Figure 1 Project Site Location

Source: AECOM, 2011

2.2 Existing Site

The project site is currently unoccupied however contains former car dealerships and administration / office buildings. The majority of the project site consists of impervious hardstand or roof areas.

2.3 Proposed Site

The following commentary provides a general description of the proposed concept plan.

Site 1 - Two buildings of mixed use retail, commercial and residential (40 floors and 24 floors), a third building containing retail and commercial (9 floors) with provision for a major supermarket and underground carpark.

Site 2 - Two buildings of mixed use retail, commercial and residential (35 floors), a third building containing retail and commercial (9 floors) with provision for a supermarket and underground carpark.

Site 3 - A designated open space which will likely be dedicated to Parramatta City Council.

Refer to Figure 2 below for an indicative project site layout.

Figure 2 Indicative Project Site Layout

(Source: Allen Jack + Cottier, 2014)

3.0 On-Site Stormwater Detention

3.1 Design Criteria

As described in the "*Flood Impact Report*" by AECOM (2012), the project site is located in the middle reaches of the Clay Cliff catchment. On this basis, the methodology and parameters used to define the requirements for On-site Stormwater Detention (OSD) for catchments outside of the Upper Parramatta River Catchment Trust (UPRCT) have been adopted in this report.

The basic parameters for the OSD designs within the Clay Cliff catchment are provided in Table 1 below:

Table 1 Basic Design Parameters for the OSD

Basic OSD Parameters	
Total Permissible Site Discharge (PSD)	235 L/sec/ha
Total Site Storage Requirement (SSR)	215 m^3/ha

Reference should be made to the Flood Impact Report (prepared by AECOM, 2014). This report serves to demonstrate through detailed flood modelling that the project site is affected in the Clay Cliff Creek 1% Annual Exceedance Probability (AEP) flood event. As a result, discharge from the proposed underground OSD tank will be affected by downstream water levels for a range of storm events.

To overcome the downstream conditions due to flooding in Clay Cliff Creek and given the architecturally preferred solution for stormwater drainage includes underground OSD tanks, the OSD storage parameters described in Table 1 are re-configured by increasing the total SSR by a factor of 1.14 to 245 m^3/ha. This is generally in accordance with the UPRCT On-site Stormwater Detention Handbook (2005) and is attained by utilising the calculation spreadsheet attached in Appendix A.

The calculation spreadsheets in Appendix A adopt a non-high early discharge secondary outlet and adjusts the SSR and the hydraulic head over the secondary outlet based on the overall water level in the flood detention storage.

3.2 Development Catchment Areas

Site 1

For the purpose of estimating OSD Site Storage Requirements (SSR) and Permissible Site Discharge (PSD) rates, the sub catchment areas of Site 2 have been estimated and are provided in Figure 3.

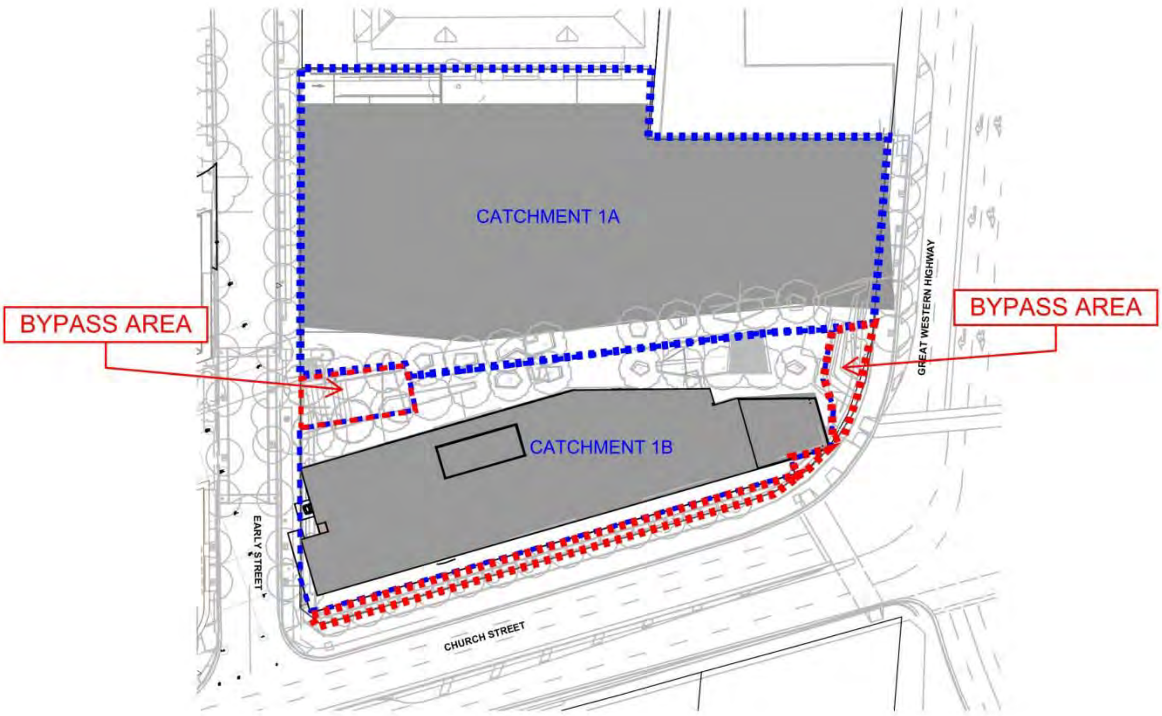


Figure 3 Site 1 Sub Catchment Areas

Table 2 below provides a summary of the indicative catchment areas shown in Figure 3.

Table 2 Site 1 Catchment Area Summary

SITE 1	
Subcatchment	**Area (m^2)**
Catchment 1A	5393
Catchment 1B	2207 (1,610 roof)
Total Residual Area (Total Area – Roof Area)	2060
Total Bypass Area	614
TOTAL	7,600

Site 2

For the purpose of estimating OSD Site Storage Requirements and Permissible Site Discharge rates, the sub catchment areas of Site 2 have been estimated and are provided in Figure 4.

