Pathways Cremorne – Residential Aged and Independent Living Units

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Flood Impact assessment

Prepared by: DPM Consulting Group

For: Pathways

19th December 2023

- Design Development
- Project Management
- Land Capability Studies
- Urban Development
- Storm Water Management
- Construction Management

Disclaimer:

The information provided in this report should be considered as "Preliminary" and used for planning purposes. The information is subject to variation following further advice and confirmation from respective authorities. It should be noted that the information contained in this report is derived from generally reliable sources; however, it is subject to variation after detailed planning, survey, design and formal liaison with the relevant authorities. It should also be noted that the development of other properties in the surrounding area may also have an impact on the development of the property.

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27.10.2023	Stormwater Report – State significant Development Application; Pathways Cremorne – Residential Aged Care and Independent Living Units (Issue no: E, 31.07.2023), Entec Consultants
27.10.2023	North Sydney LGA – Wide Floodplain risk management Study and Plan (November 2022), GRC Hydro
27.10.2023	State Significant Development Application for Pathways Cremorne Seniors Housing, NSW SES Response (ref. SSD-49472213, 19.09.2023)
27.10.2023	Pathways Residences Cremorne 50-88 Parraween Street and 59-67 Gerard Street Cremorne, NSW (Issue A, 16.06.2023), Entec Consultants
27.10.2023	TUFLOW Flood Model prepared by GRC to inform the North Sydney LGA – Wide Floodplain risk management Study and Plan (November 2022), GRC Hydro
15.12.2023	Flood Emergency Response Plan – State significant Development Application; Pathways Cremorne – Residential Aged Care and Independent Living Units (Issue no: A, 07.12.2023), Entec Consultants

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Executive Summary

At the request of Pathways (The Client), DPM Consulting Group (DPM) have undertaken a Flood Impact Assessment of the proposed development at 50-88 Parraween Street and 59-67 Gerard Street, Cremorne NSW.

As part of the State Significant Development Application (SSDA) for the proposed development, the New South Wales State Emergency Service (NSW SES), the agency responsible for dealing with floods, storms and tsunamis in NSW, have provided (ref. SSD-49472213) key considerations relating to emergency management as listed below:

- *the proponent to create a Flood Emergency Response Plan to mitigate the risks associated with isolation of the site due to flooding.*
- *further modelling for rainfall runoff for storms greater than the 1% Annual Exceedance Probability (AEP), up to and including the Probable Maximum Flood (PMF).*

In accordance with the Flood Impact and risk assessment (Department of Planning and Environment, NSW, 2023), a full range of flood events needs to be considered as issues will differ with flood frequency. Following the response from NSW SES, DPM have completed a flood impact assessment for the PMF event, analysing post-development flood impacts against typical considerations outlined within the FIRA.

It has been demonstrated that for the Probable Maximum Flood and in consideration of three different rainfall durations (15 minutes, 1 hour and 2 hours), the proposed development has **no impact** on the surrounding areas, with maximum depths, velocities and flood hazard presenting the same values under post-developed and pre-developed conditions.

The development also does not alter the duration of flooding and as such the building isolation during a PMF event remains the same as per development conditions.

The results have highlighted that flooding within the area subject of this study is characterised as flash flooding, with peak flows and depths occurring in the initial 15 minutes of the rainfall event and water receding within 30 minutes to 1 hour from the beginning of the storm, as stated in the GRC flood study.

In conclusion, in considerations of the findings of this report and the summary provided above, DPM believe that the request from NSW SES to undertake *further modelling for rainfall runoff for storms greater than the 1% Annual Exceedance Probability (AEP), up to and including the Probable Maximum Flood (PMF),* and confirm that the proposed development has **no impact** on the flooding conditions of the subject and surrounding areas has been addressed.

1. Introduction

1.1. Background Information

1.1.1. At the request of Pathways (The Client), DPM Consulting Group (DPM) have undertaken a Flood Impact Assessment of the proposed development at 50-88 Parraween Street and 59-67 Gerard Street, Cremorne NSW.

1.1.2. As part of the State Significant Development Application (SSDA) for the proposed development, the New South Wales State Emergency Service (NSW SES), the agency responsible for dealing with floods, storms and tsunamis in NSW, have provided (ref. SSD-49472213) key considerations relating to emergency management as listed below:

- *the proponent to create a Flood Emergency Response Plan to mitigate the risks associated with isolation of the site due to flooding.*
- *further modelling for rainfall runoff for storms greater than the 1% Annual Exceedance Probability (AEP), up to and including the Probable Maximum Flood (PMF).*

1.1.3. Principle 2 ("Decisions should be informed by understanding the full range of risks to the community") of the response provided by NSW SES states that *the street on which the proposed site is located becomes overtopped by floodwater on both ends, which may effectively isolate the site during floods as frequent as a 20% Annual Exceedance Probability (AEP) flood*.

1.1.4. Additionally, Principle 3 ("Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood") states that *the EIS provided states that "there are no adverse effects on downstream properties due to the development for storms up to and including the 1% AEP". We recommend further modelling for flood events up to and including the PMF, to understand any cumulative risks associated with the development on the surrounding*.

1.1.5. In order to address the queries raised by NSW SES, DPM have prepared this document to accompany the SSDA application resubmission.

1.1.6. A copy of the response can be found in Appendix C – NSW SES Response.

1.2. Objectives

1.2.1. The purpose of this document is to prepare a Flood Impact Assessment to determine the pre-development and post-developed hydraulic conditions of the proposed development.

1.2.2. In particular, this report aims to demonstrate that the delivery of the proposed development has no significant impact on the surrounding areas.

1.2.3. As mentioned within section 1.1, this report will aim to address the Request For Information (RFI) letter provided by NSW SES, with particular reference to the below:

Principle 2 Decisions should be informed by understanding the full range of risks to the Community

The Stormwater and Flood Impact Assessment Report5 provided as an appendix to the EIS states that the proposed site is indicated to be flood free for all flood events up to and including the PMF.

The street on which the proposed site is located becomes overtopped by floodwater on both ends, which may effectively isolate the site during floods as frequent as a 20% Annual Exceedance Probability (AEP) flood. The southern end of Parraween Street appears to pose a greater risk to people and vehicles during flood events, as during a Probable Maximum Flood (PMF) event the southern end of Parraween Street becomes part of the floodway.

Evacuation of hospitals and aged care can be complex and is known to be associated with an increased rate of mortality in patients and nursing facility residents. The NSW 2022 Flood Inquiry Recommendation 28 highlights that sensitive uses are known to have a higher risk to life and warrant the consideration of the impacts of even rarer flood events than the 1% AEP flood extent. This includes the impacts of essential services infrastructure disruption on the proposed development, with the preference of essential services infrastructure to be situated above the flood planning level to minimise disruption and requirement to evacuate due to secondary risks.

Principle 3 Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood

The EIS provided states that "there are no adverse effects on downstream properties due to the development for storms up to and including the 1% AEP". We recommend further modelling for flood events up to and including the PMF, to understand any cumulative risks associated with the development on the surrounding community.

1.2.4. In accordance with the direction provided by the Client, DPM have completed a flood impact assessment for the Probable Maximum Flood to determine the impact of the delivery of the proposed development within the surrounding areas.

1.3. Existing documentation

1.3.1. It is noted that DPM have been provided with the following documentation to inform this report:

- Stormwater Report – State significant Development Application; Pathways Cremorne – Residential Aged Care and Independent Living Units (Issue no: E, 31.07.2023), Entec Consultants

- Flood Emergency Response Plan; Pathways Cremorne – Residential Aged Care and Independent Living Units (Issue no: A, 07.12.2023), Entec Consultants
- North Sydney LGA – Wide Floodplain risk management Study and Plan (November 2022), GRC Hydro
- State Significant Development Application for Pathways Cremorne Seniors Housing, NSW SES Response (ref. SSD-49472213, 19.09.2023)
- Civil stormwater design drawings: Pathways Residences Cremorne 50-88 Parraween Street and 59-67 Gerard Street Cremorne, NSW (Issue A, 16.06.2023), Entec Consultants
- TUFLOW Flood Model prepared by GRC to inform the North Sydney LGA – Wide Floodplain risk management Study and Plan (November 2022), GRC Hydro

1.4. Current legislation and guidelines

1.4.1. In accordance with the North Sydney LGA – Wide Floodplain risk management Study and Plan (November 2022) prepared by GRC Hydro, DPM acknowledge the use of several policies, legislation and guidance relevant to management of flood risk in the North Sydney LGA.

1.4.2. The following policies are considered to be the most relevant for the preparation of this report and the analysis of the results:

- North Sydney Local Environmental Plan (LEP) 2013
- Australian Rainfall and Runoff 2019 (AR&R19)
- NSW Flood Prone Land Policy
- NSW Government's Floodplain Development Manual (2005)
- Flood Risk Management Manual (NSW, Department of Planning and Environment, 2023)

1.4.3. For a complete list of the current guidelines and legislation, please refer to table 4 of the GRC report (page 25).

2. Property Description

2.1. Property location

2.1.1. The proposed development is located approximately 7 km north of Sydney CBD, and it consists of a Residential Aged Care Facility (RACF) and Independent Living Units (ILU) complex which includes 2 levels of basement carparking and four (4) new multistorey buildings (see Figure 1).

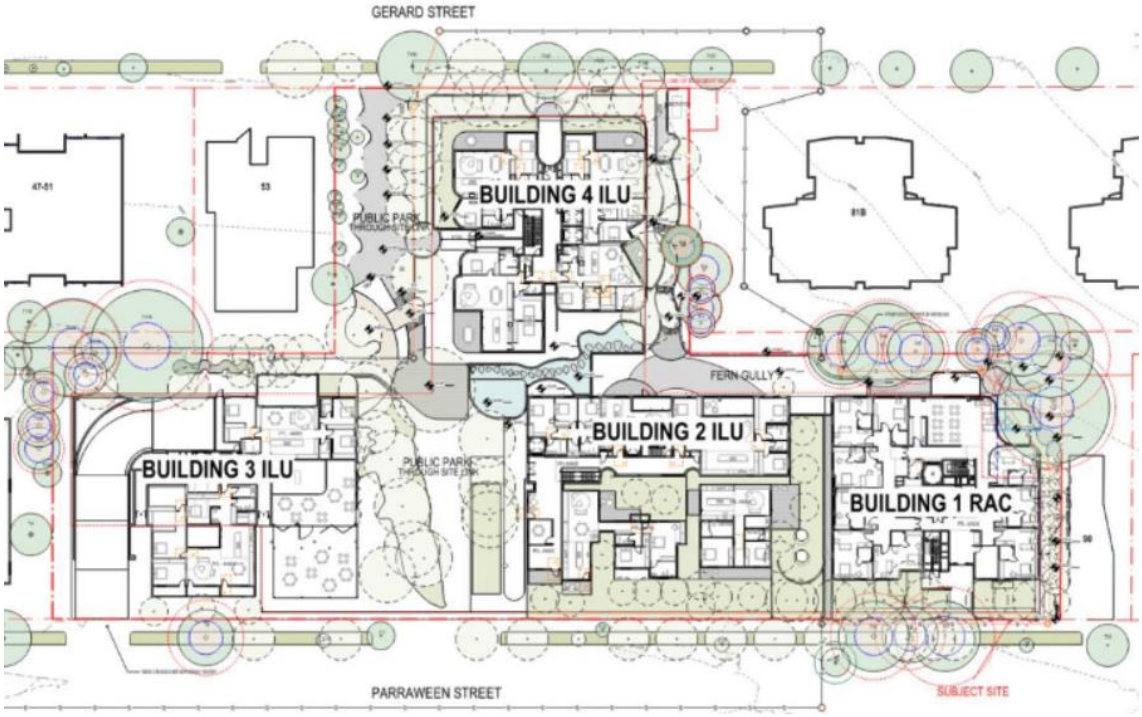

Figure 1 – Architectural Site Plan (Entec Consultants, 2023)

2.1.2. The site is within the municipality of North Sydney Council.

2.2. Site description

2.1.3. Table 1 summarises the general site characteristics.

Table 1 – Site Summary

Address		50-88 Parraween Street & 59-97 Gerard Street
Gross Area		0.7 ha
Topography		The terrain has natural grades ranging from 1:120 to 1:30 across the site
Boundaries	North	Gerard Street
	East	Existing residential development
	West	Existing residential development
	South	Parraween Street
Access		From Parraween Street

2.1.4. Access to the site will ultimately be provided from Parraween Street from the south.

3. Review of documentation received

3.1. Introduction

3.1.1. DPM understand that the flood study completed by GRC in 2022 is based on the initial flood study completed by WMAwater in 2017.

3.1.2. The study prepared by GRC have considered the latest AR&R19 with a change in the Intensity-Frequency-Duration (IFD) applicable to the hydrological and hydraulic models. In particular, the latest IFD curves provided by the Data Hub[1] were analysed against the pluviometer rain gauges closest to the North Sydney LGA catchments (i.e. Sydney Observatory Hill, Chatswood Bowling Club and Mosman).

3.1.3. Based on the analysis carried out by GRC, it was found that the Bureau Of Meteorology (BOM)'s 2016 IFD was not representative of the three gauges nearest the study area.

3.1.4. Accordingly, the IFD derived from the Observatory Hill Gauge were used in the flood modelling. This approach was noted to be consistent with the guidance by NSW OEH (2018) and it is noted that it represents a best practice approach.

3.2. Hydrological models

3.2.1. It is understood that two hydrological models were developed for the LGA as part of the Flood Study completed by WMAwater in 2017.

3.2.2. A DRAINS model was used to complete the hydrological modelling for the catchments located within the LGA, while a WBNM model was used for undertaking the modelling for catchments external to the LGA.

3.2.3. It is noted that parameters used in the two models in the flood study from 2017 were updated as part of the study completed by GRC in 2022.

3.2.4. DPM have not made any amendments to the DRAINS and WBNM models and the results from the hydrological models were used in the FIA completed as part of this report.

3.3. Hydraulic model

3.3.1. In accordance with the North Sydney LGA – Wide floodplain risk management study and plan prepared by GRC (2022), the TUFLOW hydraulic models developed for the LGA as part of the 2017 flood study were reviewed and updated.

[1] https://data.arr-software.org/

3.3.2. The study area has been subdivided into four different sub-areas (north, south, west and east) each represented by a different TUFLOW model, noting that the proposed development falls under the north area.

3.3.3. As part of the work completed for this report, DPM have undertaken a review of the existing models prepared by GRC to determine the suitability to achieve the objectives of this document.

3.3.4. In particular, DPM have run a simulation of the TUFLOW north model under pre-developed conditions to replicate the results presented by GRC in their report.

3.3.5. The inclusion of building outlines of the proposed development and the amendment of the related Manning's values (to reflect the change in the fraction imperviousness due to the development – refer to section 4 of this report for further information) represent the changes made by DPM to the TUFLOW north model to obtain the different flood characteristics (i.e. flood depth, velocities etc.) for the PMF rainfall event under post-developed conditions.

3.3.6. Further information on the above has been included within section 4 of this document.

3.4. Blockage Factor

3.4.1. In accordance with the latest AR&R19, GRC have conservatively considered the stormwater pipes less than 450 mm dia to be completely blocked.

3.4.2. A sensitivity analysis was undertaken as part of the GRC study showing that the TUFLOW model is sensitive to pipe blockage factors with flood depth increases of approximately 0.1 m and 0.2 m for blockage factors of, respectively, 20% and 50% for a 1% AEP rainfall event.

3.4.3. As part of the investigation subject of this report, DPM have made no amendments to the blockage factors considered by GRC.

3.5. Climate Change

3.5.1. It is understood that GRC have undertaken a sensitivity analysis to consider the impact of climate change on the overall LGA, in accordance with the Intergovernmental Panel on Climate Change (IPCC) greenhouse gas concentration scenarios (Representative Concentration Pathway (RCP)2.5, RCP4.5, RCP6.0 and RCP8.5).

3.5.2. It is noted that the AR&R19 recommends the use of RCP4.5 and RCP8.5 scenarios, considering the increase of rainfall intensity which can be obtained from the ARR Data Hub.

3.5.3. The results from the study highlighted that, under climate change conditions for the year 2090 and RCP8.5, maximum flood depth increases were in the order of 0.1 m. Therefore, it was deemed that the increased flood risk due to climate change did not require specific risk management measures.

3.5.4. As part of the investigation subject of this report, DPM have made no amendments to the climate change factors considered by GRC and no further investigations have been undertaken on this matter.

3.6. Design Flows

3.6.1. In accordance with section 3.3 of this document and for the purpose of this report, DPM have considered only the PMF rainfall event and associated results under pre-developed and post-developed conditions.

3.6.2. The input data which informed the TUFLOW model has been obtained from the hydrological models (DRAINS and WBNM) as per model completed by GRC.

3.6.3. In accordance with the work completed by GRC, the critical duration for each rainfall event has been outlined within Table 2, highlighting the data relevant to the PMF rainfall event.

Table 2 – Critical duration assessment (GRC, 2022) – North TUFLOW model

Rainfall Event	Critical Duration[2]
PMF	15 minutes, 1 hour, 2 hours
1% AEP	45 minutes (TP02), 1.5 hour (TP08)
2% AEP	1.5 hour (TP01)
5% AEP	1 hour (TP10)
10% AEP	1 hour (TP10)
20% AEP	1 hour (TP08)

3.6.4. The input DRAINS hydrographs at specific locations (see Figure 2) have been extrapolated from the input data from the TUFLOW model provided by North Sydney Council and included in Figure 3, Figure 4 and Figure 5, noting that the maximum design flow for a storm duration of 15 minutes is 2.6 m^3/s, for a duration of 1 hour is 1.4 m^3/s, while the maximum flow is 1.2 m^3/s for a 2-hour storm duration.

3.6.5. It is noted that the locations at which the input hydrographs were applied are based on the TUFLOW model provided by North Sydney Council. These locations were not changed by DPM as part of the work completed for this report.

