Final Report

St Georges Basin Flood Study

59918098



Prepared for
Shoalhaven City Council

19 September 2022

Cardno

now

Stantec

Contact Information

Cardno South Coast
Trading as Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 1, 47 Burelli Street
PO Box 1285
Wollongong NSW 2500

Telephone: 02 4228 4133
Facsimile: 02 4228 6811
International: +61 2 4228 4133

southcoast@cardno.com.au
www.cardno.com.au

Document Information

Prepared for	Shoalhaven City Council
Project Name	St Georges Basin Flood Study
File Reference	59918098_R004_RevFinalv2_SGB_FloodStudy.docx
Job Reference	59918098
Date	19 September 2022
Version Number	Final v2
Effective Date	19/09/2022
Date Approved:	19/09/2022

Author(s):



Frank Guo
Water Engineer



Alireza Pouya
Flood Engineer

Approved By:



David Stone
Principal Engineer

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
A	24/09/2021	Draft for client review	FG	DW
B	05/11/2021	Final Draft	FG/DW	DW
C	25/11/2021	Updated Final Draft	FG/DW	DW
D	18/02/2022	Updated Final Draft	FG/DW	DW
Final	09/09/2022	Updated Final Draft	FG/AP	DS
Final v2	19/09/2022	Updated Final Draft	FG/AP	DS

COPYRIGHT NOTICE



This document, St. Georges Basin Flood Study 2022, is licensed under the Creative Commons Attribution 4.0 Licence, unless otherwise indicated.

Please give attribution to: *© Shoalhaven City Council 2022*

We also request that you observe and retain any notices that may accompany this material as part of the attribution.

Notice Identifying Other Material and/or Rights in this Publication:

The author of this document has taken steps to both identify third-party material and secure permission for its reproduction and reuse. However, please note that where these third-party materials are not licensed under a Creative Commons licence, or similar terms of use, you should obtain permission from the rights holder to reuse their material beyond the ways you are permitted to use them under the Copyright Act 1968. Please see the Table of References at the rear of this document for a list identifying other material and/or rights in this document.

Further Information

For further information about the copyright in this document, please contact:

Shoalhaven City Council

42 Bridge Road, Nowra 2540

council@shoalhaven.nsw.gov.au

(02) 4429 3111

DISCLAIMER

The Creative Commons Attribution 4.0 Licence contains a Disclaimer of Warranties and Limitation of Liability. In addition: ***This document (and its associated data or other collateral materials, if any, collectively referred to herein as the 'document') were produced by Consultant for Council only. The views expressed in the document are those of the author(s) alone, and do not necessarily represent the views of the Council. Reuse of this study or its associated data by anyone for any other purpose could result in error and/or loss. You should obtain professional advice before making decisions based upon the contents of this document.***

Executive Summary

Background

St Georges Basin is a coastal lagoon and is located immediately south of Jervis Bay draining to the Tasman Sea through the Sussex Inlet channel. There are a number of residential areas around the Basin, along the tributary creeks and the Sussex Inlet Channel. In the past, the land usage around the Basin has undergone significant changes, from a rural community to an urbanized community. The urban area to the north of Badgee Lagoon could historically be isolated from the surrounding areas during a 1% AEP flood without being inundated, However a gated flood free access road (FFAR) has recently been constructed to Sussex Inlet Road through the Badgee Urban Release Area. Establishing an alternative evacuation route for the Badgee urban area was a recommended action in the St Georges Basin Floodplain Risk Management Study and Plan (FRMS&P) (2013). It is also notable that Badgee Lagoon connects through the Riviera Keys canal estate to the Sussex Inlet channel.

Shoalhaven City Council engaged Cardno to assist with the preparation of the St Georges Basin Flood Study. The purpose of this Flood Study is to define flood behaviour and flood risk in the St Georges Basin catchment which will be subsequently used in the Risk Management Study and Plan to identify and recommend appropriate actions to manage flood risks in the St Georges Basin catchment. This Flood Study report details:

- Data collection and review
- Community consultation and stakeholder consultation to collect flood information
- Hydrology model setup;
- Hydraulic model setup;
- Model calibration and validation;
- Design event flood estimation;
- Flood modelling of design events, parameter sensitivity testing and climate change;
- Flood model results and mapping; and
- Flood damages, flood planning and emergency response considerations.

Study Area

The study area comprises of St Georges Basin itself, the Estuary area, Sussex Inlet and upstream residential areas along the tributary creeks. The entire catchment covers an area of approximately 358 square kilometres with approximately 10% of the catchment area covered by the Basin itself. The catchment area of the Basin contains a number of creeks including Pats Creek, Home Creek, Wandandian Creek, Tomerong/Cockrow Creek, Cow Creek, Tullarwalla Creek, Erowal Creek and Worrowing Creek. Wandandian Creek and Tomerong Creek are the largest tributaries along the Basin having catchment areas of 159.3 square kilometres and 42.8 square kilometres, respectively. The upstream end of the catchment rises to an elevation of approximately 650 mAHD and is 24 kilometres away from the Basin. The catchment starts from east of Braidwood Road and follows an easterly direction to the St Georges Basin. The Basin connects to the ocean through the Sussex Inlet Channel and there are no recorded periods of closure of the Basin's entrance.

History of Flooding

Known significant flood events in the catchment occurred in:

- March 1959;
- October 1959;
- February 1971;
- June 1991; and
- August 2015.

The largest event was the February 1971 event with peak basin levels of between 2.21 mAHD and 2.7 mAHD being reported. August 2015 was the second highest basin level at around 1.85 mAHD and the June 1991 event having similar levels of 1.7 – 1.9 m AHD reported. Flooding is known to have occurred in 1959, however, no flood levels are available. Minor storm events also occurred in:

- May 1953;
- February 1958;
- March 1961;
- March 1975;
- March and October 1976;
- February 1992;
- September 1993;
- April 1994;
- August 1998;
- June 2013;
- June 2016; and
- July and August 2020.

Data Collection and Review

All available previous flood studies and floodplain risk management study reports and associated models have been reviewed. Available rainfall, water level, ocean tide gauge data and topographic/bathymetric data have been collected along with collection of additional bathymetric and structure surveys to inform the models.

Community consultation was undertaken in the form of a questionnaire to obtain information from the community about historical flood observations and relevant stakeholder agencies have been corresponded with to obtain relevant data and flood information for use in the study.

Model Setup

A Watershed Bounded Network Model (WBNM) hydrologic model was established to represent the St Georges Basin catchment including the Basin characteristics. A TUFLOW 2-dimensional hydraulic model was setup to represent the waterways within the study area including the Basin and Sussex Inlet channel areas along with the lower reaches of the tributaries flowing into the Basin and all floodplain areas. The model consists of a 5m grid 2D domain and uses ground survey and Aerial Laser Survey data to define the topography/bathymetry of the study area and includes bridges and culverts under roads. The model extends to the ocean where suitable ocean tidal boundaries have been applied.

Model Calibration and Validation

The hydrologic and hydraulic models have been calibrated through the investigation of combinations of model parameters to ensure they provide an accurate representation of the historical flood events. The August 2015 historical flood event was chosen for calibration and February 1971 and June 2013 storm events were selected for validation. While for major events there are some good flood data from community observations around the Basin and Sussex Inlet, there is limited information available in the tributaries and there are currently only two water level gauges in operation at Island Point in the Basin and in Sussex Inlet. There are no available streamflow gauges to calibrate parameters to match the flow hydrographs in the tributaries.

For the August 2015 calibration event, the overall response of the hydrologic and hydraulic model at the two Manly Hydraulics Laboratory (MHL) water level gauges shows a good correlation with recorded data with peak water levels slightly lower than gauged (100mm lower in the Basin and 55mm lower in Sussex Inlet). A good correlation of peak levels is achieved at the surveyed flood marks and levels/depths reported by the community. The average difference between predicted and surveyed peak levels is calculated to be -0.06m and the standard deviation is 0.11m for the August 2015 storm event.

Both the hydrologic and hydraulic models in combination have been able to represent the August 2015 flood event hydraulic behaviour reasonably accurately and the models are considered to be well calibrated for use in design flood estimation.

Validation against the June 2013 event showed that the model's representation of the peak level of the June 2013 storm event is generally good and is within 100mm of Island Point gauge in the Basin and matches Sussex Inlet gauge to within approximately 10mm.

Gauge data is not available for the February 1971 event, so modelled results were only compared to surveyed peak flood marks. Overall, the comparison of observed and modelled water levels shows that using the previously calibrated parameters of the August 2015 Calibration Event, a reasonable match with the recorded data is achieved for the February 1971 event. The greatest differences occur around the foreshore of the Basin, which is likely attributed to recorded water levels being affected by wind generated setup leading to water level variations across the Basin. St Georges Basin Flood Study (WMA, 2001) mentioned local residents reported that differences in flood levels of up to 0.5m were observed across the Basin in the February 1971 flood due to the wind stress across the open water body.

The modelled February 1971 flood event levels in the current study are generally higher than previous results in St Georges Basin Flood Study (WMA, 2001). This may be attributed to, for instance, different mechanisms between 2D and 1D hydraulic model, Sussex Inlet bathymetry difference, and other survey or data differences. As such, it is considered that the current study model is more representative of the current hydraulic state of the study area.

Design Floods

The hydrologic modelling of the St Georges Basin catchment for determining design flood event flows has been undertaken using the calibrated WBNM hydrologic model in accordance with the current industry standard Australian Rainfall and Runoff 2019 (ARR2019) Guidelines. The ARR2019 Guidelines includes updated Intensity-Frequency-Duration (IFD) data, areal reduction factors (ARFs), storm loss parameters, pre-burst rainfall and has introduced ensemble modelling methods to account for the variability in rainfall temporal patterns. Data specific to the catchment has been obtained from the ARR Data Hub and Bureau of Meteorology (BoM).

The data was input to the hydrologic model to simulate a range of design events and durations to define flow inputs to the hydraulic model. The design events modelled for the Flood Study include the:

- 20% Annual Exceedance Probability (AEP) event
- 10% AEP event;
- 5% AEP event;
- 2% AEP event;
- 1% AEP event;
- 0.2% AEP event; and,
- Probable Maximum Flood (PMF).

For this study the Probable Maximum Flood event is estimated using the Probable Maximum Precipitation (PMP) and rainfall and flows have been derived for both the Generalised Short Duration Method (GSDM) for shorter storm durations relevant to the tributaries and the Generalised Southeast Australia Method (GSAM) for longer duration storms relevant to the Basin and Sussex Inlet.

The flows derived from the WBNM model are used as inflow locations in the TUFLOW hydraulic model and suitable ocean boundary conditions for each design event were established in accordance with DPE guidelines.

Flood Behaviour

Flooding within the study area may occur as a result of a combination of the following factors:

- An elevated Basin level due to intense rain over the total catchment, typically for storm events occurring over multiple days. Flooding is volume driven and the Basin level rises when the rate of inflow to the Basin is greater than the outflow to the ocean. The Sussex Inlet channel and ocean conditions can act as constriction to the rate of outflow;
- Elevated water levels within the individual creeks as a result of intense rain over the local tributary catchments. Flood levels are driven by flow rates and the capacity of the channels. The levels in the creeks may also be affected by an elevated Basin level or by constrictions along their lengths (natural or hydraulic structures such as bridges and culverts). Flood characteristics can be different in these catchments, during localised storm events;
- Overland flow in small local catchments with runoff accumulating in low points. Inadequate local drainage provisions and elevated Basin levels at the outlets of the urban drainage system may compound this problem;
- Elevated ocean levels caused by storm surge (from a low-pressure system) in combination with increased wave activity. This primarily affects the Sussex Inlet area but can also lead to elevated water levels in the Basin. Higher water levels can be observed in Sussex Inlet than in the Basin due to ocean conditions; and
- Local wind conditions generating waves and setup across the fetch of the Basin.

Summary of Results

Flooding in the catchment largely affects Sussex Inlet and the Sanctuary Point area adjacent to Tomerong Creek with flooding of only a minor number of properties in the 20% AEP. For events up to the 5% AEP, flows are largely contained within the channel banks of the Sussex Inlet channel and St Georges Basin tributaries, including Wandandian Creek and Tomerong Creek, but flood extents change dramatically when flow is out of bank in the 2% AEP event and rarer events and low-lying foreshore areas around St Georges Basin begin to be affected. The PMF affects large areas of the St Georges Basin floodplain as well as the tributaries and overland flow areas.

Compared to the previous 2001 St Georges Basin Flood Study, water levels are similar to the previous flood study results. It is observed that:

- Water level differences are within +/-50mm in Sussex Inlet and in the Basin;
- Water levels are generally 60 to 200mm higher than the previous flood study in Wandandian Creek; and
- Water level differences are generally within 20mm in Tomerong Creek.

It is also noted that different methodologies are used in these two studies, i.e. different hydrology (data and methods), hydraulics (model setup and data) and tailwater ocean conditions.

There are some localised greater differences in tributaries which can be explained due to the current study using more recent structures survey and terrain data which may be more accurate in those areas and the use of a 2-dimensional model grid means that all flowpaths follow the terrain and are not assumed or depth averaged across a cross-section as is the case with the previous flood study 1D/Quasi-2D model.

Sea Level Rise predominantly affects Sussex Inlet (up to 300mm increase in water levels) and the low lying areas around the Basin foreshore (up to 150mm). There are no impacts to flood levels in Wandandian Creek beyond the Princes Highway or Tomerong Creek beyond the Wool Road.