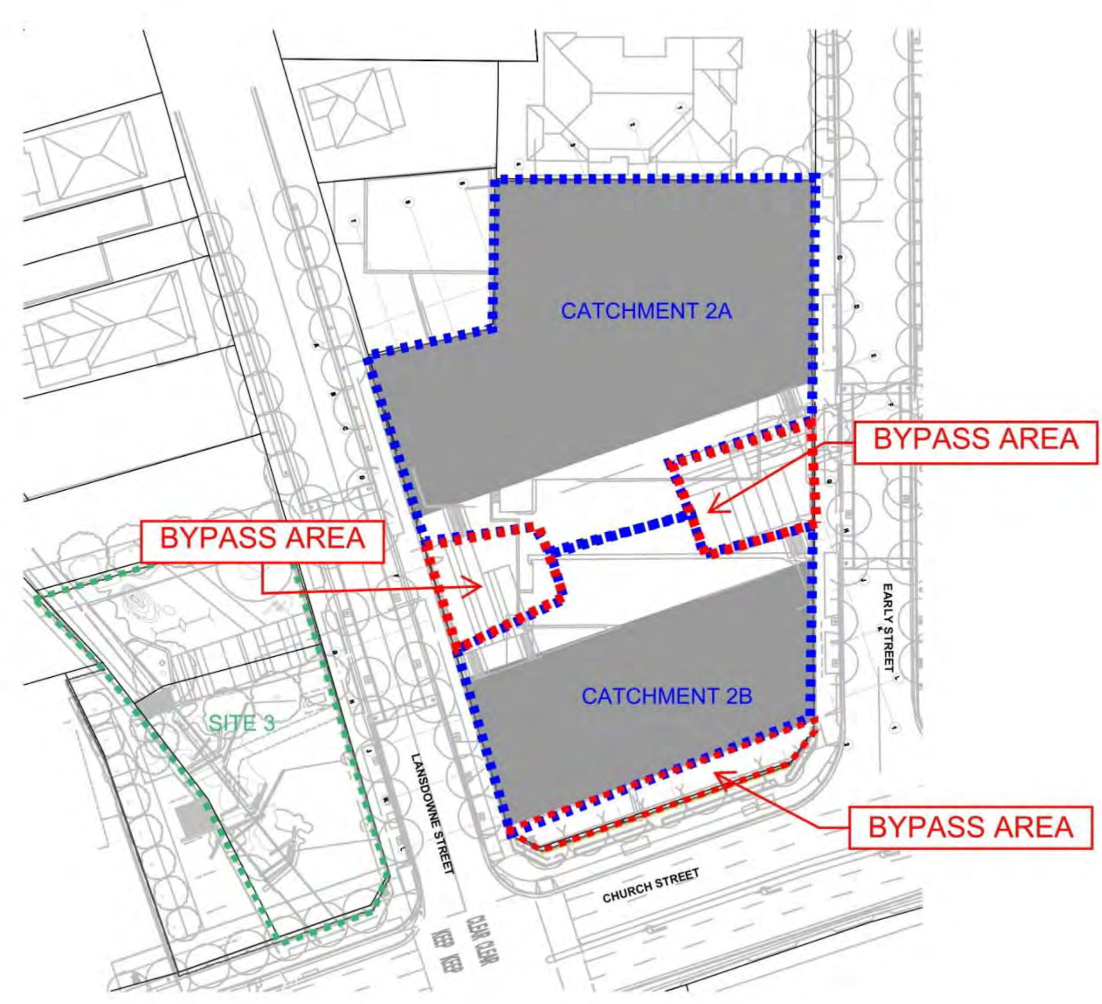


Figure 4 Site 2 Sub Catchment Areas

Table 3 below provides a summary of the indicative catchment areas.

Table 3 Site 2 Catchment Area Summary

SITE 2	
Subcatchment	**Area (m^2)**
Catchment 2A	3080
Catchment 2B	1660
Total Residual Area (Total Area – Roof Area)	1600
Total Bypass Area	480
TOTAL	4,740

Site 3

Site 3 has not been considered in estimating the OSD requirements for the development as this is nominated as a Public Domain Area. At this stage it is envisaged that the Site 3 area is likely to consist of pervious surfaces only. For completeness, Site 3 has an area of approximately 2,540 m^2.

The existing Site 3 comprises of mostly impervious surfaces including roof and hard stand concrete areas. There is likely to be a reduction in the rate of discharge from Site 3 once developed (provided there is no OSD on the site under existing conditions) as an open landscaped space.

3.3 Proposed Site Drainage

The proposed internal stormwater drainage system will generally consist of:

- A series of downpipes which will collect roof runoff from the buildings and convey it towards the proposed rainwater tanks;
- A network of grated inlet pits, grated trench drains and drainage pipes to capture surface runoff in the outdoor plaza areas; and
- Combined rainwater and OSD tanks.

Preliminary consultation with Parramatta City Council (PCC) Development Officers suggest the Council preferred method of discharging stormwater from the project site is via a direct connection to the underground drainage system within the local street network. Based on the available topographical survey information[1], the nearest existing pit and pipe network in Lansdowne Street and Early Street is located adjacent to the intersection at Church Street. Pending confirmation of the preferred OSD tank location, the existing pipe network will need to be extended to facilitate a new connection. Refer to indicative arrangement provided in Appendix B.

Four combined rainwater and OSD tanks have been incorporated into the conceptual site stormwater design. While rainwater tanks do have an effect on reducing site runoff when empty; PCC do not credit the rainwater tank volume towards the OSD Site Storage Requirement as there is a possibility that the rainwater tank could be full at the start of a major storm event.

As discussed in the Flood Impact Report (AECOM, 2012 and 2014), the project site is affected by flooding associated with Clay Cliff Creek. This will result in the outlet of the combined rainwater and OSD tanks being partially submerged during a range of storm events. Nominal provision within the estimated OSD volume has been allowed for the reduced outlet capacity.

The finished surface of the plaza and first floor level (FFL) project site is 12.90m AHD. This is generally in accordance with the recommendations in the Flood Impact Report by AECOM (2012 and 2014). The layout shown in Appendix B is based on the assumption of a 200mm thick slab and a maximum allowable top water level of 12.70mAHD. It should be noted that this arrangement only allows for 200mm freeboard to the finished surface and would need to be approved by PCC development officers. It should also be noted that a freeboard to the underside of the tank may also be required. Further consultation with PCC development officers is required to confirm actual freeboard requirements for the project.

The arrangement also reduces the available hydraulic head and subsequent capacity of the upstream surface drainage network when subjected to extreme storm events and downstream flooding.

3.4 Estimated Permissible Site Discharge

The permissible site discharge has been estimated based on the methodology defined in the UPRCT On-Site Stormwater Detention Handbook (2005). A copy of the calculations is provided in Appendix A.

