Flood Impact Assessment

24 Parkes Street, Harris Park

59918170

Prepared for
SH Parkes International Pty Ltd

23 July 2018

Cardno
Shaping the Future

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Executive Summary

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 24 Parkes Street, Parramatta. The subject site is located on the Clay Cliff Creek floodplain upstream of Harris Street.

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising four levels of basement car parking, four level of above ground parking, 4 levels of commercial retail outlets, 50 levels of residential apartments, one level of communal area and open space and two levels of sky gardens..

The flooding assessment methodology is outlined as follows:

- Impact of planned development on flooding
- Climate change impact on flooding
- Flood emergency response
- Flood warning and evacuation
- A draft emergency response plan
- Compliance with requirements of Parramatta DCP 2011

Previous Flood Assessments

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

Flood Impact Assessment

The assessment of the impact or otherwise of development on 24 Parkes Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

Flood models were established for the existing site conditions and future developed scenarios. The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by Zhinar Architects (attached in **Appendix C**).

Flood modelling was completed for the 100 year ARI, and Probable Maximum Flood events.

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2166) adopted by Council:

- 100 year ARI: 6.23 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.35 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.23 m AHD.

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively. It is concluded that the planned development has a negligible impact on 100 year ARI levels.

In the PMF there is a small local increase in the PMF level upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 20 Parkes Street. It is concluded that the planned development has a small adverse impact on PMF levels upstream of 24 Parkes Street.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity opposite 114 Harris Street and slightly increases the peak velocity in Parkes Street in the vicinity of 24-28 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 24 Parkes Street the velocity x depth in a PMF adjacent to the site in Parkes Street increases slightly. In a PMF the planned development locally decreases the flow velocity x depth in the northern section of 22 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High while in Parkes Street adjacent to the site it is Low. The impact of the planned development on provisional hazard on adjoining properties is negligible.

Flood Risk Precinct

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. The site is mapped as Low Flood Risk with a very minor area of Medium Flood Risk along the northern site boundary based on the XP-SWMM 1D/2D results. The site would be also mapped as Low Flood Risk with a very minor area of Medium Flood Risk along the northern site boundary based on mapped extents of 100 yr ARI flooding and hazard as given in Council's Flood Map attached in **Appendix B**. The section of Parkes Street adjoining the property would be also mapped by Council as Low Flood Risk.

Rate of Rise of Floodwaters

Features of the planned development include:

- Ground levels which vary from 8.96 m AHD in the southwest corner to 6.84 m AHD in the northeast corner of the property;
- Proposed ground floor level for the commercial uses of 9.0 m AHD which provides which provides 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level for commercial uses of 14.5 m AHD which is higher than the PMF level;
- Proposed floor levels for two additional levels of commercial uses which are all significantly higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 9.0 m AHD which provides 2.77 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor commercial office(s) has a freeboard of around 2.77 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 3 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 9.0 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 4 hours 45 minutes after start of the PMP storm.

Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill the three lowest levels of the car park to a depth of 0.9 m and to completely full is around 24-26 minutes and around 32-40 minutes respectively. The estimated times it would take to fill the upper level of the basement car park to a depth of 0.9 m and to completely full is around 42 minutes and around 65 minutes respectively.

Emergency Planning

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

A draft Emergency Response Plan is outlined.

Flood Emergency Response

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place. Based on the estimated peak number of persons that could be at risk in the car park and in Ground Floor the estimated maximum area of refuge required is 62 m^2. It is expected that this refuge would be provided by the communal area on Level 4 which exceeds the required area of refuge.

Assessment of Council Requirements

The development is located almost wholly in a Low Flood Risk Precinct. Consequently the development has been assessed against the planning and development controls that apply to “Residential” in a Low Flood Risk Precinct.

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. An assessment of the compliance of the proposed development with Council’s requirements is given in Section 7 of this report.

It is concluded that the assessment and details in this Flood Impact Assessment satisfy the requirements of the Parramatta DCP 2011.

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1 Introduction

1.1 Background

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 24 Parkes Street, Parramatta. The subject site is located on the Clay Cliff Creek floodplain upstream of Harris Street (refer **Figure 1** in **Appendix A**).

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising four levels of basement car parking, four level of above ground parking, 4 levels of commercial retail outlets, 50 levels of residential apartments, one level of communal area and open space and two levels of sky gardens.

1.2 Flooding Considerations

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

The flooding context for the site is provided in the flood map prepared by Parramatta City Council and given in **Figure 1** (refer also **Appendix B**) and the 10 year ARI and 100 year ARI flood extents estimated in the 2007 Cardno Willing Study as given in **Figure 2**.

1.3 Objective

The objective of the study is to address the following considerations for planned development of the sites:

- Impact of planned development on flooding;
- Climate change impact on flooding;
- Flood emergency response;
- Flood warning and evacuation;
- Outline of a draft emergency response plan; and
- Compliance with requirements of Parramatta DCP 2011

1.4 Methodology

The flooding assessment methodology is outlined as follows:

- Review of previous flood studies and available data;
- Compilation of site specific data (including proposed development layout);
- If appropriate, modify the Clay Cliff Creek floodplain model to represent existing site scenario;
- Revision of flood model to represent future site development;
- Assessment of resultant flood behaviour and flood risks;
- Review of flood emergency planning;
- Outline a flood emergency response plan;
- Review of compliance with Parramatta City Council development requirements;

2 Previous Studies

The proposed development on 24 Parkes Street, Harris Park is potentially subject to flooding by floodwaters spilling from Clay Cliff Creek and/or the Parramatta River. Consequently previous studies of flooding in the lower Parramatta River and in Clay Cliff Creek are relevant to the subject site.

2.1 2005 Lower Parramatta River Floodplain Study

The Lower Parramatta River Floodplain Risk Management Study/Plan was completed in 2005 in accordance with the provisions of the Floodplain Development Manual applicable at that time. This study included a Flood Study Review which re-assessed flood levels in a number of watercourses and in the tidal section of Parramatta River, between the Charles Street weir and Ryde (road) Bridge. The Flood Study Review provided the base data for the subsequent Floodplain Risk Management Study.

The study was commissioned by Parramatta City Council to update the previous data on flood levels and extents. PCC was aware that the results predicted in the 1986 study would now be subject to change due to changes in the catchment such as urbanisation and the construction of flood mitigation projects in the upper catchment. It also recognised that the previous flood extent mapping was based on the best information available at the time, but it was of variable reliability and did not provide an assessment of flood hazard.

The LPRFS adopted the best current practice to review the flood data which included (SKM, 2005):

- up-to-date catchment hydrology for the Upper Parramatta River Catchment;
- existing/ updated hydrology for the tributaries within the Lower Parramatta River study area;
- Airborne Laser Survey;
- an additional 70 surveyed cross-sections;
- the widely used and accepted MIKE-11 hydraulic model;
- use of GIS to develop digital terrain models;
- multiple design storms to generate maximum flood levels; and
- appropriate methodology for estimating concurrent flows in tributaries.

Generally, results from the review compared well with previous studies. However, flood levels estimated in the 1986 Lower Parramatta Flood Study prepared by Willing and Partners in the Lower Parramatta River downstream of Subiaco Creek (including the Duck River confluence) were up to 1.2 m lower than those derived in the 2005 review. The reasons for this difference as described in the 2005 Flood Study report include:

- revision of the critical duration to 9 hours for the Upper Parramatta River catchment in the 2005 study, due to the inclusion of channel routing and the effect of the Darling Mills Retarding Basin and other flood mitigation works. This leads to an increase in the volume of floodwaters;
- more detailed and complete survey data; and
- the adoption of an integrated modelling approach and consistent design storms for the main river and tributaries.

It is our understanding that Parramatta City Council adopted the design flood levels from this study for planning purposes in 2005.

Council and Council's Peer Reviewer has relied upon the flood levels estimated by this flood study in the vicinity of Wigram St and Hassall St, Harris Park as contained in Council's Flood Map (refer **Figure 1**).

2.2 2007 Clay Cliff Creek Catchment Master Drainage Plan

A Catchment Master Drainage Plan for the Clay Cliff Creek catchment at Parramatta was prepared in 2007. The aim of the study as set out by Parramatta City Council was to identify overland flow problem areas, locations of surcharge due to insufficient pipe capacity and pit inlet capacity, and localised flooding with areas of improvement. The study aimed also to prepare cost effective options based on cost benefit analysis.

The 2007 study assembled a hydrological model of the Clay Cliff Creek catchment and input local flow hydrographs into an XP-SWMM 1D/2D floodplain model. The estimated 10 year ARI and 100 year ARI flood extents are presented in **Figure 2**.

2.3 2011 Flood Impact Assessment, 111 Wigram St, Harris Park

Cardno was commissioned by ING Consulting Engineers Pty Ltd to undertake an assessment of the site and the proposed development in relation to flooding. The purpose of the assessment was to ensure that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that risk of flooding to the public is acceptable to Parramatta City Council.

Cardno assessed flood behaviour for the 100 year ARI for the existing and proposed conditions. This was undertaken through update of our 2007 XP-SWMM 1D/2D model of the Clay Cliff Creek catchment prepared for the Parramatta City Council.

The assessment concluded that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that the flood risk to the public is acceptable to Council.

2.4 2011 Flood Impact Assessment, 122 Wigram St, Harris Park

Cardno was commissioned by LJ Hooker Westmead to undertake the flood assessment of the proposed multi-storey mixed-use development at 122 Wigram Street, Harris Park. The purpose of the assessment was to ensure that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that risk of flooding to the public is acceptable to Parramatta City Council.

Cardno assessed flood behaviour for the 100 year ARI for the existing and proposed conditions. This was undertaken through update of our 2007 XP-SWMM 1D/2D model of the Clay Cliff Creek catchment prepared for the Parramatta City Council.

The assessment concluded that the proposed development would maintain the floodplain of Clay Cliff Creek and would have little impact on flood behaviour being located between the hydraulic controls of Charles and Wigram Street crossings.

2.5 2014 Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park

In 2014 a mixed-use development of 113-117 Wigram St and 23-29 Hassall St was proposed comprising retail outlets, residential apartments and a multi-storey underground car park.

This site is located adjacent to and north of Clay Cliff Creek.

The objective of the study was to address the overall conclusions of Council's Peer Reviewer as documented in a memorandum dated 21 October 2013.

A 1D/2D assessment of flooding in the vicinity of the site was undertaken to define flood behaviour and to assess the impacts if any of the proposed development using a modified version of the XP-SWMM 1D/2D floodplain model. The 1D/2D floodplain model included the floodplain of Clay Cliff Creek up to the Railway Line and a reach of the Parramatta River.

3 Flooding Assessment

The assessment of the impact or otherwise of development on 24 Parkes Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

3.1 Existing Conditions

3.1.1 Model Configuration

The floodplain model which was used for assessment purposes was an extended version of the 2007 Clay Cliff Creek model recently used to assess the impacts of planned development on 32 Tramway Avenue, Parramatta which includes development which was assessed previously on properties nearby to 26-30 Parkes St, Harris Park. The 1D/2D model of the Clay Cliff Creek floodplain which extends to its outfall into the Parramatta River was extended to include a reach of the lower Parramatta River and its floodplain. In order to reduce the size of the overall model to assess the impacts of planned development the Clay Cliff Creek model was truncated at the railway line which is a local hydraulic control (refer **Figure 2**).

The Parramatta River was represented in the 1D/2D floodplain model as 2D terrain which was created from the cross sections extracted from the lower Parramatta River floodplain model between and including PARRAMATTA_R 3248 to PARRAMATTA_R 4452. The overbank areas not already represented in the Clay Cliff Creek model were included in the 2D domain using ALS data which was previously supplied by Council for the Clay Cliff Creek study.

The adopted downstream boundary condition was a stage hydrograph extracted from the lower Parramatta River floodplain model at PARRAMATTA_R 4452.

The upstream boundary conditions were a flow hydrograph in the Parramatta River extracted from the lower Parramatta River floodplain model at PARRAMATTA_R 3248 and the flow hydrograph generated by the Clay Cliff Creek model at the Railway Line. Local inflow hydrographs were also input within the study area based on the subcatchment discretisation adopted in the 2007 Clay Cliff Creek catchment study.

3.1.2 Terrain

The Digital Terrain Model (DTM) adopted for the flood model represents the ground surface elevations and blockages to flow caused by buildings. The DTM and blockages for Existing Conditions in the vicinity of the site is shown in **Figure 3**.

3.1.3 Floodplain Roughness

The roughness zones in the vicinity of the site are plotted in **Figure 4**. The roughness values which were adopted were guided by the values previously adopted in the 2007 Clay Cliff Creek catchment study.

3.1.4 Results

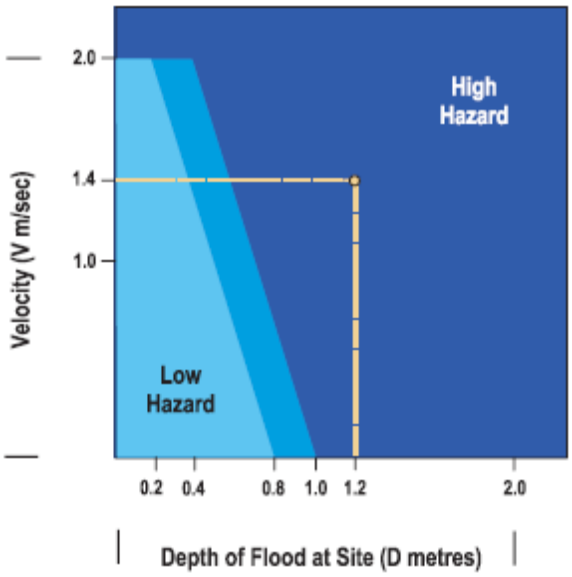
The estimated 100 year ARI flood levels and extent, depths and velocities under Existing Conditions are plotted in **Figures 5, 6** and **7** respectively.

When considering pedestrian and vehicular stability, three velocity x depth criteria were identified as follows:

Velocity x Depth	Comment
≤ 0.4 m^2/s	This is typically adopted by Councils as a limit of stability for pedestrians
0.4 – 0.6 m^2/s	Unsafe for pedestrians but safe for vehicles if overland flood depths do not exceed around 0.3 m
> 0.6 m^2/s	This is typically adopted by Councils as a limit of stability for vehicles

The estimated 100 year ARI velocity x depth under Existing Conditions is plotted in **Figure 8.**

Experience from studies of floods throughout NSW and elsewhere has allowed authorities to develop methods of assessing the hazard to life and property on floodplains. This experience has been used in developing the NSW Floodplain Development Manual to provide guidelines for managing this hazard. These guidelines are shown schematically blow.



Provisional Hazard Categories (after Figure L2, NSW Government, 2005)

To use the diagram, it is necessary to know the average depth and velocity of floodwaters at a given location. If the product of depth and velocity exceeds a critical value (as shown below), the flood flow will create a **high hazard** to life and property. There will probably be danger to persons caught in the floodwaters, and possible structural damage. Evacuation of persons would be difficult. By contrast, in **low hazard** areas people and their possessions can be evacuated safely by trucks. Between the two categories a transition zone is defined in which the degree of hazard is dependent on site conditions and the nature of the proposed development.

This calculation leads to a provisional hazard rating. The provisional hazard rating may be modified by consideration of effective flood warning times, the rate of rise of floodwaters, duration of flooding and ease or otherwise of evacuation in times of flood. The estimated 100 year ARI provisional flood hazard under updated Existing Conditions is plotted in **Figure 9.**

The estimated PMF levels and extent, depths, velocities, velocity x depth and hazards under updated Existing Conditions are plotted in **Figures 10, 11, 12, 13** and **14** respectively.

Based on the results of the assessments of 100 year ARI and PMF flooding the flood risk precincts are identified in **Figure 15**.

3.2 Future Conditions

3.2.1 Terrain

The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by Zhinar Architects (attached in **Appendix C**). It comprises four levels of basement car parking, four level of above ground parking, 4 levels of commercial retail outlets, 50 levels of residential apartments, one level of communal area and open space and two levels of sky gardens.

The DTM for the Future Conditions model was generated based on the architectural drawings prepared by Zhinar Architects. A summary of the areas blocked in the future DTM and additional features are shown in **Figure 16.**

3.2.2 Floodplain Roughness

The roughness zones under Future Conditions are plotted in **Figure 17.** The roughness values which were adopted were guided by the values previously adopted in the 2007 Clay Cliff Creek catchment study.

3.2.3 Results

The estimated 100 year ARI flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 18, 19, 20, 21** and **22** respectively.

The estimated PMF flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 23, 24, 25, 26** and **27** respectively.

3.3 Peak Flood Levels

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2166) adopted by Council:

- 100 year ARI: 6.23 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.35 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek and partially west along Parkes Street. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.23 m AHD.

3.4 Flood Impact Assessment

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively. It is concluded that the planned development has a negligible impact on 100 year ARI levels.

In the PMF there is a small local increase in the PMF level upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 20 Parkes Street. It is concluded that the planned development has a small adverse impact on PMF levels upstream of 24 Parkes Street.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity opposite 114 Harris Street and slightly increases the peak velocity in Parkes Street in the vicinity of 24-28 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 24 Parkes Street the velocity x depth in a PMF adjacent to the site in Parkes Street increases slightly. In a PMF the planned development locally decreases the flow velocity x depth in the northern section of 22 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High while in Parkes Street adjacent to the site it is Low. The impact of the planned development on provisional hazard on adjoining properties is negligible.

3.5 Climate Change

Based on discussions with Parramatta City Council in 2012 an indicative assessment of the impact of climate change on the 100 year ARI flood levels in the year 2100 was undertaken in 2012 to inform a Discussion Paper on Flooding of the DHA Site in Ermington (Cardno, 2012). This assessment was based on an assumed 15% increase in design rainfall (yielding a 12% increase in 100 year ARI flood flows) and sea level rise of 0.9 m.

The indicative 100 year ARI flood levels in the Parramatta River under climate change are around 0.34 m – 0.45 m higher than the 100 year ARI flood levels adopted by Council. It is expected that the impact of climate change in the vicinity of the site which is adjacent to Clay Cliff Creek is around 0.35 m ie. around 6.55 m AHD. The proposed level of the ground floor is at 9.0 m AHD which provides 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change while the driveway entry crest level of around 9.0 m AHD also provides 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

3.6 Cumulative Development

The cumulate impact of multiple potential developments in the vicinity has been previously represented in the floodplain model assembled during the 2005 Lower Parramatta River Floodplain Study and is already incorporated in the resulting flood levels adopted by Council. In the 2005 floodplain model overland flowpaths are primarily represented as road corridors and any existing or new development on lots or re-development lies outside the modelled flood extents. Council's plotted flood extents are based on extrapolating the calculated flood levels beyond the modelled flood extents. Consequently new development or re-development can't be represented by modification of current cross sections in Council's floodplain model and will not change the flood levels adopted by Council.

The cumulative impact of the proposed development of 24 Parkes Street, 26-30 Parkes Street and 114-118 Harris Street was also undertaken.

The estimated 100 year ARI and PMF level differences under cumulative Future Conditions in comparison with Existing Conditions are plotted in **Figures 30** and **31** respectively. In the case of the 100 yr ARI event there is a local increase on Harris Street opposite 118 Harris Street of around 0.05 m. This local impact does not extend to any adjoining property. There is also an associated small reduction in 100 yr ARI flood levels north of Clay Cliff Creek.

In the PMF there is a small local increase in the PMF level upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 20 Parkes Street.

It is concluded that the planned cumulative development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels upstream of 24 Parkes Street.

4 Flood Risks

The flood risks at and in the vicinity of 24 Parkes Street, Harris Park are discussed as follows.

4.1 Flood Levels, Velocities and Hazards

The estimated 100 year ARI flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 18, 19, 20, 21** and **22** respectively.

The estimated PMF flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 23, 24, 25, 26** and **27** respectively.

4.2 Flood Risk

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. The site is mapped as Low Flood Risk with a very minor area of Medium Flood Risk along the northern site boundary based on the XP-SWMM 1D/2D results. The site would be also mapped as Low Flood Risk with a very minor area of Medium Flood Risk along the northern site boundary based on mapped extents of 100 yr ARI flooding and hazard as given in Council's Flood Map attached in **Appendix B**. The section of Parkes Street adjoining the property would be also mapped by Council as Low Flood Risk.

4.3 Rate of Rise of Floodwaters

To understand the likely warning times and associated response times during extreme flood events it is necessary to estimate the expected rate of rise of floodwaters. At 24 Parkes Street, Harris Park the estimated rate of rise of flooding in a PMF event above the ground floor level and driveway crest level of 9.0 m AHD is around 1.0 m/hr and decreases as the peak water level is approached.

Features of the planned development include:

- Ground levels which vary from 8.96 m AHD in the southwest corner to 6.84 m AHD in the northeast corner of the property;
- Proposed ground floor level for the commercial uses of 9.0 m AHD which provides which provides 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level for commercial uses of 14.5 m AHD which is higher than the PMF level;
- Proposed floor levels for two additional levels of commercial uses which are all significantly higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 9.0 m AHD which provides 2.77 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor commercial office(s) has a freeboard of around 2.77 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 3 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 9.0 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 4 hours 45 minutes after start of the PMP storm.

Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last “basin” (Basement Level 4) filling over a shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill the three lowest levels of the car park to a depth of 0.9 m and to completely full is around 24-26 minutes and around 32-40 minutes respectively. The estimated times it would take to fill the upper level of the basement car park to a depth of 0.9 m and to completely full is around 42 minutes and around 65 minutes respectively.

In events less extreme than the PMF but of sufficient severity to overtop the driveway crest level and where the inflow volume is less than the storage volume in the car parking levels then the same flooding behaviour would be expected with flooding initially occurring on both levels but at the time inflows cease floodwaters would then continue to flow down the access ramps until the flood level in the car park reaches its maximum level (ie. Basement Level 4 would fill like a bath tub).

4.4 Duration of Inundation

The estimated maximum times of isolation in a PMF are as follows:

- Ground Floor (at 9.0 m AHD) – Around 1 hours 15 mins
- Car Park Entry (at 9.0 m AHD) – Around 1 hours 15 mins

4.5 Persons at Risk (PAR)

The direct Persons at Risk (PAR) during the PMF was estimated for the Ground Floor and the basement car parking levels and the indirect PAR was estimated for commercial offices and residents living in apartments at levels higher than the PMF level.

In the case of commercial offices a unit rate of one worker per 10 m2 of office space was assumed guided by an allowance for a workstation and access corridor.

The estimated number of workers located on the Ground Floor is 25. The estimated number of persons directly at risk on the Ground Floor under proposed conditions is 9.1 (because it accounts for periods when the offices are closed).

The estimated number of workers located on the Levels 1, 2 and 3 is 138. The estimated number of persons indirectly at risk on Levels 1, 2 and 3 under proposed conditions is 37.8 (because it accounts for periods when the offices are closed).

The number of residents and/or visitors that would be indirectly at risk during a PMF was estimated based on the following assumed occupancies of apartments.

- 1 Bedroom 1.5 persons
- 2 Bedroom 2.5 persons
- 3 Bedroom 3.5 persons

The following assumptions were also made when estimating the Population at Risk (PAR):

- During day-time hours on weekdays:
  - the average occupancy per apartment over the whole building would be reduced by one person per apartment to account for one resident in each apartment working (this is viewed as a conservative assumption);
  - the average duration of occupancy would be 9 hours per day (out of 10 hours)
  - the average occupancy of each shop was assumed to be 3 persons
  - the average duration of occupancy of the neighbourhood store would be 10 hours per day (out of 10 hours)
- During night-time on weekdays:
  - All residents would reside on site each night ie. the average occupancy per apartment applies over the whole building;
  - the average duration of occupancy would be 14 hours per night (out of 14 hours);
  - the average occupancy of the each shop was assumed to be 3 persons;
  - the average duration of occupancy of each shop would be 4hours per night (out of 14 hours)
- During weekends:
  - the average duration of occupancy of all residents would be 18 hours per day (out of 24 hours)
  - the average duration of occupancy of each shop would be 14 hours per day (out of 24 hours)

In relation to estimating the PAR in car parking levels during a flood the following assumptions were made

- During day-time hours on weekdays:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.25 hours per day;
- During night-time on weekdays:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.25 hours per day;
- During weekends:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.5 hours;

The estimated total number of workers/visitors **directly** at risk during a PMF is summarised in **Table 1** while the total number of workers and of residents/visitors that would be indirectly at risk during a PMF (all other levels higher than the PMF) is summarised in **Table 2**.

Table 1 Estimated Population at Risk (PAR) Directly during a PMF

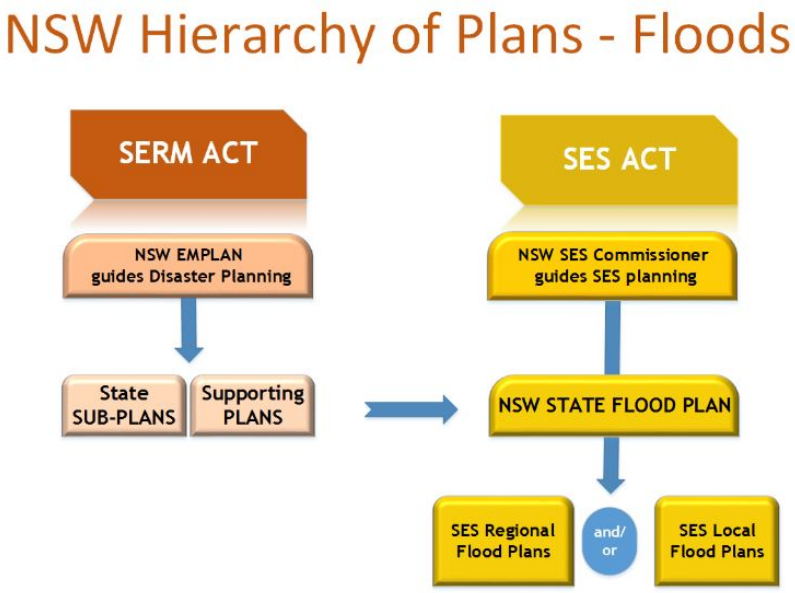
Workers/Visitors directly at Risk		
Ground Floor		Car Parking Levels B1 – B4, P1
No.	PAR	PAR
25	9.1	6.3

Table 2 Estimated Population at Risk Indirectly during a PMF

Workers/Residents/Visitors indirectly at Risk	
No.	PAR
Car Parking Levels P2-P4	
	3.8
Levels 1, 2 and 3	
138	37.8
Levels 5-57	
574	449.5

5 Emergency Planning

The hierarchy of plans which guide the planning for floods in NSW is as follows:



5.1 2017 NSW State Flood Plan

The NSW State Flood Plan is a sub plan of the State Emergency Management Plan (EMPLAN) (NSW Government, 2017). It has been prepared in accordance with the provisions of the State Emergency Service Act 1989 (NSW) and is authorised by the State Emergency Management Committee in accordance with the provisions of the State Emergency and Rescue Management Act 1989 (NSW).

The latest plan was provisionally endorsed by the State Emergency Management Committee at Meeting 107 held on 5 December 2017.

The purpose of this plan is to set out the arrangements for the emergency management of flooding in New South Wales

As described by the Plan:

> *The Plan sets out the emergency management aspects of prevention; preparation; response and initial recovery arrangements for flooding and the responsibilities of individuals, agencies and organisations with regards to these functions.*
>
> *The Plan recognises the existence of the problem of coastal inundation and erosion caused by severe weather. The management system for dealing with episodes of coastal erosion is described in the New South Wales State Storm Plan.*
>
> *The Plan recognises the existence of the threat posed by tsunami to NSW coastal communities. The arrangements for the emergency management of tsunami are contained within the State Tsunami Emergency Sub Plan.*

This Plan is intended to be read in conjunction with:

(a) The New South Wales State Emergency Management Plan (EMPLAN), of which the State Flood Sub Plan is a sub-plan;
(b) The New South Wales State Storm Plan, which covers arrangements relating to severe storm events; and
(c) NSW Floodplain Development Manual.

5.2 North West Metropolitan District Disaster Plan

On 27th June 2012 the Interim Version of the "North West Metropolitan District Disaster Plan (Displan)" was endorsed by Chairman, State Emergency Management Committee, The Displan was prepared by the North West Metropolitan District Emergency Management Committee in compliance with Section 23 (1) of the State Emergency and Rescue Management Act, 1989, (as amended). The Parramatta LGA is one of the LGAs covered by this plan.

The Plan details emergency preparedness, response and recovery arrangements for the North West Metropolitan Emergency Management District, Local Emergency Management Areas and local government. It recognises that many of the details contained in the plan are similar to those contained in Local Plans and therefore this Plan may be utilised and applied at a local level in conjunction with a Local Displan.

The Plan's aim is to ensure a controlled response to emergencies by all agencies having responsibilities and functions in emergencies, (Section 12 (2) of the SERM Act), and it reflects and applies in conjunction with arrangements agreed to at State level and detailed in the State Disaster Plan

5.3 Parramatta DISPLAN

The Parramatta Disaster Plan (DISPLAN) released in 2010 details arrangements for preparing for, responding to and recovering from emergencies within the City of Parramatta.

As described in the plan, *it encompasses arrangements for:*

a) Incidents controlled by combat agencies.
b) Emergencies controlled by combat agencies and supported by the Local Emergency Operations Controller.
c) Emergency operations for which there is no combat agency.
d) Circumstances where a combat agency has passed control to the Local Emergency Operations Controller

The area covered by the plan comprises the whole of the City of Parramatta.

The Plan is based upon operation during both normal business hours and outside of normal business hours and takes into consideration special events that may from time to time operate outside and during normal business hours.

Transportation of people will be by either government/private transport or by private vehicle, with numbers and method dependant on circumstances and location of emergency.

Each agency with a statutory role has in place arrangements which detail that agency's response.

Each Emergency Service Organisation and Functional Area has in place an appropriate supporting plan/operational procedures which detail that agency's response.

It is expected that in the Parramatta CBD that Building Owners, Managers and Tenants will be provided with education regarding their responsibilities in both evacuation and general building emergency management. It is accepted that all buildings where required will have in place a practised Emergency Management Plan in line with AS 3745 and as per NSW OH&S Regulation 2001

Section 23 of the DISPLAN discusses evacuation as follows:

23. EVACUATION

a) The LEOCon, in consultation with the Combat Agency, will determine the need for evacuation.
b) Police will control and coordinate the evacuation of persons to the chosen Safe site or marshalling point and supervise disaster victim registration.
c) Transport resources will be arranged through and coordinated by the transport functional area coordinator, if private vehicles are not available.
d) The LEOCon will determine, in consultation with the Combat Agency, when return of evacuees is possible.

Concept of Operations

The evacuation process is based on a 5 stage process

i) Decision to Evacuate
ii) Warning
iii) Withdrawal
iv) Shelter
v) Return

The concept of operations for an emergency in the Parramatta CBD can be summarised as:

Emergency occurs or is imminent in the CBD:

Buildings may/may not begin self evacuation due to the emergency;
Public transport systems are disrupted, resulting in Transport/Traffic plans being enacted to provide an emergency service;
Emergency Service Agencies begin deployment in accordance with normal arrangements;
An area requiring Evacuation is identified;
When deemed safe to do so, "return" advised through Displan arrangements, and may include some caveats;
Throughout, the Emergency Services and Functional Area agencies continue to deal with the particular emergency.

Withdrawal

If there is a decision to evacuate, or a self-evacuation commences, there is a need to follow a process to move people to a place of safety while the status of the transport system is assessed and arrangements are made to move people out of the Parramatta CBD.

The withdrawal stage for the CBD is based on the following philosophy.

Building to Assembly Area (covered by individual building evacuation plans)
Assembly Area to Safe sites in accordance with the CBD evacuation plan or this plan (based on building location) OR
Safe sites in accordance with the CBD evacuation plan or this plan

Control Measures

For the purpose of this plan, the Parramatta CBD has been divided into three (3) zones (refer to map on Annexure 2)

- *Ollie Webb Reserve*
- *Macarthur Girls High School*
- *Parramatta Golf Course*

In the event of an emergency which severely disrupts transport and requires an evacuation of an area of the CBD, the control arrangements will recommend business and residents to either:

Stay at Work

This is used for all areas of the CBD (and surrounds) where the public are not directly threatened by the emergency. It may also imply that public transport may be affected and/or may not be available. This message is intended to stop or reduce the incidence of the public rushing to transport sites or exiting by private vehicles, thus allowing time for transport/traffic services to be re-established.

Stay at Work protocols assist in achieving a desired response for business and residents in the areas of the CBD unaffected by the emergency, such as:

To carry on normal business;
Advise staff and others on their site that an emergency has resulted in a disruption to public and private transport, and to allow for communication updates.

Shelter in Place

This is used when it is assessed that for safety of the occupants of a building(s) or for control reasons, it is safer for occupants to remain in the building than to be on the streets. The time required to Shelter in Place will depend on the nature of the emergency.

CBD Residents/Permanent and Temporary

People who live in the area to be evacuated and those from temporary accommodation (hotels etc), will be directed to an Evacuation Centre (Refer to Parramatta Displan Sections 6.8. 1) and if necessary to temporary accommodation under the control of the Department of Community Services as per DISPLAN arrangements.

Commuters

People who are evacuated to their residence (as per a normal business day) will not receive further specialist management under this Annexure once their journey has concluded.

Evacuate to Safe Sites or Evacuation Centres

This is used as a control measure to identify those areas that require evacuation for safety and/or control reason. It is the intent to minimize the area of the CBD that is evacuated, noting that some emergencies may require the evacuation of some sections or large sections, if not all of the CBD.

People evacuated to Parramatta safe site will be requested to:

> *Remain in position until further information is available, or*
> *Make their way to other parts of the city and delay their journey home, or Make their way to specific transport terminals for movement out of the city, or Identify themselves if they have specific needs or Move to an Evacuation Centre, or Combinations of the above.*

Support will be provided to people in Safe Sites or Evacuation Centres in accordance with this plan.

Return

LEOCON, in consultation with the combat agency and/or Functional Area, if applicable, will allow the area to be reoccupied when it is safe to do so in accordance with this plan

Building Owners and Managers

It is accepted that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

It is expected that all building Emergency Management Plans are to contain details of the most relevant Parramatta Safety Site. All wardens trained under the building emergency plan are to be aware of the Parramatta Safety Sites, routes to the site and how to liaise with the building occupants at the site.

It is accepted that all building Emergency Management Plans are to contain detail of how the information regarding an evacuation will be disseminated from the Chief Warden to occupants of the building.

It is noted that a copy of the Parramatta CBD Evacuation Plan was not located in the time available to prepare this advice.

It is noted also that the 2010 Parramatta DISPLAN, states in part that:

i) the intent is to minimize the area of the CBD that is evacuated, noting that some emergencies may require the evacuation of some sections or large sections, if not all of the CBD; and
ii) shelter in place is used when it is assessed that for safety of the occupants of a building(s) or for control reasons that it is safer for occupants to remain in the building than to be on the streets.

It is expected that this is also the intent for the all other areas within the LGA outside the CBD.

5.4 Local Plan

The 2010 Parramatta DISPLAN states that there are no sub-plans or supporting plans.

5.5 Sizing Temporary Flood Refuge

Two primary sources of information were located when considering the size of a temporary flood refuge:

- Building Code of Australia (BCA, 2008)[1]
- US Flood Emergency Management Authority (FEMA, 2000)[2].

As outlined above, the Building Code of Australia (2008) stipulates that an area of public assembly such as halls or theatres should have a maximum density of 1 m^2 per person (BCA, 2008). FEMA, 2000 recommends a minimum of 0.45 m^2 per person for tornado shelters.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place.

Based on the estimated peak number of persons that could be at risk in the car park and on the Ground Floor commercial office(s) the estimated maximum area of refuge required is 62 m^2.

It is expected that this refuge would be provided by the communal area on Level 4 which exceeds the required area of refuge.

[1] Building Codes of Australia (2008 Edition). *Part D Access and Egress. D1.13 Number of Persons Accommodated*

[2] FEMA (2000) *Design and Construction Guidance for Community Shelters*, Federal Emergency Management Agency, Mitigation Directorate, FEMA361, 1st Ed., July 2000

6 Flood Emergency Response

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers (in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations) are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

6.1 Flood Warning

Discussions with the NSW SES have previously identified the following status of flood warnings for the Parramatta CBD:

- The Bureau of Meteorology does not prepare flood predictions for the Parramatta River;
- Only a Draft Flood Warning Plan has been prepared to date by the NSW SES. This draft was prepared a number of years ago and while it is planned that it will be updated this does not have a high priority in view of the level of flood protection in the Parramatta CBD that has been achieved by various works undertaken in the upper catchment including the Loyalty Road basin.
- Trigger levels for flood warning have not been identified for the Parramatta CBD

Other sources of information regarding approaching severe weather conditions which could cause potential flooding at the site including:

- The Bureau of Meteorology through their website (www.bom.gov.au);
- Observation of local rainfall;
- The local SES (http://parramatta-ses.com);
- Parramatta City Council Emergency Management Officer;
- Local television stations; and/or
- Local radio stations.

An important indication of likely imminent flood activity would be intense local rainfall and residents, retail workers and visitors should take notice of extreme rainfall warnings issued by the Bureau of Meteorology and disseminated by local media.

6.2 Draft Flood Emergency Detailed Response Plan

Flood Threat

The site is not inundated by floodwaters in a 100 yr ARI event and is only subject to inundation in extreme flood events approaching the PMF.

The proposed floor levels for the development are:

- Basement Level 4 Car Park: -3.5m AHD;
- Basement Level 3 Car Park: -0.5 m AHD
- Basement Level 2 Car Park: +2.5 m AHD;
- Basement Level 1 Car Park: +5.5 m AHD
- Basement Car Park driveway crest level: +9.0 m AHD

- The ground floor level for commercial office(s): +9.0 m AHD
- The floor levels for Levels 1-57 are all above the PMF level.

The indicative magnitudes of flood events in Clay Cliff Creek which would initiate over-floor inundation of the ground floor and the driveway are as follows:

- The ground floor level for retail outlets: +9.0m AHD (around 280,000 yr ARI)
- Basement Car Park driveway crest level: +9.0m AHD (around 280,000 yr ARI)

Responsibilities

In a flood emergency the NSW State Emergency Service (SES) has responsibilities including to:

- Direct the evacuation of persons and/or communities at risk of flood inundation.
- Issue evacuation warnings for individual communities that describe possible local effects, suggested actions and evacuation arrangements.

The building on-site manager shall liaise with the SES, monitor flood warnings and maintain regular communication with staff, workers and residents.

Preparedness

Visitors, retailers, workers and residents shall be advised of the potential flood threat in their locality, and recommended management and evacuation procedures in case of a flood event. They will comply with all lawful directions.

It is recommended that a practice evacuation drill or meeting is organised by management for retail staff and residents every 2 years.

Response

While in a flood event, the SES will prepare, authorise and distribute evacuation warnings it is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any residents, workers and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

Warning

The SES will advise regarding potential evacuations of properties. While in a flood event, the SES will prepare, authorise and distribute evacuation warnings it is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

Recovery

The SES will issue an ‘all clear’ message when the immediate danger to life and property has passed.

7 Assessment of Council Requirements

7.1 Parramatta DCP 2011

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. The development is located almost wholly in a Low Flood Risk Precinct (refer **Figure 15**).

Consequently the development has been assessed against the planning and development controls that apply to "Residential" in a Low Flood Risk Precinct. These controls are identified in **Table 3** and are discussed as follows.

Floor Levels

2. *Habitable floor levels to be equal to or greater than the 100 year ARI flood level plus freeboard*

   The proposed floor level of the Ground Floor retail outlets is 9.0 m AHD which provides which provides 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change.

5 *A restriction is to be placed on the title of the land, pursuant to S.886 of the Conveyancing Act, where the lowest habitable floor area is elevated more than 1.5 m above finished ground level, confirming that the subfloor space is not to be enclosed.*

   This requirement is not applicable to the planning proposal.

Table 3 PCC Floodplain Matrix

Table 2.7: FLOODPLAIN MATRIX

Planning & Development Controls

Planning Consideration	Flood Risk Precincts (FRP's)																										
	Low Flood Risk									Medium Flood Risk									High Flood Risk								
	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development
Floor Level		3			2, 5	2, 5	2, 5							2, 5	2, 5	2, 5	1, 5	4, 5								1, 5	4, 5
Building Components		2												1	1	1	1	1								1	1
Structural Soundness		2												1	1	1	1	1								1	1
Flood Affectation		2	2	1	2	2	2					1		1	1	1	2	1								1	1
Car Parking & Driveway Access		1, 3, 5, 6			1, 3, 5, 6	1, 3, 5, 6	1, 3, 5, 6	2, 4, 6, 7						1, 3, 5, 6, 7	1, 3, 5, 6, 7	1, 3, 5, 6, 7	2, 4, 6, 7	1, 5								2, 4, 6, 7	1, 5
Evacuation		2, 4, 6	5		3, 4	4	4					5, 3, 4		3, 4, 6	3, 4, 6	3, 4, 6	1, 4	3, 6								1, 4	3, 4 6
Management & Design		2, 3, 4	1									1		2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4								2, 3, 4	2, 3, 4

Not Relevant Unsuitable Land Use * For redevelopment of an existing dwelling refer also to ' Concessional Development' provisions

i. Freeboard equals an additional height of 500mm.

ii. The Parramatta LEP 2011 identifies development permissible with consent in various zones. 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 Clause 6.7 Foreshore Building Line in the Parramatta LEP 2011.

Floor Level	
1	All floor levels to be equal to or greater than the 20 year Average Recurrence Interval (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 Probable Maximum Flood (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 alternations 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	An engineers report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year ARI flood level plus freeboard.
2	An engineers report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF level.
Flood Affectation	
1	An engineers report is required to certify that the development will not increase flood affectation eleswhere, 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 cumulate 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 is to demonstrate the development is consistent with any relevant flood evacuation strategy or similar plan.
5	Applicant is 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 is 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 is 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.

Flood Affectation

2 *The impact of the development on flooding elsewhere to be considered having regard to the three factors listed in consideration 1 above.*

This report satisfies this requirement. See following

1 *An engineer's report is 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 cumulate impact of multiple potential developments in the vicinity.*

It is concluded that the planned development has a negligible impact on 100 year ARI levels.

In the PMF there is a small local increase in the PMF level upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 20 Parkes Street. It is concluded that the planned development has a small adverse impact on PMF levels upstream of 24 Parkes Street.

It is further concluded from the negligible impact of the proposed development on design flood levels that additional compensatory flood storage is not necessary as part of this development.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity opposite 114 Harris Street and slightly increases the peak velocity in Parkes Street in the vicinity of 24-28 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 24 Parkes Street the velocity x depth in a PMF adjacent to the site in Parkes Street increases slightly. In a PMF the planned development locally decreases the flow velocity x depth in the northern section of 22 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

The cumulate impact of multiple potential developments in the vicinity has been previously represented in the floodplain model assembled during the 2005 Lower Parramatta River Floodplain Study and is already incorporated in the resulting flood levels adopted by Council.

The cumulative impact of the proposed development of 24 Parkes Street, 26-30 Parkes Street and 114-118 Harris Street was also undertaken.

It is concluded that the planned cumulative development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels upstream of 24 Parkes Street.

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.*

   This requirement is not applicable to the proposed development.

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 0.5 m above the 100 year ARI flood level.*

   The proposed development complies with this requirement.

5. *The level of the driveway providing access between the road and parking spaces shall be no lower than 0.2 m below the 100 year ARI flood level.*

   The proposed development complies with this requirement.

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.*

   These systems and information are to be incorporated in the building emergency plan.

Evacuation

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.*

   It is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any workers, residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place. Under these circumstances the expected time that visitors and/or residents would need to shelter in place during a PMF would be around 1 hours 15 minutes (ground floor) while the car park entry at Harris Street (at 9.0 m AHD) would be inundated for up to 1 hours 15 mins.

4 *Applicant to demonstrate the development is consistent with any relevant flood evacuation strategy or similar plan.*

   Discussed in Section 5 of this report.

It is concluded that the merit assessment detailed above and the recommendations given in Section 6 satisfy the requirements of the Parramatta DCP 2011.

8 Summary and Conclusions

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 24 Parkes Street, Parramatta. The subject site is located on the Clay Cliff Creek floodplain upstream of Harris Street.

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising four levels of basement car parking, four level of above ground parking, 4 levels of commercial retail outlets, 50 levels of residential apartments, one level of communal area and open space and two levels of sky gardens..

The flooding assessment methodology is outlined as follows:

- Impact of planned development on flooding
- Climate change impact on flooding
- Flood emergency response
- Flood warning and evacuation
- A draft emergency response plan
- Compliance with requirements of Parramatta DCP 2011

8.1 Previous Flood Assessments

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

8.2 Flood Impact Assessment

The assessment of the impact or otherwise of development on 24 Parkes Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

Flood models were established for the existing site conditions and future developed scenarios. The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by Zhinar Architects (attached in **Appendix C**).

Flood modelling was completed for the 100 year ARI, and Probable Maximum Flood events.

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2166) adopted by Council:

- 100 year ARI: 6.23 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.35 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.23 m AHD.

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively. It is concluded that the planned development has a negligible impact on 100 year ARI levels.

In the PMF there is a small local increase in the PMF level upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 20 Parkes Street. It is concluded that the planned development has a small adverse impact on PMF levels upstream of 24 Parkes Street.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity opposite 114 Harris Street and slightly increases the peak velocity in Parkes Street in the vicinity of 24-28 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 24 Parkes Street the velocity x depth in a PMF adjacent to the site in Parkes Street increases slightly. In a PMF the planned development locally decreases the flow velocity x depth in the northern section of 22 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High while in Parkes Street adjacent to the site it is Low. The impact of the planned development on provisional hazard on adjoining properties is negligible.

8.2.1 Flood Risk Precinct

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. The site is mapped as Low Flood Risk with a very minor area of Medium Flood Risk along the northern site boundary based on the XP-SWMM 1D/2D results. The site would be also mapped as Low Flood Risk with a very minor area of Medium Flood Risk along the northern site boundary based on mapped extents of 100 yr ARI flooding and hazard as given in Council's Flood Map attached in **Appendix B**. The section of Parkes Street adjoining the property would be also mapped by Council as Low Flood Risk.

8.2.2 Rate of Rise of Floodwaters

Features of the planned development include:

- Ground levels which vary from 8.96 m AHD in the southwest corner to 6.84 m AHD in the northeast corner of the property;
- Proposed ground floor level for the commercial uses of 9.0 m AHD which provides which provides 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level for commercial uses of 14.5 m AHD which is higher than the PMF level;
- Proposed floor levels for two additional levels of commercial uses which are all significantly higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 9.0 m AHD which provides 2.77 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 2.45 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor commercial office(s) has a freeboard of around 2.77 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 3 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 9.0 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 4 hours 45 minutes after start of the PMP storm.

Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill the three lowest levels of the car park to a depth of 0.9 m and to completely full is around 24-26 minutes and around 32-40 minutes respectively. The estimated times it would take to fill the upper level of the basement car park to a depth of 0.9 m and to completely full is around 42 minutes and around 65 minutes respectively.

8.3 Emergency Planning

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

A draft Emergency Response Plan is outlined.

8.4 Flood Emergency Response

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place. Based on the estimated peak number of persons that could be at risk in the car park and in Ground Floor the estimated maximum area of refuge required is 62 m^2. It is expected that this refuge would be provided by the communal area on Level 4 which exceeds the required area of refuge.

8.5 Assessment of Council Requirements

The development is located almost wholly in a Low Flood Risk Precinct. Consequently the development has been assessed against the planning and development controls that apply to “Residential” in a Low Flood Risk Precinct.

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. An assessment of the compliance of the proposed development with Council’s requirements is given in Section 7 of this report.

It is concluded that the assessment and details in this Flood Impact Assessment satisfy the requirements of the Parramatta DCP 2011.

9 References

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24 Parkes Street, Harris Park

APPENDIX A
FIGURES

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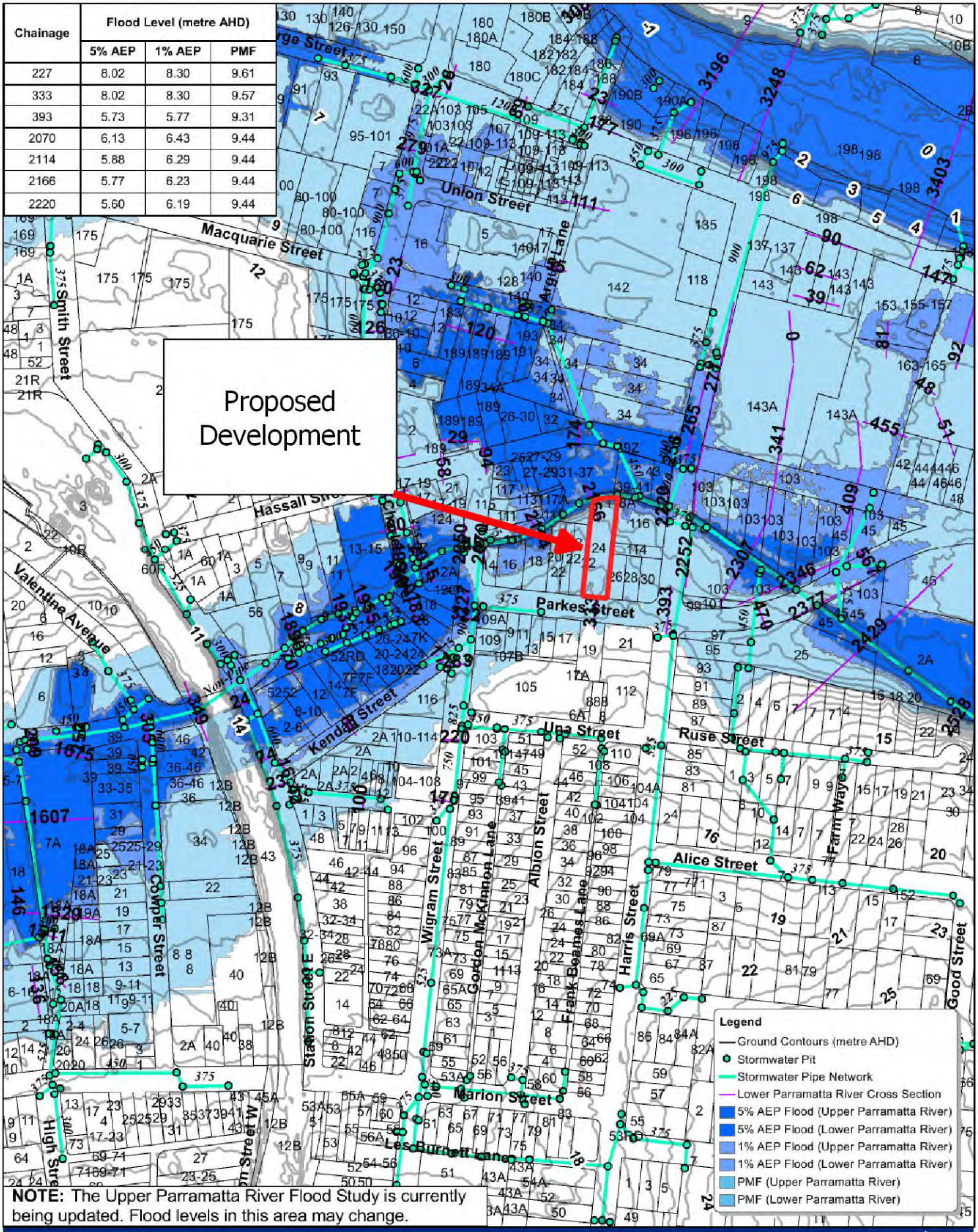

Figure 1 Locality Plan (Source: Parramatta City Council Flood Map)

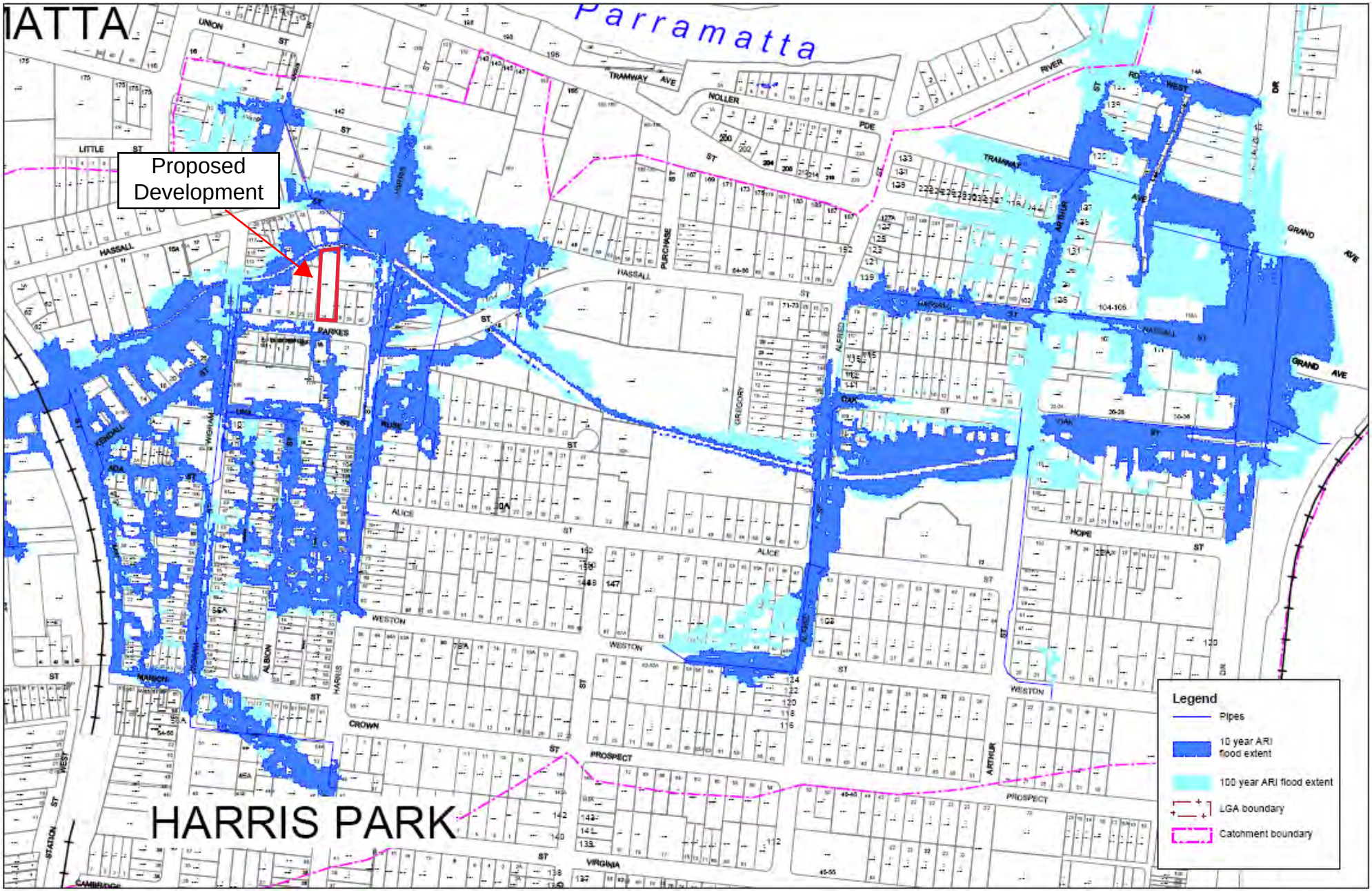

Figure 2 10 yr ARI and 100 yr ARI flood extents – Clay Cliff Creek (after Cardno Willing, 2007)

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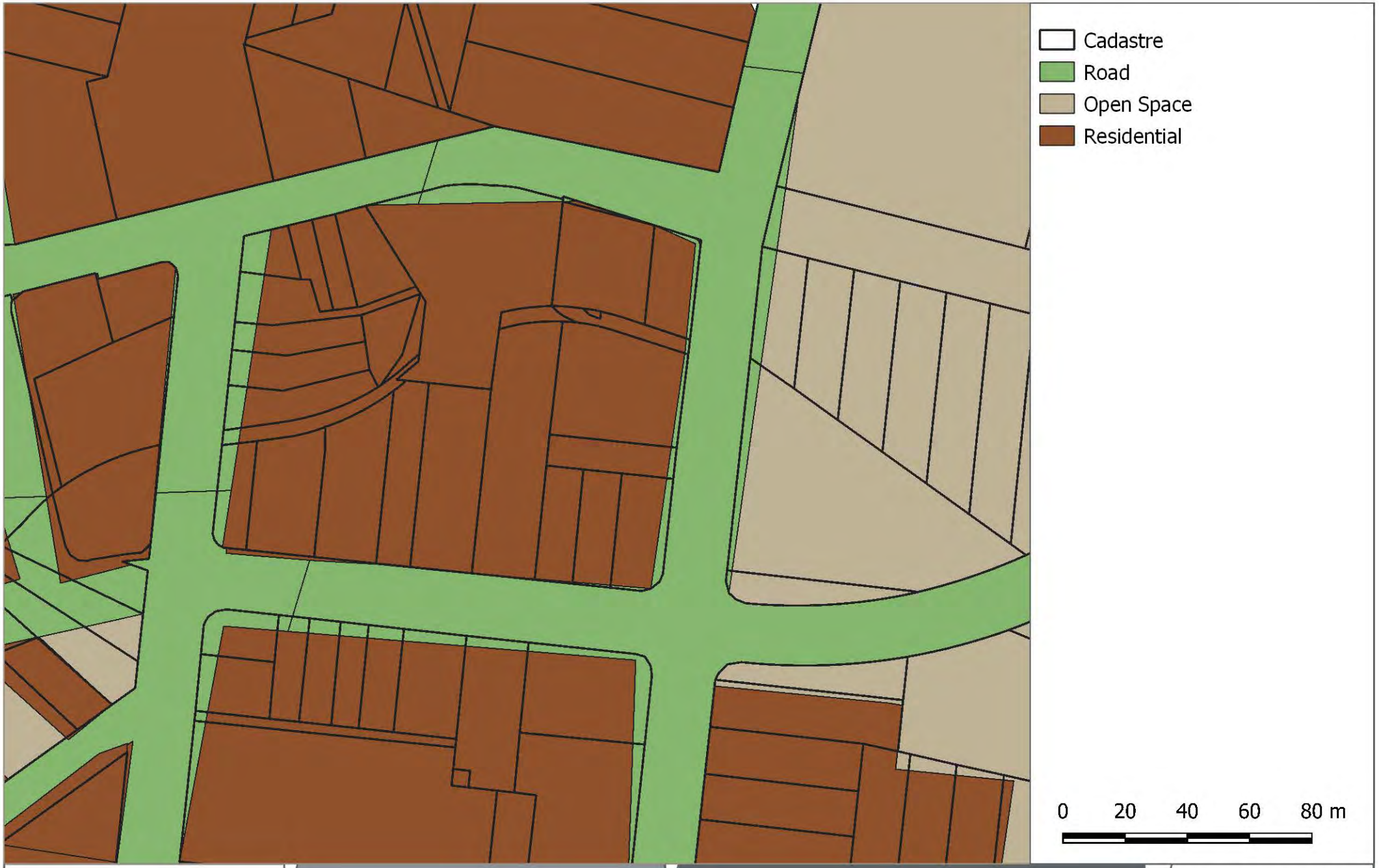
24 Parkes St

Existing Conditions

Figure 3

Floodplain Terrain

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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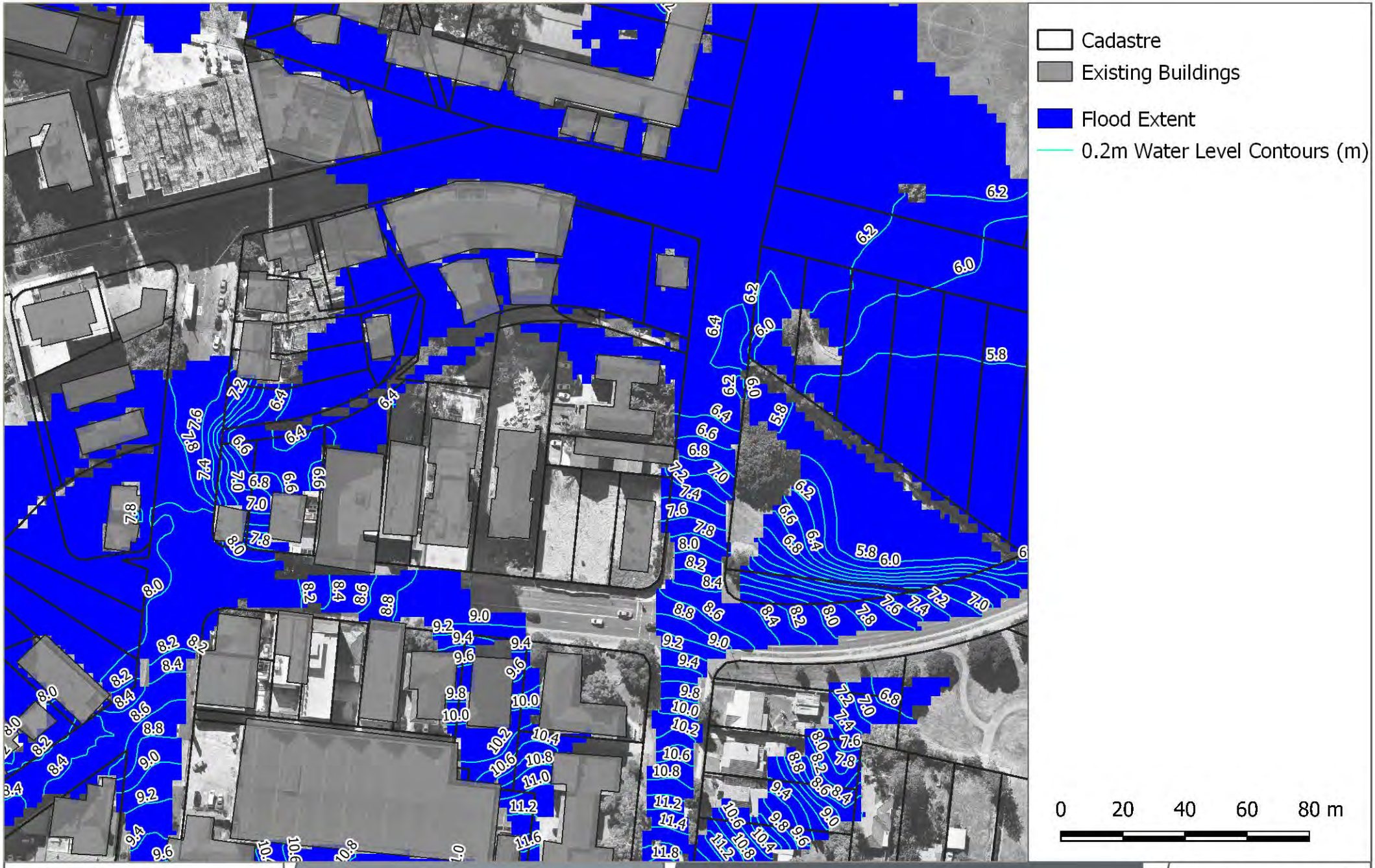
24 Parkes St
Existing Conditions

Figure 4
Floodplain Roughness

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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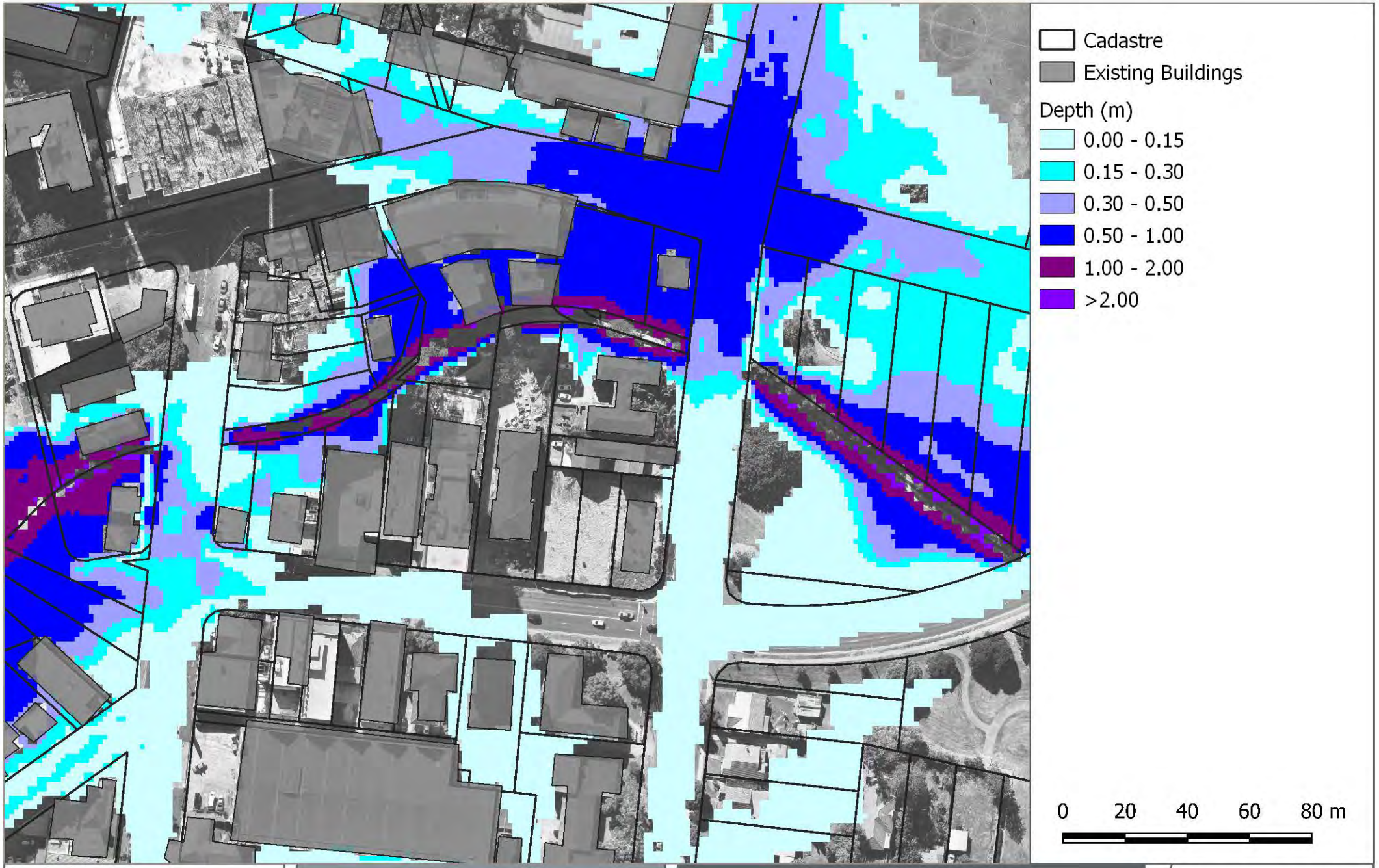
24 Parkes St
Existing Conditions

Figure 5
1% AEP Flood Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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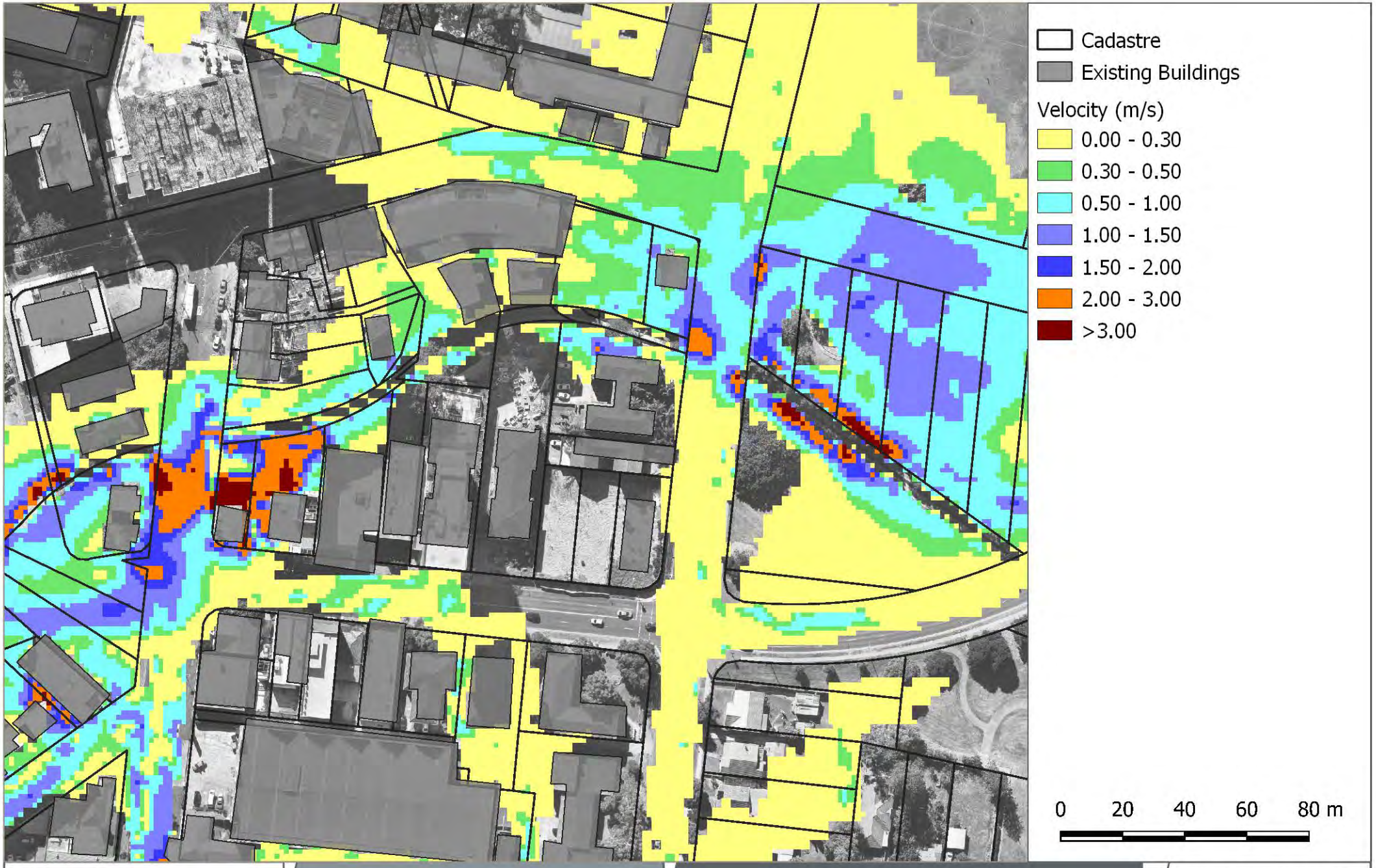
24 Parkes St