The study also assessed the potential impacts of both Climate Change induced rainfall increases and sea level rise using current recommended ARR2019 values based on global climate modelling. With rainfall increases of 16.3% due to Climate Change, associated increased flows may result in typically up to 300mm increases in flood levels in the Basin and tributaries and up to 450mm in Wandandian Creek. In combination with Sea Level Rise a further 100mm (400mm total) increase in water levels may be expected around Basin foreshore areas and up to 400mm total water level increases in Sussex Inlet.

Conclusion

The WBNM hydrologic model and TUFLOW hydraulic model have been setup and successfully calibrated, with a combined calibration/validation to three historical events. As such, the models can be used with confidence in assessing design flood behaviour. Design flood estimates have been validated against a Flood Frequency Analysis of observed annual peak St Georges Basin flood levels to provide confidence in the modelled design event Basin level estimates.

The study uses the current industry standard methods and guidelines in flood estimation using Australian Rainfall and Runoff 2019 and a series of NSW Department of Planning & Environment (DPE) floodplain management guidelines to define flood behaviour in the St Georges Basin area for a range of representative design flood events.

The 1% AEP design flood levels in the current Flood Study are similar to those derived from the previous 2001 flood study modelling that Council has adopted. Differences are explained by the use of updated data and ARR2019 methods in the current study along with differences in model setup and more up-to-date survey and catchment conditions.

The models have been run for the 20%, 10%, 5%, 2%, 1%, 0.2% AEP storms and Probable Maximum Flood (PMF) event for the existing, Projected 2050 and Projected 2100 scenarios and flood levels, depths and velocities mapped. Provisional hazard, hazard, hydraulic categories and combined hazard and hydraulic categories have also been mapped.

Assessment of the impacts of rainfall increases and sea level rise due to climate change was undertaken along with assessment of tidal inundation and sensitivity to various model parameters.

The report also provides guidance on the adoption of Flood Planning Levels and Emergency Response parameters for use in planning and by the NSW SES.

The study will be used by Council and various stakeholders to inform flood planning and emergency management in the Study Area. The outputs of the Flood Study will provide information on current and future flood risk which is important for increasing community awareness and for building resilience.

Table of Contents

Executive Summary iii
Table of Contents viii
Appendices xii
Tables xii
Figures xiv
Abbreviations xvi
Glossary xvii
1 Introduction 1
1.1 Study Context 1
1.2 Objectives 1
2 Study Area 2
2.1 Study Area Overview 2
2.2 Catchment Description 2
2.3 Description of Flood Behaviour 2
3 Review of Available Data 4
3.1 Previous Reports and Studies 4
3.2 Review of Policies and Planning 7
3.3 Survey Information 7
3.3.1 Terrain 7
3.3.2 Sussex Inlet Entrance Dredge Survey 8
3.3.3 Sussex Inlet bathymetry survey 8
3.3.4 St Georges Basin Bathymetry Data 8
3.3.5 Cross-section data from Previous Studies 9
3.3.6 Culverts and Bridges 9
3.3.7 GIS Data 9
3.4 Historical Data 12
3.4.1 Historical Flood Data 12
3.4.2 Flood Photographs 14
3.4.3 Historical Rainfall Data 14
3.4.4 Historical Flow Data 16
3.4.5 Water Level Data 16
4 Community Consultation 19
4.1 Consultation Process 19
4.2 Project Website 20
4.3 Community Newsletter and Questionnaire 21
4.3.2 Demographic Information 22
4.3.3 Community Flood Experiences 22
4.3.4 Community Preferred Flood Mitigation Options 23

5 Hydrology 25
5.1.1 Model Selection 25
5.1.2 Catchments delineation 25
5.1.3 Impervious fraction calculation 25
5.1.4 Routing of Flows 28
5.1.5 Lag Parameter 28
5.1.6 Initial and Continuing Rainfall Losses 28
5.1.7 Adopted WBNM Parameters 28
5.1.8 Hydrologic Model Calibration 29
6 Hydraulics 30
6.1.1 Model Selection 30
6.1.2 General Model Setup 30
6.1.3 Model Geometry and 1D/2D Extents 30
6.1.4 Boundary Conditions 33
6.1.5 Materials Mapping and Roughness 33
6.1.6 Structures and Blockage 36
6.1.7 Wind Wave Setup 36
7 Calibration and Validation 37
7.1 Methodology 37
7.1.1 Entrance and Sussex Inlet Channel 37
7.1.2 Culvert and Bridge Blockage Assumptions 37
7.1.3 Model Parameters 37
7.2 August 2015 Storm Event 38
7.2.1 Description 38
7.2.2 Rainfall 38
7.2.3 Entrance and Sussex Inlet Channel 38
7.2.4 Water Level Gauges & Downstream Boundary Levels 38
7.2.5 Comparison to Recorded MHL Gauge Levels 42
7.2.6 Comparison to Surveyed Flood Marks 42
7.2.7 Comparison to Community Consultation Flood Depth 42
7.2.8 Time of inundation 43
7.2.9 Model Parameter Sensitivity 49
7.2.10 Conclusion 50
7.3 June 2013 Storm Event 56
7.3.1 Description 56
7.3.2 Rainfall 56
7.3.3 Water Level Gauges & Downstream Boundary Levels 56
7.3.4 Entrance and Sussex Inlet Channel Topography 60
7.3.5 Comparison to Recorded MHL Gauge Levels 62
7.3.6 Comparison to Community Consultation Flood Depth 62

7.3.7 Time of Inundation 62
7.3.8 Conclusion and Discussion 63
7.4 Feb 1971 Storm Event 68
7.4.1 Description 68
7.4.2 Rainfall 68
7.4.3 Water Level Gauge & Downstream Boundary Levels 71
7.4.4 Entrance and Sussex Inlet Channel Topography 71
7.4.5 Comparison to Recorded Levels 71
7.4.6 Comparison with 2001 Flood Study model 71
7.4.7 Time of inundation 72
7.4.8 Conclusion and Discussion 72
8 Hydrology – Design Flood Estimation 75
8.1 Hydrology – ARR2019 Update 75
8.1.1 Intensity-Frequency-Duration Data 75
8.1.2 Temporal Pattern Data 75
8.1.3 Areal Reduction Factors (ARFs) 76
8.1.4 Pre-burst rainfall 76
8.1.5 Losses 76
8.2 Probable Maximum Flood Estimation 77
8.3 Design Event Modelling 77
8.3.1 Critical Duration 77
8.3.2 Design Event Flows 77
8.4 ARR87 Design flood estimation 80
8.4.1 Design Input Parameters 80
8.4.2 ARR87 flows 80
8.5 Parameter Sensitivity Analysis 82
8.5.1 ARR2019 Temporal Patterns 82
8.5.2 Continuing Loss 82
9 Model Scenarios 83
9.1 Design Events and Durations 83
9.2 Tailwater Conditions 83
9.3 Basin Initial Water Levels 84
9.4 Sea Level Rise Scenarios 84
9.5 Tidal Inundation 85
9.6 Parameter Sensitivity Analysis 85
9.7 Climate Change Sensitivity 86
9.7.1 Rainfall Increase 86
9.7.2 Sea Level Rise 86
9.7.3 Climate Change Scenarios 86
9.8 Wind Wave Setup Assessment 87

10 Results **89**
10.1 Peak Flood Levels, Extents and Depths 89
10.2 Comparison with Previous Flood Study Results 93
10.3 Flow Velocities 95
10.4 Hazard and Hydraulic Categories 95
10.4.1 Flood Hazard 95
10.4.2 Hydraulic Categories 97
10.5 Combined Hazard and Hydraulic Category 98
10.6 Tidal Inundation 99
10.7 Parameter Sensitivity Analysis 99
10.7.1 Hydrology Parameter Sensitivity 100
10.7.2 Mannings Roughness 101
10.7.3 Tailwater Level and Inlet Bathymetry 101
10.7.4 Blockage 102
10.7.5 ARR87 IFD and Temporal Patterns 105
10.8 Climate Change Scenarios 106
10.8.1 Increased Rainfall 106
10.8.2 Increased Rainfall and SLR Scenarios 106
10.9 Validation of design event results 111
10.10 Wind Wave Climate 112
11 Impacts of Flooding on the Community **113**
11.1 Impacts of Flooding 113
11.1.2 Sussex Inlet 113
11.1.3 Sanctuary Point 113
11.1.4 Worrowing Heights, Erowal Bay and Old Erowal Bay 114
11.1.5 Basin Foreshore areas 114
11.1.6 Wandandian and Bewong 114
11.2 Flood Intelligence 114
11.3 Flood Planning Area 114
11.4 Flood Damages 115
11.4.2 Input Data 116
11.4.3 Damage Analysis Methodology 117
11.4.4 Adopted Damages Curves 119
11.4.5 Total Damages 120
11.4.6 Average Annual Damage 123
11.5 Flood Emergency Response Classification of the Floodplain 123
11.6 Impacts of development in the floodplain 125
12 Conclusion **126**
12.1 Next Stage in Floodplain Risk Management Process 126
13 References **127**

Appendices

Appendix A Structures Survey Plans
Appendix B Community Questionnaire
Appendix C Responses to Community Questionnaire
Appendix D WBNM Catchments Details
Appendix E Calibration Events Peak Levels Comparison
Appendix F ARR IFD and Data Hub Record
Appendix G Design Event Flood Maps
Appendix H Sensitivity Flood Maps
Appendix I Flood Planning Area
Appendix J Flood Emergency Response Classification
Appendix K Wind Wave Climate Assessment

Tables

Table 3-1 Summary of Previous Studies and Report 4
Table 3-2 DEM Source Review 8
Table 3-3 Historical Storm Events 12
Table 3-4 Ranking of Historical Events 13
Table 3-5 Recorded Levels of Recent Flooding at the St Georges Basin 13
Table 3-6 Rain Gauges in the St Georges Basin Area 14
Table 3-7 Rain Gauge Comparison of June 2013 Event (21/6/2013 to 30/6/2013) 15
Table 3-8 Rain Gauge Comparison of August 2015 Event (22/8/2015 to 30/08/2015) 15
Table 3-9 Rain Gauge Comparison of June 2016 Event (30/5/2016 to 5/6/2016) 15
Table 3-10 Rain Gauge Comparison of February 1971 Event (01/02/1971 – 07/02/1971) 16
Table 3-11 Water Level gauges near the St Georges Basin area 16
Table 4-1 Consultation Plan 19
Table 5-1 Impervious Fraction and Land Use 25
Table 5-2 Adopted WBNM Parameters 29
Table 6-1 Adopted roughness values in the existing case 33
Table 7-1 Adopted WBNM Parameters 37
Table 7-2 Adopted Manning’s n 38
Table 7-3 Summary of the Difference between Modelled and Surveyed Flood Level 42
Table 7-4 Calibration to information received for the 2015 Event through Community Consultation 43
Table 7-5 Check C sensitivity value in WBNM using IL of 5mm and CL of 1.6mm/hr 49
Table 7-6 Check IL in WBNM using C of 1.6 and CL of 1.6mm/hr 49
Table 7-7 Check CL in WBNM using C of 1.6 and IL of 15mm 49
Table 7-8 Calibration to Information received for the 2013 Event through Community Consultation 62

Table 7-9 February 1971 Event Results - comparison with 2001 Flood Study results 72
Table 7-10 Summary of the Difference between Predicted and Surveyed Flood Level – February 1971 Event 72
Table 8-1 Design event flows and critical duration from WBNM Hydrology Model at Key Locations 79
Table 8-2 ARR87 Peak 1% AEP flows at various locations 81
Table 8-3 IFD Comparison - ARR2019 rainfall change from ARR87 rainfall 81
Table 9-1 Design events and durations 83
Table 9-2 Combinations of Catchment Flooding and Oceanic Inundation Scenarios (source: Table 8.1 OEH, 2015) 83
Table 9-3 Hydraulic Model Tailwater Levels for Design Events 84
Table 9-4 Sea Level Rise scenarios for Design Events 84
Table 9-5 Sensitivity Analysis Scenarios 85
Table 9-6 ARR Data Hub recommended Climate Change Data 86
Table 9-7 Climate Change Scenarios 87
Table 10-1 Peak flood level at reference locations for design events – Existing Scenario 91
Table 10-2 Peak flood level at reference locations for design events – Projected 2050 scenario 92
Table 10-3 Peak flood level at reference locations for design events – Projected 2100 scenario 93
Table 10-4 Comparison to previous flood study – 1% AEP water level difference 94
Table 10-5 Comparison with previous study - projected 2050 and projected 2100 flood levels 95
Table 10-6 Peak water level due to tidal inundation (HAT) 99
Table 10-7 Hydrology Parameter Sensitivity – 1% AEP (48 hour duration) water level difference 100
Table 10-8 Sensitivity Analysis – water level difference at reference locations 103
Table 10-9 Sensitivity Analysis – ARR87 water level difference at reference locations 105
Table 10-10 Climate Change – 5% AEP Rainfall Increase (Existing sea level) water level difference 107
Table 10-11 Climate Change – 1% AEP Rainfall Increase (Existing sea level) water level difference 108
Table 10-12 Climate Change – 5% AEP Rainfall Increase + SLR water level difference 109
Table 10-13 Climate Change – 1% AEP Rainfall Increase + SLR water level difference 110
Table 10-14 Calculated wind setup and wave runup 112
Table 11-1 Flood affected properties by location 113
Table 11-2 Flood intelligence summary information 114
Table 11-3 Types of Flood Damages 115
Table 11-4 Average Weekly Earnings (AWE) Statistics for Residential Damage Curves 118
Table 11-5 CPI Statistics for Commercial Damage Curves 118
Table 11-6 CPI Statistics for Industrial Damage Curves 119
Table 11-7 Flood Damages Assessment Summary 122
Table 11-8 Flood Emergency Response Classification (source ADR guideline 7-2) 124