Table 4 below provides a summary of the estimated permissible site discharge. It should be noted that the PSD is to be confirmed in future design stages in consultation with PCC Development Officers.

[1] PLAN OF LAND COMPRISED IN CERTIFICATES OF TITLE 14/12623, 16/12623, 15/651039, 20/732622, 10/733044 AND B/304570 AT PARRAMATTA by DUNLOP THORPE & CO (reference no 16434 dated 19/12/2007).

Table 4 Estimated Permissible Site Discharge Rates

Catchment	PSD (L/s)
1A	65
1B	27
2A	37
2B	20

3.5 Estimated Site Storage Requirement

The estimated site storage requirements have been calculated based on the methodology defined in the UPRCT On-Site Stormwater Detention Handbook. A copy of the calculations is provided in Appendix A.

Table 5 below provides a summary of the estimated site storage requirements. It should be noted that the SSR is to be confirmed in future design stages in consultation with PCC Development Officers.

Table 5 Estimated Site Storage Requirements

Catchment	SSR (m^3)
1A	135
1B	54
2A	75
2B	41

3.6 Rainwater Tanks

Rainwater harvesting is proposed for the development and will be combined with the OSD tanks. It should be noted that Parramatta City Council do not credit rainwater tank volumes towards the sizing of an OSD tank. The design of rainwater tanks is further discussed in Section 4.2 below.

4.0 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is an approach to water management which aims to minimise the effect of urbanisation on the existing natural water courses.

The WSUD requirements for the proposed development are generally defined in Parramatta City Council's (PCC) Development Control Plan 2011 (DCP) and include pollutant load reduction targets. An extract of the DCP is provided below for reference purposes.

Gross Pollutants (GP)	*90% reduction in the post development mean annual load of GP*
Total Suspended Solids (TSS)	*85% reduction in the post development mean annual load of TSS*
Total Phosphorus (TP)	*60% reduction in the post development mean annual load of TP*
Total Nitrogen (TN)	*45% reduction in the post development mean annual load of TN*
Hydrocarbons, motor oils, oils and grease	*No visible oils for flows up to 50% of the one-year ARI peak flor specific for service stations, depots, vehicle body repair workshops, vehicle repair stations, vehicle sales or hire premises, car parks associated with retails premises, places of worship, tourist and visitor accommodation, registered clubs and pubs.*

At this stage, a Model for Urban Stormwater Improvement Conceptualisation (MUSIC) has not been prepared for the project as the general site layout is yet to be finalised. The purpose of this report is to comment on the likely WSUD measures which may be adopted in the design. A MUSIC model will be prepared prior to the submission of a development application for the development.

4.1 Existing Conditions

Under existing conditions the project site is fully covered with an impervious surface. Based on visual observation, there does not appear to be any WSUD initiatives on the existing project site.

4.2 Proposed Conditions

The development will aim to achieve the pollution reduction targets summarised above by adopting the following WSUD treatment initiatives prior to connection to the Council's stormwater system:

Rainwater Harvesting

Table 6 below provides a summary of the intended rainwater tank volumes to be combined within the OSD tanks in the proposed development.

Table 6 Proposed Rainwater Tank volumes

RAINWATER TANK VOLUMES			
Site 1	OSD 1A	Building D	50 m^3
		Building E	40 m^3
	OSD 1B	Building F	40 m^3
Site 2	OSD 2A	Building J	50 m^3
	OSD 2B	Building L	20 m^3

A first flush device will be connected to the building roof drainage system to treat harvested rainwater. The rainwater will be reticulated through the buildings via pressure booster pumps. Treated rainwater will be reticulated through the building as a non-potable water service for the purposes of toilet and urinal flushing and nominal landscape watering.

On-site Stormwater Detention

OSD will be incorporated into the surface drainage system in an attempt to reduce peak stormwater discharge rates from the project site. The outlet pipe from the OSD tanks will be fitted with a trash screen to reduce the likelihood of blockage in the outlet pipe and trap gross pollutants.

Gross Pollutant Trap

A Gross Pollutant Trap will provide physical filtration of stormwater runoff exiting the site through OSD tanks.

Silt and Grease Arrestor with Basement Carpark Areas

A silt and grease arrestor system will be installed within the basement carpark in an attempt to collect oils and hydrocarbons prior to connection to the stormwater / pump out collection system.

Rainwater Absorption

Where practically possible, the placement of vegetation and grassy areas within the project sites will promote ground infiltration and minimise the impact of overland flows due to impervious surfaces.

Lots 83 and 65 will incorporate planter boxes within public outdoor spaces i.e. the plaza area.

Lot 57 provides an opportunity for absorption through the large open landscaped areas.

As part of the site's WSUD strategy, regular maintenance will be undertaken on the pollution reduction devices/ initiatives described above.

Given the scale and extent of the development, there is minimal opportunity to incorporate bio filtration and infiltration basins into the development. Additional measures such as vegetated filter strips and swales and permeable paving will be considered as part of the stormwater drainage design as the site layout progresses.

5.0 Safety in Design

A high level safety in design assessment has been undertaken to inform the development of this Stormwater Management Plan in future design stages. Hazards identified at this stage include (but not be limited to):

- Operation and Maintenance of the project site stormwater drainage system including:
  - Number and location of access lids.
  - Minimum and maximum depth of OSD and rainwater tanks and surface inlet pits.
  - Maintaining stormwater infrastructure during flash floods and extreme flood events.
  - Interaction between maintenance personnel and vehicles particularly in loading bays/docks.
  - Confined spaces in drainage infrastructure.
- Overland flow paths through public open spaces.
- Minimum finished surface level and grading of basement entry driveways.
- Freeboard to the finished floor level of surface inlet pits and OSD tanks.