Existing Conditions

Figure 6

1% AEP Peak Flood Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
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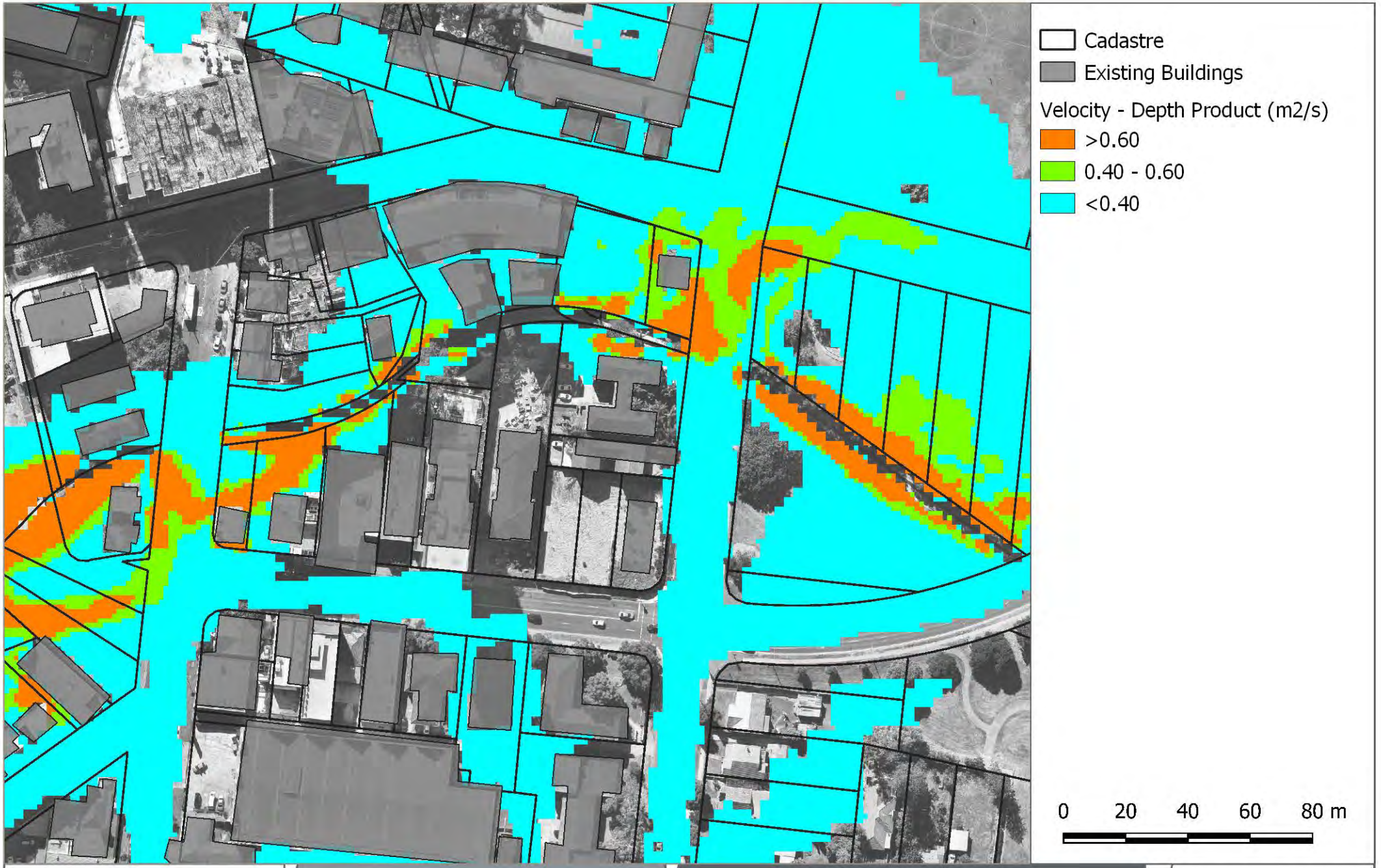
24 Parkes St
Existing Conditions

Figure 7
1% AEP Peak Flood Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
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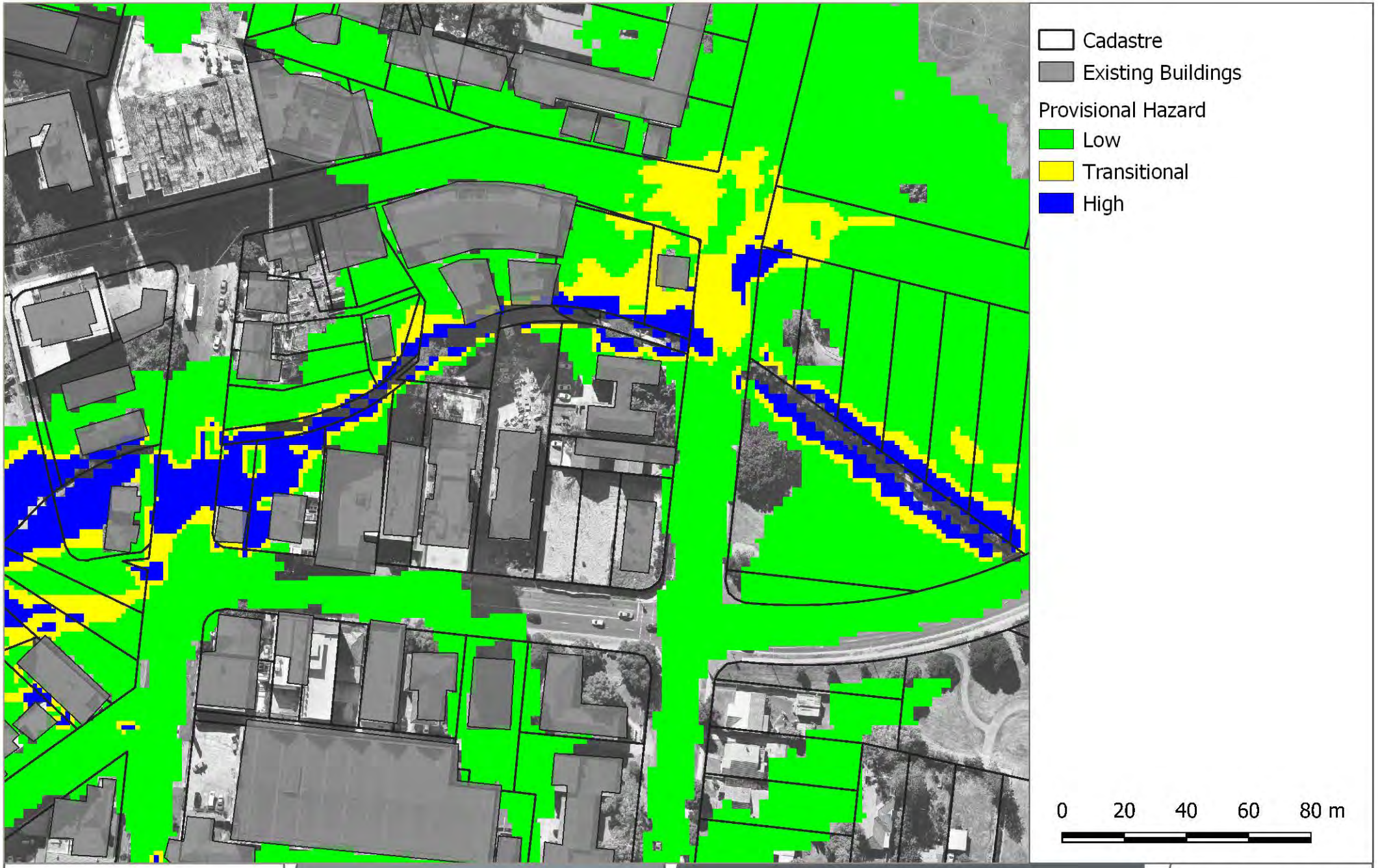
24 Parkes St
Existing Conditions

Figure 8
1% AEP Peak Flood Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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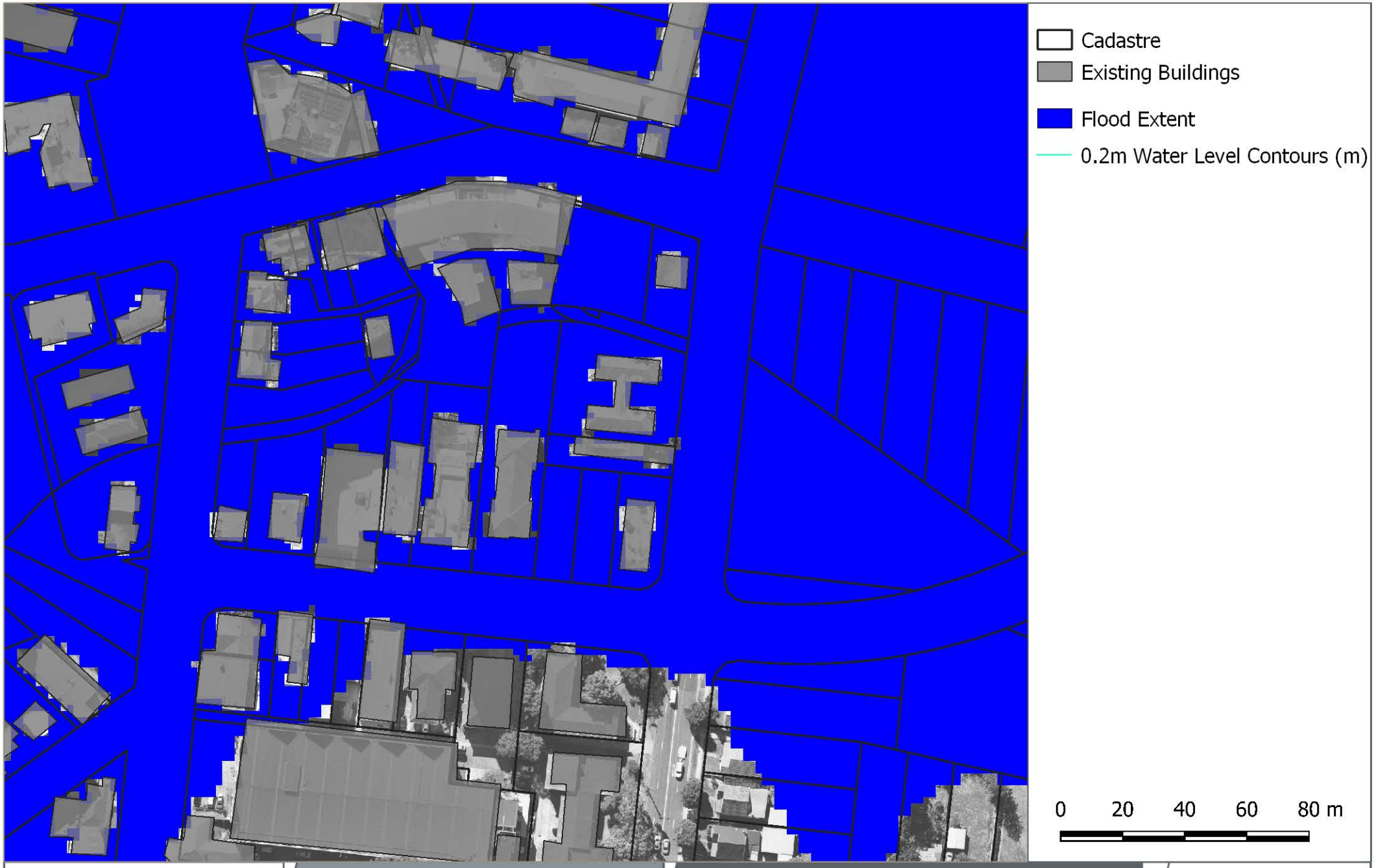
24 Parkes St
Existing Conditions

Figure 9
1% AEP Peak Flood Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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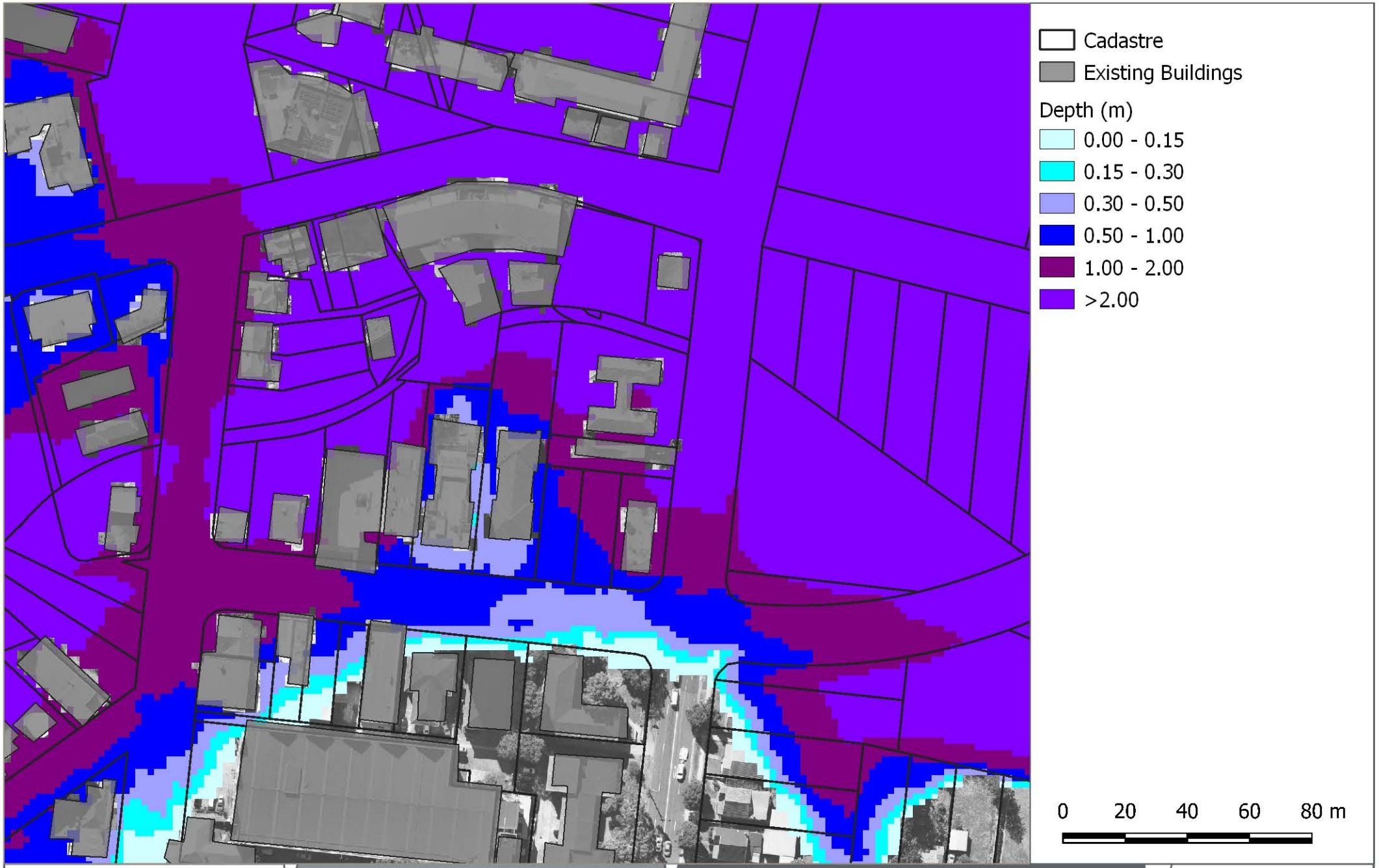
24 Parkes St

Existing Conditions

Figure 10

PMF Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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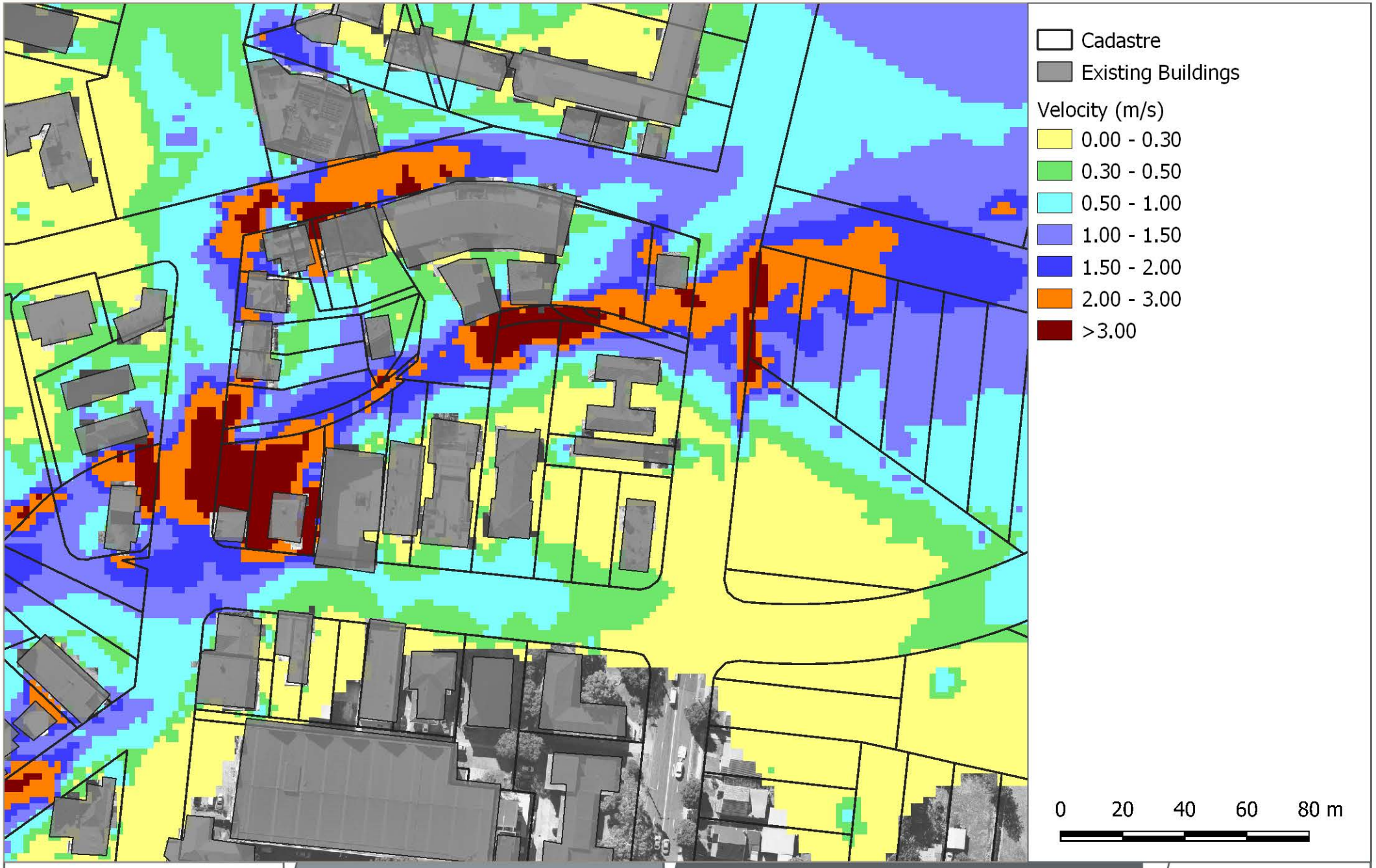
24 Parkes St
Existing Conditions

Figure 11
PMF Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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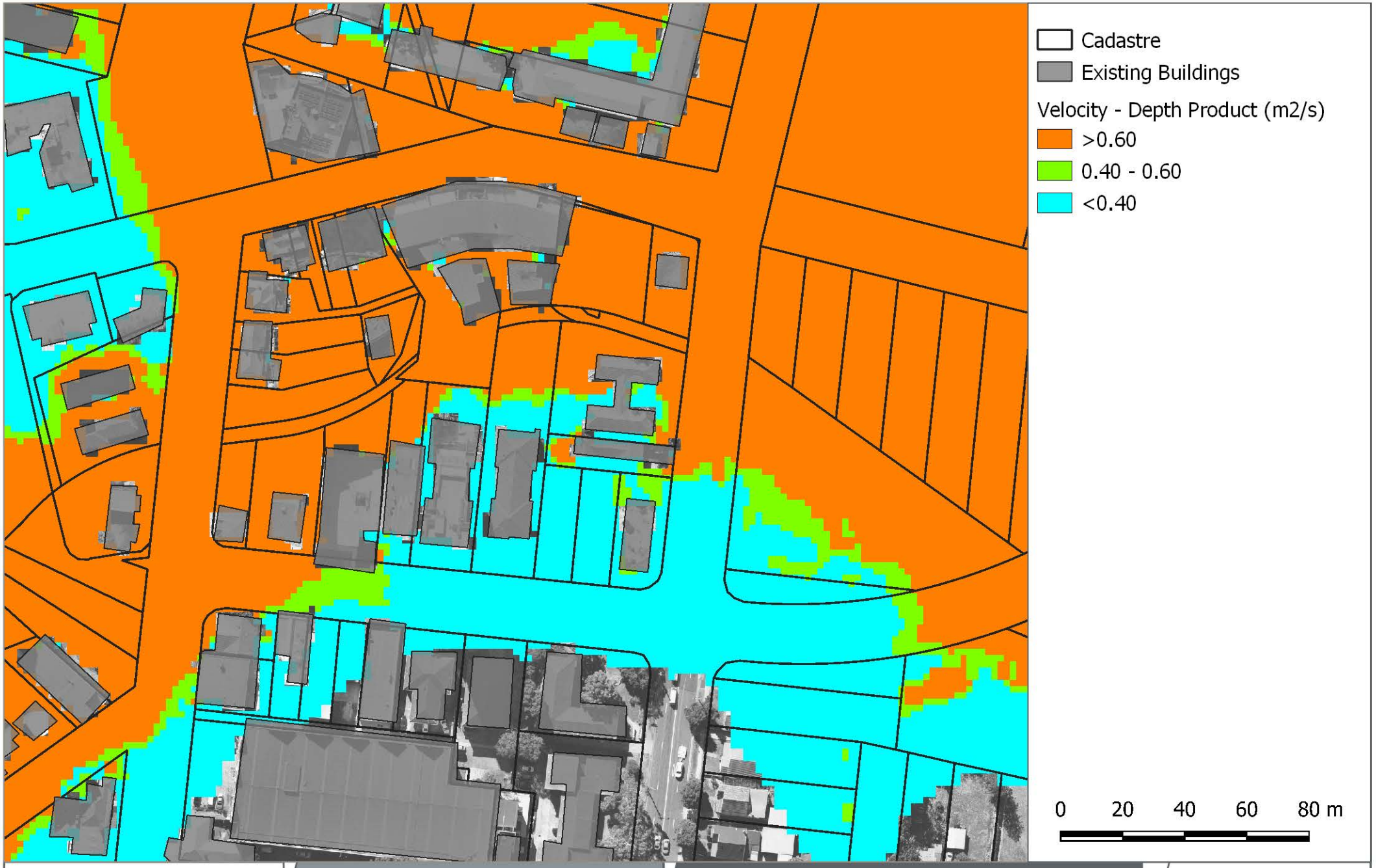
24 Parkes St
Existing Conditions

Figure 12
PMF Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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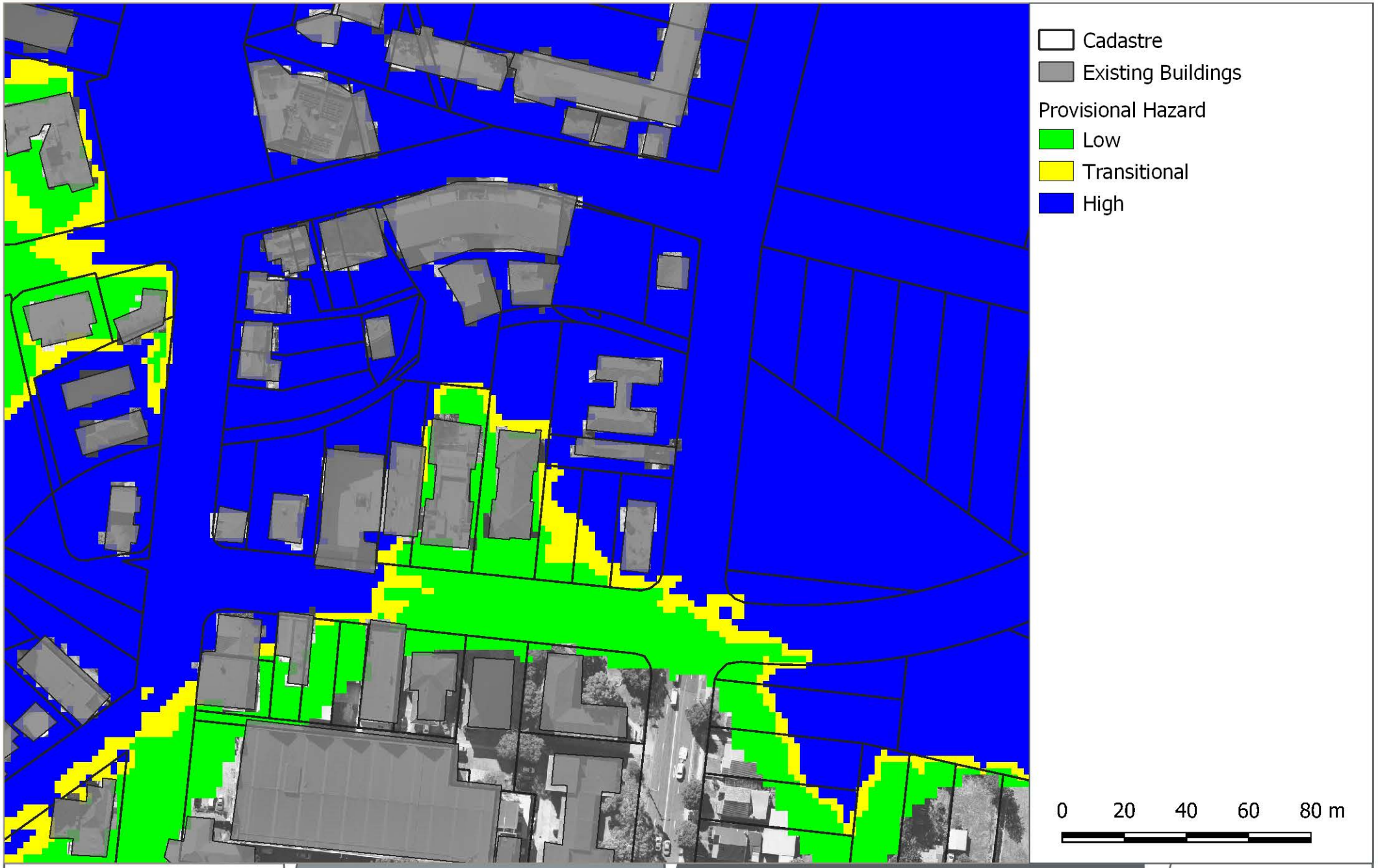
24 Parkes St

Existing Conditions

Figure 13

PMF Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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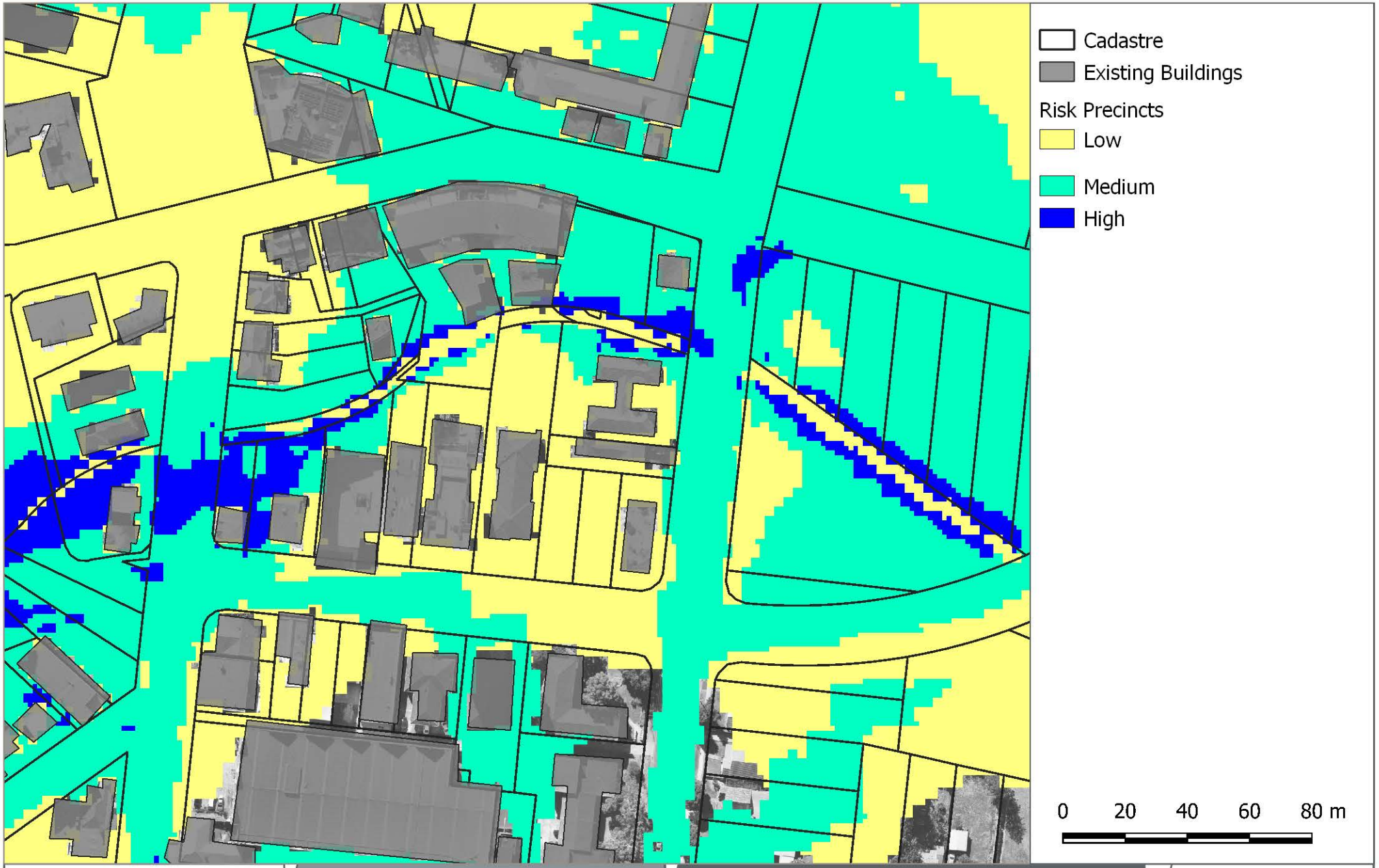
24 Parkes St

Existing Conditions

Figure 14

PMF Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
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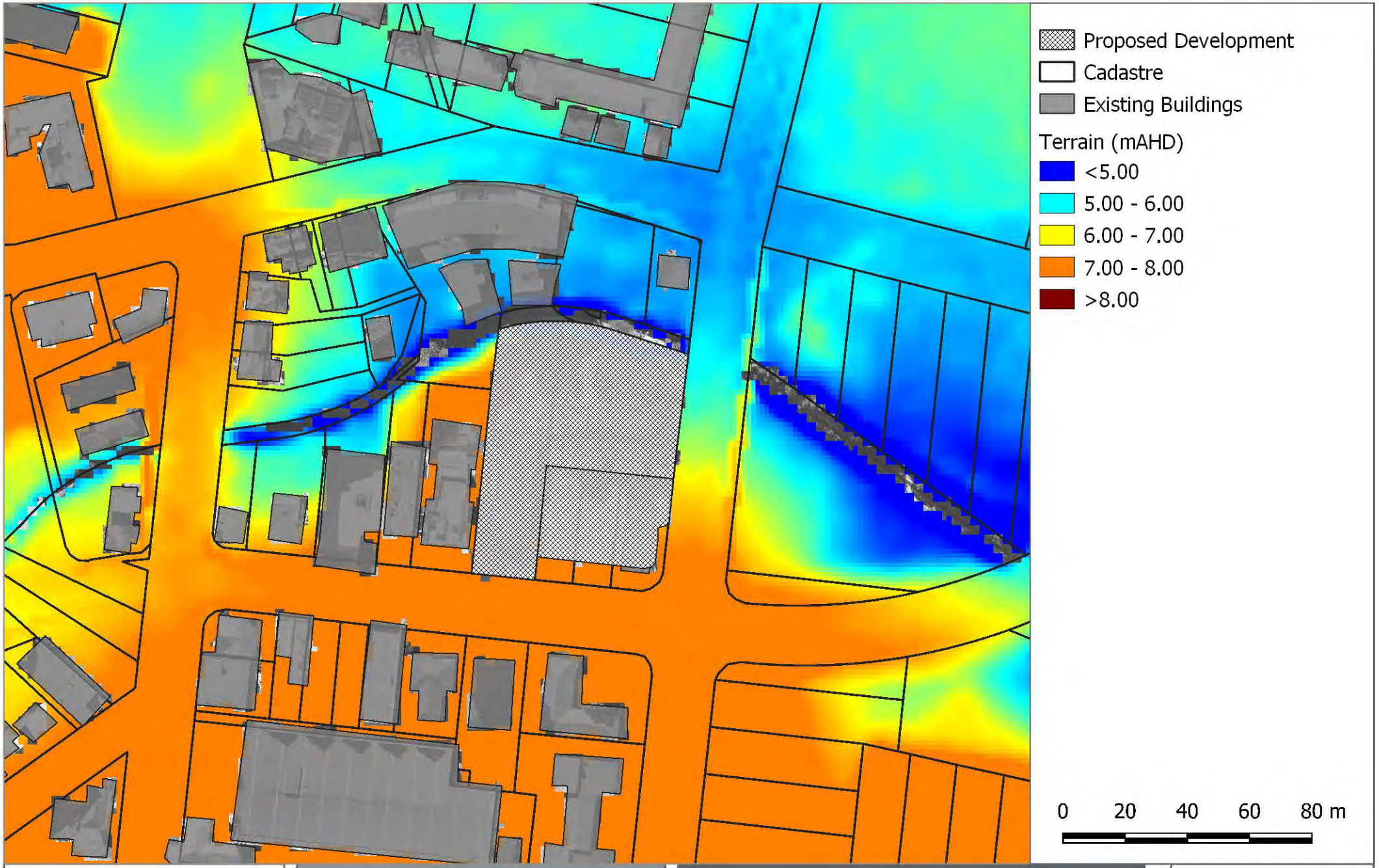
24 Parkes St
Existing Conditions

Figure 15
Flood Risk Precincts

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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24 Parkes St

Future Conditions

Figure 16

Cumulative Floodplain Blockages and Terrain

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170

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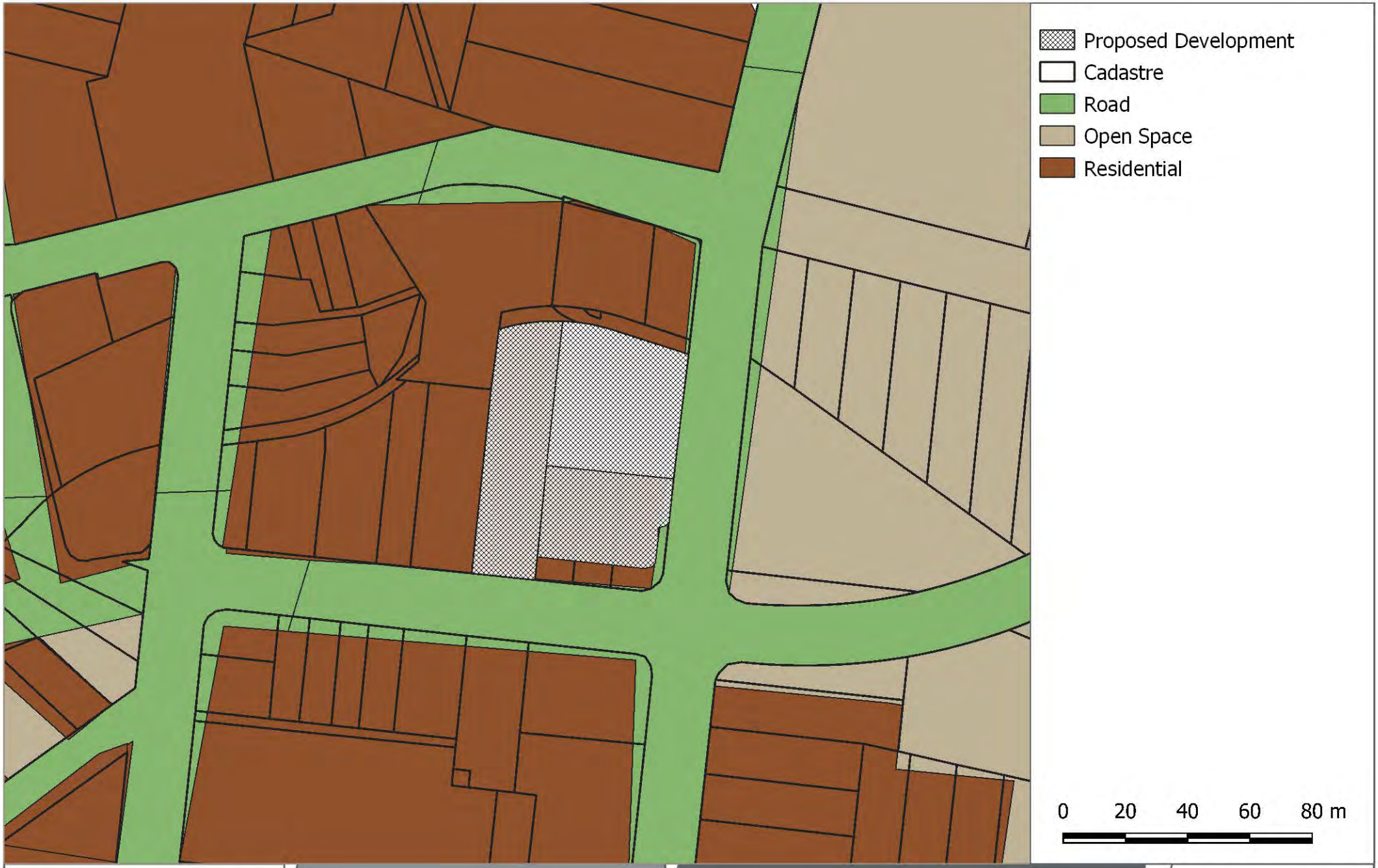
24 Parkes St

Future Conditions

Figure 16

Floodplain Terrain

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



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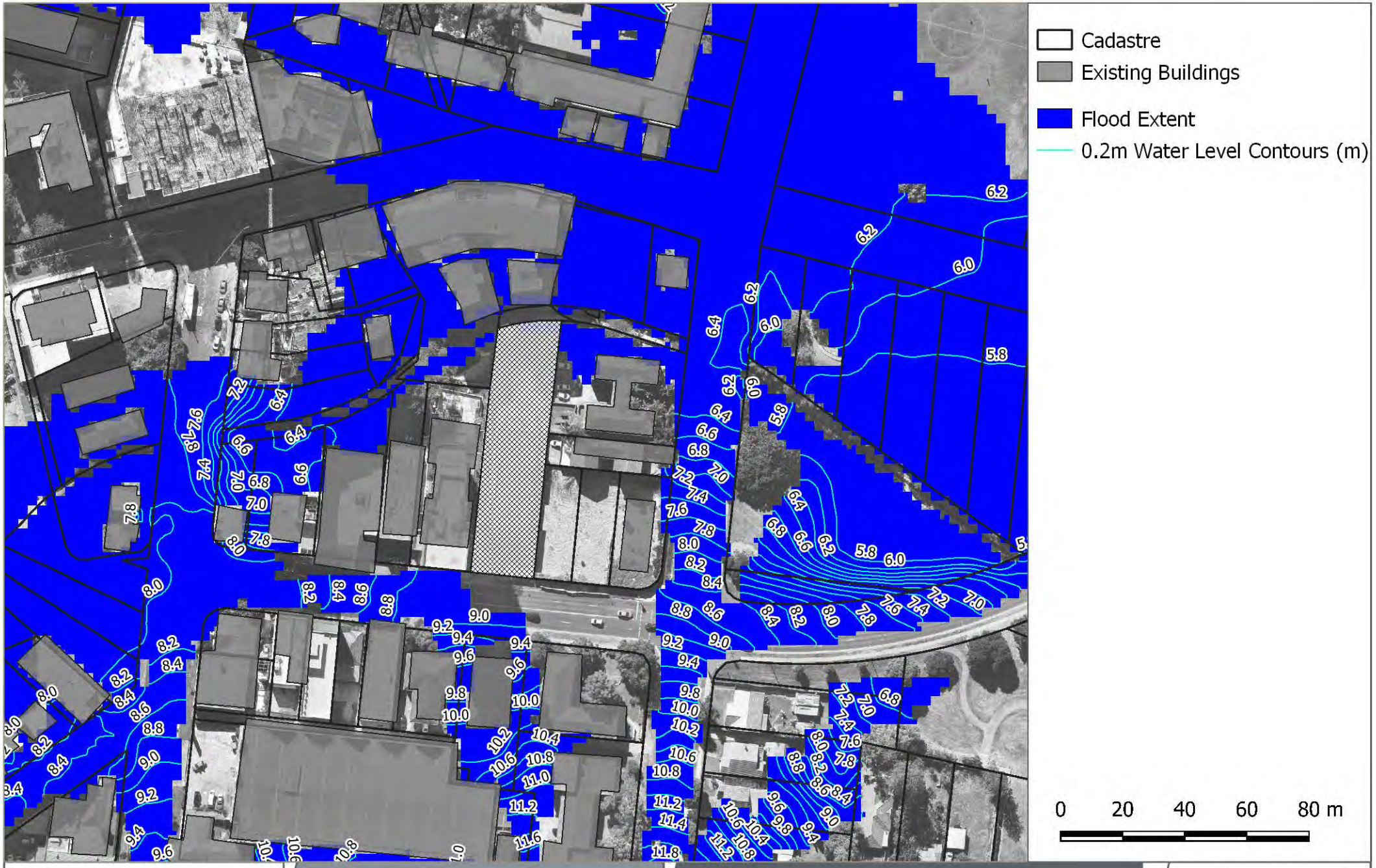
24 Parkes St
Future Conditions

Figure 17
Floodplain Roughness

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
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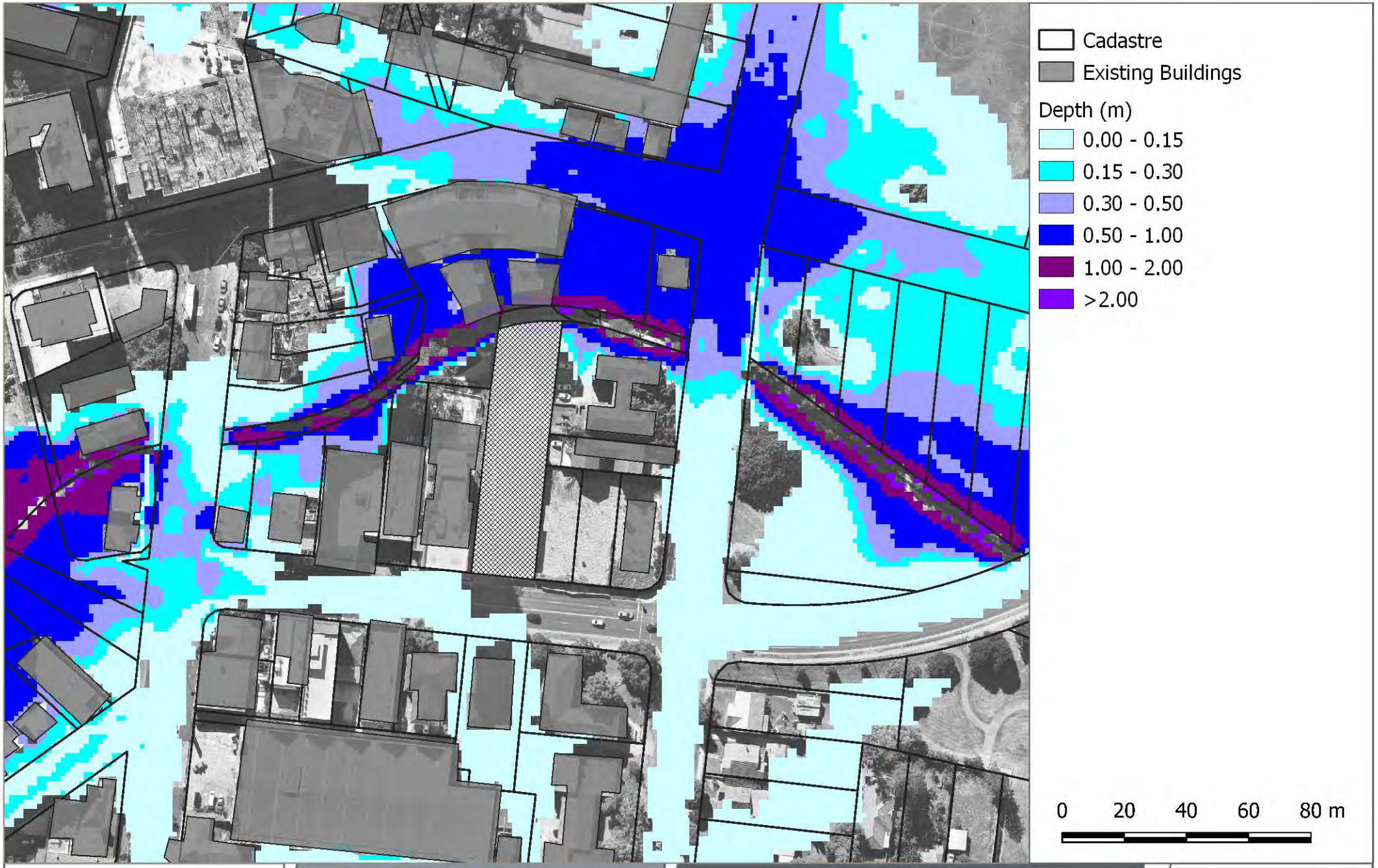
24 Parkes St
Future Conditions

Figure 18
1% AEP Flood Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

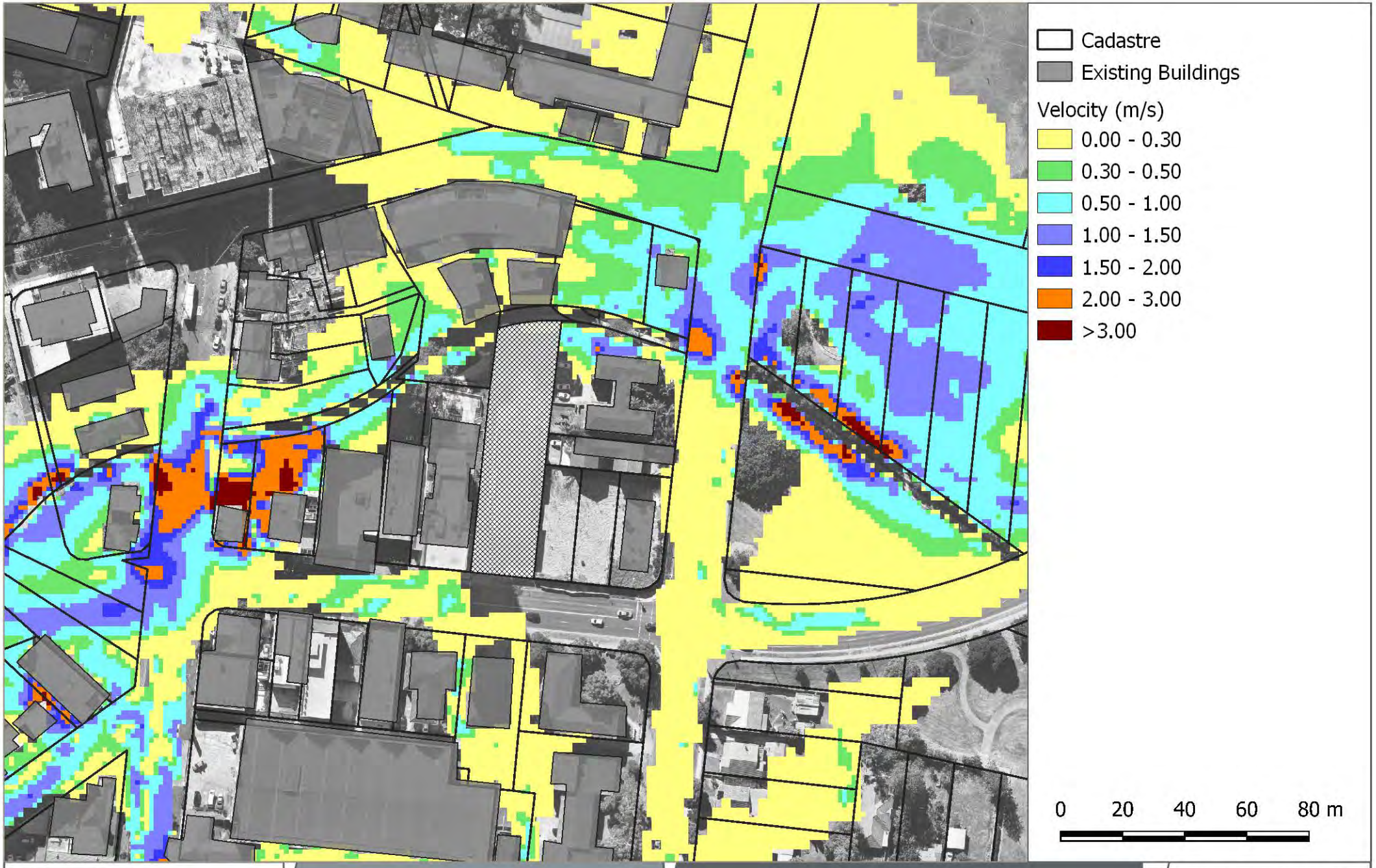
24 Parkes St

Future Conditions

Figure 19

1% AEP Peak Flood Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

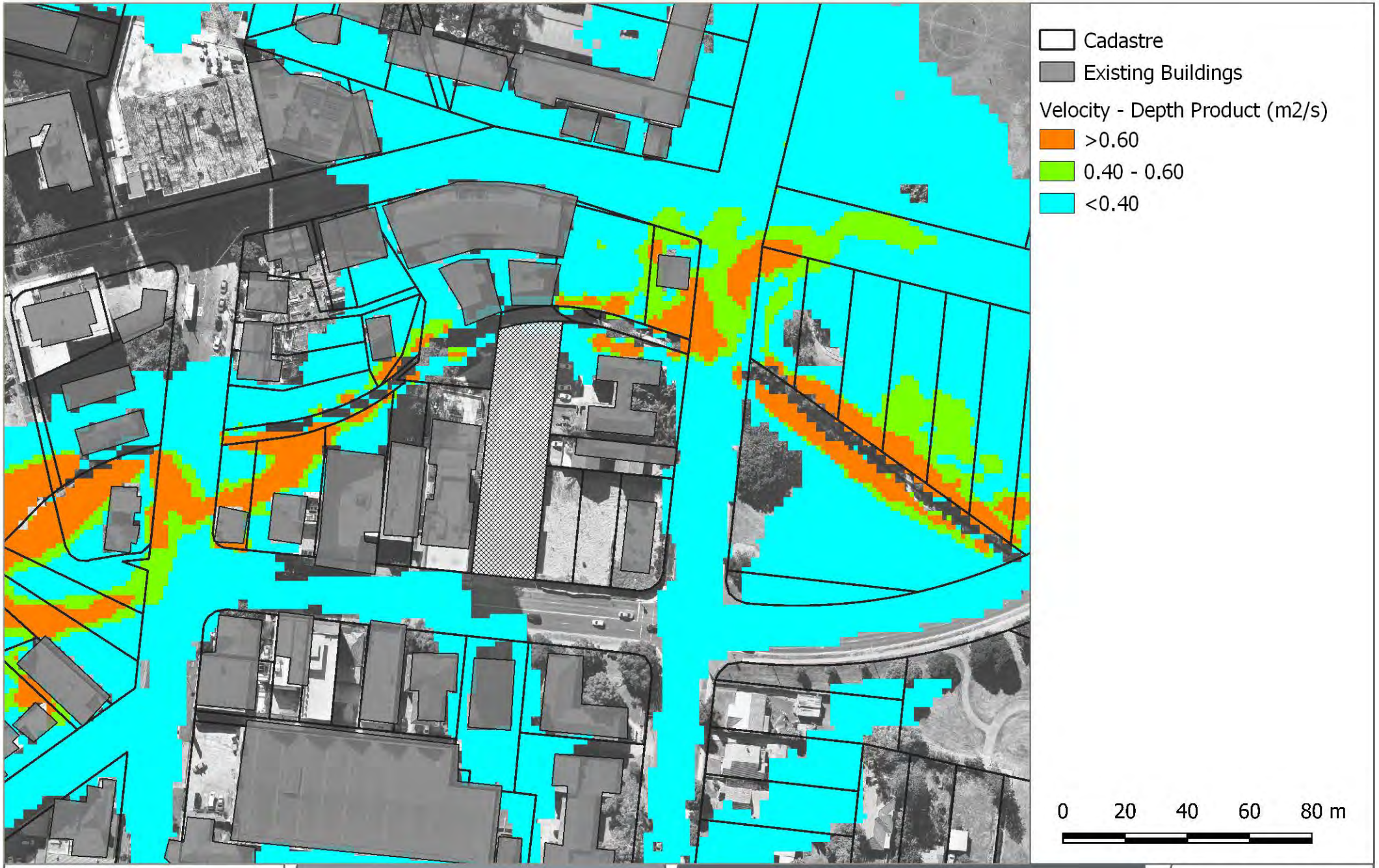
24 Parkes St

Future Conditions

Figure 20

1% AEP Peak Flood Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

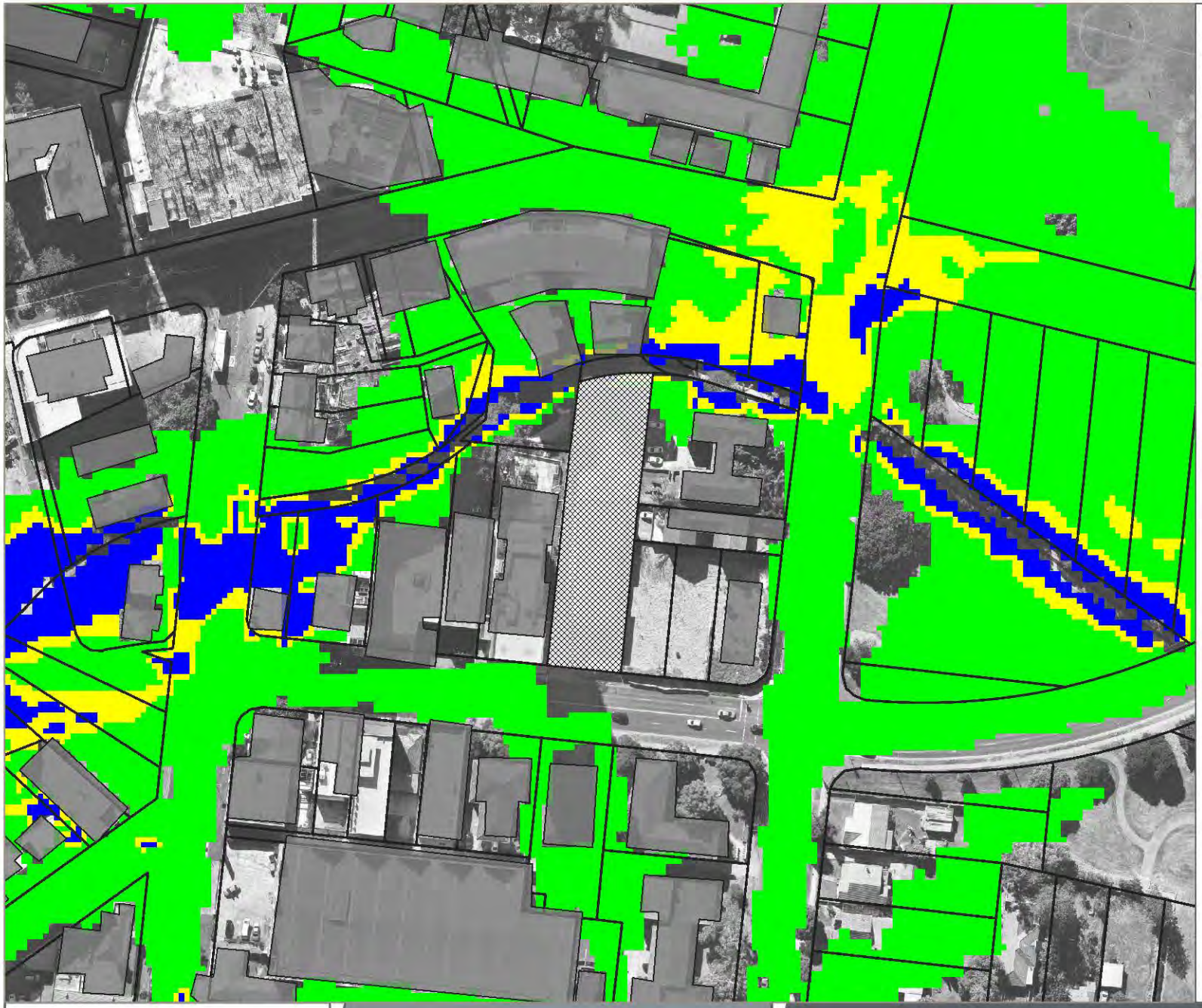
24 Parkes St

Future Conditions

Figure 21

1% AEP Peak Flood Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

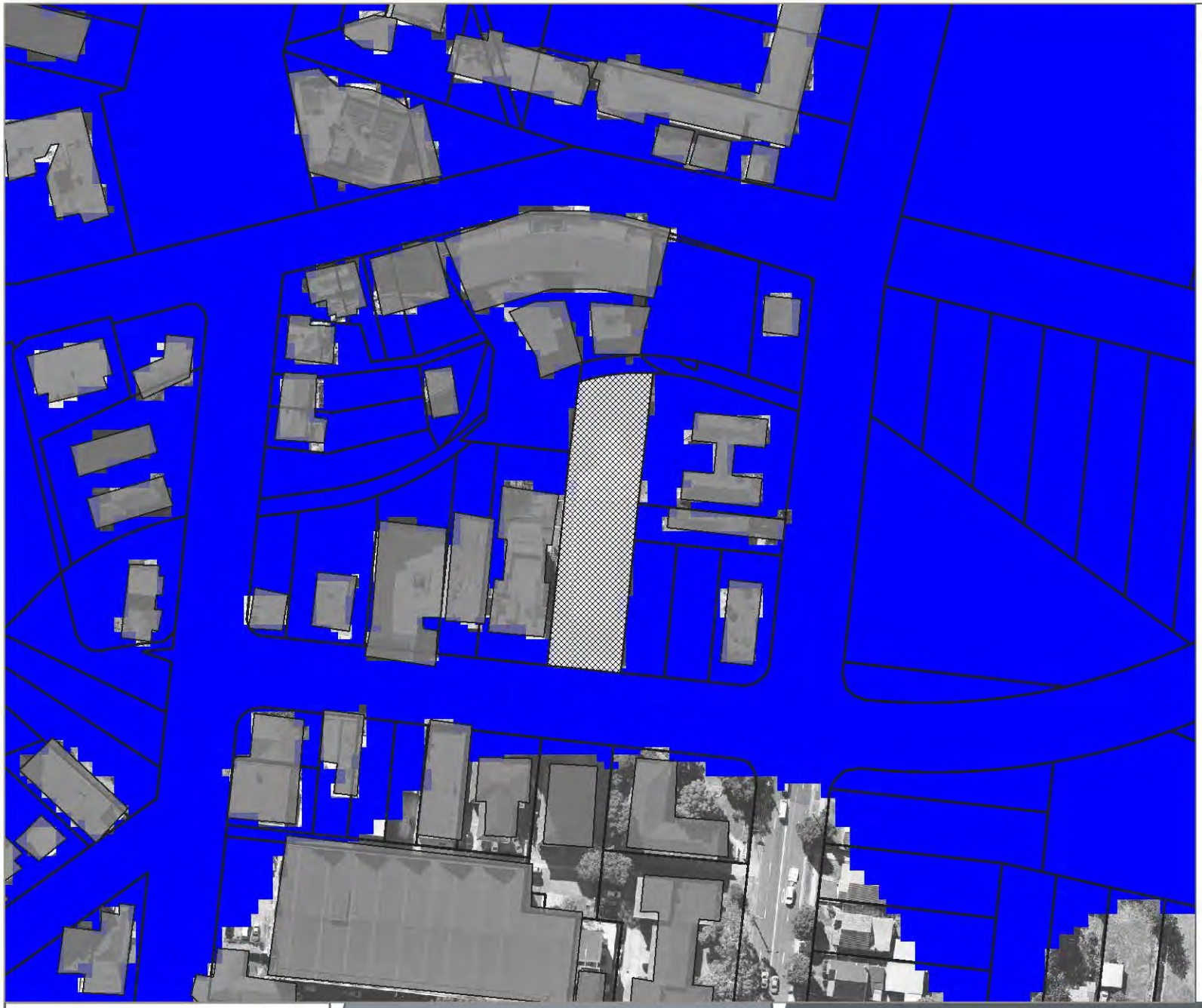
24 Parkes St

Future Conditions

Figure 22

1% AEP Peak Flood Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170

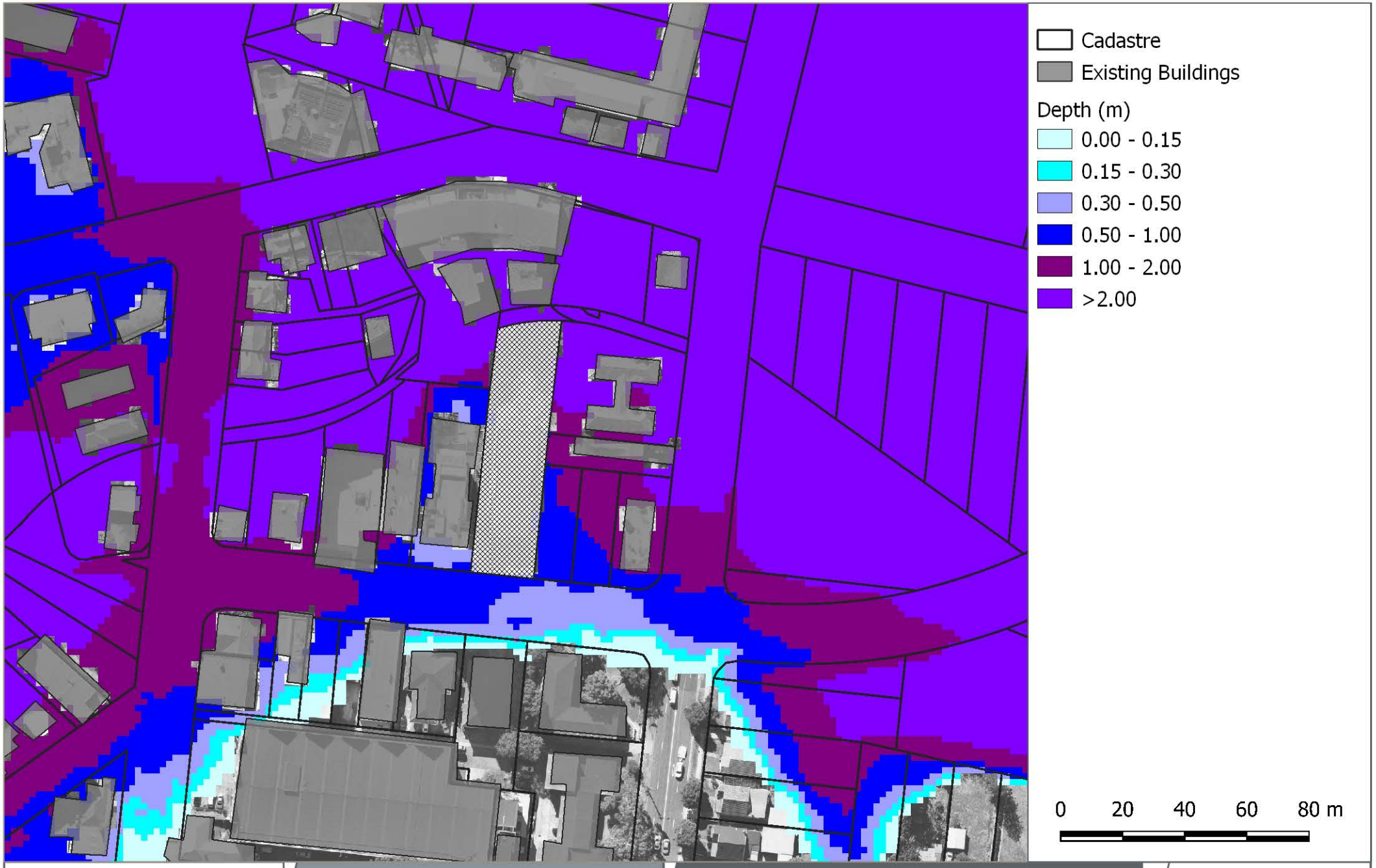


Cardno
Shaping the Future

24 Parkes St
Future Conditions

Figure 23
PMF Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

24 Parkes St

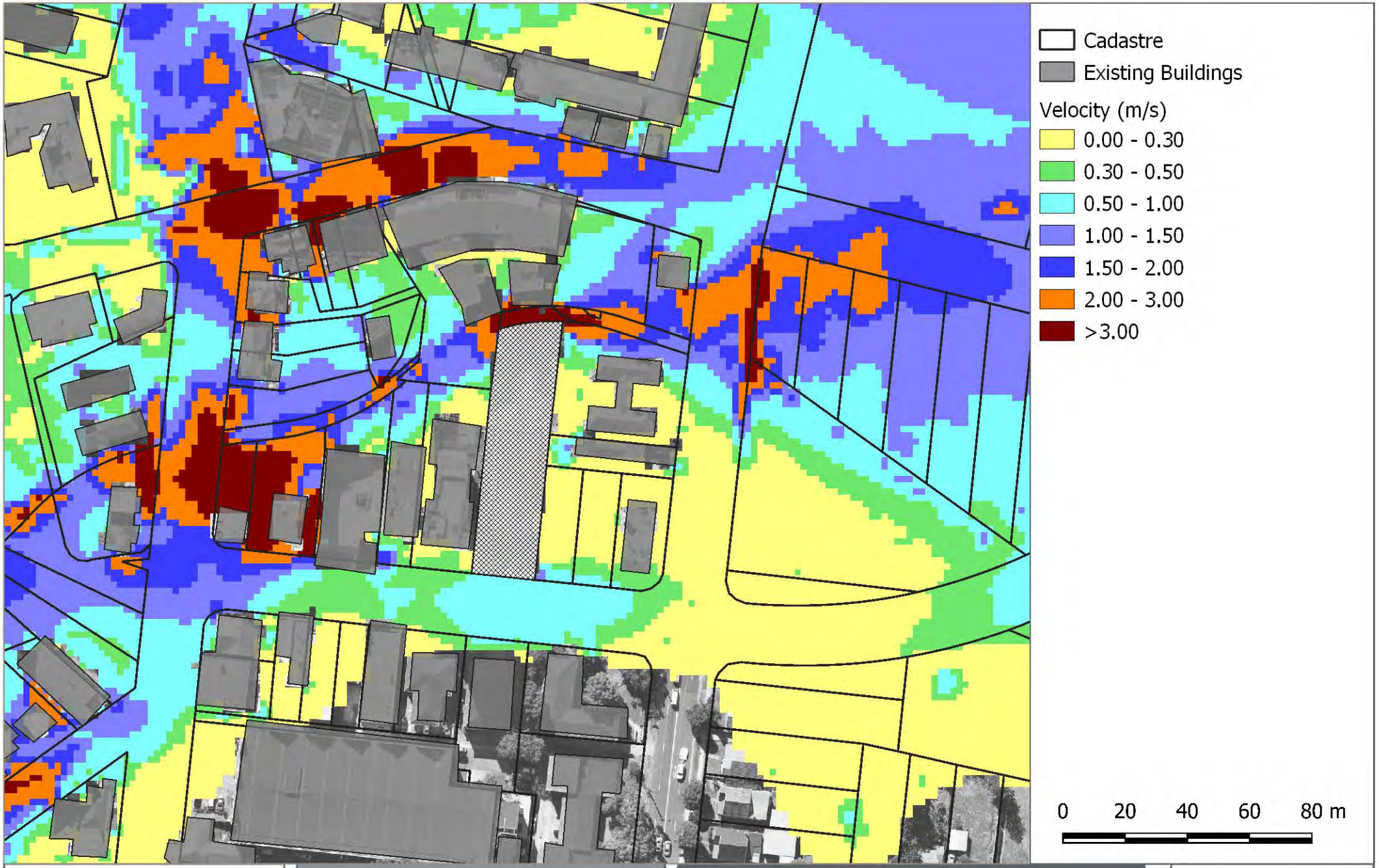
Future Conditions

Figure 24

PMF Depths

N

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

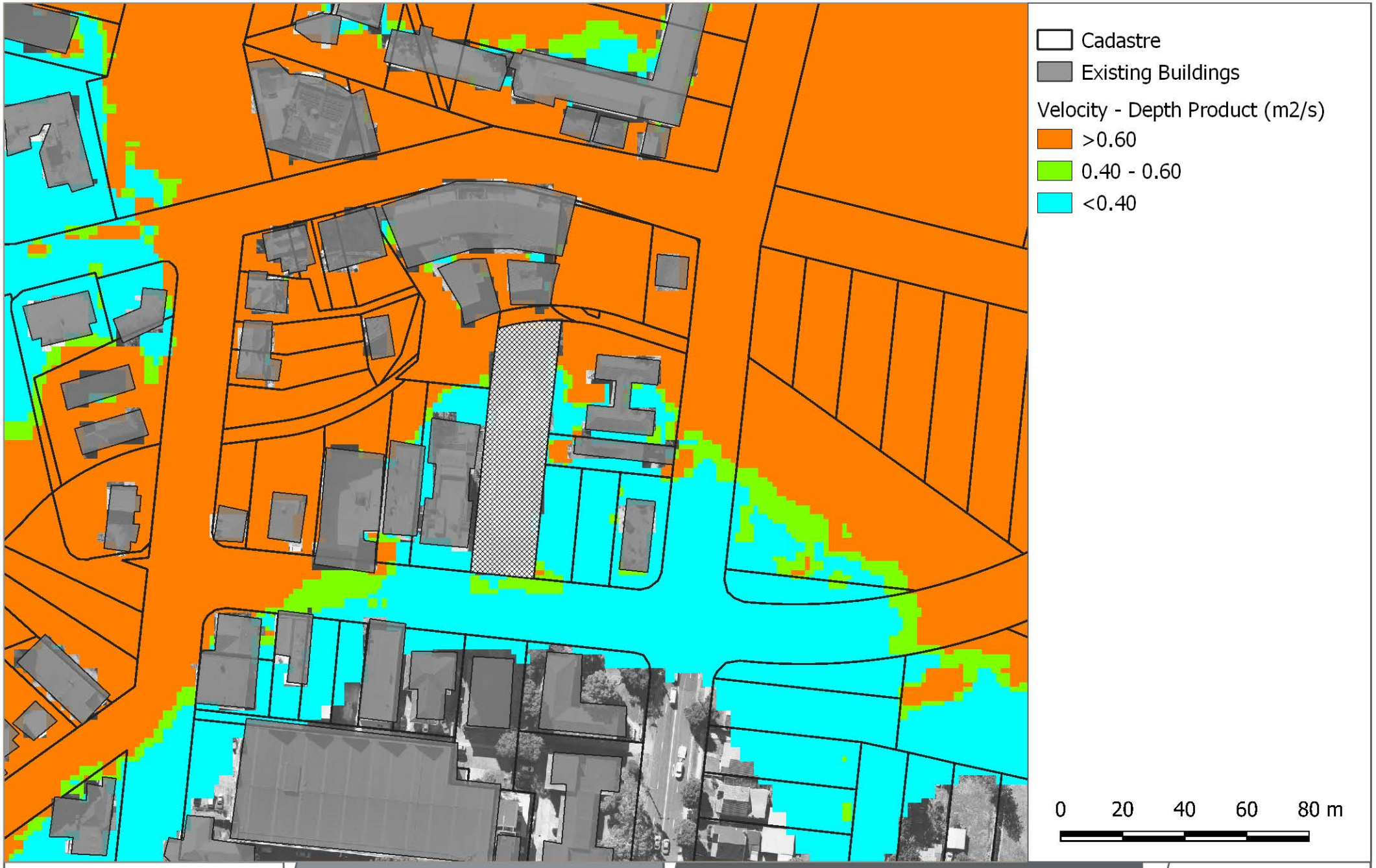
24 Parkes St

Future Conditions

Figure 25

PMF Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

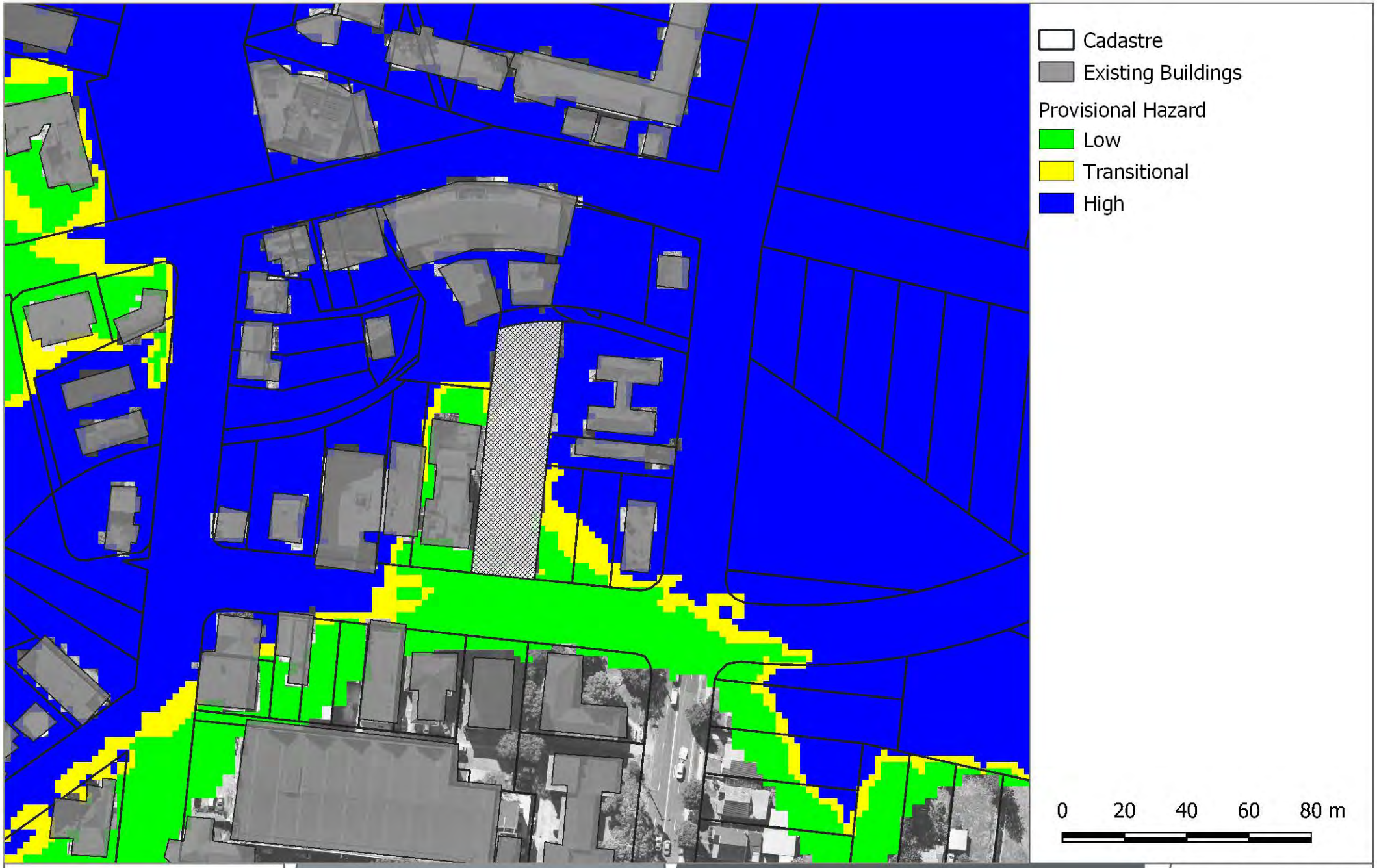
24 Parkes St

Future Conditions

Figure 26

PMF Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

24 Parkes St
Future Conditions

Figure 27
PMF Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918170

Cadastre
Existing Buildings

Water Level Difference (m)
>0.10
0.05 to 0.10
0.03 to 0.05
0.02 to 0.03
0.01 to 0.02
-0.02 to -0.01
-0.03 to -0.02
-0.05 to -0.03
-0.10 to -0.05
<-0.10