Figures

Figure 2-1 St Georges Basin Study Area 3
Figure 3-1 Surveyed Structures Reference Location 10
Figure 3-2 Structures from Council GIS Layer and Previous Studies 11
Figure 3-3 Rain Gauge Station Reference Location 17
Figure 3-4 Water Level Gauge Reference Location (MHL) 18
Figure 4-1 Locations of Community Responses 21
Figure 4-2 Residence Time within Catchment 22
Figure 4-3 Areas Impacted by Flooding 22
Figure 4-4 Actions taken against flood damage 23
Figure 4-5 Flood risks in the catchment 23
Figure 4-6 Future flooding expectations 23
Figure 4-7 Actions required to reduce future flood risk 24
Figure 5-1 Sub-Catchment Delineation 27
Figure 6-1 Topographic Data Extents 31
Figure 6-2 Hydraulic Model Extents 32
Figure 6-3 Inflow and Tailwater Locations 34
Figure 6-4 St Georges Basin Hydraulic Model Roughness Mapping 35
Figure 7-1 Rainfall Isohyet - 2015 event 48 Hours (24/08 – 25/08) Total Rainfall (mm) 39
Figure 7-2 August 2015 Daily Rainfall Totals 39
Figure 7-3 August 2015 Temporal Patterns – Nowra Ran Air Station AWS Pluviometer 40
Figure 7-4 August 2015 Water Level Data (MHL) 41
Figure 7-5 Modelled Flood Levels and Recorded MHL Gauge Levels at Sussex Inlet, 2015 Event 44
Figure 7-6 Modelled Flood Levels and Recorded MHL Gauge Levels at Island Point, 2015 Event 45
Figure 7-7 August 2015 Council Surveyed Flood vs Modelled Level Comparison 46
Figure 7-8 Community Consultation Response Location, 2015 Storm 47
Figure 7-9 Time of inundation, 2015 Storm 48
Figure 7-10 Sensitivity Test for lag parameter (C value) in WBNM at Island Point for the 2015 storm event 51
Figure 7-11 Sensitivity Test for Initial Loss (IL) in WBNM at Island Point for the 2015 storm event 52
Figure 7-12 Sensitivity Test for Continuing Loss (CL) in WBNM at Island Point for the 2015 storm event 53
Figure 7-13 Sensitivity Test for Continuing Loss (CL) in TUFLOW at Island Point for the 2015 storm event 54
Figure 7-14 Sensitivity Test for Continuing Loss (CL) in TUFLOW at Sussex Inlet for the 2015 storm event 55
Figure 7-15 Rainfall Isohyet – 2013 Event 72 Hours (23/06 – 25/06) Total Rainfall (mm) 57
Figure 7-16 June 2013 Daily Rainfall Totals 57
Figure 7-17 June 2013 Temporal Patterns – Point Perpendicular AWS & Nowra RAN Air Station AWS 58
Figure 7-18 June 2013 Water Level Data (MHL) 59
Figure 7-19 Location of the Assumed Berm for Entrance Sensitivity Scenarios 61
Figure 7-20 Entrance Bathymetry Sensitivity Results for 2013 Storm 62
Figure 7-21 Modelled Flood Levels and Recorded MHL Gauge Levels at Sussex Inlet, 2013 Event 64
Figure 7-22 Modelled Flood Levels and Recorded MHL Gauge Levels at Island Point, 2013 Event 65

Figure 7-23 Community Consultation Response Locations, 2013 Storm 66
Figure 7-24 Time of Inundation, 2013 Storm Event 67
Figure 7-25 Rainfall Isohyet – February 1971 event 48 Hours (06/02 – 07/02) Total Rainfall(mm) 68
Figure 7-26 February 1971 Daily Rainfall Totals 69
Figure 7-27 February 1971 Temporal Patterns – Nowra Ran Air Station AWS & Sassafras Ettrema Pluviometer 70
Figure 7-28 February 1971 Water Level Data (source: St Georges Basin Flood Study, 2001) 71
Figure 7-29 Council February 1971 Flood vs Modelled Level Comparison 73
Figure 7-30 Time of inundation, February 1971 Storm Event 74
Figure 8-1 IFD location 75
Figure 8-2 Bins for temporal patterns versus AEP (source: ARR Figure 2.5.12) 76
Figure 8-3 Key Flow Locations 78
Figure 8-4 ARR87 Intensity-Frequency-Duration Rainfall Depths (mm) (St Georges Basin Flood Study WMA, 2001) 80
Figure 8-5 Basin Water levels for 1% AEP 48 hr temporal patterns from WBNM hydrologic model 82
Figure 9-1 Schematic Representation of Wave Runup (WMA, 2001) 88
Figure 10-1 Key Locations 90
Figure 10-2 Provisional Hazard Categories from Appendix L of the Floodplain Development Manual 96
Figure 10-3 Hazard Categories from ARR 2019 97
Figure 10-4 Modified Sussex Inlet entrance bathymetry cross-section 101
Figure 10-5 Comparison of flood model results with Basin historical event stage frequency analysis 111
Figure 11-1 Residential Damage Curves 119
Figure 11-2 Low Value Industrial and Low Value Commercial Damage Curves 120
Figure 11-3 Total Damage Curve (Existing Condition) for St Georges Basin 121

Abbreviations

AEP	Annual Exceedance Probability
ALS	Aerial Laser Survey
ARF	Areal Reduction Factor
ARI	Average Recurrence Interval
ARR87	Australian Rainfall and Runoff 1987 edition
ARR2019	Australian Rainfall and Runoff 2019 edition
BoM	Bureau of Meteorology
DCP	Development Control Plan
DECCW	NSW Department of Land and Water Conservation (now DPE)
DPE	NSW Department of Planning & Environment
FDM	Floodplain Development Manual
FFA	Flood Frequency Analysis
FPL	Flood Planning Level
FRMC	Floodplain Risk Management Committee
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
GIS	Geographic Information System
ha	Hectare
IFD	Intensity Frequency Duration
km	Kilometres
km^2	Square kilometres
LEP	Local Environment Plan
LiDAR	Light Detection and Ranging aerial survey
LGA	Local Government Area
m	Metre
m^2	Square metre
m^3	Cubic metre
m^3/s	Cubic metres per second (flow)
mAHD	Metres to Australian Height Datum
mm	Millimetre
m/s	Metres per second (velocity)
NSW	New South Wales
OEH	NSW Office of Environment & Heritage (now DPE)
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
SES	State Emergency Service
SCC	Shoalhaven City Council

Glossary

Annual Exceedance Probability (AEP)	Refers to the probability or risk of a flood of a given size occurring or being exceeded in any given year. A 90% AEP flood has a high probability of occurring or being exceeded each year; it would occur quite often and would be relatively small. A 1%AEP flood has a low probability of occurrence or being exceeded each year; it would be fairly rare but it would be relatively large.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average Recurrence Interval (ARI)	The average or expected value of the periods between exceedances of a given rainfall total accumulated over a given duration. It is implicit in this definition that periods between exceedances are generally random
Cadastre, cadastral base	Information in map or digital form showing the extent and usage of land, including streets, lot boundaries, water courses etc.
Catchment	The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Creek Rehabilitation	Rehabilitating the natural 'biophysical' (i.e. geomorphic and ecological) functions of the creek.
Design flood	A significant event to be considered in the design process; various works within the floodplain may have different design events. E.g. some roads may be designed to have a 1% AEP flood immunity while other roads may be designed to be overtopped in the 20 year ARI or 5% AEP flood event.
Development	The erection of a building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land.
Discharge	The rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving.
Flash flooding	Flooding which is sudden and often unexpected because it is caused by sudden local heavy rainfall or rainfall in another area. Often defined as flooding which occurs within 6 hours of the rain which causes it.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from super elevated sea levels and/or waves overtopping coastline defences.
Flood fringe	The remaining area of flood-prone land after floodway and flood storage areas have been defined.
Flood hazard	Potential risk to life and limb caused by flooding.
Flood-prone land	Land susceptible to inundation by the probable maximum flood (PMF) event, i.e. the maximum extent of flood liable land. Floodplain Risk Management Plans encompass all flood-prone land, rather than being restricted to land subject to designated flood events.
Floodplain	Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.

Floodplain management measures	The full range of techniques available to floodplain managers.
Floodplain management options	The measures which might be feasible for the management of a particular area.
Flood planning area	The area of land below the flood planning level and thus subject to flood related development controls.
Flood planning levels (FPLs)	Flood levels selected for planning purposes, as determined in floodplain management studies and incorporated in floodplain management plans. Selection should be based on an understanding of the full range of flood behaviour and the associated flood risk. It should also take into account the social, economic and ecological consequences associated with floods of different severities. Different FPLs may be appropriate for different categories of land use and for different flood plains. As FPLs do not necessarily extend to the limits of flood prone land (as defined by the probable maximum flood), floodplain management plans may apply to flood prone land beyond the defined FPLs.
Flood storages	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.
Floodway areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often, but not always, aligned with naturally defined channels. Floodways are areas which, even if only partially blocked, would cause a significant redistribution of flood flow, or significant increase in flood levels. Floodways are often, but not necessarily, areas of deeper flow or areas where higher velocities occur. As for flood storage areas, the extent and behaviour of floodways may change with flood severity. Areas that are benign for small floods may cater for much greater and more hazardous flows during larger floods. Hence, it is necessary to investigate a range of flood sizes before adopting a design flood event to define floodway areas.
Geographical Information Systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
High hazard	Flood conditions that pose a possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty wading to safety; potential for significant structural damage to buildings.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydrograph	A graph that shows how the discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Low hazard	Flood conditions such that should it be necessary, people and their possessions could be evacuated by trucks; able-bodied adults would have little difficulty wading to safety.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of the principal watercourses in a catchment. Mainstream flooding generally excludes watercourses constructed with pipes or artificial channels considered as stormwater channels.

Management plan	A document including, as appropriate, both written and diagrammatic information describing how a particular area of land is to be used and managed to achieve defined objectives. It may also include description and discussion of various issues, special features and values of the area, the specific management measures which are to apply and the means and timing by which the plan will be implemented.
Mathematical/computer models	The mathematical representation of the physical processes involved in runoff and stream flow. These models are often run on computers due to the complexity of the mathematical relationships. In this report, the models referred to are mainly involved with rainfall, runoff, pipe and overland stream flow.
Overland Flow	The flow of water over the ground surface either along formal flowpaths such as roads and formed channels, or informal flowpaths along topographic low points and through properties and open space areas. The term overland flow is used interchangeably in this report with “flooding”.
Peak discharge	The maximum discharge occurring during a flood event.
Probable Maximum Flood (PMF)	The flood calculated to be the maximum that is likely to occur.
Probability	A statistical measure of the expected frequency or occurrence of flooding. For a fuller explanation see Annual Exceedance Probability.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.
Stage	Equivalent to 'water level'. Both are measured with reference to a specified datum.
Stage hydrograph	A graph that shows how the water level changes with time. It must be referenced to a particular location and datum.
Stormwater flooding	Inundation by local runoff. Stormwater flooding can be caused by local runoff exceeding the capacity of an urban stormwater drainage system or by the backwater effects of mainstream flooding causing the urban stormwater drainage system to overflow.
Topography	A surface which defines the ground level of a chosen area.
TUFLOW	One-dimensional (1D) and two-dimensional (2D) flood and tide simulation software (hydraulic model)
WBNM	Watershed Bounded Network Model – hydrologic runoff routing computer model

* Terminology in this Glossary have been derived or adapted from the NSW Government Floodplain Development Manual, 2005, where available.

1 Introduction

Shoalhaven City Council has engaged Cardno to assist with the preparation of the St Georges Basin Flood Study. The purpose of this Flood Study is to define flood behaviour and flood risk in the St Georges Basin catchment which will be subsequently used in the Risk Management Study and Plan to identify and recommend appropriate actions to manage flood risks in the St Georges Basin catchment. This Flood Study report details:

- Hydrology model setup;
- Hydraulic model setup;
- Model calibration and validation;
- Design event flood estimation;
- Flood modelling of design events, sensitivity testing and climate change;
- Flood model results and mapping; and
- Flood damages, flood planning and emergency response considerations.

1.1 Study Context

The Floodplain Management process progresses through 6 stages in an iterative process:

- Stage 1 - Formation of a Floodplain Management Committee;
- Stage 2 - Data Collection;
- Stage 3 - Flood Study;
- Stage 4 - Floodplain Risk Management Study (FRMS);
- Stage 5 - Floodplain Risk Management Plan (FRMP); and
- Stage 6 - Implementation of the Floodplain Risk Management Plan.

This project covers Stages 2 to 5 of the process. This Flood Study report addresses Stage 2 and Stage 3 of the Floodplain Management process.

1.2 Objectives

The objectives of Flood Study are to:

- Collate and review available flood information for the catchment;
- Develop updated hydrologic and hydraulic models using recent information and software, calibrated and validated to historical events;
- Derive design flood event flows, water levels and other hydraulic parameters through hydraulic modelling;
- Define and document flood risk in the catchment including mapping; and
- Determine impacts of flooding on the community, flood planning levels, flood damages and emergency response considerations.

The completed Flood Study will form the basis of the FRMS&P, which will include identification and analysis of flood risk and the floodplain risk management options assessment.