Appendix A - OSD Calculation Spreadsheets

On-Site Detention Calculation Sheet for
Catchments outside Upper Parramatta River Catchment
Non-HED Secondary Outlet
(Due to Elevated Downstream 100 yr ARI Flood Level)

Project:	**Gateway South Parramatta**
Site Address	**57 – 83 Church St, Parramatta - Catchment 1A**
Job No:	**60322150**
Designer:	**AECOM**
Telephone:	**(02) 8934 0000**

Site Data

OSD Area:	**Upper Parramatta River Catchment**					
L.G.A	**Parramatta City Council**					
Site Area	**0.5393**	ha	**5,393**	m^2		
Total Roof Area	**0.3935**	ha	**3,935**	m^2		
Area of Site draining to OSD Storage	**0.4956**	ha	**4,956**	m^2	Satisfactory	
Residual Site Area (Lot Area - Roof Area)	**0.146**	ha				
Area Bypassing Storage	**0.0437**	ha				
Area Bypassing / Residual Site Area	**30.0%**				Satisfactory	30% Max
No. of Dwellings on Site	**518**				Satisfactory	
Site Area per Dwelling	**0.001**	ha				
Roof Area per Dwelling	**0.001**	ha				

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**165**	m^3/ha	Total Storage (1.14 x SSR_{THED})	**245**	m^3/ha
Basic SRDs	Primary Outlet	**63**	L/s/ha	Secondary Outlet	**172**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**70%**			
Adjusted SRDs	**31**	L/s/ha	**90**	L/s/ha

OSD Calculations

		Extended Detention			Detention	
Basic SSR Volume	Ext Detention Storage	**88.98**	m^3	Total Storage	**132.13**	m^3
Total Rainwater Tank Credits		**0.00**	m^3		**0.00**	m^3
Storage Volume				Total	**132.13**	m^3
Storage Volume	Ext Detention Storage	**88.98**	m^3	Flood Detention Storage	**43.14**	m^3
OSD Discharges	Primary Outlet	**16.72**	L/s	Secondary Outlet	**48.57**	L/s
RL of Top Water Level of Storage		**12.400**	m		**12.600**	m
RL of Orifice Centre-line		**12.200**	m		**12.200**	m
Number of Orifices		**1**			**1**	
Estimated Downstream Flood Level		**12.40**	1.5 yr ARI		**12.40**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**0.20**	Raise Orifice Level	Raise Orifice Level	**0.20**	
Design Head to Orifice Centre		**0.200**	m	TWL Detn Storage - RL Orifice	**0.400**	m
Calculated Orifice Diameter		**134**	mm Satisfactory	Satisfactory	**192**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**12.900**	m
RL of Minimum Garage Floor Level		**-10.800**	m
Length of Overflow Weir		**2.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.65**	
Storm Intensity (5 min 100 yr ARI)		**208**	mm/h
Peak Flow over Weir		**185.1**	L/s

Depth of Flow over Weir			147	mm
Freeboard to Habitable Floor		Unacceptable - Min Freeboard = 200 mm	153	mm
Freeboard to Garage Floor		Unacceptable - Min Freeboard = 100 mm	-23547	mm

Rainwater Tank Calculations (per Dwelling)

Only Complete this Section if a Rainwater Tank Airspace Credit is Claimed

The calculations assume that the same size rainwater tank is installed on each dwelling

				Min		Max
% of Roof draining to Rainwater Tank			Satisfactory	0.0%		100%
Total Rainwater Tank Volume		kL	Minimum 0.0 kL			
Min Volume that triggers Top-up		kL	Note - Min Vol in Tank < 10% Total Tank Vol			
Total Tank Vol - Min Top-up Vol	0.00	kL				
Dedicated Airspace						
Dedicated Airspace		kL	Satisfactory			
	Extended Detention			Detention		
Dedicated Airspace Credit	0.00	kL		0.00	kL	
Maximum Tank PSD	63	L/s/ha				
Maximum Tank Discharge	0.0	L/s				
Maximum Head to Centre of Tank Orifice		m	No Dedicated Airspace			
Calculated Orifice Diameter	0	mm	No Dedicated Airspace			
Dynamic Airspace						
Maximum Dynamic Storage (Nett Vol)	0.00	kL	Controls minimum % Roof to Rainwater Tank			
Daily Demand on Rainwater Tank		kL/d	Satisfactory			
Dynamic Airspace at start of Storm	0.00	kL				
	Extended Detention			Detention		
Dynamic Airspace Credit	0.00	kL		0.00	kL	
Combined Rainwater Tank Credit	0.00	kL		0.00	kL	
Maximum Rainwater Tank Credit	0.00	kL		0.00	kL	
Rainwater Tank Credit per Dwelling	0.00	kL		0.00	kL	
Rainwater Tank Credit for the Site	0.00	m^3		0.00	m^3	

Signature: ______________________ **Date:** ____________

On-Site Detention Calculation Sheet for

Catchments outside Upper Parramatta River Catchment

Non-HED Secondary Outlet

(Due to Elevated Downstream 100 yr ARI Flood Level)

Project:	**Gateway South Parramatta**
Site Address	**57 – 83 Church St, Parramatta - Catchment 1B**
Job No:	**60322150**
Designer:	**AECOM**
Telephone:	**(02) 8934 0000**

Site Data

OSD Area:	**Claycliff Creek Catchment**					
L.G.A	**Parramatta City Council**					
Site Area	**0.2207**	ha	**2,207**	m^2		
Total Roof Area	**0.161**	ha	**1,610**	m^2		
Area of Site draining to OSD Storage	**0.203**	ha	**2,030**	m^2	**Satisfactory**	
Residual Site Area (Lot Area - Roof Area)	**0.060**	ha				
Area Bypassing Storage	**0.0177**	ha				
Area Bypassing / Residual Site Area	**29.6%**				**Satisfactory**	**30% Max**
No. of Dwellings on Site	**1**				**Satisfactory**	
Site Area per Dwelling	**0.221**	ha				
Roof Area per Dwelling	**0.161**	ha				

Basic OSD Parameters

		Extended Detention			**Detention**	
Basic SSR Vols	Ext Detention Storage	**165**	m^3/ha	Total Storage (1.14 x SSR_{THED})	**245**	m^3/ha
Basic SRDs	Primary Outlet	**63**	L/s/ha	Secondary Outlet	**172**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**70%**			
Adjusted SRDs	**31**	L/s/ha	**91**	L/s/ha

OSD Calculations

		Extended Detention			**Detention**	
Basic SSR Volume	Ext Detention Storage	**36.42**	m^3	Total Storage	**54.07**	m^3
Total Rainwater Tank Credits		**0.00**	m^3		**0.00**	m^3
Storage Volume				Total	**54.07**	m^3
Storage Volume	Ext Detention Storage	**36.42**	m^3	Flood Detention Storage	**17.66**	m^3
OSD Discharges	Primary Outlet	**6.86**	L/s	Secondary Outlet	**20.02**	L/s
RL of Top Water Level of Storage		**12.400**	m		**12.700**	m
RL of Orifice Centre-line		**11.800**	m		**11.800**	m
Number of Orifices		**1**			**1**	
Estimated Downstream Flood Level		**12.40**	1.5 yr ARI		**12.40**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**0.60**	**Raise Orifice Level**	**Raise Orifice Level**	**0.60**	
Design Head to Orifice Centre		**0.600**	m	TWL Detn Storage - RL Orifice	**0.900**	m
Calculated Orifice Diameter		**65**	mm **Satisfactory**	**Satisfactory**	**101**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**12.900**	m
RL of Minimum Garage Floor Level		**-10.800**	m
Length of Overflow Weir		**2.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.65**	