Wet & Dry Analysis
Was Wet, Now Dry
Was Dry, Now Wet

0 20 40 60 80 m

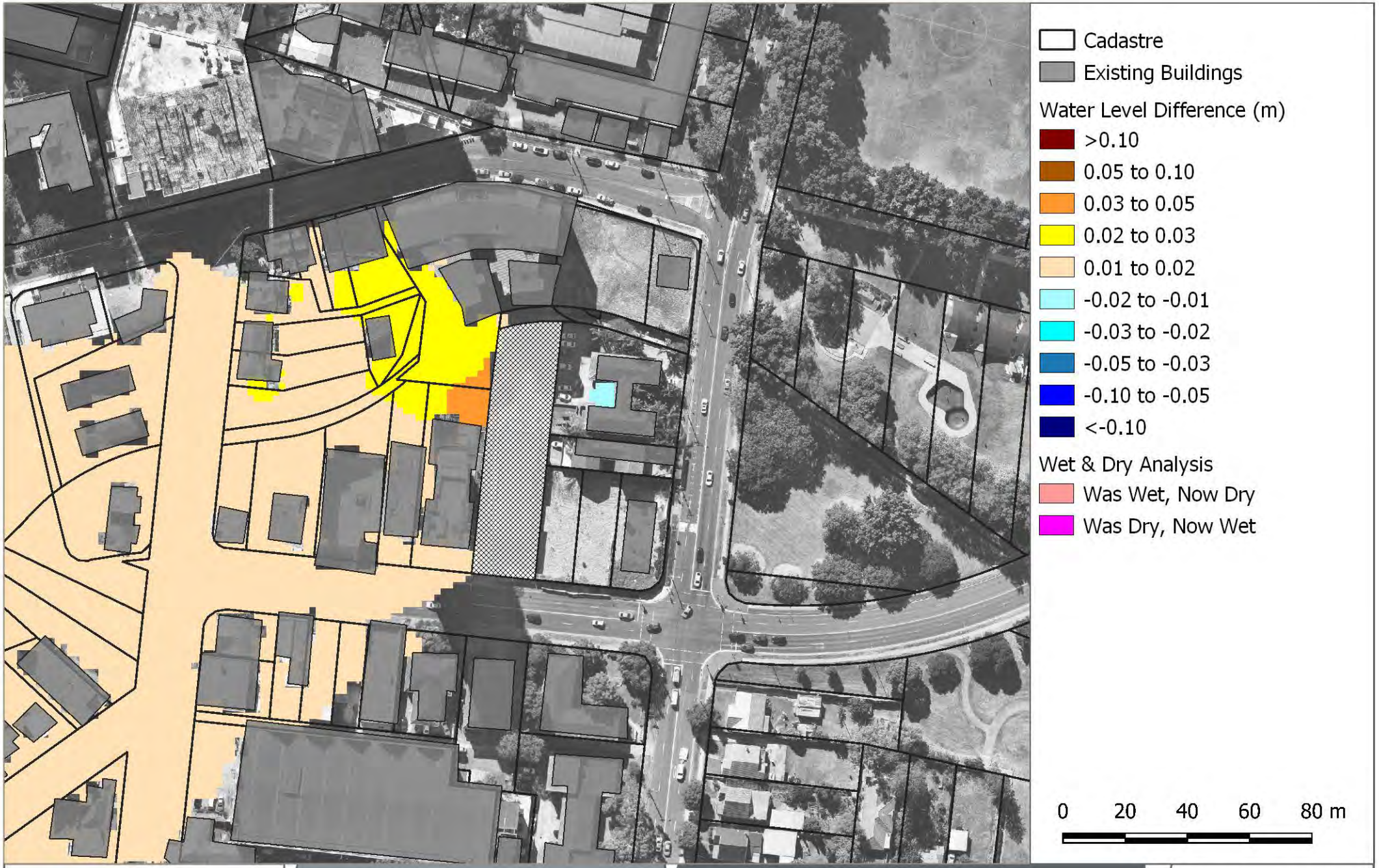
Cardno
Shaping the Future

24 Parkes St
Future Less Existing Conditions

Figure 28
1% AEP Flood Level Differences

N

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
Shaping the Future

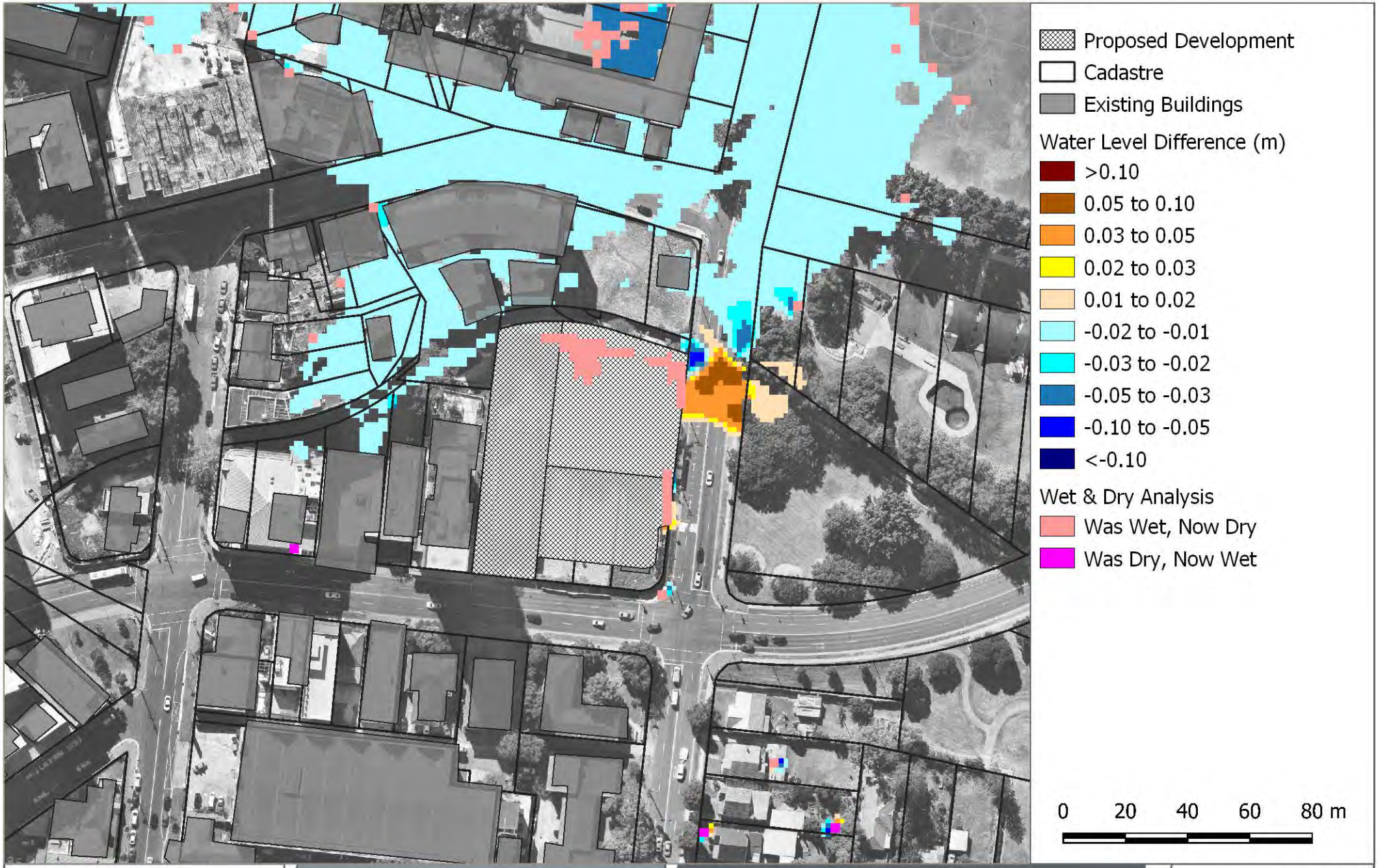
24 Parkes St

Future Less Existing Conditions

Figure 29

PMF Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170



Cardno
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24 Parkes St

Future Less Existing Conditions

Figure 30

Cumulative 1% AEP Flood Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170

Cardno
Shaping the Future

24 Parkes St

Future Less Existing Conditions

Figure 31

Cumulative PMF Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918170

24 Parkes Street, Harris Park

APPENDIX B
PARRAMATTA CITY COUNCIL FLOOD CERTIFICATE

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Flood Enquiry Information Issued - 19 July 2018

Mainstream Flooding

Is this property affected by mainstream flooding? **24 Parkes Street, 30 Parkes Street and 116 Harris Street, Harris Park**		☒ Yes ☐ No
Flood Levels	Closest Cross Sections: *(Please refer to Flood Study):* **Refer to Flood Map**	
☒ 5% AEP	Varies – RL 5.8 m AHD at Western Boundary of 24 Parkes Street to RL 5.6m AHD at street frontage (Eastern Boundary) of 116 Harris Street.	Comments: **See Note on Flood/Hazard Map**
☒ 1% AEP	RL 6.2 m AHD	
☒ PMF	RL 9.5 m AHD	
☒ Refer to flood maps provided for detailed flood levels.		
Flood information is obtained from the following flood study report: **Lower Parramatta River Floodplain Risk Management Study – Flood Study Review, 2005 (SKM)**		

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

Local Flooding

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 likely to be affected by overland stormwater run-off from the local catchment? *Note: No site inspection conducted for this assessment. Based solely on the information supplied for this flood enquiry application.*	☐ Yes ☒ Subject to Detailed Investigation
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.	

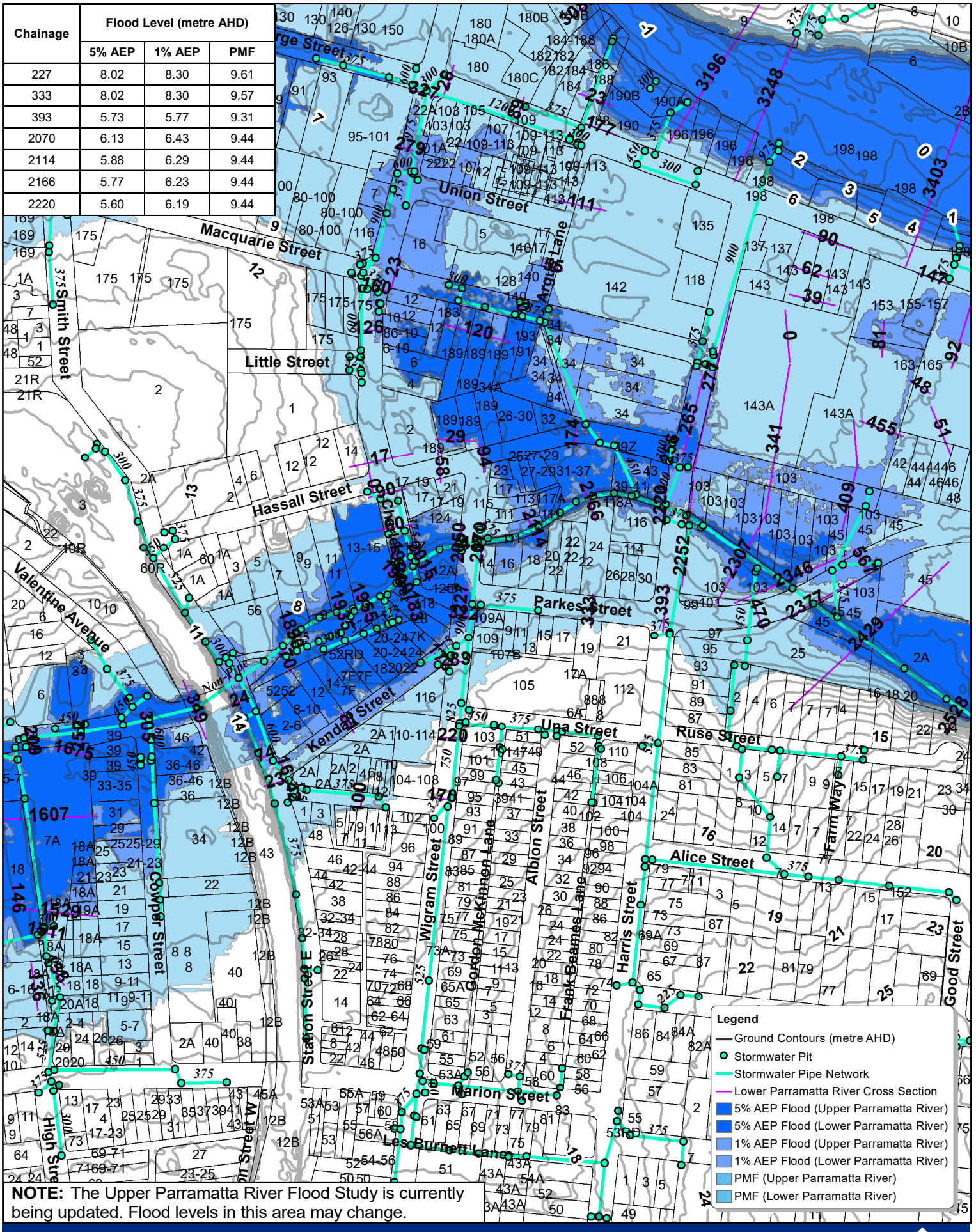
Additional Recommended Actions

☒	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 pre-lodgement 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.

Chainage	Flood Level (metre AHD)		
	5% AEP	1% AEP	PMF
227	8.02	8.30	9.61
333	8.02	8.30	9.57
393	5.73	5.77	9.31
2070	6.13	6.43	9.44
2114	5.88	6.29	9.44
2166	5.77	6.23	9.44
2220	5.60	6.19	9.44



NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.

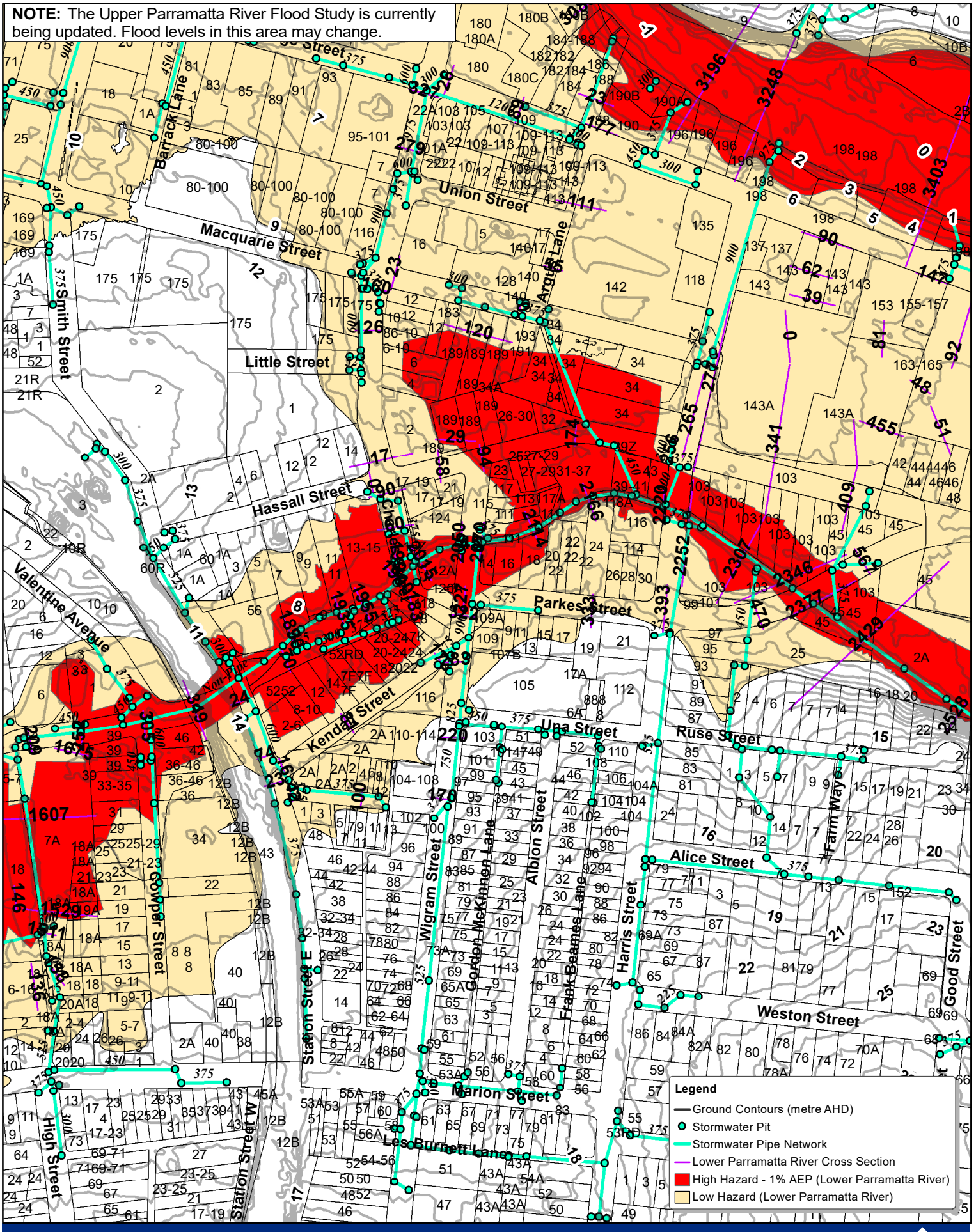
City of Parramatta Council Flood Map

N

1:4,000

Printed 18/07/2018

NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.



City of Parramatta Council Hydraulic Hazard Map

N

1:4,000

Printed 18/07/2018

24 Parkes Street, Harris Park

APPENDIX C
SELECTED ARCHITECTURAL DRAWINGS

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CONCEPT DESIGN

Proposed Option SK-8
24 Parkes Street Parramatta NSW 2150

Site Area 1631 m²

COMMERCIAL -	
Ground -L3	1,630 m²
	FSR 1:1
RESIDENTIAL	GFA
Typical L5 - L18	
L20-L41	
L43-L55	18,406
Penthouse L56	350
	18,756 m²
	FSR 11.5:1

ISSUE	AMENDMENT	DATE	DRAWN	CHECKED

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GENERAL NOTES:

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28 495 869 790 / abn

PROJECT STATUS :

Option SK-8

PROJECT NAME

Concept Design

24 Parkes Street
Parramatta NSW 2150

L.G.A. : Parramatta City Council

NORTH:

SHEET TITLE:

Cover Sheet

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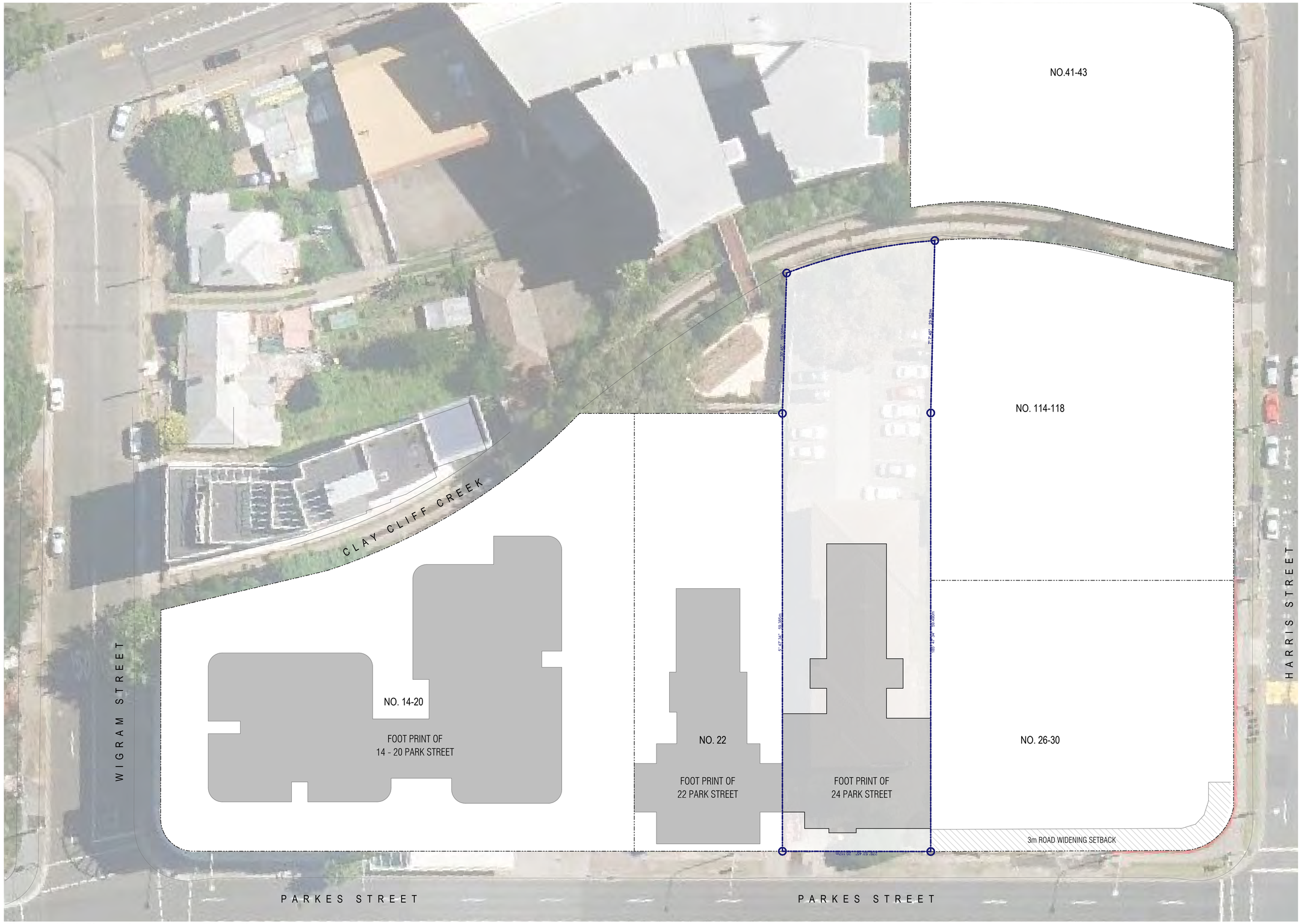
AHM	AH	February 2016		A3 SHEET

08486 JOB No. | SK-8 01 DRAWING No. | 8 ISSUE

PRINT DATE: Thursday, 10 May 2018 1:33 pm



Potential Development Site Plan

Scale @A1 - 1:250

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SHEET TITLE:

Potential Development Site Plan

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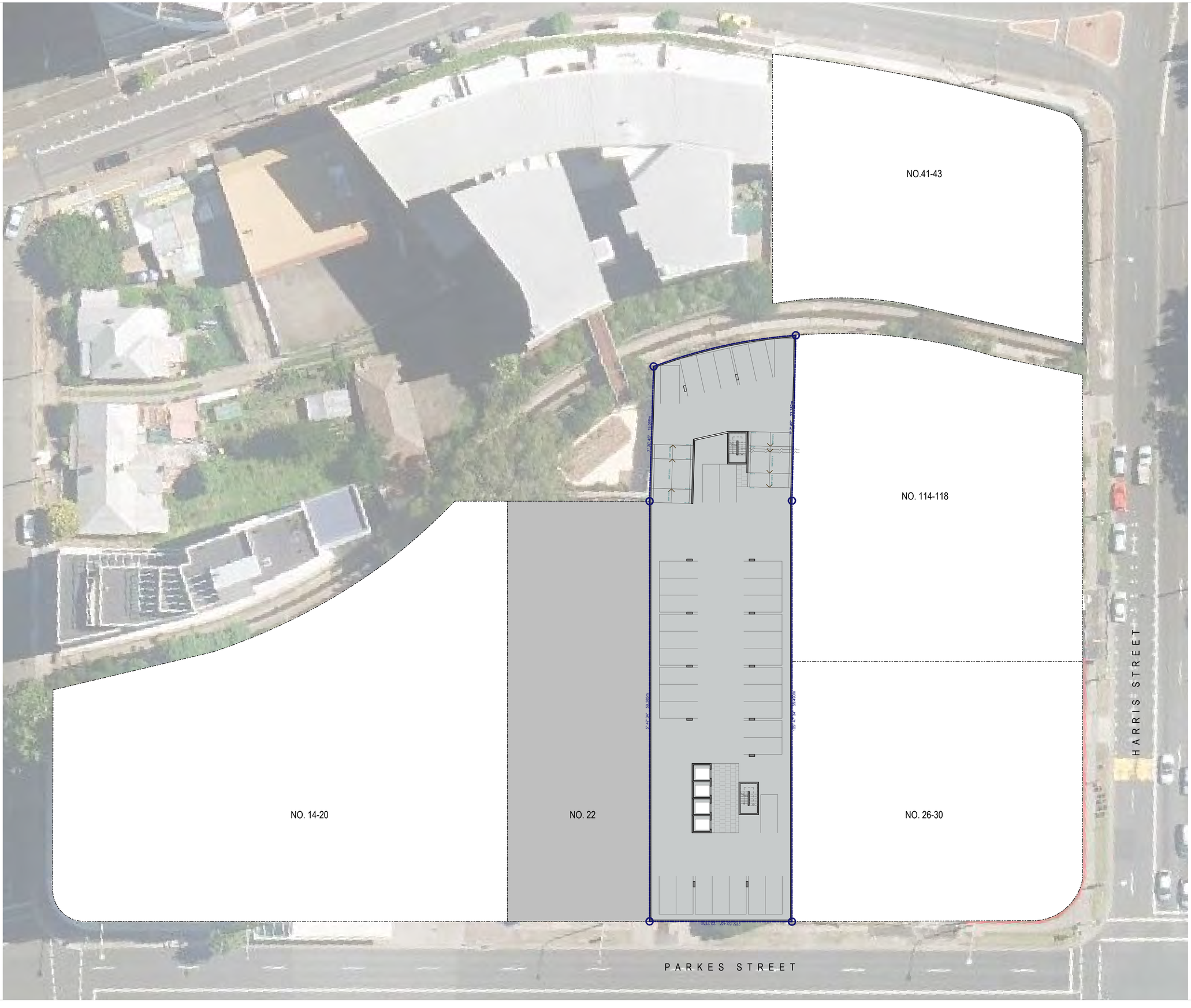

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SHEET TITLE:

Typical Basements

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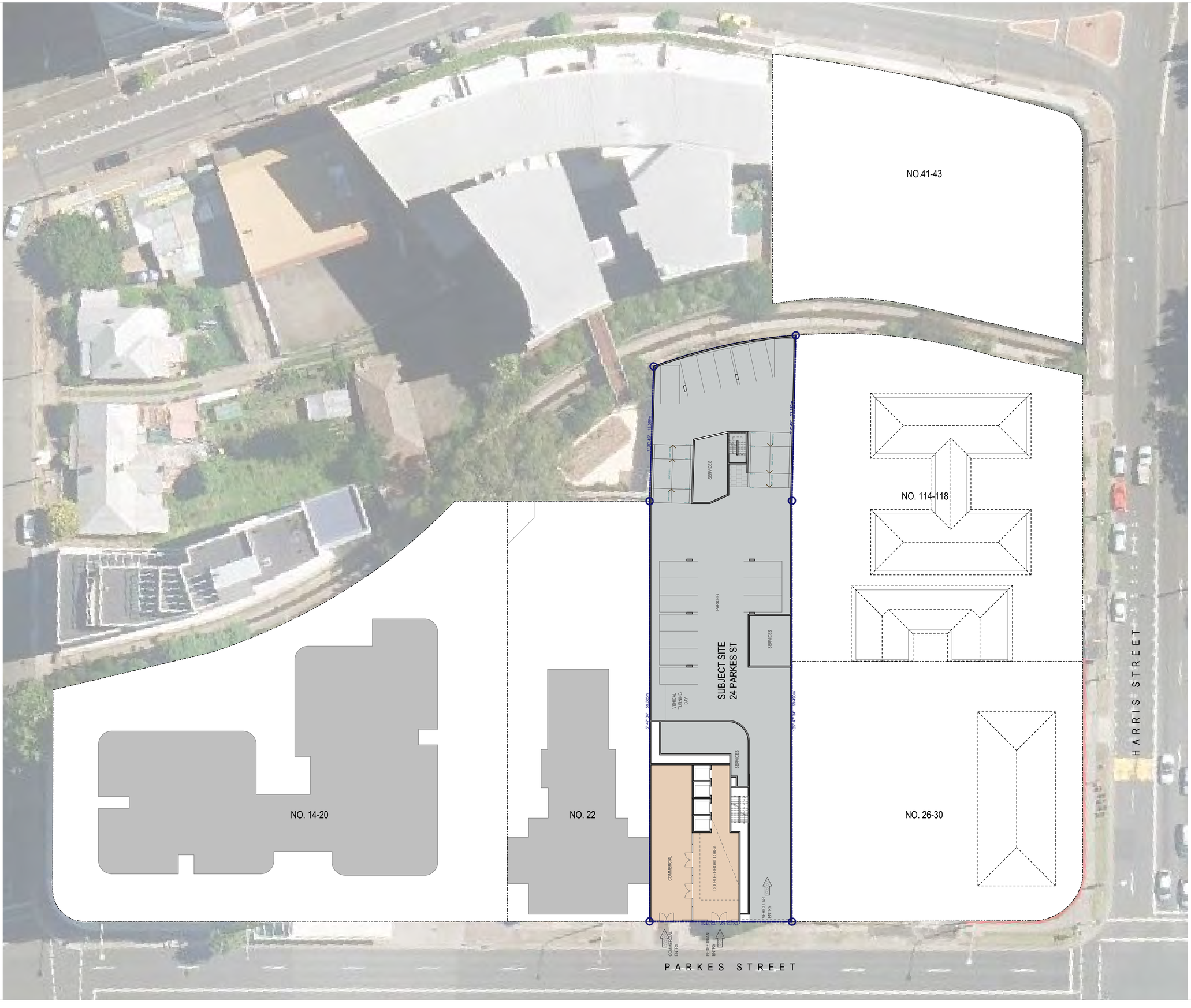

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SHEET TITLE:

Ground - Entry & Commercial

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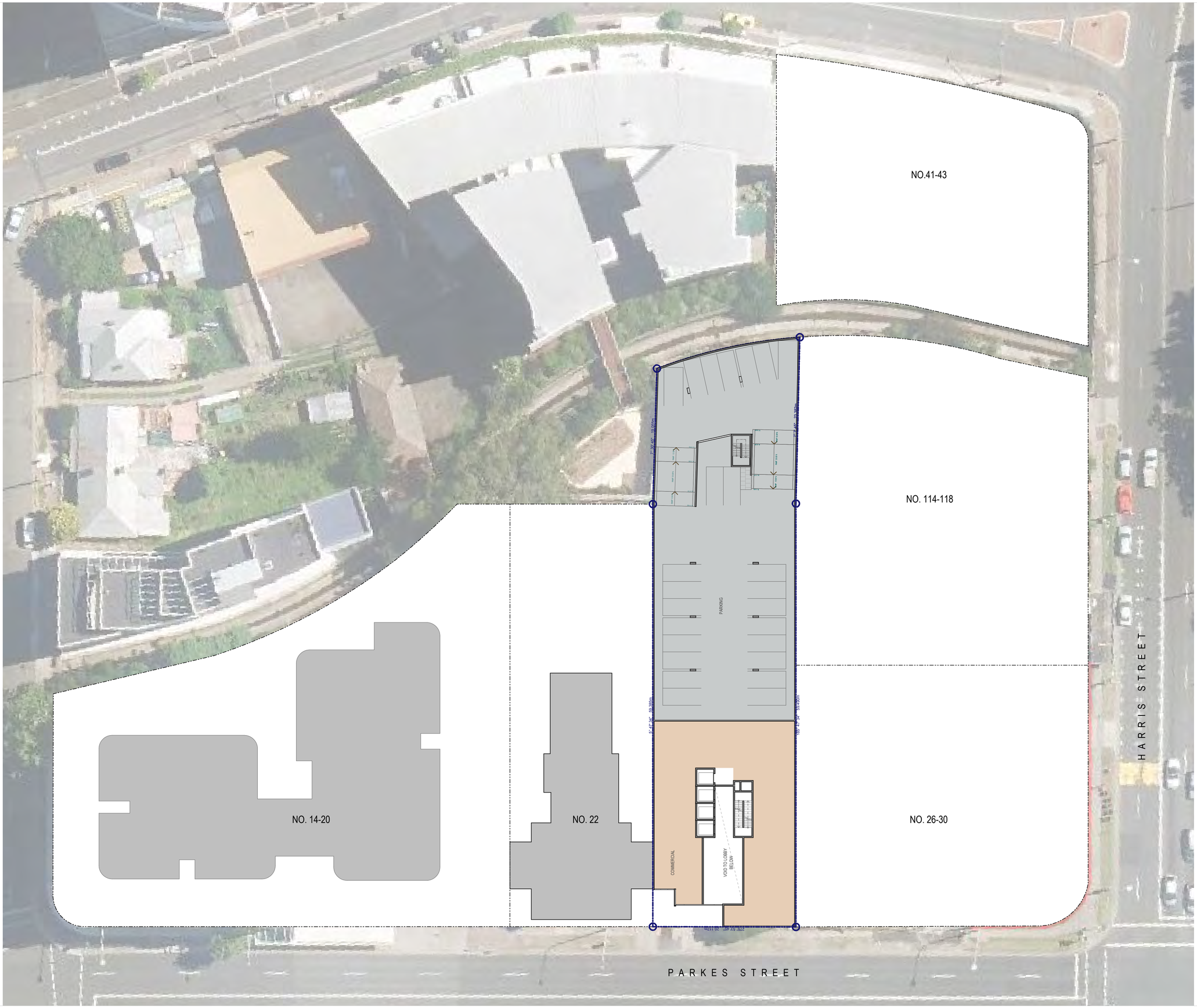

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SHEET TITLE:

L1 - Commercial

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AHM	AH	February 2016	1:500	A3 SHEET

08486	SK-8 05	8
JOB No.	DRAWING No.	ISSUE

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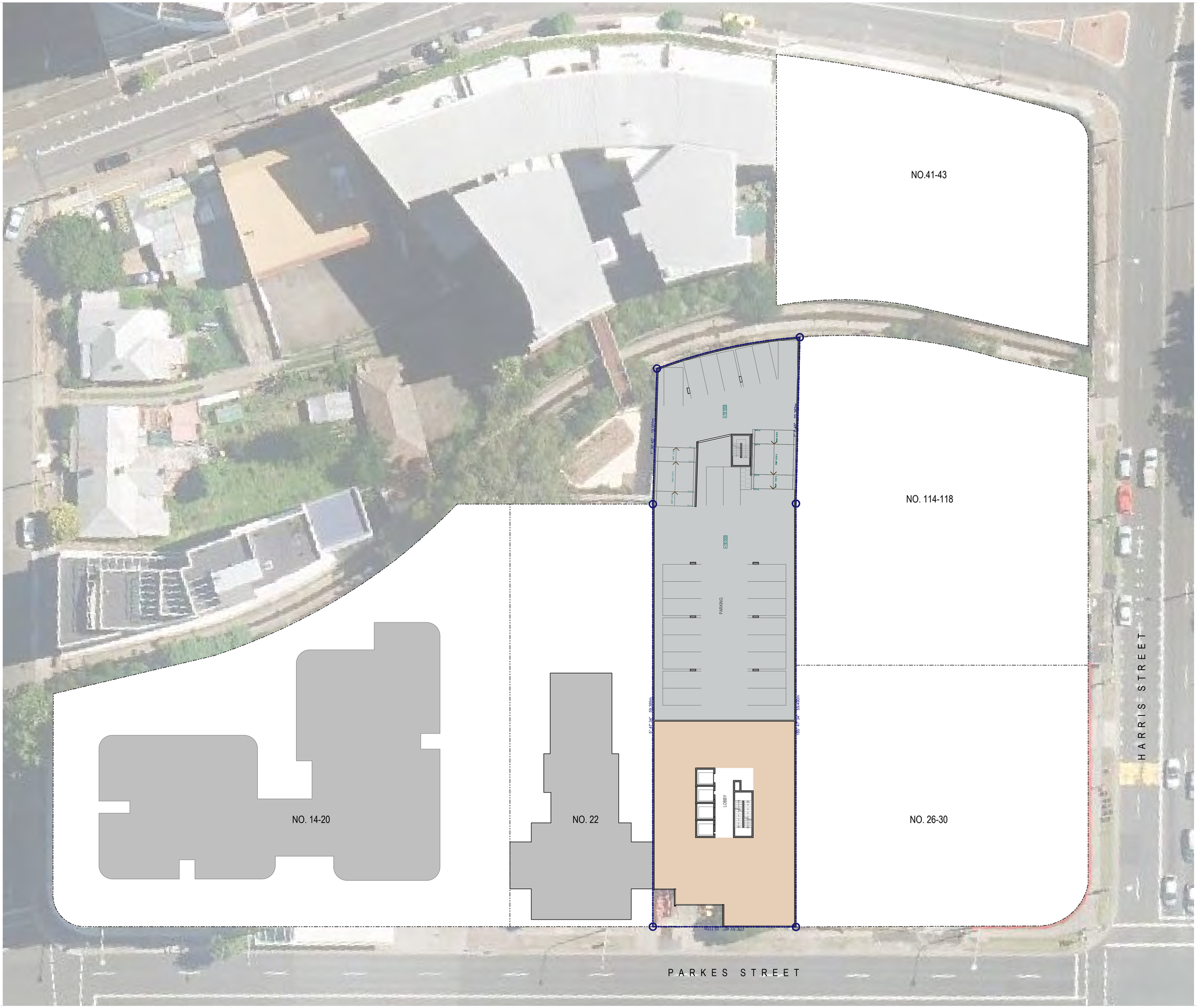

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L2&3 - Typical Commercial

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SHEET TITLE:

L4 - Podium COS

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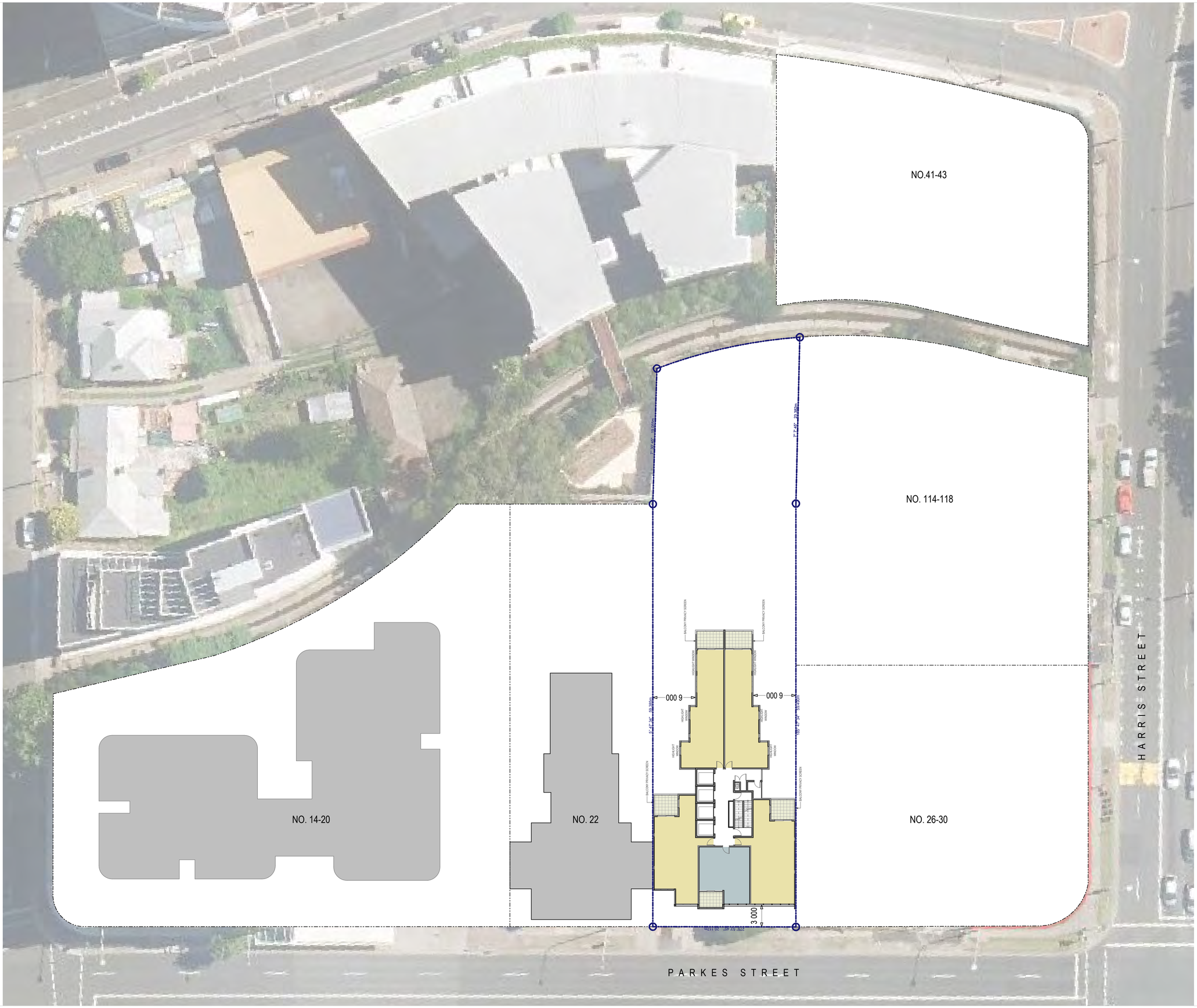

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1 BEDROOM UNIT

2 BEDROOM UNIT

3 BEDROOM UNIT

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SHEET TITLE:

L5-18 + L20-41 + L43-55 - Typical Residential

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08486 JOB No. | SK-8 08 DRAWING No. | 8 ISSUE

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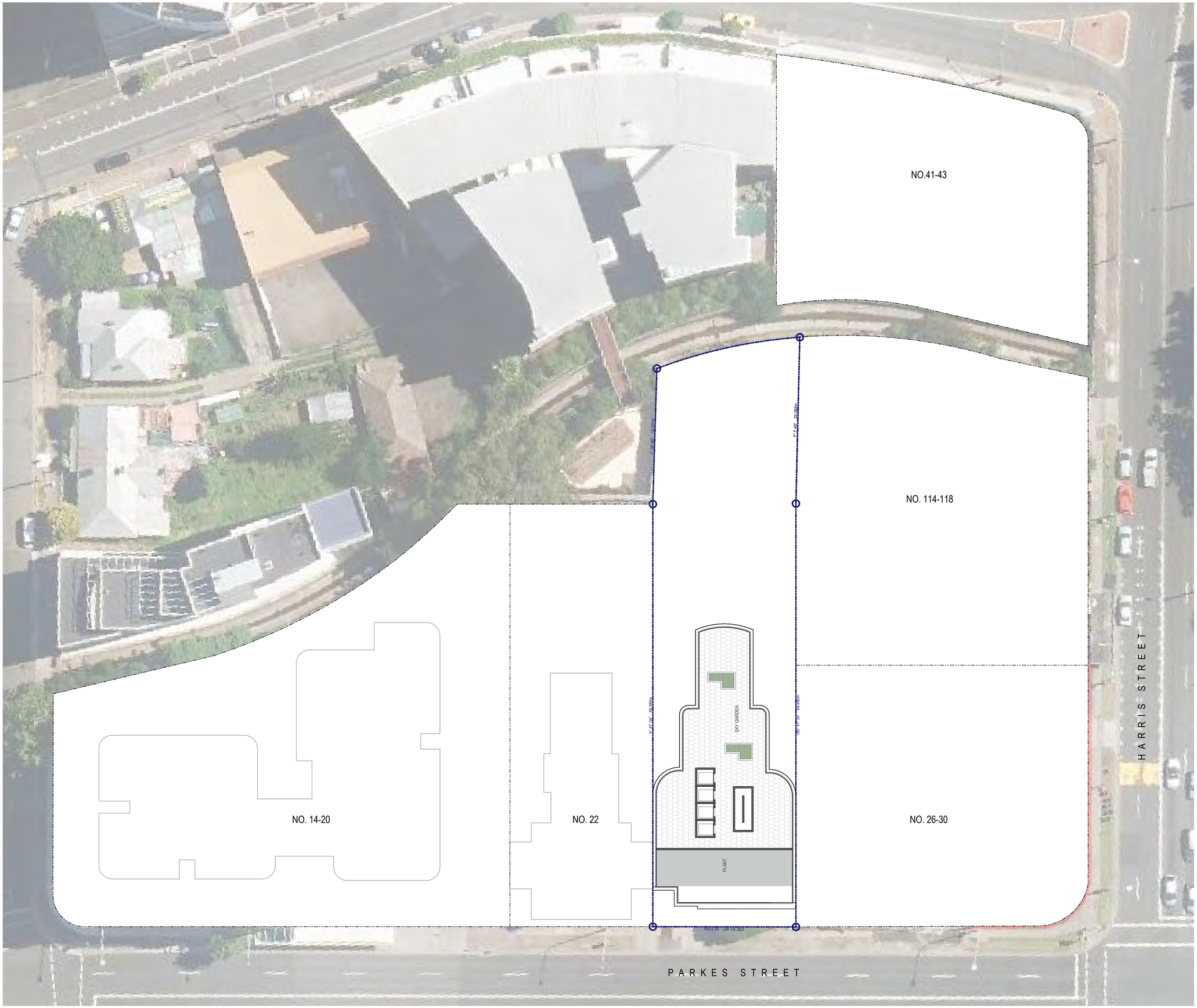

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NORTH:

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SHEET TITLE:

L19+42 - Typical Service & COS

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AHM	AH	February 2016	1:500	A3 SHEET

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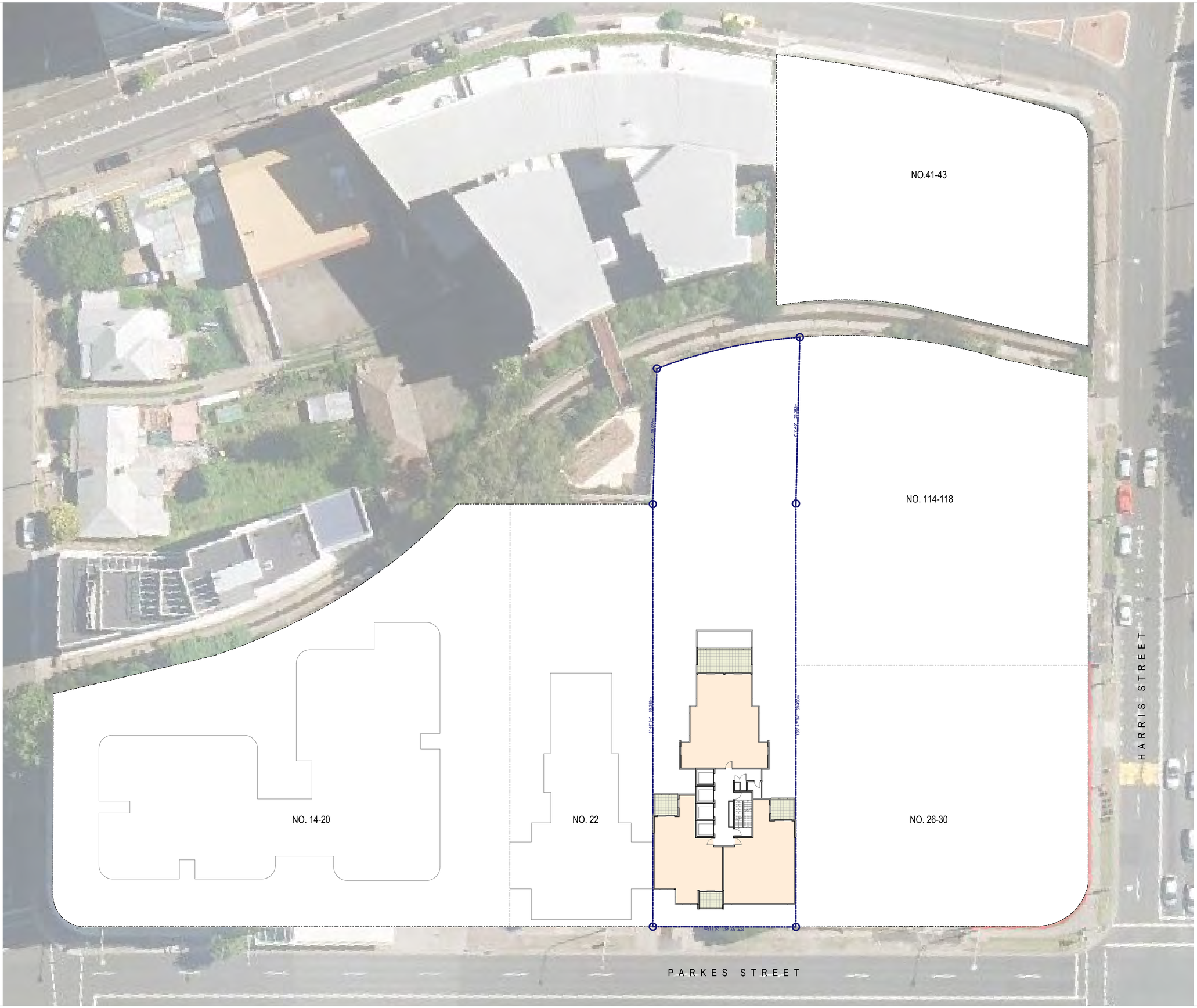

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1 BEDROOM UNIT

2 BEDROOM UNIT

3 BEDROOM UNIT

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Any discrepancies to be verified back to Zhinar Architects before proceeding.
All workmanship and materials shall comply with all relevant codes, ordinances, Australian Standards and manufacturer's instructions.
Unless noted 'Issued for Construction', drawing not to be used for construction.

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PROJECT STATUS :

Option SK-8

PROJECT NAME

Concept Design

24 Parkes Street
Parramatta NSW 2150

L.G.A. : Parramatta City Council

NORTH:

DIAL BEFORE YOU DIG www.1100.com.au

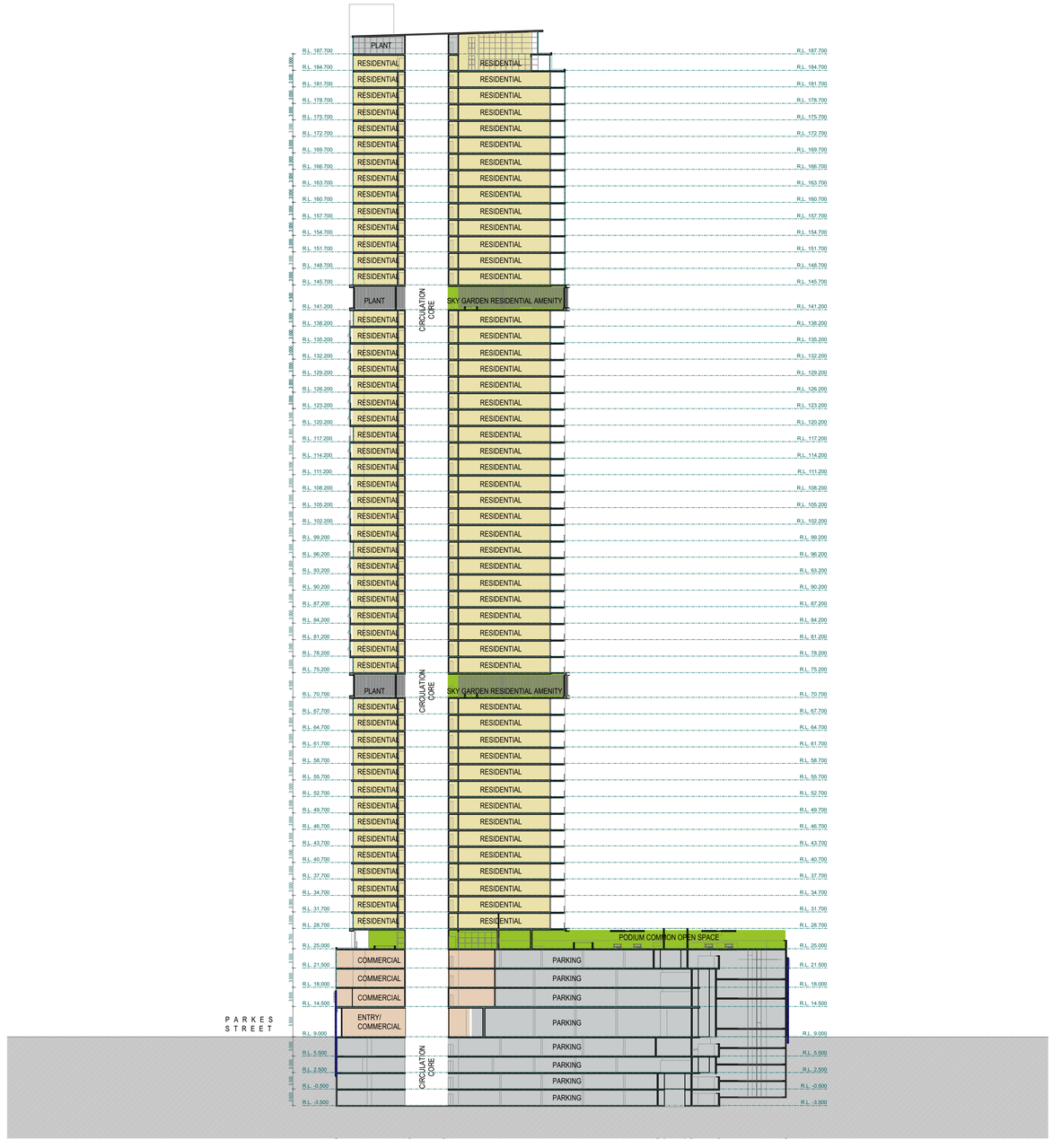
SHEET TITLE:

L56 - Residential Penthouse

DESIGNED:	DRAWN:	COMMENCED:	SCALE:	PRINT:
AHM	AH	February 2016		A3 SHEET

08486 JOB No. | SK-8 10 DRAWING No. | 8 ISSUE

PRINT DATE: Thursday, 10 May 2018 11:09 am



LONG SECTION (east)

Scale @A1 - 1:500

ISSUE	AMENDMENT	DATE	DRAWN	CHECKED

PRINT DATE: Thursday, 10 May 2018 2:09 pm

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GENERAL NOTES:

Figured dimensions shall be taken in preference to scaling. Drawing to be read in conjunction with information on first page. Check all dimensions and levels on site before commencing work or ordering materials. All existing ground lines & trees location are approximate, therefore to be verified on-site by the builder. Any discrepancies to be verified back to Zhinar Architects before proceeding. All workmanship and materials shall comply with all relevant codes, ordinances, Australian Standards and manufacturer's instructions. Unless noted 'Issued for Construction', drawing not to be used for construction.

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SHEET TITLE:

Section

DESIGNED:	DRAWN:	COMMENCED:	SCALE:	PRINT:
AHM	AH	February 2016	AS NOTED	A3 SHEET

L.G.A : Parramatta City Council

NORTH:

PROJECT STATUS :

Option SK-8

PRELIMINARY

PROJECT NAME

Concept Design

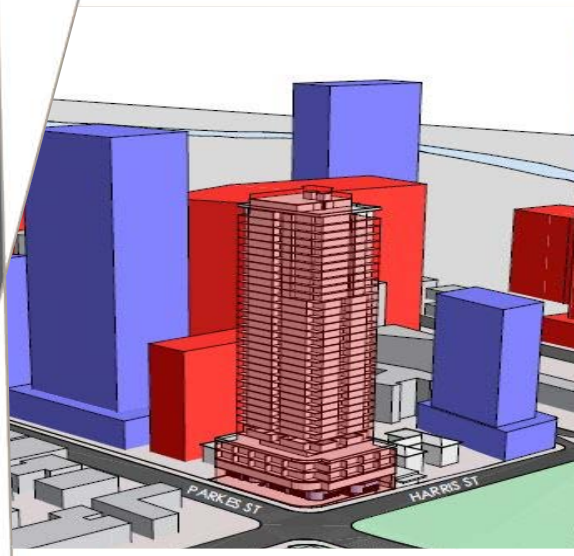
24 Parkes Street
Parramatta NSW 2150

08486	SK-8 13	8
JOB No.	DRAWING No.	ISSUE

Flood Impact Assessment

26-30 Parkes Street, Harris Park

59918169



Prepared for
Parkes St NSW Pty Ltd

23 July 2018

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Shaping the Future

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Executive Summary

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 26-30 Parkes Street, Parramatta. The subject site is located on the Clay Cliff Creek floodplain just upstream of Harris Street.

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising four levels of basement car parking, 2 levels of commercial retail outlets, 33 levels of residential apartments, one level of communal area and open space and a rooftop bar.

The flooding assessment methodology is outlined as follows:

- Impact of planned development on flooding
- Climate change impact on flooding
- Flood emergency response
- Flood warning and evacuation
- Outline of a draft emergency response plan
- Compliance with requirements of Parramatta DCP 2011

Previous Flood Assessments

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

Flood Impact Assessment

The assessment of the impact or otherwise of development on 26-30 Parkes Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

Flood models were established for the existing site conditions and future developed scenarios. The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by Project Tourism International Architecture (attached in **Appendix C**).

Flood modelling was completed for the 100 year ARI, and Probable Maximum Flood events.

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2220) adopted by Council:

- 100 year ARI: 6.19 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.30 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.19 m AHD.

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively. It is concluded that the planned development has a negligible impact on 100 year ARI and PMF levels.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity in 114 Harris Street while lowering the peak velocity in Parkes Street in the vicinity of 18-24 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 26-30 Parkes Street the velocity x depth in a PMF adjacent to the site in Harris Street and Parkes Street is < 0.4 m^2/s. In a PMF the planned development locally increases the flow velocity x depth in 114 Harris Street and in the southeast corner of 24 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High while in Parkes Street adjacent to the site it is Low. The impact of the planned development on provisional hazard is negligible.

Flood Risk Precinct

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. While the site is mapped as Low Flood Risk with a very minor area of Medium Flood Risk based on the XP-SWMM 1D/2D results the site would be solely mapped as Low Flood Risk based on mapped extents of 100 yr ARI flooding and hazard as given in in Council's Flood Map attached in **Appendix B**.

Rate of Rise of Floodwaters

Features of the planned development include:

- Ground levels which vary from 8.78 m AHD in the southwest corner to 7.19 m AHD in the northeast corner of the property;
- Proposed ground floor level for the commercial and retail outlets of 9.1 m AHD which provides which provides 2.55 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level or the commercial uses of 13.3 m AHD which is higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 7.05 m AHD which provides 0.96 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 0.5 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor commercial and retail outlets has a freeboard of around 2.9 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 3 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 7.05 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 3 hours 45 minutes after start of the PMP storm. Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.
It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a slightly shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill each level of the car park to a depth of 0.9 m and to completely full is around 16-20 minutes and around 21-26 minutes respectively**.**

Emergency Planning

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

A draft Emergency Response Plan is outlined.

Flood Emergency Response

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place. Based on the estimated peak number of persons that could be at risk in the car park and in Ground Floor the estimated maximum area of refuge required is 60 m^2. It is expected that this refuge would be provided by the communal area on Level 4 which far exceeds the required area of refuge.

Assessment of Council Requirements

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. An assessment of the compliance of the proposed development with Council's requirements is given in Section 7 of this report.

The development is located almost wholly in a Low Flood Risk Precinct. Consequently the development has been assessed against the planning and development controls that apply to "Residential" in a Low Flood Risk Precinct.

It is concluded that the assessment and details in this Flood Impact Assessment satisfy the requirements of the Parramatta DCP 2011.

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Appendices

Tables

Figures

1 Introduction

1.1 Background

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 26-30 Parkes Street, Parramatta. The subject site is located on the Clay Cliff Creek floodplain just upstream of Harris Street (refer **Figure 1** in **Appendix A**).

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising four levels of basement car parking, 2 levels of commercial retail outlets, 33 levels of residential apartments, one level of communal area and open space and a rooftop bar.

1.2 Flooding Considerations

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

The flooding context for the site is provided in the flood map prepared by Parramatta City Council and given in **Figure 1** (refer also **Appendix B**) and the 10 year ARI and 100 year ARI flood extents estimated in the 2007 Cardno Willing Study as given in **Figure 2**.

1.3 Objective

The objective of the study is to address the following considerations for planned development of the sites:

- Impact of planned development on flooding;
- Climate change impact on flooding;
- Flood emergency response;
- Flood warning and evacuation;
- Outline of a draft emergency response plan; and
- Compliance with requirements of Parramatta DCP 2011

1.4 Methodology

The flooding assessment methodology is outlined as follows:

- Review of previous flood studies and available data;
- Compilation of site specific data (including proposed development layout);
- If appropriate, modify the Clay Cliff Creek floodplain model to represent existing site scenario;
- Revision of flood model to represent future site development;
- Assessment of resultant flood behaviour and flood risks;
- Review of flood emergency planning;
- Outline a flood emergency response plan;
- Review of compliance with Parramatta City Council development requirements;

2 Previous Studies

The proposed development on 26-30 Parkes Street, Harris Park is potentially subject to flooding by floodwaters spilling from Clay Cliff Creek and/or the Parramatta River. Consequently previous studies of flooding in the lower Parramatta River and in Clay Cliff Creek are relevant to the subject site.

2.1 2005 Lower Parramatta River Floodplain Study

The Lower Parramatta River Floodplain Risk Management Study/Plan was completed in 2005 in accordance with the provisions of the Floodplain Development Manual applicable at that time. This study included a Flood Study Review which re-assessed flood levels in a number of watercourses and in the tidal section of Parramatta River, between the Charles Street weir and Ryde (road) Bridge. The Flood Study Review provided the base data for the subsequent Floodplain Risk Management Study.

The study was commissioned by Parramatta City Council to update the previous data on flood levels and extents. PCC was aware that the results predicted in the 1986 study would now be subject to change due to changes in the catchment such as urbanisation and the construction of flood mitigation projects in the upper catchment. It also recognised that the previous flood extent mapping was based on the best information available at the time, but it was of variable reliability and did not provide an assessment of flood hazard.

The LPRFS adopted the best current practice to review the flood data which included (SKM, 2005):

- up-to-date catchment hydrology for the Upper Parramatta River Catchment;
- existing/ updated hydrology for the tributaries within the Lower Parramatta River study area;
- Airborne Laser Survey;
- an additional 70 surveyed cross-sections;
- the widely used and accepted MIKE-11 hydraulic model;
- use of GIS to develop digital terrain models;
- multiple design storms to generate maximum flood levels; and
- appropriate methodology for estimating concurrent flows in tributaries.

Generally, results from the review compared well with previous studies. However, flood levels estimated in the 1986 Lower Parramatta Flood Study prepared by Willing and Partners in the Lower Parramatta River downstream of Subiaco Creek (including the Duck River confluence) were up to 1.2 m lower than those derived in the 2005 review. The reasons for this difference as described in the 2005 Flood Study report include:

- revision of the critical duration to 9 hours for the Upper Parramatta River catchment in the 2005 study, due to the inclusion of channel routing and the effect of the Darling Mills Retarding Basin and other flood mitigation works. This leads to an increase in the volume of floodwaters;
- more detailed and complete survey data; and
- the adoption of an integrated modelling approach and consistent design storms for the main river and tributaries.

It is our understanding that Parramatta City Council adopted the design flood levels from this study for planning purposes in 2005.

Council and Council's Peer Reviewer has relied upon the flood levels estimated by this flood study in the vicinity of Wigram St and Hassall St, Harris Park as contained in Council's Flood Map (refer **Figure 1**).

2.2 2007 Clay Cliff Creek Catchment Master Drainage Plan

A Catchment Master Drainage Plan for the Clay Cliff Creek catchment at Parramatta was prepared in 2007. The aim of the study as set out by Parramatta City Council was to identify overland flow problem areas, locations of surcharge due to insufficient pipe capacity and pit inlet capacity, and localised flooding with areas of improvement. The study aimed also to prepare cost effective options based on cost benefit analysis.

The 2007 study assembled a hydrological model of the Clay Cliff Creek catchment and input local flow hydrographs into an XP-SWMM 1D/2D floodplain model. The estimated 10 year ARI and 100 year ARI flood extents are presented in **Figure 2**.

2.3 2011 Flood Impact Assessment, 111 Wigram St, Harris Park

Cardno was commissioned by ING Consulting Engineers Pty Ltd to undertake an assessment of the site and the proposed development in relation to flooding. The purpose of the assessment was to ensure that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that risk of flooding to the public is acceptable to Parramatta City Council.

Cardno assessed flood behaviour for the 100 year ARI for the existing and proposed conditions. This was undertaken through update of our 2007 XP-SWMM 1D/2D model of the Clay Cliff Creek catchment prepared for the Parramatta City Council.

The assessment concluded that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that the flood risk to the public is acceptable to Council.

2.4 2011 Flood Impact Assessment, 122 Wigram St, Harris Park

Cardno was commissioned by LJ Hooker Westmead to undertake the flood assessment of the proposed multi-storey mixed-use development at 122 Wigram Street, Harris Park. The purpose of the assessment was to ensure that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that risk of flooding to the public is acceptable to Parramatta City Council.

Cardno assessed flood behaviour for the 100 year ARI for the existing and proposed conditions. This was undertaken through update of our 2007 XP-SWMM 1D/2D model of the Clay Cliff Creek catchment prepared for the Parramatta City Council.

The assessment concluded that the proposed development would maintain the floodplain of Clay Cliff Creek and would have little impact on flood behaviour being located between the hydraulic controls of Charles and Wigram Street crossings.

2.5 2014 Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park

In 2014 a mixed-use development of 113-117 Wigram St and 23-29 Hassall St was proposed comprising retail outlets, residential apartments and a multi-storey underground car park.

This site is located adjacent to and north of Clay Cliff Creek.

The objective of the study was to address the overall conclusions of Council's Peer Reviewer as documented in a memorandum dated 21 October 2013.

A 1D/2D assessment of flooding in the vicinity of the site was undertaken to define flood behaviour and to assess the impacts if any of the proposed development using a modified version of the XP-SWMM 1D/2D floodplain model. The 1D/2D floodplain model included the floodplain of Clay Cliff Creek up to the Railway Line and a reach of the Parramatta River.