[2] TP = Temporal Pattern

Figure 2 – Locations of main DRAINS hydrographs used as boundary conditions

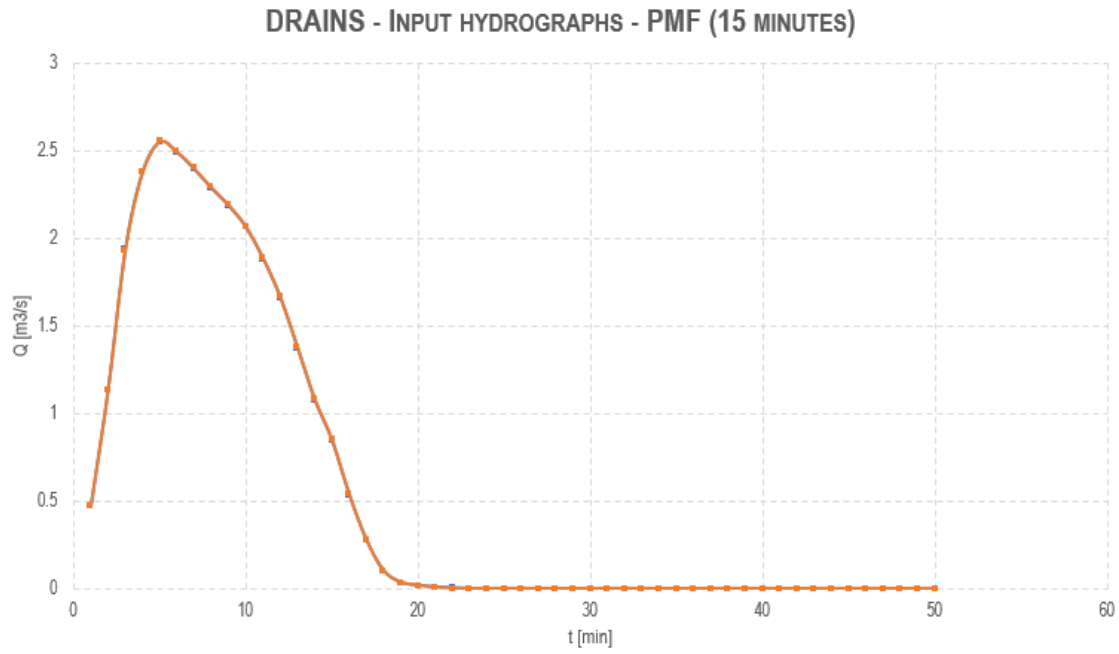

Figure 3 – Input hydrographs for PMF (15 minutes) along Parraween Street and Gerard Street

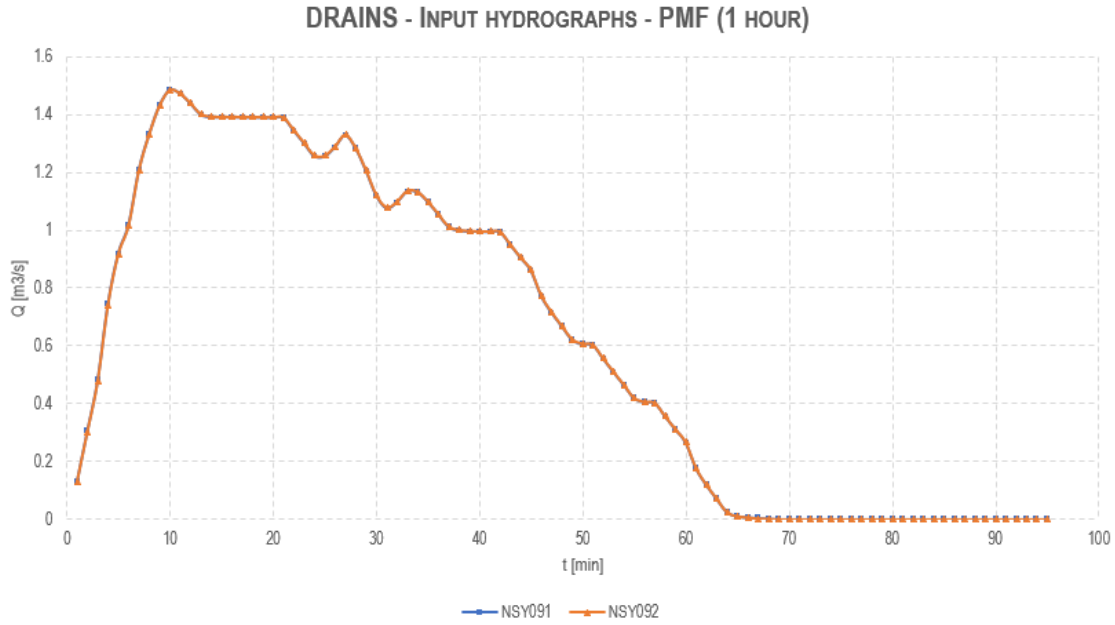

Figure 4 – Input hydrographs for PMF (1 hour) along Parraween Street and Gerard Street

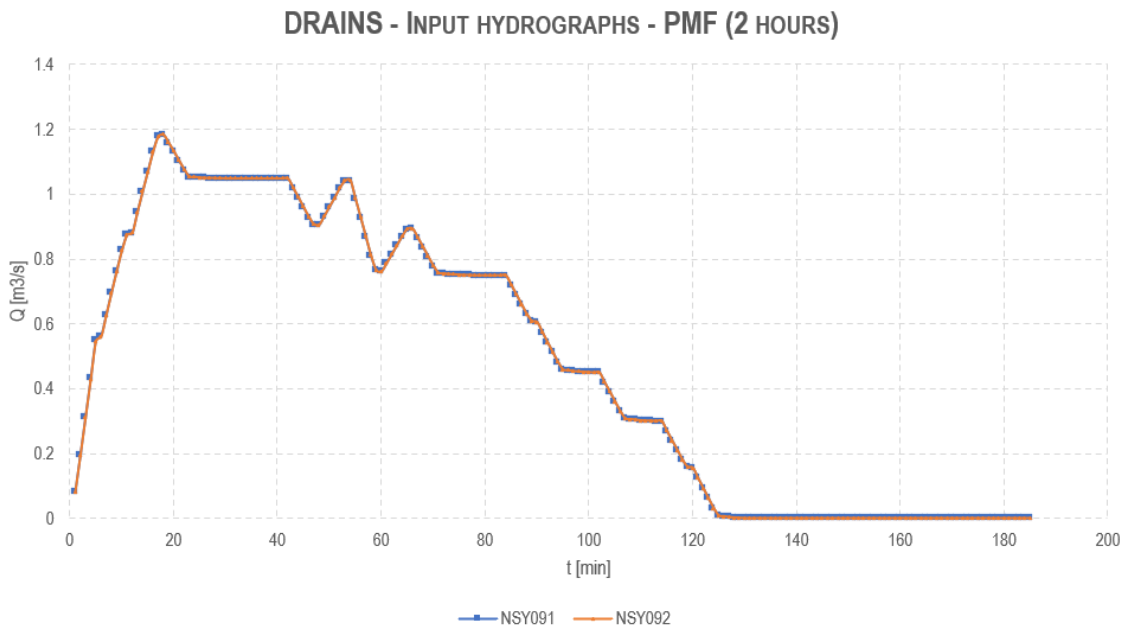

Figure 5 – Input hydrographs for PMF (2 hours) along Parraween Street and Gerard Street

4. Hydraulic investigation

4.1. Model Topography

4.1.1. The TUFLOW model topography has been created based on the 1 m LiDAR contours obtained from the Commonwealth of Australia (Geoscience Australia) 2021[3].

4.1.2. A grid cell size of 2 m has been adopted for the hydraulic model, using the Classic Engine with double precision.

4.1.3. As mentioned previously in the report, the study area has been subdivided into four different sub-areas (north, south, west and east) each represented by a different TUFLOW model with the proposed development falling under the north area (see Figure 6).

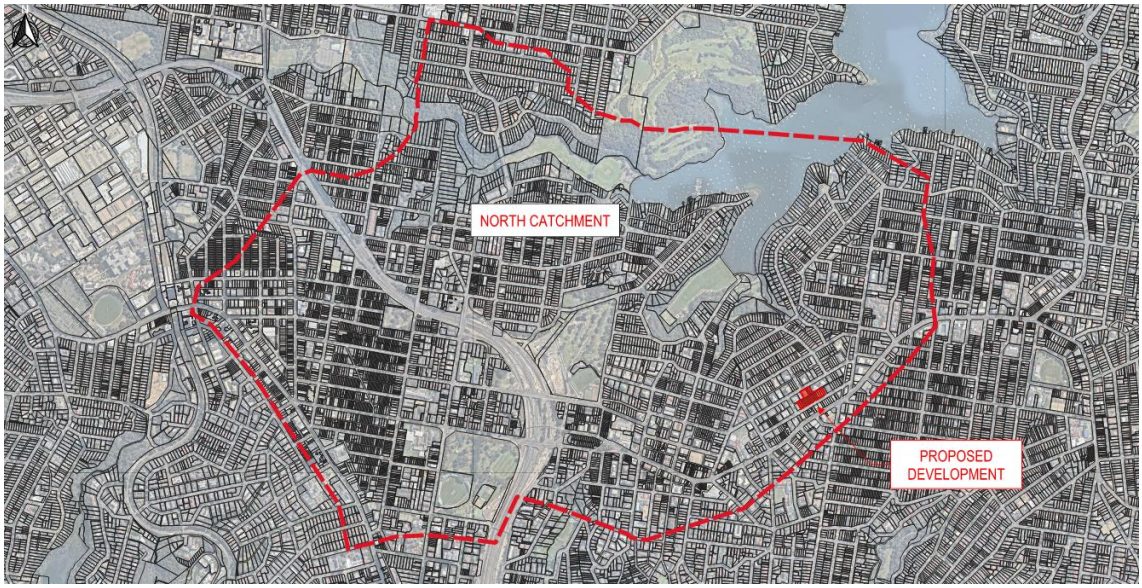

Figure 6 – Hydraulic model boundary extent and topography of the site

4.2. Boundary Conditions

4.2.1. As outlined within section 3.3, the results from the hydrological models (DRAINS and WBNM) were used to inform the hydraulic model.

4.2.2. In accordance with the GRC report, critical storm durations were obtained from DRAINS with the use of the highest median peak discharge and applied at strategic locations within the hydraulic domain.

4.2.3. Tailwater levels have been assigned the norther boundary of the hydraulic model to represent the water levels within the bay.

[3] https://elevation.fsdf.org.au/

4.3. Validation of the hydraulic model

4.3.1. DPM have completed the validation of the hydraulic model based on the work completed by GRC (2022) and the TUFLOW model provided by North Sydney Council.

4.3.2. The calibration was driven by the objective of replicating the results obtained by GRC in relation to the maximum flood depths within the subject area for the PMF rainfall event.

4.3.3. It is understood that the hydraulic Manning's roughness has been created based on aerial imaginary and the results of the Feature and Level survey.

Table 3 – Land use (Manning's values)

Land Use	Manning's value
Residential – Urban (higher density) – DPM	0.350
Default	0.050
Roads/Pavement	0.025
Light Vegetation	0.040
Medium Vegetation	0.070
Heavy Vegetation	0.100
Residential Low Density	0.050
Residential High Density	0.050
Industrial/Commercial	0.030
Lake or Estuary/Ocean	0.030
Concrete -lined Channel	0.020
Waterway/channels – minimal vegetation	0.030
Waterway/channels – vegetated	0.070

4.3.4. It is noted that, for the area subject to the proposed development, GRC have assigned a Manning's value of 0.05, while DPM have conservatively assigned a value of 0.35 to represent the high density character of the proposed development.

4.4. Probable Maximum Flood – Pre-developed conditions

4.4.1. DPM have reviewed the GRC TUFLOW model provided by North Sydney Council to determine the suitability to the objectives of this report.

4.4.2. It is noted that the results from the GRC TUFLOW model presented several warnings and checks which it is understood are associated to the existing drainage networks represented within the hydraulic model.

4.4.3. Based on a review of the warnings and checks, it appears that those are of very minor significance (i.e. minor changes in elevation of the domain to suit the covers of pit or invert level of pipes) and do not have an impact on the overall results.

4.4.4. The results (in ASCII format) of the GRC model were also provided as part of the material provided for review and they have been used to represent the basic case scenario (namely pre-developed conditions).

4.4.5. Figure 7, Figure 8 and Figure 9 show the maximum depth results provided by GRC for the PMF event for 15 minutes, 1 hour and 2 hours durations.

Figure 7 – Maximum depth for 15 minutes duration rainfall – PMF (GRC, 2022)

Figure 8 – Maximum depth for 1 hour duration rainfall – PMF (GRC, 2022)

Figure 9 – Maximum depth for 2 hours duration rainfall – PMF (GRC, 2022)

4.4.6. DPM have run the existing model in order to obtain the same results outlined within the report prepared by GRC (2022).

4.4.7. It is noted that the model prepared by GRC was run with TUFLOW version 2013-12-AC. DPM understand that this is quite an old version and that TUFLOW has implemented numerous QA procedures to ensure the input data have up to date modelling standard.

4.4.8. Due to the above, the current TUFLOW release could not run and DPM have contacted TUFLOW development team to investigate this matter further. For the purpose of this report, DPM have undertaken their internal QA and identified that a couple of 2d_bc files used for 1d/2d connections seem to don't work correctly.

4.4.9. Those files have been switched off and not considered within the TUFLOW model, noting that the 1d/2d connections creating issues to the model are located further north, away from the area of interest and therefore do not impact on the modelling results for the development.

4.4.10. Based on the above, DPM have run the TUFLOW model obtaining the results shown in Figure 10, Figure 11 and Figure 12 for a 15 minute rainfall for a PMF event.

Figure 10 – Maximum flood depth for 15 minutes duration rainfall – PMF (pre-developed conditions)

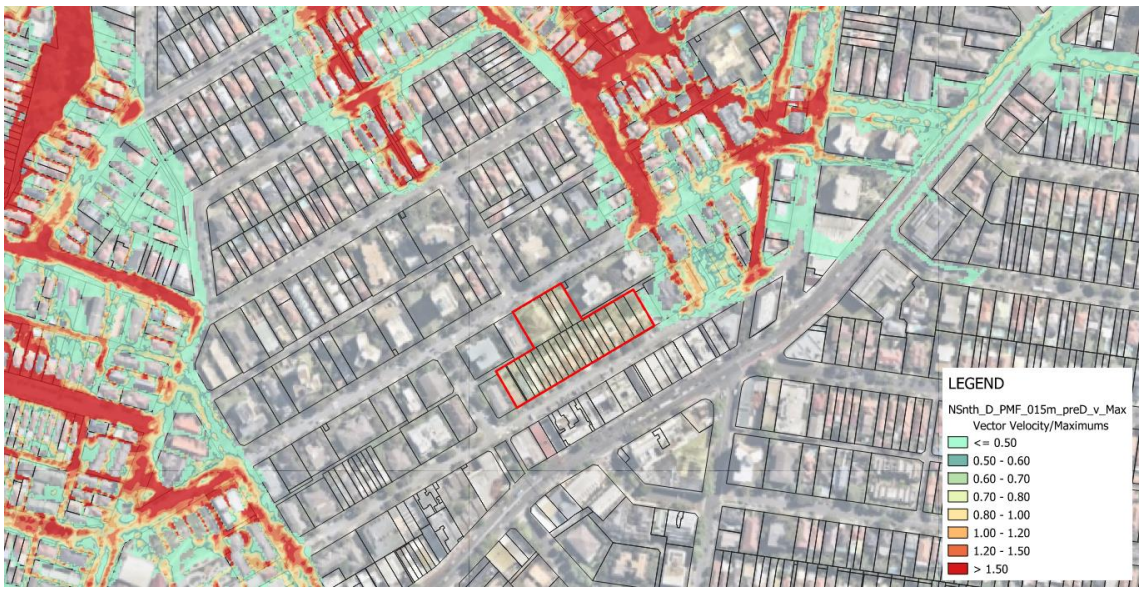

Figure 11 – Maximum velocity for 15 minutes duration rainfall – PMF (pre-developed conditions)

Figure 12 – Maximum flood hazard for 15 minutes duration rainfall – PMF (pre-developed conditions)

4.4.11. Figure 13, Figure 14 and Figure 15 show the maximum depth, velocity and flood hazard considering pre-developed conditions with a rainfall duration of 1 hour for the PMF.

Figure 13 – Maximum flood depth for 1 hour duration rainfall – PMF (pre-developed conditions)

Figure 14 – Maximum velocity for 1 hour duration rainfall – PMF (pre-developed conditions)

Figure 15 – Maximum flood hazard for 1 hour duration rainfall – PMF (pre-developed conditions)

4.4.12. Finally, Figure 16, Figure 17 and Figure 18 show the TUFLOW results for a 2-hour rainfall event under pre-developed conditions for the Probable Maximum Precipitation.

Figure 16 – Maximum flood depth for 2-hour duration rainfall – PMF (pre-developed conditions)

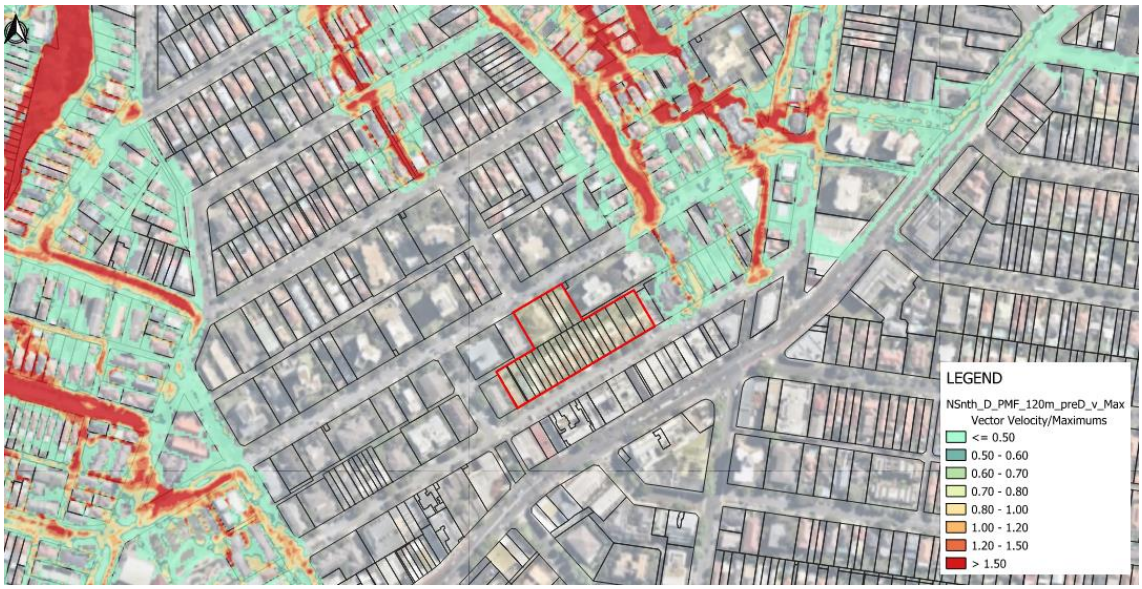

Figure 17 – Maximum velocity for 2-hour duration rainfall – PMF (pre-developed conditions)

Figure 18 – Maximum flood hazard for 2-hour duration rainfall – PMF (pre-developed conditions)

4.4.13. Based on the results provided by GRC and the TUFLOW results obtained by DPM, it is noted that negligible or no differences are observed within the area of interest.

4.4.14. The only differences occur within the northern part of the hydraulic model within the locations closer to the bay. This has no impact or effect on the flood depths, velocities and flood hazard within the area subject of this report.

4.4.15. Based on the above, the results obtained by DPM are deemed acceptable and in line with the findings outlined within the report prepared by GRC (2022) and as such the model is deemed to be calibrated and suitable to be used to determine the post-development scenarios.

4.5. Probable Maximum Flood – Post-developed conditions

4.5.1. DPM have undertaken the hydraulic modelling of the area of interest considering the delivery of the proposed development under post-developed conditions.

4.5.2. In order to represent the proposed development within the TUFLOW model, DPM have included the building outline of the proposed buildings and basement, and increased the roughness coefficient (Manning's) to the value of 0.35 within the area subject to the development to represent the slight increase in impervious surfaces (pre-developed impervious area is 66% of the total site, while post-developed impervious area is 75%).