2 Study Area

2.1 Study Area Overview

St Georges Basin is a coastal lagoon and is located immediately south of Jervis Bay draining to the Tasman Sea through the Sussex Inlet channel. There are a number of residential areas around the Basin, along the tributary creeks and the Sussex Inlet Channel, which are listed later. In the past, the land usage around the Basin has undergone significant changes, from a rural community to an urbanized community. The urban area to the north of Badgee Lagoon could historically be isolated from the surrounding areas during a 1% AEP flood without being inundated. However a gated flood free access road (FFAR) has recently been constructed to Sussex Inlet Road through the Badgee Urban Release Area. Establishing an alternative evacuation route for the Badgee urban area was a recommended action in the St Georges Basin FRMS&P (2013). It is also notable that Badgee Lagoon connects through the Riviera Keys canal estate to the Sussex Inlet channel. Study area boundary is shown in **Figure 2-1.**

2.2 Catchment Description

The study area comprises of St Georges Basin itself, the Estuary area, Sussex Inlet and upstream residential areas along the tributary creeks. The entire catchment covers an area of approximately 358 square kilometres with approximately 10% of the catchment area covered by the Basin itself. The catchment area of the Basin contains a number of creeks including Pats Creek, Home Creek, Wandandian Creek, Tomerong/Cockrow Creek, Cow Creek, Tullarwalla Creek and Worrowing Creek. Wandandian Creek and Tomerong Creek are the largest tributaries along the Basin having catchment areas of 159.3 square kilometres and 42.8 square kilometres, respectively. The upstream end of the catchment rises to an elevation of approximately 650 mAHD and is 24 kilometres away from the Basin. The catchment starts from east of Braidwood Road and follows an easterly direction to the St Georges Basin. The Basin connects to the ocean through the Sussex Inlet Channel and there are no recorded periods of closure of the Basin's entrance.

2.3 Description of Flood Behaviour

Flooding within the study area may occur as a result of a combination of the following factors:

- An elevated Basin level due to intense rain over the total catchment, typically for storm events occurring over multiple days. Flooding is volume driven and the Basin level rises when the rate of inflow to the Basin is greater than the outflow to the ocean. The Sussex Inlet channel and ocean conditions can act as constriction to the rate of outflow;
- Elevated water levels within the individual creeks as a result of intense rain over the local tributary catchments. Flood levels are driven by flow rates and the capacity of the channels. The levels in the creeks may also be affected by an elevated Basin level or by constrictions along their lengths (natural or hydraulic structures such as bridges and culverts). Flood characteristics can be different in these catchments, during localised storm events;
- Overland flow in small local catchments with runoff accumulating in low points. Inadequate local drainage provisions and elevated Basin levels at the outlets of the urban drainage system may compound this problem;
- Elevated ocean levels caused by storm surge (from a low-pressure system) in combination with increased wave activity. This primarily affects the Sussex Inlet area but can also lead to elevated water levels in the Basin. Higher water levels can be observed in Sussex Inlet than in the Basin due to ocean conditions; and
- Local wind conditions generating waves and setup across the fetch of the Basin.

As reported in the St Georges Basin Floodplain Risk Management Study (WMA, 2006), some local residents had reported during the flood study process that during the 1971 flood, levels at the eastern end of the Basin were 0.5m higher than at the western end due to the effects of wind stress across the fetch of the water body.

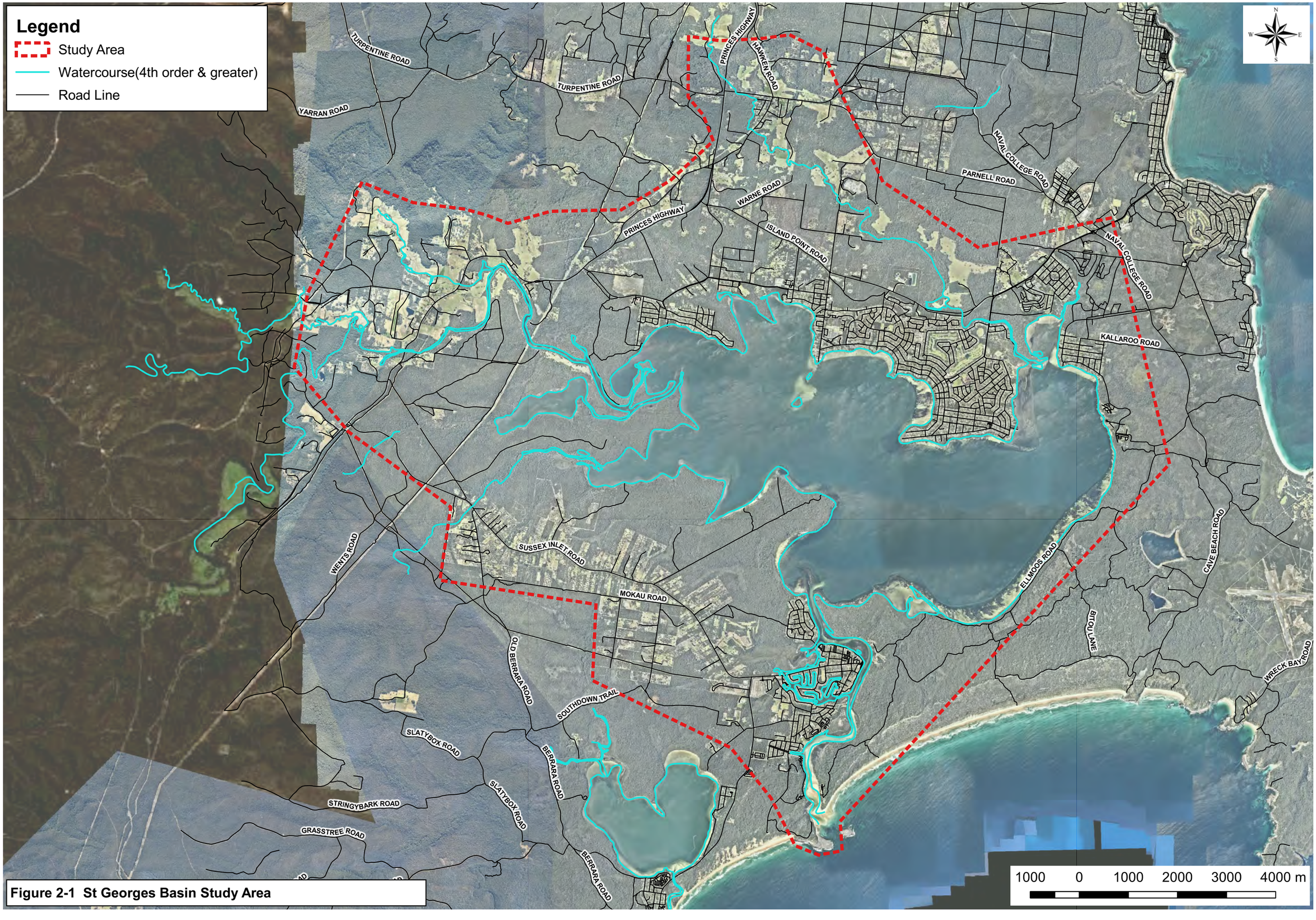


Figure 2-1 St Georges Basin Study Area

3 Review of Available Data

3.1 Previous Reports and Studies

A number of previous studies have been conducted within and around the study area. These studies have been reviewed as part of this study and relevant information incorporated. Previous studies are summarised in **Table 3-1.**

Table 3-1 Summary of Previous Studies and Report

Study / Report	Description	Implications for St Georges Basin Study
St Georges Basin Flood Study (Webb, McKeown & Associates, 2001)	The flood study for the region was undertaken in 1992 using the early version of WBNM hydrologic model. The hydrologic model was not able to be calibrated to historical events due to lack of flow gauging data. Only one gauge location (centroid of the catchment) was adopted in the design storm simulation. The hydraulic model was built based on a quasi-two-dimensional RUBICON model. The RUBICON model was not configured to define velocity around the Basin over bank areas. In addition to that, Tomerong Creek catchment was not included in the hydraulic model domain. The models were calibrated to an event in June 1991 (~10% AEP), with some verification provided by the floods of February 1971 (larger than 1% AEP) and February 1992 (~50% AEP). Results were provided at various locations around the basin for the 5%, 2%, 1% AEP and Extreme (estimated as three times the 1% AEP flow) events. It is noted that these results are representative of the volumetric ("still") water levels. The accuracy of the modelled water levels were considered up to ± 0.5m.	This study established hydrologic and hydraulic models for the St Georges Basin which were further refined in the Flood Risk Management Study (2006). The study provides overall catchments extents, initial hydrologic model parameters for the current model as a starting point. The hydraulic model results have a reasonable indication of the possible flood extents and critical storm durations to assist the current 2D hydraulic model establishment. The study also has creek channel survey data, which can potentially be used in the current study. The study is referred as St Georges Basin Flood Study, 2001 in the following sections of this report.
St Georges Basin Floodplain Risk Management Study & Plan (Webb, McKeown & Associates Pty Ltd, 2006)	The primary objectives of the Study were to define the nature and extent of the hazard; to identify, assess and optimise measures aimed at reducing the impact of flooding on both existing and future development. Examples of mitigation measures proposed include: ▪ Local drainage improvements measures; ▪ Investigate possible levee improvements works; ▪ Property flood proofing; ▪ Flood related policy, planning, response and evacuation reviews and improvements.	This study refines the previous hydraulic model (2001). It provides information on possible flood mitigation options in the St Georges Basin floodplain.

Study / Report	Description	Implications for St Georges Basin Study
St Georges Basin Floodplain Risk Management Study & Plan-Climate Change Assessment (WMAwater, 2013)	This study comprised an amendment to the 2006 study to incorporate the predicted impacts of climate change. The study adopted NSW Government sea level rise estimates of 0.4 m by 2050 and 0.9 m by 2100, and increases in precipitation of 10%, 20% and 30% in line with OEH Guidelines. Based on these values, the findings of the previous 2006 study were updated including planning levels, flood damages, flood mitigation options and evacuation procedures. The assessment in this report also provides the predicted increases (from Figure 4 to Figure 11 in the report) in flood water in various locations within the catchments due to the climate change.	This study provides information on climate change impacts. Implications for mitigation options can be utilized in the FRMS. Information in Figure 4 to Figure 11 of this report provide clear potential climate change impacts at various locations that can also be utilised.
Shoalhaven August 2015 Post Flood Survey Report (Haskoning Australia Pty Ltd, 2015)	The post flood survey captured the flood mark levels in the catchments of Shoalhaven River, St Georges Basin, Sussex Inlet and Lake Conjola where flooding was experienced due to rainfall totals of over 400mm on the 24th and 25th August 2015.	The study provides information on historic flood levels in the St Georges Basin catchment. The flood level information has been used to calibrate and validate the current flood model for the 2015 event.
Caravan Parks Flood Safety Study (Bewsher Consulting Pty Ltd, 2008)	The study was undertaken to: ▪ Assess the flood risk of, and prepare emergency plans for, 30 caravan parks in the Shoalhaven LGA; and, ▪ Prepare a revised flood risk management policy for caravan parks and manufactured homes estates in the Shoalhaven LGA. A draft policy was prepared for Council which was to be applied to all caravan parks within the LGA. This policy includes the following performance criteria: ▪ No increase in risk to life; ▪ Safe evacuation of both residents and mobile homes; ▪ No impacts on adjacent sites; ▪ Redevelopment of high-risk zones where possible. ▪ Long term sites should have no greater risk than allowed for residential developments; short term sites may adopt a higher risk.	This study provides information on flood risk and emergency plan for the Caravan Parks within the St Georges Basin catchment. This information can be considered when identifying flood mitigation options.
Revised Estuary Management Plan (SCC, 2013)	The study revised the previous 1998 plan. The study identified additional actions in new management areas including: catchment wastewater/stormwater inflows, biodiversity, recreation, cultural heritage, climate change and flood risk.	This study provides a good understanding of how St Georges Basin estuary area have been managed not only from flooding perspective but also in water quality, biodiversity, ecologic, public recreation and cultural heritage.

Study / Report	Description	Implications for St Georges Basin Study
St Georges Basin Foreshore Erosion Study (WBM Oceanics Australia,2003)	The study explained the main erosion mechanism for the Basin is local wind-generated waves and tidal action is the main erosive force in Sussex Inlet area. The study also identified some erosion affected areas and it provided a works schedule for foreshore revegetation and remediation.	This study provides a good understanding of erosion related factors in the current study area. This may form part of mitigation considerations to ensure that erosion issues are considered and proposed measures either address or do not worsen the risk.
Draft Coastal Zone Management Plan for the Shoalhaven Coastline (SMEC, 2009)	This draft Coastal Zone Management Plan for the Shoalhaven coastline is designed to manage coastal risk. It addresses immediate coastal hazards and longer term coastal hazards for sea level rise that are based on 40 cm above 1990 levels by 2050 and 90 cm above 1990 levels by 2100. The plan aims to reduce known risk in five ways: 1. Avoid Risk; 2. Change the likelihood; 3. Change the Consequence; 4. Share the risk; 5. Informed risk retention. The key action include: ▪ Managing access ways, preparing planting guides and reserve vegetation plans with local communities; ▪ To take into account ecological processes; ▪ Safety; ▪ Views and access.	The study does not directly cover the area related to St Georges Basin. The plan reviews the management plan for the Shoalhaven Heads and Culburra Beach within the Lower Shoalhaven River catchment. It identifies the preferred options, their benefits and how Council may implement these programs.
Drainage Investigation Report- Tasman Road, St Georges Basin (SCC, 1996)	This report investigated some local drainage/erosion problems in the Tasman Road and the Wool Road area of St Georges Basin. The report also suggested some mitigation options to tackle local drainage and erosion issues. The options included: 1. Backfilling the eroded channel, and; 2. Constructing erosion resistant grassed lined open channel; 3. Constructing series of rock drop structures along the channel; 4. Filling the entire gully with proper pipe system installed.	The report provides some background information about local stormwater and erosion related issues. Proposed mitigation options may be considered for this study.