3 Flooding Assessment

The assessment of the impact or otherwise of development on 26-30 Parkes Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

3.1 Existing Conditions

3.1.1 Model Configuration

The floodplain model which was used for assessment purposes was an extended version of the 2007 Clay Cliff Creek model recently used to assess the impacts of planned development on 32 Tramway Avenue, Parramatta which includes development which was assessed previously on properties nearby to 26-30 Parkes St, Harris Park. The 1D/2D model of the Clay Cliff Creek floodplain which extends to its outfall into the Parramatta River was extended to include a reach of the lower Parramatta River and its floodplain. In order to reduce the size of the overall model to assess the impacts of planned development the Clay Cliff Creek model was truncated at the railway line which is a local hydraulic control (refer **Figure 2**).

The Parramatta River was represented in the 1D/2D floodplain model as 2D terrain which was created from the cross sections extracted from the lower Parramatta River floodplain model between and including PARRAMATTA_R 3248 to PARRAMATTA_R 4452. The overbank areas not already represented in the Clay Cliff Creek model were included in the 2D domain using ALS data which was previously supplied by Council for the Clay Cliff Creek study.

The adopted downstream boundary condition was a stage hydrograph extracted from the lower Parramatta River floodplain model at PARRAMATTA_R 4452.

The upstream boundary conditions were a flow hydrograph in the Parramatta River extracted from the lower Parramatta River floodplain model at PARRAMATTA_R 3248 and the flow hydrograph generated by the Clay Cliff Creek model at the Railway Line. Local inflow hydrographs were also input within the study area based on the subcatchment discretisation adopted in the 2007 Clay Cliff Creek catchment study.

3.1.2 Terrain

The Digital Terrain Model (DTM) adopted for the flood model represents the ground surface elevations and blockages to flow caused by buildings. The DTM and blockages for Existing Conditions in the vicinity of the site is shown in **Figure 3**.

3.1.3 Floodplain Roughness

The roughness zones in the vicinity of the site are plotted in **Figure 4**. The roughness values which were adopted were guided by the values previously adopted in the 2007 Clay Cliff Creek catchment study.

3.1.4 Results

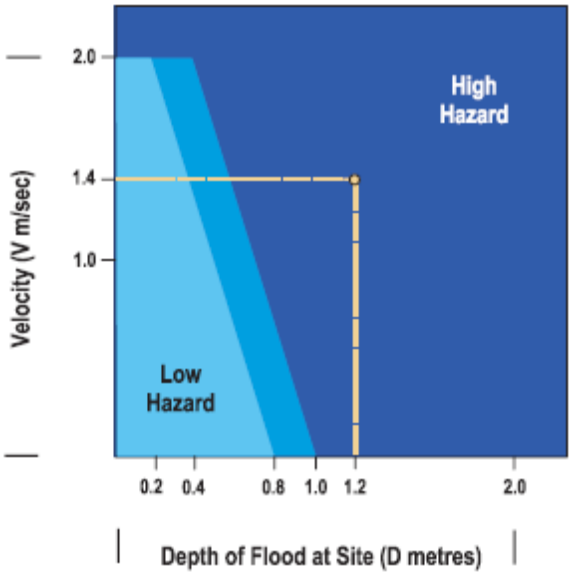
The estimated 100 year ARI flood levels and extent, depths and velocities under Existing Conditions are plotted in **Figures 5, 6** and **7** respectively.

When considering pedestrian and vehicular stability, three velocity x depth criteria were identified as follows:

Velocity x Depth	Comment
≤ 0.4 m^2/s	This is typically adopted by Councils as a limit of stability for pedestrians
0.4 – 0.6 m^2/s	Unsafe for pedestrians but safe for vehicles if overland flood depths do not exceed around 0.3 m
> 0.6 m^2/s	This is typically adopted by Councils as a limit of stability for vehicles

The estimated 100 year ARI velocity x depth under Existing Conditions is plotted in **Figure 8.**

Experience from studies of floods throughout NSW and elsewhere has allowed authorities to develop methods of assessing the hazard to life and property on floodplains. This experience has been used in developing the NSW Floodplain Development Manual to provide guidelines for managing this hazard. These guidelines are shown schematically blow.



Provisional Hazard Categories (after Figure L2, NSW Government, 2005)

To use the diagram, it is necessary to know the average depth and velocity of floodwaters at a given location. If the product of depth and velocity exceeds a critical value (as shown below), the flood flow will create a **high hazard** to life and property. There will probably be danger to persons caught in the floodwaters, and possible structural damage. Evacuation of persons would be difficult. By contrast, in **low hazard** areas people and their possessions can be evacuated safely by trucks. Between the two categories a transition zone is defined in which the degree of hazard is dependent on site conditions and the nature of the proposed development.

This calculation leads to a provisional hazard rating. The provisional hazard rating may be modified by consideration of effective flood warning times, the rate of rise of floodwaters, duration of flooding and ease or otherwise of evacuation in times of flood. The estimated 100 year ARI provisional flood hazard under updated Existing Conditions is plotted in **Figure 9.**

The estimated PMF levels and extent, depths, velocities, velocity x depth and hazards under updated Existing Conditions are plotted in **Figures 10, 11, 12, 13** and **14** respectively.

Based on the results of the assessments of 100 year ARI and PMF flooding the flood risk precincts are identified in **Figure 15**.

3.2 Future Conditions

3.2.1 Terrain

The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by Project Tourism International Architecture (attached in **Appendix C**). It comprises four levels of basement car parking, 2 levels of commercial / retail outlets, 33 levels of residential apartments, one level of communal area and open space and a rooftop bar.

The DTM for the Future Conditions model was generated based on the architectural drawings prepared by Project Tourism International Architecture. A summary of the areas blocked in the future DTM and additional features are shown in **Figure 16.**

3.2.2 Floodplain Roughness

The roughness zones under Future Conditions are plotted in **Figure 17.** The roughness values which were adopted were guided by the values previously adopted in the 2007 Clay Cliff Creek catchment study.

3.2.3 Results

The estimated 100 year ARI flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 18, 19, 20, 21** and **22** respectively.

The estimated PMF flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 23, 24, 25, 26** and **27** respectively.

3.3 Peak Flood Levels

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2220) adopted by Council:

- 100 year ARI: 6.19 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.30 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.19 m AHD.

3.4 Flood Impact Assessment

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively. It is concluded that the planned development has a negligible impact on 100 year ARI and PMF levels.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity in 114 Harris Street while lowering the peak velocity in Parkes Street in the vicinity of 18-24 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 26-30 Parkes Street the velocity x depth in a PMF adjacent to the site in Harris Street and Parkes Street is < 0.4 m^2/s. In a PMF the planned development locally increases the flow velocity x depth in 114 Harris Street and in the southeast corner of 24 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High while in Parkes Street adjacent to the site it is Low. The impact of the planned development on provisional hazard is negligible.

3.5 Climate Change

Based on discussions with Parramatta City Council in 2012 an indicative assessment of the impact of climate change on the 100 year ARI flood levels in the year 2100 was undertaken in 2012 to inform a Discussion Paper on Flooding of the DHA Site in Ermington (Cardno, 2012). This assessment was based on an assumed 15% increase in design rainfall (yielding a 12% increase in 100 year ARI flood flows) and sea level rise of 0.9 m.

The indicative 100 year ARI flood levels in the Parramatta River under climate change are around 0.34 m – 0.45 m higher than the 100 year ARI flood levels adopted by Council. It is expected that the impact of climate change in the vicinity of the site which is adjacent to Clay Cliff Creek is around 0.35 m ie. around 6.55 m AHD. The proposed level of the ground floor is at 9.1 m AHD which provides 2.55 m freeboard to the indicative 100 yr ARI flood level under climate change while the driveway entry crest level of around 7.05 m AHD provides 0.5 m freeboard to the indicative 100 yr ARI flood level under climate change.

3.6 Cumulative Development

The cumulate impact of multiple potential developments in the vicinity has been previously represented in the floodplain model assembled during the 2005 Lower Parramatta River Floodplain Study and is already incorporated in the resulting flood levels adopted by Council. In the 2005 floodplain model overland flowpaths are primarily represented as road corridors and any existing or new development on lots or re-development lies outside the modelled flood extents. Council's plotted flood extents are based on extrapolating the calculated flood levels beyond the modelled flood extents. Consequently new development or re-development can't be represented by modification of current cross sections in Council's floodplain model and will not change the flood levels adopted by Council.

The cumulative impact of the proposed development of 24 Parkes Street, 26-30 Parkes Street and 114-118 Harris Street was also undertaken.

The estimated 100 year ARI and PMF level differences under cumulative Future Conditions in comparison with Existing Conditions are plotted in **Figures 30** and **31** respectively. In the case of the 100 yr ARI event there is a local increase on Harris Street opposite 118 Harris Street of around 0.05 m. This local impact does not extend to any adjoining property. There is also an associated small reduction in 100 yr ARI flood levels north of Clay Cliff Creek.

In the PMF there is a small local increase in the PMF level upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 20 Parkes Street.

It is concluded that the planned cumulative development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels upstream of 24 Parkes Street.

4 Flood Risks

The flood risks at and in the vicinity of 26-30 Parkes Street, Harris Park are discussed as follows.

4.1 Flood Levels, Velocities and Hazards

The estimated 100 year ARI flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 18, 19, 20, 21** and **22** respectively.

The estimated PMF flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 23, 24, 25, 26** and **27** respectively.

4.2 Flood Risk

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. While the site is mapped as Low Flood Risk with a very minor area of Medium Flood Risk based on the XP-SWMM 1D/2D results the site would be solely mapped as Low Flood Risk based on mapped extents of 100 yr ARI flooding and hazard as given in in Council's Flood Map attached in **Appendix B**. Likewise the sections of Harris Street and Parkes Street adjoin the property would be also mapped by Council as Low Flood Risk.

4.3 Rate of Rise of Floodwaters

To understand the likely warning times and associated response times during extreme flood events it is necessary to estimate the expected rate of rise of floodwaters. At 26-30 Parkes Street, Harris Park the estimated rate of rise of flooding in a PMF event at the driveway is around 2.5 m/hr. The estimated rate of rise of flooding in a PMF event above the ground floor level of 9.1 m AHD is around 1.0 m/hr and decreases as the peak water level is approached.

Features of the planned development include:

- Ground levels which vary from 8.78 m AHD in the southwest corner to 7.19 m AHD in the northeast corner of the property;
- Proposed ground floor level for the commercial and retail outlets of 9.1 m AHD which provides which provides 2.55 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level or the commercial uses of 13.3 m AHD which is higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 7.05 m AHD which provides 0.96 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 0.5 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor commercial and retail outlets has a freeboard of around 2.9 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 3 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 7.05 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 3 hours 45 minutes after start of the PMP storm.

Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a slightly shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill each level of the car park to a depth of 0.9 m and to completely full is around 16-20 minutes and around 21-26 minutes respectively**.**

In events less extreme than the PMF but of sufficient severity to overtop the driveway crest level and where the inflow volume is less than the storage volume in the car parking levels then the same flooding behaviour would be expected with flooding initially occurring on both levels but at the time inflows cease floodwaters would then continue to flow down the access ramps until the flood level in the car park reaches its maximum level (ie. Basement Level 4 would fill like a bath tub).

4.4 Duration of Inundation

The estimated maximum times of isolation in a PMF are as follows:

- Ground Floor (at 9.1 m AHD) – Around 1 hours 10 mins
- Car Park Entry (at 7.05 m AHD) – Around 3 hours 35 mins

4.5 Persons at Risk (PAR)

The direct Persons at Risk (PAR) during the PMF was estimated for the Ground Floor and the car parking levels and the indirect PAR was estimated for residents living in apartments at levels higher than the PMF level (Levels 1-6).

In the case of the retail on the Ground Floor, the PAR was based on the approach adopted to estimate the PAR within Warringah Mall previously reported by Cardno, 2007. The PAR for Warringah Mall was based on:

- An estimated average 6,667 visitors to Warringah Mall each trading hour;
- 60% of all visitors are visiting ground floor retailers (estimate provided by Centre Management) giving 4,000 ground floor visitors per hour;
- The area of retail premises that experience overfloor flooding greater than 0.2 m in a 100 yr ARI flood as a proportion of the total ground floor retail area;
- On average 9.2 hours of trading each weekday; and
- On average 15 hours of trading each weekend.

In the case of 26-30 Parkes St the average number of visitors per hour to the Ground Floor was scaled based on the ratio of the floor level of the retail outlets to the area of ground floor retailers at Warringah Mall. This gave an estimate of around 22 visitors per hour to the Ground Floor at 26-30 Parkes St.

The estimated number of persons directly at risk on the Ground Floor under proposed conditions is 8.0 (because it accounts for periods when the retail outlets are not trading).

In the case of commercial offices a unit rate of one worker per 10 m^2 of office space was assumed guided by an allowance for a workstation and access corridor.

The estimated number of workers located on Level 1 is 138. The estimated number of persons indirectly at risk on Level 1 is 35.0 (because it accounts for periods when workers are not present).

The number of residents and/or visitors that would be indirectly at risk during a PMF was estimated based on the following assumed occupancies of apartments.

- 1 Bedroom 1.5 persons
- 2 Bedroom 2.5 persons
- 3 Bedroom 3.5 persons

The following assumptions were also made when estimating the Population at Risk (PAR):

- During day-time hours on weekdays:
  - the average occupancy per apartment over the whole building would be reduced by one person per apartment to account for one resident in each apartment working (this is viewed as a conservative assumption);
  - the average duration of occupancy would be 9 hours per day (out of 10 hours)
  - the average occupancy of each shop was assumed to be 3 persons
  - the average duration of occupancy of the neighbourhood store would be 10 hours per day (out of 10 hours)
- During night-time on weekdays:
  - All residents would reside on site each night ie. the average occupancy per apartment applies over the whole building;
  - the average duration of occupancy would be 14 hours per night (out of 14 hours);
  - the average occupancy of the each shop was assumed to be 3 persons;
  - the average duration of occupancy of each shop would be 4hours per night (out of 14 hours)
- During weekends:
  - the average duration of occupancy of all residents would be 18 hours per day (out of 24 hours)
  - the average duration of occupancy of each shop would be 14 hours per day (out of 24 hours)

In relation to estimating the PAR in car parking levels during a flood the following assumptions were made

- During day-time hours on weekdays:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.25 hours per day;
- During night-time on weekdays:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.25 hours per day;
- During weekends:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.5 hours;

The estimated total number of residents/visitors/retail staff **directly** at risk during a PMF is summarised in **Table 1** while the total number of workers and of residents/visitors that would be indirectly at risk during a PMF (all other levels higher than the PMF) is summarised in **Table 2**.

Table 1 Estimated Population at Risk (PAR) Directly during a PMF

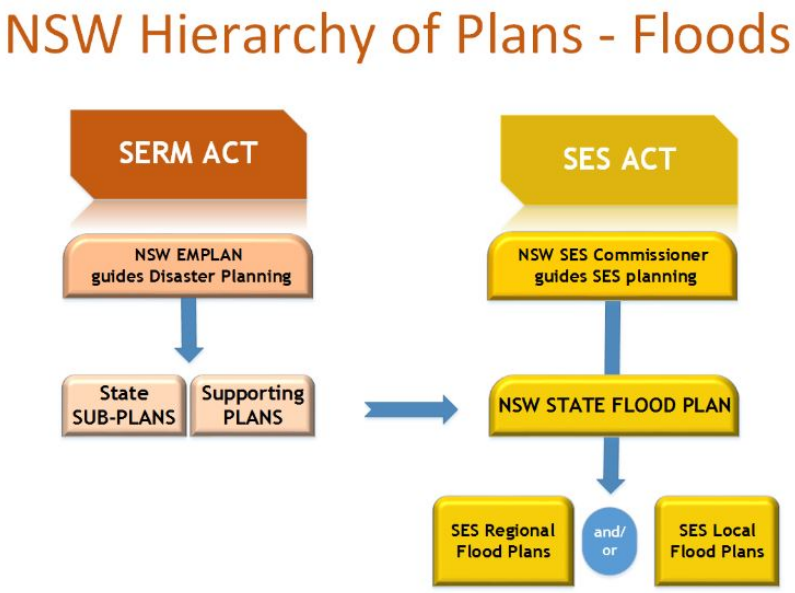
Residents/Visitors directly at Risk		
Ground Floor		Car Parking Levels
No.	PAR	PAR
22	8.0	7.6

Table 2 Estimated Population at Risk Indirectly during a PMF

Workers/Residents/Visitors indirectly at Risk	
No.	PAR
Level 1	
128	35.0
Levels 2 - 35	
436	337.2

5 Emergency Planning

The hierarchy of plans which guide the planning for floods in NSW is as follows:



5.1 2017 NSW State Flood Plan

The NSW State Flood Plan is a sub plan of the State Emergency Management Plan (EMPLAN) (NSW Government, 2017). It has been prepared in accordance with the provisions of the State Emergency Service Act 1989 (NSW) and is authorised by the State Emergency Management Committee in accordance with the provisions of the State Emergency and Rescue Management Act 1989 (NSW).

The latest plan was provisionally endorsed by the State Emergency Management Committee at Meeting 107 held on 5 December 2017.

The purpose of this plan is to set out the arrangements for the emergency management of flooding in New South Wales

As described by the Plan:

> *The Plan sets out the emergency management aspects of prevention; preparation; response and initial recovery arrangements for flooding and the responsibilities of individuals, agencies and organisations with regards to these functions.*
>
> *The Plan recognises the existence of the problem of coastal inundation and erosion caused by severe weather. The management system for dealing with episodes of coastal erosion is described in the New South Wales State Storm Plan.*
>
> *The Plan recognises the existence of the threat posed by tsunami to NSW coastal communities. The arrangements for the emergency management of tsunami are contained within the State Tsunami Emergency Sub Plan.*

This Plan is intended to be read in conjunction with:

(a) The New South Wales State Emergency Management Plan (EMPLAN), of which the State Flood Sub Plan is a sub-plan;
(b) The New South Wales State Storm Plan, which covers arrangements relating to severe storm events; and
(c) NSW Floodplain Development Manual.

5.2 North West Metropolitan District Disaster Plan

On 27th June 2012 the Interim Version of the "North West Metropolitan District Disaster Plan (Displan)" was endorsed by Chairman, State Emergency Management Committee, The Displan was prepared by the North West Metropolitan District Emergency Management Committee in compliance with Section 23 (1) of the State Emergency and Rescue Management Act, 1989, (as amended). The Parramatta LGA is one of the LGAs covered by this plan.

The Plan details emergency preparedness, response and recovery arrangements for the North West Metropolitan Emergency Management District, Local Emergency Management Areas and local government. It recognises that many of the details contained in the plan are similar to those contained in Local Plans and therefore this Plan may be utilised and applied at a local level in conjunction with a Local Displan.

The Plan's aim is to ensure a controlled response to emergencies by all agencies having responsibilities and functions in emergencies, (Section 12 (2) of the SERM Act), and it reflects and applies in conjunction with arrangements agreed to at State level and detailed in the State Disaster Plan

5.3 Parramatta DISPLAN

The Parramatta Disaster Plan (DISPLAN) released in 2010 details arrangements for preparing for, responding to and recovering from emergencies within the City of Parramatta.

As described in the plan, *it encompasses arrangements for:*

a) Incidents controlled by combat agencies.
b) Emergencies controlled by combat agencies and supported by the Local Emergency Operations Controller.
c) Emergency operations for which there is no combat agency.
d) Circumstances where a combat agency has passed control to the Local Emergency Operations Controller

The area covered by the plan comprises the whole of the City of Parramatta.

The Plan is based upon operation during both normal business hours and outside of normal business hours and takes into consideration special events that may from time to time operate outside and during normal business hours.

Transportation of people will be by either government/private transport or by private vehicle, with numbers and method dependant on circumstances and location of emergency.

Each agency with a statutory role has in place arrangements which detail that agency's response.

Each Emergency Service Organisation and Functional Area has in place an appropriate supporting plan/operational procedures which detail that agency's response.

It is expected that in the Parramatta CBD that Building Owners, Managers and Tenants will be provided with education regarding their responsibilities in both evacuation and general building emergency management. It is accepted that all buildings where required will have in place a practised Emergency Management Plan in line with AS 3745 and as per NSW OH&S Regulation 2001

Section 23 of the DISPLAN discusses evacuation as follows:

23. EVACUATION

a) The LEOCon, in consultation with the Combat Agency, will determine the need for evacuation.
b) Police will control and coordinate the evacuation of persons to the chosen Safe site or marshalling point and supervise disaster victim registration.
c) Transport resources will be arranged through and coordinated by the transport functional area coordinator, if private vehicles are not available.
d) The LEOCon will determine, in consultation with the Combat Agency, when return of evacuees is possible.

Concept of Operations

The evacuation process is based on a 5 stage process

i) Decision to Evacuate
ii) Warning
iii) Withdrawal
iv) Shelter
v) Return

The concept of operations for an emergency in the Parramatta CBD can be summarised as:

Emergency occurs or is imminent in the CBD:

Buildings may/may not begin self evacuation due to the emergency;
Public transport systems are disrupted, resulting in Transport/Traffic plans being enacted to provide an emergency service;
Emergency Service Agencies begin deployment in accordance with normal arrangements;
An area requiring Evacuation is identified;
When deemed safe to do so, "return" advised through Displan arrangements, and may include some caveats;
Throughout, the Emergency Services and Functional Area agencies continue to deal with the particular emergency.

Withdrawal

If there is a decision to evacuate, or a self-evacuation commences, there is a need to follow a process to move people to a place of safety while the status of the transport system is assessed and arrangements are made to move people out of the Parramatta CBD.

The withdrawal stage for the CBD is based on the following philosophy.

Building to Assembly Area (covered by individual building evacuation plans)
Assembly Area to Safe sites in accordance with the CBD evacuation plan or this plan (based on building location) OR
Safe sites in accordance with the CBD evacuation plan or this plan

Control Measures

For the purpose of this plan, the Parramatta CBD has been divided into three (3) zones (refer to map on Anexure 2)

- *Ollie Webb Reserve*
- *Macarthur Girls High School*
- *Parramatta Golf Course*

In the event of an emergency which severely disrupts transport and requires an evacuation of an area of the CBD, the control arrangements will recommend business and residents to either:

Stay at Work

This is used for all areas of the CBD (and surrounds) where the public are not directly threatened by the emergency. It may also imply that public transport may be affected and/or may not be available. This message is intended to stop or reduce the incidence of the public rushing to transport sites or exiting by private vehicles, thus allowing time for transport/traffic services to be re-established.

Stay at Work protocols assist in achieving a desired response for business and residents in the areas of the CBD unaffected by the emergency, such as:

To carry on normal business;
Advise staff and others on their site that an emergency has resulted in a disruption to public and private transport, and to allow for communication updates.

Shelter in Place

This is used when it is assessed that for safety of the occupants of a building(s) or for control reasons, it is safer for occupants to remain in the building than to be on the streets. The time required to Shelter in Place will depend on the nature of the emergency.

CBD Residents/Permanent and Temporary

People who live in the area to be evacuated and those from temporary accommodation (hotels etc), will be directed to an Evacuation Centre (Refer to Parramatta Displan Sections 6.8. 1) and if necessary to temporary accommodation under the control of the Department of Community Services as per DISPLAN arrangements.

Commuters

People who are evacuated to their residence (as per a normal business day) will not receive further specialist management under this Annexure once their journey has concluded.

Evacuate to Safe Sites or Evacuation Centres

This is used as a control measure to identify those areas that require evacuation for safety and/or control reason. It is the intent to minimize the area of the CBD that is evacuated, noting that some emergencies may require the evacuation of some sections or large sections, if not all of the CBD.

People evacuated to Parramatta safe site will be requested to:

> *Remain in position until further information is available, or*
> *Make their way to other parts of the city and delay their journey home, or Make their way to specific transport terminals for movement out of the city, or Identify themselves if they have specific needs or Move to an Evacuation Centre, or Combinations of the above.*

Support will be provided to people in Safe Sites or Evacuation Centres in accordance with this plan.

Return

LEOCON, in consultation with the combat agency and/or Functional Area, if applicable, will allow the area to be reoccupied when it is safe to do so in accordance with this plan

Building Owners and Managers

It is accepted that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

It is expected that all building Emergency Management Plans are to contain details of the most relevant Parramatta Safety Site. All wardens trained under the building emergency plan are to be aware of the Parramatta Safety Sites, routes to the site and how to liaise with the building occupants at the site.

It is accepted that all building Emergency Management Plans are to contain detail of how the information regarding an evacuation will be disseminated from the Chief Warden to occupants of the building.

It is noted that a copy of the Parramatta CBD Evacuation Plan was not located in the time available to prepare this advice.

It is noted also that the 2010 Parramatta DISPLAN, states in part that:

i) the intent is to minimize the area of the CBD that is evacuated, noting that some emergencies may require the evacuation of some sections or large sections, if not all of the CBD; and
ii) shelter in place is used when it is assessed that for safety of the occupants of a building(s) or for control reasons that it is safer for occupants to remain in the building than to be on the streets.

It is expected that this is also the intent for the all other areas within the LGA outside the CBD.

5.4 Local Plan

The 2010 Parramatta DISPLAN states that there are no sub-plans or supporting plans.

5.5 Sizing Temporary Flood Refuge

Two primary sources of information were located when considering the size of a temporary flood refuge:

- Building Code of Australia (BCA, 2008)[1]
- US Flood Emergency Management Authority (FEMA, 2000)[2].

As outlined above, the Building Code of Australia (2008) stipulates that an area of public assembly such as halls or theatres should have a maximum density of 1 m^2 per person (BCA, 2008). FEMA, 2000 recommends a minimum of 0.45 m^2 per person for tornado shelters.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place.

Based on the estimated peak number of persons that could be at risk in the car park and on the Ground Floor retail outlets the estimated maximum area of refuge required is 60 m^2.

It is expected that this refuge would be provided by the communal area on Level 4 which far exceeds the required area of refuge.

[1] Building Codes of Australia (2008 Edition). *Part D Access and Egress. D1.13 Number of Persons Accommodated*

[2] FEMA (2000) *Design and Construction Guidance for Community Shelters*, Federal Emergency Management Agency, Mitigation Directorate, FEMA361, 1st Ed., July 2000

6 Flood Emergency Response

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers (in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations) are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

6.1 Flood Warning

Discussions with the NSW SES have previously identified the following status of flood warnings for the Parramatta CBD:

- The Bureau of Meteorology does not prepare flood predictions for the Parramatta River;
- Only a Draft Flood Warning Plan has been prepared to date by the NSW SES. This draft was prepared a number of years ago and while it is planned that it will be updated this does not have a high priority in view of the level of flood protection in the Parramatta CBD that has been achieved by various works undertaken in the upper catchment including the Loyalty Road basin.
- Trigger levels for flood warning have not been identified for the Parramatta CBD

Other sources of information regarding approaching severe weather conditions which could cause potential flooding at the site including:

- The Bureau of Meteorology through their website (www.bom.gov.au);
- Observation of local rainfall;
- The local SES (http://parramatta-ses.com);
- Parramatta City Council Emergency Management Officer;
- Local television stations; and/or
- Local radio stations.

An important indication of likely imminent flood activity would be intense local rainfall and residents, retail workers and visitors should take notice of extreme rainfall warnings issued by the Bureau of Meteorology and disseminated by local media.

6.2 Draft Flood Emergency Detailed Response Plan

Flood Threat

The site is not inundated by floodwaters in a 100 yr ARI event and is only subject to inundation in extreme flood events approaching the PMF.

The proposed floor levels for the development are:

- Basement Level 4 Car Park: -2.1m AHD;
- Basement Level 3 Car Park: +0.7 m AHD
- Basement Level 2 Car Park: +3.5 m AHD;
- Basement Level 1 Car Park: +6.3 m AHD
- Basement Car Park driveway crest level: +7.05 m AHD

- The ground floor level for retail outlets: +9.1m AHD
- The floor levels for Levels 2-35 are all above the PMF level.

The indicative magnitudes of flood events in Clay Cliff Creek which would initiate over-floor inundation of the ground floor and the driveway are as follows:

- The ground floor level for retail outlets: +9.1m AHD (around 350,000 yr ARI)
- Basement Car Park driveway crest level: +7.05 m AHD (around 1,200 yr ARI)

Responsibilities

In a flood emergency the NSW State Emergency Service (SES) has responsibilities including to:

- Direct the evacuation of persons and/or communities at risk of flood inundation.
- Issue evacuation warnings for individual communities that describe possible local effects, suggested actions and evacuation arrangements.

The building on-site manager shall liaise with the SES, monitor flood warnings and maintain regular communication with staff, workers and residents.

Preparedness

Visitors, retailers, workers and residents shall be advised of the potential flood threat in their locality, and recommended management and evacuation procedures in case of a flood event. They will comply with all lawful directions.

It is recommended that a practice evacuation drill or meeting is organised by management for retail staff and residents every 2 years.

Response

While in a flood event, the SES will prepare, authorise and distribute evacuation warnings it is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any residents, workers and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

Warning

The SES will advise regarding potential evacuations of properties. While in a flood event, the SES will prepare, authorise and distribute evacuation warnings it is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

Recovery

The SES will issue an ‘all clear’ message when the immediate danger to life and property has passed.

7 Assessment of Council Requirements

7.1 Parramatta DCP 2011

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. The development is located almost wholly in a Low Flood Risk Precinct (refer **Figure 15**).

Consequently the development has been assessed against the planning and development controls that apply to "Residential" in a Low Flood Risk Precinct. These controls are identified in **Table 3** and are discussed as follows.

Floor Levels

2. *Habitable floor levels to be equal to or greater than the 100 year ARI flood level plus freeboard*

   The proposed floor level of the Ground Floor retail outlets is 9.1 m AHD which provides which provides 2.55 m freeboard to the indicative 100 yr ARI flood level under climate change.

5 *A restriction is to be placed on the title of the land, pursuant to S.886 of the Conveyancing Act, where the lowest habitable floor area is elevated more than 1.5 m above finished ground level, confirming that the subfloor space is not to be enclosed.*

   This requirement is not applicable to the planning proposal.

Table 3 PCC Floodplain Matrix

Table 2.7: FLOODPLAIN MATRIX

Planning & Development Controls

Planning Consideration	Flood Risk Precincts (FRP's)																										
	Low Flood Risk									Medium Flood Risk									High Flood Risk								
	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development
Floor Level		3			2, 5	2, 5	2, 5							2, 5	2, 5	2, 5	1, 5	4, 5								1, 5	4, 5
Building Components		2												1	1	1	1	1								1	1
Structural Soundness		2												1	1	1	1	1								1	1
Flood Affectation		2	2	1	2	2	2					1		1	1	1	2	1								1	1
Car Parking & Driveway Access		1, 3, 5, 6			1, 3, 5, 6	1, 3, 5, 6	1, 3, 5, 6	2, 4, 6, 7						1, 3, 5, 6, 7	1, 3, 5, 6, 7	1, 3, 5, 6, 7	2, 4, 6, 7	1, 5								2, 4, 6, 7	1, 5
Evacuation		2, 4, 6	5		3, 4	4	4					5, 3, 4		3, 4, 6	3, 4, 6	3, 4, 6	1, 4	3, 6								1, 4	3, 4 6
Management & Design		2, 3, 4	1									1		2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4								2, 3, 4	2, 3, 4

Not Relevant Unsuitable Land Use * For redevelopment of an existing dwelling refer also to ' Concessional Development' provisions

i. Freeboard equals an additional height of 500mm.

ii. The Parramatta LEP 2011 identifies development permissible with consent in various zones. 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 Clause 6.7 Foreshore Building Line in the Parramatta LEP 2011.

Floor Level	
1	All floor levels to be equal to or greater than the 20 year Average Recurrence Interval (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 Probable Maximum Flood (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 alternations 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	An engineers report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year ARI flood level plus freeboard.
2	An engineers report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF level.
Flood Affectation	
1	An engineers report is required to certify that the development will not increase flood affectation eleswhere, 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 cumulate 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 is to demonstrate the development is consistent with any relevant flood evacuation strategy or similar plan.
5	Applicant is 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 is 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 is 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.

Flood Affectation

2 *The impact of the development on flooding elsewhere to be considered having regard to the three factors listed in consideration 1 above .*

This report satisfies this requirement. See following

1 *An engineer's report is 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 cumulate impact of multiple potential developments in the vicinity.*

It is concluded that the planned development has a negligible impact on 100 year ARI and PMF levels.

It is further concluded from the negligible impact of the proposed development on design flood levels that additional compensatory flood storage is not necessary as part of this development.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity in 114 Harris Street while lowering the peak velocity in Parkes Street in the vicinity of 18-24 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 26-30 Parkes Street the velocity x depth in a PMF adjacent to the site in Harris Street and Parkes Street is < 0.4 m^2/s. In a PMF the planned development locally increases the flow velocity x depth in 114 Harris Street and in the southeast corner of 24 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High while in Parkes Street adjacent to the site it is Low. The impact of the planned development on provisional hazard is negligible.

The cumulate impact of multiple potential developments in the vicinity has been previously represented in the floodplain model assembled during the 2005 Lower Parramatta River Floodplain Study and is already incorporated in the resulting flood levels adopted by Council.

The cumulative impact of the proposed development of 24 Parkes Street, 26-30 Parkes Street and 114-118 Harris Street was also undertaken.

It is concluded that the planned cumulative development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels upstream of 24 Parkes Street.

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.*

   This requirement is not applicable to the proposed development.

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 0.5 m above the 100 year ARI flood level.*

   The proposed development complies with this requirement.

5. *The level of the driveway providing access between the road and parking spaces shall be no lower than 0.2 m below the 100 year ARI flood level.*

   The proposed development complies with this requirement.

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.*

   These systems and information are to be incorporated in the building emergency plan.

Evacuation

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.*

   It is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any workers, residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place. Under these circumstances the expected time that visitors and/or residents would need to shelter in place during a PMF would be around 1 hours 10 minutes (ground floor) while the car park entry at Harris Street (at 7.05 m AHD) would be inundated for up to 3 hours 35 mins.

4 *Applicant to demonstrate the development is consistent with any relevant flood evacuation strategy or similar plan.*

   Discussed in Section 5 of this report.

It is concluded that the merit assessment detailed above and the recommendations given in Section 6 satisfy the requirements of the Parramatta DCP 2011.

8 Summary and Conclusions

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 26-30 Parkes Street, Parramatta. The subject site is located on the Clay Cliff Creek floodplain just upstream of Harris Street.

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising four levels of basement car parking, 2 levels of commercial retail outlets, 33 levels of residential apartments, one level of communal area and open space and a rooftop bar.

The flooding assessment methodology is outlined as follows:

- Impact of planned development on flooding
- Climate change impact on flooding
- Flood emergency response
- Flood warning and evacuation
- A draft emergency response plan
- Compliance with requirements of Parramatta DCP 2011

8.1 Previous Flood Assessments

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

8.2 Flood Impact Assessment

The assessment of the impact or otherwise of development on 26-30 Parkes Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

Flood models were established for the existing site conditions and future developed scenarios. The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by Project Tourism International Architecture (attached in **Appendix C**).

Flood modelling was completed for the 100 year ARI, and Probable Maximum Flood events.

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2220) adopted by Council:

- 100 year ARI: 6.19 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.30 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.19 m AHD.

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively. It is concluded that the planned development has a negligible impact on 100 year ARI and PMF levels.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.5 m/s) except along the Clay Cliff Creek channel. The impact of the planned development on flow velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) and in Parkes Street east of Wigram Street are generally low (up to 0.3 - 0.6 m/s). In a PMF the planned development locally increases the flow velocity in 114 Harris Street while lowering the peak velocity in Parkes Street in the vicinity of 18-24 Parkes Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The impact of the planned development on flow velocity x depth is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location and in Parkes Street east of Wigram Street also varies depending on location. In the case of 26-30 Parkes Street the velocity x depth in a PMF adjacent to the site in Harris Street and Parkes Street is < 0.4 m^2/s. In a PMF the planned development locally increases the flow velocity x depth in 114 Harris Street and in the southeast corner of 24 Parkes Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High while in Parkes Street adjacent to the site it is Low. The impact of the planned development on provisional hazard is negligible.

8.2.1 Flood Risk Precinct

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. While the site is mapped as Low Flood Risk with a very minor area of Medium Flood Risk based on the XP-SWMM 1D/2D results the site would be solely mapped as Low Flood Risk based on mapped extents of 100 yr ARI flooding and hazard as given in in Council's Flood Map attached in **Appendix B**.

8.2.2 Rate of Rise of Floodwaters

Features of the planned development include:

- Ground levels which vary from 8.78 m AHD in the southwest corner to 7.19 m AHD in the northeast corner of the property;
- Proposed ground floor level for the commercial and retail outlets of 9.1 m AHD which provides which provides 2.55 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level or the commercial uses of 13.3 m AHD which is higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 7.05 m AHD which provides 0.96 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 0.5 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor commercial and retail outlets has a freeboard of around 2.9 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 3 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 7.05 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 3 hours 45 minutes after start of the PMP storm. Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.
It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a slightly shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill each level of the car park to a depth of 0.9 m and to completely full is around 16-20 minutes and around 21-26 minutes respectively**.**

8.3 Emergency Planning

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

A draft Emergency Response Plan is outlined.

8.4 Flood Emergency Response

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place. Based on the estimated peak number of persons that could be at risk in the car park and in Ground Floor the estimated maximum area of refuge required is 60 m^2. It is expected that this refuge would be provided by the communal area on Level 4 which far exceeds the required area of refuge.

8.5 Assessment of Council Requirements

The development is located almost wholly in a Low Flood Risk Precinct. Consequently the development has been assessed against the planning and development controls that apply to “Residential” in a Low Flood Risk Precinct.

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. An assessment of the compliance of the proposed development with Council’s requirements is given in Section 7 of this report.

It is concluded that the assessment and details in this Flood Impact Assessment satisfy the requirements of the Parramatta DCP 2011.

9 References

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SKM (2013) “Flood Control Study for Rosehill/Camellia”, *Final Report*, prepared for Parramatta City Council, 8 March 2013.

26-30 Parkes Street, Harris Park

APPENDIX A
FIGURES

Cardno
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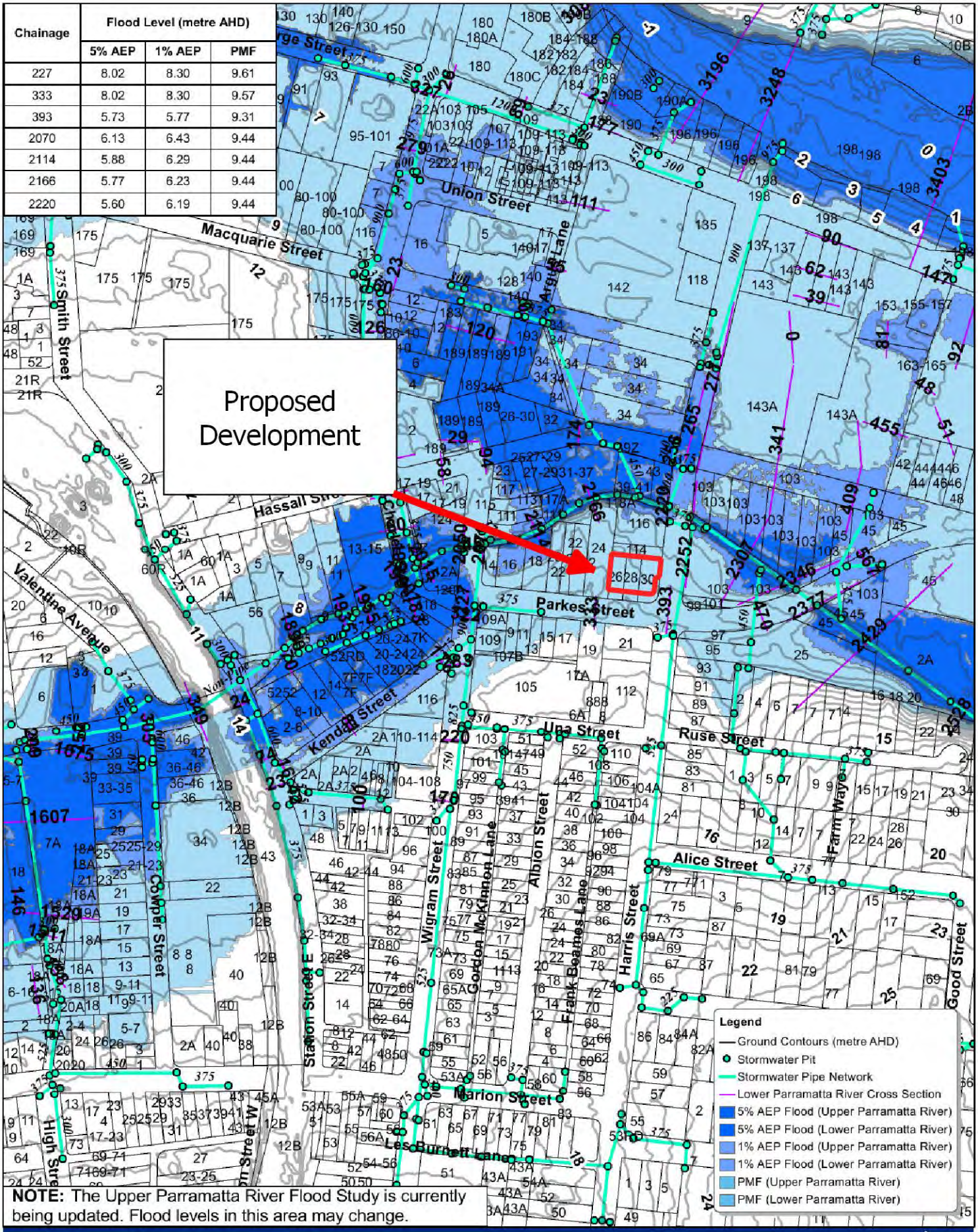

Figure 1 Locality Plan (Source: Parramatta City Council Flood Map)

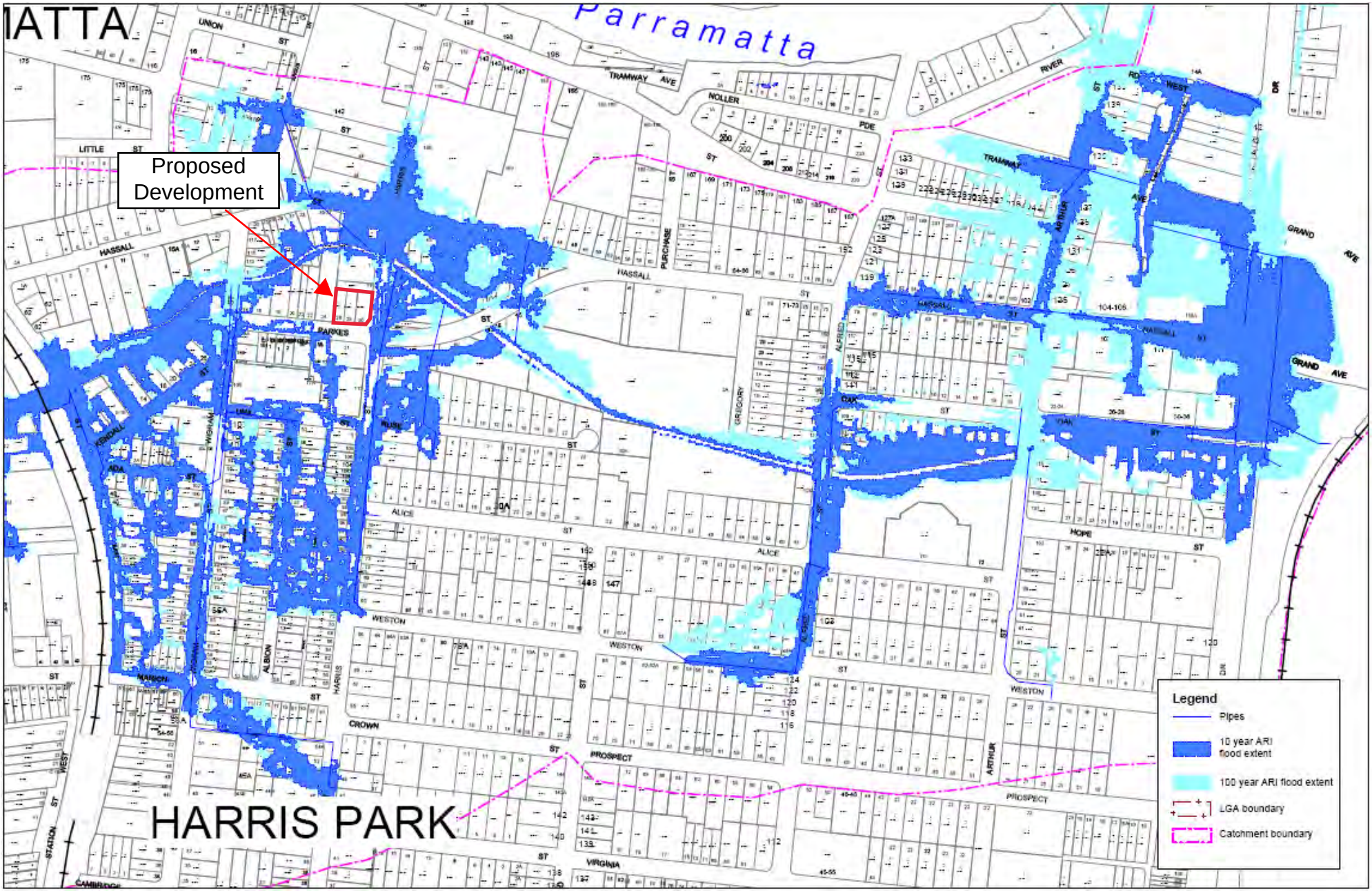

Figure 2 10 yr ARI and 100 yr ARI flood extents – Clay Cliff Creek (after Cardno Willing, 2007)

Cardno
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26 - 30 Parkes St

Existing Conditions

Figure 3

Floodplain Terrain

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

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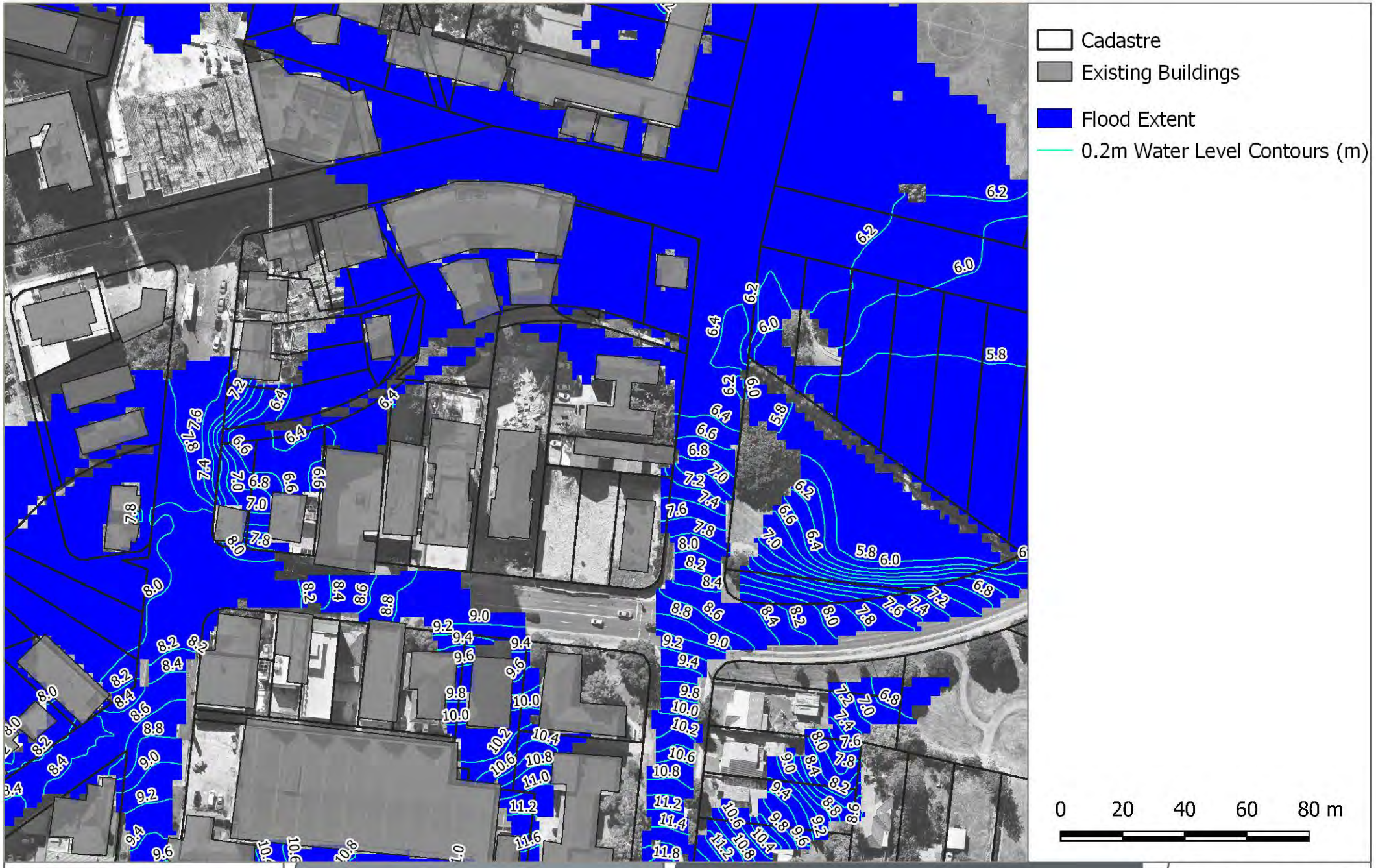
26 - 30 Parkes St
Existing Conditions

Figure 4
Floodplain Roughness

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
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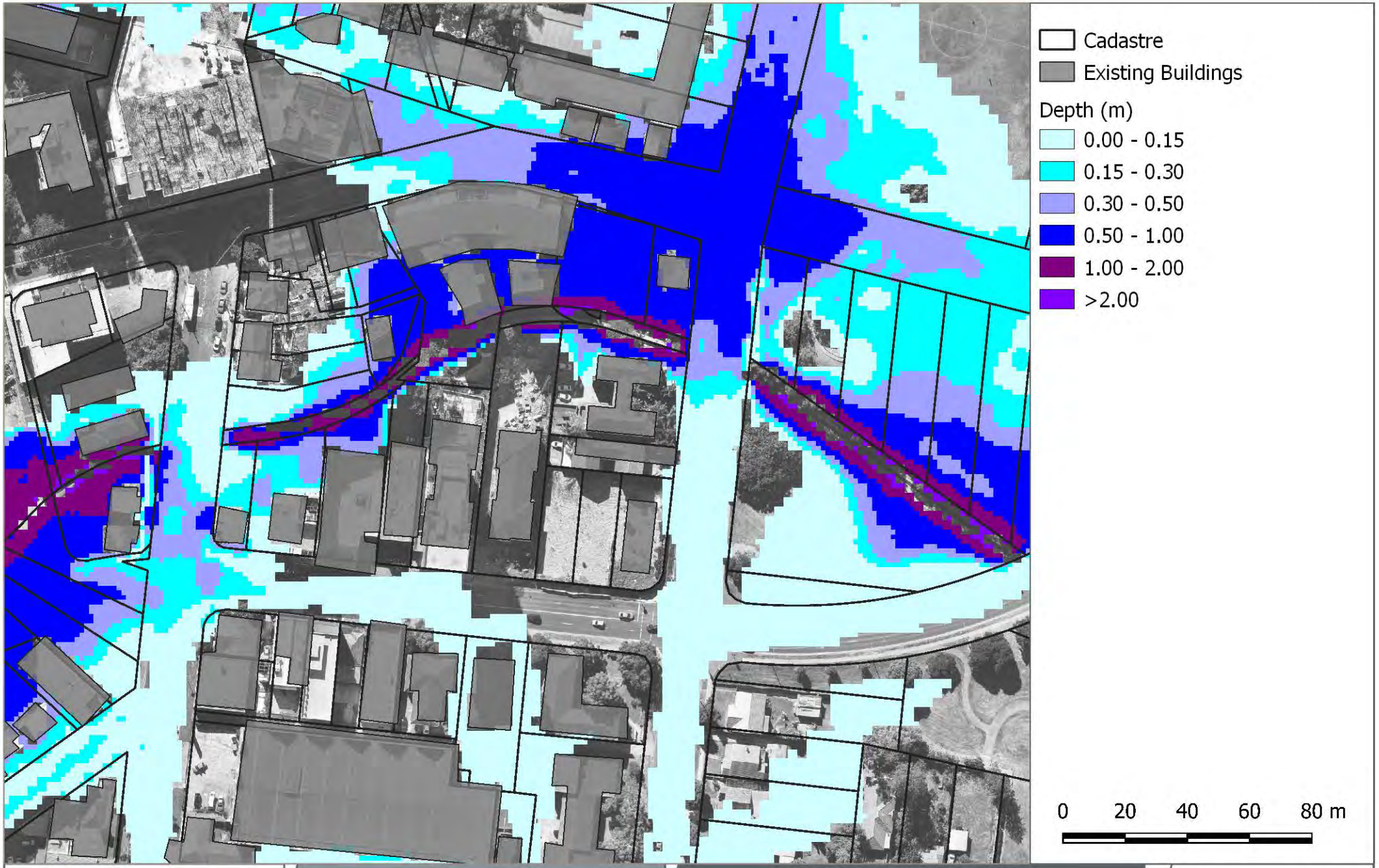
26 - 30 Parkes St
Existing Conditions

Figure 5
1% AEP Flood Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
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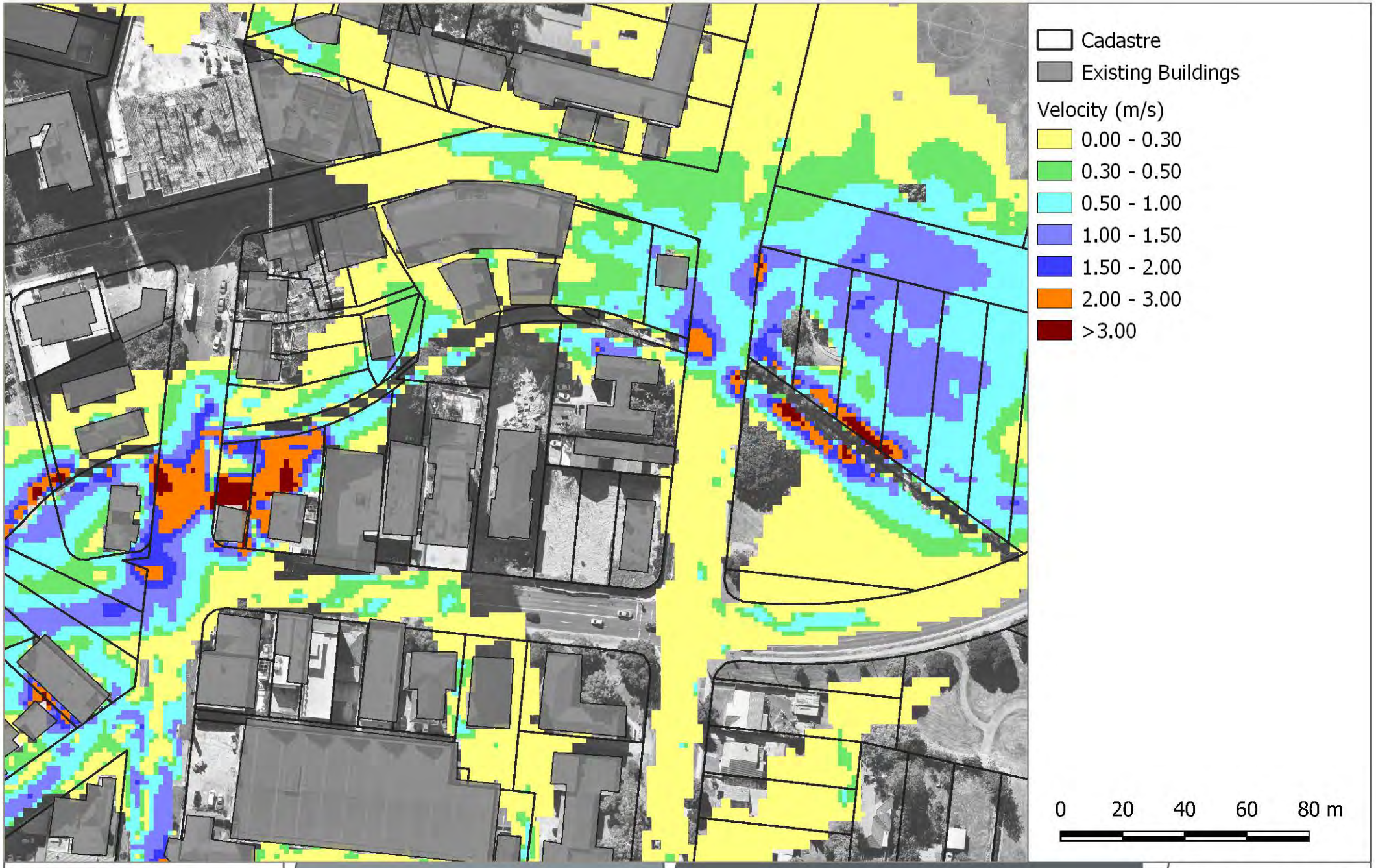
26 - 30 Parkes St
Existing Conditions

Figure 6
1% AEP Peak Flood Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
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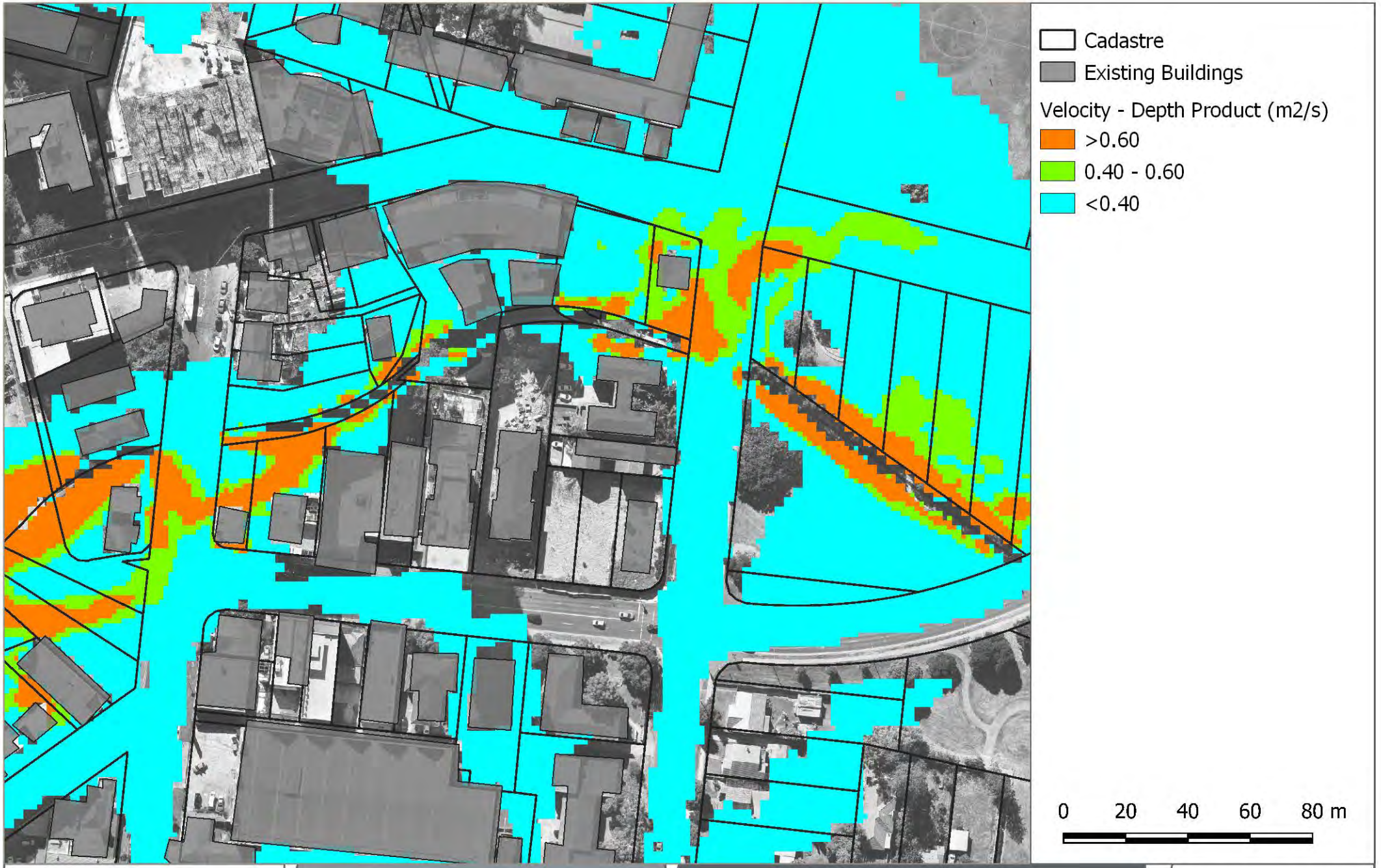
26 - 30 Parkes St
Existing Conditions

Figure 7
1% AEP Peak Flood Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



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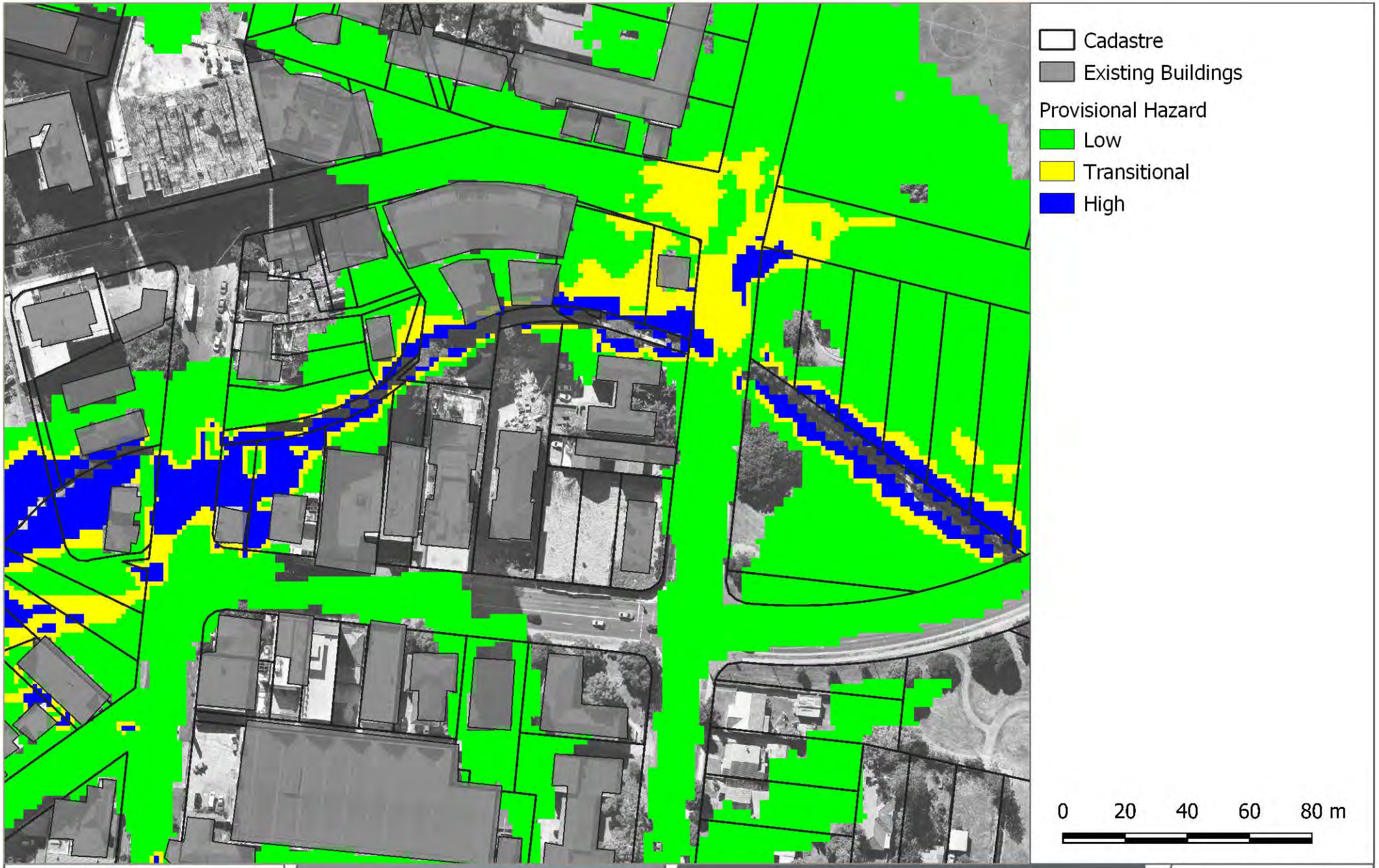
26 - 30 Parkes St
Existing Conditions

Figure 8
1% AEP Peak Flood Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



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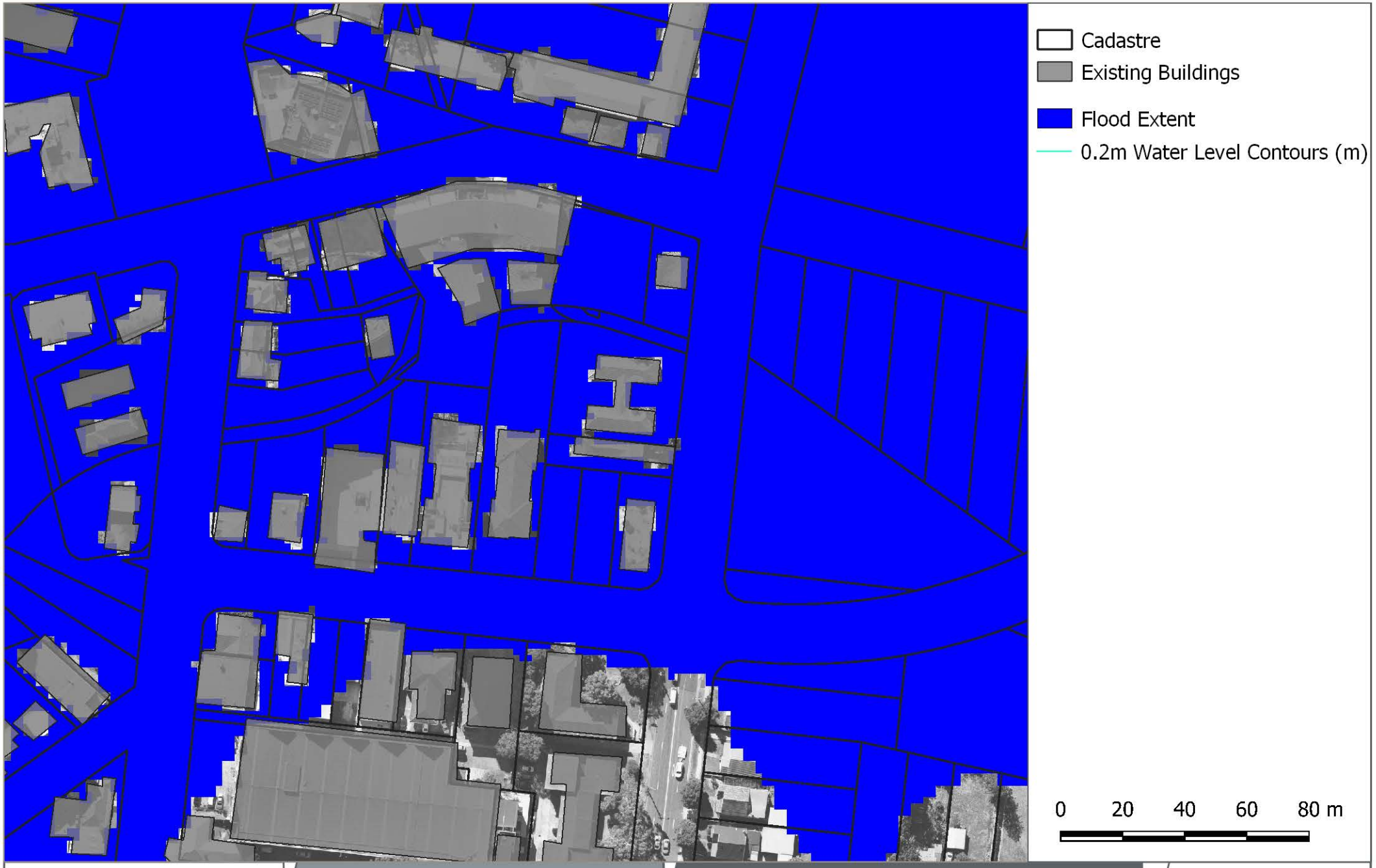
26 - 30 Parkes St
Existing Conditions

Figure 9
1% AEP Peak Flood Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
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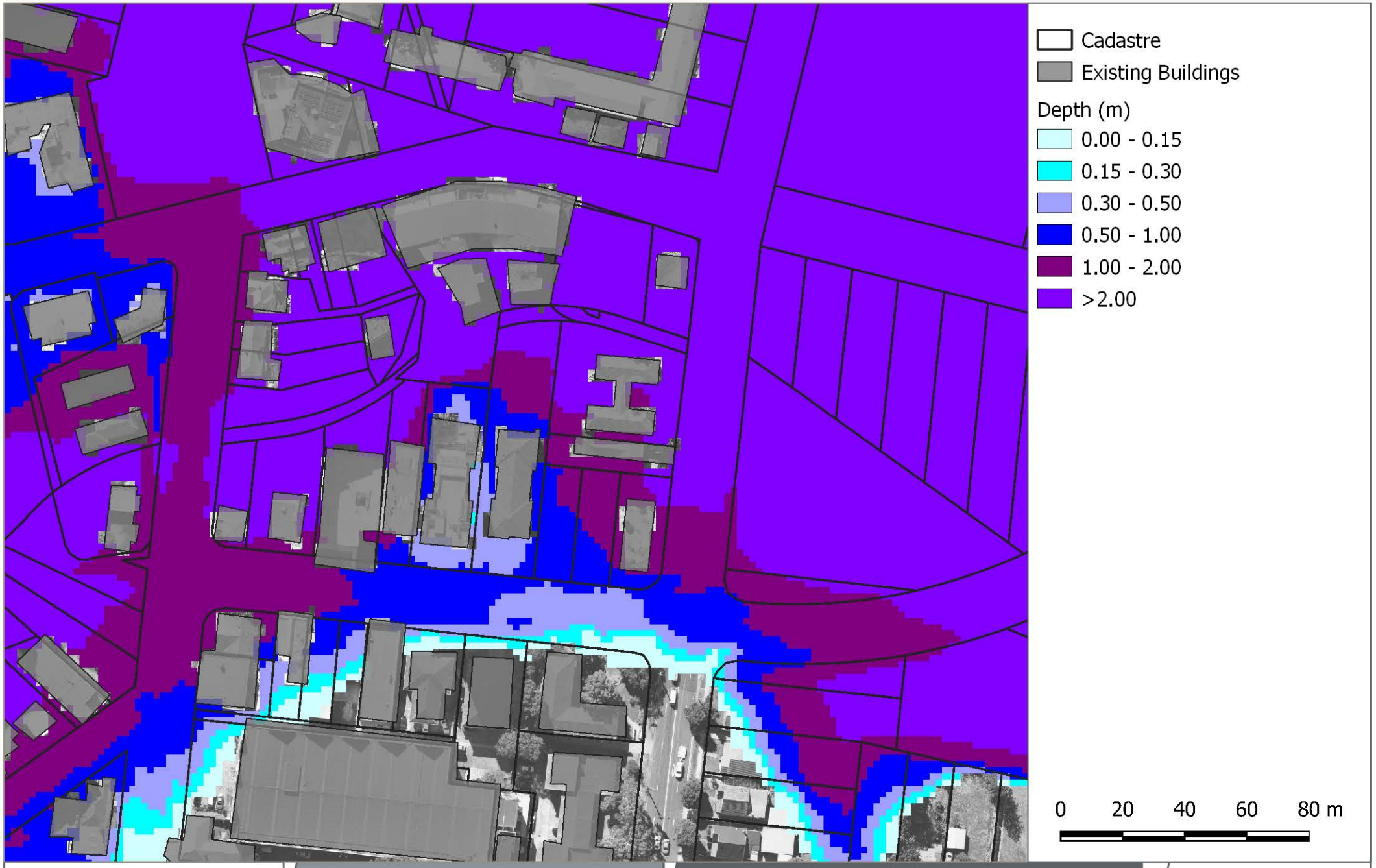
26 - 30 Parkes St
Existing Conditions