4.5.3. It is noted that the current land use of the area subject to this report is residential and GRC had already allocated a roughness coefficient of 0.05 to represent the presence of existing residential dwellings.

4.5.4. The proposed development aims at minimising the impact on the current land used and the surrounding areas, maintaining the current imperviousness of the site. However, in order to provide a conservative approach to this study, DPM have assumed an increased roughness coefficient representing the proposed development.

4.5.5. The results for a rainfall duration of 15 minutes for the Probable Maximum Flood are shown in Figure 19, Figure 20 and Figure 21.

Figure 19 – Maximum flood depth for 15 minutes duration rainfall – PMF (post-developed conditions)

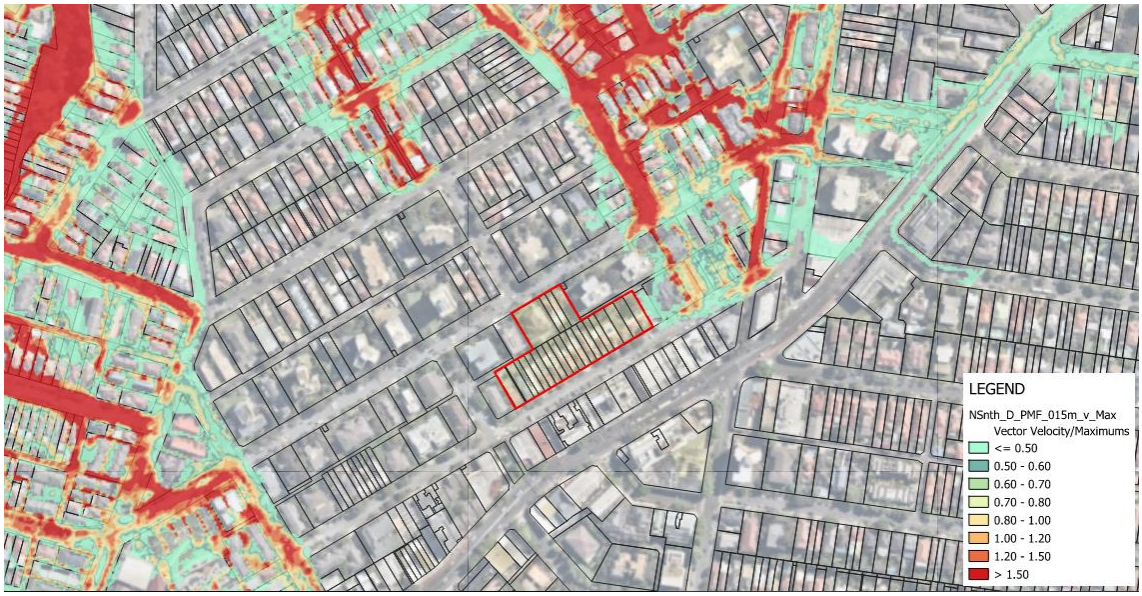

Figure 20 – Maximum velocity for 15 minutes duration rainfall – PMF (post-developed conditions)

Figure 21 – Maximum flood hazard for 15 minutes duration rainfall – PMF (post-developed conditions)

4.5.6. The results for a rainfall duration of 1 hour for the Probable Maximum Flood are shown in Figure 22, Figure 23 and Figure 24.

Figure 22 – Maximum flood depth for 1 hour duration rainfall – PMF (post-developed conditions)

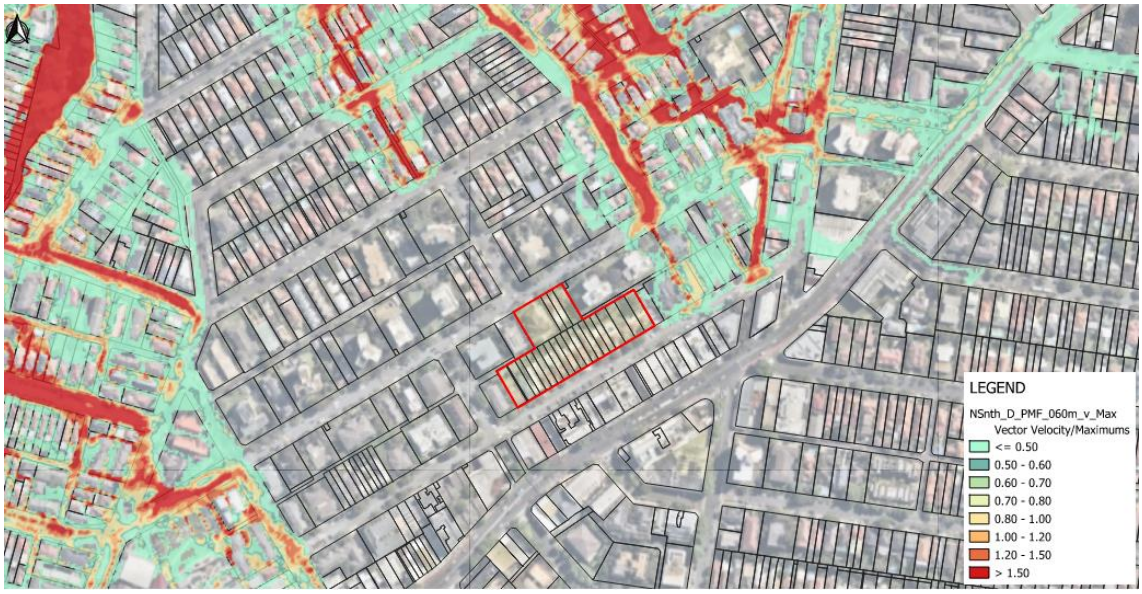

Figure 23 – Maximum velocity for 1 hour duration rainfall – PMF (post-developed conditions)

Figure 24 – Maximum flood hazard for 1 hour duration rainfall – PMF (post-developed conditions)

4.5.7. The results for a rainfall duration of 2 hours for the Probable Maximum Flood are shown in Figure 25, Figure 26 and Figure 27.

Figure 25 – Maximum flood depth for 2 hour duration rainfall – PMF (post-developed conditions)

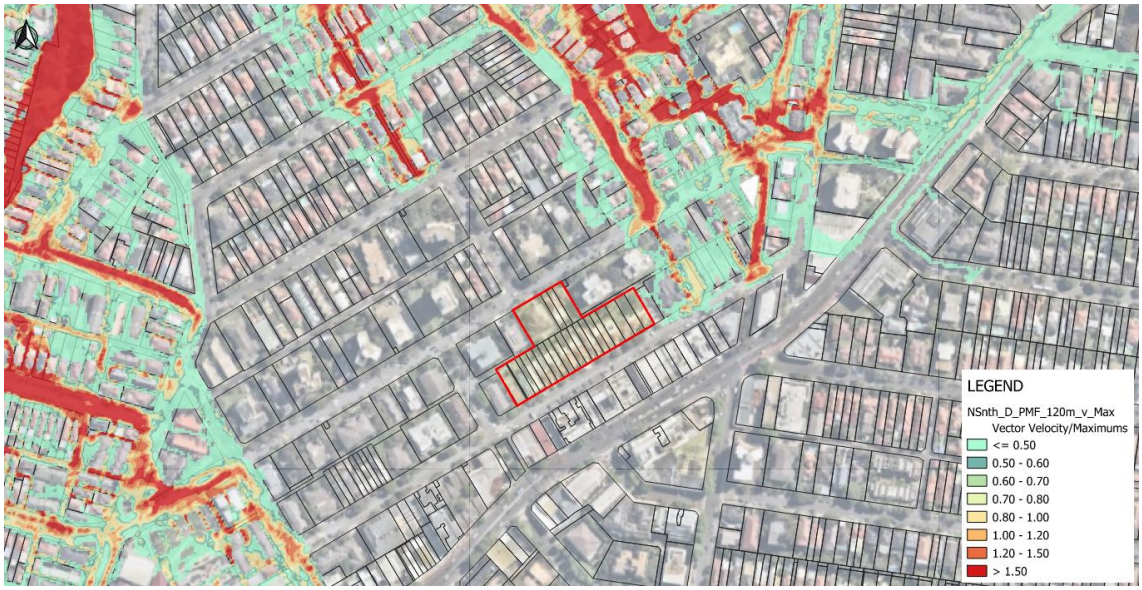

Figure 26 – Maximum velocity for 2 hour duration rainfall – PMF (post-developed conditions)

Figure 27 – Maximum flood depth for 2 hour duration rainfall – PMF (post-developed conditions)

4.5.8. A review of the results and a comparison between the results under pre-developed and post-developed conditions will be undertaken within section 4.6 of this report.

4.6. Hydraulic models results

4.6.1. The results from the TUFLOW model under post-developed conditions have been analysed against the criteria outlined within the Flood Impact and Risk Assessment (FIRA - Department of Planning and Environment, NSW, 2023).

4.6.2. As outlined within the FIRA, *the full range of flood events needs to be considered as issues will differ with flood frequency. For example, while the impacts of development on peak flood levels may be acceptable for the 1% AEP flood event, the impact the development may have on the rate of rise of an extreme flood event may be unacceptable due to the inability of the community to evacuate via a designated evacuation route.*

4.6.3. In accordance with the FIRA, post-development flood impacts need to be analysed against typical considerations as per Table 4.

Table 4 – Typical considerations when assessing impact due to development (FIRA, 2023)

Key Considerations	Reasons for considering
Flood level change	▪ May increase inundation and damage to existing development ▪ May inundate additional existing development ▪ May create new or larger floodways or flowpaths ▪ May isolate new areas
Change in duration of flooding	▪ May increase damage ▪ May increase duration of isolation
Velocity change	▪ May increase scour potential and/or damage to structures

Change in warning and evacuation time	▪ May decrease available warning time and time available for evacuation
Change in frequency of inundation	▪ Properties may become flood affected in more frequent events ▪ Access may be cut more frequently ▪ Areas may be isolated more frequently
Flood function categorisation change	▪ May change categorisation (e.g. flood storage to floodway) and change impacts on flooding on existing development
Flood function categorisation change	▪ May reduce safety to vehicles, people or buildings

4.6.4. As highlighted within the Stormwater Report prepared by Entec Consultants (Issue no. E, 31.07.2023), the area subject of the development is flood free and not within a flood risk zone or subject to external flooding for all flood events up to and including the PMF.

4.6.5. In accordance with the results provided by the post-developed TUFLOW model and summarised below (see Figure 28, Figure 29 and Figure 30), **no increase in flood depths or flood hazard** occurs with the delivery of the proposed development.

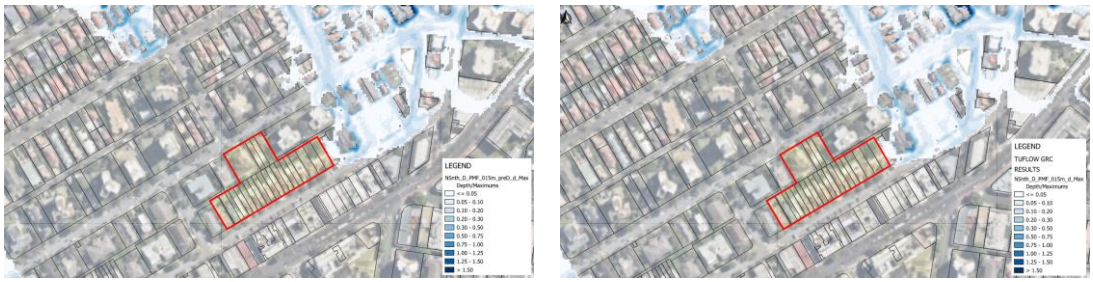

Figure 28 - Maximum depth comparison for pre-developed (left) and post-developed (right) conditions for 15 minutes PMF

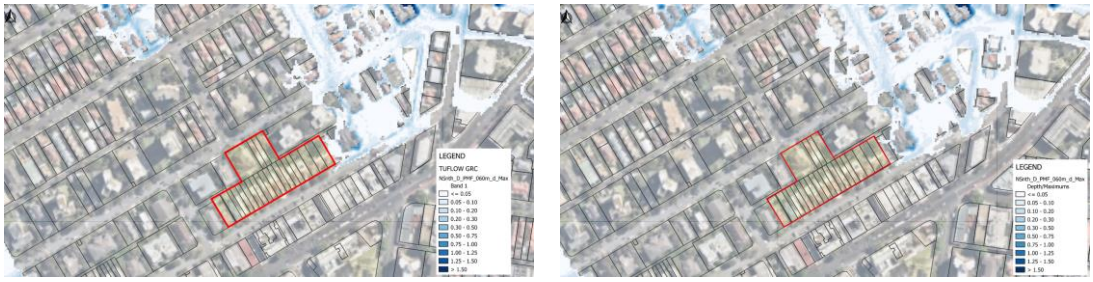

Figure 29 – Maximum depth comparison for pre-developed (left) and post-developed (right) conditions for 1 hour PMF

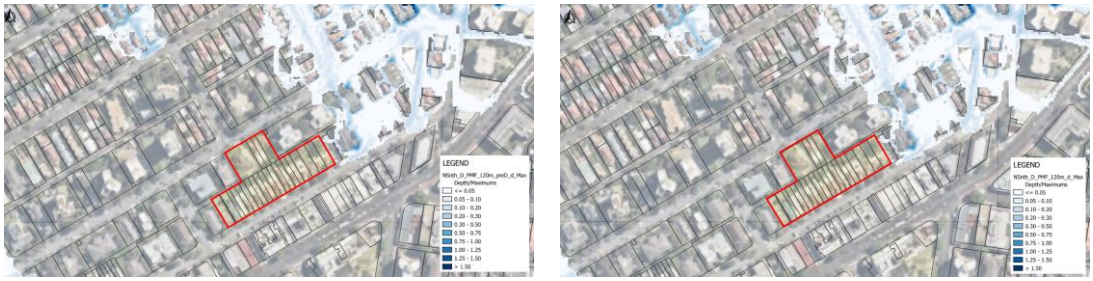

Figure 30 – Maximum depth comparison for pre-developed (left) and post-developed (right) conditions for 2 hours PMF

4.6.6. The proposed development has **no impact on the surrounding areas**, and the flood conditions for the Probable Maximum Flood under the three rainfall events considered are maintained between pre-developed and post-developed conditions.

4.6.7. Refer to Appendix B – Hydraulic Results for the full set of results for the three rainfall durations (15 minutes, 1 hour and 2 hours) for the PMF under pre-developed and post-developed conditions.

4.6.8. Additionally, in reviewing the information outlined within Table 4, the results from the hydraulic model have confirmed that the proposed development do not increase duration of flooding or isolation timing within the subject area.

4.6.9. It is noted that the site stormwater drainage design proposed an underground onsite detention tank to attenuate post-developed flows to pre-developed conditions, which has not been considered in the TUFLOW model.

4.6.10. The underground tank will further contribute to limiting the potential flood impact of the development on the surrounding areas.

4.6.11. As shown in the results from the GRC report and confirmed by the DPM hydraulic results, the surrounding neighbourhood and road networks are affected by flooding during storm events.

4.6.12. Considering the Probable Maximum Flood, it has been shown that flooding within the area subject of this study is characterised as flash flooding, with peak flows and depths occurring in the initial 15 minutes of the rainfall event and water receding within 30 minutes to 1 hour from the beginning of the storm.

4.6.13. The Flood Emergency Response Plan prepared by Entec has highlighted that, due to the vulnerability of the residents of the proposed development, isolation during flooding can cause significant risk to their health and therefore evacuation from flood-isolated buildings is recommended by the State Emergency Service of New South Wales (SES).

4.6.14. The aforementioned report has outlined the main evacuation route for the Pathways development for a 1% AEP rainfall event, indicating that the proposed roads along the route to the hospital have a hazard classification of either H1 or H2 for all storms up to the 1% AEP.

4.6.15. This hazard classification is considered safe for all people and larger vehicles. It is therefore possible to evacuate residents to the RNSH or for emergency vehicles, such as ambulances, to access the Pathways site during these flood events.

4.6.16. Furthermore, considering the PMF, the report highlights how the proposed development might be isolated from the Royal Hospital for a limited period of time. Considering the short duration of the PMF, isolation of the development appears to be less than an hour.

4.6.17. Please refer to the Flood Emergency Response Plan for further information.

4.7. Sensitivity test

4.7.1. It is understood that GRC have completed a sensitivity analysis to determine the impact of different model parameters on the results.

4.7.2. The sensitivity analysis was undertaken on the rainfall losses, hydraulic roughness and pipe blockage factors, showing that the model results were generally insensitive to the rainfall losses and hydraulic roughness.

4.7.3. Conversely, the results demonstrated to be more sensitive to pipe blockage factors, whereby, for a 1% AEP rainfall event, a flood levels increase in the order of 0.1 m (20% blockage factor) and 0.2 m (blockage factor) were observed.

4.7.4. DPM have reviewed the sensitivity analysis results included in the GRC report and have deemed the results provided acceptable and suitable for the purpose of this report.

5. Conclusions

5.1.1. DPM Consulting Group have completed a Flood Impact Assessment for the proposed development at 50-88 Parraween Street and 59-67 Gerard Street, Cremorne NSW and have confirmed via assessment of the site's topography, flood modelling and building layout that the proposed development can achieve the key objectives required by the New South Wales State Emergency Service and subject of this report.

5.1.2. In accordance with the Flood Impact and risk assessment (Department of Planning and Environment, NSW, 2023), a full range of flood events needs to be considered as issues will differ with flood frequency. Following the response from NSW SES, DPM have completed a flood impact assessment for the PMF event, analysing post-development flood impacts against typical considerations outlined within the FIRA.

5.1.3. It has been demonstrated that for the Probable Maximum Flood and in consideration of three different rainfall durations (15 minutes, 1 hour and 2 hours), the proposed development has **no impact** on the surrounding areas, with maximum depths, velocities and flood hazard presenting the same values under post-developed and pre-developed conditions.

5.1.4. The development also does not alter the duration of flooding and as such the building isolation during a PMF event remains the same as per development conditions.

5.1.5. The results have highlighted that flooding within the area subject of this study is characterised as flash flooding, with peak flows and depths occurring in the initial 15 minutes of the rainfall event and water receding within 30 minutes to 1 hour from the beginning of the storm, as stated in the GRC flood study.

5.1.6. Evacuation route for the residents of the proposed development has been outlined within the Flood Emergency Response Plan prepared by Entec, showing that, under the PMF, the proposed development might be isolated for a limited period of time (less than one hour).

5.1.7. In conclusion, in considerations of the findings of this report and the summary provided above, DPM believe that the request from NSW SES to undertake *further modelling for rainfall runoff for storms greater than the 1% Annual Exceedance Probability (AEP), up to and including the Probable Maximum Flood (PMF),* and confirm that the proposed development has **no impact** on the flooding conditions of the subject and surrounding areas has been addressed.