Study / Report	Description	Implications for St Georges Basin Study
Sanctuary Point Floodplain Management Study & Plan (Environmental Management Pty Ltd, 1993)	The study identified flood risk and local stormwater problems in Cockrow Creek back to early 1990s. The study also provided some mitigation options including: Wool Road raising, constructing a retarding basin, channel clearing, by-pass road embankment, house flood proofing/ raising, high risk property purchasing at various locations and flood warning systems.	The data used in this study is out-of-date. The study provided some mitigation options that may be considered in the relevant areas of the current study.
Shoalhaven Coastal Hazard Mapping Review (Advisian, 2016)	This study presented an updated coastal hazard assessment at the beaches in the Shoalhaven. It describes the coastal processes affecting the beaches and the impact of these processes on the areas where property is at risk. This study has adopted sea-level rise of: ▪ 100 mm for 2030; ▪ 230 mm for 2050; and, ▪ 350 mm for 2100.	The study does not cover the areas related to St Georges Basin. This study can provide the information on sea-level rise at Shoalhaven Heads and Culburra Beach that can be potentially used in the sea-level rise scenario of the current study.

3.2 Review of Policies and Planning

The St Georges Basin catchment is located in the Shoalhaven Local Government Area (LGA) where development is controlled through the Shoalhaven Local Environment Plan (LEP) and various Development Control Plans (DCPs). The LEP is a planning instrument which designates land use and development in the LGA, while DCPs regulate development with specific guidelines and parameters.

Other policies and plans which will be reviewed in detail and discussed in later stages of the study include:

- Shoalhaven City Council Engineering Design Specifications;
- Jervis Bay Settlement Strategy and Sussex Inlet Strategy;
- SCC Community Engagement Policy and SCC Community Strategic Plan;
- Emergency Management Plans – DISPLAN and Shoalhaven City Local Flood Plan Draft;
- Growth Management Strategy; and
- Illawarra Regional Plan.

3.3 Survey Information

3.3.1 Terrain

Various sources of the terrain information were available around the study area for use in developing the model Digital Elevation Model (DEM), including:

- LiDAR data 2010 (LPI);
- 10m Contours (LPI); and
- DEM product of 1 second Shuttle Radar Topography Mission (SRTM) data, sourced from Geoscience Australia.

A review has been undertaken to ensure appropriate data was adopted in the study. The results are summarised in **Table 3-2.**

Table 3-2 DEM Source Review

Data	Source	Coverage	Accuracy	Comments
LiDAR data	LPI LiDAR 2010	Full coverage in the study area	Horizontal: 0.8m Vertical: 0.3m	Will be used in hydrologic and hydraulic modelling
10m Contour	NSW Digital Topographic Database (DTDB), with multiple sources, e.g. Registered Image Trace, Engineering Design File (CAD), Scanned Map Image Trace, Survey Controlled, etc.	Full Catchment-wide coverage	5m	Not used. Too many input sources that are less controlled than other data. Potential interpolation error if converted to DEM.
1 SEC SRTM	National elevation data products derived from the Shuttle Radar Topography Mission (SRTM) data.	Full Catchment-wide coverage	3.75m ±1.99	Poor resolution in grid size (~30m), suitable for catchment delineation in the absence of LiDAR

LiDAR was found to be suitable for hydrologic and hydraulic modelling within the study extents and 1 SEC SRTM data, suitable for catchment delineation in the absence of LiDAR. The DEM adopted is presented in **Figure 5-1**.

3.3.2 Sussex Inlet Entrance Dredge Survey

Survey data of Sussex Inlet Entrance prior to and after the 2016 dredging has been provided to Cardno by Shoalhaven City Council in DWG format. Three sets of survey were undertaken by Council in February 2016, May 2017 and December 2017 respectively. This survey data was consolidated and reviewed. It was noted that the extent of this data only covers a small area of the Sussex Inlet. It was found that the recent survey both pre and post dredge varied from the 1992 sections (St Georges Basin Flood Study, 2001) that covers the whole Inlet. As such it was recommended that the full length of the inlet be resurveyed to ensure that the hydraulic model accurately reflects the current condition in the inlet.

3.3.3 Sussex Inlet bathymetry survey

Based on the recommendation above, bathymetry survey of Sussex Inlet was undertaken by Shoalhaven City Council, and provided to Cardno on 24th August 2018 in DWG 3d triangle format. The survey data was reviewed and considered suitable for flood modelling.

Further Sussex Inlet Channel bathymetry surveys were completed by Council and DPE in September 2020. This data was reviewed and found to be similar to the 2018 survey information with minor lateral shifts in the channel invert and shoals.

3.3.4 St Georges Basin Bathymetry Data

St Georges Basin Bathymetry data was downloaded from the DPE website (https://webtest.environment.nsw.gov.au/estuaries/stats/StGeorgesBasin.htm). The survey was undertaken by Land & Water Conservation on 4th and 5th of February, 1992. The survey was derived by Odom DF3200 Echo-Trac dual frequency echo sounder. It is noted that coordinate conversion from ISG 56 to MGA 56 has been conducted. This data is used in the 2D hydraulic modelling for the basin terrain below the water surface.

3.3.5 Cross-section data from Previous Studies

River channel cross-section data was obtained from the previous hydraulic modelling (St Georges Basin Flood Study, 2001). Conversion of coordinates was conducted for the data not in MGA94 Zone 56 coordinate system and a minor discrepancy was observed through the process.

A review was done of profiles of the Sussex Inlet data comparing the 1992 data to the most recent survey in 2017 and 2020. It was found that the Sussex inlet channel was shallower and narrower in 2017 and 2020 compared to the conditions in 1992. Cross-section data for other creeks used in the previous study (St Georges Basin Flood Study, 2001), e.g. Wandandian Creek, Tomerong, Tullarwalla Creek, etc. were incorporated in the hydraulic model by creating a 2D surface of the channel normal below water surface through interpolation between sections and then incorporated in the model DEM.

3.3.6 Culverts and Bridges

The St Georges Basin study area has a number of culverts and bridges, mainly along the Princes Highway, with some major crossings at other locations. The culverts are included as 1D elements in the hydraulic model and connected directly to the 2D domain with flows routed into and out of the drainage elements by the hydraulic model. The bridges are modelled as 2D layered flow constriction layers to represent the relevant hydraulic losses and blockage of the structure at different elevations of the structure (e.g. pier losses or deck blockage).

A total of 87 structures have been identified within the hydraulic model area. These structures were provided to Council to review and provide further information (survey, drawings or other knowledge) in order to finalise the survey brief.

The survey was undertaken by Allen Price & Scarratts Pty Ltd. The data was progressively provided to Cardno with the final set delivered on 15 March 2019. A total of 56 structures were surveyed (refer **Figure 3-1** for the structures location, **Appendix A** for survey full details) within the study area which includes 18 bridges, 20 culverts, 15 pipes, one spillway and two sag pits.

There were 19 structures (refer **Figure 3-2**) identified either from Council's GIS drainage layer or previous studies which have known culverts sizes but no information on invert levels. These structures were incorporated in the model with assumed invert levels to match the survey.

3.3.7 GIS Data

The following Geographic Information System (GIS) data was provided by Council as part of the study:

- Acid Sulphate Soils;
- Aerial Photo;
- Cadastre;
- Drainage;
- Endangered Ecological Communities;
- Estuarine Macrophytes;
- SEPP14 Wetlands;
- SLEP2014 land use zoning;
- Vegetation;
- Wastewater;
- Water and Water Catchment; and
- Waterways.

GIS data provided by Council was reviewed. Cardno Geohub data is used in areas that are not covered by Council's data.