Figure 10
PMF Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



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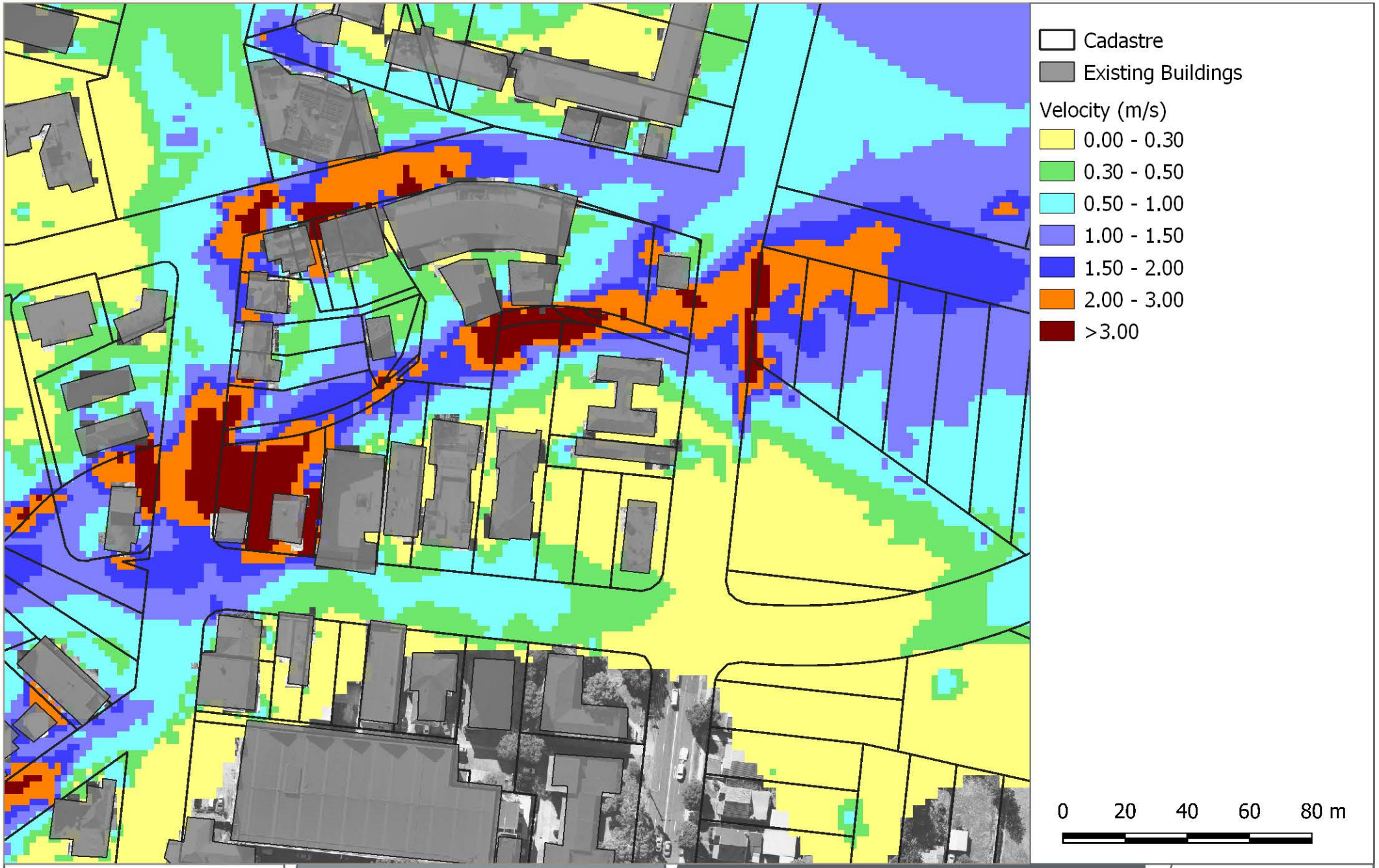
26 - 30 Parkes St
Existing Conditions

Figure 11
PMF Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



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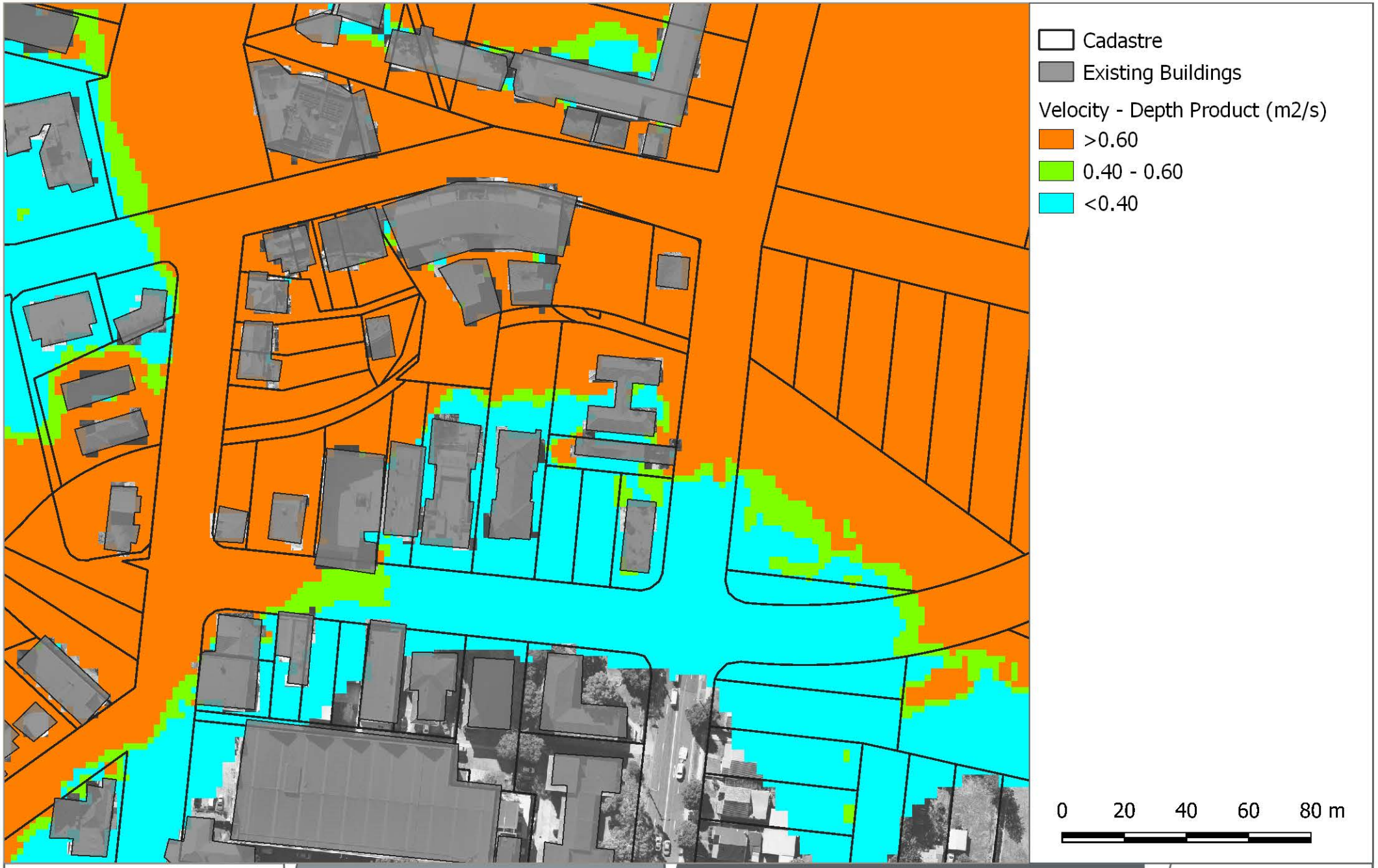
26 - 30 Parkes St
Existing Conditions

Figure 12
PMF Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

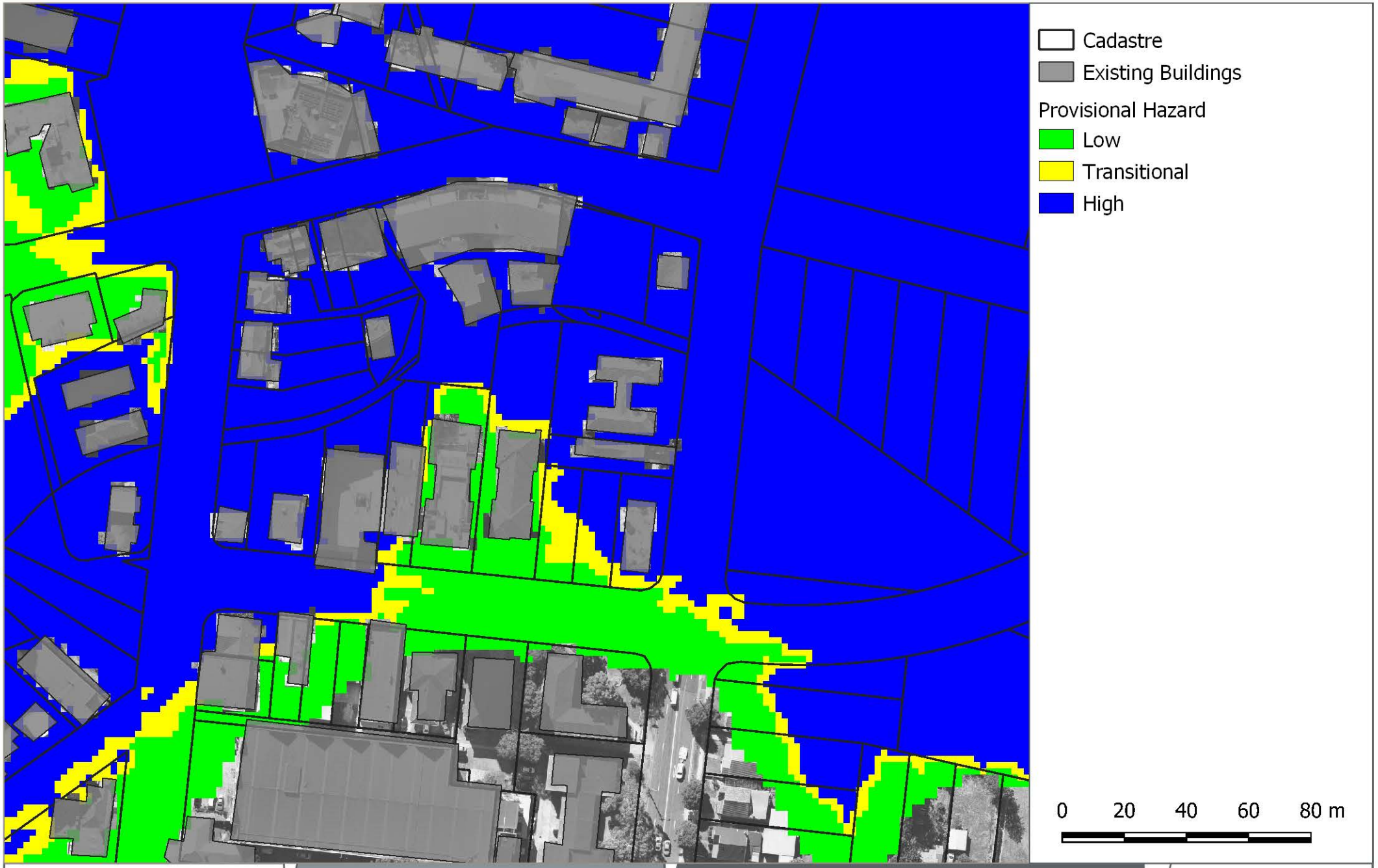


Cardno
Shaping the Future

26 - 30 Parkes St
Existing Conditions

Figure 13
PMF Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

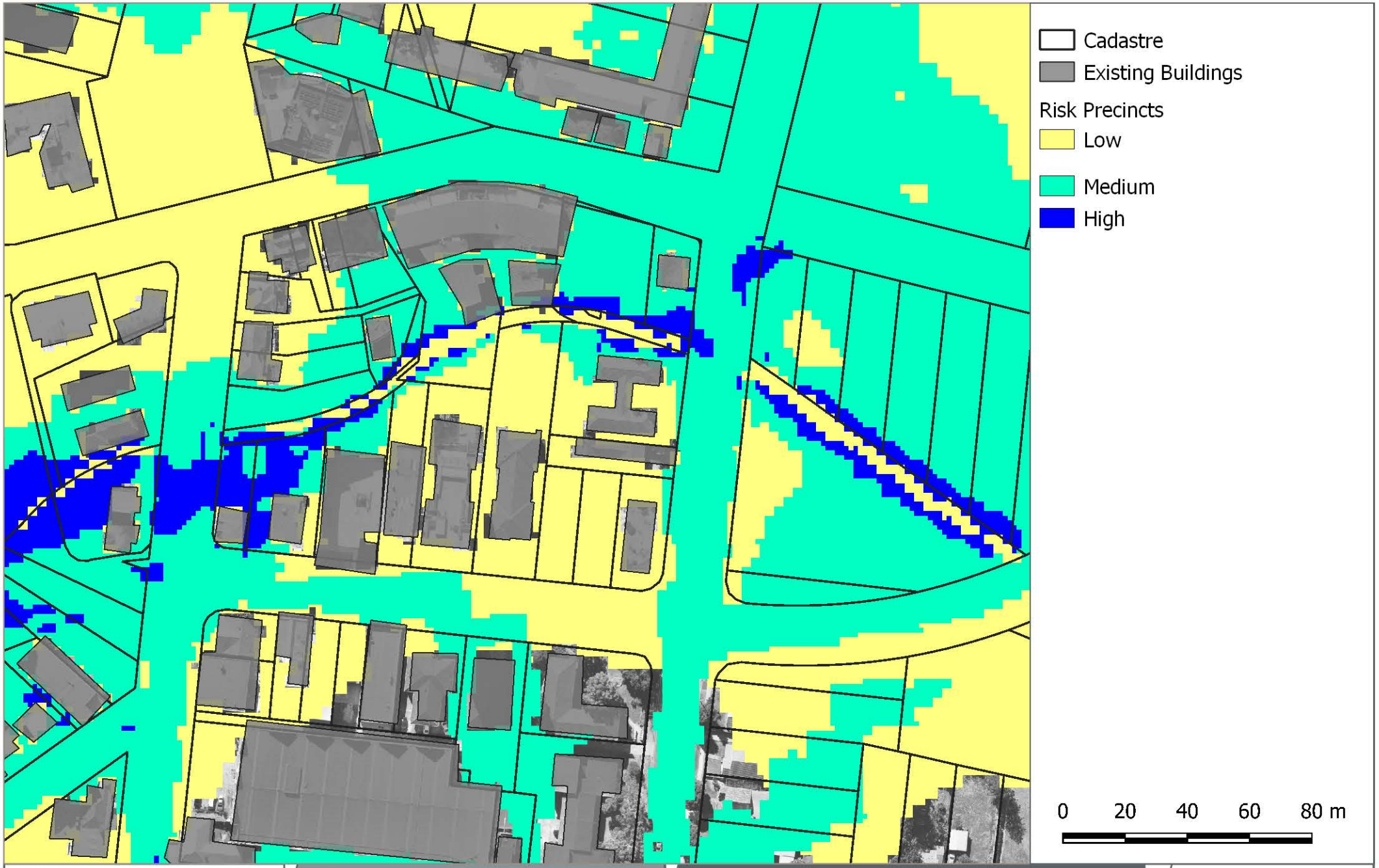


Cardno
Shaping the Future

26 - 30 Parkes St
Existing Conditions

Figure 14
PMF Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
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26 - 30 Parkes St
Existing Conditions

Figure 15
Flood Risk Precincts

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

Cardno
Shaping the Future

26 - 30 Parkes St

Future Conditions

Figure 16

Floodplain Terrain

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

Cardno
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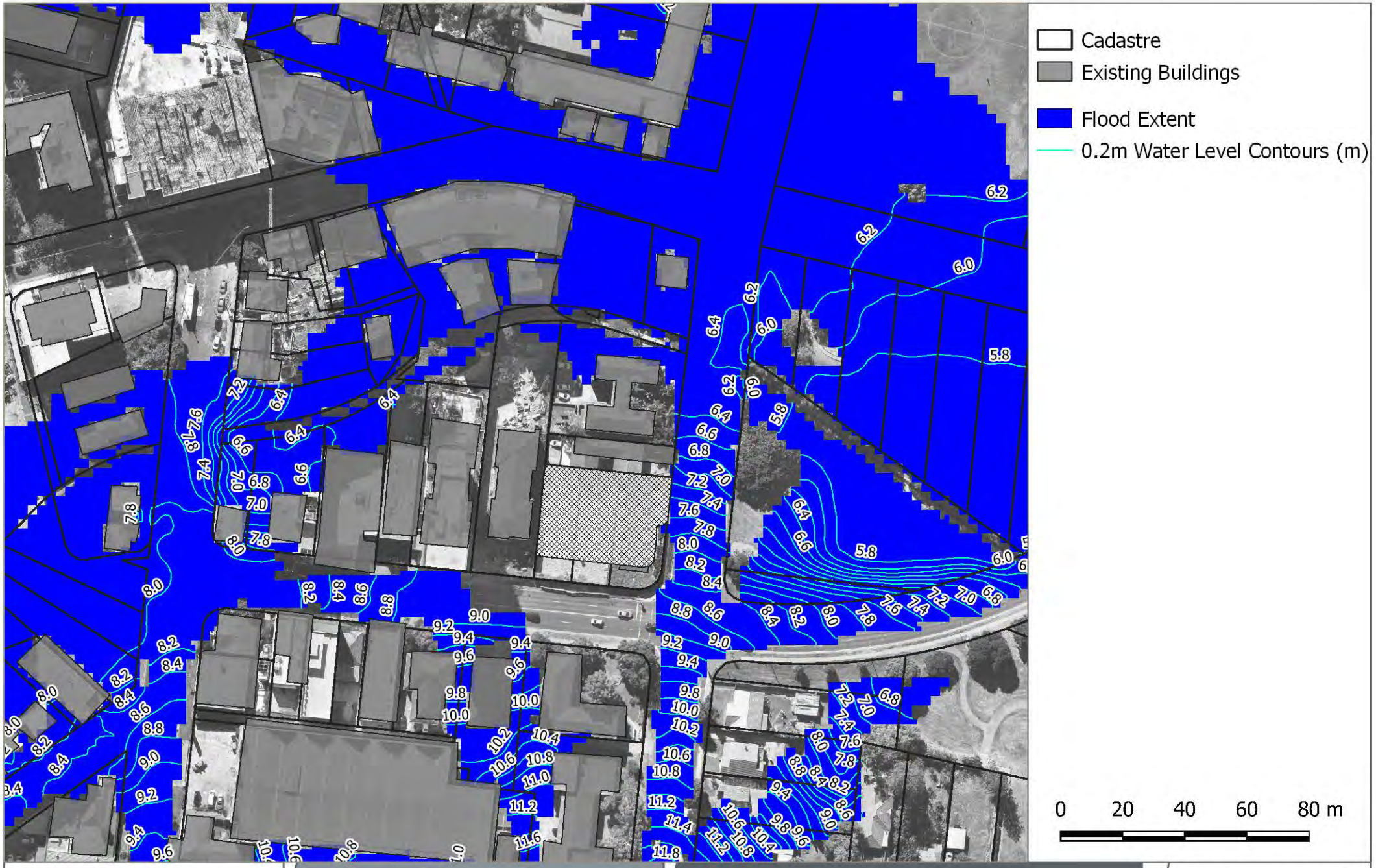
26 - 30 Parkes St
Future Conditions

Figure 17
Floodplain Roughness

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

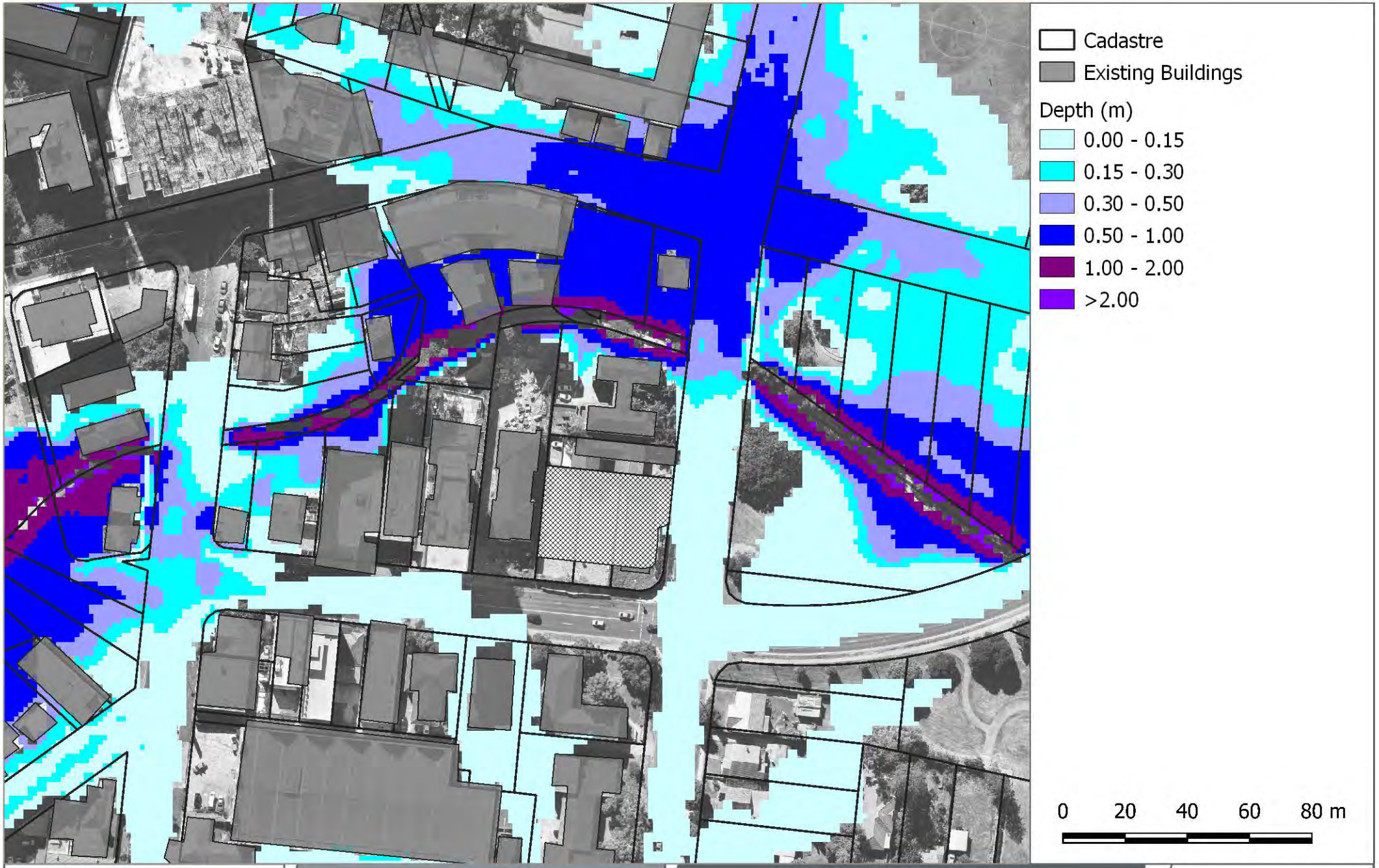


Cardno
Shaping the Future

26 - 30 Parkes St
Future Conditions

Figure 18
1% AEP Flood Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
Shaping the Future

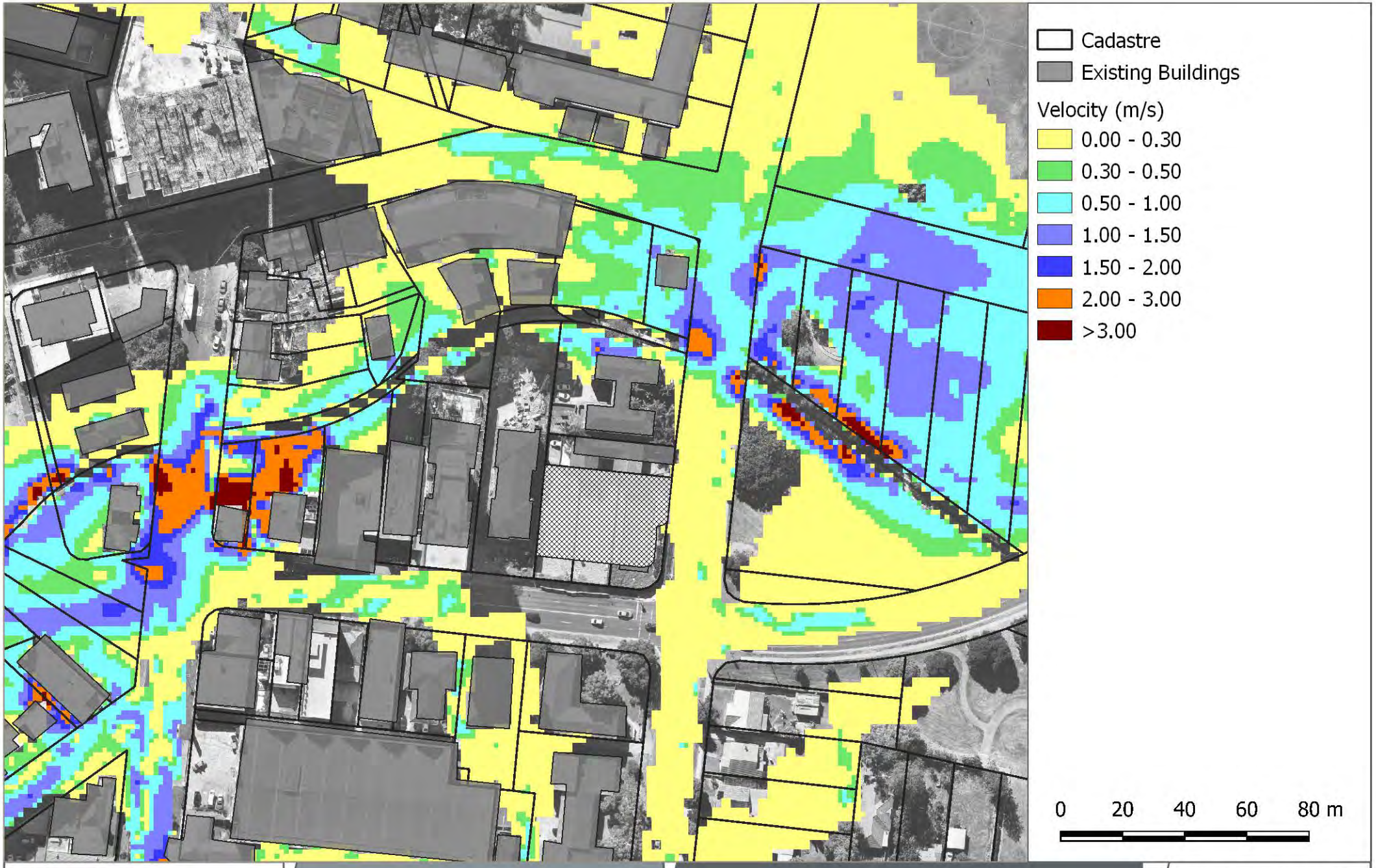
26 - 30 Parkes St

Future Conditions

Figure 19

1% AEP Peak Flood Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
Shaping the Future

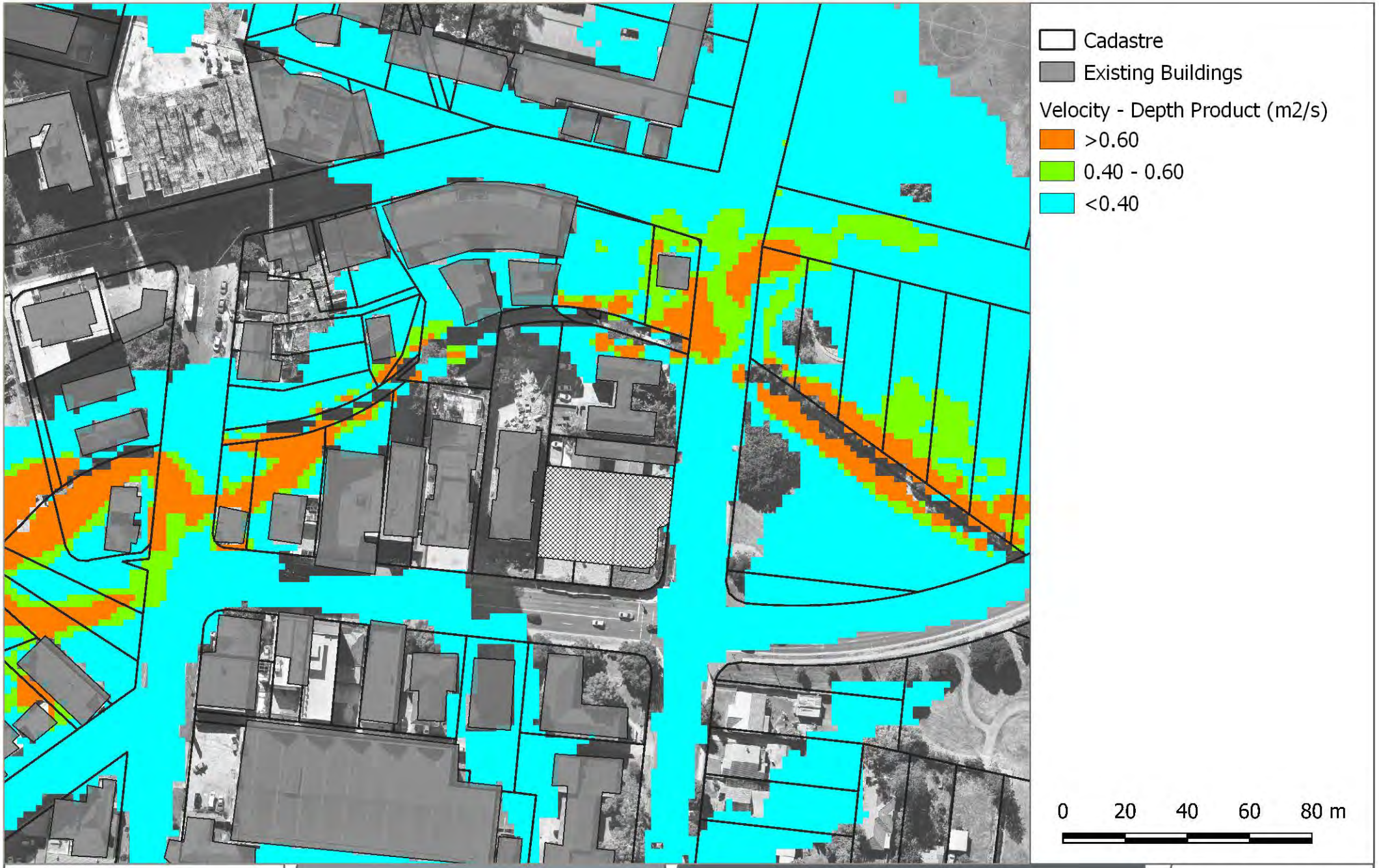
26 - 30 Parkes St

Future Conditions

Figure 20

1% AEP Peak Flood Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

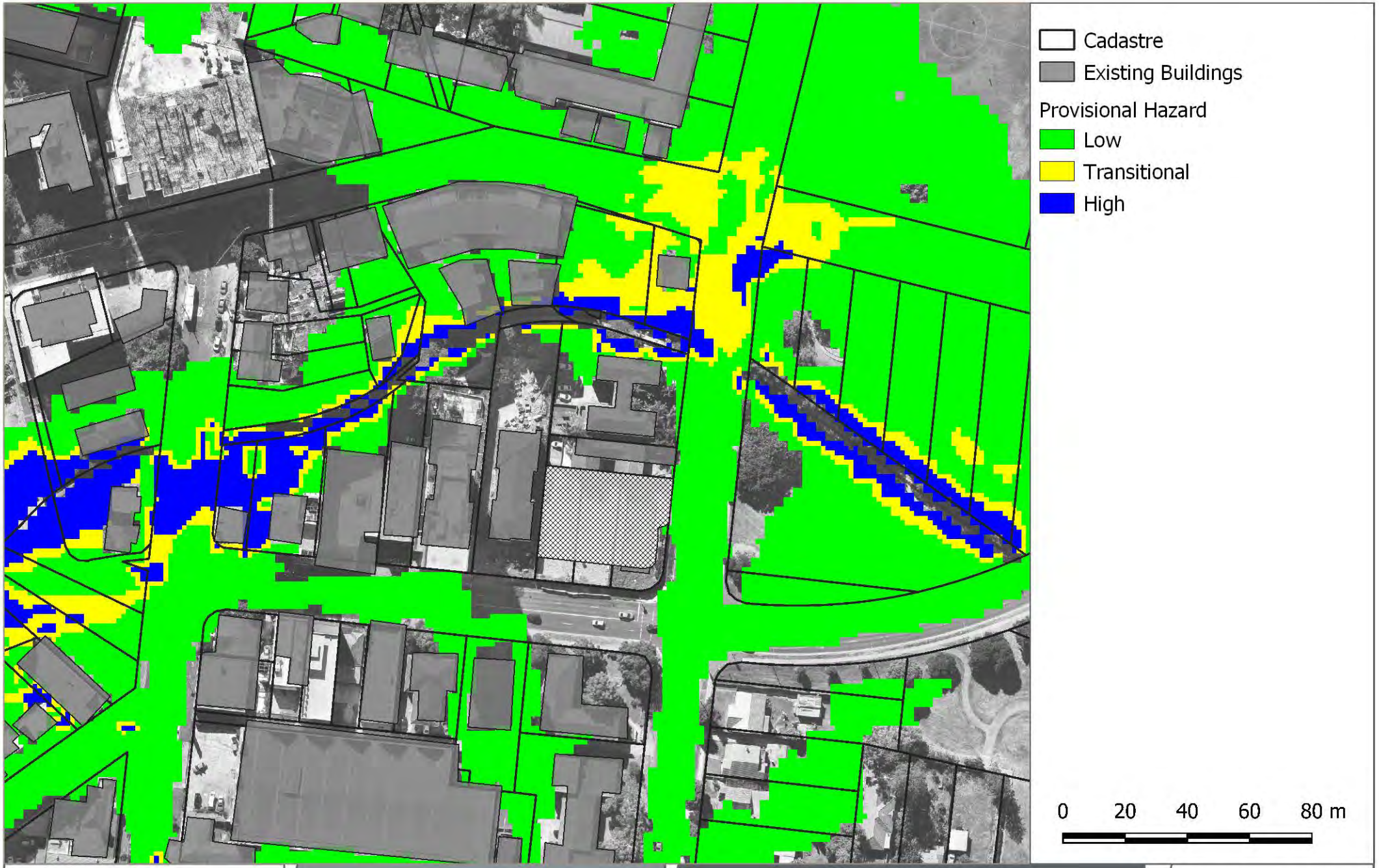


Cardno
Shaping the Future

26 - 30 Parkes St
Future Conditions

Figure 21
1% AEP Peak Flood Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

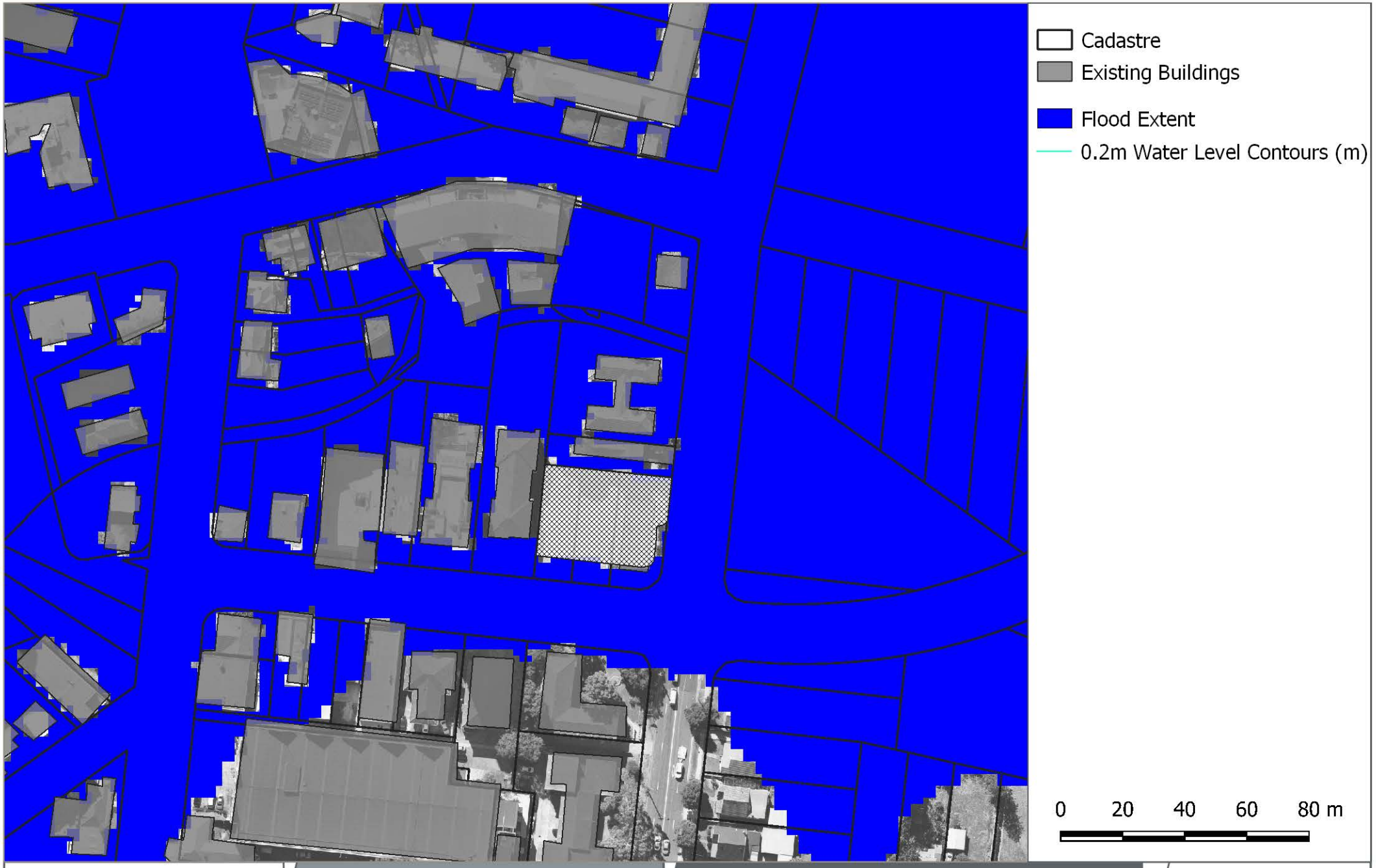


Cardno
Shaping the Future

26 - 30 Parkes St
Future Conditions

Figure 22
1% AEP Peak Flood Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

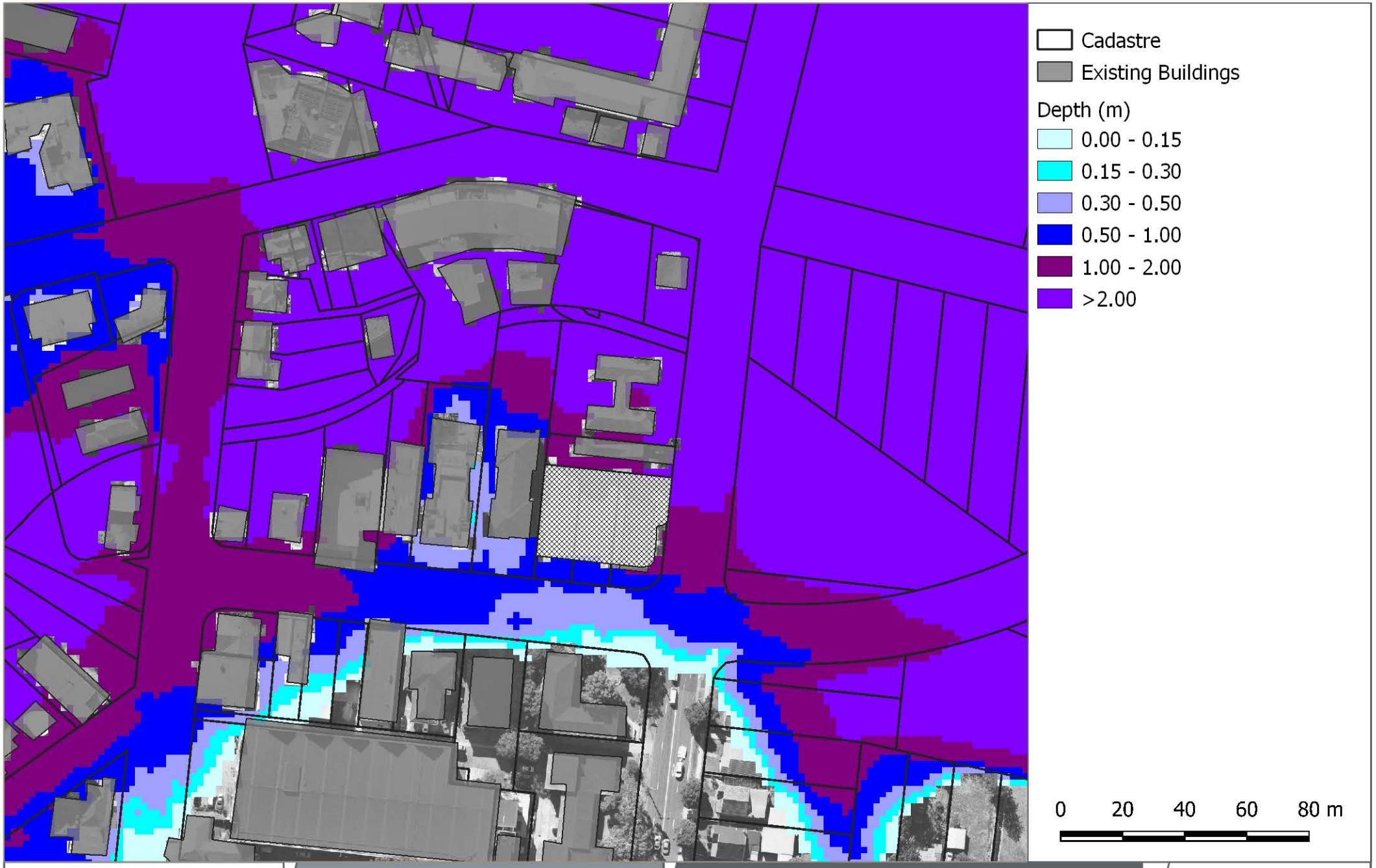


Cardno
Shaping the Future

26 - 30 Parkes St
Future Conditions

Figure 23
PMF Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

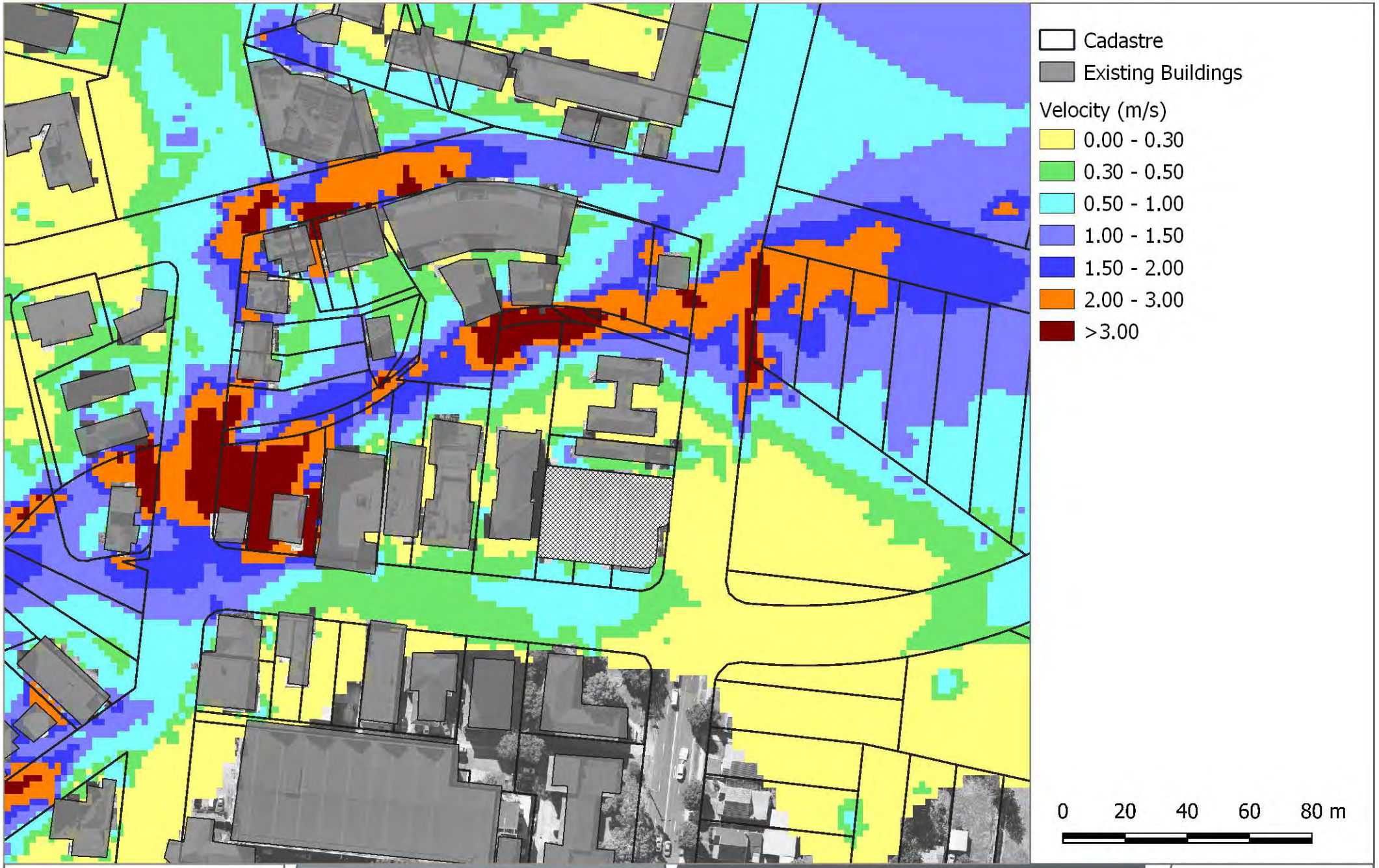


Cardno
Shaping the Future

26 - 30 Parkes St
Future Conditions

Figure 24
PMF Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

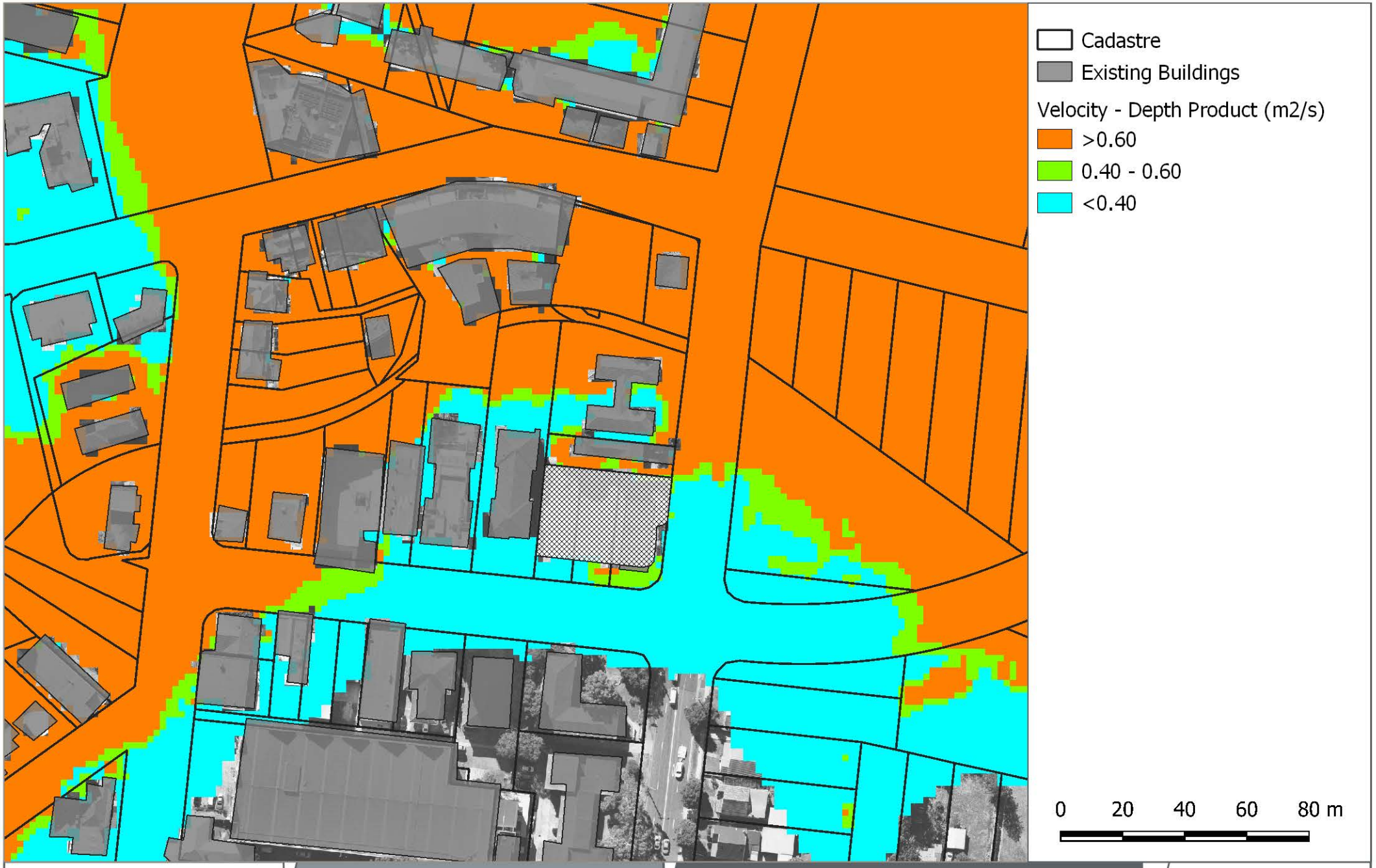


Cardno
Shaping the Future

26 - 30 Parkes St
Future Conditions

Figure 25
PMF Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
Shaping the Future

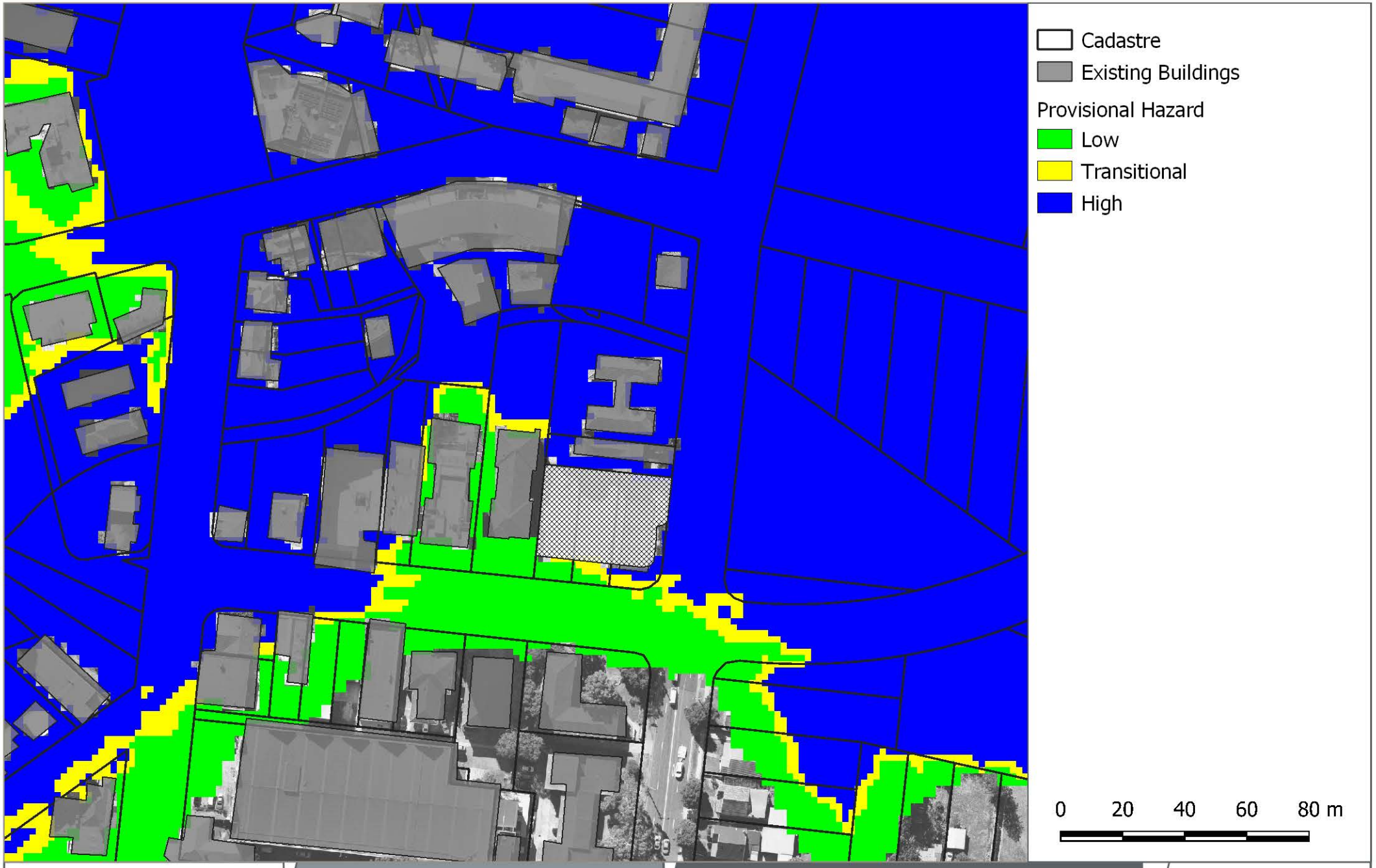
26 - 30 Parkes St

Future Conditions

Figure 26

PMF Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

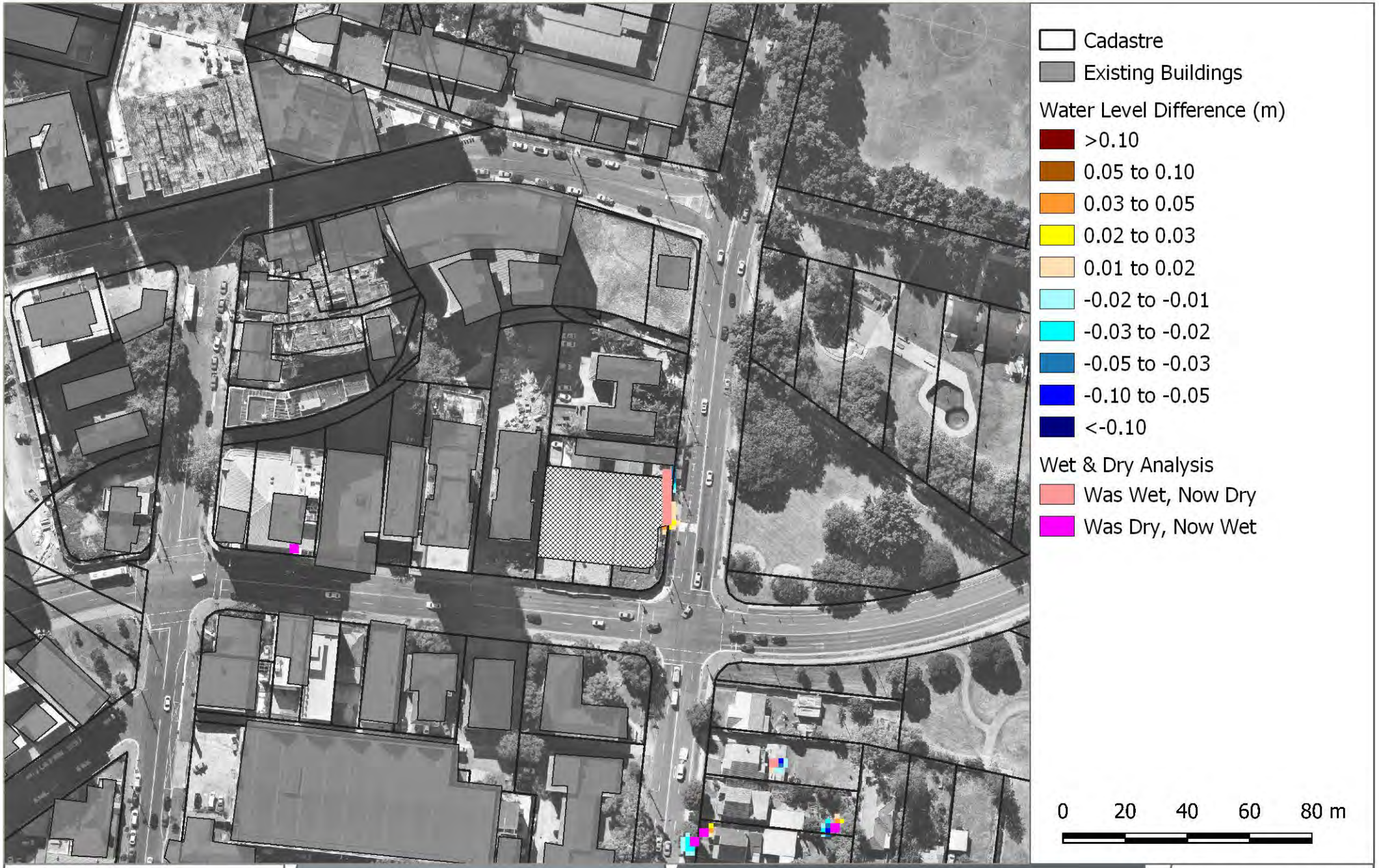


Cardno
Shaping the Future

26 - 30 Parkes St
Future Conditions

Figure 27
PMF Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
Shaping the Future

26 - 30 Parkes St

Future Less Existing Conditions

Figure 28

1% AEP Flood Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

Cadastre
Existing Buildings

Water Level Difference (m)
>0.10
0.05 to 0.10
0.03 to 0.05
0.02 to 0.03
0.01 to 0.02
-0.02 to -0.01
-0.03 to -0.02
-0.05 to -0.03
-0.10 to -0.05
<-0.10

Wet & Dry Analysis
Was Wet, Now Dry
Was Dry, Now Wet

0 20 40 60 80 m

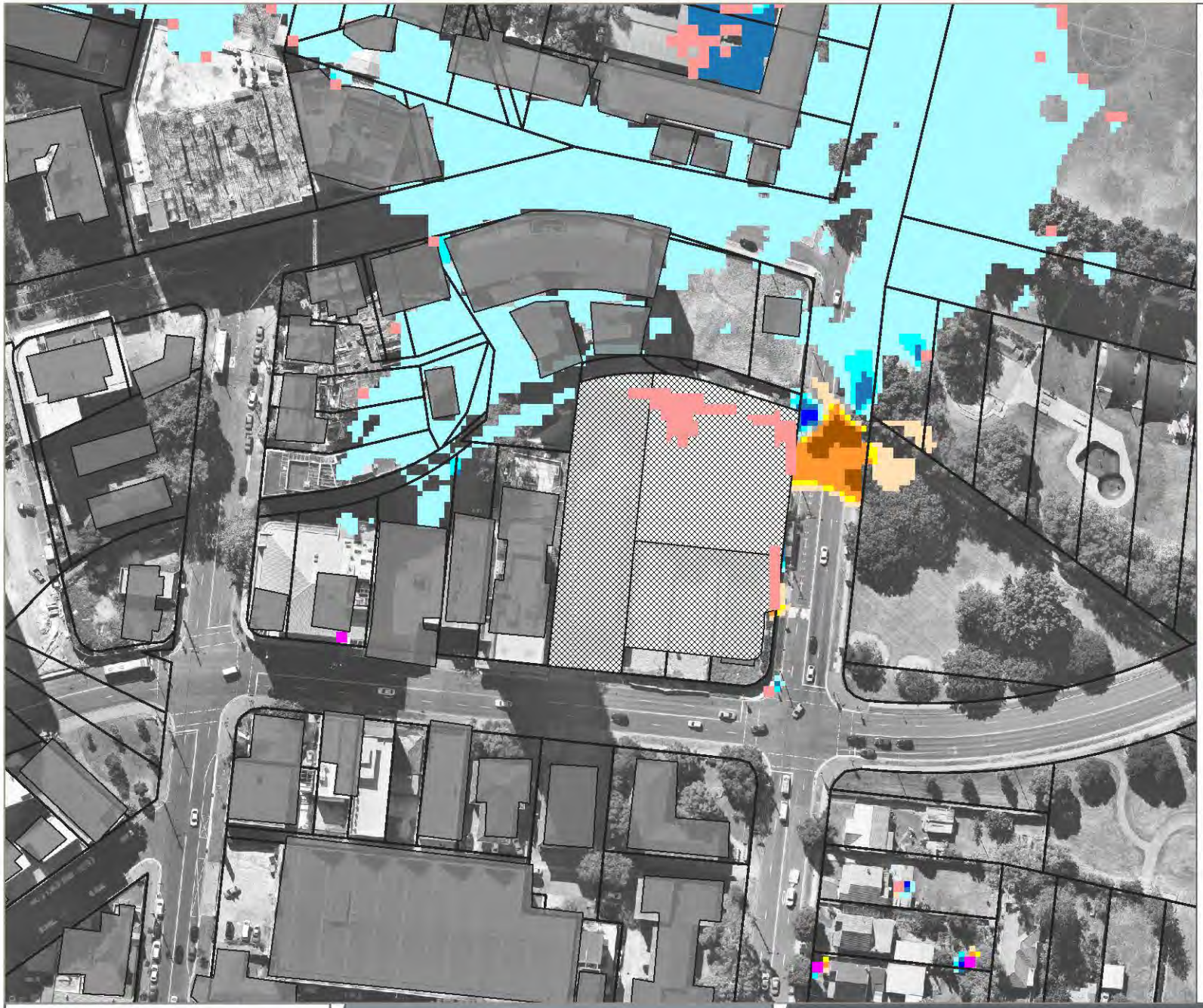
Cardno
Shaping the Future

26 - 30 Parkes St
Future Less Existing Conditions

Figure 29
PMF Level Differences

N

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169



Cardno
Shaping the Future

26 - 30 Parkes St

Future Less Existing Conditions

Figure 30

Cumulative 1% AEP Flood Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

Cardno
Shaping the Future

26 - 30 Parkes St

Future Less Existing Conditions

Figure 31

Cumulative PMF Flood Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918169

26-30 Parkes Street, Harris Park

APPENDIX B
PARRAMATTA CITY COUNCIL FLOOD CERTIFICATE

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Flood Enquiry Information Issued - 19 July 2018

Mainstream Flooding

Is this property affected by mainstream flooding? **24 Parkes Street, 30 Parkes Street and 116 Harris Street, Harris Park**		☒ Yes ☐ No
Flood Levels	Closest Cross Sections: *(Please refer to Flood Study):* **Refer to Flood Map**	
☒ 5% AEP	Varies – RL 5.8 m AHD at Western Boundary of 24 Parkes Street to RL 5.6m AHD at street frontage (Eastern Boundary) of 116 Harris Street.	Comments: **See Note on Flood/Hazard Map**
☒ 1% AEP	RL 6.2 m AHD	
☒ PMF	RL 9.5 m AHD	
☒ Refer to flood maps provided for detailed flood levels.		
Flood information is obtained from the following flood study report: **Lower Parramatta River Floodplain Risk Management Study – Flood Study Review, 2005 (SKM)**		

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

Local Flooding

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 likely to be affected by overland stormwater run-off from the local catchment? *Note: No site inspection conducted for this assessment. Based solely on the information supplied for this flood enquiry application.*	☐ Yes ☒ Subject to Detailed Investigation
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.	

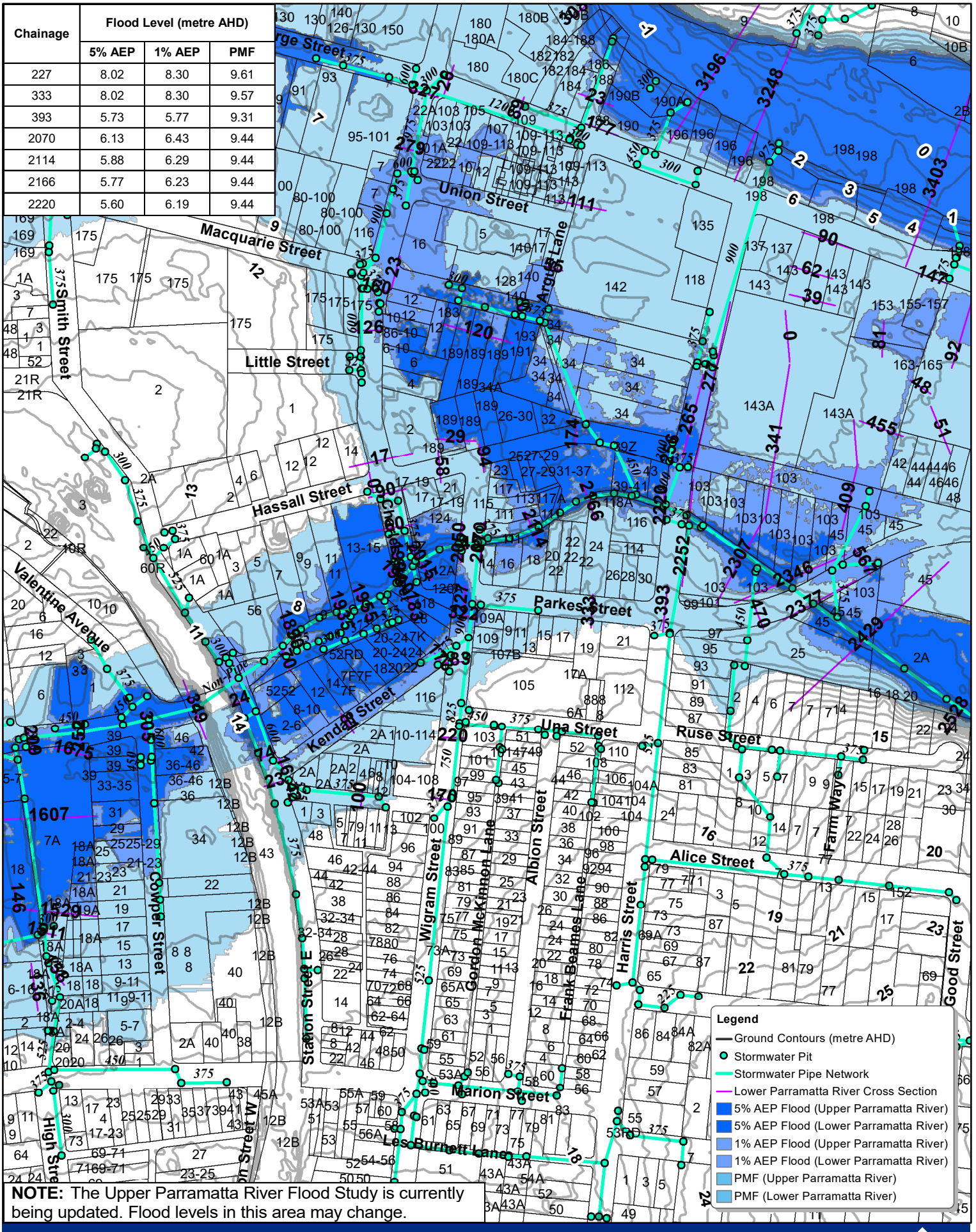
Additional Recommended Actions

☒	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 pre-lodgement 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.

Chainage	Flood Level (metre AHD)		
	5% AEP	1% AEP	PMF
227	8.02	8.30	9.61
333	8.02	8.30	9.57
393	5.73	5.77	9.31
2070	6.13	6.43	9.44
2114	5.88	6.29	9.44
2166	5.77	6.23	9.44
2220	5.60	6.19	9.44



NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.

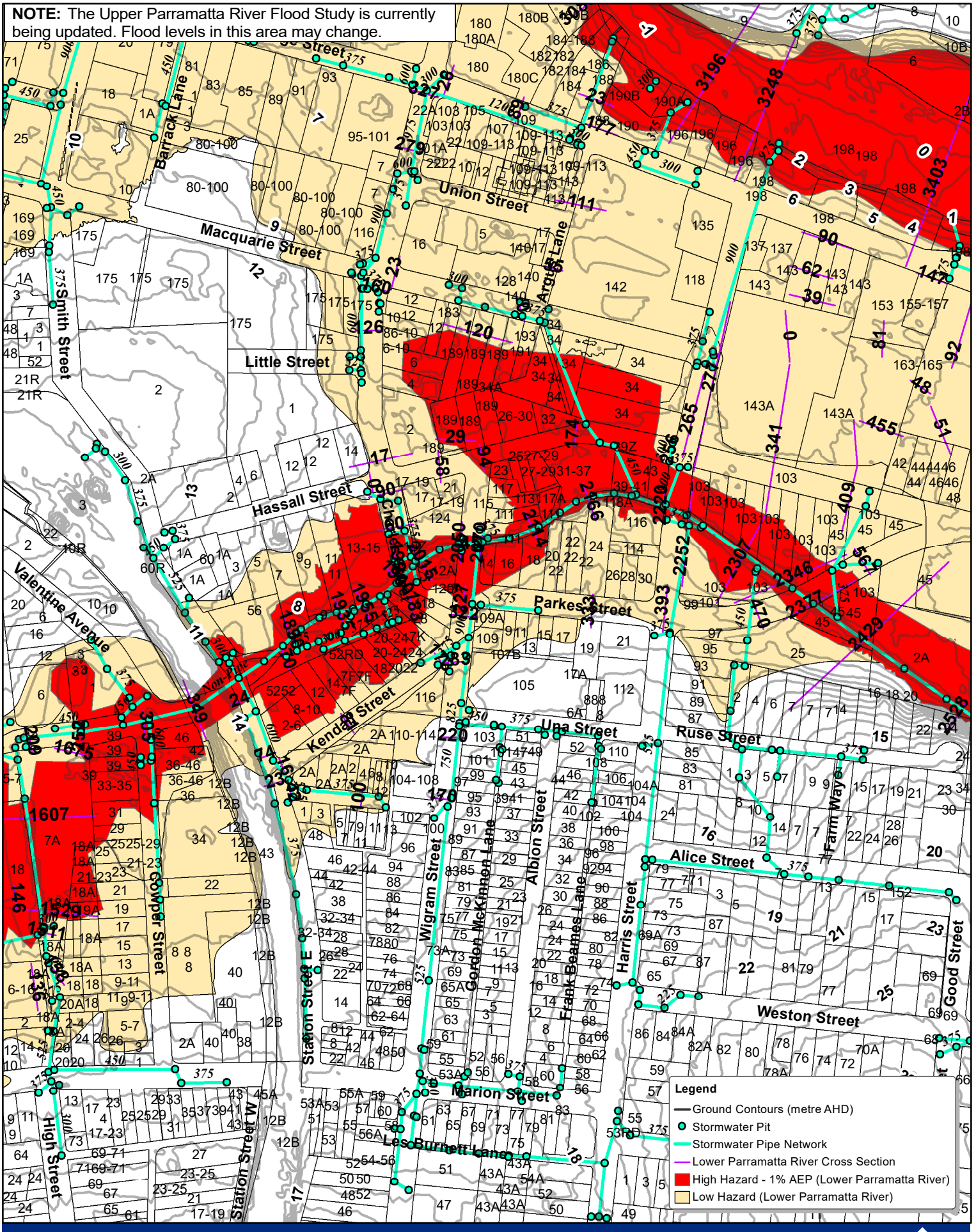
City of Parramatta Council Flood Map

N

1:4,000

Printed 18/07/2018

NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.