David Moret

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BCivEng, MCivEng, MBA, CPEng, NER

DPM Consulting Group

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22 Business Park Drive, Notting Hill Victoria 3168 Australia

Appendix A – Proposed Development Layout

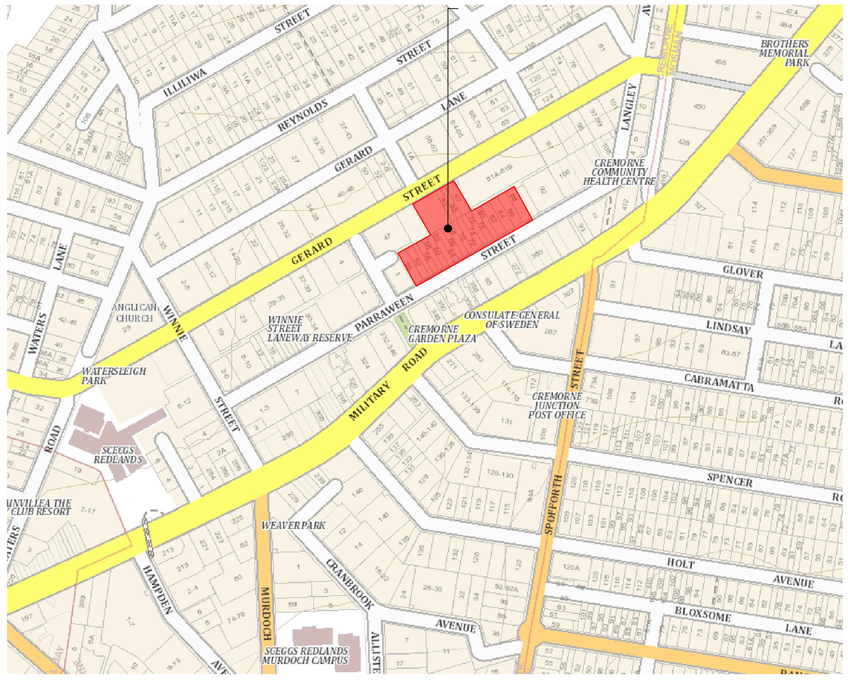
PATHWAYS RESIDENCES CREMORNE
50-88 PARRAWEEN STREET
AND 59-67 GERARD STREET,
CREMORNE, NSW

CIVIL LEGEND

PIPELINES

- PROPOSED STORMWATER DRAINAGE
- PROPOSED BASEMENT STORMWATER DRAINAGE
- PROPOSED EMERGENCY PUMP LINE
- S — PROPOSED SEWER DRAINAGE
- S — EXISTING SEWER DRAINAGE
- W — EXISTING WATER
- G — EXISTING GAS
- E — EXISTING ELECTRICAL
- C — EXISTING COMMS
- HV — EXISTING HIGH VOLTAGE CABLE
- X X X X X X — REDUNDANT SERVICE
- SMH — PROPOSED SEWER MANHOLE
- eSMH — EXISTING SEWER MANHOLE
- STORMWATER OVERLAND FLOW PATH
- GRASS LINED SWALE DRAIN (GRASS TO BE LAID KIKUYU OR EQUAL)
- P56.20 — FINISHED SURFACE LEVEL
- EX56.20 — EXISTING SURFACE LEVEL
- GRATED DRAIN
- SSD — SUBSOIL DRAINAGE LINE
- SSD IR — SSD HER — SUBSOIL HIGH END RISER AND INTERMEDIATE RISER
- DP — DOWNPIPE CONNECTION (Ø150 uPVC UNO)
- P5 — STORMWATER DRAINAGE STRUCTURE WITH NUMBER (REFER STORMWATER DRAINAGE STRUCTURES SCHEDULE)
- STORMWATER DRAINAGE LINE WITH;
  - IL 25.30 — INVERT LEVEL UPSTREAM
  - Ø375 RCP '2' — PIPE SIZE AND MATERIAL CLASS
  - 13.30m @ 1.0% — PIPE GRADE
  - 10m — PIPE LENGTH
  - IL 25.10 — INVERT LEVEL DOWNSTREAM

SITE LOCATION



DRAWING SCHEDULE

C01	COVER SHEET
C02	NOTES SHEET
C03	EROSION AND SEDIMENT CONTROL PLAN
C04	EROSION AND SEDIMENT CONTROL DETAILS
C05	STORMWATER MANAGEMENT PLAN
C06	STORMWATER MANAGEMENT DETAILS
C07	SEWER DIVERSION PLAN

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	DATE	DRAWN	APP
A	ISSUE FOR SSDA	16.06.23	SM	NP

CLIENT: PATHWAYS RESIDENCES

ARCHITECT: CHROFI mdp architecture

CIVIL CONSULTANT: ENTEC CONSULTANTS

PROJECT: PATHWAYS RESIDENCES CREMORNE
50-88 PARRAWEEN STREET and 59-67 GERARD STREET, CREMORNE, N.S.W.

NORTH POINT

DRAWING TITLE: CIVIL SERVICES
COVER SHEET, LEGEND & DRAWING SCHEDULE

DRAWN	DATE	SCALE A1	QA CHECK	DATE
JL	JUNE 23	NTS	NP	16.06.23
DESIGNED	PROJECT NO.		DRAWING NO.	ISSUE
NP	220059		C01	A

C:\Central\Creative Synch\2020 Projects\220059 Pathways 50-88 Parraween St Cremorne\Drawings\Civil\220059_C01-C06.dwg
Jun 16, 2023 - 12:13pm

SITEWORKS NOTES

1. ORIGIN OF LEVELS :- AUSTRALIAN HEIGHT DATUM (A.H.D.)
2. CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORK.
3. ALL WORK IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS, THE SPECIFICATIONS AND THE DIRECTIONS OF THE PRINCIPAL'S REPRESENTATIVE.
4. EXISTING SERVICES HAVE BEEN PLOTTED FROM SUPPLIED DATA AND AS SUCH THEIR ACCURACY CANNOT BE GUARANTEED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ESTABLISH THE LOCATION AND LEVEL OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF ANY WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE PRINCIPAL'S REPRESENTATIVE. CLEARANCES SHALL BE OBTAINED FROM THE RELEVANT SERVICE AUTHORITY.
5. WHERE NEW WORKS ABUT EXISTING THE CONTRACTOR SHALL ENSURE THAT A SMOOTH EVEN PROFILE, FREE FROM ABRUPT CHANGES IS OBTAINED.
6. THE CONTRACTOR SHALL ARRANGE ALL SURVEY SETOUT TO BE CARRIED OUT BY A REGISTERED SURVEYOR.
7. CARE IS TO BE TAKEN WHEN EXCAVATING NEAR EXISTING SERVICES. NO MECHANICAL EXCAVATIONS ARE TO BE UNDERTAKEN OVER COMMUNICATIONS OR ELECTRICAL SERVICES. HAND EXCAVATE IN THESE AREAS.
8. ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH AN APPROVED NON-NATURAL GRANULAR MATERIAL AND COMPACTED TO 98% STANDARD MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS.1289.5.1.1.
9. ALL TRENCH BACKFILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.
10. ON COMPLETION OF PIPE INSTALLATION ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL AND GRASSED AREAS AND ROAD PAVEMENTS.
11. PROVIDE 10mm WIDE EXPANDING CORK JOINTS BETWEEN CONCRETE PAVEMENTS AND ALL BUILDINGS , WALLS, FOOTINGS, COLUMNS, KERBS, DISH DRAINS, GRATED DRAINS, BOLLARD FOOTINGS ETC
12. CONTRACTOR TO OBTAIN ALL AUTHORITY APPROVALS.
13. ALL BATTERS TO BE GRASSED LINED WITH MINIMUM 100 TOPSOIL AND APPROVED COUCH LAID AS TURF.
14. MAKE SMOOTH TRANSITION TO EXISTING SERVICES AND MAKE GOOD.
15. THE CONTRACTOR SHALL PROVIDE ALL TEMPORARY DIVERSION DRAINS AND MOUNDS TO ENSURE THAT AT ALL TIMES EXPOSED SURFACES ARE FREE DRAINING AND WHERE NECESSARY EXCAVATE SUMPS AND PROVIDE PUMPING EQUIPMENT TO DRAIN EXPOSED AREAS.
16. THESE PLANS SHALL BE READ IN CONJUNCTION WITH APPROVED ARCHITECTURAL, STRUCTURAL, HYDRAULIC AND ELECTRICAL DRAWINGS AND SPECIFICATIONS.
17. TRENCHES THROUGH EXISTING ROAD AND CONCRETE PAVEMENTS SHALL BE SAWCUT TO FULL DEPTH OF CONCRETE AND A MIN 50mm IN BITUMINOUS PAVING.
18. ALL BRANCH GAS AND WATER SERVICES UNDER DRIVEWAYS AND BRICK PAVING SHALL BE LOCATED IN Ø80 uPVC SEWER GRADE CONDUITS EXTENDING A MIN OF 500mm PAST PAVING.
19. ON COMPLETION OF WORKS ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL INCLUDING, BUT NOT LIMITED TO, KERBS, FOOTPATHS, CONCRETE AREAS, GRASS AND LANDSCAPED AREAS.

EROSION AND SEDIMENT CONTROL NOTES

GENERAL INSTRUCTIONS

E1. THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING PLANS, AND ANY OTHER PLANS OR WRITTEN INSTRUCTIONS THAT MAY BE ISSUED AND RELATING TO DEVELOPMENT AT THE SUBJECT SITE.

E2. THE PRINCIPAL'S REPRESENTATIVE WILL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE UNDERTAKEN AS INSTRUCTED IN THIS SPECIFICATION AND CONSTRUCTED FOLLOWING THE GUIDELINES OF "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION", DEPT OF HOUSING, 2004 (BLUE BOOK).

E3. ALL BUILDERS AND SUB-CONTRACTORS WILL BE INFORMED OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWNSLOPE LANDS AND WATERWAYS.

CONSTRUCTION SEQUENCE

E4. THE SOIL EROSION POTENTIAL ON THIS SITE SHALL BE MINIMISED. HENCE WORKS SHALL BE UNDERTAKEN IN THE FOLLOWING SEQUENCE :

a. INSTALL SEDIMENT FENCES, TEMPORARY CONSTRUCTION EXIT AND SANDBAG KERB INLET SEDIMENT TRAP.
b. UNDERTAKE SITE DEVELOPMENT WORKS IN ACCORDANCE WITH THE ENGINEERING PLANS. PHASE DEVELOPMENT SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF WORKABLE SIZE.

EROSION CONTROL

E5. DURING WINDY CONDITIONS, LARGE, UNPROTECTED AREAS WILL BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL.

E6. FINAL SITE LANDSCAPING WILL BE UNDERTAKEN AS SOON AS POSSIBLE AND WITHIN 20 WORKING DAYS FROM COMPLETION OF CONSTRUCTION ACTIVITIES.

FENCING

E7. STOCKPILES WILL NOT BE LOCATED WITHIN 2 METRES OF HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS. WHERE THEY ARE BETWEEN 2 AND 5 METRES FROM SUCH AREAS, SPECIAL SEDIMENT CONTROL MEASURES SHOULD BE TAKEN TO MINIMISE POSSIBLE POLLUTION TO DOWNSLOPE WATERS, E.G. THROUGH INSTALLATION OF SEDIMENT FENCING.

E8. ANY SAND USED IN THE CONCRETE CURING PROCESS (SPREAD OVER THE SURFACE) WILL BE REMOVED AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM PLACEMENT.

E9. WATER WILL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNLESS IT IS RELATIVELY SEDIMENT FREE, I.E. THE CATCHMENT AREA HAS BEEN PERMANENTLY LANDSCAPED AND/OR ANY LIKELY SEDIMENT HAS BEEN FILTERED THROUGH AN APPROVED STRUCTURE.

E10. TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED.

OTHER MATTERS

E11. ACCEPTABLE RECEPTORS WILL BE PROVIDED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.

E12. RECEPTORS FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER ARE TO BE EMPTIED AS NECESSARY. DISPOSAL OF WASTE SHALL BE IN A MANNER APPROVED BY THE PRINCIPAL'S REPRESENTATIVE.

SITE INSPECTION & MAINTENANCE

E13. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED AFTER RAINFALL EVENTS TO ENSURE THAT THEY OPERATE EFFECTIVELY. REPAIR AND OR MAINTENANCE SHALL BE UNDERTAKEN AS REQUIRED.

STORMWATER NOTES

1. ALL 375 DIA. DRAINAGE PIPES AND LARGER SHALL BE CLASS "2" APPROVED SPIGOT AND SOCKET FRC OR RCP PIPES WITH RUBBER RING JOINTS. (U.N.O.) ALL DOWNPIPE DRAINAGE LINES SHALL BE SEWER GRADE uPVC WITH SOLVENT WELD JOINTS. (U.N.O.)
2. EQUIVALENT STRENGTH REINFORCED CONCRETE PIPES MAY BE USED.
3. ALL PIPE JUNCTIONS UP TO AND INCLUDING 450 DIA. AND TAPERS SHALL BE VIA PURPOSE MADE FITTINGS.
4. MINIMUM GRADE TO STORMWATER LINES TO BE 1%. (U.N.O.)
5. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORK.
6. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN A TRADESMAN-LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE A SMOOTH FINISH.
7. PRECAST PITS SHALL NOT BE USED UNLESS WRITTEN APPROVAL IS OBTAINED FROM THE ENGINEER.
8. WHERE TRENCHES ARE IN ROCK, THE PIPE SHALL BE BEDDED ON A MIN. 50MM CONCRETE BED (OR 75MM THICK BED OF 12MM BLUE METAL) UNDER THE BARREL OF THE PIPE. THE PIPE COLLAR AT NO POINT SHALL BEAR ON THE ROCK. IN OTHER THAN ROCK, PIPES SHALL BE LAID ON A 75MM THICK SAND BED. IN ALL CASES BACKFILL THE TRENCH WITH SAND TO 200MM ABOVE THE PIPE. WHERE THE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH WITH SAND OR APPROVED GRANULAR BACKFILL COMPACTED IN 150MM LAYERS TO 98% STANDARD MAX. DRY DENSITY.
9. BEDDING SHALL BE (U.N.O.) TYPE HS2, IN ACCORDANCE WITH CURRENT RELEVANT AUSTRALIAN STANDARDS.
10. WHERE STORMWATER LINES PASS UNDER FLOOR SLABS SEWER GRADE RUBBER RING JOINTS ARE TO BE USED.
11. WHERE SUBSOIL DRAINAGE LINES PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS UNSLOTTED UPVC SEWER GRADE PIPE SHALL BE USED.
12. PROVIDE 3.0M LENGTH OF 100 DIA. SUBSOIL DRAINAGE PIPE WRAPPED IN FABRIC SOCK, AT UPSTREAM END OF EACH PIT.

ON-SITE DETENTION NOTES

1. CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS, SERVICES AND STRUCTURES ON SITE PRIOR TO COMMENCEMENT OF WORK.
2. ALL WORK SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS AND THE SPECIFICATION.
3. ON COMPLETION OF PROPOSED WORKS ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL, GRASSED & LANDSCAPE AREAS AND ROAD PAVEMENTS. (U.N.O.)
4. CONTRACTOR TO OBTAIN ALL AUTHORITY APPROVALS.
5. MAKE SMOOTH TRANSITION TO EXISTING SERVICES AND MAKE GOOD.
6. WHERE NEW WORKS ABUT EXISTING THE CONTRACTOR SHALL ENSURE THAT A SMOOTH EVEN PROFILE, FREE FROM ABRUPT CHANGES IS OBTAINED.
7. CARE IS TO BE TAKEN WHEN EXCAVATING NEAR EXISTING SERVICES. NO MECHANICAL EXCAVATIONS ARE TO BE UNDERTAKEN OVER THESE SERVICES. HAND EXCAVATE IN THESE AREAS.
8. THESE PLANS SHALL BE READ IN CONJUNCTION WITH APPROVED ARCHITECTURAL, STRUCTURAL, HYDRAULIC, AND OTHER SERVICES DRAWINGS AND SPECIFICATIONS.
9. EQUIVALENT STRENGTH FRC PIPES MAY BE USED.
10. ALL PIPE JUNCTIONS, BENDS AND TAPERS UP TO AND INCLUDING 450 DIA SHALL BE VIA PURPOSE MADE FITTINGS.
11. MINIMUM GRADE TO STORMWATER LINES TO BE 1%. (U.N.O.)
12. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORK.
13. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN A TRADESMAN-LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE A SMOOTH FINISH.
14. WHERE TRENCHES ARE IN ROCK, THE PIPE SHALL BE BEDDED ON A MIN. 50mm CONCRETE BED (OR 75mm THICK BED OF 12mm BLUE METAL) UNDER THE BARREL OF THE PIPE. THE PIPE COLLAR AT NO POINT SHALL BEAR ON THE ROCK. IN OTHER THAN ROCK, PIPES SHALL BE LAID ON A 75mm THICK SAND BED. IN ALL CASES BACKFILL THE TRENCH WITH SAND TO 200mm ABOVE THE PIPE. WHERE THE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH WITH SAND OR APPROVED GRANULAR BACKFILL COMPACTED IN 150mm LAYERS TO 98% STANDARD MAX. DRY DENSITY.
15. BEDDING SHALL BE (U.N.O.) TYPE H1, IN ACCORDANCE WITH CURRENT RELEVANT AUSTRALIAN STANDARDS.
16. WHERE STORMWATER LINES PASS UNDER FLOOR SLABS SEWER GRADE RUBBER RING JOINTS ARE TO BE USED.
17. PROVIDE 3.0m LENGTH OF 100 DIA. SUBSOIL DRAINAGE PIPE WRAPPED IN FABRIC SOCK, AT UPSTREAM END OF EACH PIT.

RAINWATER REUSE SYSTEM

MARKING & LABELLING

1. THE WATER SUPPLY SYSTEM FROM A RAINWATER TANK SHALL BE CLEARLY MARKED `RAINWATER' AT INTERVALS NOT EXCEEDING 1m WITH CONTRASTING COLOURED WORDING. WATER OUTLETS SHALL BE IDENTIFIED AS `RAINWATER' WITH A LABEL OR A RAINWATER TAP IDENTIFIED BY A GREEN COLOURED INDICATOR WITH THE LETTERS `RW'.

NON-DRINKING WATER SERVICES - HOSE TAP OUTLETS

2. HOSE TAP OUTLETS SHALL:

a. BE CLEARLY MARKED `WARNING: NOT FOR DRINKING' IN ACCORDANCE WITH THE REQUIREMENTS OF AS 1319.
b. BE OF A TYPE THAT HAS A REMOVABLE HANDLE.

PROXIMITY TO OTHER SERVICES

3. THE FOLLOWING APPLIES:

a. ABOVEGROUND INSTALLATION OF NON-DRINKING WATER SERVICES SHALL NOT BE INSTALLED WITHIN 100mm OF ANY PARALLEL DRINKING WATER SERVICE, EXCEPT WHEN INSTALLED IN PIPE DUCT OR STRUCTURALLY SEPARATED.
b. BELOW-GROUND INSTALLATIONS OF NON-DRINKING WATER SERVICES SHALL NOT BE INSTALLED WITHIN 300mm OF ANY PARALLEL DRINKING WATER SUPPLY.