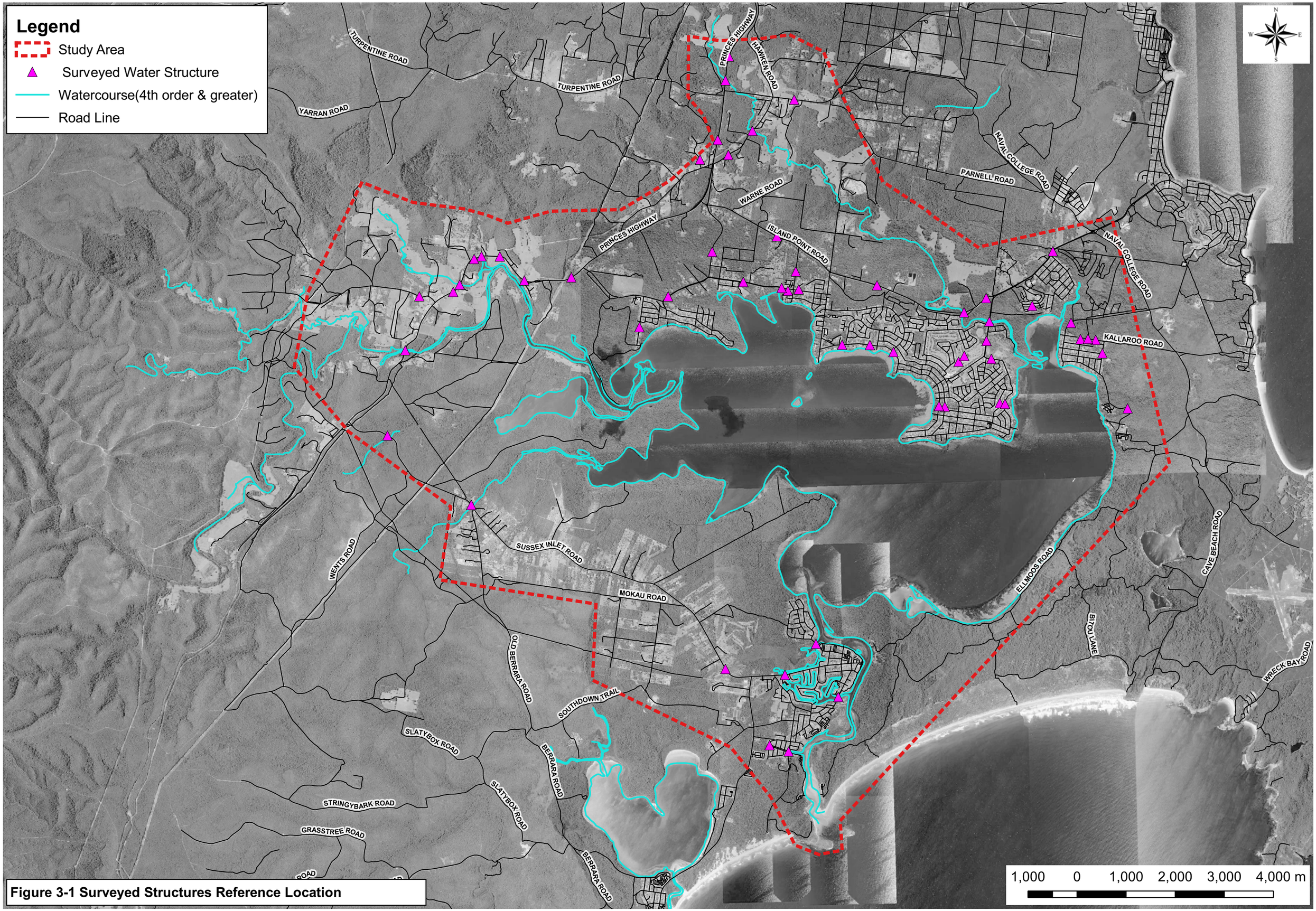


Figure 3-1 Surveyed Structures Reference Location

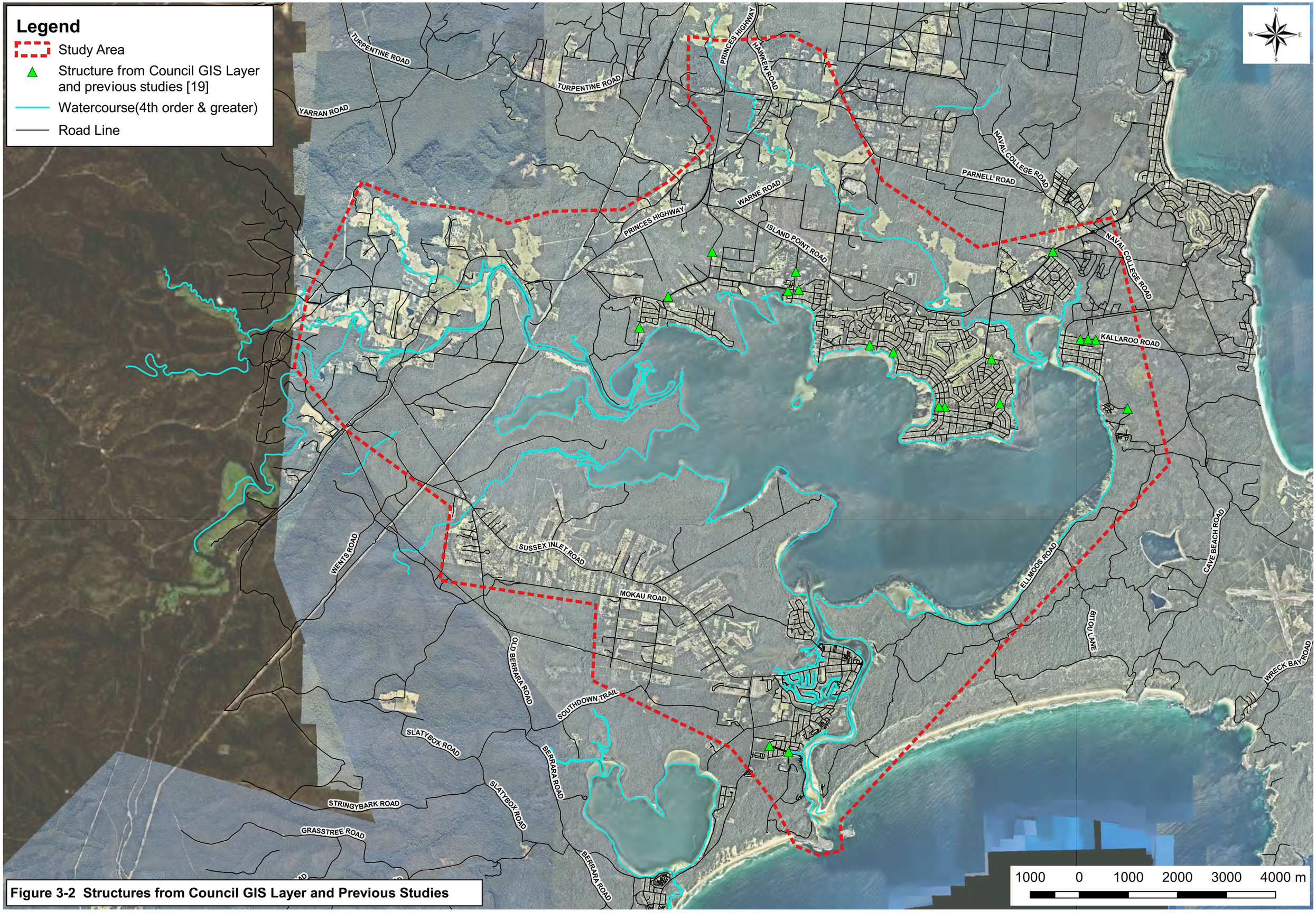


Figure 3-2 Structures from Council GIS Layer and Previous Studies

3.4 Historical Data

3.4.1 Historical Flood Data

The Island Point Water level gauge in St Georges Basin was installed in July 1991, providing water level records from that time. A number of floods are known to have occurred in the 1950's, however, no water level data is available. The largest event was the February 1971 event with peak basin levels of between 2.21m AHD and 2.7m AHD being reported.

Recently, settlements in this catchment have experienced flooding due to the East Coast Low (ECL) weather systems that took place in August 2015, June 2016 and July/August 2020. A peak water level at St Georges Basin at Island Point Road was recorded as 1.85m AHD during August 2015 flood which is higher than the current 10% AEP flood level estimate (1.68m AHD). The MHL gauge recorded peak water level of 1.46m AHD at Sussex Inlet during the August 2015 flood is higher than the 20% AEP flood level (1.4m AHD), but below the 10% AEP flood level (1.6m AHD). The historical flooding information for earlier events listed in St Georges Basin FRMS&P (WMA, 2006) are tabulated in **Table 3-3**. A review and ranking of the recorded flood levels within the Basin are provided for each event in **Table 3-4**. The Sussex Inlet and the Sanctuary Point townships can be inundated for a couple of days and consideration needs to be given to both existing and future developments.

Table 3-3 Historical Storm Events

Events	Comments
March 1959	Significant storm event, basin water levels are not available
October 1959	Significant storm event, basin water levels are not available
February 1971	Significant storm event, peak flood mark levels are available, gauged basin water levels are not available
June 1991	Significant storm event, peak flood mark levels are available, gauged basin water levels are not available
May 1953	Minor storm event
February 1958	Minor storm event
March 1961	Minor storm event
March 1975	Minor storm event
March 1976	Minor storm event
October 1976	Minor storm event
February 1992	Minor storm event, flood levels are available
September 1993	Minor storm event, flood levels are available
April 1994	Minor storm event, flood levels are available
August 1998	Minor storm event, no gauged data
June 2013	Second largest event recorded by MHL gauges, gauged data available
August 2015	Largest storm recorded by MHL gauges, gauged data available
June 2016	Minor storm event, gauged data available
July 2020	Minor storm event, gauged data available
August 2020	Minor storm event, gauged data available

Table 3-4 Ranking of Historical Events

Event	Basin Level	Source	Model	Notes
1971	2.2	St Georges Basin Flood Study (2001)	Yes	Significant changes to ground levels in Sussex Inlet after 1971 which make calibration to this event difficult.
August 2015	1.853	MHL	Yes	Largest storm recorded by the two MHL gauges and event selected for calibration. Event similar magnitude as 1991 event, with better data.
June 1991	1.7 – 1.9	St Georges Basin Flood Study (2001)	No	Variation in recorded levels in close proximity and no levels recorded as being “very good” accuracy. Peak levels only recorded means that the rate of rise and fall cannot be verified.
June 2013	1.418	MHL	Yes	2nd largest event recorded by MHL gauges and event selected for validation.
July 2020	1.353	MHL	No	
August 1998	1.28	MHL	No	Less certainty on bathymetry due to date. No gauge data at Sussex Inlet available.
February 1992	1.18	MHL	No	Similar magnitude to 2016 event.
June 2016	1.171	MHL	No	Flooding event recorded by MHL gauges. Known bathymetry within Sussex Inlet during event due to recent survey.

Parts of the topography of the study area has been changed due to development, changes in the Sussex Inlet morphology, sediment movement, channel bank erosion and regular dredging works in the past. As such, recent flooding information has been used to calibrate and validate the models.

Initially the June 2013, August 2015 and June 2016 events were selected for use in the calibration and validation as these events allowed comparison to the water level gauges at both Island Point and Sussex Inlet across the storms. However, the February 1971 storm event was later selected to replace the June 2016 event for validation of the flood model after discussion with Council and DPE as it is the largest event on record.

Table 3-5 provides the recorded levels at MHL gauges from the flooding events in 2013, 2015 and 2016.

Table 3-5 Recorded Levels of Recent Flooding at the St Georges Basin

Location	June 2013			August 2015			June 2016		
	Peak Time	Date	MHL Gauge Level (mAHD)	Peak Time	Date	MHL Gauge Level (mAHD)	Peak Time	Date	MHL Gauge Level (mAHD)
Island Point	6:30 am	26/06/2013	1.418	21:30 pm	26/08/2015	1.85	11:00 am	6/06/2016	1.17
Sussex Inlet	22:00 pm	25/06/2013	1.243	17:30 pm	26/08/2015	1.457	21:30 pm	6/06/2016	1.18

The Island Point gauge was not in operation for the 6th February 1971 flood event. Reported levels around the basin are provided in **Appendix E** and were typically between 2.21 and 2.7m AHD with varying data quality.

3.4.2 Flood Photographs

A number of flood photographs are available from Council. These photos include floods in 1974 at Sanctuary Point, 1975 at various locations and 1991 at various locations. This information is valuable to provide a qualitative description of flooding but are normally of less value for providing peak flood levels as the photographs may not be taken at the time of peak and estimating flood levels from them can be challenging. These events were not modelled so these photographs were of limited use in this study. Photographs were also obtained through community consultation for the 2015 event and were used for comparison with the calibration event.

3.4.3 Historical Rainfall Data

There are three rainfall gauges in the immediate catchment area, and a number of rainfall gauges in the nearby areas that hold records for varying periods. Details of the rainfall gauges in the catchment and surrounding area are shown in **Table 3-6** and the locations of the rain gauges are shown in **Figure 3-3**.

Active gauges during the three identified calibration events are included and compared to the local rainfall record and the gauge comparison are shown in **Table 3-7**, **Table 3-8**, **Table 3-9** and **Table 3-10** for storm events in June 2013, August 2015, June 2016 and February 1971 respectively.

Table 3-6 Rain Gauges in the St Georges Basin Area

Station	Name	Reporting Frequency	Years of Record
69025	Bendalong (Jacaranda Av)	Daily	1971 - 1989
68229	Bendalong STP	Daily	1939-Current
68251	Callala Bay (Donovan Close)	Daily	2003-2004
68245	Callala Treatment Plant	Daily	2001-Current
68140	Cape St George	Daily	1867 - 1899
68078	Hyams Beach Cyrus Street	Daily	1960 - 1974
68151	Jervis Bay (Point Perpendicular AWS)	Minute	2001 - Current
68034	Jervis Bay (Point Perpendicular Lighthouse)	3 hourly	1899 - 2004
68079	Jervis Bay Nature Reserve	Daily	1958 - 1993
69129	Nerriga AWS	Minute	2013-2019
68182	Nerriga (Glengarry)	Daily	1969-1973
69099	Nerriga (Swellmans Lodge)	Daily	1969-2013
68183	Nerriga (Touga)	Daily	1961-1977
68076	Nowra Ran Air Station	Half hourly	1942 - 2000
68072	Nowra Ran Air Station AWS	Minute	2000 - Current
68088	Sanctuary Point (Salinas Street)	Daily	2000 - Current
69081	Sassafras	Daily	1901 - 1918
68203	Sassafras (Ettrema Hollerith)	Minute	1954 - 1972
68204	Sussex Inlet Bowling Club	Daily	1952 - Current
68249	Touga	Daily	2002-2018
68222	Wandandian Post Office	Daily	1985 - 2003
68082	Yalwal	Daily	1903-1984
69008	Yatteyattah (Pointer Road)	Daily	1998-2016

Table 3-7 Rain Gauge Comparison of June 2013 Event (21/6/2013 to 30/6/2013)

Station	Name	Reporting Frequency	Total Rainfall of the Event (10 days Daily Total) (mm)	Years of Record
68229	Bendalong STP	Daily	215	1936-Current
68245	Callala Treatment Plant	Daily	257.8	2001-Current
68151	Jervis Bay (Point Perpendicular AWS)	Minute	322.8	2011-Current
69129	Nerriga AWS	Minute	42.4	2013-2019
68072	Nowra Ran Air Station AWS	Minute	304.8	2000-Current
68088	Sanctuary Point (Salinas Street)	Daily	315.2	2000-Current
68204	Sussex Inlet Bowling Club	Daily	262.4	1952-Current
68249	Touga	Daily	206.8	2002-2018
69008	Yatteyattah (Pointer Road)	Daily	217.6	1998-2016

Table 3-8 Rain Gauge Comparison of August 2015 Event (22/8/2015 to 30/08/2015)

Station	Name	Reporting Frequency	Total Rainfall of the Event (9 days Daily Total) (mm)	Years of Record
68229	Bendalong STP	Daily	474.4	1936-Current
68245	Callala Treatment Plant	Daily	314.2	2001-Current
68151	Jervis Bay (Point Perpendicular AWS)	Minute	19.2*	2011-Current
69129	Nerriga AWS	Minute	123.6	2013-2019
68072	Nowra Ran Air Station AWS	Minute	428	2000-Current
68088	Sanctuary Point (Salinas Street)	Daily	413.2	2000-Current
68204	Sussex Inlet Bowling Club	Daily	373	1952-Current
68249	Touga	Daily	142	2002-2018
69008	Yatteyattah (Pointer Road)	Daily	288.2	1998-2016

* note data is missing from the gauge and cannot be used for this event.

Table 3-9 Rain Gauge Comparison of June 2016 Event (30/5/2016 to 5/6/2016)

Station	Name	Reporting Frequency	Total Rainfall of the Event (7 days Daily Total) (mm)	Year of Record
68229	Bendalong STP	Daily	281.8	1936-Current
68245	Callala Treatment Plant	Daily	309.1	2001-Current
68151	Jervis Bay (Point Perpendicular AWS)	Minute	339.8	2011-Current
69129	Nerriga AWS	Minute	198.8	2013-2019
68072	Nowra Ran Air Station AWS	Minute	374.6	2011-Current
68088	Sanctuary Point (Salinas Street)	Daily	346.2	2000-Current
68249	Touga	Daily	263.2	2002-2018
69008	Yatteyattah (Pointer Road)	Daily	337.6	1998-2016

Table 3-10 Rain Gauge Comparison of February 1971 Event (01/02/1971 – 07/02/1971)

Station	Name	Reporting Frequency	Total Rainfall of the Event (7 Day Daily Total) (mm)	Year of Record
69025	Bendalong	Daily	695.1	1971-1989
68204/69068	Sussex Inlet Bowling Club	Daily	747.4	1952-Current
68078	Hyams Beach Cyrus Street	Daily	395.7	1960-1974
68203	Sassafras (Ettrema Hollerith)	Minute	258.6#	1963-1983
68076	Nowra Ran Air Station	Minute	374.0	1964-1998

missing data on various days. Not reliable.

3.4.4 Historical Flow Data

There are no flow gauges within the study area. Therefore, calibration of the hydrologic model to historical flow is not possible. Different approaches have been undertaken to validate the hydrologic model in parallel with the calibration of hydraulic model results to water level gauges and other flood level information. This is described in **Sections 7** and **8.3**.

3.4.5 Water Level Data

A list of water level gauges available near the study area operated by Manly Hydraulics Laboratory (MHL) is shown in **Table 3-11**. Water level data at Island Point and Sussex inlet will be used for hydraulic model calibration. Jervis Bay gauge will be used for the most downstream tailwater condition in the historical events calibration. The locations of these three gauges are shown in **Figure 3-4**.