Storm Intensity (5 min 100 yr ARI)		208	mm/h
Peak Flow over Weir		75.8	L/s
Depth of Flow over Weir		81	mm
Freeboard to Habitable Floor	Unacceptable - Min Freeboard = 200 mm	119	mm
Freeboard to Garage Floor	Unacceptable - Min Freeboard = 100 mm	-23581	mm

Rainwater Tank Calculations (per Dwelling)

Only Complete this Section if a Rainwater Tank Airspace Credit is Claimed

The calculations assume that the same size rainwater tank is installed on each dwelling

				Min	Max	
% of Roof draining to Rainwater Tank			Satisfactory	0.0%	100%	
Total Rainwater Tank Volume		kL	Minimum 0.0 kL			
Min Volume that triggers Top-up		kL	Note - Min Vol in Tank < 10% Total Tank Vol			
Total Tank Vol - Min Top-up Vol	0.00	kL				
Dedicated Airspace						
Dedicated Airspace		kL	Satisfactory			
	Extended Detention			Detention		
Dedicated Airspace Credit	0.00	kL		0.00	kL	
Maximum Tank PSD	63	L/s/ha				
Maximum Tank Discharge	0.0	L/s				
Maximum Head to Centre of Tank Orifice		m	No Dedicated Airspace			
Calculated Orifice Diameter	0	mm	No Dedicated Airspace			
Dynamic Airspace						
Maximum Dynamic Storage (Nett Vol)	0.00	kL	Controls minimum % Roof to Rainwater Tank			
Daily Demand on Rainwater Tank		kL/d	Satisfactory			
Dynamic Airspace at start of Storm	0.00	kL				
	Extended Detention			Detention		
Dynamic Airspace Credit	0.00	kL		0.00	kL	
Combined Rainwater Tank Credit	0.00	kL		0.00	kL	
Maximum Rainwater Tank Credit	0.00	kL		0.00	kL	
Rainwater Tank Credit per Dwelling	0.00	kL		0.00	kL	
Rainwater Tank Credit for the Site	0.00	m^3		0.00	m^3	

Signature: ____________________ **Date:** ____________

On-Site Detention Calculation Sheet for
Catchments outside Upper Parramatta River Catchment
Non-HED Secondary Outlet
(Due to Elevated Downstream 100 yr ARI Flood Level)

Project:	**Gateway South Parramatta**
Site Address	**57 – 83 Church St, Parramatta - Catchment 2A**
Job No:	**60322150**
Designer:	**AECOM**
Telephone:	**(02) 8934 0000**

Site Data

OSD Area:	**Upper Parramatta River Catchment**					
L.G.A	**Parramatta City Council**					
Site Area	**0.308**	ha	**3,080**	m^2		
Total Roof Area	**0.204**	ha	**2,040**	m^2		
Area of Site draining to OSD Storage	**0.2768**	ha	**2,768**	m^2	Satisfactory	
Residual Site Area (Lot Area - Roof Area)	**0.104**	ha				
Area Bypassing Storage	**0.0312**	ha				
Area Bypassing / Residual Site Area	**30.0%**				Satisfactory	30% Max
No. of Dwellings on Site	**216**				Satisfactory	
Site Area per Dwelling	**0.001**	ha				
Roof Area per Dwelling	**0.001**	ha				

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**165**	m^3/ha	Total Storage (1.14 x SSR_{THED})	**245**	m^3/ha
Basic SRDs	Primary Outlet	**63**	L/s/ha	Secondary Outlet	**172**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**70%**			
Adjusted SRDs	**31**	L/s/ha	**90**	L/s/ha

OSD Calculations

		Extended Detention				Detention	
Basic SSR Volume	Ext Detention Storage	**50.82**	m^3		Total Storage	**75.46**	m^3
Total Rainwater Tank Credits		**0.00**	m^3			**0.00**	m^3
Storage Volume					Total	**75.46**	m^3
Storage Volume	Ext Detention Storage	**50.82**	m^3		Flood Detention Storage	**24.64**	m^3
OSD Discharges	Primary Outlet	**9.55**	L/s		Secondary Outlet	**27.72**	L/s
RL of Top Water Level of Storage		**12.700**	m			**12.700**	m
RL of Orifice Centre-line		**12.000**	m			**12.000**	m
Number of Orifices		1				1	
Estimated Downstream Flood Level		**12.40**	1.5 yr ARI			**12.40**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**0.40**	Raise Orifice Level		Raise Orifice Level	**0.40**	
Design Head to Orifice Centre		**0.700**	m		TWL Detn Storage - RL Orifice	**0.700**	m
Calculated Orifice Diameter		**74**	mm	Satisfactory	Satisfactory	**126**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**12.900**	m
RL of Minimum Garage Floor Level		**2.950**	m
Length of Overflow Weir		**2.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.65**	
Storm Intensity (5 min 100 yr ARI)		**208**	mm/h
Peak Flow over Weir		**103.4**	L/s
Depth of Flow over Weir		**100**	mm
Freeboard to Habitable Floor	Unacceptable - Min Freeboard = 200 mm	**100**	mm
Freeboard to Garage Floor	Unacceptable - Min Freeboard = 100 mm	**-9850**	mm

Rainwater Tank Calculations (per Dwelling)

Only Complete this Section if a Rainwater Tank Airspace Credit is Claimed

The calculations assume that the same size rainwater tank is installed on each dwelling