City of Parramatta Council Hydraulic Hazard Map

N

1:4,000

Printed 18/07/2018

26-30 Parkes Street, Harris Park

APPENDIX C
SELECTED ARCHITECTURAL DRAWINGS

Cardno
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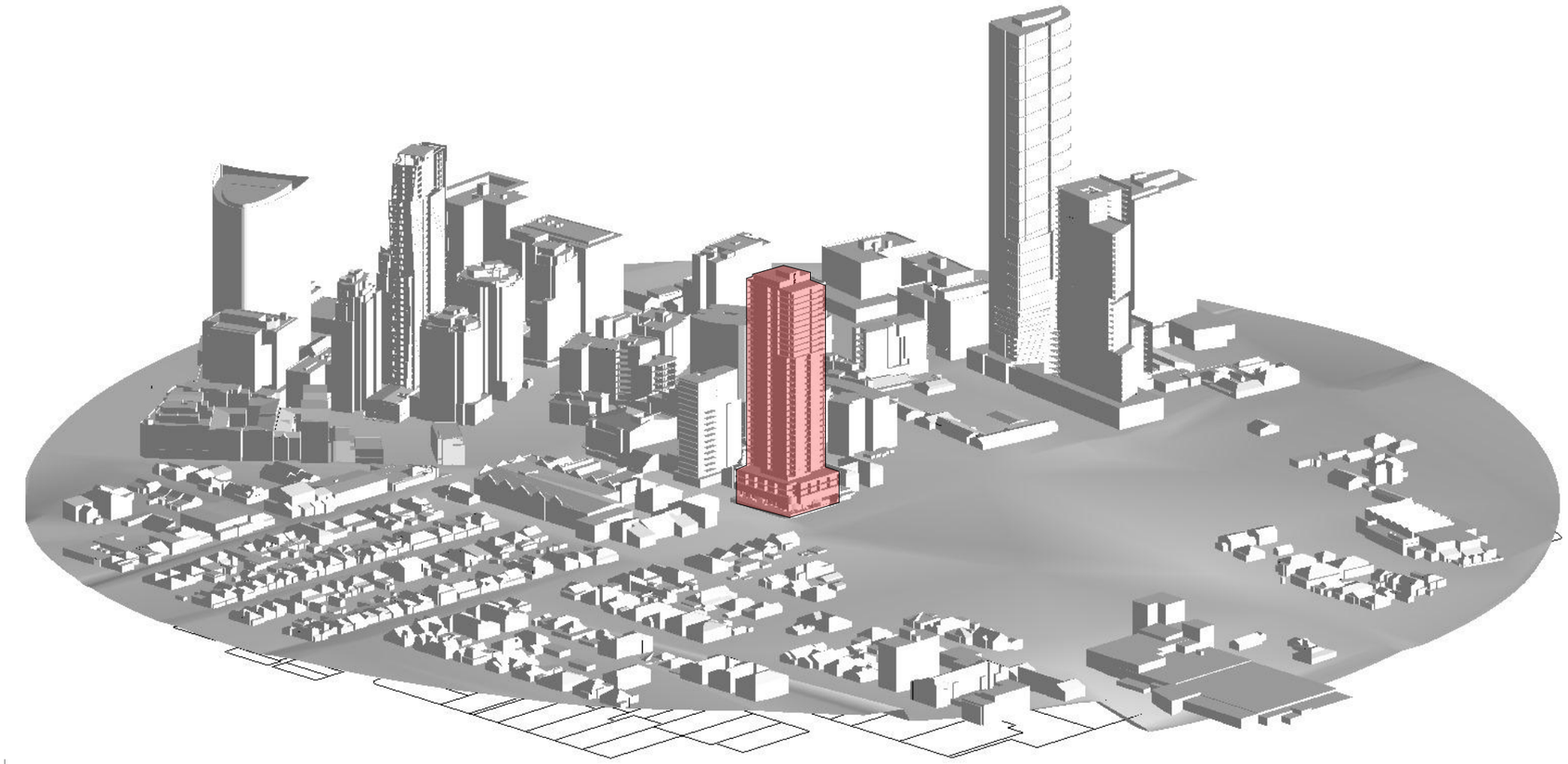
26-30 PARKES STREET, PARRAMATTA

UPDATED PLANNING PROPOSAL

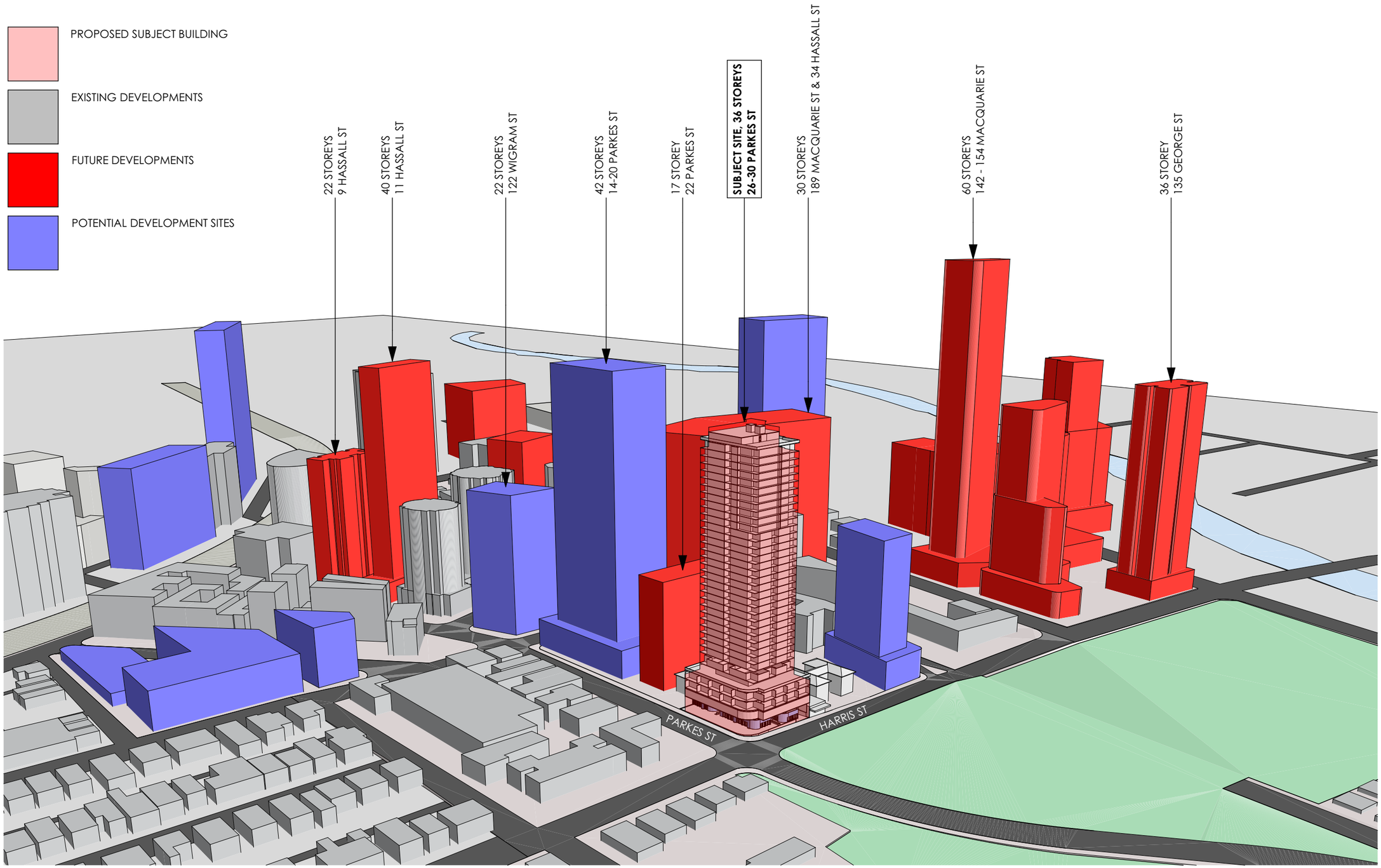
FEBRUARY/2018

PREPARED FOR

PARKES STREET NSW PTY LTD.



Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064



1 MASSING PERSPECTIVE FROM SOUTH EAST

Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064)

REV	DESCRIPTION	BY	DATE
P1	ISSUED FOR COUNCIL MEETING	AB	3/10/17
P2	ISSUED FOR REVIEW	AB	23/10/17
P3	ISSUED FOR REVIEW	AB	09/11/17
P4	ISSUED FOR REVIEW	AB	26/02/18

CLIENT:
PARKES STREET NSW PTY LTD.

PROJECT TITLE:
26-30 PARKES STREET, PARRAMATTA

DRAWING TITLE:
MASSING PERSPECTIVE

NORTH POINT:

DRAWN BY: AB
CHECKED BY: PI
SCALE: 1:100
PROJECT No: P368

SK stage. 04 dwg no. P4 revision

1 GROUND FLOOR
1:200

REV	DESCRIPTION	BY	DATE
P1	ISSUED FOR COUNCIL MEETING	AB	3/10/17
P2	ISSUED FOR REVIEW	AB	23/10/17
P3	ISSUED FOR REVIEW	AB	09/11/17
P4	ISSUED FOR REVIEW	AB	26/02/18

CLIENT:
PARKES STREET NSW PTY LTD.

PROJECT TITLE:
26-30 PARKES STREET, PARRAMATTA

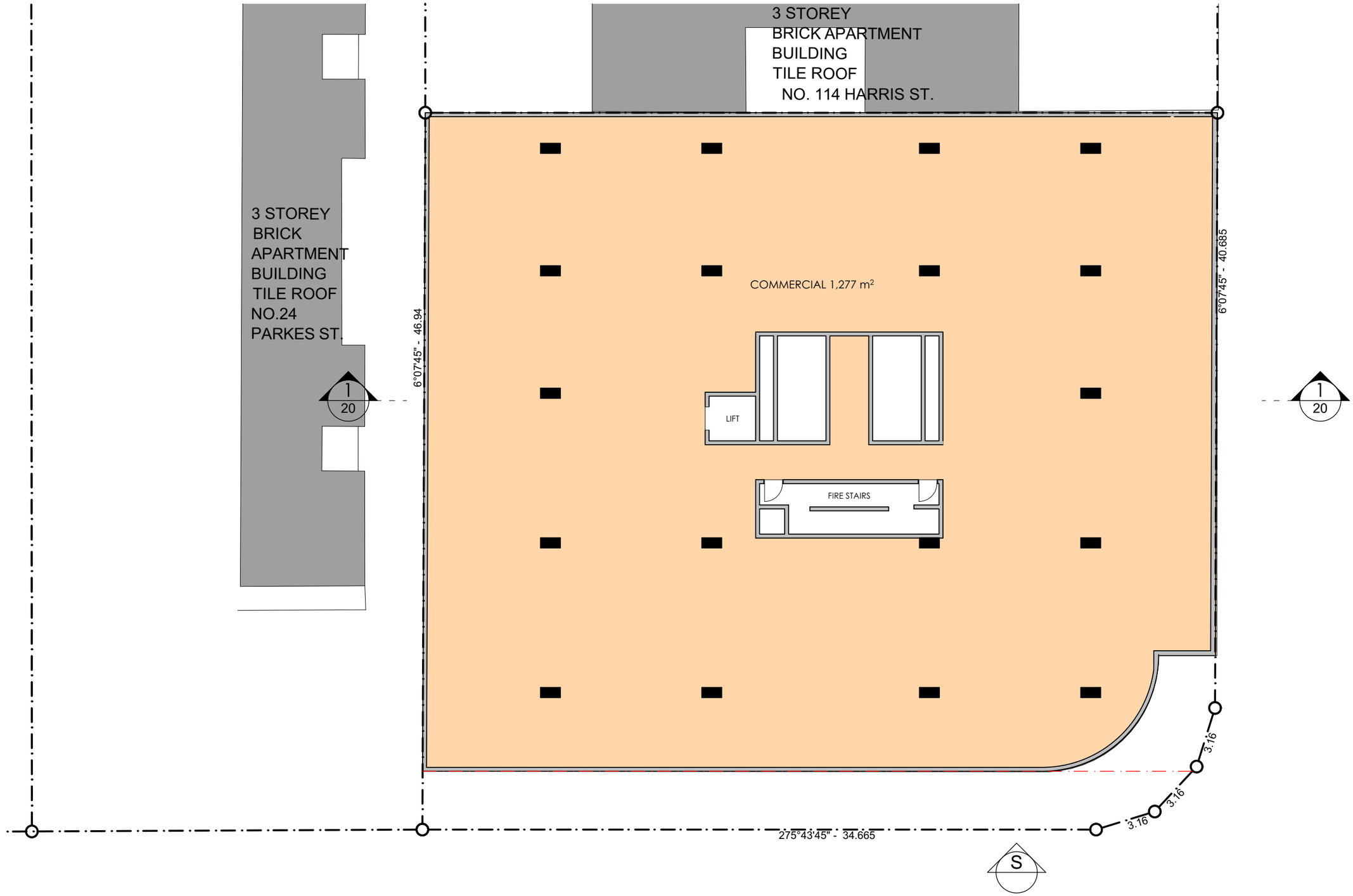
DRAWING TITLE:
GROUND FLOOR

NORTH POINT:

DRAWN BY: AB
CHECKED BY: PI
SCALE: 1:200
PROJECT No: P368

SK stage. 11 dwg no. P4 revision

Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064)



1 LEVEL 1 (COMMERCIAL)
1:200

Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064)

REV	DESCRIPTION	BY	DATE
P1	ISSUED FOR COUNCIL MEETING	AB	3/10/17
P2	ISSUED FOR REVIEW	AB	23/10/17
P3	ISSUED FOR REVIEW	AB	09/11/17
P4	ISSUED FOR REVIEW	AB	26/02/18

CLIENT:
PARKES STREET NSW PTY LTD.

PROJECT TITLE:
26-30 PARKES STREET, PARRAMATTA

DRAWING TITLE:
LEVEL 1 (COMMERCIAL)

NORTH POINT:

DRAWN BY: AB
CHECKED BY: PI
SCALE: 1:200
PROJECT No: P368

SK stage. 12 dwg no. P4 revision

1 LEVEL 2-3 APARTMENT
1:200

PARKES STREET

Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064)

REV	DESCRIPTION	BY	DATE
P1	ISSUED FOR COUNCIL MEETING	AB	3/10/17
P2	ISSUED FOR REVIEW	AB	23/10/17
P3	ISSUED FOR REVIEW	AB	09/11/17
P4	ISSUED FOR REVIEW	AB	26/02/18

CLIENT: PARKES STREET NSW PTY LTD.

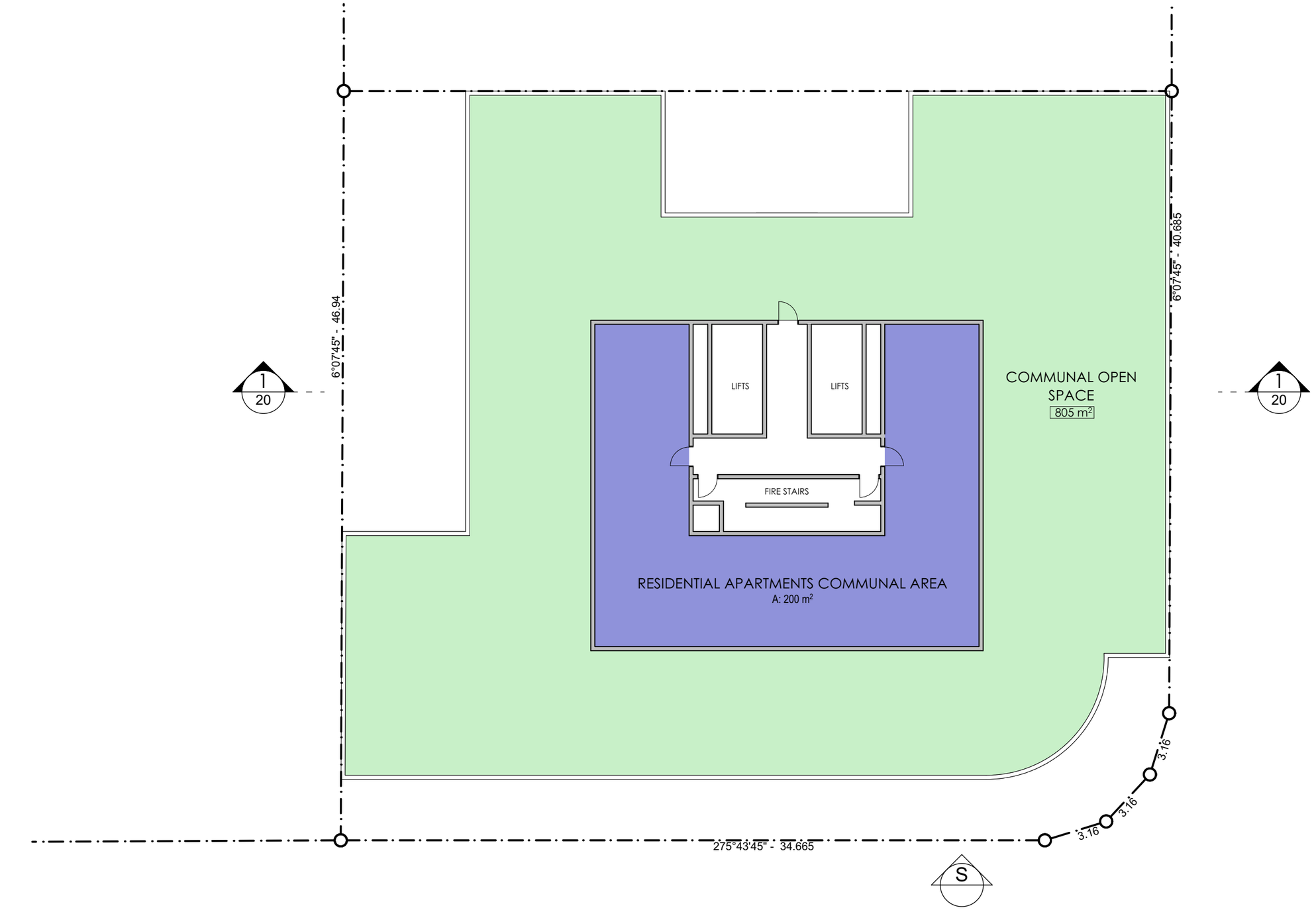
PROJECT TITLE: 26-30 PARKES STREET, PARRAMATTA

DRAWING TITLE: LEVEL 2-3 (RESIDENTIAL)

NORTH POINT:

DRAWN BY: AB
CHECKED BY: PI
SCALE: 1:200
PROJECT No: P368

SK stage. 13 dwg no. P4 revision



1 LEVEL 4 (PODIUM)
1:200

Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064)

REV	DESCRIPTION	BY	DATE
P1	ISSUED FOR COUNCIL MEETING	AB	3/10/17
P2	ISSUED FOR REVIEW	AB	23/10/17
P3	ISSUED FOR REVIEW	AB	09/11/17
P4	ISSUED FOR REVIEW	AB	26/02/18

CLIENT:
PARKES STREET NSW PTY LTD.

PROJECT TITLE:
26-30 PARKES STREET, PARRAMATTA

DRAWING TITLE:
LEVEL 4 (PODIUM)

NORTH POINT:

DRAWN BY: AB
CHECKED BY: PI
SCALE: 1:200
PROJECT No: P368

SK stage. 14 dwg no. P4 revision

1 LEVEL 5-24 (TYPICAL APARTMENTS)
1:200

Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064)

REV	DESCRIPTION	BY	DATE
P1	ISSUED FOR COUNCIL MEETING	AB	3/10/17
P2	ISSUED FOR REVIEW	AB	23/10/17
P3	ISSUED FOR REVIEW	AB	09/11/17
P4	ISSUED FOR REVIEW	AB	26/02/18

CLIENT:
PARKES STREET NSW PTY LTD.

PROJECT TITLE:
26-30 PARKES STREET, PARRAMATTA

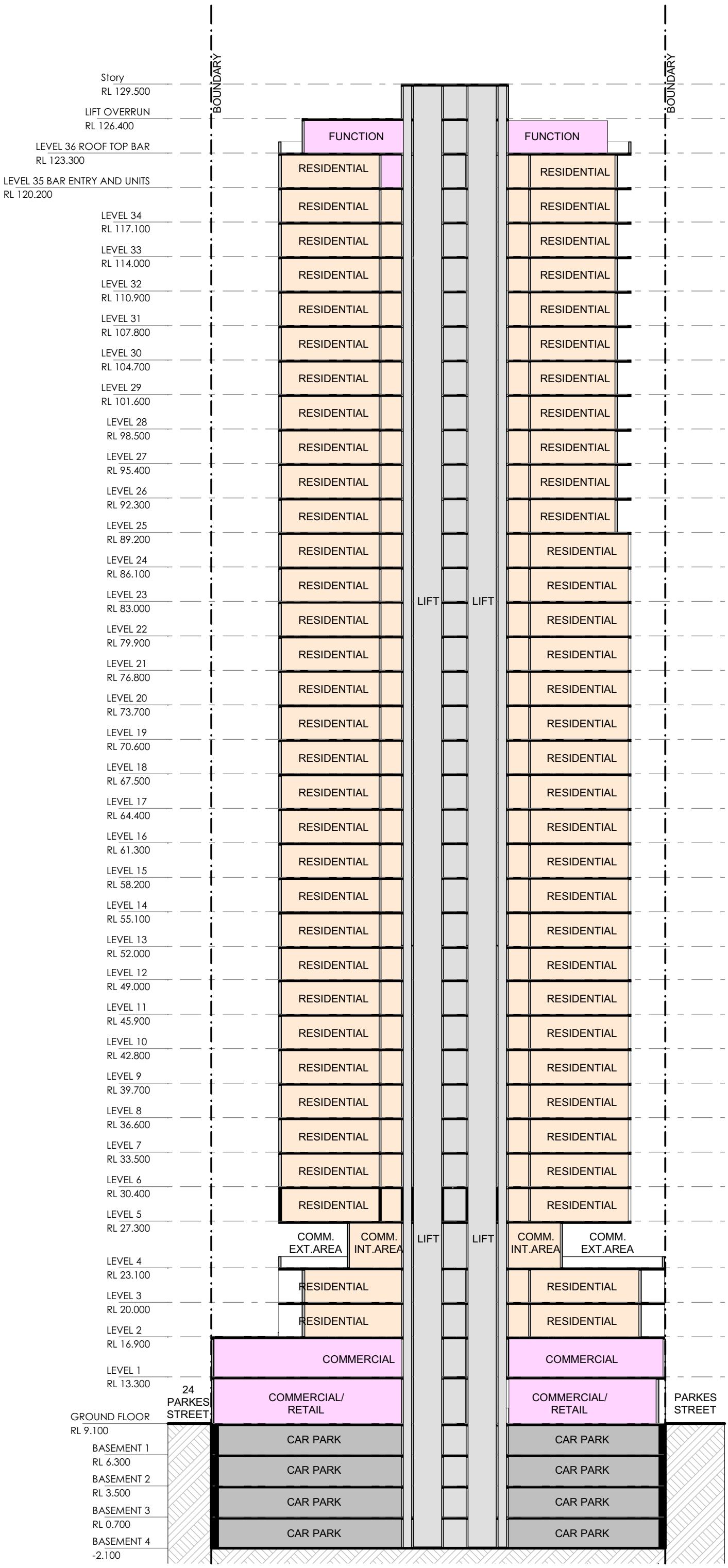
DRAWING TITLE:
LEVEL 5-24 TYPICAL RESIDENTIAL LEVELS

NORTH POINT:

DRAWN BY: AB
CHECKED BY: PI
SCALE: 1:200
PROJECT No: P368

SK stage. 15 dwg no. P4 revision

Project Tourism International Architecture Pty Ltd
Level 10, 263 Clarence Street Sydney NSW 2000
T +61 2 9283 0860 www.ptigroup.com.au ABN 90 050 071 022
Nominated Registered Architect: Peter Israel (reg no. 5064)



REV	DESCRIPTION	BY	DATE
P1	ISSUED FOR COUNCIL MEETING	AB	3/10/17
P2	ISSUED FOR REVIEW	AB	23/10/17
P3	ISSUED FOR REVIEW	AB	09/11/17
P4	ISSUED FOR REVIEW	AB	26/02/18

CLIENT:
PARKES STREET NSW PTY LTD.

PROJECT TITLE:
26-30 PARKES STREET,
PARRAMATTA

DRAWING TITLE:
SECTIONS

NORTH POINT:

DRAWN BY: AB
CHECKED BY: PI
SCALE: 1:350
PROJECT No: P368

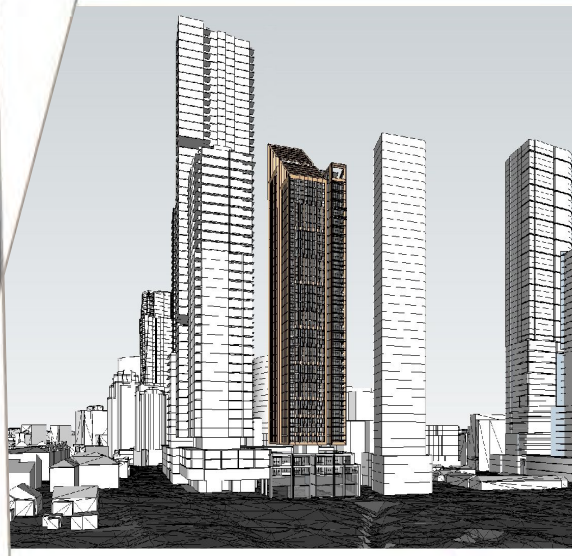
stage: SK
dwg no. 20
revision P4

K:\PTI 2015\P368 - 26-30 Parkes St, Parramatta\DRAWINGS\00_STAGE - \01_PLN\20180227_26-30 Parkes St, Parramatta_V21.pln Printed: 27/02/2018

Flood Impact Assessment

114-118 Harris Street, Harris Park

59918168



Prepared for
Harris Street Developments Pty Ltd

23 July 2018

Cardno
Shaping the Future

Contact Information

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Document Information

Prepared for	Harris Street Developments Pty Ltd
Project Name	114-118 Harris Street, Harris Park
File Reference	59918168 114-118 Harris St R001 23Jul18.docx
Job Reference	59918168
Date	23 July 2018

Document Control

Version	Date	Description of Revision	Prepared By	Prepared (Signature)	Reviewed By	Reviewed (Signature)
1	23/7/18	Draft Final	BCP	Brett C. Phillips	SH	

Version	Reason for Issue	Approved for Release By	Approved (Signature)	Approved Release Date
1	Draft Final Report for Review	BCP	Brett C. Phillips	23/7/18

Document Reference: *N:\Projects\599\FY18\168_FIA, 114-118 Harris St\Report\59918168 114-118 Harris St R001 23Jul18.docx*

Executive Summary

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 114-118 Harris Street, Harris Park. The subject site is located on the Clay Cliff Creek floodplain just upstream of Harris Street.

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising, one level of retail outlets, one level of commercial offices, 35 levels of residential apartments and one level of communal open space. Guided by planning proposals for adjoining properties it is expected that there will be four levels of basement car parking based on the ground floor footprint of the development.

The flooding assessment methodology is outlined as follows:

- Impact of planned development on flooding
- Climate change impact on flooding
- Flood emergency response
- Flood warning and evacuation
- A draft emergency response plan
- Compliance with requirements of Parramatta DCP 2011

Previous Flood Assessments

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

Flood Impact Assessment

The assessment of the impact or otherwise of development on 114-118 Harris Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

Flood models were established for the existing site conditions and future developed scenarios. The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by aleksandar design group (attached in **Appendix C**).

Flood modelling was completed for the 100 year ARI, and Probable Maximum Flood events.

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2220) adopted by Council:

- 100 year ARI: 6.19 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.30 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.19 m AHD.

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively.

In the case of the 100 yr ARI event there is a local increase on Harris Street opposite 118 Harris Street of around 0.05 m. This local impact does not extend to any adjoining property. There is also an associated small reduction in 100 yr ARI flood levels north of Clay Cliff Creek.

In the PMF there is a small local increase in the PMF level on and upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 22 Parkes Street.

It is concluded that the planned development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels on and upstream of 24 Parkes Street.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) except along the Clay Cliff Creek channel. The planned development has a local impact on flow velocities in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on peak velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s). In a PMF the planned development locally decreases the flow velocity in 114 Harris Street while locally increasing the peak velocity on 41-43 Hassall and on a section of Hassall Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The planned development t has a local impact on velocity-depths in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on velocity-depths is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location. In the case of 114-118 Harris Street the velocity x depth in a PMF adjacent to the site is > 0.6 m^2/s. In a PMF the planned development locally reduces the flow velocity-depth opposite 114 -118 Harris Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High. The impact of the planned development on provisional hazard is negligible.

Flood Risk Precinct

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. The site is mapped as primarily Low Flood Risk with a small area of Medium Flood Risk and a fringing area of High Flood Risk based on the XP-SWMM 1D/2D results. Similar Flood Risk precincts would be mapped based on the extents of 100 yr ARI flooding and hazard as given in in Council's Flood Map attached in **Appendix B**. Council would map the section of Harris Street adjoining the property as Low Flood Risk.

Rate of Rise of Floodwaters

Features of the planned development include:

- Ground levels which vary from 8.49 m AHD in the southwest corner of 118 Harris Street to 5.74 m AHD in the in the vicinity of the northern boundary of the property;
- Proposed ground floor level for the commercial and retail outlets of 7.0 m AHD which provides which provides 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level or the commercial uses of 11.2 m AHD which is higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 7.0 m AHD which provides 0.81 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor retail outlets has a freeboard of around 0.81 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 2 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 7.0 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 3 hours 45 minutes after start of the PMP storm.

Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill each level of the car park to a depth of 0.9 m and to completely full is around 23-27 minutes and around 30-34 minutes respectively**.**

Emergency Planning

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

A draft Emergency Response Plan is outlined.

Flood Emergency Response

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place. Based on the estimated peak number of persons that could be at risk in the car park and on the Ground Floor retail outlets the estimated maximum area of refuge required is 118 m^2. It is expected that this refuge would be provided by the communal room on Level 4 which exceeds the required area of refuge.

Assessment of Council Requirements

The site is mapped as primarily Low Flood Risk with a small area of Medium Flood Risk and a fringing area of High Flood Risk. Consequently the development has been assessed against the planning and development controls that apply to “Residential” in a Medium Flood Risk Precinct.

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. An assessment of the compliance of the proposed development with Council’s requirements is given in Section 7 of this report.

It is concluded that the assessment and details in this Flood Impact Assessment satisfy the requirements of the Parramatta DCP 2011.

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Appendices

Tables

Figures

1 Introduction

1.1 Background

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 114-118 Harris Street, Harris Park. The subject site is located on the Clay Cliff Creek floodplain just upstream of Harris Street (refer **Figure 1** in **Appendix A**).

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising, one level of retail outlets, one level of commercial offices, 35 levels of residential apartments and one level of communal open space. Guided by planning proposals for adjoining properties it is expected that there will be four levels of basement car parking based on the ground floor footprint of the development.

1.2 Flooding Considerations

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

The flooding context for the site is provided in the flood map prepared by Parramatta City Council and given in **Figure 1** (refer also **Appendix B**) and the 10 year ARI and 100 year ARI flood extents estimated in the 2007 Cardno Willing Study as given in **Figure 2**.

1.3 Objective

The objective of the study is to address the following considerations for planned development of the sites:

- Impact of planned development on flooding;
- Climate change impact on flooding;
- Flood emergency response;
- Flood warning and evacuation;
- Outline of a draft emergency response plan; and
- Compliance with requirements of Parramatta DCP 2011

1.4 Methodology

The flooding assessment methodology is outlined as follows:

- Review of previous flood studies and available data;
- Compilation of site specific data (including proposed development layout);
- If appropriate, modify the Clay Cliff Creek floodplain model to represent existing site scenario;
- Revision of flood model to represent future site development;
- Assessment of resultant flood behaviour and flood risks;
- Review of flood emergency planning;
- Outline a flood emergency response plan;
- Review of compliance with Parramatta City Council development requirements;

2 Previous Studies

The proposed development on 114-118 Harris Street, Harris Park is potentially subject to flooding by floodwaters spilling from Clay Cliff Creek and/or the Parramatta River. Consequently previous studies of flooding in the lower Parramatta River and in Clay Cliff Creek are relevant to the subject site.

2.1 2005 Lower Parramatta River Floodplain Study

The Lower Parramatta River Floodplain Risk Management Study/Plan was completed in 2005 in accordance with the provisions of the Floodplain Development Manual applicable at that time. This study included a Flood Study Review which re-assessed flood levels in a number of watercourses and in the tidal section of Parramatta River, between the Charles Street weir and Ryde (road) Bridge. The Flood Study Review provided the base data for the subsequent Floodplain Risk Management Study.

The study was commissioned by Parramatta City Council to update the previous data on flood levels and extents. PCC was aware that the results predicted in the 1986 study would now be subject to change due to changes in the catchment such as urbanisation and the construction of flood mitigation projects in the upper catchment. It also recognised that the previous flood extent mapping was based on the best information available at the time, but it was of variable reliability and did not provide an assessment of flood hazard.

The LPRFS adopted the best current practice to review the flood data which included (SKM, 2005):

- up-to-date catchment hydrology for the Upper Parramatta River Catchment;
- existing/ updated hydrology for the tributaries within the Lower Parramatta River study area;
- Airborne Laser Survey;
- an additional 70 surveyed cross-sections;
- the widely used and accepted MIKE-11 hydraulic model;
- use of GIS to develop digital terrain models;
- multiple design storms to generate maximum flood levels; and
- appropriate methodology for estimating concurrent flows in tributaries.

Generally, results from the review compared well with previous studies. However, flood levels estimated in the 1986 Lower Parramatta Flood Study prepared by Willing and Partners in the Lower Parramatta River downstream of Subiaco Creek (including the Duck River confluence) were up to 1.2 m lower than those derived in the 2005 review. The reasons for this difference as described in the 2005 Flood Study report include:

- revision of the critical duration to 9 hours for the Upper Parramatta River catchment in the 2005 study, due to the inclusion of channel routing and the effect of the Darling Mills Retarding Basin and other flood mitigation works. This leads to an increase in the volume of floodwaters;
- more detailed and complete survey data; and
- the adoption of an integrated modelling approach and consistent design storms for the main river and tributaries.

It is our understanding that Parramatta City Council adopted the design flood levels from this study for planning purposes in 2005.

Council and Council's Peer Reviewer has relied upon the flood levels estimated by this flood study in the vicinity of Wigram St and Hassall St, Harris Park as contained in Council's Flood Map (refer **Figure 1**).

2.2 2007 Clay Cliff Creek Catchment Master Drainage Plan

A Catchment Master Drainage Plan for the Clay Cliff Creek catchment at Parramatta was prepared in 2007. The aim of the study as set out by Parramatta City Council was to identify overland flow problem areas, locations of surcharge due to insufficient pipe capacity and pit inlet capacity, and localised flooding with areas of improvement. The study aimed also to prepare cost effective options based on cost benefit analysis.

The 2007 study assembled a hydrological model of the Clay Cliff Creek catchment and input local flow hydrographs into an XP-SWMM 1D/2D floodplain model. The estimated 10 year ARI and 100 year ARI flood extents are presented in **Figure 2**.

2.3 2011 Flood Impact Assessment, 111 Wigram St, Harris Park

Cardno was commissioned by ING Consulting Engineers Pty Ltd to undertake an assessment of the site and the proposed development in relation to flooding. The purpose of the assessment was to ensure that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that risk of flooding to the public is acceptable to Parramatta City Council.

Cardno assessed flood behaviour for the 100 year ARI for the existing and proposed conditions. This was undertaken through update of our 2007 XP-SWMM 1D/2D model of the Clay Cliff Creek catchment prepared for the Parramatta City Council.

The assessment concluded that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that the flood risk to the public is acceptable to Council.

2.4 2011 Flood Impact Assessment, 122 Wigram St, Harris Park

Cardno was commissioned by LJ Hooker Westmead to undertake the flood assessment of the proposed multi-storey mixed-use development at 122 Wigram Street, Harris Park. The purpose of the assessment was to ensure that the proposed development does not have an adverse effect on 100 year ARI flood levels upstream and downstream of site and that risk of flooding to the public is acceptable to Parramatta City Council.

Cardno assessed flood behaviour for the 100 year ARI for the existing and proposed conditions. This was undertaken through update of our 2007 XP-SWMM 1D/2D model of the Clay Cliff Creek catchment prepared for the Parramatta City Council.

The assessment concluded that the proposed development would maintain the floodplain of Clay Cliff Creek and would have little impact on flood behaviour being located between the hydraulic controls of Charles and Wigram Street crossings.

2.5 2014 Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park

In 2014 a mixed-use development of 113-117 Wigram St and 23-29 Hassall St was proposed comprising retail outlets, residential apartments and a multi-storey underground car park.

This site is located adjacent to and north of Clay Cliff Creek.

The objective of the study was to address the overall conclusions of Council's Peer Reviewer as documented in a memorandum dated 21 October 2013.

A 1D/2D assessment of flooding in the vicinity of the site was undertaken to define flood behaviour and to assess the impacts if any of the proposed development using a modified version of the XP-SWMM 1D/2D floodplain model. The 1D/2D floodplain model included the floodplain of Clay Cliff Creek up to the Railway Line and a reach of the Parramatta River.

3 Flooding Assessment

The assessment of the impact or otherwise of development on 114-118 Harris Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

3.1 Existing Conditions

3.1.1 Model Configuration

The floodplain model which was used for assessment purposes was an extended version of the 2007 Clay Cliff Creek model recently used to assess the impacts of planned development on 32 Tramway Avenue, Parramatta which includes development which was assessed previously on properties nearby to 114-118 Harris Street, Harris Park. The 1D/2D model of the Clay Cliff Creek floodplain which extends to its outfall into the Parramatta River was extended to include a reach of the lower Parramatta River and its floodplain. In order to reduce the size of the overall model to assess the impacts of planned development the Clay Cliff Creek model was truncated at the railway line which is a local hydraulic control (refer **Figure 2**).

The Parramatta River was represented in the 1D/2D floodplain model as 2D terrain which was created from the cross sections extracted from the lower Parramatta River floodplain model between and including PARRAMATTA_R 3248 to PARRAMATTA_R 4452. The overbank areas not already represented in the Clay Cliff Creek model were included in the 2D domain using ALS data which was previously supplied by Council for the Clay Cliff Creek study.

The adopted downstream boundary condition was a stage hydrograph extracted from the lower Parramatta River floodplain model at PARRAMATTA_R 4452.

The upstream boundary conditions were a flow hydrograph in the Parramatta River extracted from the lower Parramatta River floodplain model at PARRAMATTA_R 3248 and the flow hydrograph generated by the Clay Cliff Creek model at the Railway Line. Local inflow hydrographs were also input within the study area based on the subcatchment discretisation adopted in the 2007 Clay Cliff Creek catchment study.

3.1.2 Terrain

The Digital Terrain Model (DTM) adopted for the flood model represents the ground surface elevations and blockages to flow caused by buildings. The DTM and blockages for Existing Conditions in the vicinity of the site is shown in **Figure 3**.

3.1.3 Floodplain Roughness

The roughness zones in the vicinity of the site are plotted in **Figure 4**. The roughness values which were adopted were guided by the values previously adopted in the 2007 Clay Cliff Creek catchment study.

3.1.4 Results

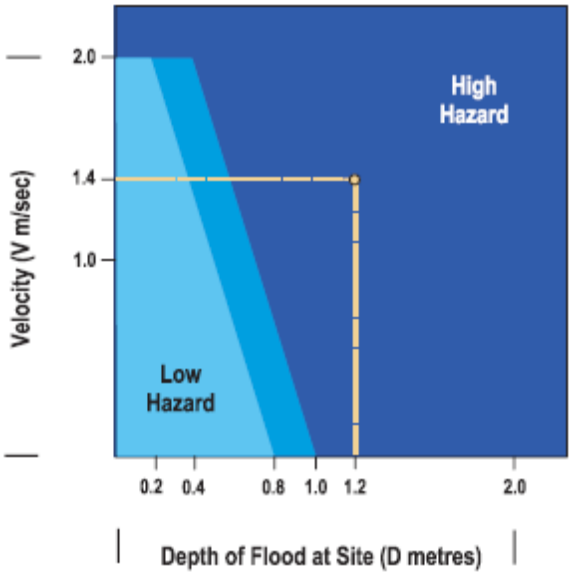
The estimated 100 year ARI flood levels and extent, depths and velocities under Existing Conditions are plotted in **Figures 5, 6** and **7** respectively.

When considering pedestrian and vehicular stability, three velocity x depth criteria were identified as follows:

Velocity x Depth	Comment
≤ 0.4 m^2/s	This is typically adopted by Councils as a limit of stability for pedestrians
0.4 – 0.6 m^2/s	Unsafe for pedestrians but safe for vehicles if overland flood depths do not exceed around 0.3 m
> 0.6 m^2/s	This is typically adopted by Councils as a limit of stability for vehicles

The estimated 100 year ARI velocity x depth under Existing Conditions is plotted in **Figure 8.**

Experience from studies of floods throughout NSW and elsewhere has allowed authorities to develop methods of assessing the hazard to life and property on floodplains. This experience has been used in developing the NSW Floodplain Development Manual to provide guidelines for managing this hazard. These guidelines are shown schematically blow.



Provisional Hazard Categories (after Figure L2, NSW Government, 2005)

To use the diagram, it is necessary to know the average depth and velocity of floodwaters at a given location. If the product of depth and velocity exceeds a critical value (as shown below), the flood flow will create a **high hazard** to life and property. There will probably be danger to persons caught in the floodwaters, and possible structural damage. Evacuation of persons would be difficult. By contrast, in **low hazard** areas people and their possessions can be evacuated safely by trucks. Between the two categories a transition zone is defined in which the degree of hazard is dependent on site conditions and the nature of the proposed development.

This calculation leads to a provisional hazard rating. The provisional hazard rating may be modified by consideration of effective flood warning times, the rate of rise of floodwaters, duration of flooding and ease or otherwise of evacuation in times of flood. The estimated 100 year ARI provisional flood hazard under updated Existing Conditions is plotted in **Figure 9.**

The estimated PMF levels and extent, depths, velocities, velocity x depth and hazards under updated Existing Conditions are plotted in **Figures 10, 11, 12, 13** and **14** respectively.

Based on the results of the assessments of 100 year ARI and PMF flooding the flood risk precincts are identified in **Figure 15**.

3.2 Future Conditions

3.2.1 Terrain

The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by aleksandar design group (attached in **Appendix C**). It comprises one level of retail outlets, one level of commercial offices, 35 levels of residential apartments and one level of communal open space. Guided by planning proposals for adjoining properties it is expected that there will be four levels of basement car parking based on the ground floor footprint of the development.

The DTM for the Future Conditions model was generated based on the architectural drawings prepared by aleksandar design group. A summary of the areas blocked in the future DTM and additional features are shown in **Figure 16.**

3.2.2 Floodplain Roughness

The roughness zones under Future Conditions are plotted in **Figure 17.** The roughness values which were adopted were guided by the values previously adopted in the 2007 Clay Cliff Creek catchment study.

3.2.3 Results

The estimated 100 year ARI flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 18, 19, 20, 21** and **22** respectively.

The estimated PMF flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 23, 24, 25, 26** and **27** respectively.

3.3 Peak Flood Levels

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2220) adopted by Council:

- 100 year ARI: 6.19 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.30 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.19 m AHD.

3.4 Flood Impact Assessment

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively.

In the case of the 100 yr ARI event there is a local increase on Harris Street opposite 118 Harris Street of around 0.05 m. This local impact does not extend to any adjoining property. There is also an associated small reduction in 100 yr ARI flood levels north of Clay Cliff Creek.

In the PMF there is a small local increase in the PMF level on and upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 22 Parkes Street.

It is concluded that the planned development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels on and upstream of 24 Parkes Street.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) except along the Clay Cliff Creek channel. The planned development has a local impact on flow velocities in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on peak velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s). In a PMF the planned development locally decreases the flow velocity in 114 Harris Street while locally increasing the peak velocity on 41-43 Hassall and on a section of Hassall Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The planned development t has a local impact on velocity-depths in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on velocity-depths is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location. In the case of 114-118 Harris Street the velocity x depth in a PMF adjacent to the site is > 0.6 m^2/s. In a PMF the planned development locally reduces the flow velocity-depth opposite 114 -118 Harris Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High. The impact of the planned development on provisional hazard is negligible.

3.5 Climate Change

Based on discussions with Parramatta City Council in 2012 an indicative assessment of the impact of climate change on the 100 year ARI flood levels in the year 2100 was undertaken in 2012 to inform a Discussion Paper on Flooding of the DHA Site in Ermington (Cardno, 2012). This assessment was based on an assumed 15% increase in design rainfall (yielding a 12% increase in 100 year ARI flood flows) and sea level rise of 0.9 m.

The indicative 100 year ARI flood levels in the Parramatta River under climate change are around 0.34 m – 0.45 m higher than the 100 year ARI flood levels adopted by Council. It is expected that the impact of climate change in the vicinity of the site which is adjacent to Clay Cliff Creek is around 0.35 m ie. around 6.55 m AHD. The proposed level of the ground floor is at 7.0 m AHD which provides 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change while a driveway entry crest level of around 7.0 m AHD would also provide 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change.

3.6 Cumulative Development

The cumulate impact of multiple potential developments in the vicinity has been previously represented in the floodplain model assembled during the 2005 Lower Parramatta River Floodplain Study and is already incorporated in the resulting flood levels adopted by Council. In the 2005 floodplain model overland flowpaths are primarily represented as road corridors and any existing or new development on lots or re-development lies outside the modelled flood extents. Council's plotted flood extents are based on extrapolating the calculated flood levels beyond the modelled flood extents. Consequently new development or re-development can't be represented by modification of current cross sections in Council's floodplain model and will not change the flood levels adopted by Council.

The cumulative impact of the proposed development of 24 Parkes Street, 26-30 Parkes Street and 114-118 Harris Street was also undertaken.

The estimated 100 year ARI and PMF level differences under cumulative Future Conditions in comparison with Existing Conditions are plotted in **Figures 30** and **31** respectively. In the case of the 100 yr ARI event there is a local increase on Harris Street opposite 118 Harris Street of around 0.05 m. This local impact does not extend to any adjoining property. There is also an associated small reduction in 100 yr ARI flood levels north of Clay Cliff Creek.

In the PMF there is a small local increase in the PMF level upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 20 Parkes Street.

It is concluded that the planned cumulative development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels upstream of 24 Parkes Street.

4 Flood Risks

The flood risks at and in the vicinity of 114-118 Harris Street, Harris Park are discussed as follows.

4.1 Flood Levels, Velocities and Hazards

The estimated 100 year ARI flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 18, 19, 20, 21** and **22** respectively.

The estimated PMF flood levels and extent, depths, velocities, velocity x depth and hazards under Future Conditions are plotted in **Figures 23, 24, 25, 26** and **27** respectively.

4.2 Flood Risk

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. The site is mapped as primarily Low Flood Risk with a small area of Medium Flood Risk and a fringing area of High Flood Risk based on the XP-SWMM 1D/2D results. Similar Flood Risk precincts would be mapped based on the extents of 100 yr ARI flooding and hazard as given in in Council's Flood Map attached in **Appendix B**. Council would map the section of Harris Street adjoining the property as Low Flood Risk.

4.3 Rate of Rise of Floodwaters

To understand the likely warning times and associated response times during extreme flood events it is necessary to estimate the expected rate of rise of floodwaters. At 114-118 Harris Street, Harris Park the estimated rate of rise of flooding in a PMF event at the ground floor entry and the driveway is around 2.5 m/hr.

Features of the planned development include:

- Ground levels which vary from 8.49 m AHD in the southwest corner of 118 Harris Street to 5.74 m AHD in the in the vicinity of the northern boundary of the property;
- Proposed ground floor level for the commercial and retail outlets of 7.0 m AHD which provides which provides 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level or the commercial uses of 11.2 m AHD which is higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 7.0 m AHD which provides 0.81 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor retail outlets has a freeboard of around 0.81 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 2 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 7.0 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 3 hours 45 minutes after start of the PMP storm.

Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a slightly shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill each level of the car park to a depth of 0.9 m and to completely full is around 23-27 minutes and around 30-34 minutes respectively**.**

In events less extreme than the PMF but of sufficient severity to overtop the driveway crest level and where the inflow volume is less than the storage volume in the car parking levels then the same flooding behaviour would be expected with flooding initially occurring on both levels but at the time inflows cease floodwaters would then continue to flow down the access ramps until the flood level in the car park reaches its maximum level (ie. Basement Level 4 would fill like a bath tub).

4.4 Duration of Inundation

The estimated maximum times of isolation in a PMF are as follows:

- Ground Floor (at 7.0 m AHD) – Around 3 hours 35 mins
- Car Park Entry (at 7.0 m AHD) – Around 3 hours 35 mins

4.5 Persons at Risk (PAR)

The direct Persons at Risk (PAR) during the PMF was estimated for the Ground Floor and the car parking levels and the indirect PAR was estimated for workers on Level 1 and residents living in apartments at levels higher than the PMF level (Levels 2-37).

In the case of the retail on the Ground Floor, the PAR was based on the approach adopted to estimate the PAR within Warringah Mall previously reported by Cardno, 2007. The PAR for Warringah Mall was based on:

- An estimated average 6,667 visitors to Warringah Mall each trading hour;
- 60% of all visitors are visiting ground floor retailers (estimate provided by Centre Management) giving 4,000 ground floor visitors per hour;
- The area of retail premises that experience overfloor flooding greater than 0.2 m in a 100 yr ARI flood as a proportion of the total ground floor retail area;
- On average 9.2 hours of trading each weekday; and
- On average 15 hours of trading each weekend.

In the case of 114-118 Harris Street the average number of visitors per hour to the Ground Floor was scaled based on the ratio of the floor level of the retail outlets to the area of ground floor retailers at Warringah Mall. This gave an estimate of around 47 visitors per hour to the Ground Floor at 114-118 Harris Street.

The estimated number of persons directly at risk on the Ground Floor under proposed conditions is 17.1 (because it accounts for periods when the retail outlets are not trading).

In the case of commercial offices a unit rate of one worker per 10 m^2 of office space was assumed guided by an allowance for a workstation and access corridor.

The estimated number of workers located on Level 1 is 156. The estimated number of persons indirectly at risk on Level 1 is 42.7 (because it accounts for periods when workers are not present).

The number of residents and/or visitors that would be indirectly at risk during a PMF was estimated based on the following assumed occupancies of apartments.

- 1 Bedroom 1.5 persons
- 2 Bedroom 2.5 persons
- 3 Bedroom 3.5 persons
- 4 Bedroom 4.5 persons

The following assumptions were also made when estimating the Population at Risk (PAR):

- During day-time hours on weekdays:
  - the average occupancy per apartment over the whole building would be reduced by one person per apartment to account for one resident in each apartment working (this is viewed as a conservative assumption);
  - the average duration of occupancy would be 9 hours per day (out of 10 hours)
  - the average occupancy of each shop was assumed to be 3 persons
  - the average duration of occupancy of the neighbourhood store would be 10 hours per day (out of 10 hours)
- During night-time on weekdays:
  - All residents would reside on site each night ie. the average occupancy per apartment applies over the whole building;
  - the average duration of occupancy would be 14 hours per night (out of 14 hours);
  - the average occupancy of the each shop was assumed to be 3 persons;
  - the average duration of occupancy of each shop would be 4hours per night (out of 14 hours)
- During weekends:
  - the average duration of occupancy of all residents would be 18 hours per day (out of 24 hours)
  - the average duration of occupancy of each shop would be 14 hours per day (out of 24 hours)

In relation to estimating the PAR in car parking levels during a flood the following assumptions were made

- During day-time hours on weekdays:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.25 hours per day;
- During night-time on weekdays:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.25 hours per day;
- During weekends:
  - the average occupancy per apartment over the whole building applies;
  - the average duration of occupancy of the car park would be 0.5 hours;

The estimated total number of visitors/retail staff **directly** at risk during a PMF is summarised in **Table 1** while the total number of workers and of workers/residents/visitors that would be indirectly at risk during a PMF (all other levels higher than the PMF) is summarised in **Table 2**.

Table 1 Estimated Population at Risk (PAR) Directly during a PMF

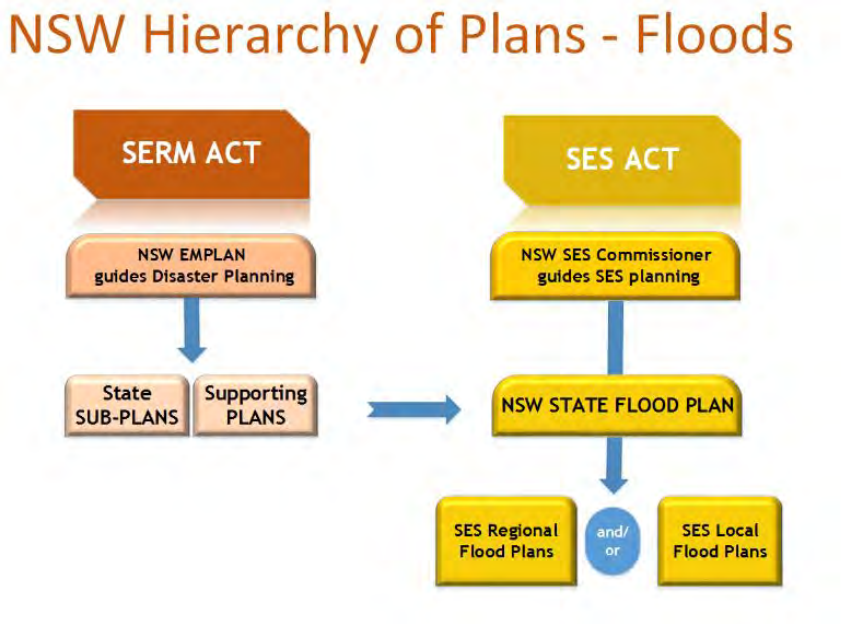
Retail staff/Visitors directly at Risk		
Ground Floor		Car Parking Levels
No.	PAR	PAR
47	17.1	11.7

Table 2 Estimated Population at Risk Indirectly during a PMF

Workers/Residents/Visitors indirectly at Risk	
No.	PAR
Level 1	
156	42.7
Levels 2-37	
655	518.5

5 Emergency Planning

The hierarchy of plans which guide the planning for floods in NSW is as follows:



5.1 2017 NSW State Flood Plan

The NSW State Flood Plan is a sub plan of the State Emergency Management Plan (EMPLAN) (NSW Government, 2017). It has been prepared in accordance with the provisions of the State Emergency Service Act 1989 (NSW) and is authorised by the State Emergency Management Committee in accordance with the provisions of the State Emergency and Rescue Management Act 1989 (NSW).

The latest plan was provisionally endorsed by the State Emergency Management Committee at Meeting 107 held on 5 December 2017.

The purpose of this plan is to set out the arrangements for the emergency management of flooding in New South Wales

As described by the Plan:

> *The Plan sets out the emergency management aspects of prevention; preparation; response and initial recovery arrangements for flooding and the responsibilities of individuals, agencies and organisations with regards to these functions.*
>
> *The Plan recognises the existence of the problem of coastal inundation and erosion caused by severe weather. The management system for dealing with episodes of coastal erosion is described in the New South Wales State Storm Plan.*
>
> *The Plan recognises the existence of the threat posed by tsunami to NSW coastal communities. The arrangements for the emergency management of tsunami are contained within the State Tsunami Emergency Sub Plan.*

This Plan is intended to be read in conjunction with:

(a) The New South Wales State Emergency Management Plan (EMPLAN), of which the State Flood Sub Plan is a sub-plan;
(b) The New South Wales State Storm Plan, which covers arrangements relating to severe storm events; and
(c) NSW Floodplain Development Manual.

5.2 North West Metropolitan District Disaster Plan

On 27th June 2012 the Interim Version of the "North West Metropolitan District Disaster Plan (Displan)" was endorsed by Chairman, State Emergency Management Committee, The Displan was prepared by the North West Metropolitan District Emergency Management Committee in compliance with Section 23 (1) of the State Emergency and Rescue Management Act, 1989, (as amended). The Parramatta LGA is one of the LGAs covered by this plan.

The Plan details emergency preparedness, response and recovery arrangements for the North West Metropolitan Emergency Management District, Local Emergency Management Areas and local government. It recognises that many of the details contained in the plan are similar to those contained in Local Plans and therefore this Plan may be utilised and applied at a local level in conjunction with a Local Displan.

The Plan's aim is to ensure a controlled response to emergencies by all agencies having responsibilities and functions in emergencies, (Section 12 (2) of the SERM Act), and it reflects and applies in conjunction with arrangements agreed to at State level and detailed in the State Disaster Plan

5.3 Parramatta DISPLAN

The Parramatta Disaster Plan (DISPLAN) released in 2010 details arrangements for preparing for, responding to and recovering from emergencies within the City of Parramatta.

As described in the plan, *it encompasses arrangements for:*

a) Incidents controlled by combat agencies.
b) Emergencies controlled by combat agencies and supported by the Local Emergency Operations Controller.
c) Emergency operations for which there is no combat agency.
d) Circumstances where a combat agency has passed control to the Local Emergency Operations Controller

The area covered by the plan comprises the whole of the City of Parramatta.

The Plan is based upon operation during both normal business hours and outside of normal business hours and takes into consideration special events that may from time to time operate outside and during normal business hours.

Transportation of people will be by either government/private transport or by private vehicle, with numbers and method dependant on circumstances and location of emergency.

Each agency with a statutory role has in place arrangements which detail that agency's response.

Each Emergency Service Organisation and Functional Area has in place an appropriate supporting plan/operational procedures which detail that agency's response.

It is expected that in the Parramatta CBD that Building Owners, Managers and Tenants will be provided with education regarding their responsibilities in both evacuation and general building emergency management. It is accepted that all buildings where required will have in place a practised Emergency Management Plan in line with AS 3745 and as per NSW OH&S Regulation 2001

Section 23 of the DISPLAN discusses evacuation as follows:

23. EVACUATION

a) The LEOCon, in consultation with the Combat Agency, will determine the need for evacuation.
b) Police will control and coordinate the evacuation of persons to the chosen Safe site or marshalling point and supervise disaster victim registration.
c) Transport resources will be arranged through and coordinated by the transport functional area coordinator, if private vehicles are not available.
d) The LEOCon will determine, in consultation with the Combat Agency, when return of evacuees is possible.

Concept of Operations

The evacuation process is based on a 5 stage process

i) Decision to Evacuate
ii) Warning
iii) Withdrawal
iv) Shelter
v) Return

The concept of operations for an emergency in the Parramatta CBD can be summarised as:

Emergency occurs or is imminent in the CBD:

Buildings may/may not begin self evacuation due to the emergency;
Public transport systems are disrupted, resulting in Transport/Traffic plans being enacted to provide an emergency service;
Emergency Service Agencies begin deployment in accordance with normal arrangements;
An area requiring Evacuation is identified;
When deemed safe to do so, "return" advised through Displan arrangements, and may include some caveats;
Throughout, the Emergency Services and Functional Area agencies continue to deal with the particular emergency.

Withdrawal

If there is a decision to evacuate, or a self-evacuation commences, there is a need to follow a process to move people to a place of safety while the status of the transport system is assessed and arrangements are made to move people out of the Parramatta CBD.

The withdrawal stage for the CBD is based on the following philosophy.

Building to Assembly Area (covered by individual building evacuation plans)
Assembly Area to Safe sites in accordance with the CBD evacuation plan or this plan (based on building location) OR
Safe sites in accordance with the CBD evacuation plan or this plan

Control Measures

For the purpose of this plan, the Parramatta CBD has been divided into three (3) zones (refer to map on Anexure 2)

- *Ollie Webb Reserve*
- *Macarthur Girls High School*
- *Parramatta Golf Course*

In the event of an emergency which severely disrupts transport and requires an evacuation of an area of the CBD, the control arrangements will recommend business and residents to either:

Stay at Work

This is used for all areas of the CBD (and surrounds) where the public are not directly threatened by the emergency. It may also imply that public transport may be affected and/or may not be available. This message is intended to stop or reduce the incidence of the public rushing to transport sites or exiting by private vehicles, thus allowing time for transport/traffic services to be re-established.

Stay at Work protocols assist in achieving a desired response for business and residents in the areas of the CBD unaffected by the emergency, such as:

To carry on normal business;
Advise staff and others on their site that an emergency has resulted in a disruption to public and private transport, and to allow for communication updates.

Shelter in Place

This is used when it is assessed that for safety of the occupants of a building(s) or for control reasons, it is safer for occupants to remain in the building than to be on the streets. The time required to Shelter in Place will depend on the nature of the emergency.

CBD Residents/Permanent and Temporary

People who live in the area to be evacuated and those from temporary accommodation (hotels etc), will be directed to an Evacuation Centre (Refer to Parramatta Displan Sections 6.8. 1) and if necessary to temporary accommodation under the control of the Department of Community Services as per DISPLAN arrangements.

Commuters

People who are evacuated to their residence (as per a normal business day) will not receive further specialist management under this Annexure once their journey has concluded.

Evacuate to Safe Sites or Evacuation Centres

This is used as a control measure to identify those areas that require evacuation for safety and/or control reason. It is the intent to minimize the area of the CBD that is evacuated, noting that some emergencies may require the evacuation of some sections or large sections, if not all of the CBD.

People evacuated to Parramatta safe site will be requested to:

> *Remain in position until further information is available, or*
> *Make their way to other parts of the city and delay their journey home, or Make their way to specific transport terminals for movement out of the city, or Identify themselves if they have specific needs or Move to an Evacuation Centre, or Combinations of the above.*

Support will be provided to people in Safe Sites or Evacuation Centres in accordance with this plan.

Return

LEOCON, in consultation with the combat agency and/or Functional Area, if applicable, will allow the area to be reoccupied when it is safe to do so in accordance with this plan

Building Owners and Managers

It is accepted that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

It is expected that all building Emergency Management Plans are to contain details of the most relevant Parramatta Safety Site. All wardens trained under the building emergency plan are to be aware of the Parramatta Safety Sites, routes to the site and how to liaise with the building occupants at the site.

It is accepted that all building Emergency Management Plans are to contain detail of how the information regarding an evacuation will be disseminated from the Chief Warden to occupants of the building.

It is noted that a copy of the Parramatta CBD Evacuation Plan was not located in the time available to prepare this advice.

It is noted also that the 2010 Parramatta DISPLAN, states in part that:

i) the intent is to minimize the area of the CBD that is evacuated, noting that some emergencies may require the evacuation of some sections or large sections, if not all of the CBD; and
ii) shelter in place is used when it is assessed that for safety of the occupants of a building(s) or for control reasons that it is safer for occupants to remain in the building than to be on the streets.

It is expected that this is also the intent for the all other areas within the LGA outside the CBD.

5.4 Local Plan

The 2010 Parramatta DISPLAN states that there are no sub-plans or supporting plans.

5.5 Sizing Temporary Flood Refuge

Two primary sources of information were located when considering the size of a temporary flood refuge:

- Building Code of Australia (BCA, 2008)[1]
- US Flood Emergency Management Authority (FEMA, 2000)[2].

As outlined above, the Building Code of Australia (2008) stipulates that an area of public assembly such as halls or theatres should have a maximum density of 1 m^2 per person (BCA, 2008). FEMA, 2000 recommends a minimum of 0.45 m^2 per person for tornado shelters.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place.

Based on the estimated peak number of persons that could be at risk in the car park and on the Ground Floor retail outlets the estimated maximum area of refuge required is 118 m^2.

It is expected that this refuge would be provided by the communal room on Level 4 which exceeds the required area of refuge.

[1] Building Codes of Australia (2008 Edition). *Part D Access and Egress. D1.13 Number of Persons Accommodated*

[2] FEMA (2000) *Design and Construction Guidance for Community Shelters*, Federal Emergency Management Agency, Mitigation Directorate, FEMA361, 1st Ed., July 2000

6 Flood Emergency Response

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers (in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations) are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

6.1 Flood Warning

Discussions with the NSW SES have previously identified the following status of flood warnings for the Parramatta CBD:

- The Bureau of Meteorology does not prepare flood predictions for the Parramatta River;
- Only a Draft Flood Warning Plan has been prepared to date by the NSW SES. This draft was prepared a number of years ago and while it is planned that it will be updated this does not have a high priority in view of the level of flood protection in the Parramatta CBD that has been achieved by various works undertaken in the upper catchment including the Loyalty Road basin.
- Trigger levels for flood warning have not been identified for the Parramatta CBD

Other sources of information regarding approaching severe weather conditions which could cause potential flooding at the site including:

- The Bureau of Meteorology through their website (www.bom.gov.au);
- Observation of local rainfall;
- The local SES (http://parramatta-ses.com);
- Parramatta City Council Emergency Management Officer;
- Local television stations; and/or
- Local radio stations.

An important indication of likely imminent flood activity would be intense local rainfall and residents, retail workers and visitors should take notice of extreme rainfall warnings issued by the Bureau of Meteorology and disseminated by local media.

6.2 Draft Flood Emergency Detailed Response Plan

Flood Threat

The site is not inundated by floodwaters in a 100 yr ARI event and is only subject to inundation in extreme flood events approaching the PMF.

The proposed floor levels for the development are:

- Basement Car Park driveway crest level: +7.0 m AHD
- The ground floor level for retail outlets: +7.0 m AHD
- The floor levels for Levels 2-35 are all above the PMF level.

The indicative magnitudes of flood events in Clay Cliff Creek which would initiate over-floor inundation of the ground floor and the driveway are as follows:

- The ground floor level for retail outlets: +7.0 m AHD (around 1,200 yr ARI)
- Basement Car Park driveway crest level: +7.0 m AHD (around 1,200 yr ARI)

Responsibilities

In a flood emergency the NSW State Emergency Service (SES) has responsibilities including to:

- Direct the evacuation of persons and/or communities at risk of flood inundation.
- Issue evacuation warnings for individual communities that describe possible local effects, suggested actions and evacuation arrangements.

The building on-site manager shall liaise with the SES, monitor flood warnings and maintain regular communication with staff, workers and residents.

Preparedness

Visitors, retailers, workers and residents shall be advised of the potential flood threat in their locality, and recommended management and evacuation procedures in case of a flood event. They will comply with all lawful directions.

It is recommended that a practice evacuation drill or meeting is organised by management for retail staff and residents every year.

Response

While in a flood event, the SES will prepare, authorise and distribute evacuation warnings it is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any residents, workers and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

In the case of flood events approaching the PMF then retail staff or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

Warning

The SES will advise regarding potential evacuations of properties. While in a flood event, the SES will prepare, authorise and distribute evacuation warnings it is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

Recovery

The SES will issue an ‘all clear’ message when the immediate danger to life and property has passed.

7 Assessment of Council Requirements

7.1 Parramatta DCP 2011

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. The site is mapped as primarily Low Flood Risk with a small area of Medium Flood Risk and a fringing area of High Flood Risk (refer **Figure 15**). Consequently the development has been assessed against the planning and development controls that apply to "Residential" in a Medium Flood Risk Precinct. These controls are identified in **Table 3** and are discussed as follows.

Floor Levels

2. *Habitable floor levels to be equal to or greater than the 100 year ARI flood level plus freeboard*

   The proposed floor level of the Ground Floor retail outlets is 7.0 m AHD which provides which provides 0.81 m freeboard above the 100 yr ARI flood levels and 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change.

5 *A restriction is to be placed on the title of the land, pursuant to S.886 of the Conveyancing Act, where the lowest habitable floor area is elevated more than 1.5 m above finished ground level, confirming that the subfloor space is not to be enclosed.*

   This requirement is not applicable to the planning proposal.

Table 3 PCC Floodplain Matrix

Table 2.7: FLOODPLAIN MATRIX

Planning & Development Controls

Planning Consideration	Flood Risk Precincts (FRP's)																										
	Low Flood Risk									Medium Flood Risk									High Flood Risk								
	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development	Sensitive Uses & Facilities	Critical Uses & Facilities	Subdivision	Filling	Residential*	Commercial & Industrial	Tourist Related Development	Open Space & Non-Urban	Concessional Development
Floor Level		3			2, 5	2, 5	2, 5							2, 5	2, 5	2, 5	1, 5	4, 5								1, 5	4, 5
Building Components		2												1	1	1	1	1								1	1
Structural Soundness		2												1	1	1	1	1								1	1
Flood Affectation		2	2	1	2	2	2					1		1	1	1	2	1								1	1
Car Parking & Driveway Access		1, 3, 5, 6			1, 3, 5, 6	1, 3, 5, 6	1, 3, 5, 6	2, 4, 6, 7						1, 3, 5, 6, 7	1, 3, 5, 6, 7	1, 3, 5, 6, 7	2, 4, 6, 7	1, 5								2, 4, 6, 7	1, 5
Evacuation		2, 4, 6	5		3, 4	4	4					5, 3, 4		3, 4, 6	3, 4, 6	3, 4, 6	1, 4	3, 6								1, 4	3, 4 6
Management & Design		2, 3, 4	1									1		2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4								2, 3, 4	2, 3, 4

Not Relevant Unsuitable Land Use * For redevelopment of an existing dwelling refer also to ' Concessional Development' provisions

i. Freeboard equals an additional height of 500mm.

ii. The Parramatta LEP 2011 identifies development permissible with consent in various zones. 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 Clause 6.7 Foreshore Building Line in the Parramatta LEP 2011.