MARKING & LABELLING OF NON-DRINKING WATER PIPES & OUTLETS

GENERAL

a. ALL PIPES, PIPE SLEEVES, IDENTIFICATION TAPES, & OUTLETS SHALL BE COLOURED LILAC (P23) IN ACCORDANCE WITH AS 2700
b. ALL PIPES, PIPE SLEEVES & IDENTIFICATION TAPES, IN ACCORDANCE WITH AS 1345, SHALL BE MARKED WITH THE FOLLOWING, WARNING: RECYCLED OR RECLAIMED - WATER - DO NOT DRINK

BELOW GROUND PIPES

a. ALL BELOW GROUND PIPES SHALL HAVE AN IDENTIFICATION TAPE IN ACCORDANCE WITH CLAUSE GENERAL INSTALLED ON TOP OF THE WATER PIPELINE, RUNNING LONGITUDINALLY, & FASTENED TO THE PIPE AT NOT MORE THAN 3m INTERVALS.

OUTLET POINTS

a. ALL OUTLET POINTS SHALL BE CLEARLY & PERMANENTLY MARKED `WARNING: NOT FOR DRINKING' WITH SAFETY SIGNS TO COMPLY WITH AS 1319 & AS 1345.

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	DATE	DRAWN	APP
A	ISSUE FOR SSDA	16.06.23	SM	NP

CLIENT: PATHWAYS RESIDENCES

ARCHITECT: CHROFI / mdp architecture

CIVIL CONSULTANT: ENTEC CONSULTANTS

PROJECT: PATHWAYS RESIDENCES CREMORNE
50-88 PARRAWEEN STREET
and 59-67 GERARD STREET,
CREMORNE, N.S.W.

NORTH POINT

DRAWING TITLE: CIVIL SERVICES NOTES SHEET

DRAWN	DATE	SCALE A1	QA CHECK	DATE
JL	JUNE 23	NTS	NP	16.06.23

DESIGNED	PROJECT NO.	DRAWING NO.	ISSUE
NP	220059	C02	A


GERARD STREET
PARRAWEEN STREET
BUILDING 1
RAC
BUILDING 2
ILU
BUILDING 3
ILU
STOCKPILE
BOUNDARY
EXISTING SEWER
NEW SEWER DIVERSION
PROPOSED SEWER DIVERSION
EXISTING SUBSTATION
NEW SUBSTATION
PUBLIC PARK
OUTDOOR SEATING
COURTYARD
LOBBY
FOYER
ENTRY
LANDSCAPING
TERRACE BELOW
RAMP TO BASEMENT
BALCONY
CARPARK
ENTRY/EXIT
FH/FS BOOSTER VALVE
LEGEND
SEDIMENT FENCE
GEOTEXTILE INLET FILTER
STABILISED SITE ACCESS
DIRECTION OF OVERLAND FLOW
SANDBAG, TEMPORARY GUTTER
GROSS SEDIMENT / POLLUTION TRAP
MESH AND GRAVEL INLET FILTER
STOCKPILES
NOTE
EXACT LOCATION OF STABILISED SITE ACCESS AND TEMPORARY STOCKPILE TO BE DETERMINED ON-SITE DURING CONSTRUCTION BY CONTRACTOR.

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	DATE	DRAWN	APP
A	ISSUE FOR SSDA	16.06.23	SM	NP

CLIENT: PATHWAYS RESIDENCES

ARCHITECT: CHROFI / mdp architecture

CIVIL CONSULTANT: ENTEC CONSULTANTS

PROJECT: PATHWAYS RESIDENCES CREMORNE

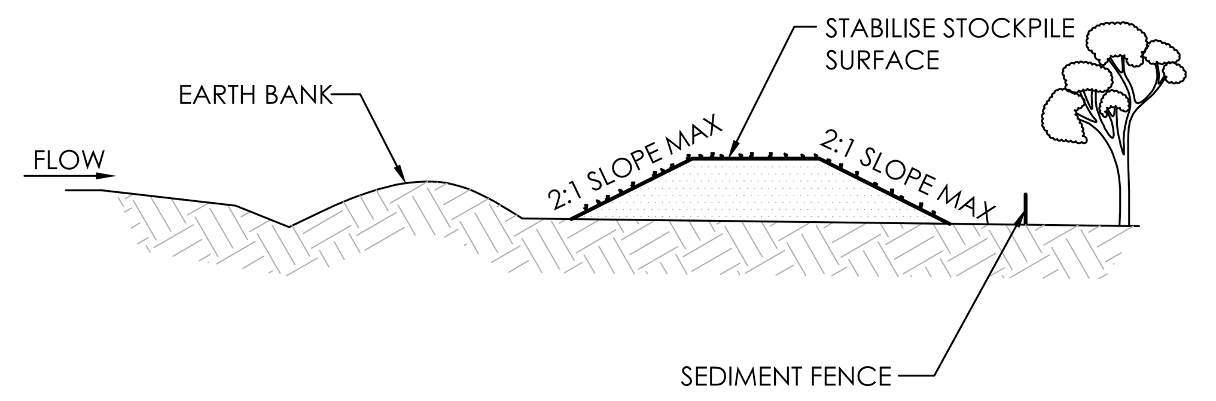
50-88 PARRAWEEN STREET and 59-67 GERARD STREET, CREMORNE, N.S.W.

NORTH POINT

DRAWING TITLE: CIVIL SERVICES EROSION AND SEDIMENT CONTROL PLAN

DRAWN	DATE	SCALE	A1	QA CHECK	DATE
JL	JUNE 23	1:200		NP	16.06.23
DESIGNED	PROJECT NO.			DRAWING NO.	ISSUE
NP	220059			C03	A

SOURCE: MANAGING URBAN STORMWATER
SOILS AND CONSTRUCTION
THIRD EDITION, AUGUST 1998
PRODUCED BY THE DEPARTMENT OF
HOUSING.

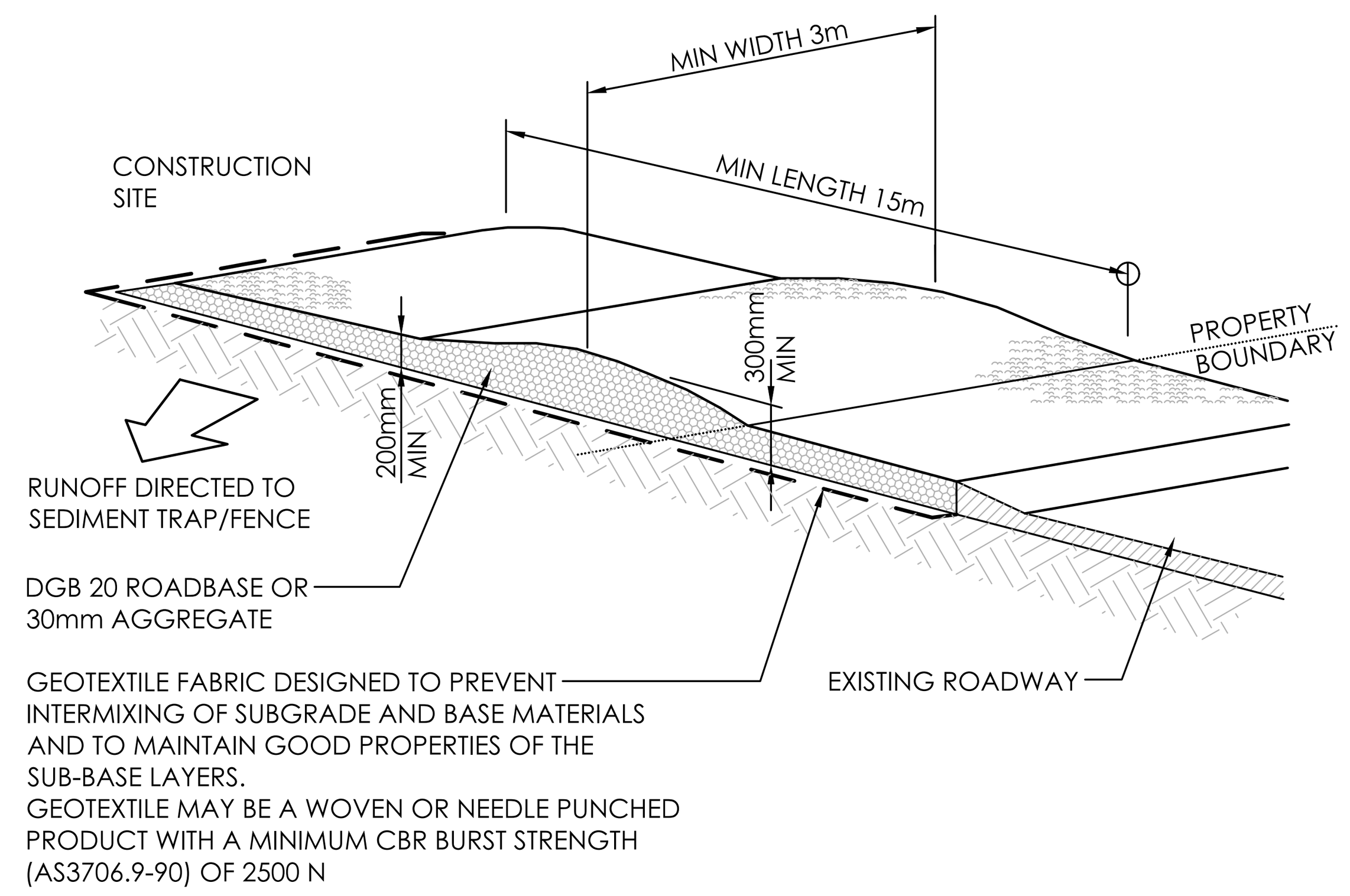


CONSTRUCTION NOTES:

1. LOCATE STOCKPILE AT LEAST 5 METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOWS, ROADS AND HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS A LOW, FLAT, ELONGATED MOUND.
3. WHERE THERE IS SUFFICIENT AREA TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METERS IN HEIGHT.
4. REHABILITATE IN ACCORDANCE WITH THE SWMP/ESCP.
5. CONSTRUCT EARTH BANK (STANDARD DRAWING 5-2) ON THE UPSLOPE SIDE TO DIVERT RUN OFF AROUND THE STOCKPILE AND A SEDIMENT FENCE (STANDARD DRAWING 6-7) 1 TO 2 METRES DOWNSLOPE OF STOCKPILE.

STOCKPILES

SOURCE: MANAGING URBAN STORMWATER
SOILS AND CONSTRUCTION
THIRD EDITION, AUGUST 1998
PRODUCED BY THE DEPARTMENT OF
HOUSING.

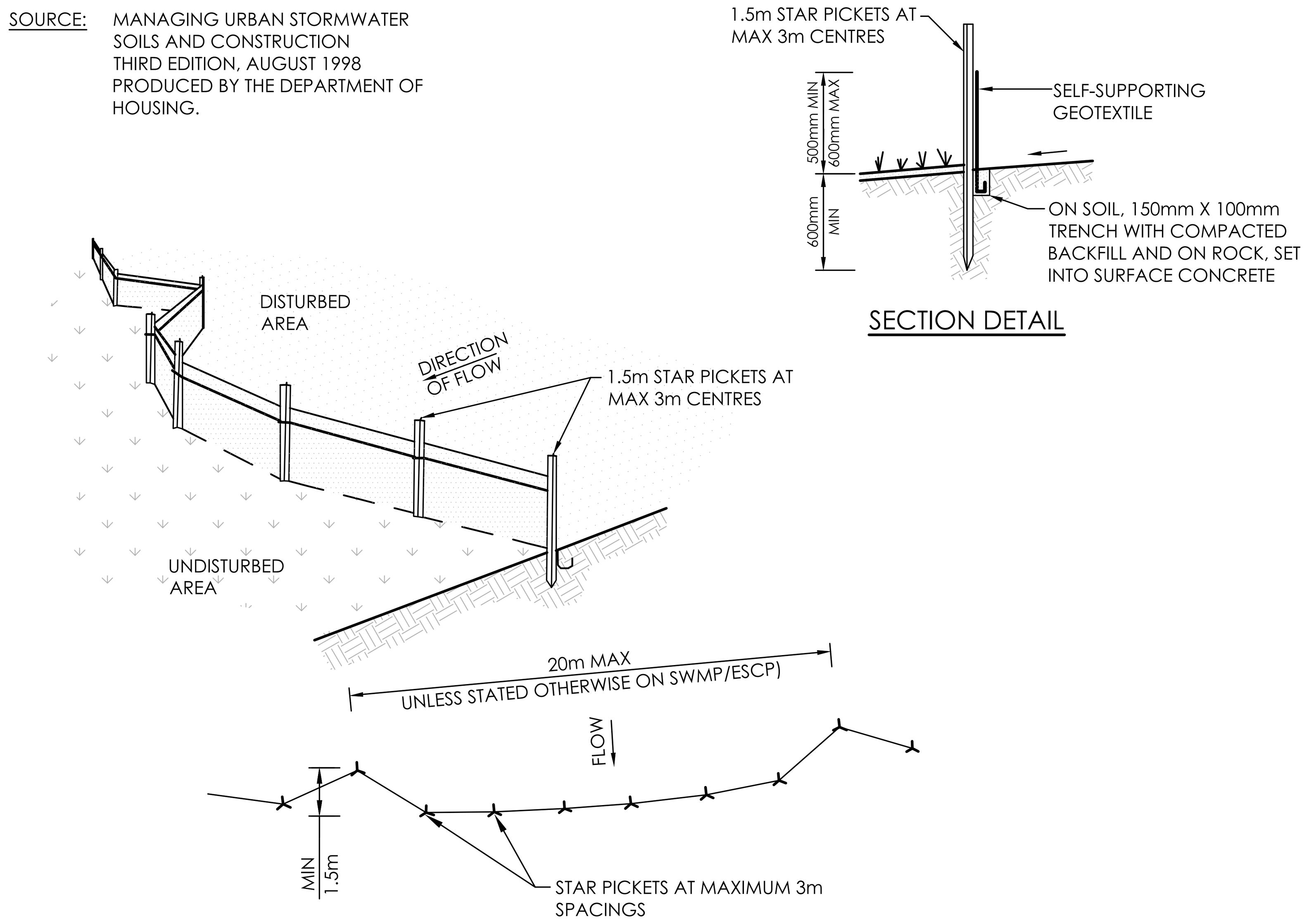


CONSTRUCTION NOTES:

1. STRIP TOPSOIL AND LEVEL SITE.
2. COMPACT SUBGRADE.
3. COVER AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
4. CONSTRUCT 200MM THICK PAD OVER GEOTEXTILE USING ROADBASE OR 30MM AGREGATE. MINIMUM LENGTH 15M OR TO BUILDING ALIGNMENT, MINIMUM WIDTH 3 METRES.
5. CONSTRUCT HUMP IMMEDIATELY WITHIN BUUNDARY TO DIVERT WATER TO A SEDIMENT FENCE OR OTHER SEDIMENT TRAP.

STABILISED SITE ACCESS

SOURCE: MANAGING URBAN STORMWATER
SOILS AND CONSTRUCTION
THIRD EDITION, AUGUST 1998
PRODUCED BY THE DEPARTMENT OF
HOUSING.

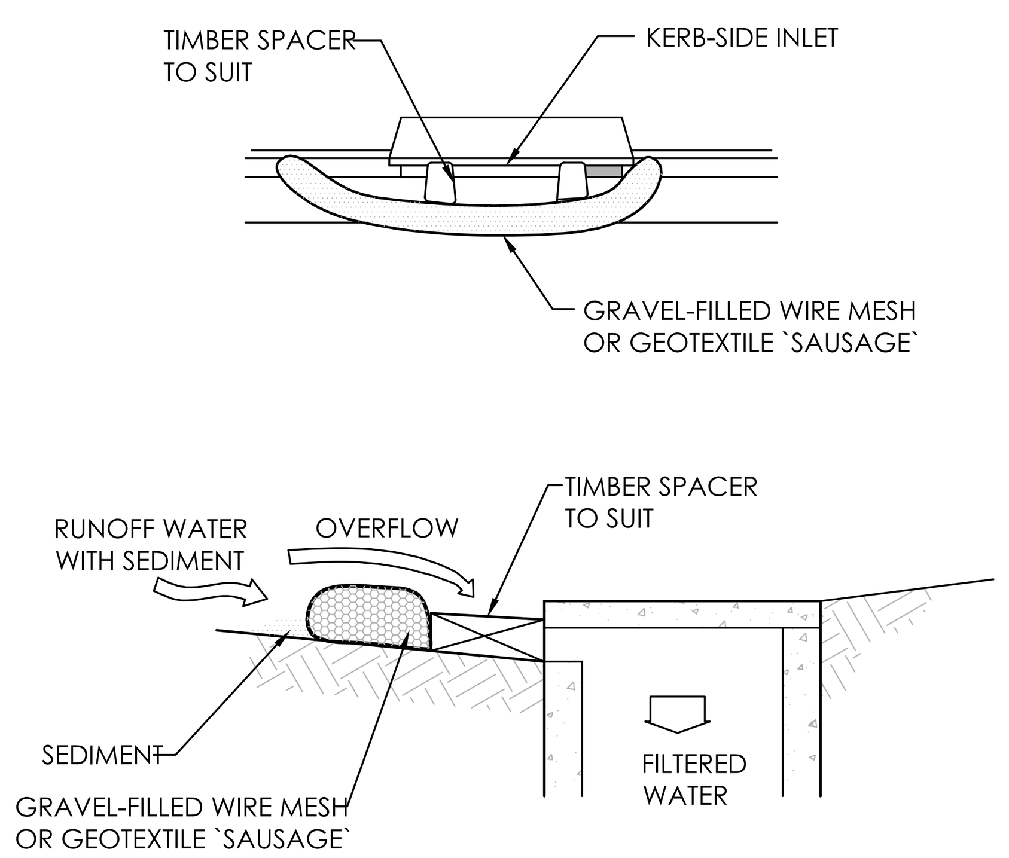


CONSTRUCTION NOTES

1. CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE TO PARALLEL TO THE CONTOURS OF THE SITE.
2. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND, 3 METRES APART.
3. DIG A 150 MM DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
4. BACKFILL TRENCH OVER BASE OF FABRIC.
5. FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANUFACTURER.
6. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150 MM OVERLAP.

SEDIMENT FENCE

SOURCE: MANAGING URBAN STORMWATER
SOILS AND CONSTRUCTION
THIRD EDITION, AUGUST 1998
PRODUCED BY THE DEPARTMENT OF
HOUSING.