				Min	**Max**	
% of Roof draining to Rainwater Tank			**Satisfactory**	**0.0%**	**100%**	
Total Rainwater Tank Volume		kL	**Minimum 0.0 kL**			
Min Volume that triggers Top-up		kL	**Note - Min Vol in Tank < 10% Total Tank Vol**			
Total Tank Vol - Min Top-up Vol	**0.00**	kL				
Dedicated Airspace						
Dedicated Airspace		kL	**Satisfactory**			
	Extended Detention			**Detention**		
Dedicated Airspace Credit	**0.00**	kL		**0.00**	kL	
Maximum Tank PSD	**63**	L/s/ha				
Maximum Tank Discharge	**0.0**	L/s				
Maximum Head to Centre of Tank Orifice		m	**No Dedicated Airspace**			
Calculated Orifice Diameter	**0**	mm	**No Dedicated Airspace**			
Dynamic Airspace						
Maximum Dynamic Storage (Nett Vol)	**0.00**	kL	**Controls minimum % Roof to Rainwater Tank**			
Daily Demand on Rainwater Tank		kL/d	**Satisfactory**			
Dynamic Airspace at start of Storm	**0.00**	kL				
	Extended Detention			**Detention**		
Dynamic Airspace Credit	**0.00**	kL		**0.00**	kL	
Combined Rainwater Tank Credit	**0.00**	kL		**0.00**	kL	
Maximum Rainwater Tank Credit	**0.00**	kL		**0.00**	kL	
Rainwater Tank Credit per Dwelling	**0.00**	kL		**0.00**	kL	
Rainwater Tank Credit for the Site	**0.00**	m^3		**0.00**	m^3	

Signature: ______________________ **Date:** ____________

On-Site Detention Calculation Sheet for
Catchments outside Upper Parramatta River Catchment
Non-HED Secondary Outlet
(Due to Elevated Downstream 100 yr ARI Flood Level)

Project:	**Gateway South Parramatta**
Site Address	**57 – 83 Church St, Parramatta - Catchment 2B**
Job No:	**60322150**
Designer:	**AECOM**
Telephone:	**(02) 8934 0000**

Site Data

OSD Area:	**Upper Parramatta River Catchment**					
L.G.A	**Parramatta City Council**					
Site Area	**0.166**	ha	**1,660**	m^2		
Total Roof Area	**0.11**	ha	**1,100**	m^2		
Area of Site draining to OSD Storage	**0.1492**	ha	**1,492**	m^2	Satisfactory	
Residual Site Area (Lot Area - Roof Area)	**0.056**	ha				
Area Bypassing Storage	**0.0168**	ha				
Area Bypassing / Residual Site Area	**30.0%**				Satisfactory	30% Max
No. of Dwellings on Site	**216**				Satisfactory	
Site Area per Dwelling	**0.001**	ha				
Roof Area per Dwelling	**0.001**	ha				

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**165**	m^3/ha	Total Storage (1.14 x SSR_{THED})	**245**	m^3/ha
Basic SRDs	Primary Outlet	**63**	L/s/ha	Secondary Outlet	**172**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**70%**			
Adjusted SRDs	**31**	L/s/ha	**90**	L/s/ha

OSD Calculations

		Extended Detention				Detention	
Basic SSR Volume	Ext Detention Storage	**27.39**	m^3		Total Storage	**40.67**	m^3
Total Rainwater Tank Credits		**0.00**	m^3			**0.00**	m^3
Storage Volume					Total	**40.67**	m^3
Storage Volume	Ext Detention Storage	**27.39**	m^3		Flood Detention Storage	**13.28**	m^3
OSD Discharges	Primary Outlet	**5.15**	L/s		Secondary Outlet	**14.94**	L/s
RL of Top Water Level of Storage		**12.700**	m			**12.700**	m
RL of Orifice Centre-line		**12.000**	m			**12.000**	m
Number of Orifices		1				1	
Estimated Downstream Flood Level		**12.40**	1.5 yr ARI			**12.40**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**0.40**	Raise Orifice Level		Raise Orifice Level	**0.40**	
Design Head to Orifice Centre		**0.700**	m		TWL Detn Storage - RL Orifice	**0.700**	m
Calculated Orifice Diameter		**54**	mm	Satisfactory	Satisfactory	**92**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**12.900**	m
RL of Minimum Garage Floor Level		**2.950**	m
Length of Overflow Weir		**2.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.65**	
Storm Intensity (5 min 100 yr ARI)		**208**	mm/h
Peak Flow over Weir		**55.7**	L/s
Depth of Flow over Weir		**66**	mm
Freeboard to Habitable Floor	Unacceptable - Min Freeboard = 200 mm	**134**	mm
Freeboard to Garage Floor	Unacceptable - Min Freeboard = 100 mm	**-9816**	mm

Rainwater Tank Calculations (per Dwelling)

Only Complete this Section if a Rainwater Tank Airspace Credit is Claimed

The calculations assume that the same size rainwater tank is installed on each dwelling

				Min	**Max**	
% of Roof draining to Rainwater Tank			**Satisfactory**	**0.0%**	**100%**	
Total Rainwater Tank Volume		kL	**Minimum 0.0 kL**			
Min Volume that triggers Top-up		kL	**Note - Min Vol in Tank < 10% Total Tank Vol**			
Total Tank Vol - Min Top-up Vol	**0.00**	kL				
Dedicated Airspace						
Dedicated Airspace		kL	**Satisfactory**			
	Extended Detention			**Detention**		
Dedicated Airspace Credit	**0.00**	kL		**0.00**	kL	
Maximum Tank PSD	**63**	L/s/ha				
Maximum Tank Discharge	**0.0**	L/s				
Maximum Head to Centre of Tank Orifice		m	**No Dedicated Airspace**			
Calculated Orifice Diameter	**0**	mm	**No Dedicated Airspace**			
Dynamic Airspace						
Maximum Dynamic Storage (Nett Vol)	**0.00**	kL	**Controls minimum % Roof to Rainwater Tank**			
Daily Demand on Rainwater Tank		kL/d	**Satisfactory**			
Dynamic Airspace at start of Storm	**0.00**	kL				
	Extended Detention			**Detention**		
Dynamic Airspace Credit	**0.00**	kL		**0.00**	kL	
Combined Rainwater Tank Credit	**0.00**	kL		**0.00**	kL	
Maximum Rainwater Tank Credit	**0.00**	kL		**0.00**	kL	
Rainwater Tank Credit per Dwelling	**0.00**	kL		**0.00**	kL	
Rainwater Tank Credit for the Site	**0.00**	m^3		**0.00**	m^3	