Floor Level	
1	All floor levels to be equal to or greater than the 20 year Average Recurrence Interval (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 Probable Maximum Flood (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 alternations 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	An engineers report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year ARI flood level plus freeboard.
2	An engineers report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF level.
Flood Affectation	
1	An engineers report is required to certify that the development will not increase flood affectation eleswhere, 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 cumulate 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 is to demonstrate the development is consistent with any relevant flood evacuation strategy or similar plan.
5	Applicant is 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 is 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 is 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.

Building Components

1 *All structures to have flood compatible building components below the 100 year ARI flood level plus freeboard.*

It is proposed that flood compatible building components be used in accordance with this requirement.

Structural Soundness

1 *An engineer's report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year ARI flood level plus freeboard.*

In a 100 yr ARI event partial flooding of the site occurs from Clay Cliff Creek. There will be no difficulty in complying with this requirement.

Flood Affectation

1 *An engineer's report is 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 cumulate impact of multiple potential developments in the vicinity.*

In the case of the 100 yr ARI event there is a local increase on Harris Street opposite 118 Harris Street of around 0.05 m. This local impact does not extend to any adjoining property. There is also an associated small reduction in 100 yr ARI flood levels north of Clay Cliff Creek.

In the PMF there is a small local increase in the PMF level on and upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 22 Parkes Street.

It is concluded that the planned development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels on and upstream of 24 Parkes Street.

It is further concluded from the negligible impact of the proposed development on design flood levels that additional compensatory flood storage is not necessary as part of this development.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) except along the Clay Cliff Creek channel. The planned development has a local impact on flow velocities in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on peak velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s). In a PMF the planned development locally decreases the flow velocity in 114 Harris Street while locally increasing the peak velocity on 41-43 Hassall and on a section of Hassall Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The planned development t has a local impact on velocity-depths in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on velocity-depths is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location. In the case of 114-118 Harris Street the velocity x depth in a PMF adjacent to the site is > 0.6 m^2/s. In a PMF the planned development locally reduces the flow velocity-depth opposite 114 -118 Harris Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High. The impact of the planned development on provisional hazard is negligible.

The cumulate impact of multiple potential developments in the vicinity has been previously represented in the floodplain model assembled during the 2005 Lower Parramatta River Floodplain Study and is already incorporated in the resulting flood levels adopted by Council.

The cumulative impact of the proposed development of 24 Parkes Street, 26-30 Parkes Street and 114-118 Harris Street was also undertaken.

It is concluded that the planned cumulative development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels upstream of 24 Parkes Street.

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.*

   This requirement is not applicable to the proposed development.

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 0.5 m above the 100 year ARI flood level.*

   The proposed development complies with this requirement.

5. *The level of the driveway providing access between the road and parking spaces shall be no lower than 0.2 m below the 100 year ARI flood level.*

   The proposed development complies with this requirement.

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.*

   These systems and information are to be incorporated in the building emergency plan.

7. Restraints or vehicle barriers to be provided to prevent floating vehicles leaving a site during a 100 year ARI flood.

While this requirement is noted it is not expected to be an issue for the proposed development because all parking is located underground within the multi-storey car park and any vehicles which are floated by floodwaters will be trapped within the car park levels.

Evacuation

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.

It is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any workers, residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place. Under these circumstances the expected time that visitors and/or residents would need to shelter in place during a PMF would be around 3 hours 35 minutes (ground floor) while the car park entry at Harris Street (at 7.0 m AHD) would be inundated for up to 3 hours 35 mins.

4 Applicant to demonstrate the development is consistent with any relevant flood evacuation strategy or similar plan.

Discussed in Section 5 of this report.

6 Adequate flood warning is available to allow safe and orderly evacuation without increased reliance upon SES or other authorised emergency services personnel.

Discussed in Section 6 of this report.

Management & Design

2 Site Emergency Response Flood plan required where the site is affected by the 100 year ARI flood level, (except for single dwelling-houses).

While the proposed development is affected by the 100 yr ARI flood a draft plan is outlined in Section 6.2.

3 Applicant is to demonstrate that area is available to store goods above the 100 year flood level plus freeboard.

This requirement is noted.

4 No storage of materials below the 100 year ARI flood level.

This requirement is noted.

It is concluded that the merit assessment detailed above and the recommendations given in Section 6 satisfy the requirements of the Parramatta DCP 2011.

8 Summary and Conclusions

This report details the assessment of the stormwater flooding extent and behaviour for the planning proposal for 114-118 Harris Street, Harris Park. The subject site is located on the Clay Cliff Creek floodplain just upstream of Harris Street.

It is proposed to redevelop the site as a multi-storey mixed use apartment complex comprising, one level of retail outlets, one level of commercial offices, 35 levels of residential apartments and one level of communal open space. Guided by planning proposals for adjoining properties it is expected that there will be four levels of basement car parking based on the ground floor footprint of the development.

The flooding assessment methodology is outlined as follows:

- Impact of planned development on flooding
- Climate change impact on flooding
- Flood emergency response
- Flood warning and evacuation
- A draft emergency response plan
- Compliance with requirements of Parramatta DCP 2011

8.1 Previous Flood Assessments

It is noted that flooding investigations have been previously completed for the Clay Cliff Creek floodplain in the vicinity of the subject property as follows:

- The Lower Parramatta River Floodplain Risk Management Study, Flood Study Review prepared by SKM in 2005;
- The Clay Cliff Creek Catchment Master Drainage Plan prepared by Cardno Willing in 2007;
- Flood Impact Assessment of Development of 14-16 Parkes St, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 111 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 122 Wigram St, Harris Park prepared by Cardno in 2011;
- Flood Impact Assessment, 40-72 Church Street, Parramatta prepared by Cardno in 2011;
- Flood Impact Assessment, 113-117 Wigram St and 23-29 Hassall St, Harris Park prepared by Cardno in 2014; and
- Flood Impact Assessment, 5-7 Parkes St, Parramatta prepared by Cardno in 2017.

8.2 Flood Impact Assessment

The assessment of the impact or otherwise of development on 114-118 Harris Street, Harris Park was undertaken using a version of the 2007 Clay Cliff Creek XP-SWMM 1D/2D floodplain model last updated for the 2017 assessment of flooding of 32 Tramway Avenue, Parramatta. The model extent covers the subject site.

Flood models were established for the existing site conditions and future developed scenarios. The layout of the proposed multi-storey mixed use apartment complex is shown in the selected architectural drawings prepared by aleksandar design group (attached in **Appendix C**).

Flood modelling was completed for the 100 year ARI, and Probable Maximum Flood events.

Council's Flood Map (**Figure 1** and **Appendix B**) indicate the following peak flood levels (at Chainage 2220) adopted by Council:

- 100 year ARI: 6.19 m AHD; and
- PMF: 9.44 m AHD

The flood modelling of existing and future site conditions completed as described in Sections 3.1 and 3.3 estimated the following peak flood levels (at a comparable location):

- 100 year ARI: 6.30 m AHD; and
- PMF: 9.50 m AHD.

It is noted that the floodplain model predicts shallow overland flows which discharge north down Harris Street towards Clay Cliff Creek. These shallow overland flows are not plotted in Council's Flood Map given in **Appendix B**.

For the purpose of assessing compliance with Council's DCP requirements and flood emergency management Council's and in accordance with Council's stated policy the flood levels reported in Council's Flood Map (at Chainage 2220) were adopted when considering the planning proposal.

The 100 year ARI flood level adopted for the review of the development floor levels is 6.19 m AHD.

The estimated 100 year ARI and PMF level differences under Future Conditions in comparison with Existing Conditions are plotted in **Figures 28** and **29** respectively.

In the case of the 100 yr ARI event there is a local increase on Harris Street opposite 118 Harris Street of around 0.05 m. This local impact does not extend to any adjoining property. There is also an associated small reduction in 100 yr ARI flood levels north of Clay Cliff Creek.

In the PMF there is a small local increase in the PMF level on and upstream of 24 Parkes Street of around 0.03 m. This impact decreases west of 22 Parkes Street.

It is concluded that the planned development has a local adverse impact on 100 year ARI in Harris Street which does not extend to any adjoining property and a small adverse impact on PMF levels on and upstream of 24 Parkes Street.

Peak overland flow velocities in a 100 year ARI event in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s) except along the Clay Cliff Creek channel. The planned development has a local impact on flow velocities in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on peak velocities is negligible.

In a PMF event peak flow velocities in Harris Street south of Clay Cliff Creek are low (< 0.3 m/s). In a PMF the planned development locally decreases the flow velocity in 114 Harris Street while locally increasing the peak velocity on 41-43 Hassall and on a section of Hassall Street.

In a 100 year event, the velocity-depth product is less than 0.4 m^2/s in Harris Street south of Clay Cliff Creek and in Parkes Street east of Wigram Street. The planned development t has a local impact on velocity-depths in Harris Street at the Clay Cliff Creek crossing. This local impact does not extend onto any adjoining property. Elsewhere the impact on velocity-depths is negligible.

In a PMF event velocity x depth in Harris Street south of Clay Cliff Creek varies depending on location. In the case of 114-118 Harris Street the velocity x depth in a PMF adjacent to the site is > 0.6 m^2/s. In a PMF the planned development locally reduces the flow velocity-depth opposite 114 -118 Harris Street.

In a 100 year event, the provisional hazard in Harris Street south of Clay Cliff Creek is Low. The impact of the planned development on provisional hazard is negligible.

In a PMF event provisional hazard in Harris Street adjacent to the site is High. The impact of the planned development on provisional hazard is negligible.

8.2.1 Flood Risk Precinct

The flood risk precincts in the vicinity of the site are plotted in **Figure 15**. The site is mapped as primarily Low Flood Risk with a small area of Medium Flood Risk and a fringing area of High Flood Risk based on the XP-SWMM 1D/2D results. Similar Flood Risk precincts would be mapped based on the extents of 100 yr ARI flooding and hazard as given in in Council's Flood Map attached in **Appendix B**. Council would map the section of Harris Street adjoining the property as Low Flood Risk.

8.2.2 Rate of Rise of Floodwaters

Features of the planned development include:

- Ground levels which vary from 8.49 m AHD in the southwest corner of 118 Harris Street to 5.74 m AHD in the in the vicinity of the northern boundary of the property;
- Proposed ground floor level for the commercial and retail outlets of 7.0 m AHD which provides which provides 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change;
- Proposed Level 1 floor level or the commercial uses of 11.2 m AHD which is higher than the PMF level;
- Proposed floor levels for all the apartments which are all significantly higher than the PMF level;
- A driveway crest level of around 7.0 m AHD which provides 0.81 m freeboard to the 100 yr ARI flood level in Clay Cliff Creek and 0.45 m freeboard to the indicative 100 yr ARI flood level under climate change in Clay Cliff Creek.

While the entry to the ground floor retail outlets has a freeboard of around 0.81 m above the current 100 year ARI flood level, this freeboard would be overwhelmed in a PMF event (within around 2 hours). The PMF is estimated to reach a level of around 9.44 m AHD.

The representative spill level to initiate flow down the driveway is 7.0 m AHD (assuming that the ingress of floodwaters via any vents or lift shafts is limited) and it is estimated that in a 4 hour PMF event that the onset of flows down the car park ramps would occur around 3 hours 45 minutes after start of the PMP storm.

Consequently, it is expected that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place.

It was envisaged that the car park levels would be progressively filled by floodwaters in a similar timeframe due to the expected flooding of each car parking level (from Basement Level 1 to Basement Level 2 to Basement Level 3 to Basement Level 4) in order to drive flows down the access ramp ie. the Basement Level 1 car park would act like a retarding basin with the last "basin" (Basement Level 4) filling over a shorter time than Basement Level 1.

The time it would take to fill each level of the car park to a depth of 0.9 m was also estimated using a simple hydraulic model of flows down the ramps. For the case of the PMF (which is the most rapidly rising flood that was assessed) the estimated times it would take to fill each level of the car park to a depth of 0.9 m and to completely full is around 23-27 minutes and around 30-34 minutes respectively**.**

8.3 Emergency Planning

As indicated in the 2010 Parramatta DISPLAN, it is expected that Building Owners and Managers in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Parramatta regulations, are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

A draft Emergency Response Plan is outlined.

8.4 Flood Emergency Response

In the case of flood events approaching the PMF then workers or visitors on the Ground Floor could retreat to the Communal Area on Level 4.

In the case of the proposed development a conservative maximum density of 2 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place. Based on the estimated peak number of persons that could be at risk in the car park and on the Ground Floor retail outlets the estimated maximum area of refuge required is 118 m^2. It is expected that this refuge would be provided by the communal room on Level 4 which exceeds the required area of refuge.

8.5 Assessment of Council Requirements

The site is mapped as primarily Low Flood Risk with a small area of Medium Flood Risk and a fringing area of High Flood Risk. Consequently the development has been assessed against the planning and development controls that apply to “Residential” in a Medium Flood Risk Precinct.

Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. An assessment of the compliance of the proposed development with Council’s requirements is given in Section 7 of this report.

It is concluded that the assessment and details in this Flood Impact Assessment satisfy the requirements of the Parramatta DCP 2011.

9 References

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SKM (2013) “Flood Control Study for Rosehill/Camellia”, *Final Report*, prepared for Parramatta City Council, 8 March 2013.

114-118 Harris Street, Harris Park

APPENDIX A
FIGURES

Cardno
Shaping the Future

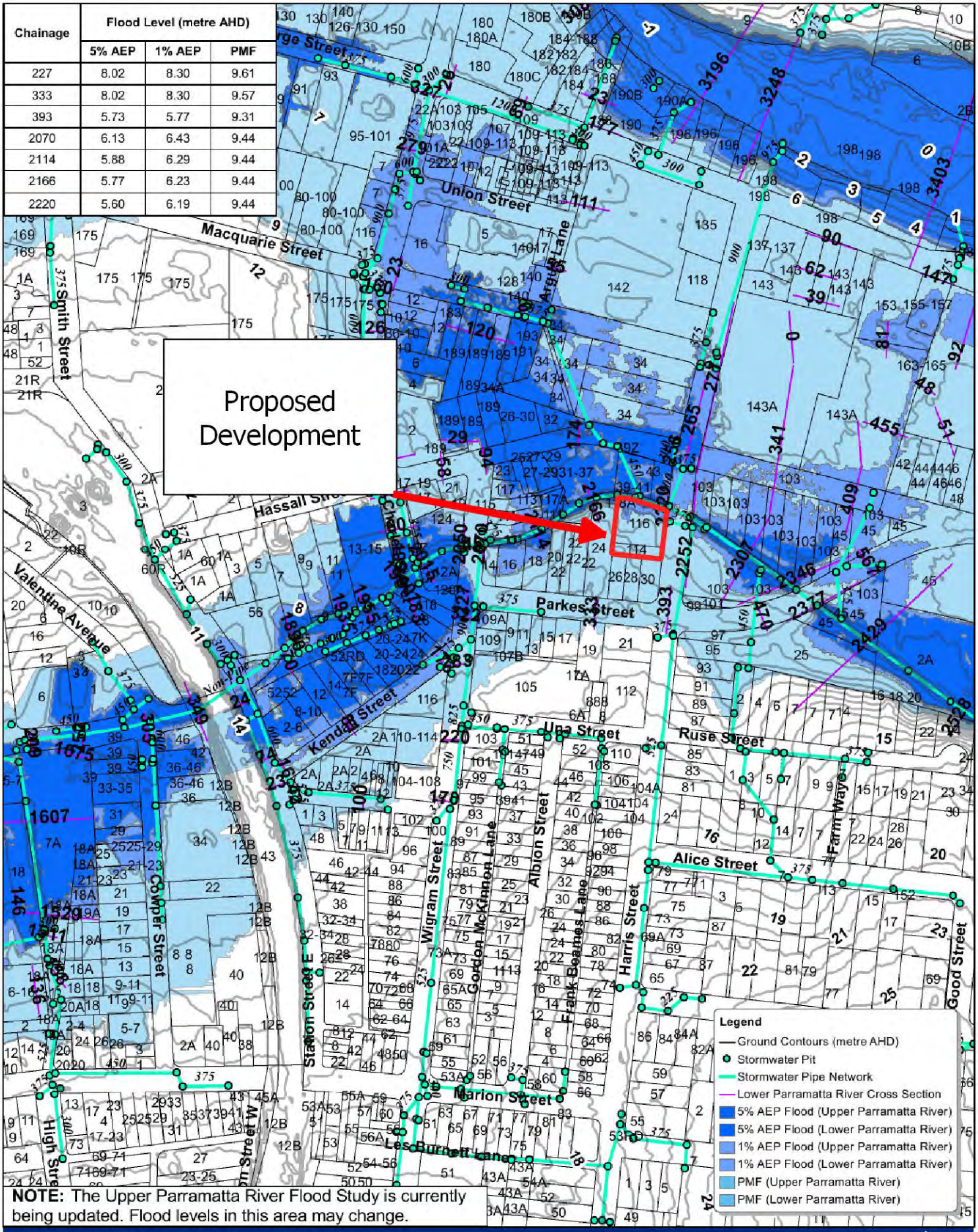

Figure 1 Locality Plan (Source: Parramatta City Council Flood Map)

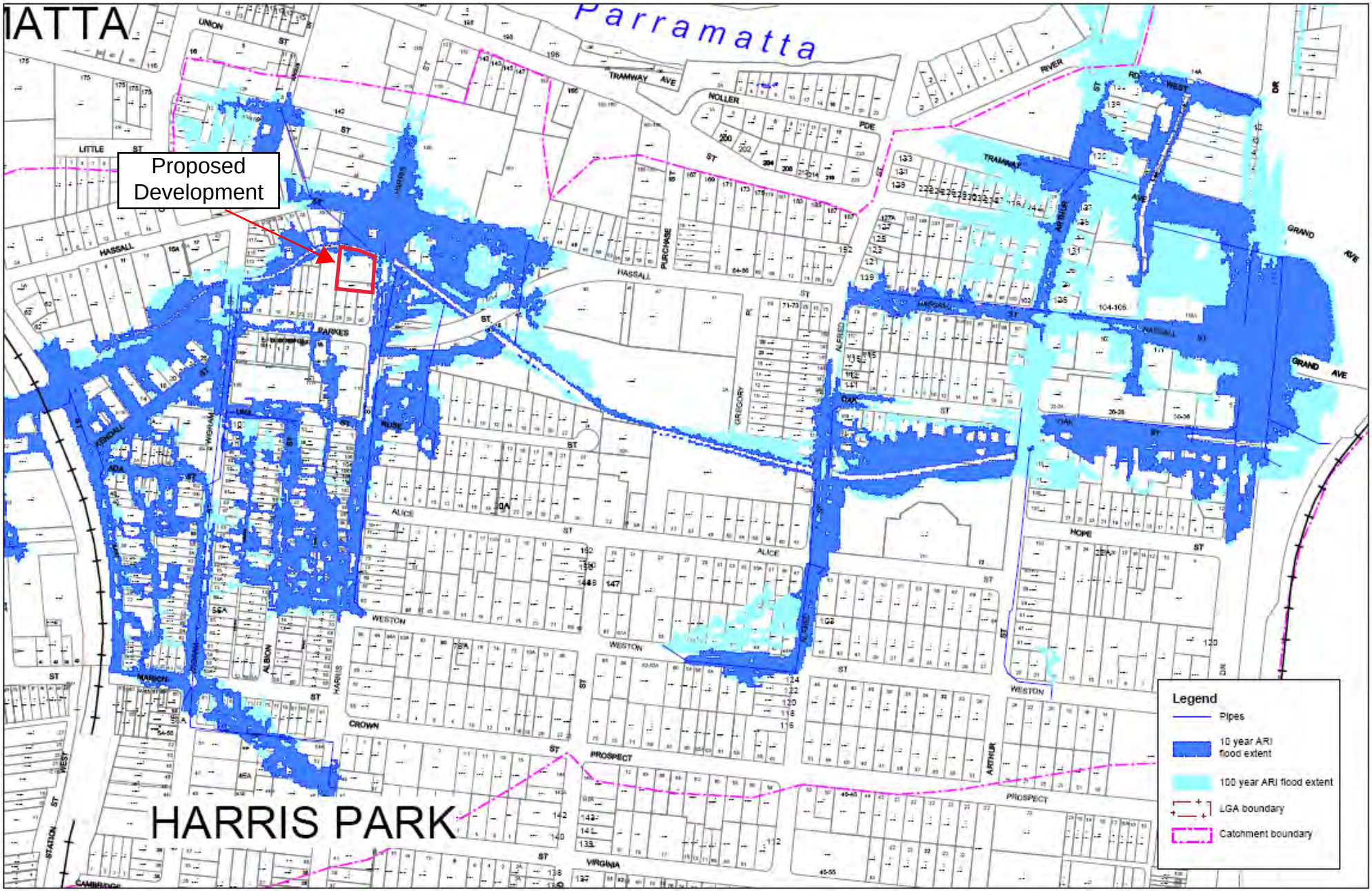

Figure 2 10 yr ARI and 100 yr ARI flood extents – Clay Cliff Creek (after Cardno Willing, 2007)

Cardno
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114 - 118 Harris Street
Existing Conditions

Figure 3
Floodplain Terrain

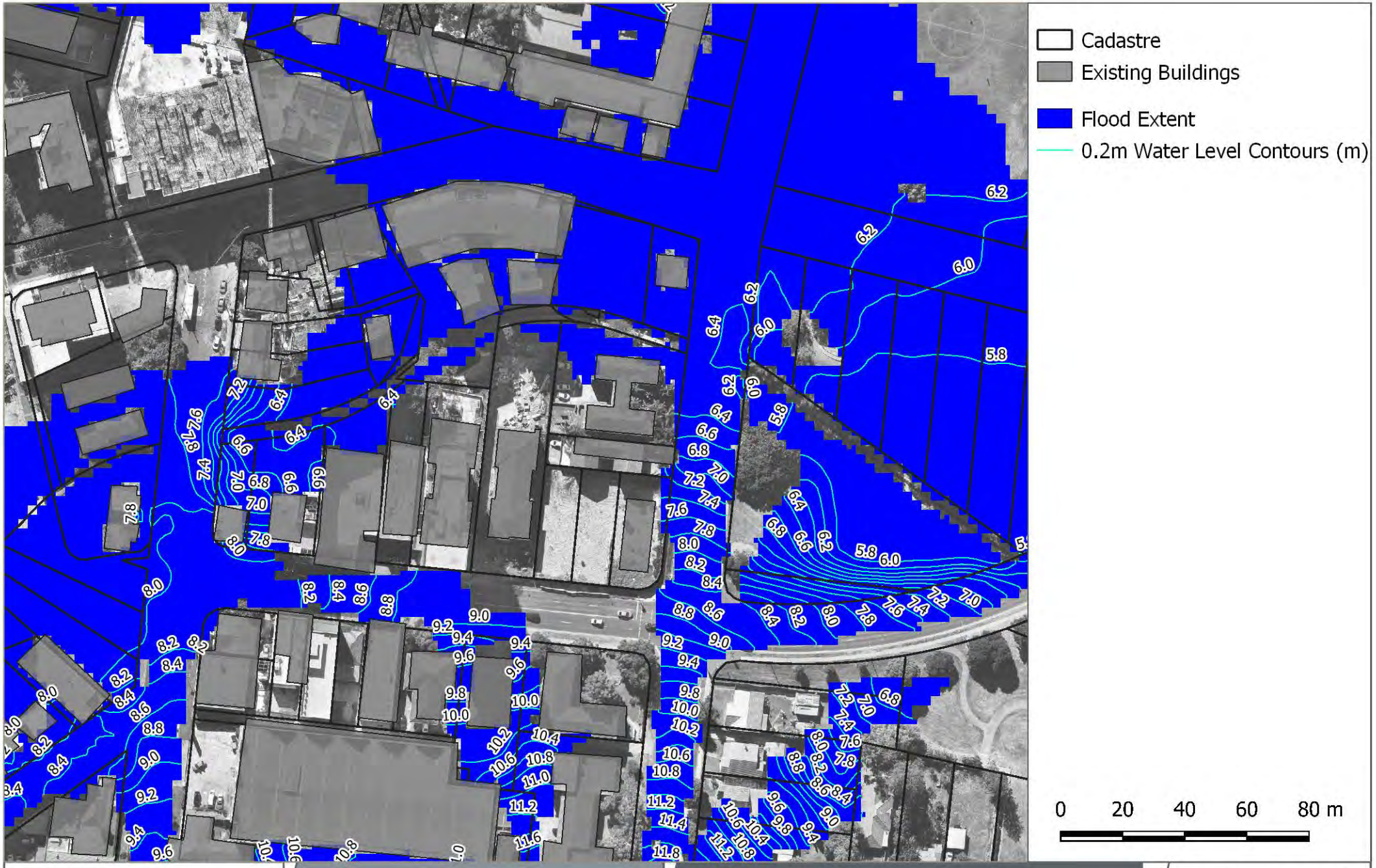
Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 4
Floodplain Roughness

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

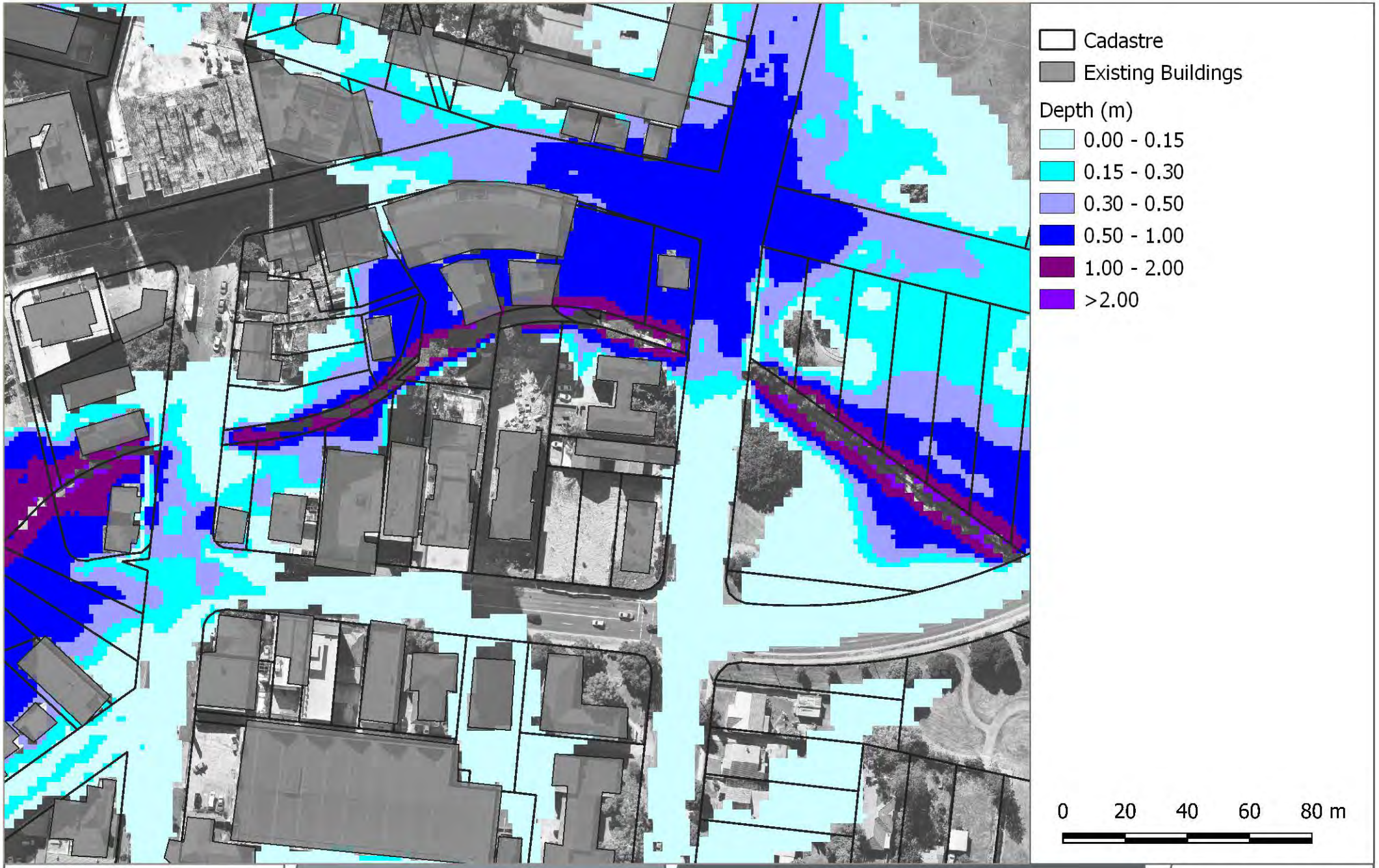


Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 5
1% AEP Flood Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

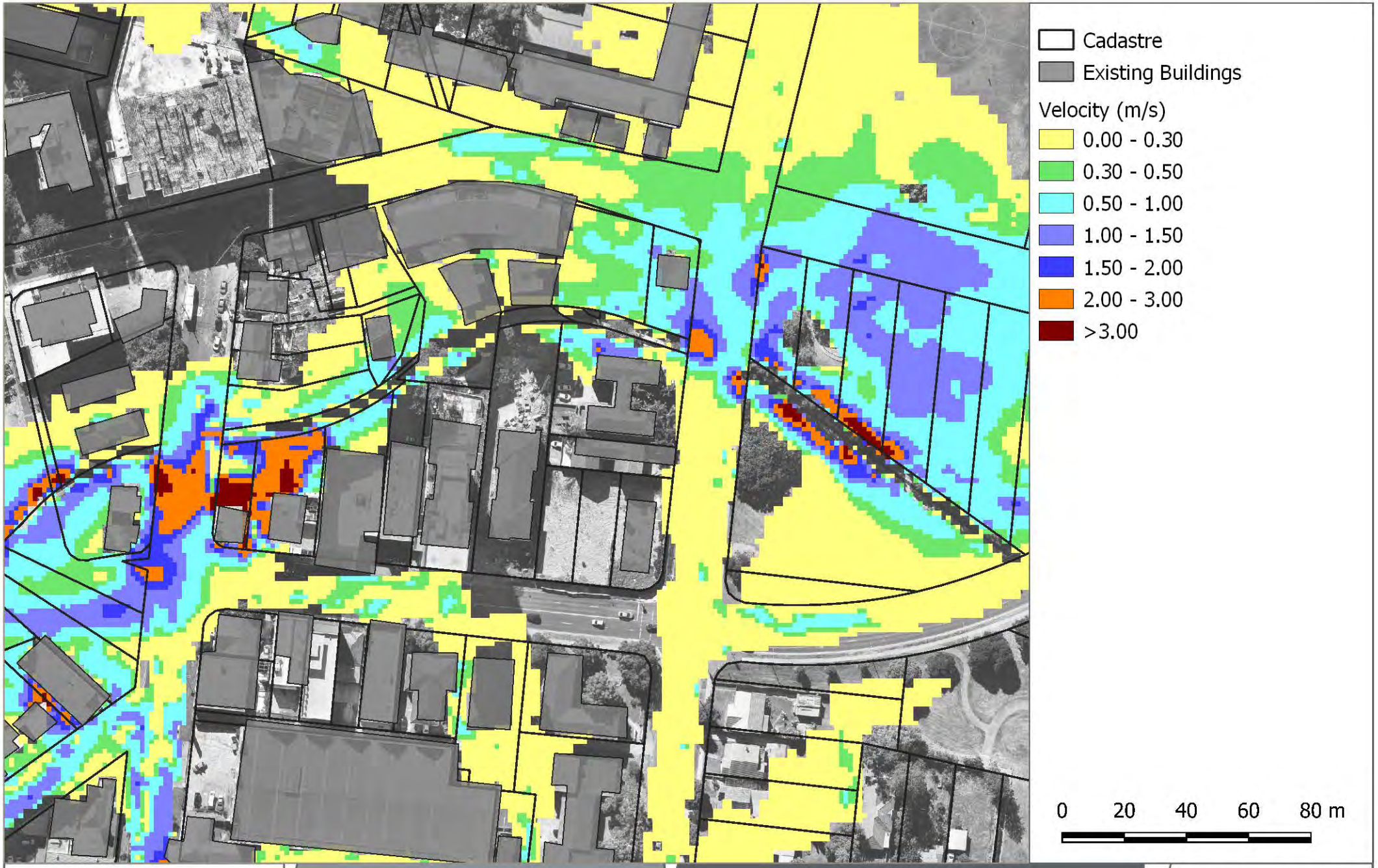


Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 6
1% AEP Peak Flood Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



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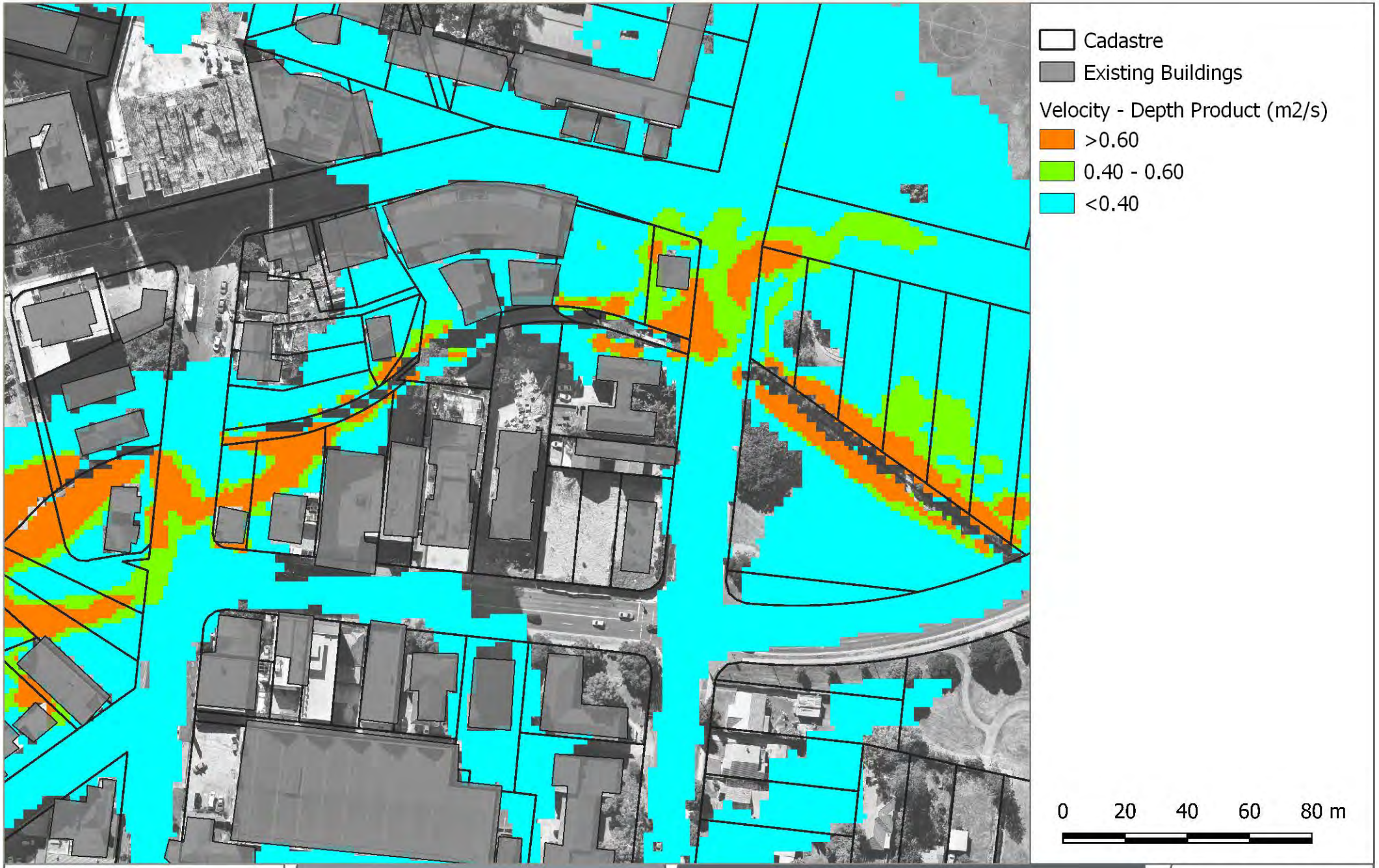
114 - 118 Harris Street
Existing Conditions

Figure 7
1% AEP Peak Flood Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

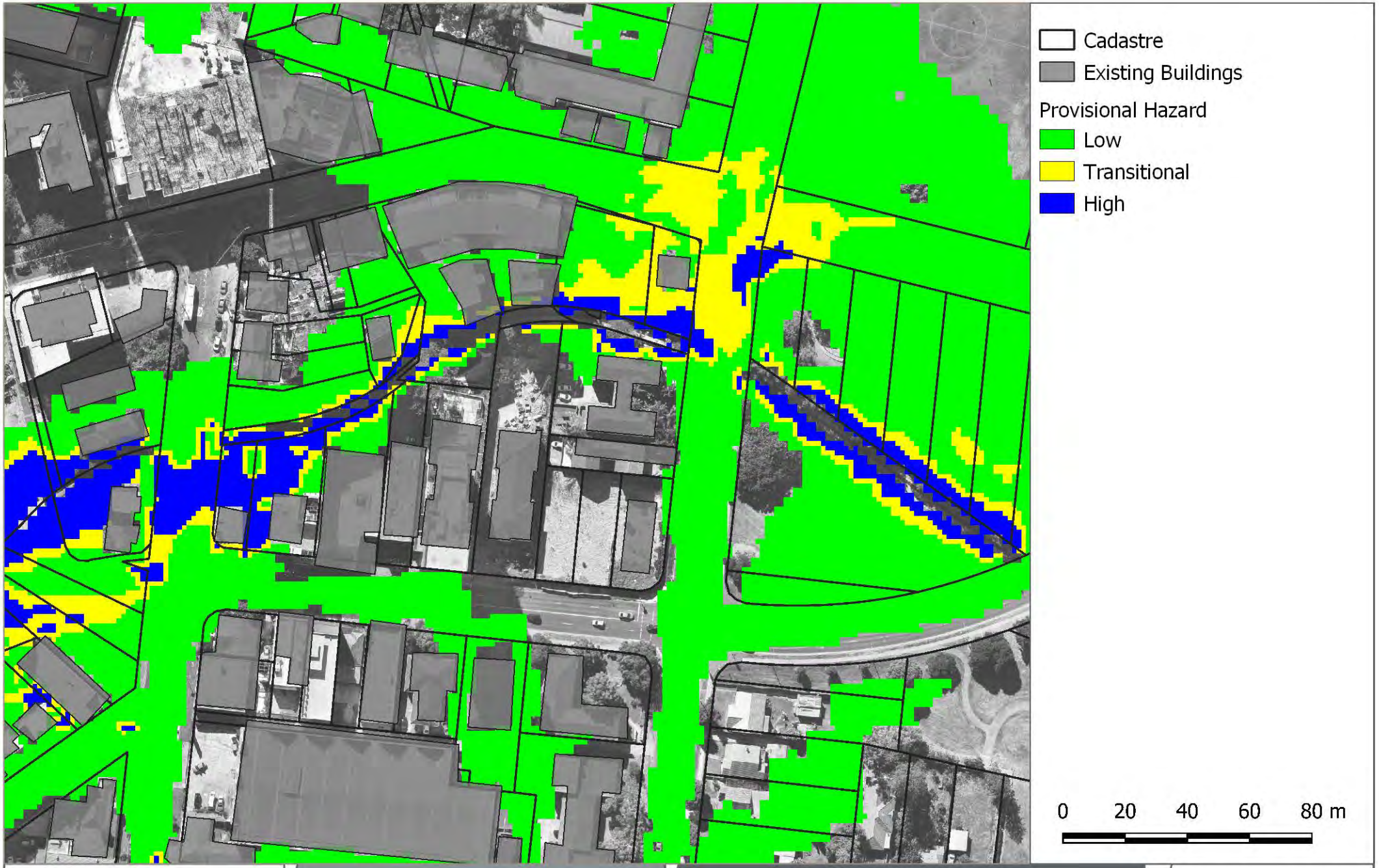


Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 8
1% AEP Peak Flood Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Cardno
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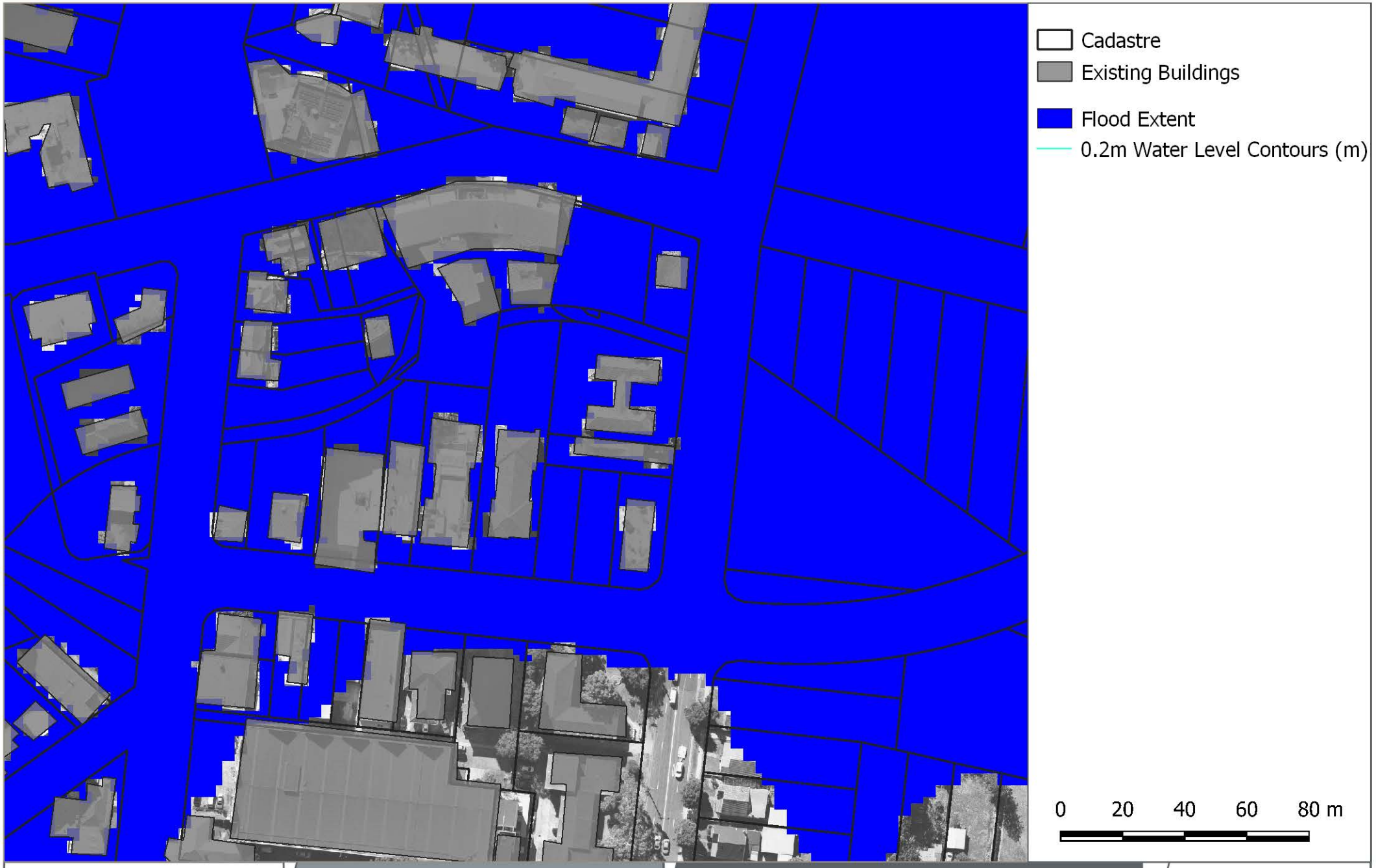
114 - 118 Harris Street
Existing Conditions

Figure 9
1% AEP Peak Flood Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Cardno
Shaping the Future

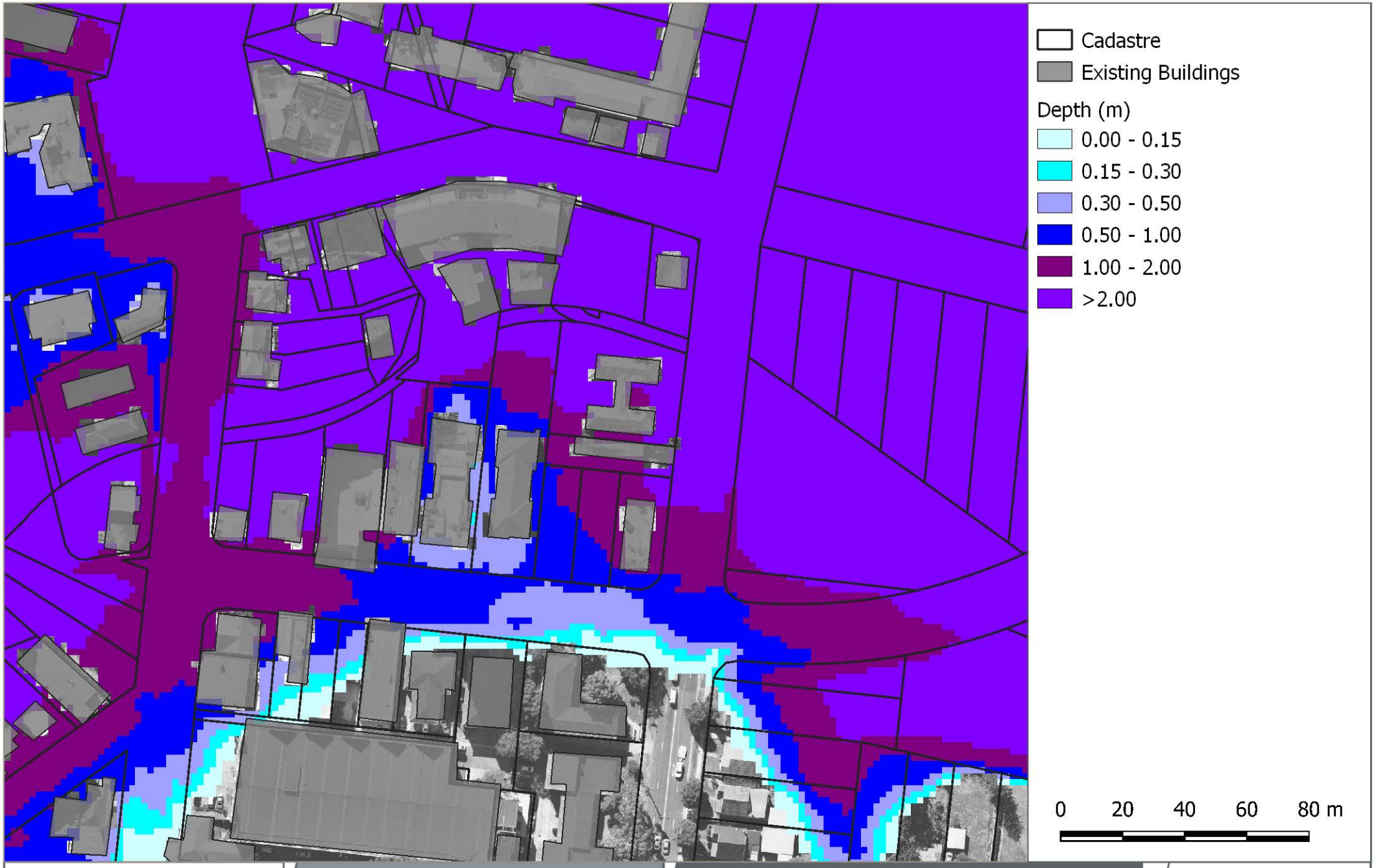
114 - 118 Harris Street
Existing Conditions

Figure 10

PMF Extents and Flood Levels

N

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



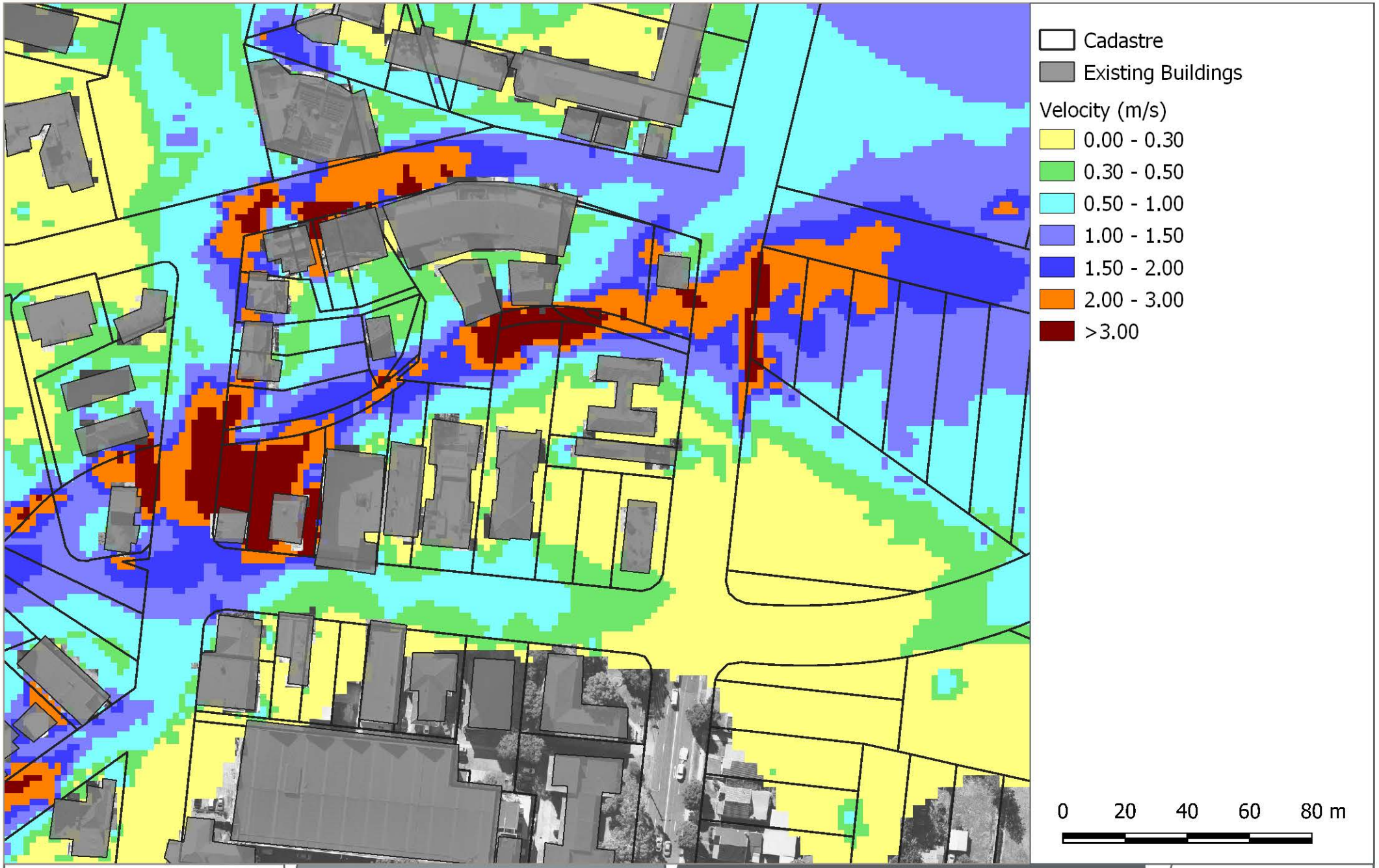
Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 11
PMF Depths

N

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

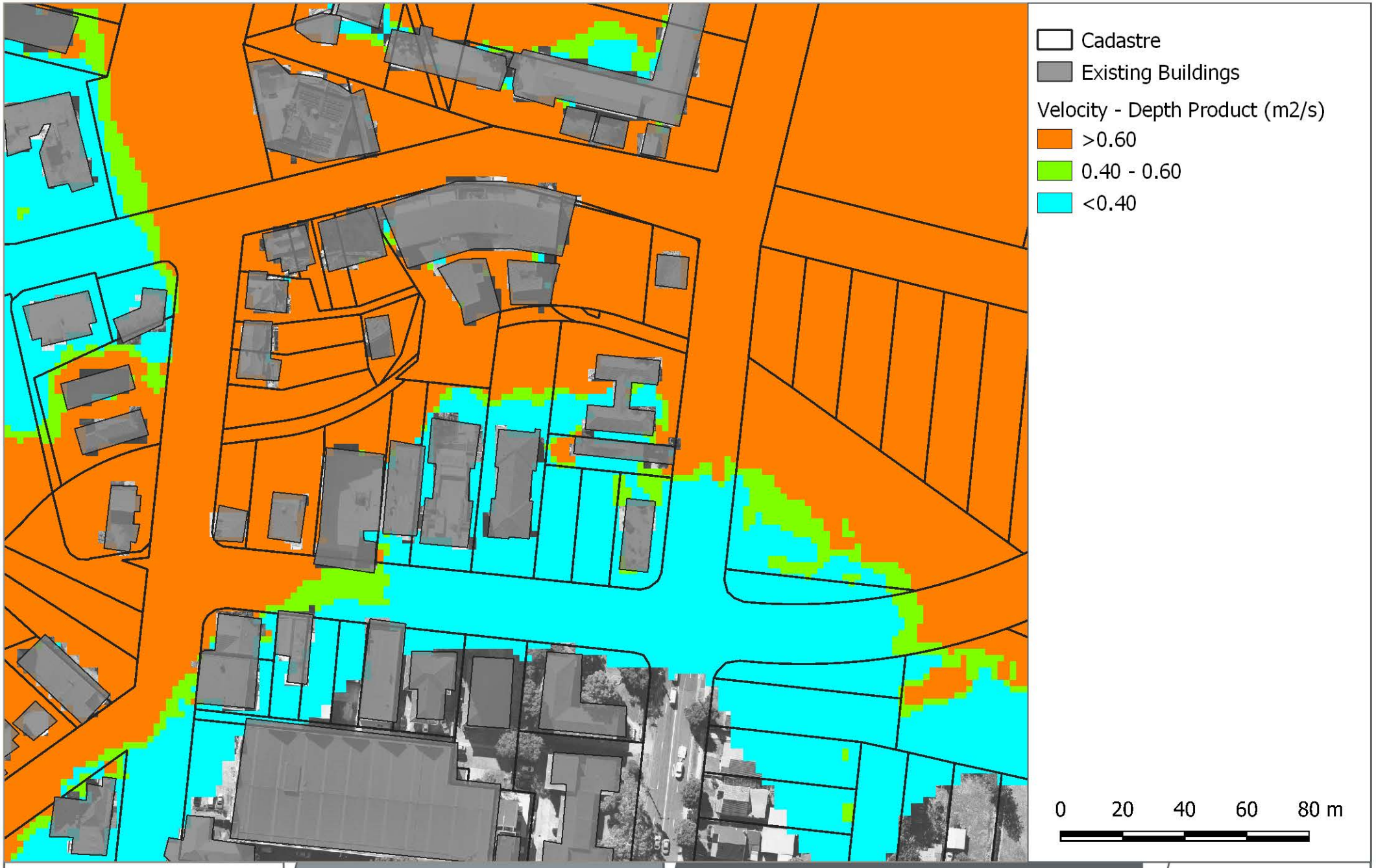


Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 12
PMF Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

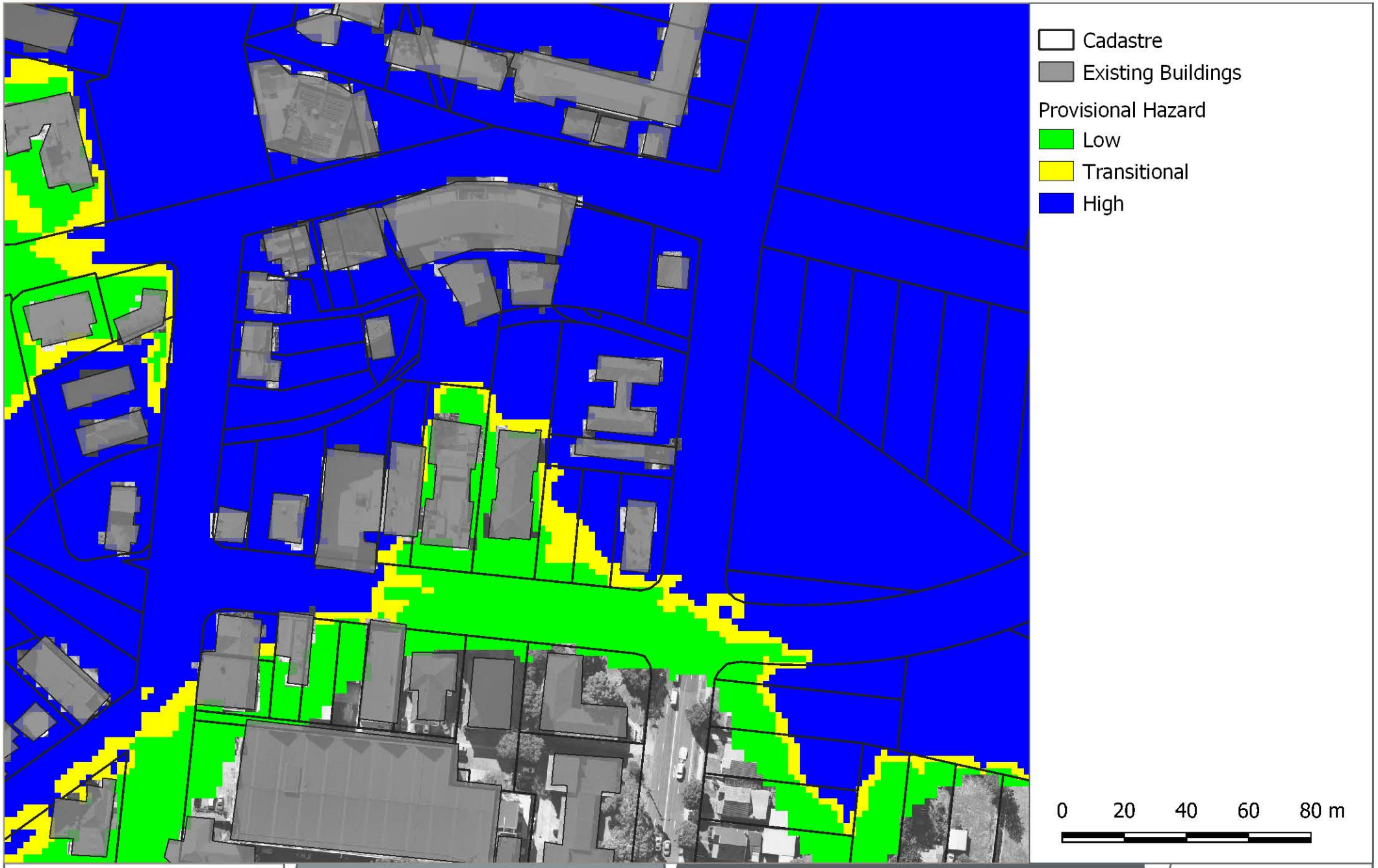


Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 13
PMF Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

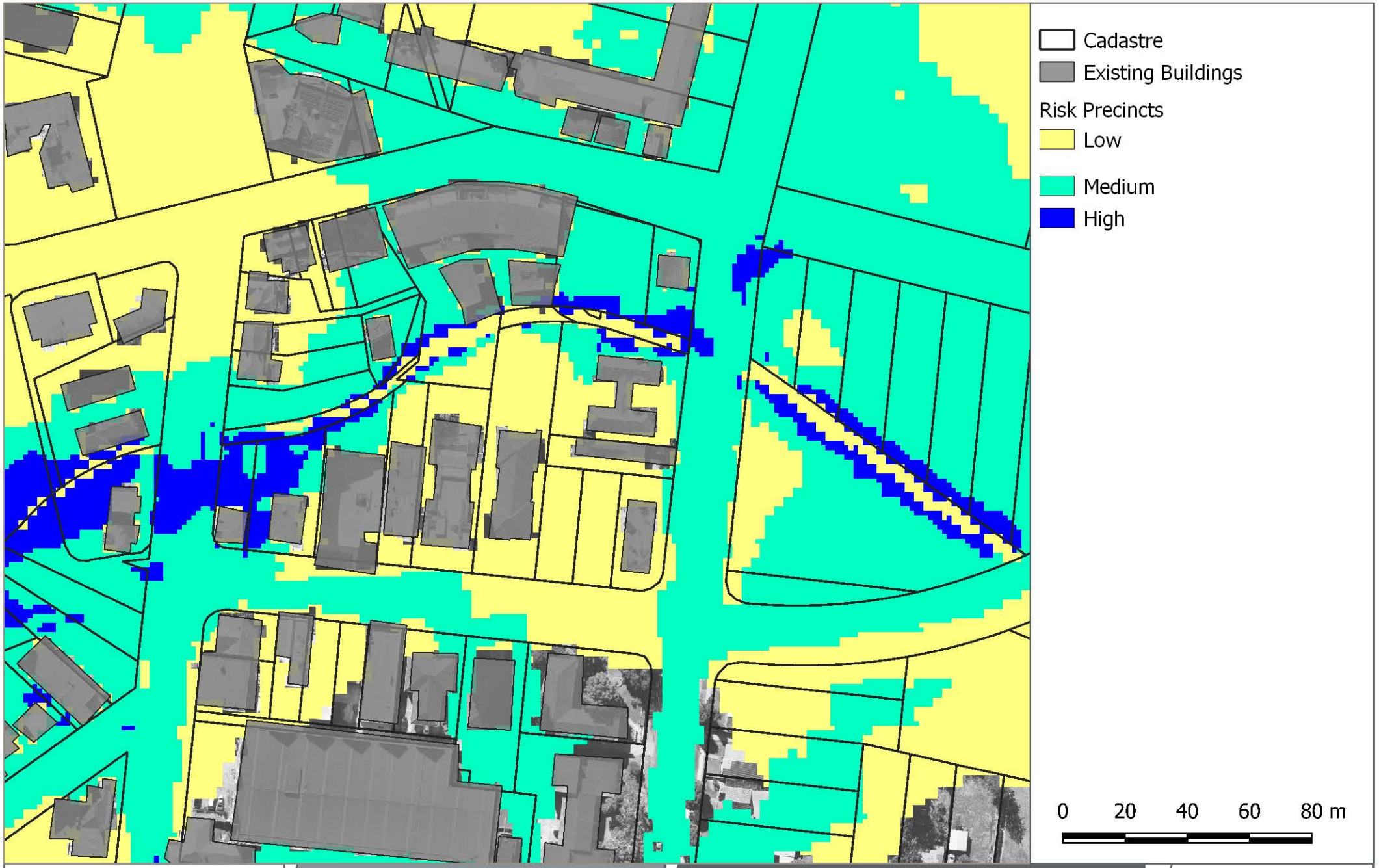


Cardno
Shaping the Future

114 - 118 Harris Street
Existing Conditions

Figure 14
PMF Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Cardno
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114 - 118 Harris Street
Existing Conditions

Figure 15
Flood Risk Precincts

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

Cardno
Shaping the Future

114 - 118 Harris Street

Future Conditions

Figure 16

Floodplain Terrain

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

Cardno
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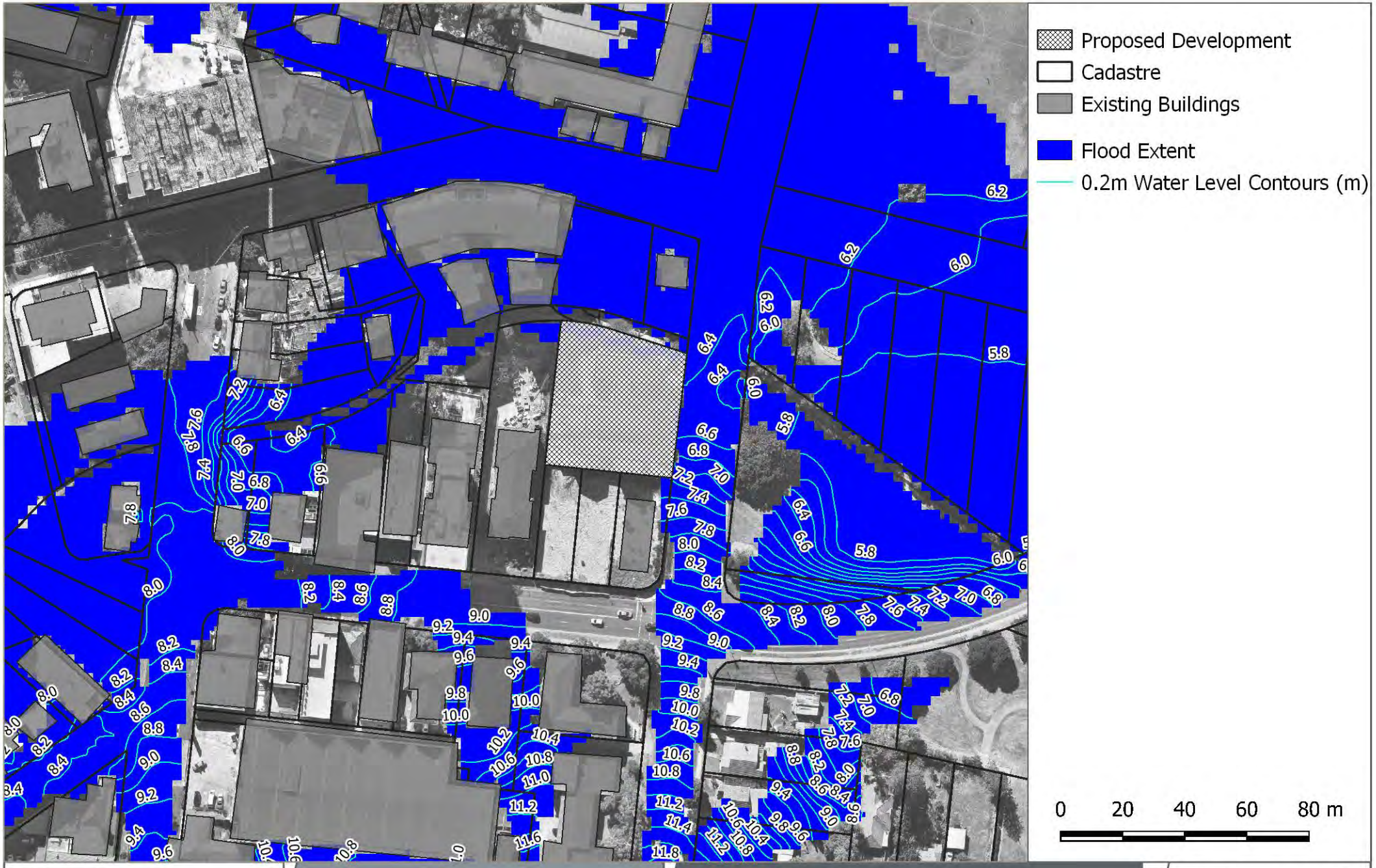
114 - 118 Harris Street
Future Conditions

Figure 17
Floodplain Roughness

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Cardno
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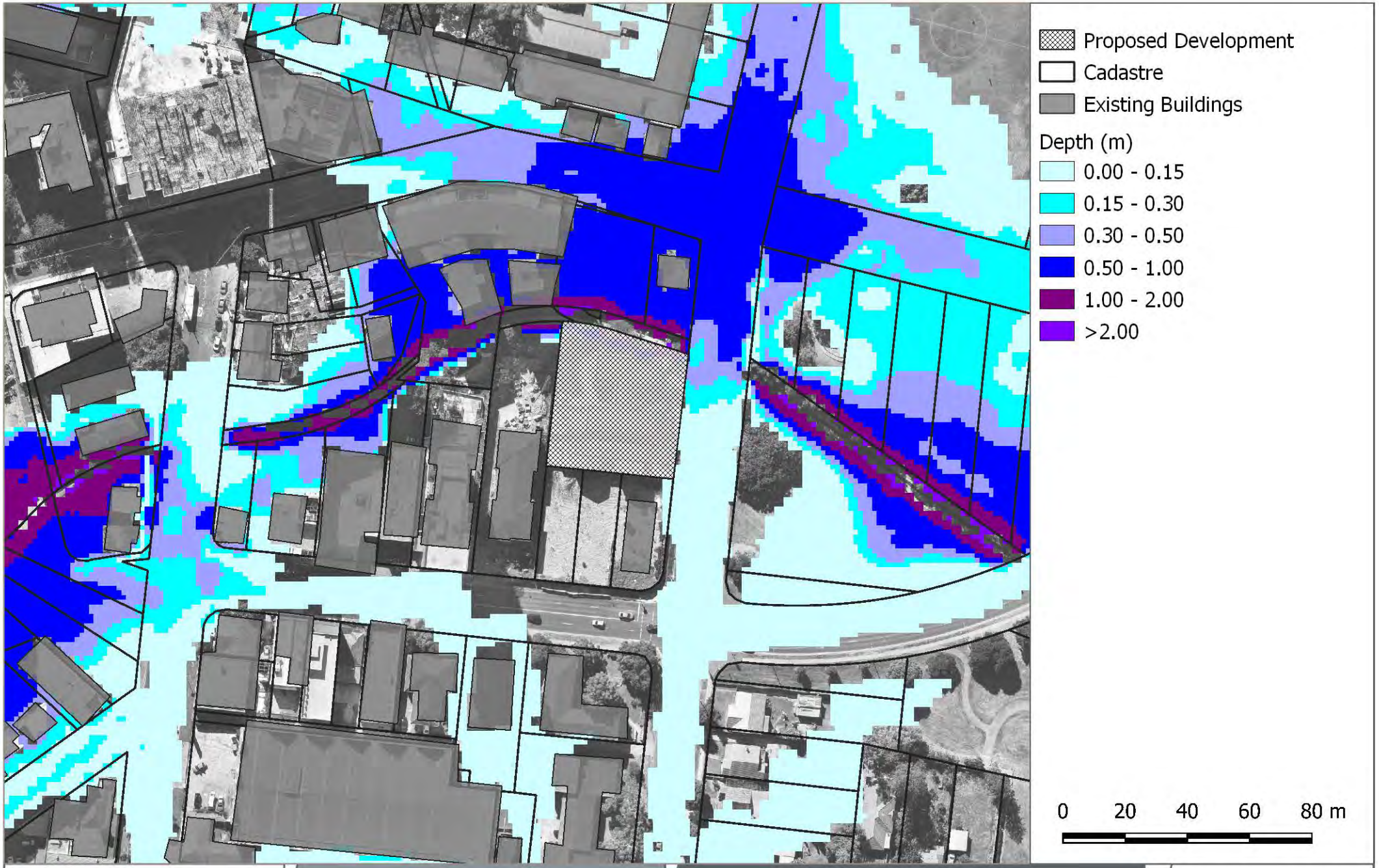
114 - 118 Harris Street
Future Conditions