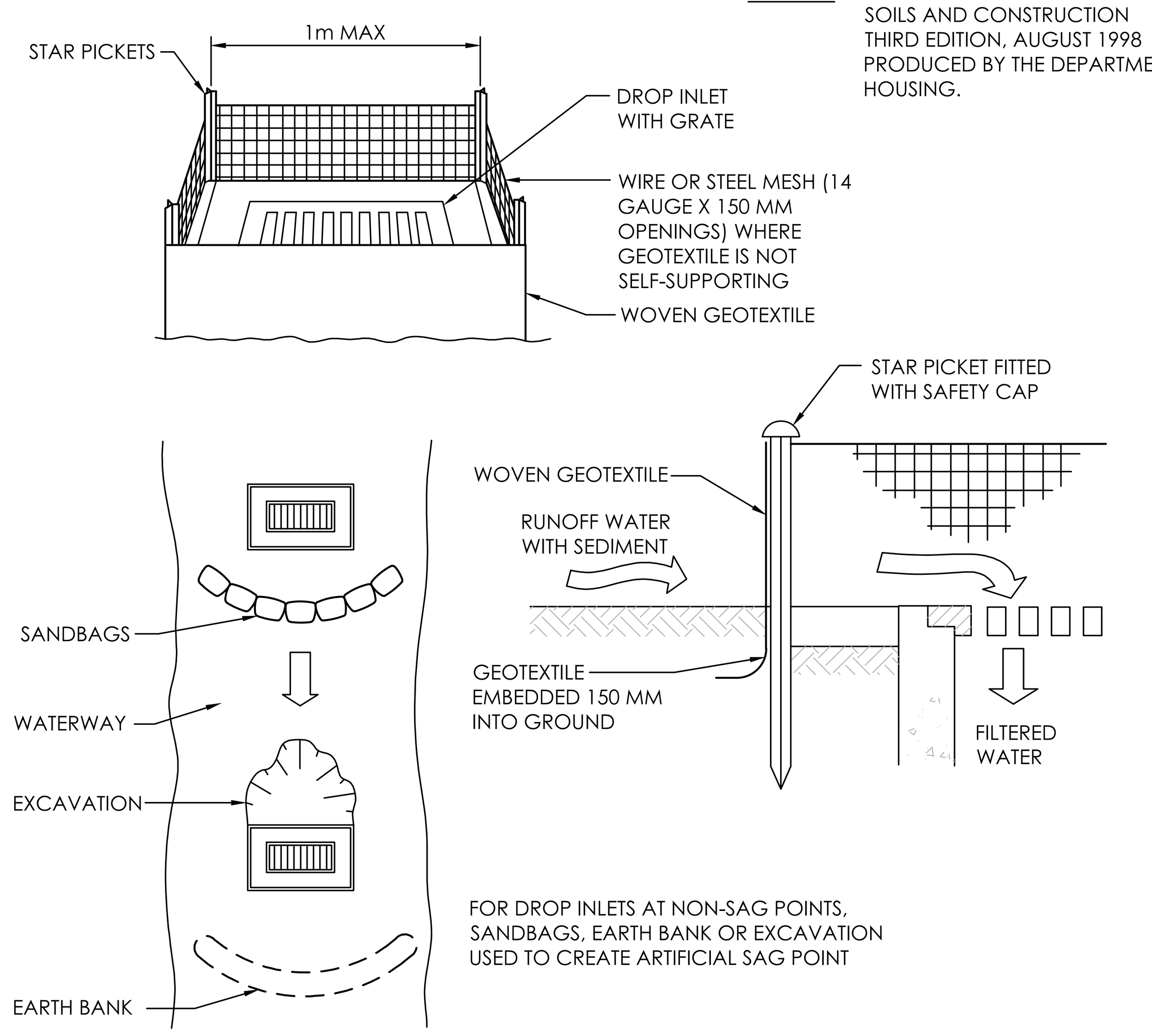
NOTE: THIS PRACTICE ONLY TO BE USED WHERE SPECIFIED IN AN APPROVED SWMP/ESCP.

CONSTRUCTION NOTES:

1. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT.
2. FILL THE SLEEVE WITH 25MM TO 50MM GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150MM HIGH X 400MM WIDE.
4. PLACE THE FILTER AT THE OPENING OF THE KERB INLET LEAVING A 100MM GAP AT THE TOP TO ACT AS AN EMERGENCY SPILLWAY.
5. MAINTAIN THE OPENING WITH SPACER BLOCKS.
6. FORM A SEAL WITH THE KERBING AND PREVENT SEDIMENT BYPASSING THE FILTER.
7. FIT TO ALL KERB INLETS AT SAG POINTS.

MESH AND GRAVEL INLET FILTER

SOURCE: MANAGING URBAN STORMWATER
SOILS AND CONSTRUCTION
THIRD EDITION, AUGUST 1998
PRODUCED BY THE DEPARTMENT OF
HOUSING.



CONSTRUCTION NOTES:

1. FABRICATE A SEDIMENT BARRIER FROM GEOTEXTILE OR STRAW BALES.
2. SUPPORT GEOTEXTILE WITH MESH TIED TO POSTS AT 1 METRE CENTRES.
3. DO NOT COVER INLET WITH GEOTEXTILE.
4. CONSTRUCTION DETAILS ARE SIMILAR TO TYPICAL SEDIMENT FENCING DETAIL.

GEOTEXTILE INLET FILTER

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	DATE	DRAWN	APP
A	ISSUE FOR SSDA	16.06.23	SM	NP

CLIENT: PATHWAYS RESIDENCES

ARCHITECT: CHROFI | mdp architecture

CIVIL CONSULTANT: ENTEC CONSULTANTS

PROJECT: PATHWAYS RESIDENCES CREMORNE
50-88 PARRAWEEN STREET and 59-67 GERARD STREET, CREMORNE, N.S.W.

NORTH POINT

DRAWING TITLE: CIVIL SERVICES
EROSION AND SEDIMENT CONTROL DETAILS

DRAWN	DATE	SCALE A1	QA CHECK	DATE
JL	JUNE 23	NTS	NP	16.06.23
DESIGNED	PROJECT NO.		DRAWING NO.	ISSUE
NP	220059		C04	A


GERARD STREET
WATER QUALITY CHAMBER (WSUD) 7 x STORMWATER CARTRIDGES - OCEAN PROTECT
EXTEND 375DIA COUNCIL STORMWATER DRAINAGE 94m TO SITE BOUNDARY
USIL 78.20 375Ø RCP 94m @ 1% DSIL 77.24
EMERGENCY OVERLAND FLOW PATH FOR PIT SURCHARGE DURING LARGE STORM EVENTS
USIL 78.30 375Ø RCP 7m @ 1% DSIL 78.23
USIL 82.05 300Ø PVC 9m @ 1% DSIL 81.95
USIL 81.90 300Ø PVC 8m @ 1% DSIL 81.80
USIL 81.75 300Ø PVC 15m @ 1% DSIL 81.60
USIL 81.55 300Ø PVC 5m @ 1% DSIL 81.50
NON-RETURN FLAP VALVE TO BE INSTALLED ON OUTLET TO PREVENT BACKFLOW FROM COUNCIL DRAINAGE SYSTEM
USIL 78.38 375Ø RCP 5m @ 1% DSIL 78.33
USIL 81.45 300Ø PVC 5m @ 1% DSIL 81.40
50kL RAINWATER TANK LOCATED IN LOWER GROUND FLOOR. OVERFLOW TO CONNECT TO EXTERNAL STORMWATER DRAINAGE
OSD BASE OF TANK SLAB RL78.50 Volume = 100m³ Area = 60m² 20m x 3m x 1.7m TOP OF TANK RL80.50 (APPROX)
USIL 82.45 300Ø RCP 22m @ 1.5% DSIL 82.10
TOWER FFL G = 83.40 LG = 80.00 B1 = 76.80
WATER QUALITY (WSUD) ALL SURFACE INLET PITS ARE TO HAVE FILTER BASKET INSERTS (TYPICAL) - ALLOWANCE FOR 24 TOTAL FOR THE SITE
USIL 78.70 225Ø PVC 25m @ 1% DSIL 78.45
BASEMENT SLAB RL 83.20
WATER QUALITY CHAMBER (WSUD) 12 x STORMWATER CARTRIDGES - OCEAN PROTECT
USIL 82.90 300Ø PVC 15m @ 2% DSIL 82.50
WATER QUALITY CHAMBER (WSUD) 3 x STORMWATER CARTRIDGES - OCEAN PROTECT
USIL 84.40 225Ø PVC 27m @ 2.3% DSIL 83.90
USIL 83.85 225Ø PVC 15m @ 2% DSIL 83.70
USIL 78.83 225Ø PVC 8m @ 1% DSIL 78.75
EMERGENCY PUMP PIT TO KERB TO REMOVE FLOOD WATER INCASE OF BLOCKAGE
STORMWATER DRAINAGE TO DROP INTO BASEMENT AND SUSPENDED ALONG BASEMENT WALL. ASSUME 1m FROM TOP OF SLAB LEVEL
TERRACE FFL = 80.00
USIL 79.45 225Ø PVC 20m @ 1% DSIL 79.25
ILU ROOF DRAINAGE TO BE SUSPENDED AT HIGH LEVEL AND DROP ON NORTHERN EDGE
ILU ROOF DRAINAGE 225% TO FALL TO REAR OF BUILDING AND TRAVERSE BASEMENT WALL TO ON SITE DETENTION
USIL 78.98 225Ø PVC 12m @ 1% DSIL 78.86
USIL 79.20 225Ø PVC 20m @ 1% DSIL 79.00
RACF ROOF DRAINAGE 225% TO FALL TO REAR OF BUILDING AND TRAVERSE BEHIND RETAINING WALL TO ON SITE DETENTION
ILU FFL G = 84.90
USIL 83.90 225Ø uPVC 10m @ 0.5% DSIL 83.85
ILU FFL G = 84.90
USIL 83.95 225Ø uPVC 5m @ 0.5% DSIL 83.93
USIL 84.10 100Ø uPVC 7m @ 1% DSIL 83.03
RACF FFL G = 83.50 LG = 80.00
ILU FFL G = 84.45
USIL 84.15 100Ø uPVC 13m @ 0.5% DSIL 84.00
BASEMENT SLAB RL 84.30
USIL 84.00 100Ø uPVC 5m @ 1% DSIL 83.95
USIL 83.65 100Ø uPVC 15m @ 1% DSIL 83.50
ILU FFL G = 84.90
ILU COTTAGE DOWNPIPES TO DISCHARGE TO BYPASS OSD AND CONNECT TO KERB
USIL 84.50 100Ø PVC 11m @ 1% DSIL 84.39
USIL 84.50 100Ø PVC 11m @ 1% DSIL 84.39
USIL 83.95 225Ø uPVC 15m @ 0.5% DSIL 83.98
ILU FFL G = 84.90
ILU FFL G = 84.79
USIL 83.90 100Ø uPVC 10m @ 1% DSIL 83.80
USIL 82.95 150Ø uPVC 10m @ 1% DSIL 82.85
USIL 82.82 225Ø PVC 20m @ 1% DSIL 82.62
USIL 82.59 225Ø PVC 10m @ 1% DSIL 82.49
USIL 84.50 100Ø PVC 5m @ 1% DSIL 84.45
USIL 83.98 100Ø uPVC 5m @ 1% DSIL 83.93
BUILDING 3 ILU
BUILDING 2 ILU
USIL 82.39 225Ø PVC 31m @ 1% DSIL 82.08
USIL 82.46 225Ø PVC 4m @ 1% DSIL 82.42
STORMWATER KERB OUTLET. 100Ø TYPICAL
PARRAWEEN STREET
BUILDING 1 RAC
CONSTRUCT NEW KERB INLET PIT
EXTEND EXISTING 225Ø COUNCIL STORMWATER DRAINAGE 31m TO SITE BOUNDARY
NEW SUBSTATION
EXISTING SUBSTATION
EXISTING SEWER
PROPOSED SEWER DIVERSION
NEW SEWER DIVERSION
PUBLIC PARK
COURTYARD
LOBBY
FOYER
ENTRY
BALCONY
RAMP TO BASEMENT
CARPARK ENTRY/EXIT
EX. PP

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	DATE	DRAWN	APP
A	ISSUE FOR SSDA	16.06.23	SM	NP

CLIENT: PATHWAYS RESIDENCES

ARCHITECT: CHROFI / mdp architecture

CIVIL CONSULTANT: ENTEC CONSULTANTS

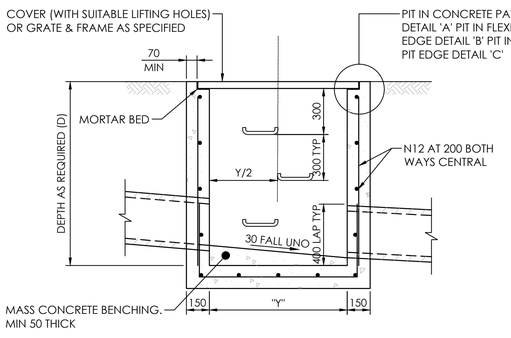
PROJECT: PATHWAYS RESIDENCES CREMORNE
50-88 PARRAWEEN STREET and 59-67 GERARD STREET, CREMORNE, N.S.W.

NORTH POINT

DRAWING TITLE: CIVIL SERVICES STORMWATER MANAGEMENT PLAN

DRAWN	DATE	SCALE A1	QA CHECK	DATE
JL	JUNE 23	1:200	NP	16.06.23

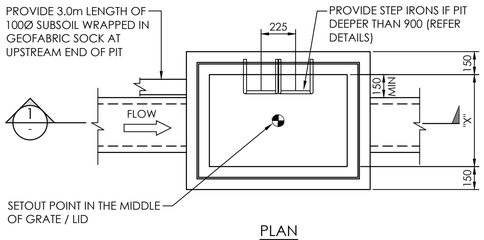
DESIGNED	PROJECT NO.	DRAWING NO.	ISSUE
NP	220059	C05	A



SECTION 1
SCALE 1:20

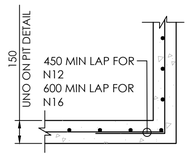
MINIMUM INTERNAL PIT DIMENSIONS		
"D"	"X"	"Y"
D≤ 600	450	450*
D≤ 900	600	600*
D≤ 1200	600	900
D> 1200	900	900

NOTE
PITS DENOTED * SHALL BE USED ONLY WHERE SPECIFIED IN DRAINAGE SCHEDULE OR ON PLAN.

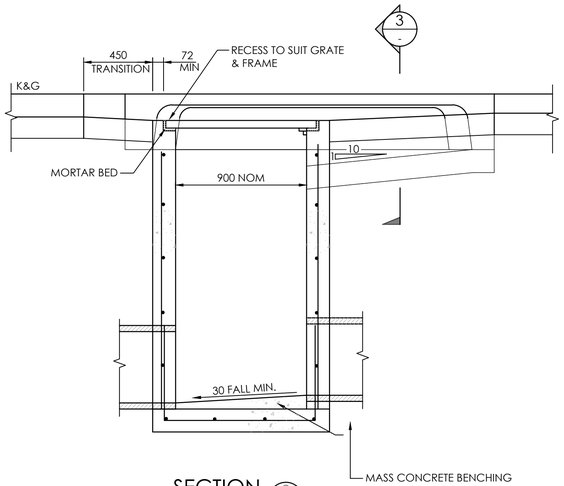


PLAN

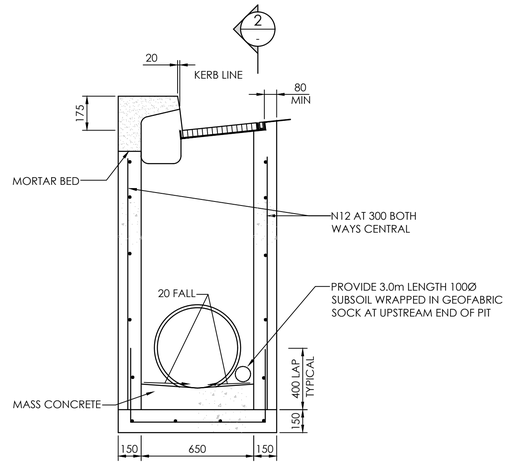
SURFACE INLET/JUNCTION PIT
SCALE 1:20



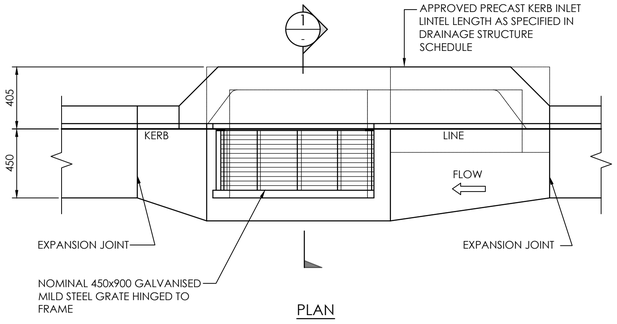
TYPICAL PIT CORNER DETAIL
SCALE 1:20



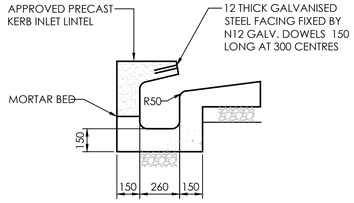
SECTION 2
SCALE 1:20



SECTION 3
SCALE 1:20

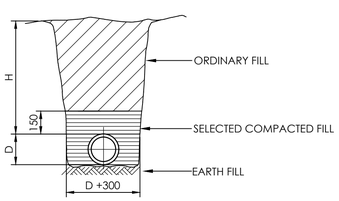


PLAN

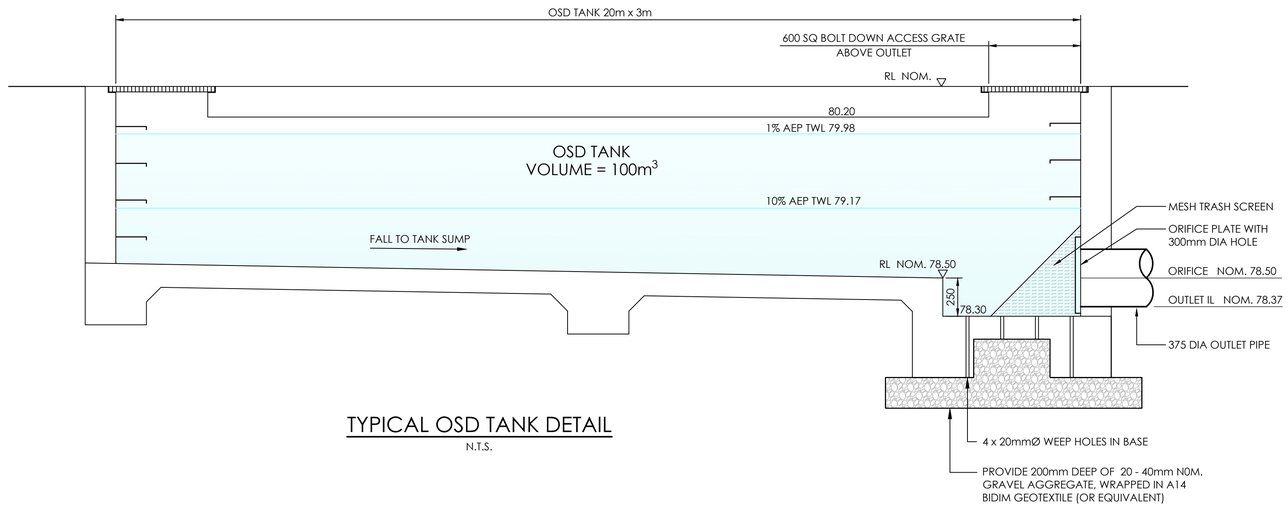


SECTION 3
SCALE 1:20

KERB INLET PIT TYPE "C"
SCALE 1:20



EARTH FOUNDATIONS TRENCH CONDITIONS
SCALE 1:20



TYPICAL OSD TANK DETAIL
N.T.S.