Table 3-11 Water Level gauges near the St Georges Basin area

Station ID	Station name	Type	Period of Record	Source
216415	Island Point	Water Level (15 min)	Jul 1991 - Aug 2018	MHL
216470	Jervis Bay	Water Level (15 min)	Sep 1989 - Aug 2018	MHL
216412	Sussex Inlet	Water Level (15 min)	Jan 2001 - Aug 2018	MHL

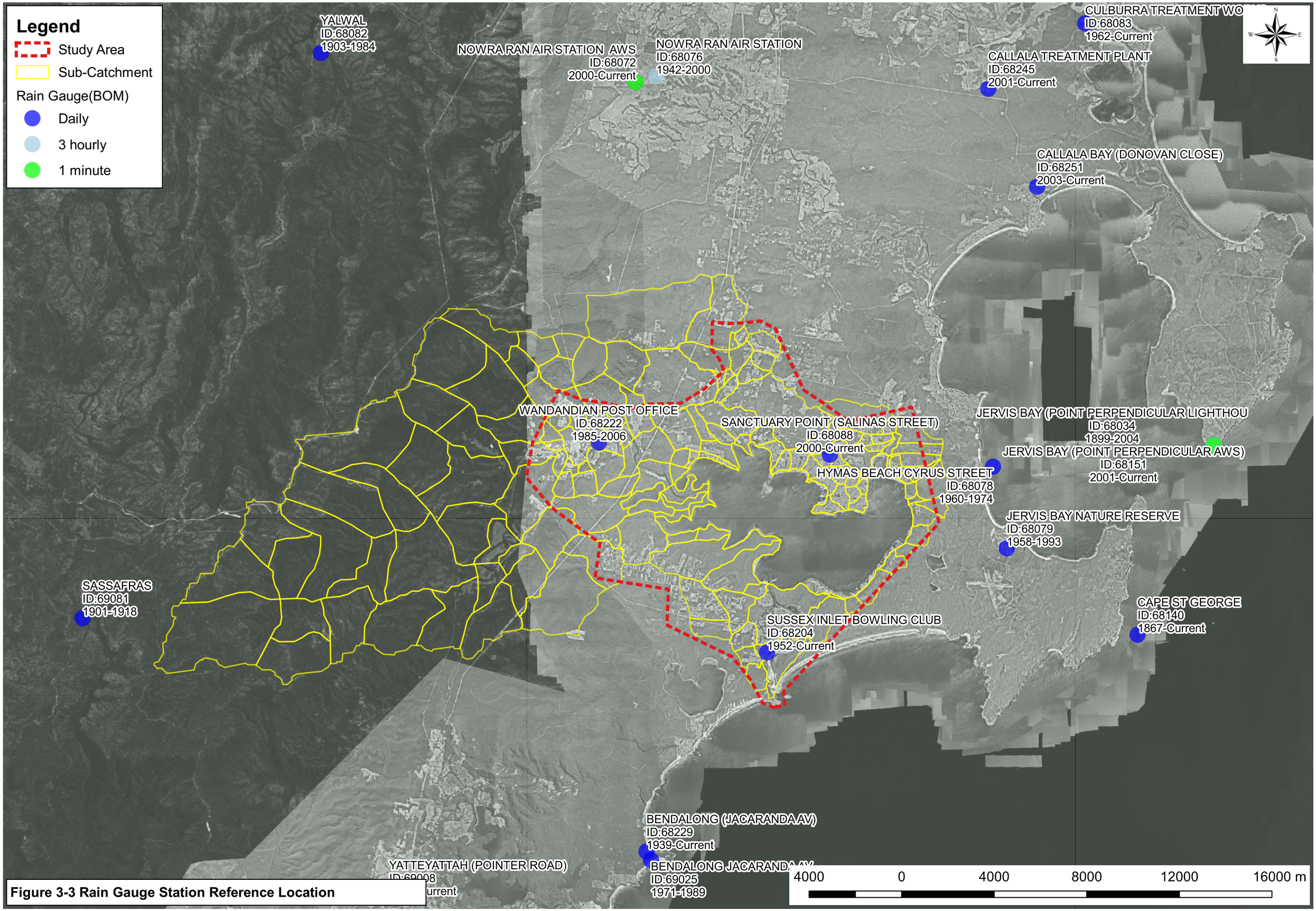


Figure 3-3 Rain Gauge Station Reference Location

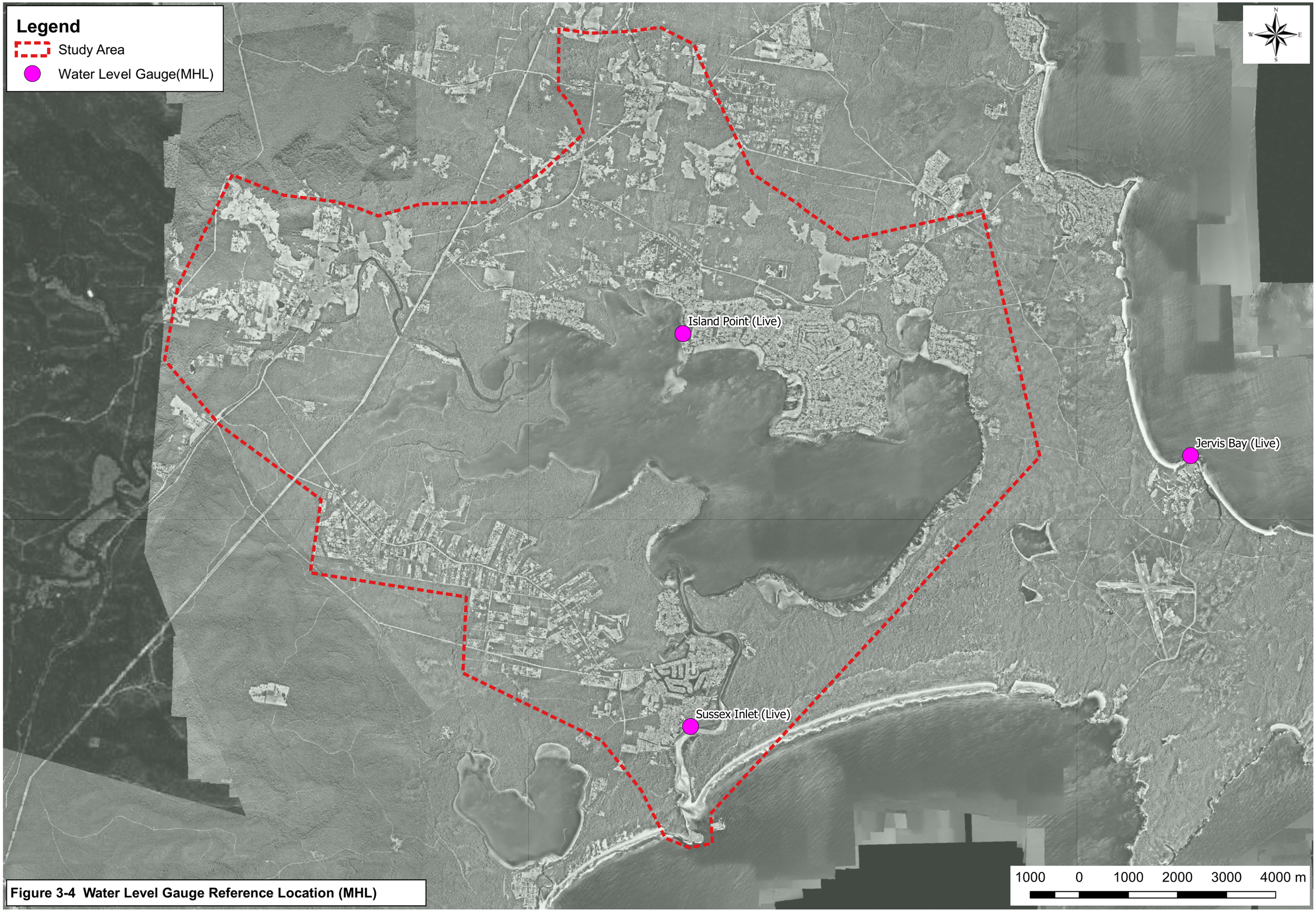


Figure 3-4 Water Level Gauge Reference Location (MHL)

4 Community Consultation

4.1 Consultation Process

Consultation with the community and stakeholders is an important component in the development of a Flood Study and Floodplain Risk Management Study & Plan. Consultation provides an opportunity to collect feedback and observations from the community on problem areas and potential floodplain management measures. It also provides a mechanism to inform the community about the current study and flood risk within the study area and seeks to improve their awareness and readiness for dealing with flooding.

Table 4-1 details the community and stakeholder consultation plan that forms basis of the consultation process to be undertaken as part of this study.

Table 4-1 Consultation Plan

Task	Description	Expected Outcome	Status
Media Release & Project Website	Cardno will draft a media release for Council's consideration and publication. Cardno will provide the relevant information to Council to upload onto the project website.	• Public awareness of the study; • Assist in engagement with the community through the newsletter/questionnaire, workshops and public exhibition; • Assist in the public acceptance of the study outcomes and implications for development and floodplain risk management in the future; • Provide key information to the community.	• Media Release is complete. Project Website updates are ongoing.
Community Newsletter and Questionnaire	Cardno will draft a newsletter and questionnaire for Council's consideration. Once finalised Council will distribute them to flood affected communities within the catchment. The brochure and survey will also be made available online by Council.	• Inform the community about the study and provide background information; • Identify community concerns and awareness; • Gather information from the community on potential flood mitigation options; • Develop and maintain community confidence in the study results.	• Complete

Task	Description	Expected Outcome	Status
Stakeholder Consultation	Cardno will contact relevant agency stakeholders via letter and follow up email and/or phone. Meetings will be held with key stakeholders and community groups.	• Inform the agencies of the study; • Obtain relevant information; • Provide an opportunity for input from the relevant agencies.	• Initial stakeholder consultation undertaken. Further consultation to be undertaken as part of the FRMSP.
Community Workshops	Cardno will prepare materials for and present at 2 community workshops. The first workshop will obtain feedback on flood modification options while the second workshop will be held during public exhibition.	• Provide the community with an understanding of the preliminary findings of the study and provide an opportunity for input prior to the preparation of the Draft and Final FRMS&P;	• To be undertaken at relevant stages of the FRMSP.
Community Liaison	Cardno will liaise with residents which may be affected by any proposed flood mitigation options.	• Provide an opportunity to residents to ask questions, get an understanding of the impacts (if any), and provide feedback.	• To be undertaken after the community workshop as part of the FRMSP.
Public Exhibition Period	Council will arrange for the public exhibition of the Draft Flood Study and subsequent Floodplain Risk Management Study and Plan.	• Provide an opportunity for the community to review and provide comment on the Draft Study and Plan.	• To be undertaken upon adoption of the final draft Flood Study and subsequent FRMSP.

The consultation plan identified that consultation was to be undertaken at key stages of the study. The main consultation elements for this study are:

- A press release, project website and newsletter introducing the project to the community and keeping them updated;
- A questionnaire sent to the community in digital and hard copy format;
- A call for information from all affected stakeholders within the catchment;
- Public exhibition and community consultation for the Flood Study, including drop in sessions;
- Public Exhibition of Draft Floodplain Risk Management Study; and
- Collation and acknowledgement of written submissions during the public exhibition.

This process ensures that community participation is maximised during the development of the Flood Study and subsequent FRMS&P.

4.2 Project Website

A project website was published by Council to inform the community of the flood management process and how they could participate in it. It also included the details of the study area, the future steps and details of relevant contacts. Cardno prepared information for the website. The website address is:

https://getinvolved.shoalhaven.nsw.gov.au/review-of-the-St-Georges-Basin-floodplain-risk-management-study-and-plan.

The website has been developed to provide the community with detailed information about the study and gather information.

4.3 Community Newsletter and Questionnaire

An information newsletter was prepared for the digital and physical distribution to the residents within the catchment. The newsletter informed residents about the study and how to complete the survey either online or submit their responses on a hard copy questionnaire. The brochure provided an outline of the floodplain risk management process and the objectives of the study. Council opted to publish this information through targeting advertising and community forums.

The online questionnaire was prepared on the SurveyMonkey platform. The survey sought information about historical flooding events and flood awareness within the community. The online and physical copy of the questionnaires are attached in **Appendix B**.

The survey was open from 19 November 2018 to 1 February 2019. A total of 55 responses were recorded from the online consultation. All responses are provided in **Appendix C**.



Figure 4-1 Locations of Community Responses

4.3.2 Demographic Information

- On average, respondents have lived in the area for under 10 years, with the majority of respondents within the 0-5 year range as shown in **Figure 4-2**; and
- The majority of residents (71%) did not have any individuals within the household that required care.