Figure 18
1% AEP Flood Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

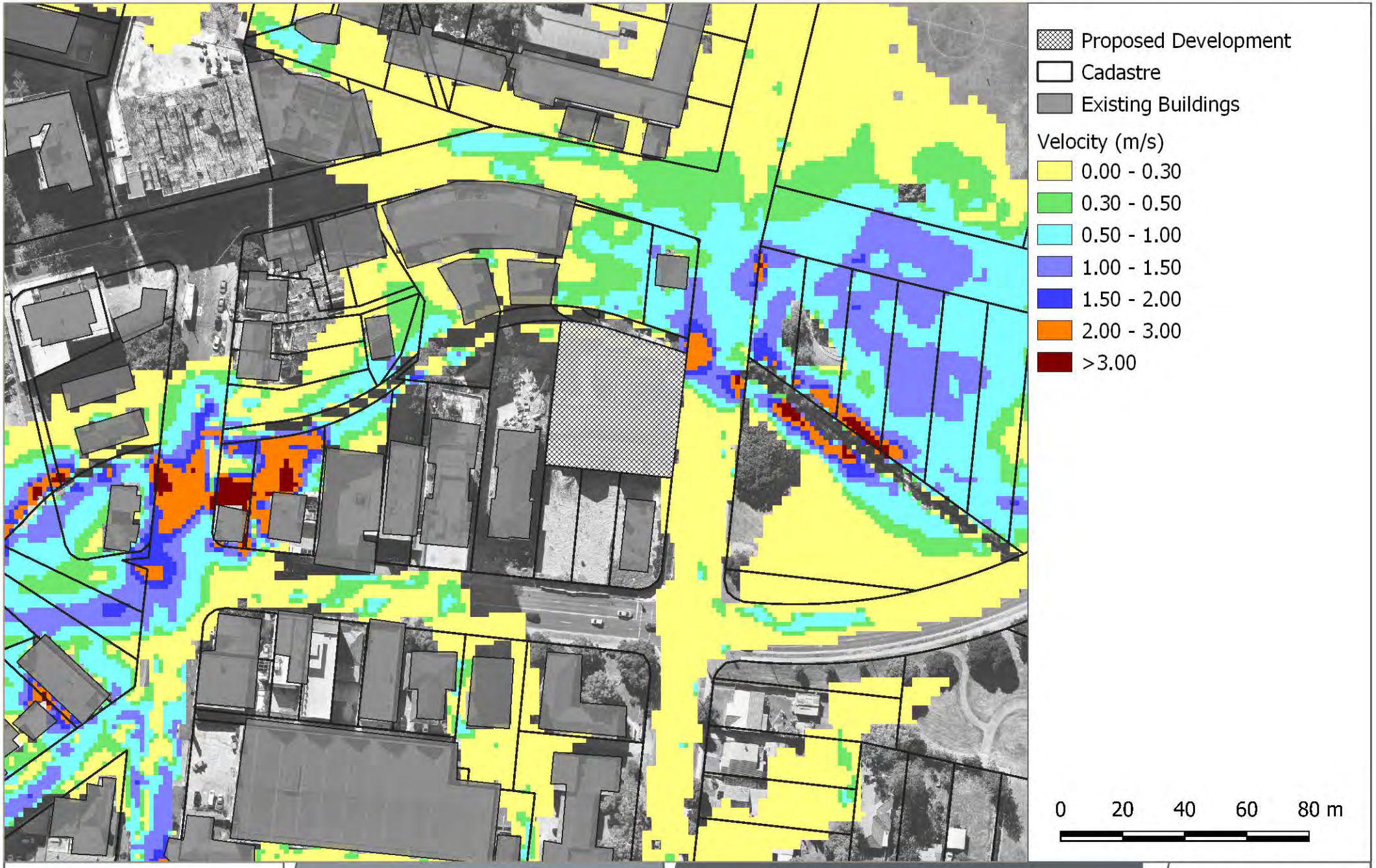


Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 19
1% AEP Peak Flood Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

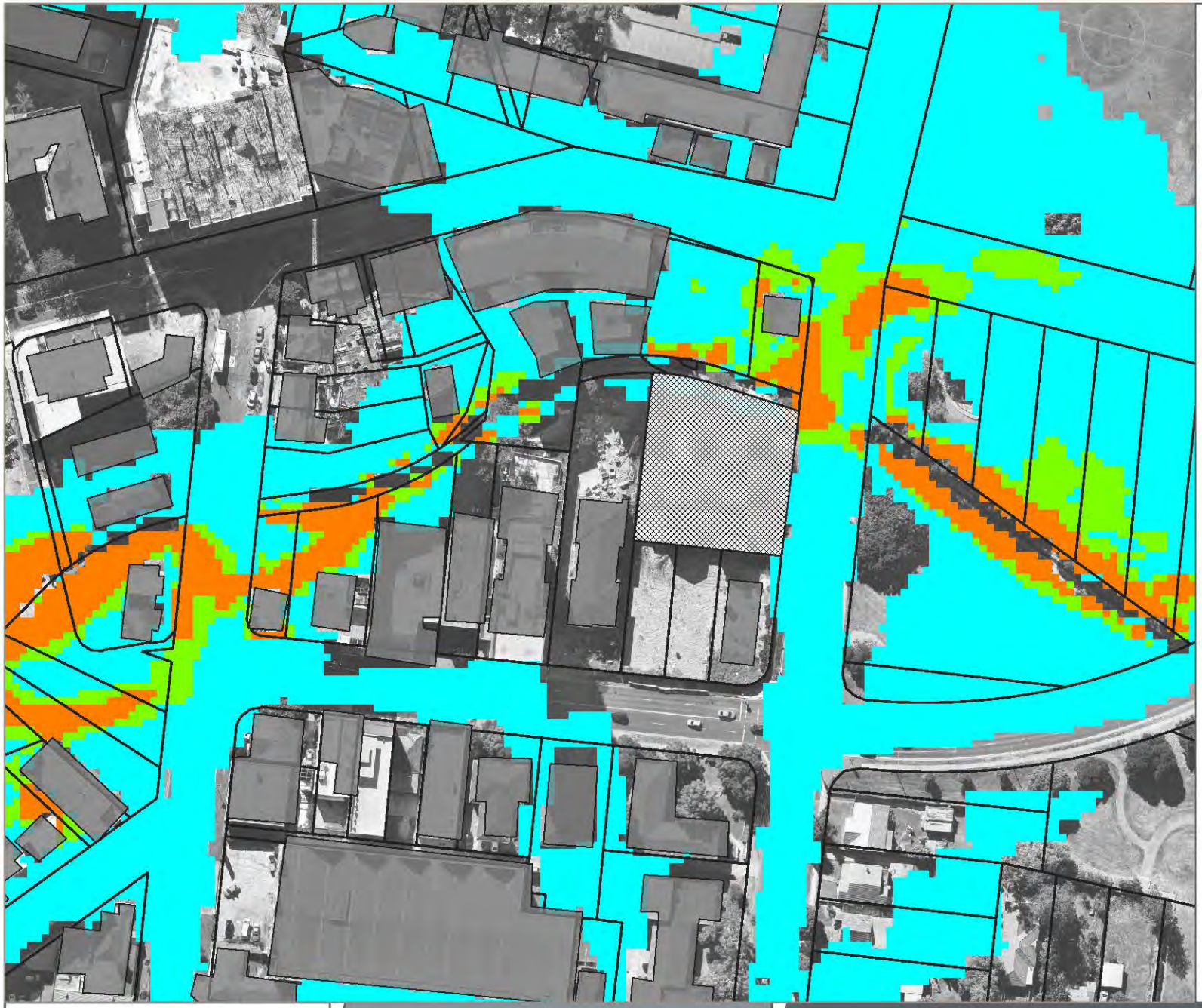


Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 20
1% AEP Peak Flood Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Proposed Development
Cadastre
Existing Buildings
Velocity - Depth Product (m2/s)
>0.60
0.40 - 0.60
<0.40

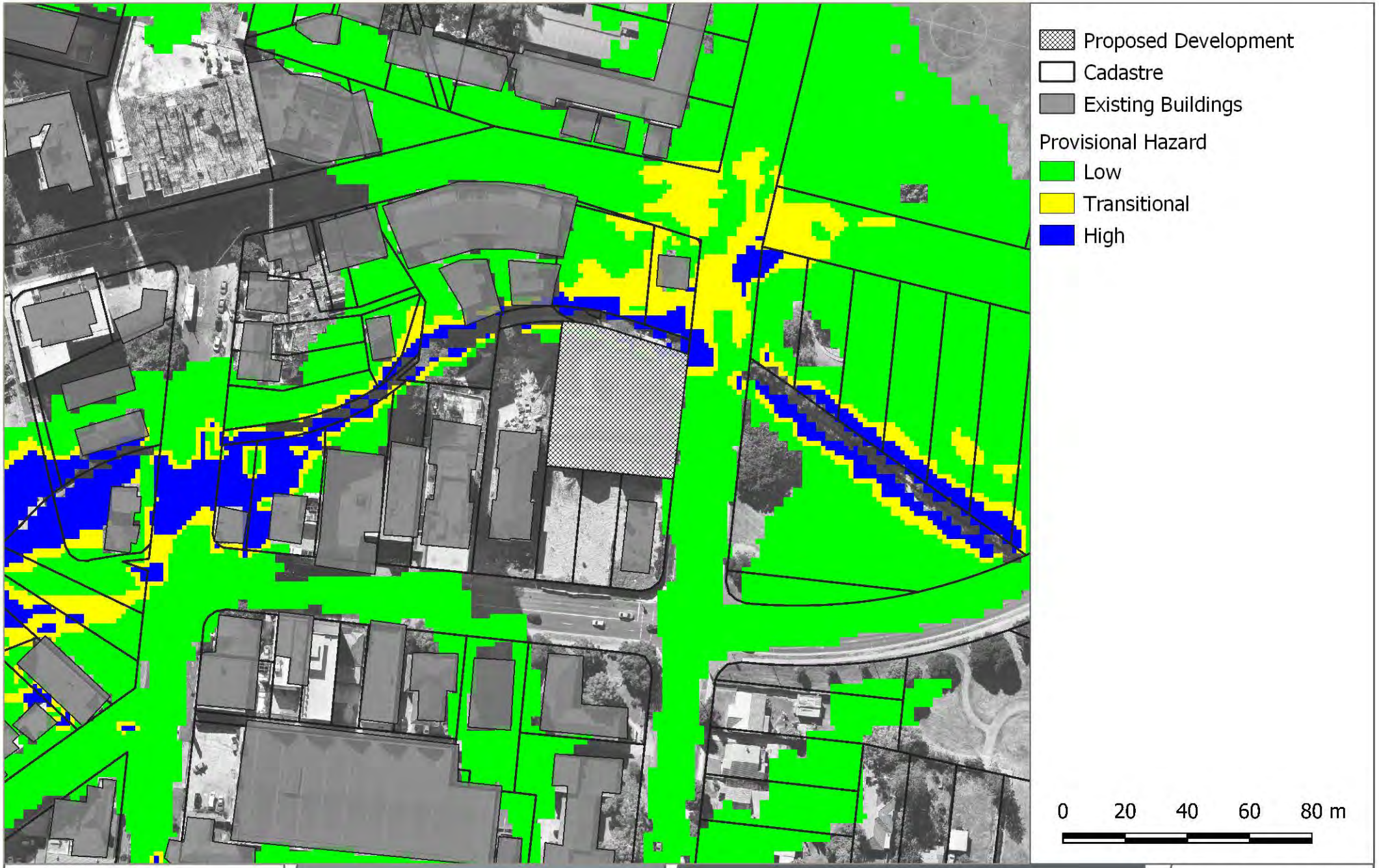
0 20 40 60 80 m

Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 21
1% AEP Peak Flood Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

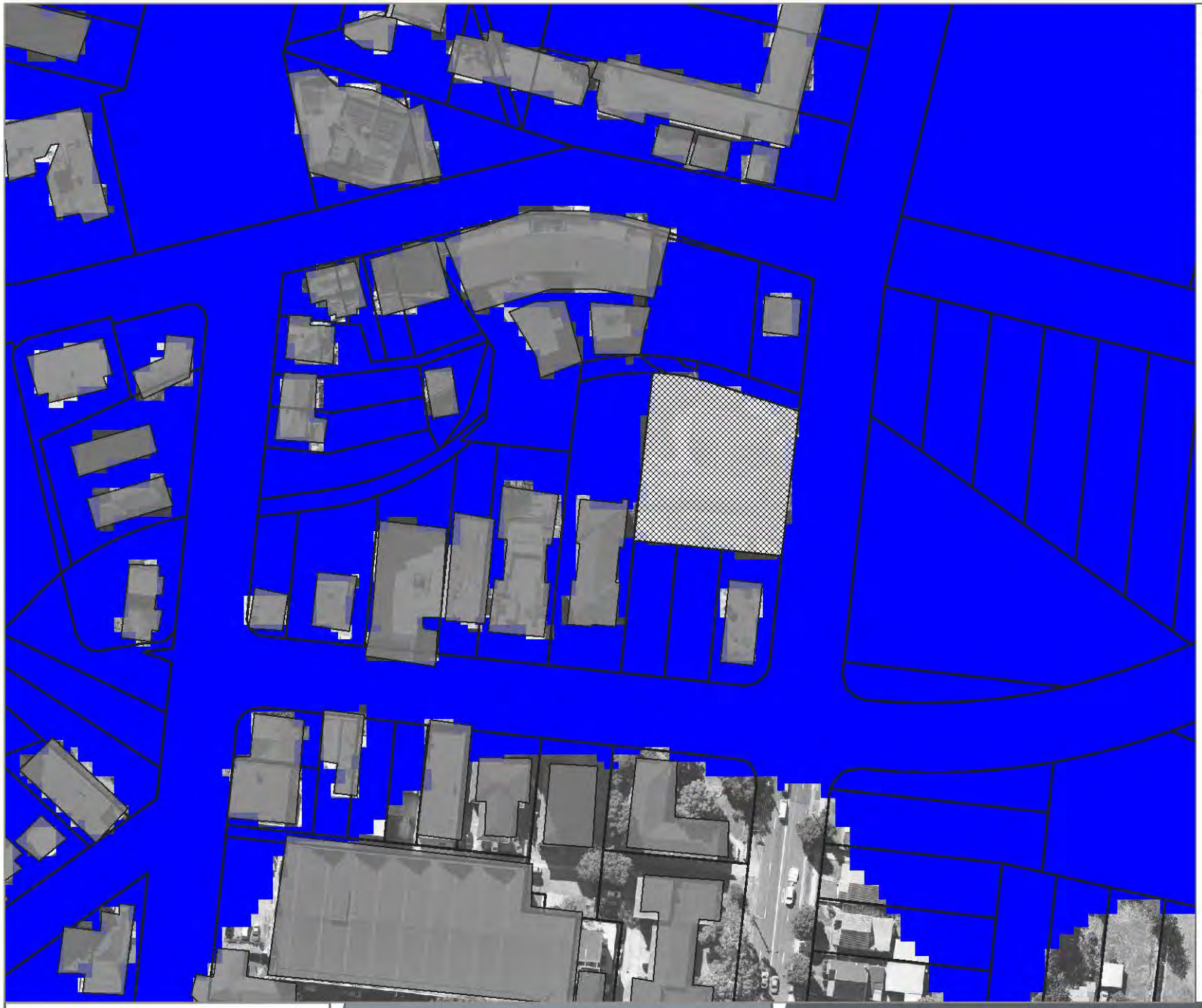


Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 22
1% AEP Peak Flood Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Proposed Development
Cadastre
Existing Buildings
Flood Extent
0.2m Water Level Contours (m)

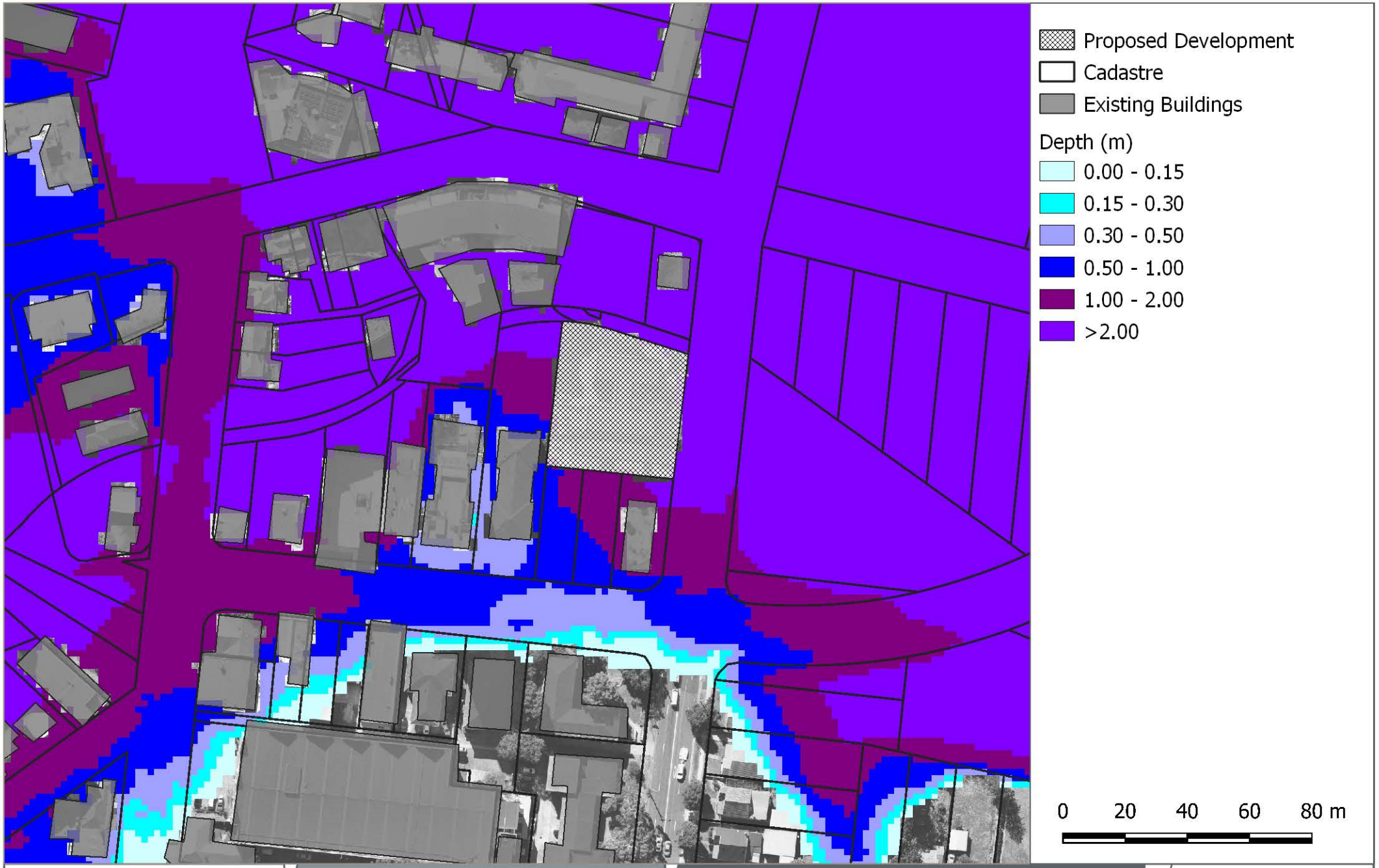
0 20 40 60 80 m

Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 23
PMF Extents and Flood Levels

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

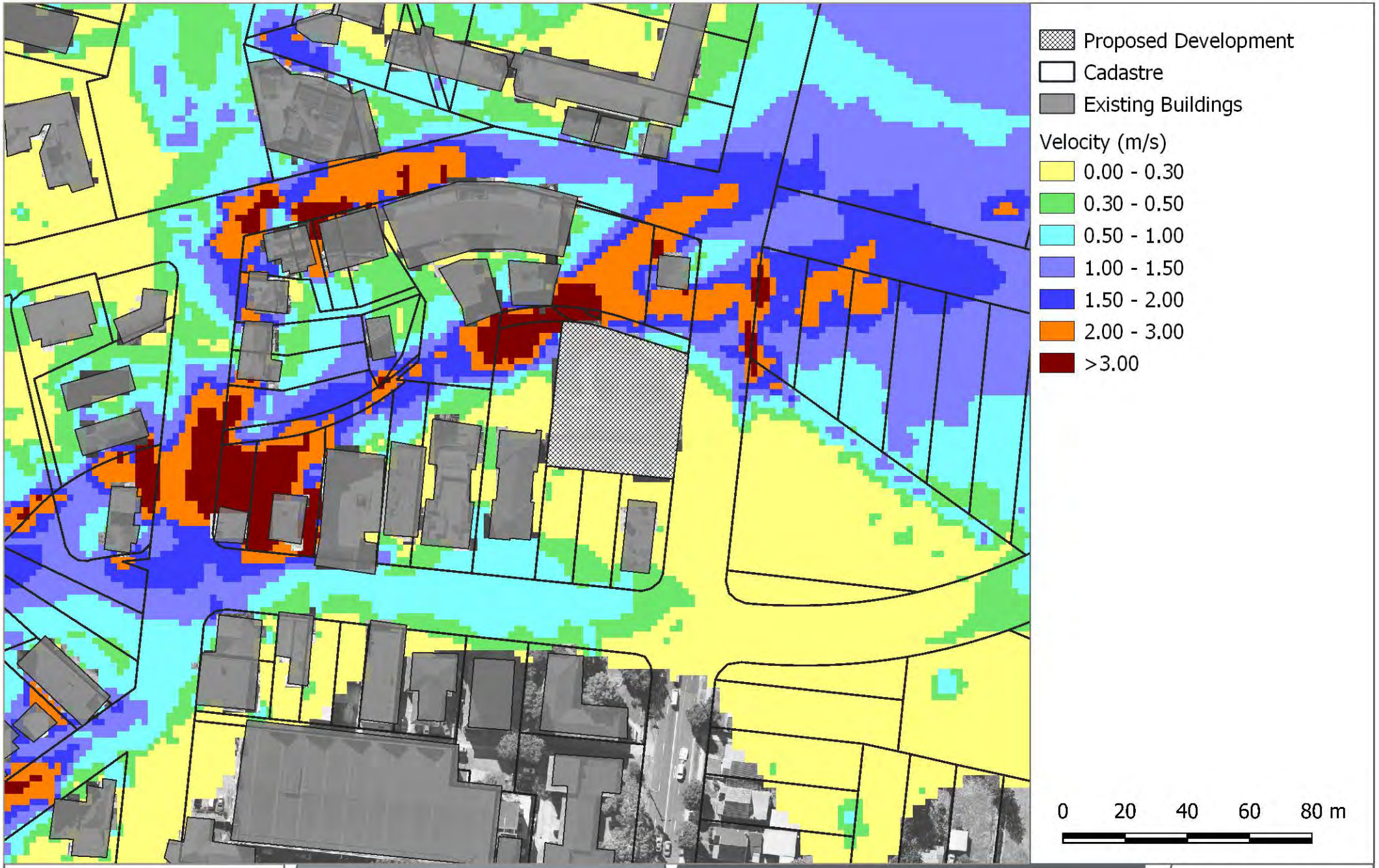


Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 24
PMF Depths

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

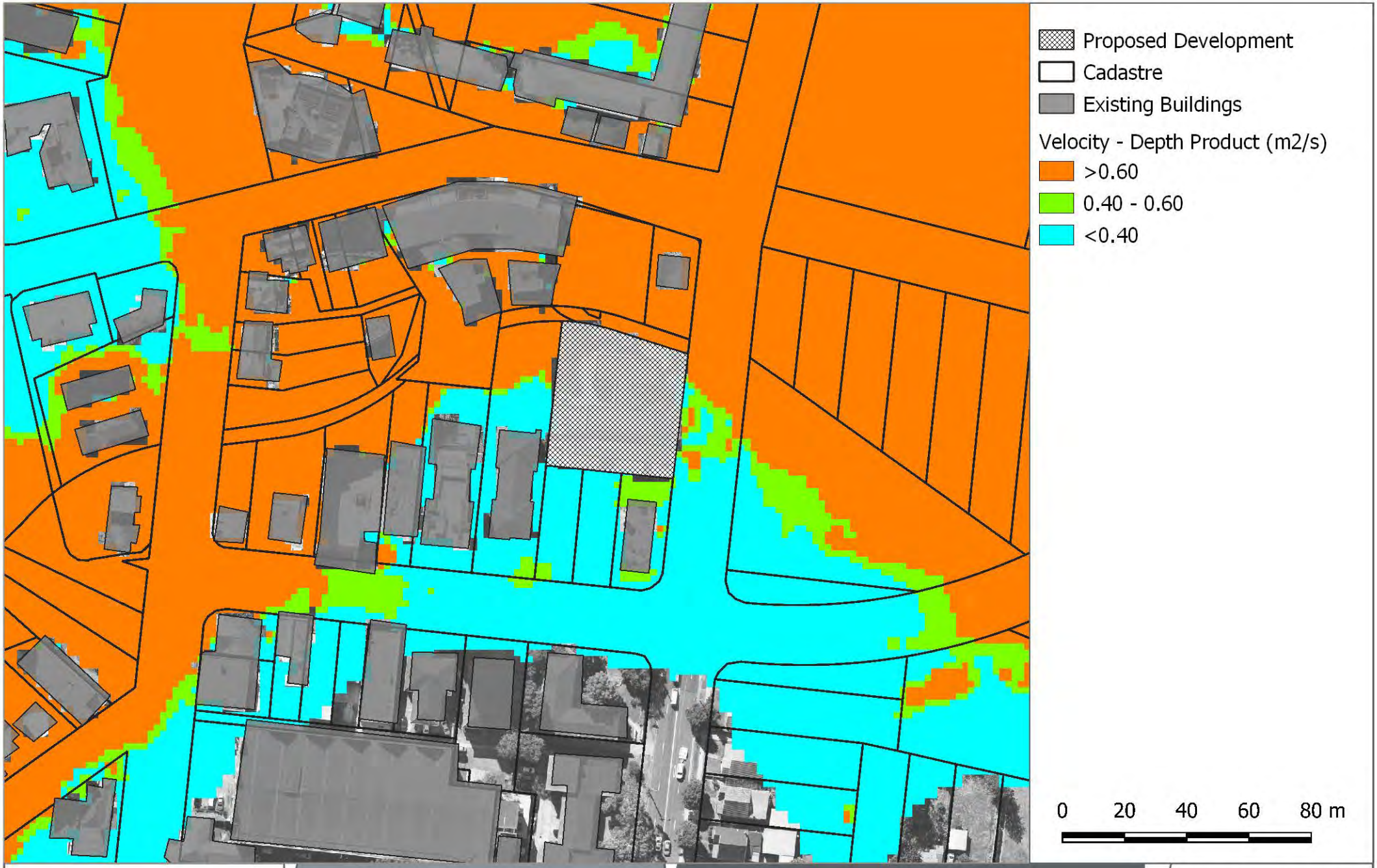


Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 25
PMF Velocities

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Cardno
Shaping the Future

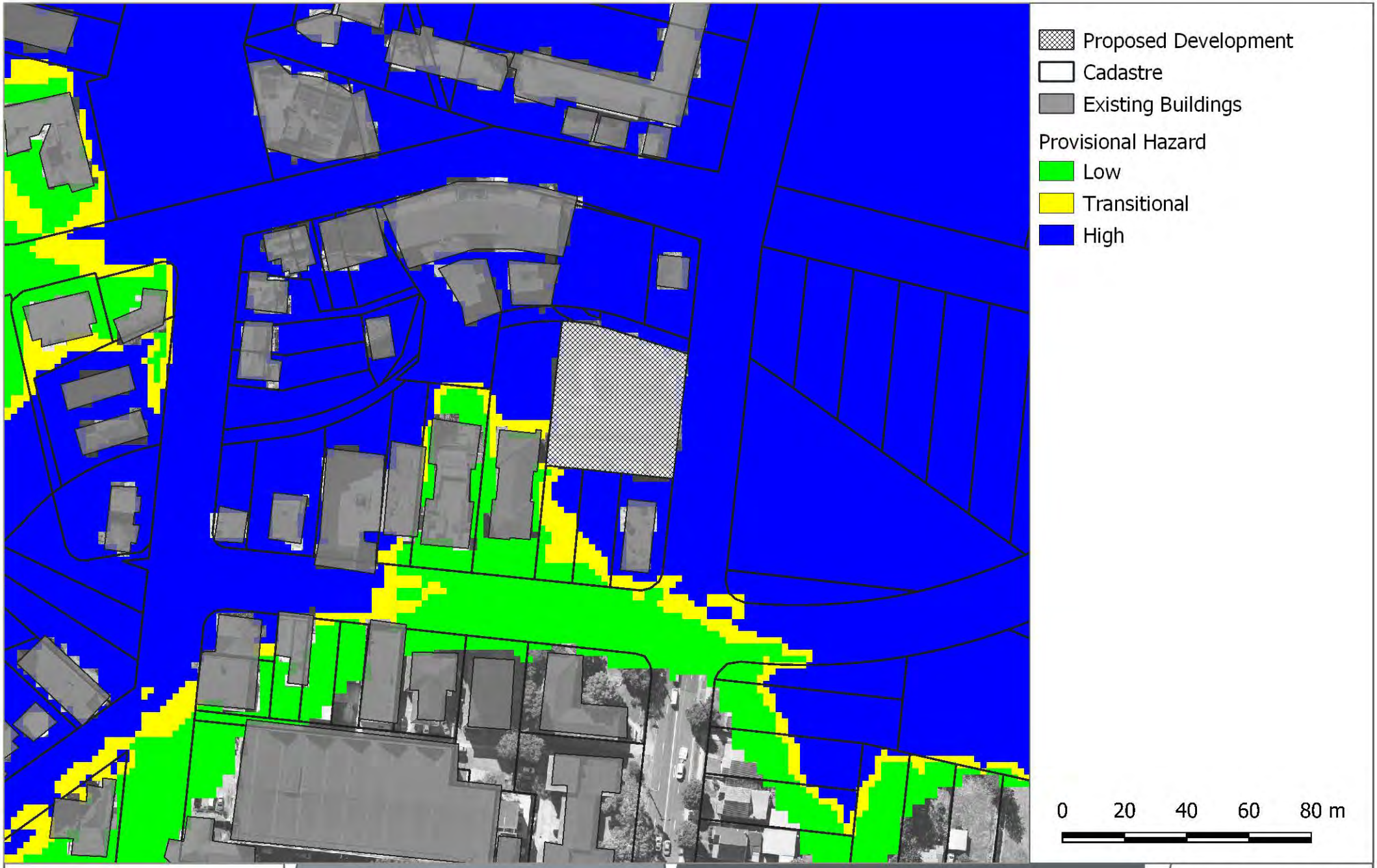
114 - 118 Harris Street

Future Conditions

Figure 26

PMF Velocity - Depth Product

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

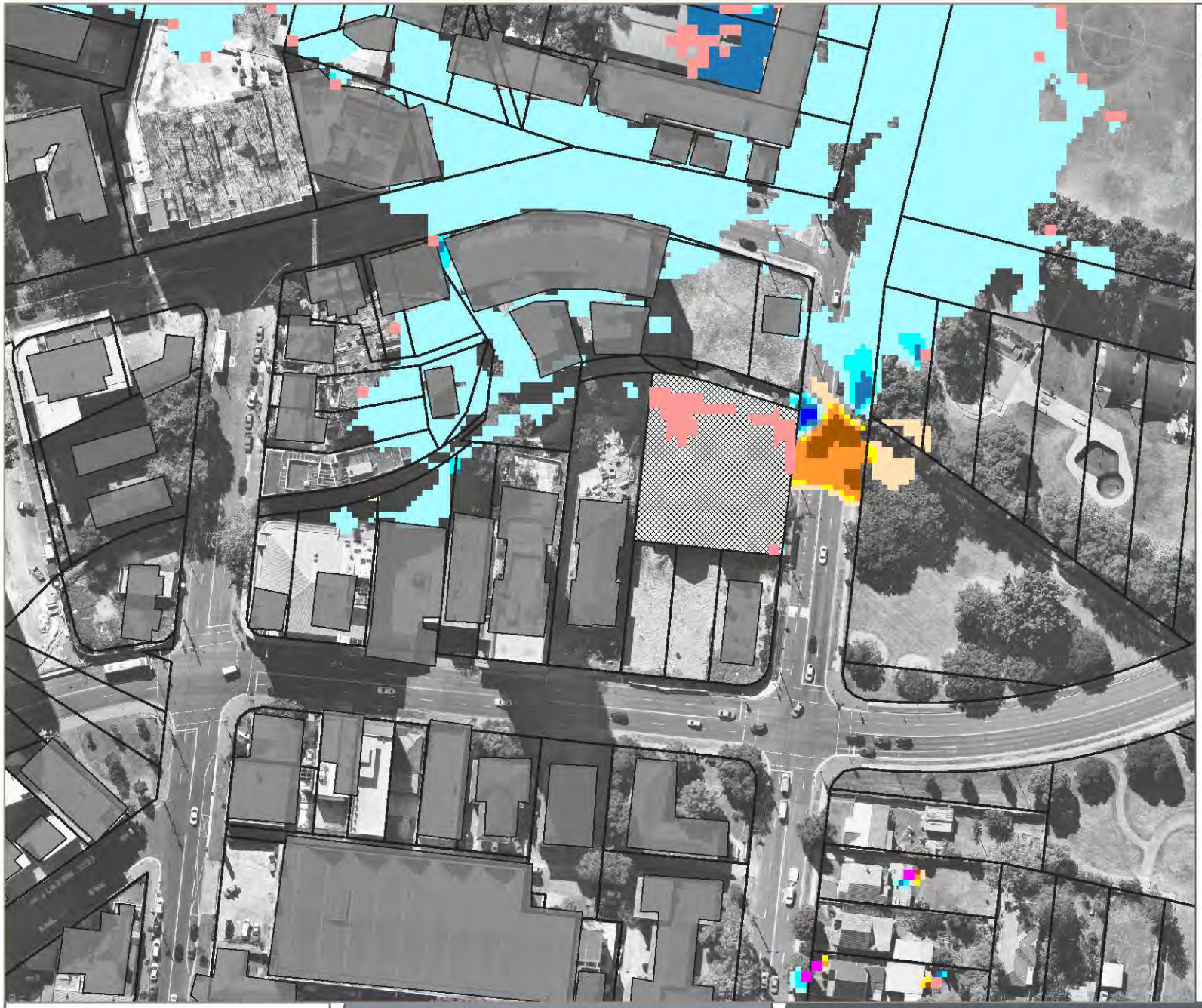


Cardno
Shaping the Future

114 - 118 Harris Street
Future Conditions

Figure 27
PMF Provisional Hazards

Map Produced by Cardno Water & Environment
Date: 19/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



Cadastre
Existing Buildings

Water Level Difference (m)
>0.10
0.05 to 0.10
0.03 to 0.05
0.02 to 0.03
0.01 to 0.02
-0.02 to -0.01
-0.03 to -0.02
-0.05 to -0.03
-0.10 to -0.05
<-0.10

Wet & Dry Analysis
Was Wet, Now Dry
Was Dry, Now Wet

0 20 40 60 80 m

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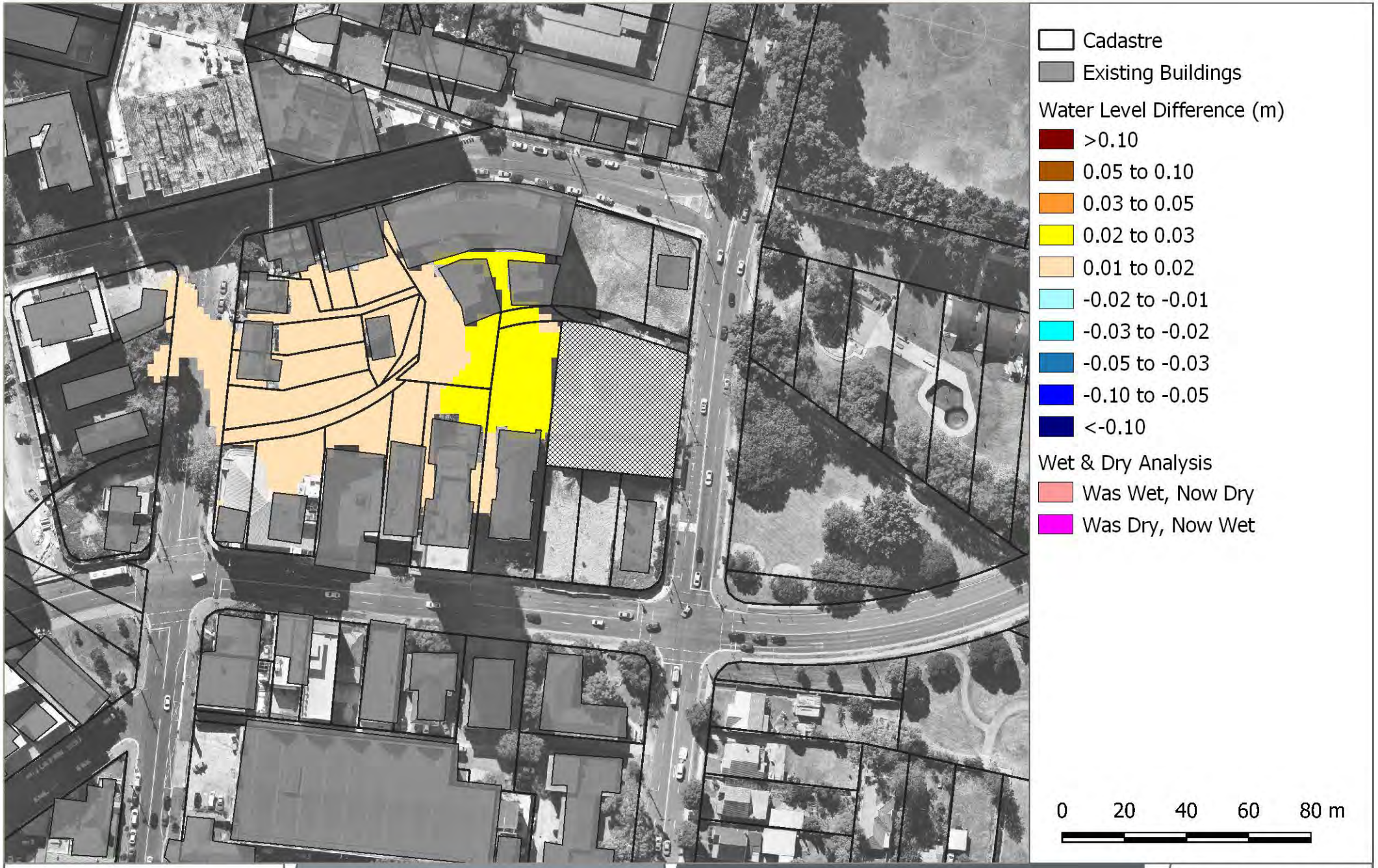
Shaping the Future

114 - 118 Harris Street
Future Less Existing Conditions

Figure 28
1% AEP Flood Level Differences

N

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



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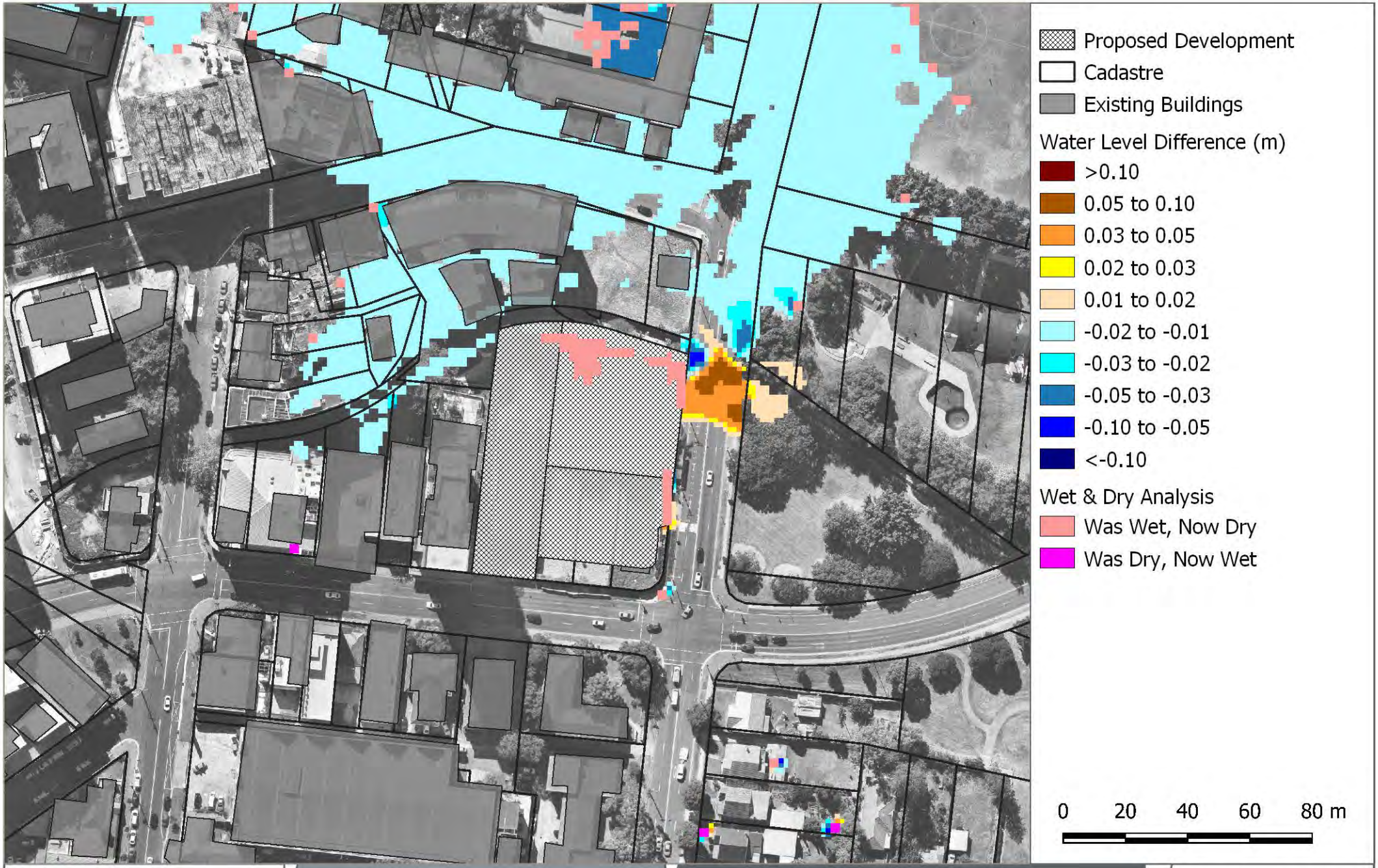
114 - 118 Harris Street

Future Less Existing Conditions

Figure 29

PMF Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168



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114 - 118 Harris Street

Future Less Existing Conditions

Figure 30

Cumulative 1% AEP Flood Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

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114 - 118 Harris Street

Future Less Existing Conditions

Figure 31

Cumulative PMF Level Differences

Map Produced by Cardno Water & Environment
Date: 20/7/2018
Coordinate System: MGA Zone 56
Project: 59918168

114-118 Harris Street, Harris Park

APPENDIX B
PARRAMATTA CITY COUNCIL FLOOD CERTIFICATE

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Flood Enquiry Information Issued - 19 July 2018

Mainstream Flooding

Is this property affected by mainstream flooding? **24 Parkes Street, 30 Parkes Street and 116 Harris Street, Harris Park**		☒ Yes ☐ No
Flood Levels	Closest Cross Sections: *(Please refer to Flood Study):* **Refer to Flood Map**	
☒ 5% AEP	Varies – RL 5.8 m AHD at Western Boundary of 24 Parkes Street to RL 5.6m AHD at street frontage (Eastern Boundary) of 116 Harris Street.	Comments: **See Note on Flood/Hazard Map**
☒ 1% AEP	RL 6.2 m AHD	
☒ PMF	RL 9.5 m AHD	
☒ Refer to flood maps provided for detailed flood levels.		
Flood information is obtained from the following flood study report: **Lower Parramatta River Floodplain Risk Management Study – Flood Study Review, 2005 (SKM)**		

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

Local Flooding

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 likely to be affected by overland stormwater run-off from the local catchment? *Note: No site inspection conducted for this assessment. Based solely on the information supplied for this flood enquiry application.*	☐ Yes ☒ Subject to Detailed Investigation
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.	

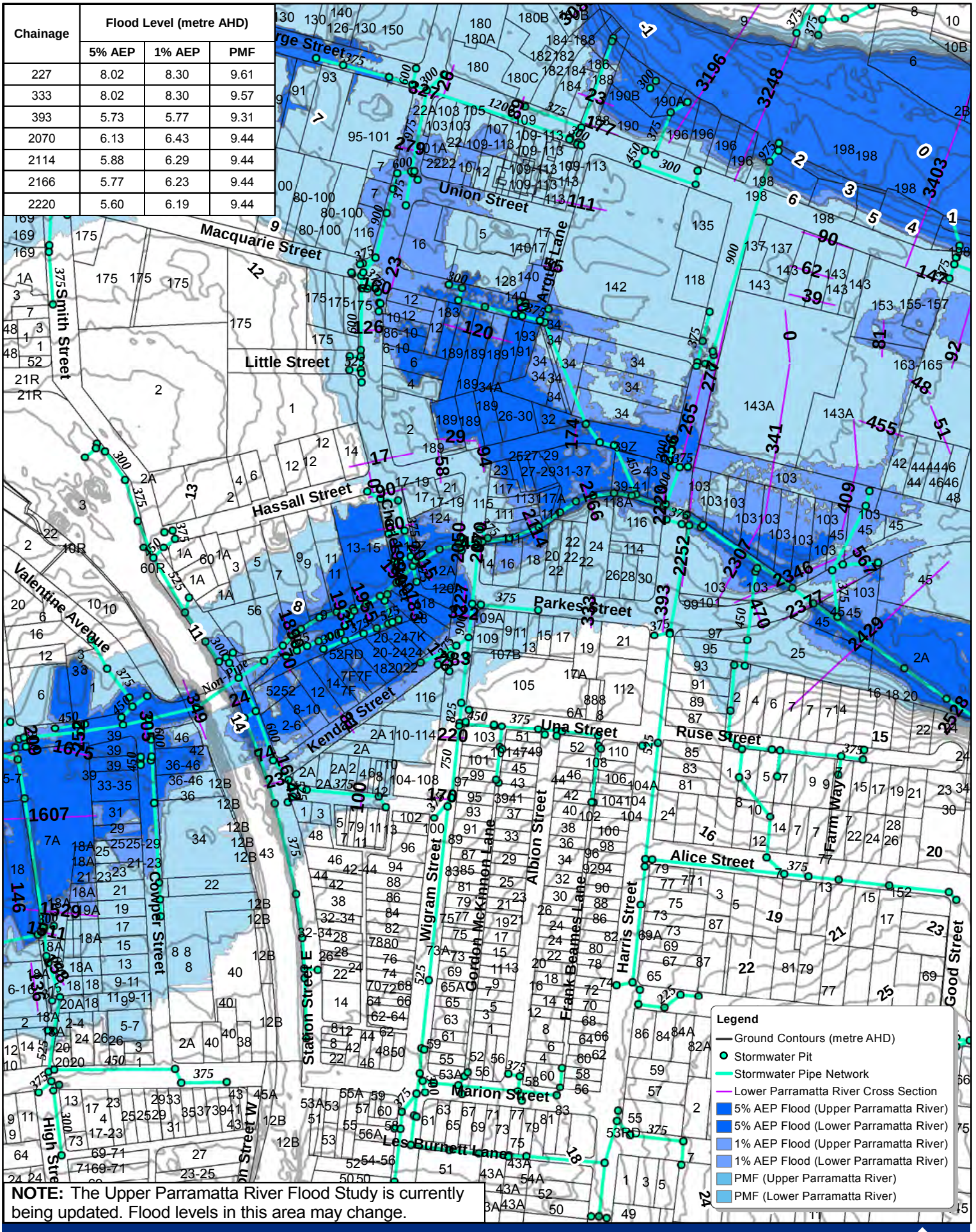
Additional Recommended Actions

☒	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 pre-lodgement 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.

Chainage	Flood Level (metre AHD)		
	5% AEP	1% AEP	PMF
227	8.02	8.30	9.61
333	8.02	8.30	9.57
393	5.73	5.77	9.31
2070	6.13	6.43	9.44
2114	5.88	6.29	9.44
2166	5.77	6.23	9.44
2220	5.60	6.19	9.44



NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.

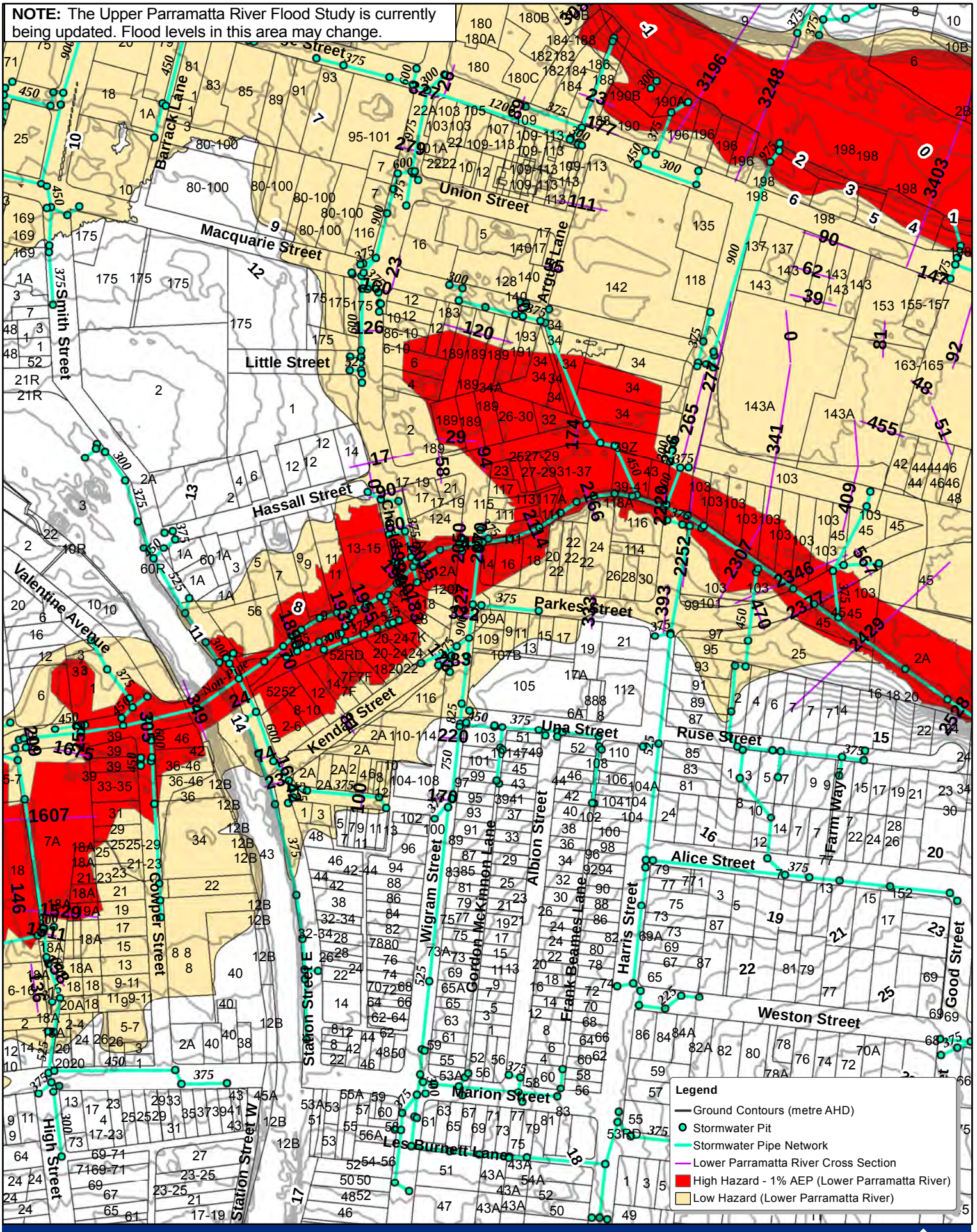
City of Parramatta Council Flood Map

N

1:4,000

Printed 18/07/2018

NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.



City of Parramatta Council Hydraulic Hazard Map

N

1:4,000

Printed 18/07/2018

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.
City of Parramatta 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.

114-118 Harris Street, Harris Park

APPENDIX C
SELECTED ARCHITECTURAL DRAWINGS

Cardno
Shaping the Future

114, 116 + 118 HARRIS STREET, HARRIS PARK
MASSING STUDY

13TH APRIL 2018

SITE AREA	1776 M2				
YIELD					
LEVEL	GFA (M2)	1 BED	2 BED	3 BED	4 BED
GF	1150				
LEVEL 01	1560				
LEVEL 02	990	4	3	4	
LEVEL 03	990	4	3	4	
LEVEL 04	300		480 - COMMUNAL OPEN SPACE		
LEVEL 05	650	1	7		
LEVEL 06	650	1	7		
LEVEL 07	650	1	7		
LEVEL 08	650	1	7		
LEVEL 09	650	1	7		
LEVEL 10	650	1	7		
LEVEL 11	650	1	7		
LEVEL 12	650	1	7		
LEVEL 13	650	1	7		
LEVEL 14	650	1	7		
LEVEL 15	650	1	7		
LEVEL 16	650	1	7		
LEVEL 17	650	1	7		
LEVEL 18	650	1	7		
LEVEL 19	650	1	7		
LEVEL 20	650	1	7		
LEVEL 21	650	1	7		
LEVEL 22	650	1	7		
LEVEL 23	650	1	7		
LEVEL 24	650	1	7		
LEVEL 25	650	1	7		
LEVEL 26	650	1	7		
LEVEL 27	650	1	7		
LEVEL 28	650	1	7		
LEVEL 29	650	1	7		
LEVEL 30	650	1	7		
LEVEL 31	650	1	7		
LEVEL 32	645		1	5	
LEVEL 33	645		1	5	
LEVEL 34	645		1	5	
LEVEL 35	400				2
LEVEL 36	400				2
LEVEL 37	400				2
HEIGHT LIMITED TO 35 STOREYS (AT 3.1M FLR TO FLR) DUE TO OVERSHADOWING OF EXPERIMENT FARM COTTAGE					
TOTALS	**25675**	**35**	**198**	**23**	**6**
CURRENT STAGE:	MASSING STUDY	DATE:	16.04.2018	ISSUE:	PRELIM.
		13.4%	**75.6%**	**8.8%**	**2.3%**
			TOTAL UNITS		**262**
			FSR	14.46	:1

Potential areas of yield are approximate only and subject to site survey, detailed design, Apartment Design Guide compliance, overshadowing, consultant input + council approval

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nominated architect:
aleksandar jelicic registration no. 7167

Client
HARRIS STREET DEVELOPMENTS PTY LTD

Project No 17112

Address
114, 116 + 118 HARRIS ST, HARRIS PARK

Title
CALCULATIONS

Drawing No SK01
Issue F
Date 18/04/18
Scale 1:500

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Project No 17112

Address
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Title
GF MASSING PLAN

Drawing No SK01
Issue C
Date 13/04/18
Scale 1:500

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Project No 17112

Address
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Title
L01 MASSING PLAN

Drawing No SK02
Issue C
Date 13/04/18
Scale 1:500

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Project No 17112

Address
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Title
L02-03 MASSING PLAN

Drawing No SK03
Issue C
Date 13/04/18
Scale 1:500

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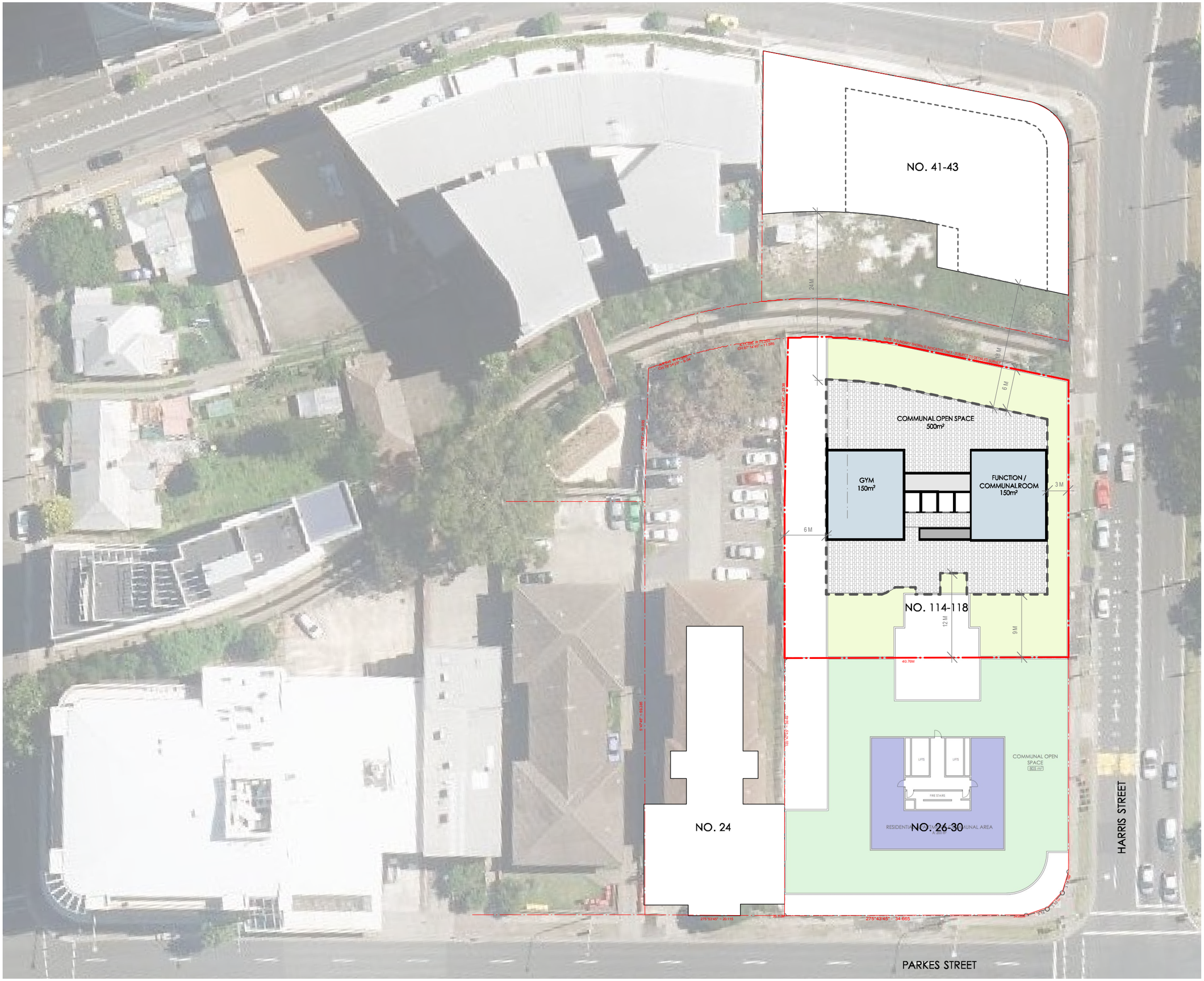

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Project No 17112

Address
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HARRIS PARK

Title
L04 MASSING PLAN

Drawing No SK04
Issue D
Date 13/04/18
Scale 1:500

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Project No 17112

Address
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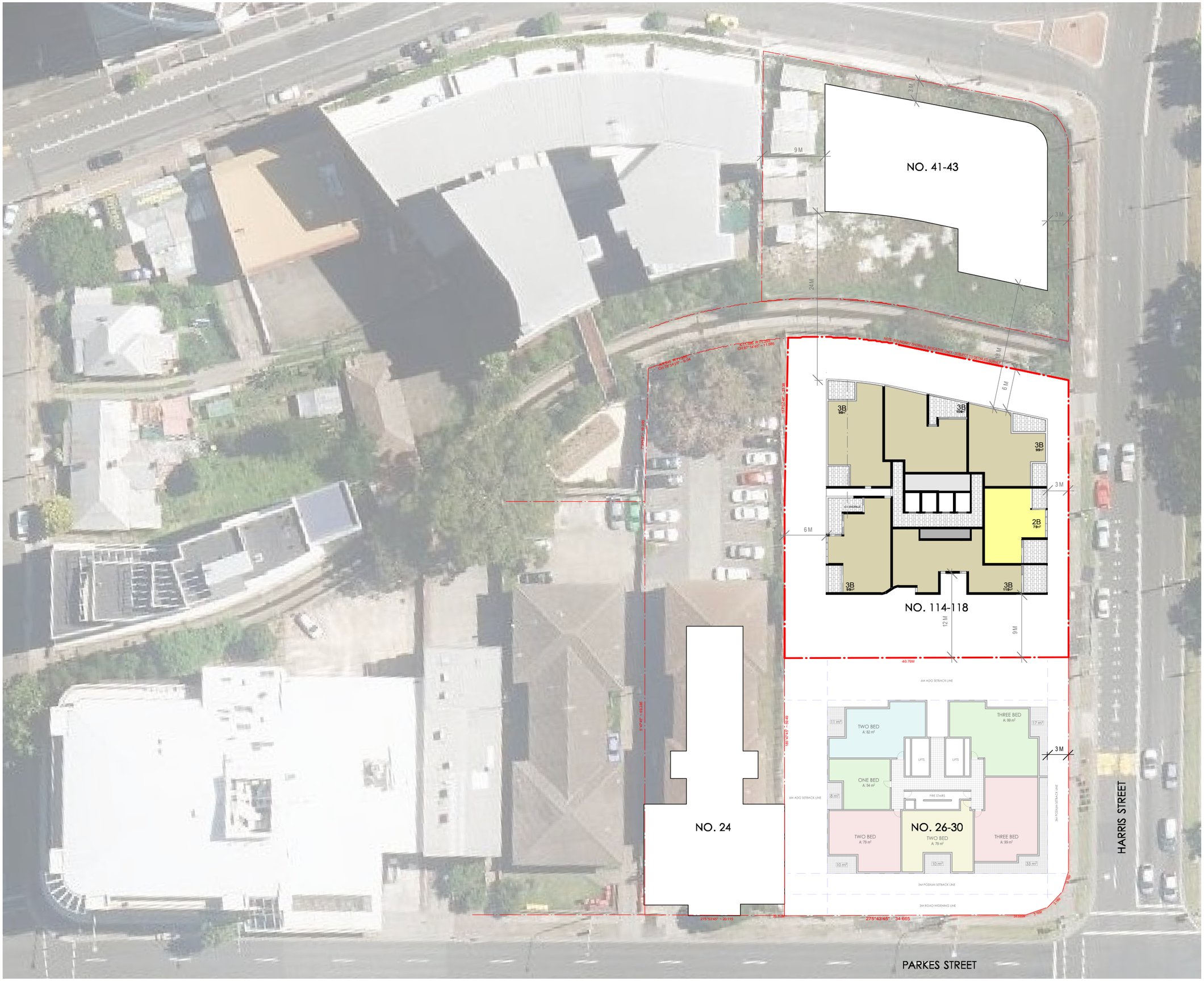
Title
L05+ MASSING PLAN

Drawing No SK05
Issue C
Date 13/04/18
Scale 1:500

Potential areas of yield are approximate only and subject to site survey, detailed design, Apartment Design Guide compliance, overshadowing, consultant input + council approval



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Project No 17112

Address
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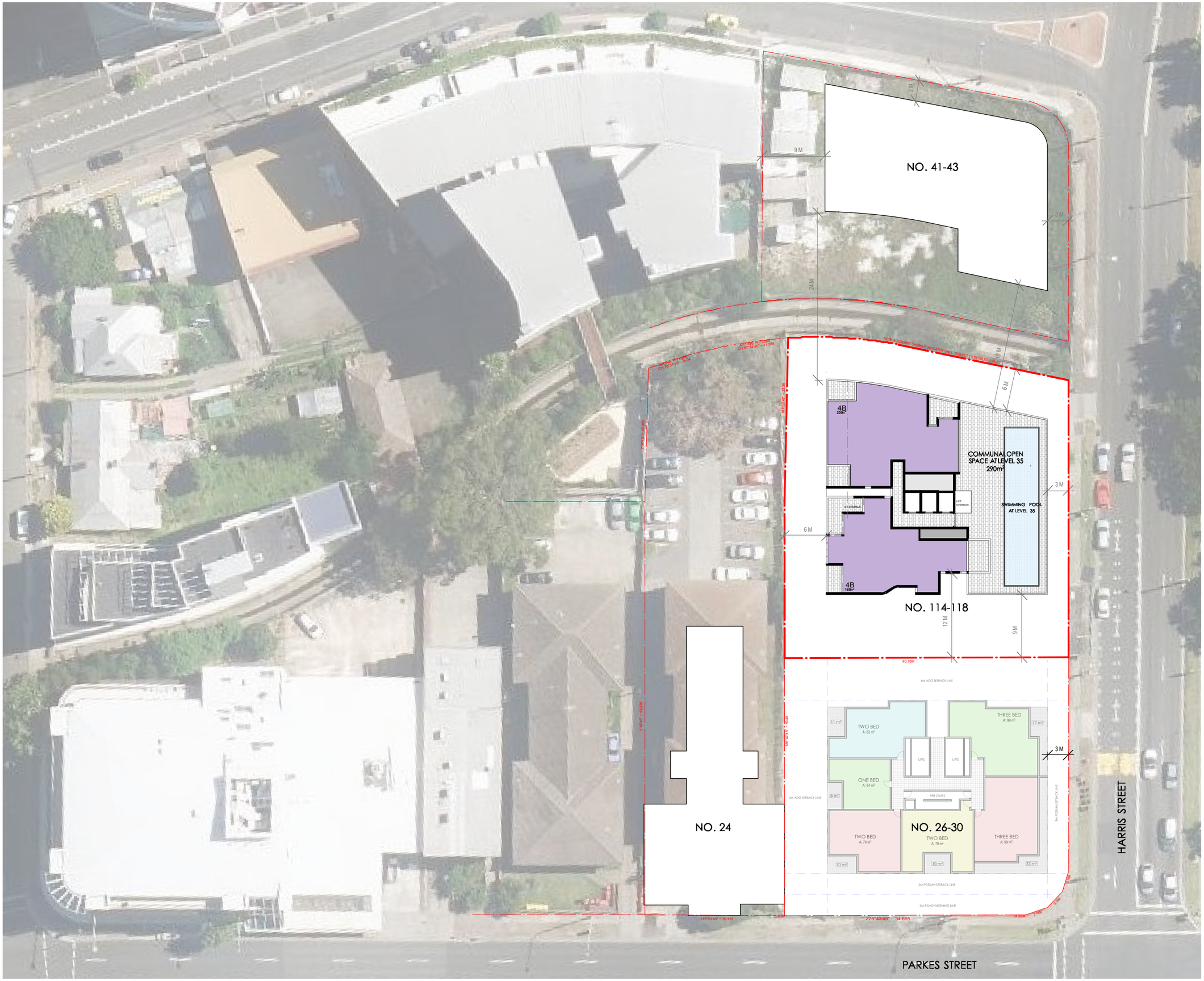
Title
L32-34 MASSING PLAN

Drawing No SK06
Issue A
Date 16/04/18
Scale 1:500

Potential areas of yield are approximate only and subject to site survey, detailed design, Apartment Design Guide compliance, overshadowing, consultant input + council approval



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nominated architect:
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Client
HARRIS STREET DEVELOPMENTS PTY LTD

Project No 17112

Address
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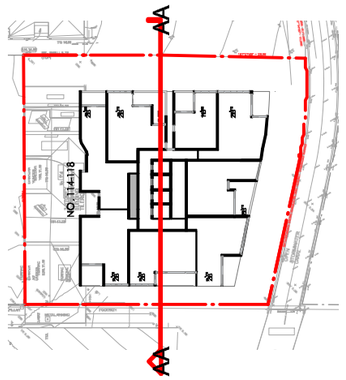
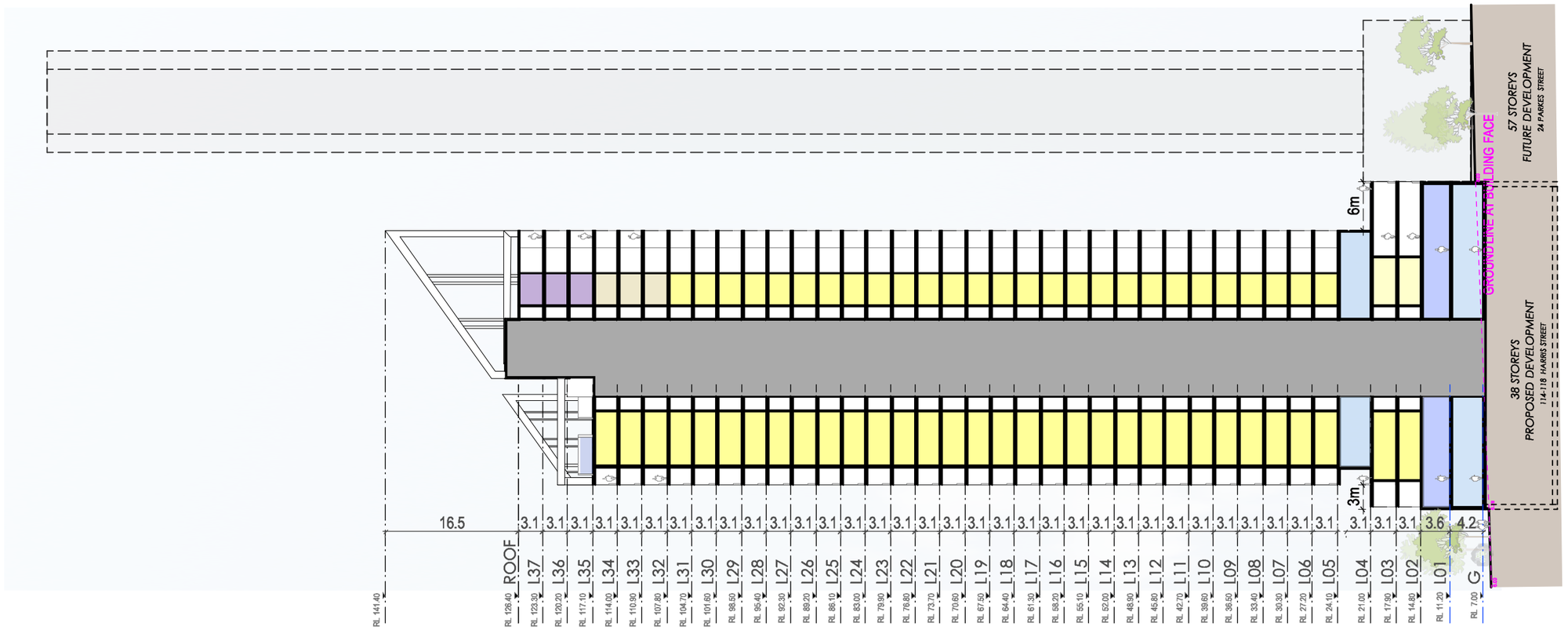
Title
L35-37 MASSING PLAN

Drawing No SK07
Issue B
Date 18/04/18
Scale 1:500

Potential areas of yield are approximate only and subject to site survey, detailed design, Apartment Design Guide compliance, overshadowing, consultant input + council approval





LEGEND

- COMMERCIAL
- RETAIL
- 3 BEDROOM APARTMENT
- 4 BEDROOM APARTMENT
- 1 BEDROOM APARTMENT
- 2 BEDROOM APARTMENT

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PRELIMINARY

Client
HARRIS STREET
DEVELOPMENTS PTY LTD

Project No 17112

Address
114, 116 + 118 HARRIS ST,
HARRIS PARK

Title
SECTION A-A

Drawing No SK11
Issue A
Date 04/05/18
Scale 1:600

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