DESIGN CRITERIA		
CATCHMENT AREA =		7350m^2
PRE-DEVELOPMENT IMPERVIOUS AREA =		66%
POST-DEVELOPMENT IMPERVIOUS AREA =		75%
PRE-DEVELOPMENT FLOWS (L/s)	1% AEP	442
	5% AEP	330
	10% AEP	278
	20% AEP	228
POST-DEVELOPMENT FLOWS	1% AEP	318
	5% AEP	244
	10% AEP	221
	20% AEP	190
OSD STORAGE VOLUME =		100m^3

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	DATE	DRAWN	APP
A	ISSUE FOR SSDA	16.06.23	SM	NP

CLIENT: PATHWAYS RESIDENCES

ARCHITECT: CHROFI mdp architecture

CIVIL CONSULTANT: ENTEC CONSULTANTS

PROJECT: PATHWAYS RESIDENCES CREMORNE
50-88 PARRAWEEN STREET and 59-67 GERARD STREET, CREMORNE, N.S.W.

NORTH POINT

DRAWING TITLE: CIVIL SERVICES STORMWATER MANAGEMENT DETAILS

DRAWN	DATE	SCALE A1	QA CHECK	DATE
JL	JUNE 23	NTS	NP	16.06.23
DESIGNED	PROJECT NO.		DRAWING NO.	ISSUE
NP	220059		C06	A

INVERT TO BE CONFIRMED BY SURVEYOR. ASSUMED 1.8% GRADE IL 78.52

SEWER TO BE CONSTRUCTED BELOW EXISTING AUTHORITY SERVICES

eSMH

IL 78.55

IL 77.72

IL 77.72

eSMH

eSMH

IL 80.97

SMH

IL 81.00

EXISTING SUBSTATION

IL 80.03

eSMH

IL 80.03

EXISTING SEWER TO BE MADE REDUNDANT AND REMOVED FROM SITE

225Ø 1% FALL

TOWER FFL
G = 83.40
LG = 80.00
B1 = 76.80

BASEMENT SLAB RL 83.20

UP

IL 80.19

IL 80.23

eSMH

eSMH

IL 81.71

IL 81.64

eSMH

CONSTRUCT NEW MANHOLE OVER EXISTING SEWER

IL 81.37

SMH

DIN

IL 81.40 (CALC) TBC

83200

TERRACE RETAINING WALL

IL 80.34

IL 80.41

IL 80.51

IL 80.54

eSMH

IL 80.64

IL 80.51

225Ø 0.45% FALL

IL 80.64

SMH

IL 80.67

81967

82850

82655

82840

83500

TERRACE FFL = 80.00

EXISTING SEWER TO BE MADE REDUNDANT AND REMOVED FROM SITE

84800

225Ø 0.5% FALL

83500

82197

ILU FFL
G = 84.90

ILU FFL
G = 84.90

84300

IL 80.75

SMH

IL 80.78

FFL 84900

RL 84400

FFL 84900

UP

RACF FFL
G = 83.50
LG = 80.00

BASEMENT WALL

FFL 76570

FFL 8

ILU FFL
G = 84.45

83300

83500

8.8"

6.4"

2.9"

ILU FFL
G = 84.90

BASEMENT SLAB RL 84.30

ILU FFL
G = 84.90

ILU FFL
G = 84.79

RL 84444

RL 84000

UP

225Ø 0.5% FALL

CONSTRUCT NEW MANHOLE OVER EXISTING SEWER

SMH

IL 92

225Ø 0.5% FALL

IL 80.89

SMH

IL 81.08 (CALC)

EX. PP

eSMH

eSMH

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	DATE	DRAWN	APP
A	ISSUE FOR SSDA	16.06.23	SM	NP

CLIENT
PATHWAYS
RESIDENCES

ARCHITECT
CHROFI
mdp architecture

CIVIL CONSULTANT
ENTEC
CONSULTANTS

PROJECT
PATHWAYS RESIDENCES
CREMORNE
50-88 PARRAWEEN STREET
and 59-67 GERARD STREET,
CREMORNE, N.S.W.

NORTH POINT

DRAWING TITLE
CIVIL SERVICES
SEWER DIVERSION PLAN

DRAWN	DATE	SCALE A1	QA CHECK	DATE
SM	JUNE 23	1:200	NP	16.06.23
DESIGNED	PROJECT NO.		DRAWING NO.	ISSUE
NP	220059		C07	A

C:\Users\mp.Desktop\Sync\2022 Projects\220059 Pathways 50-88 Parraween St Cremorne\Drawings\Civil\C07\220059_C07.dwg
Jun 16, 2023 - 11:21am

Appendix B – Hydraulic Results

No.	Conditions	Rainfall Event	Rainfall Duration	Type
01	Pre-developed	PMF	15 minutes	Maximum Depth
02	Pre-developed	PMF	15 minutes	Maximum Depth (Zoom)
03	Pre-developed	PMF	15 minutes	Maximum Velocity
04	Pre-developed	PMF	15 minutes	Maximum Velocity (Zoom)
05	Pre-developed	PMF	15 minutes	Maximum Flood Hazard
06	Pre-developed	PMF	15 minutes	Maximum Flood Hazard (Zoom)
07	Pre-developed	PMF	1 hour	Maximum Depth
08	Pre-developed	PMF	1 hour	Maximum Depth (Zoom)
09	Pre-developed	PMF	1 hour	Maximum Velocity
10	Pre-developed	PMF	1 hour	Maximum Velocity (Zoom)
11	Pre-developed	PMF	1 hour	Maximum Flood Hazard
12	Pre-developed	PMF	1 hour	Maximum Flood Hazard (Zoom)
13	Pre-developed	PMF	2 hours	Maximum Depth
14	Pre-developed	PMF	2 hours	Maximum Depth (Zoom)
15	Pre-developed	PMF	2 hours	Maximum Velocity
16	Pre-developed	PMF	2 hours	Maximum Velocity (Zoom)
17	Pre-developed	PMF	2 hours	Maximum Flood Hazard
18	Pre-developed	PMF	2 hours	Maximum Flood Hazard (Zoom)
19	Post-Developed	PMF	15 minutes	Maximum Depth
20	Post-Developed	PMF	15 minutes	Maximum Depth (Zoom)
21	Post-Developed	PMF	15 minutes	Maximum Velocity
22	Post-Developed	PMF	15 minutes	Maximum Velocity (Zoom)
23	Post-Developed	PMF	15 minutes	Maximum Flood Hazard
24	Post-Developed	PMF	15 minutes	Maximum Flood Hazard (Zoom)
25	Post-Developed	PMF	1 hour	Maximum Depth
26	Post-Developed	PMF	1 hour	Maximum Depth (Zoom)
27	Post-Developed	PMF	1 hour	Maximum Velocity

28	Post-Developed	PMF	1 hour	Maximum Velocity (Zoom)
29	Post-Developed	PMF	1 hour	Maximum Flood Hazard
30	Post-Developed	PMF	1 hour	Maximum Flood Hazard (Zoom)
31	Post-Developed	PMF	2 hours	Maximum Depth
32	Post-Developed	PMF	2 hours	Maximum Depth (Zoom)
33	Post-Developed	PMF	2 hours	Maximum Velocity
34	Post-Developed	PMF	2 hours	Maximum Velocity (Zoom)
35	Post-Developed	PMF	2 hours	Maximum Flood Hazard
36	Post-Developed	PMF	2 hours	Maximum Flood Hazard (Zoom)

CREMORNE PATHWAYS

CREMORNE PATHWAYS

Pre-developed conditions - Probable Maximum Flood, 15 minutes rainfall event

Maximum depth

DPM Results

Job Number: 3242/M/C
Revision: P1
Designed: DM
Checked: DM
Project Manager: DM
Date: 08.12.2023

0 100 200 m

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: GDA1994, MGA 55

Consulting Group

CREMORNE PATHWAYS

CREMORNE PATHWAYS

Pre-developed conditions - Probable Maximum Flood, 15 minutes rainfall event

Maximum depth

DPM Results

Job Number: 3242/M/C
Revision: P1
Designed: DM
Checked: DM
Project Manager: DM
Date: 08.12.2023

0 50 100 m

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
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Grid: GDA1994, MGA 55

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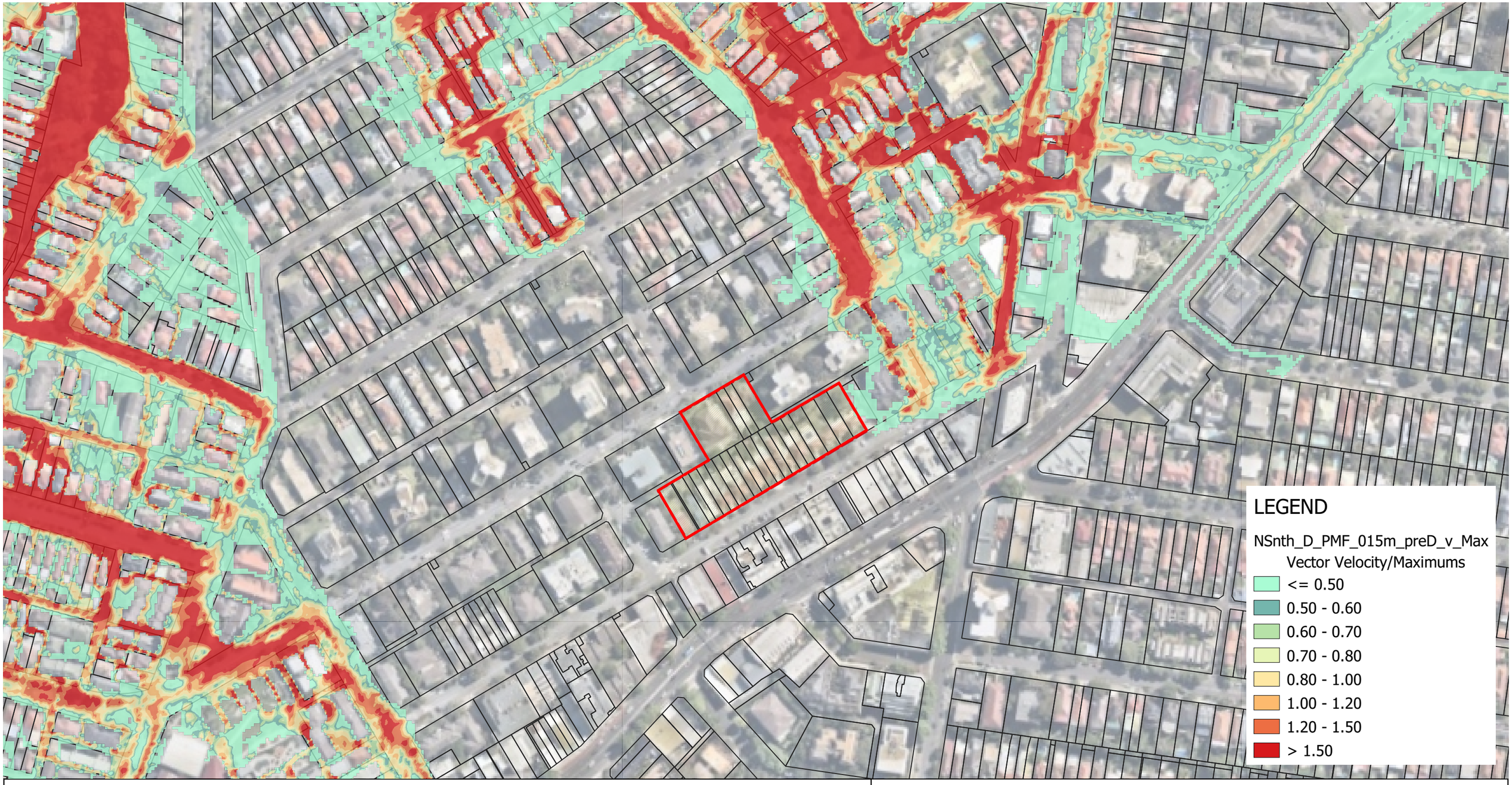
CREMORNE PATHWAYS



CREMORNE PATHWAYS

Pre-developed conditions - Probable Maximum Flood, 15 minutes rainfall event

Maximum velocity

DPM Results

Job Number: 3242/M/C
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Checked: DM
Project Manager: DM
Date: 08.12.2023

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CREMORNE PATHWAYS

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CREMORNE PATHWAYS

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Pre-developed conditions - Probable Maximum Flood, 15 minutes rainfall event

Maximum Flood Hazard

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CREMORNE PATHWAYS

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CREMORNE PATHWAYS

CREMORNE PATHWAYS

Pre-developed conditions - Probable Maximum Flood, 60 minutes rainfall event

Maximum depth

DPM Results

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Revision: P1
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Project Manager: DM
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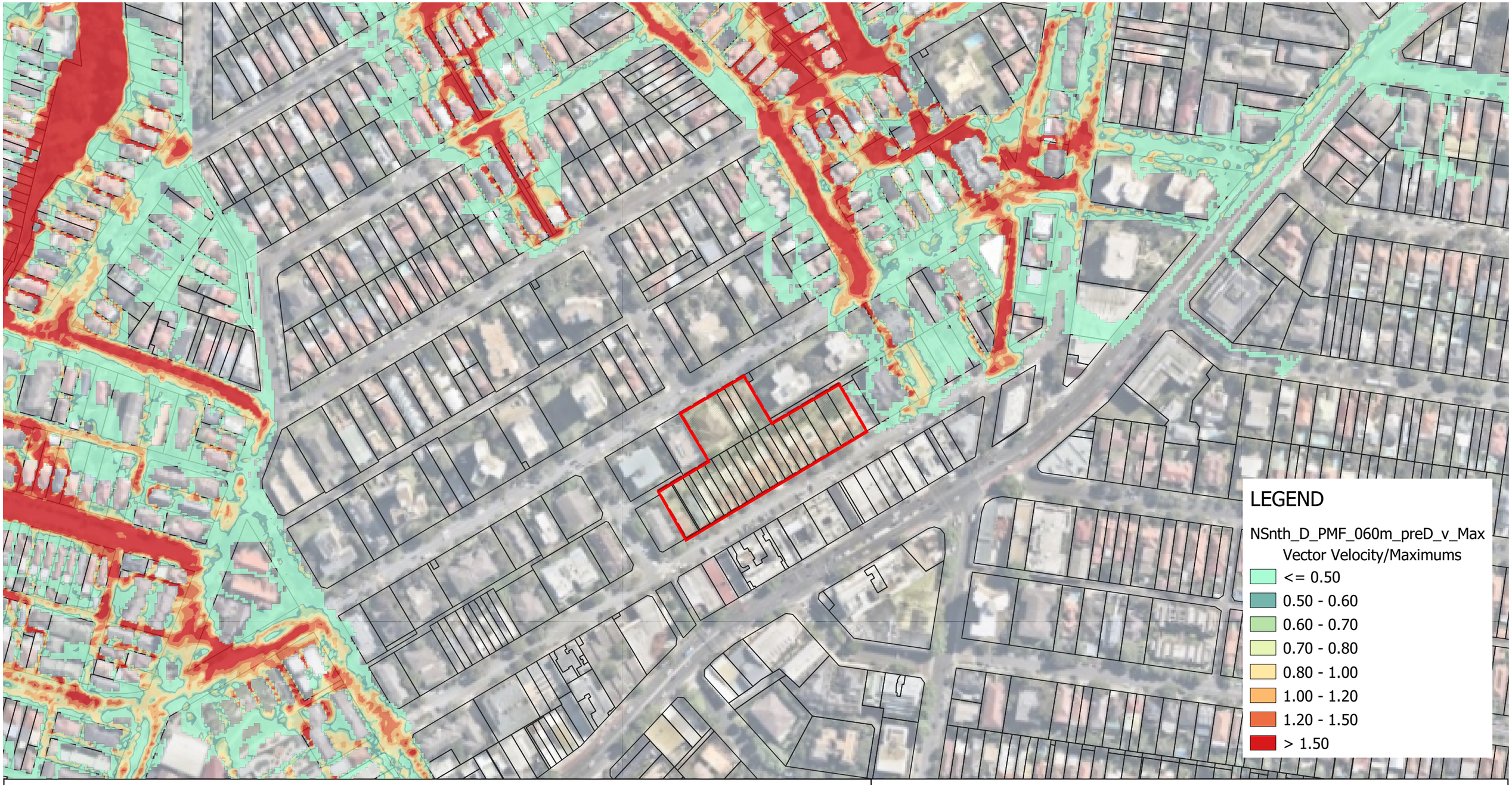

CREMORNE PATHWAYS

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CREMORNE PATHWAYS

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Pre-developed conditions - Probable Maximum Flood, 120 minutes rainfall event

Maximum depth

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CREMORNE PATHWAYS

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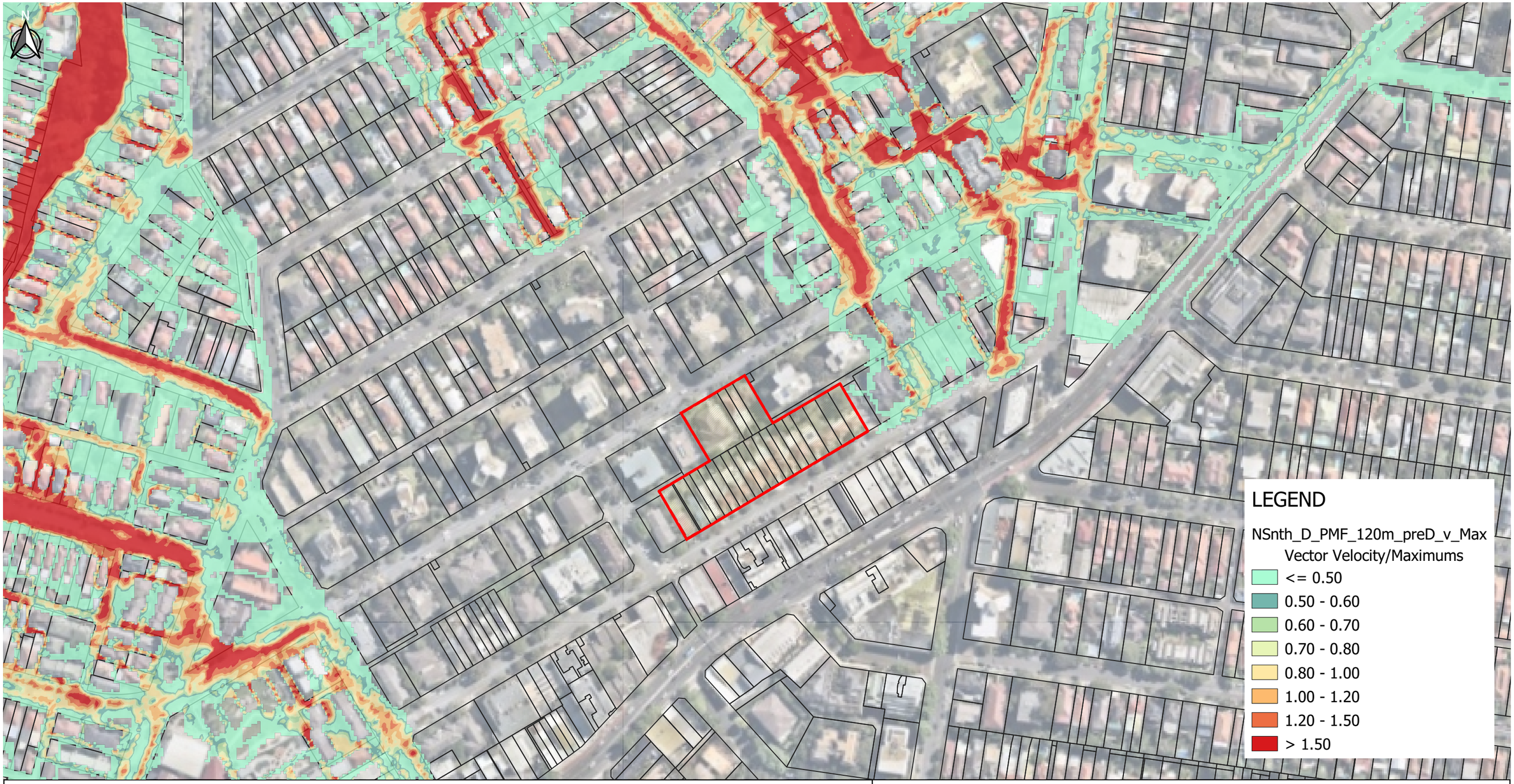