Signature: ______________________ **Date:** ____________

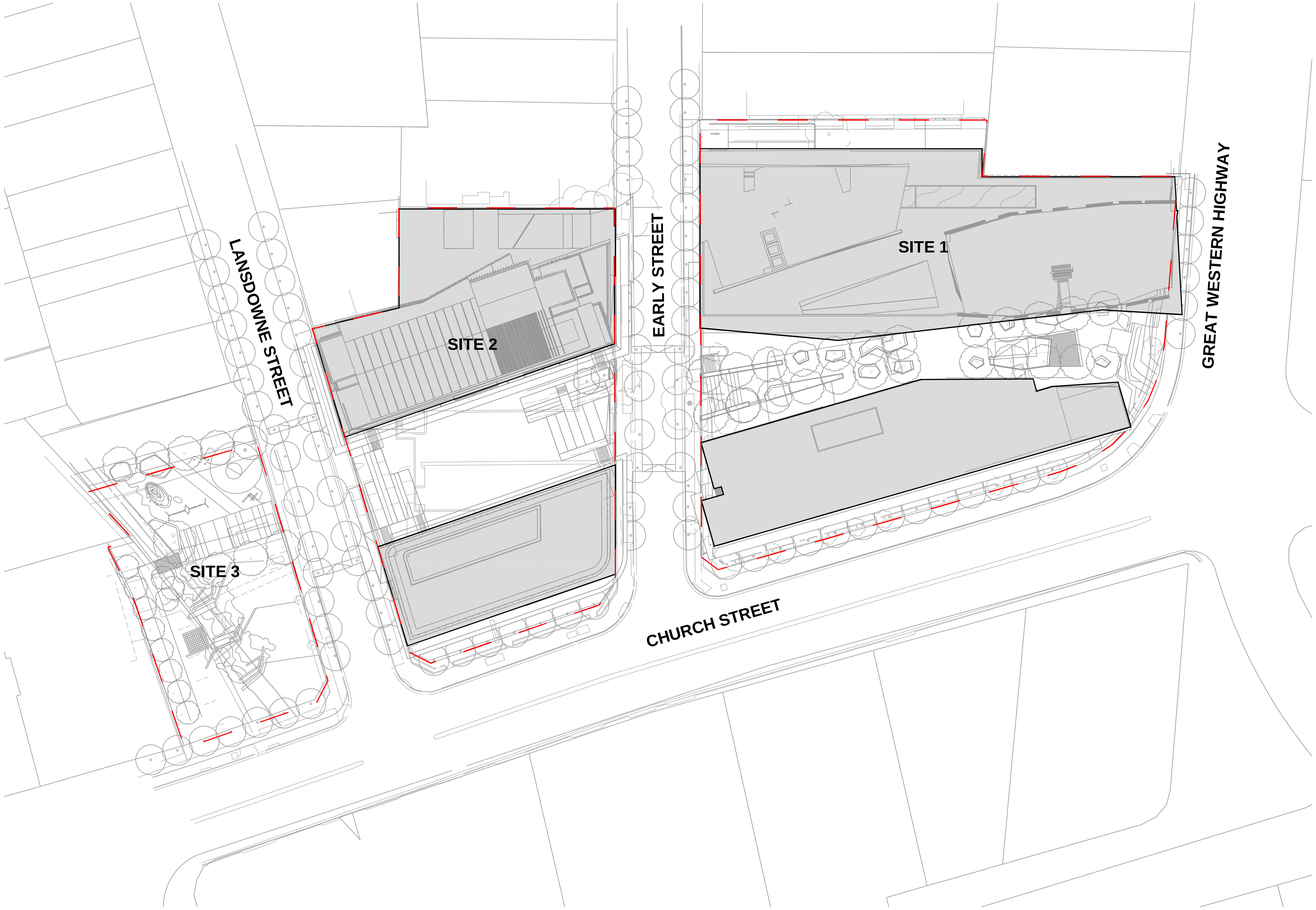
Appendix B - Indicative OSD and RWT Layout

ISO A1 594mm x 841mm

LEGEND

PROPERTY BOUNDARY

ROOF EXTENTS



AECOM

PROJECT

Gateway
South Parramatta

63 Church Street

CLIENT

Boyded Industries

Caverstock Group Pty Ltd

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?

- [ ] NO
- [ ] YES

SCALES

0 12.5 25 m

1:500

PROJECT MANAGEMENT INITIALS

NM	-	-
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

01	08/08/14	DRAFT ISSUE
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60322150