CREMORNE PATHWAYS

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CREMORNE PATHWAYS

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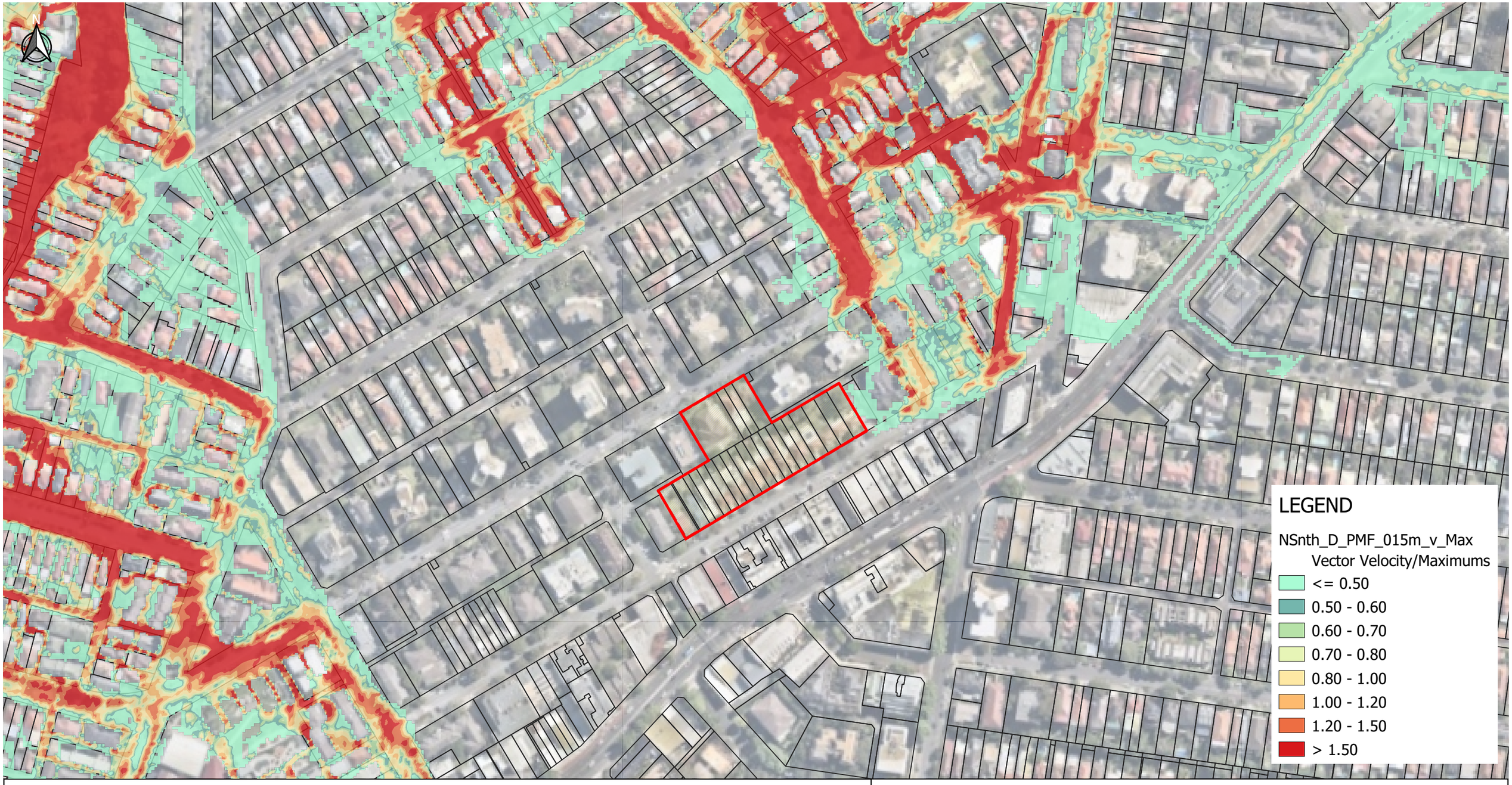
CREMORNE PATHWAYS



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CREMORNE PATHWAYS

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Post-developed conditions - Probable Maximum Flood, 1 hour rainfall event

Maximum depth

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CREMORNE PATHWAYS

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Post-developed conditions - Probable Maximum Flood, 1 hour rainfall event

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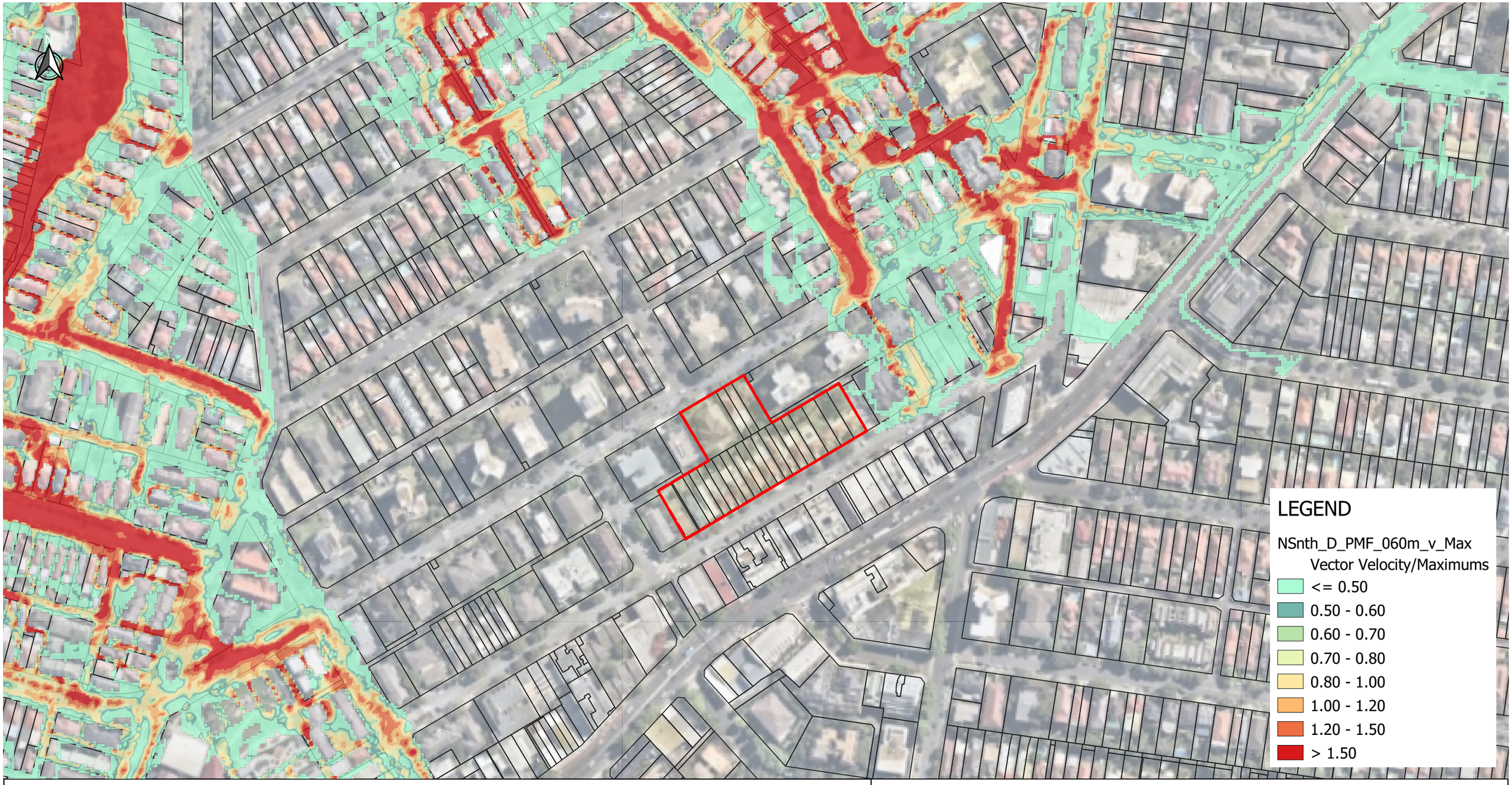
CREMORNE PATHWAYS



CREMORNE PATHWAYS

Post-developed conditions - Probable Maximum Flood, 1 hour rainfall event

Maximum velocity

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CREMORNE PATHWAYS

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CREMORNE PATHWAYS

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CREMORNE PATHWAYS

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Post-developed conditions - Probable Maximum Flood, 2 hour rainfall event

Maximum depth

DPM Results

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0 100 200 m

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CREMORNE PATHWAYS

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Post-developed conditions - Probable Maximum Flood, 2 hour rainfall event

Maximum depth

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CREMORNE PATHWAYS

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Post-developed conditions - Probable Maximum Flood, 2 hour rainfall event

Maximum velocity

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Post-developed conditions - Probable Maximum Flood, 2 hour rainfall event

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Appendix C – NSW SES Response

Our Ref: ID 2085
Your Ref: SSD-49472213

19 September 2023

Elena Sliogeris
Department of Planning & Environment
Locked Bag 5022
Parramatta NSW 2124

email: elena.sliogeris@dpie.nsw.gov.au
CC: shelly.stingmore@one.ses.nsw.gov.au

Dear Elena,

State Significant Development Application for Pathways Cremorne Seniors Housing

Thank you for the opportunity to provide comment on the State Significant Development Application for Pathways Cremorne Seniors Housing. It is understood that the proposed development seeks to:

- Construct a Residential Care Facility within a five-storey building, comprising:
  - 41 single rooms each with an ensuite
  - Kitchen, laundry, and communal facilities, including rooftop open space
- Construct 2 four-storey buildings containing Independent Living Units, comprising
  - 8 two-bedroom and 19 three-bedroom self-contained apartments
  - On-site ancillary services including café
  - Rooftop communal open space areas
- Construct an 8-storey building containing Independent Living Units, comprising
  - 9 two-bedroom, 21 three-bedroom, and 1 four-bedroom self-contained apartments
  - Rooftop communal open space areas
- Reinstatement/adaptive reuse of 9 cottages on Parraween St
- Amalgamation of multiple driveways into a single vehicular driveway on Parraween St
- Construction of a two-level basement containing 134 carparking spaces, 1 ambulance bay, 56 bicycle parking spaces, and 9 motor cycle parking spaces[1]
- Creation of a public park
- Extensive landscaping, tree replenishment and public domain works
- Site preparation including demolition, remediation, earthworks, services and utility works.

1

STATE HEADQUARTERS
93 - 99 Burelli Street, Wollongong 2500
PO Box 6126, Wollongong NSW 2500
P (02) 4251 6111
F (02) 4251 6190
www.ses.nsw.gov.au
ABN: 88 712 649 015

The NSW State Emergency Service (NSW SES) is the agency responsible for dealing with floods, storms and tsunami in NSW. This role includes, planning for, responding to and coordinating the initial recovery from floods. As such, the NSW SES has an interest in the public safety aspects of the development of flood prone land, particularly the potential for changes to land use to either exacerbate existing flood risk or create new flood risk for communities in NSW.

The NSW SES recommends that consideration of flooding issues is undertaken in accordance with the requirements of NSW Government's Flood Prone Land Policy as set out in the Flood Risk Management Manual 2023 (the Manual) and supporting guidelines, including the Support for Emergency Management Planning and relevant planning directions under the *Environmental Planning and Assessment Act, 1979*.

Key considerations relating to emergency management are detailed in Appendix A. In summary, we recommend:

- **the proponent to create a Flood Emergency Response Plan to mitigate the risks associated with isolation of the site due to flooding.**
- **further modelling for rainfall runoff for storms greater than the 1% Annual Exceedance Probability (AEP), up to and including the Probable Maximum Flood (PMF).**
- **consideration of above-ground carparking options, to reduce the risks associated with basement carparks.**

You may also find the following Guidelines, originally developed for the Hawkesbury Nepean Valley and available on the NSW SES website useful:

- Reducing Vulnerability of Buildings to Flood Damage
- Designing Safer Subdivisions
- Managing Flood Risk Through Planning Opportunities

Please feel free to contact Claire Flashman via email at rra@ses.nsw.gov.au should you wish to discuss any of the matters raised in this correspondence. The NSW SES would also be interested in receiving future correspondence regarding the outcome of this referral via this email address.

Yours sincerely

Elspeth O'Shannessy
Manager Risk Assessment Emergency Risk Management
NSW State Emergency Service

ATTACHMENT A: Principles Outlined in the Support for Emergency Management Planning Guideline[2]

Principle 1 Any proposed Emergency Management strategy should be compatible with any existing community Emergency Management strategy.

Although flood modelling indicates that the proposed site is unlikely to be directly affected by floodwater, the modelling indicates that due to floodwater overtopping Parraween Road at both ends, the site and surrounding buildings are likely to become isolated by floodwater in events as frequent as the 20% AEP flood event[3].

There is no thing as a safe period of isolation, however, the longer the period of isolation, the more chance there is for mishap requiring external intervention. Even relatively brief periods of isolation, in the order of a few hours, can lead to personal medical emergencies that have to be responded to. During flooding it is likely that there will be a reduced capacity for the relevant emergency service agency to respond in these times.

People should not drive or walk through flood water. Flood waters can include infectious diseases, sewerage, chemical hazards and contaminated material[4], electrical hazards, displaced wildlife and debris such as glass and metal that can cause injury. We recommend a Flood Emergency Response Plan is created for the proposed site, to assist in reducing risks related to flooding and isolation due to flooding. NSW SES has developed a home FloodSafe toolkit and a Business FloodSafe toolkit which can be utilised in creating a Flood Emergency Response Plan for the site.

Principle 2 Decisions should be informed by understanding the full range of risks to the community.

The Stormwater and Flood Impact Assessment Report[5] provided as an appendix to the EIS states that the proposed site is indicated to be flood free for all flood events up to and including the PMF.

The street on which the proposed site is located becomes overtopped by floodwater on both ends, which may effectively isolate the site during floods as frequent as a 20% Annual Exceedance Probability (AEP) flood.[6] The southern end of Parraween Street appears to pose a

[2] NSW Government. 2023. Principles Outlined in the Support for Emergency Management Planning Guideline
[3] North Sydney LGA-Wide FRMSP, 2022, GRC Hydro, Figure 15, page 171
[4] As mentioned in section 7.8.2 of the Environmental Impact Statement, page 109
[5] Stormwater Report, ENTEC Consultants, Section 3, page 15
[6] North Sydney Local Government Wide Flood Study – Merged Figures, 2017, WMAWater, Figure 28, page 36

greater risk to people and vehicles during flood events, as during a Probable Maximum Flood (PMF) event the southern end of Parraween Street becomes part of the floodway.[7,8]

Evacuation of hospitals and aged care can be complex and is known to be associated with an increased rate of mortality in patients and nursing facility residents.[9,10,11] The NSW 2022 Flood Inquiry Recommendation 28 highlights that sensitive uses are known to have a higher risk to life and warrant the consideration of the impacts of even rarer flood events than the 1% AEP flood extent. This includes the impacts of essential services infrastructure disruption on the proposed development, with the preference of essential services infrastructure to be situated above the flood planning level to minimise disruption and requirement to evacuate due to secondary risks.

Principle 3 Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood.

The EIS provided states that "*there are no adverse effects on downstream properties due to the development for storms up to and including the 1% AEP*".[12] We recommend further modelling for flood events up to and including the PMF, to understand any cumulative risks associated with the development on the surrounding community.

Principle 4 Decisions on redevelopment within the floodplain does not increase risk to life from flooding.

It is the preference of NSW SES that all facilities follow the application of sound land use planning and flood risk management. This includes site selection, design and stormwater management measures that minimise any risk to the community.

Basement car parks have inherent risks to life and property[13] and can often restrict safe evacuation of the occupants. This can be managed through building design, such as crest levels above a certain level (e.g. the PMF) to prevent water ingress and flooding. At least one site nearby (a couple of streets away) has required NSW SES attendance in recent years to pump

[7] North Sydney Local Government Wide Flood Study – Merged Figures, 2017, WMAWater, Figure 31, page 39
[8] North Sydney LGA-Wide FRMSP, 2022, GRC Hydro, Figure 28, page 184
[9] Terui, T., Kunii., Y., Hoshino, H., Kakamu, T., Hikada, T., Fukushima, T., Anzai, N., Gotoh, D., Miura, I., Yabe, H. 2021. Long-term observation of mortality among inpatients evacuated from psychiatric hospitals in Fukushima prefecture following the Fukushima nuclear disaster. Science Reports 11, 14651.
[10] Rojek A, Little M. Review article: evacuating hospitals in Australia: what lessons can we learn from the world literature? *Emergency Medicine Australasia.*
[11] NSW Government. 2016. Evacuation Decision Guidelines for Private Health and Residential Care Facilities
[12] Environmental Impact Statement, Section 7.15.3 Mitigation Measures, page 134
[13] Louise Collier, Dr Brett Phillips, and Martin Griffin, 'BASEMENT DEVELOPMENT IN THE FLOODPLAIN – QUANTIFYING AND MANAGING RISK', 2017.

water out of the underground carpark due to the threat to townhouses. The risk of basement flooding and the potential for pumping should be considered for the proposed site, especially as the basement is proposed to be fully tanked for the life of the building.[14] NSW SES would also like to receive further information regarding the 'pump out facility' as mentioned in the Mitigation Measures report.[15]

Principle 5 Risks faced by the itinerant population need to be managed.

Managing these risks is particularly important given the risk of people entering floodwater for visitation or staffing purposes in particular.

Principle 6 Recognise the need for effective flood warning and associated limitations.

Locations where flood height prediction is either not available at all or within a reasonable time frame or where prediction is inherently uncertain flood planning, warning and response timing is very difficult. There are many locations where the time from rainfall to flooding is less than six hours and these are termed flash flood environments. In these locations, Severe Weather Warnings are currently the most likely form of advice about the potential for flood producing storms and rainfall.

Business owners/operators must be weather aware and act early on publicly broadcast severe weather and flood warnings. The Australian Government Bureau of Meteorology has an excellent website (www.bom.gov.au) that lists all current warnings and has access to some real time data.

Principle 7 Ongoing community awareness of flooding is critical to assist effective emergency response.

[14] Mitigation Measures Report, Mitigation Measure 81, page 14
[15] Mitigation Measures Report, Mitigation Measure 82, page 14