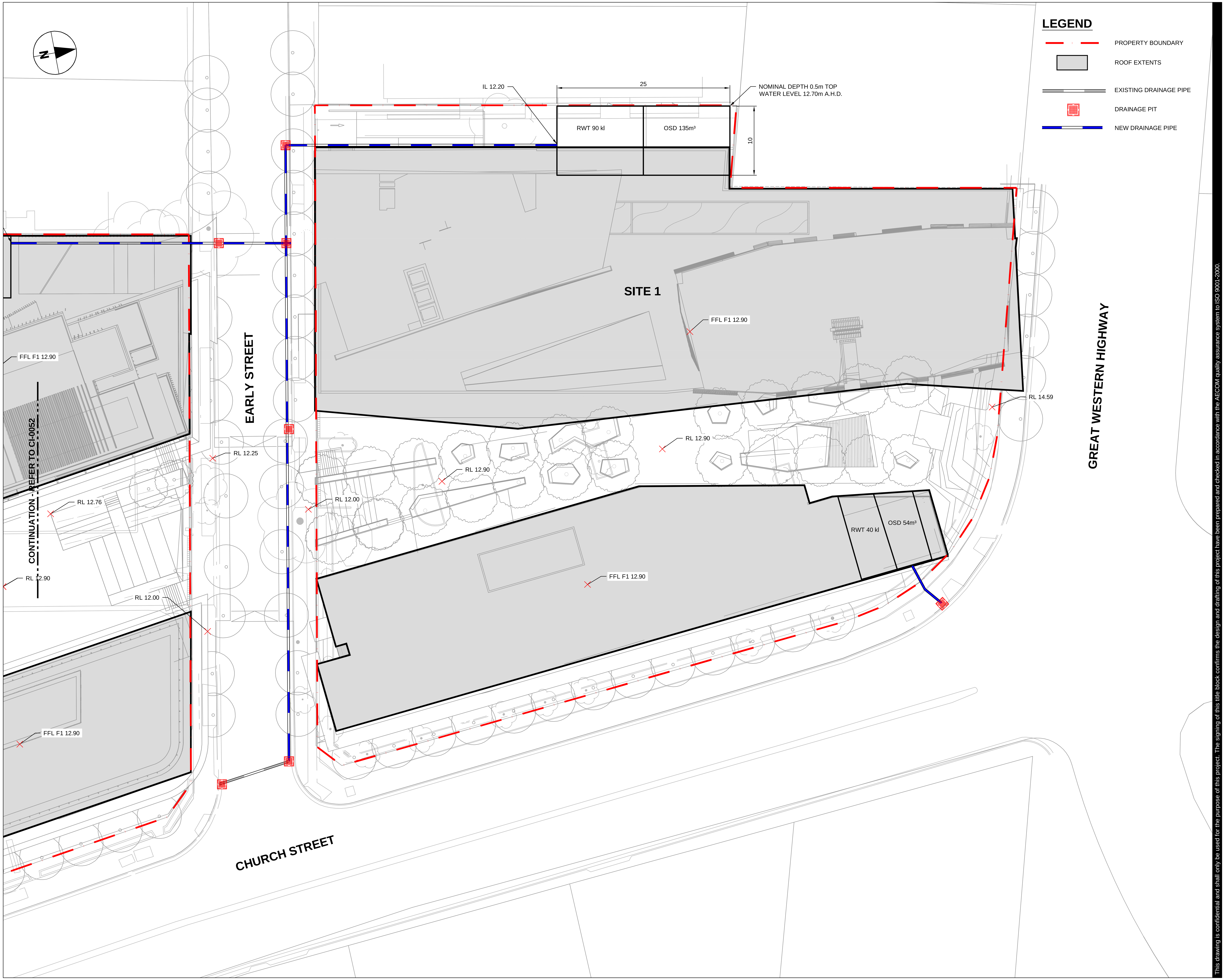
SHEET TITLE

CIVIL
SITE
PLAN

SHEET NUMBER

60322150-SHT-CI-0011

Last saved by: COOKJ3(2014-08-05) Last Plotted: 2014-08-08
Filename: P:\60322150_GATEWAY_SOUTH\5. CAD\02-SHEETS\60322150-SHT-CI-0011.DWG



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SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?

☐ NO
☐ YES

SCALES

0 6.25 12.5 m
1:250

PROJECT MANAGEMENT INITIALS

NM	-	-
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

01	08/08/14	DRAFT ISSUE
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

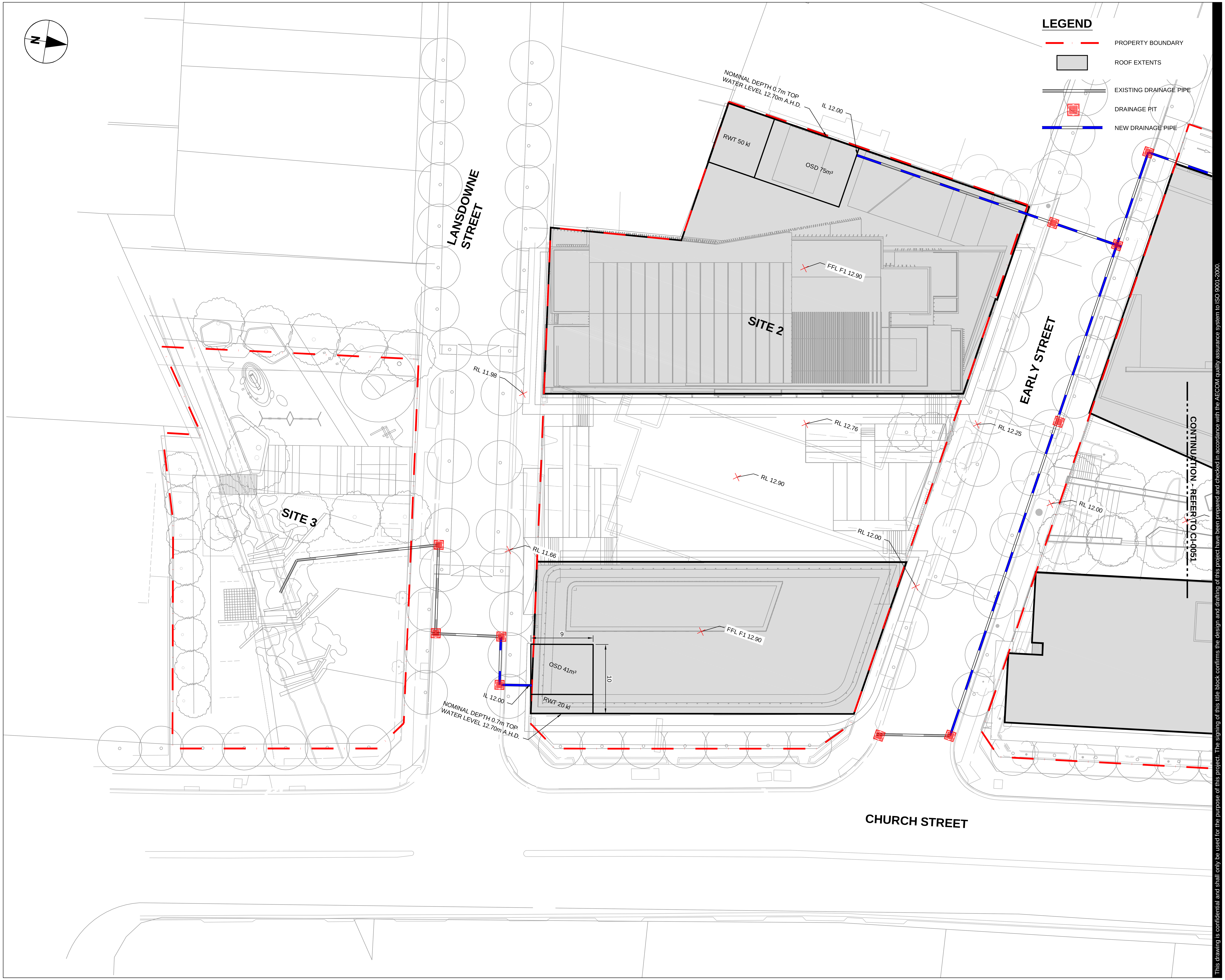
60322150

SHEET TITLE

CIVIL
STORMWATER MANAGEMENT
PLAN SHEET 1

SHEET NUMBER

60322150-SHT-CI-0051



AECOM

PROJECT

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South Parramatta

63 Church Street

CLIENT

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SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?

☐ NO
☐ YES

SCALES

0 6.25 12.5 m

1:250

PROJECT MANAGEMENT INITIALS

NM	-	-
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

01	08/08/14	DRAFT ISSUE
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60322150

SHEET TITLE

CIVIL
STORMWATER MANAGEMENT
PLAN SHEET 2

SHEET NUMBER

60322150-SHT-CI-0052