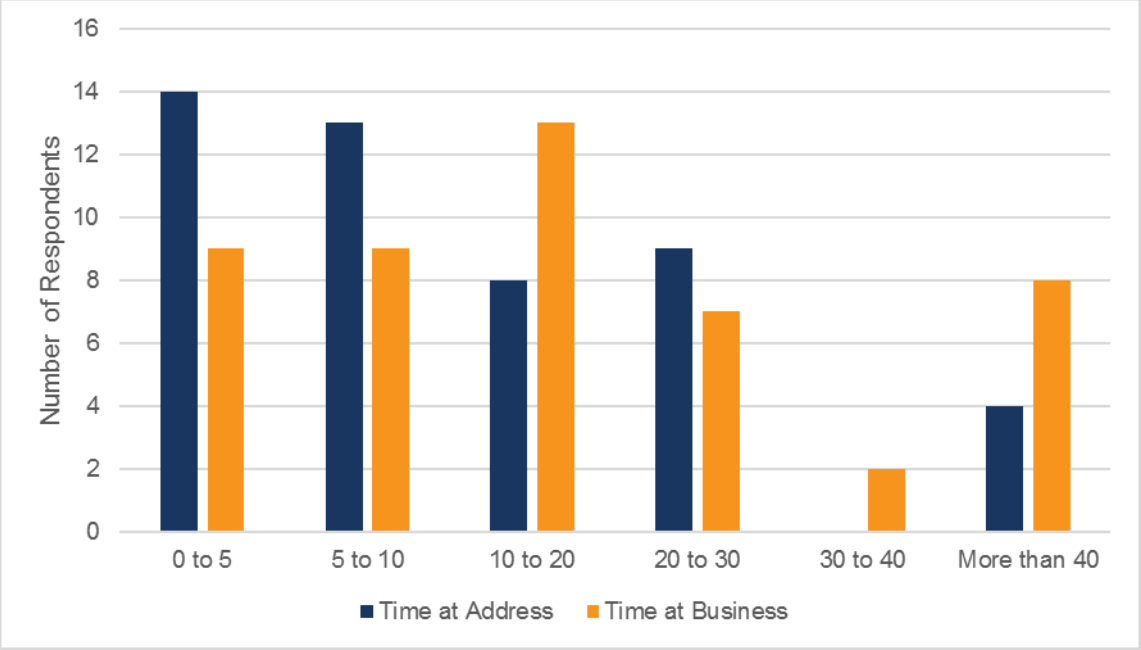


Figure 4-2 Residence Time within Catchment

4.3.3 Community Flood Experiences

- The majority of respondents (66%) experienced flooding. This information was used in hydraulic model calibration for the relevant storm events (refer Section 7.2.9). Figure 4-3 shows the areas of flooding on the property;

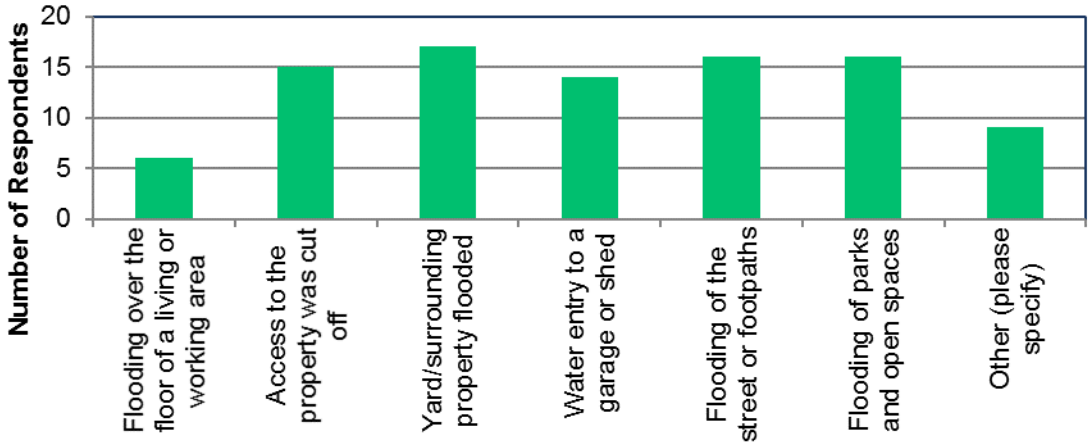


Figure 4-3 Areas Impacted by Flooding

- For past flood events, the majority of respondents (58%) did not take action to protect their property or business against flood damage;
- For those residents/businesses that did take actions, these are summarised in **Figure 4-4**. Results indicate that several respondents were forced to move their belongings and assets;

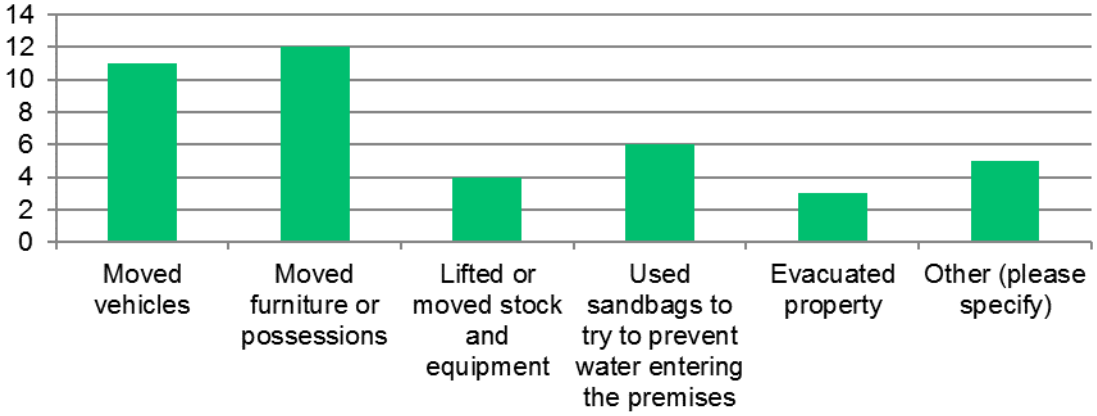


Figure 4-4 Actions taken against flood damage

- For the majority of those impacted by flooding, 67% experienced no damages;
- The community considers risk to property as the greatest flood risk in the catchment, with 53% of respondents concerned about property damages as shown in **Figure 4-5**; and

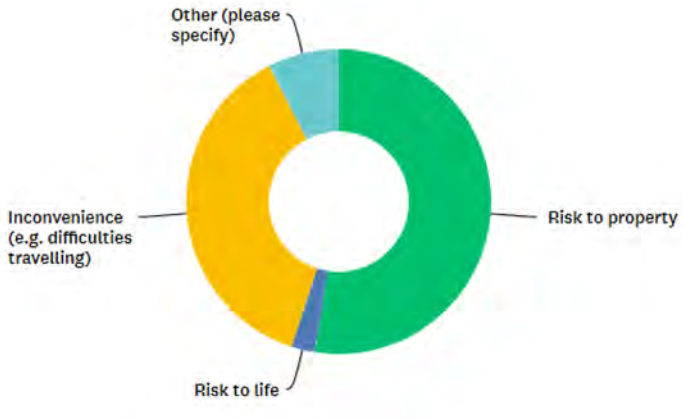


Figure 4-5 Flood risks in the catchment

- The majority of respondents are concerned about their home or business being flood affected in the future as shown in **Figure 4-6**.

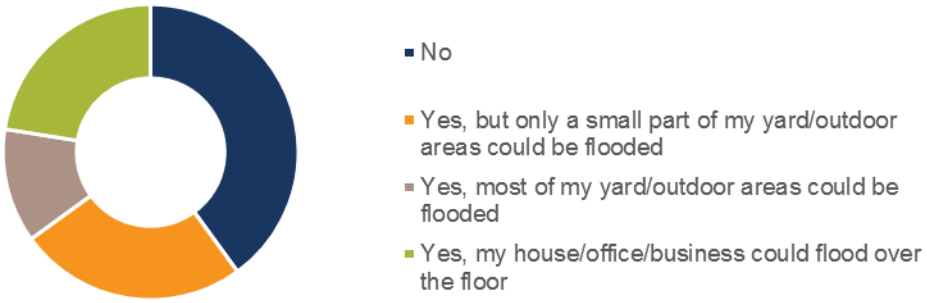


Figure 4-6 Future flooding expectations

4.3.4 Community Preferred Flood Mitigation Options

- Respondents were invited to provide feedback on their preferred flood mitigation options. 68% of respondents believe that Council should undertake additional works to reduce the flood risk at their property;
- The local community was also given a platform to share any ideas to reduce flood risks by suggesting future flood management options. Several options were suggested with provision for input of additional ideas. Respondents chose the options with an order of preference. These preferences were ranked based on the number of respondents for each preference. A high ranking average score indicates that the response was more heavily favoured amongst the community.

Results suggest that improved flowpaths and channel improvements are the preferred community options for further investigation. Improved entrance management strategy is also a strongly favoured mitigation option. **Figure 4-7** shows the various options and their respective scores;

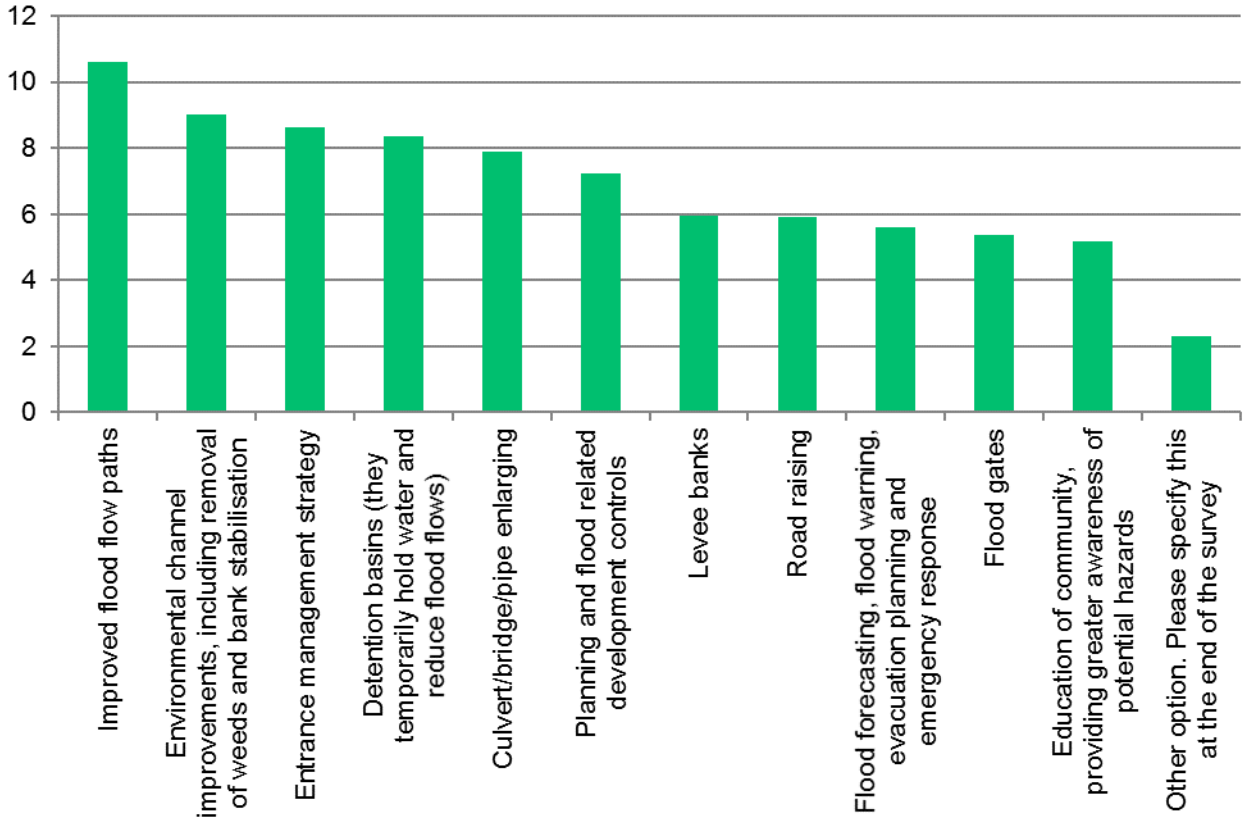


Figure 4-7 Actions required to reduce future flood risk

- Respondents also voiced their concern on new developments. The general consensus was that some level of control is necessary. 44% of respondents were in favour of new developments on land with potential to flood. The other respondents preferred a combination of advisory and restrictive policies to reduce flood damages; and
- Majority of respondents (85%) are interested in receiving further information from Council about flooding in the study area. The preferred method of receiving information is primarily through email newsletters.

5 Hydrology

5.1.1 Model Selection

Hydrology model files in Boyd format (very old version of Watershed Bounded Network Model (WBNM)) were provided by Council from the St Georges Basin Flood Study (WMA, 2001). This model is not executable with the current WBNM software. As such, limited information was retrieved from the 2001 hydrology model, i.e. lag parameters, rainfall losses. Information, such as sub-catchment delineation and impervious percentages, were not able to be extracted. To allow for the recent methodology changes as part of ARR2019 and to resolve the compatibility issues of the old hydrology model, a revised WBNM model has been established using the latest version of the software.

5.1.2 Catchments delineation

The St Georges Basin catchments and sub-catchments were delineated based on LiDAR data and 1 SEC SRTM (where LiDAR was not available). The two datasets were combined into a final DEM and is shown in **Figure 5-1**. Refer **Appendix D** for more sub-catchment details.

5.1.3 Impervious fraction calculation

Catchment impervious percentage was calculated based on Land Use zoning (from Council LEP zoning maps), Cadastre and Nearmap aerial imagery. Impervious fraction values adopted in the hydrology model are presented in **Table 5-1**.

Table 5-1 Impervious Fraction and Land Use

Zoning (LEP)	Land Use (LEP)	Impervious Fraction (%)
B2	Local Centre	100
B4	Mixed Use	100
B5	Business Development	100
DM	Deferred Matter	0
E1	National Parks and Nature Reserves	0
E2	Environmental Conservation	0
E3	Environmental Management	0
E4	Environmental Living	5
IN1	General Industrial	100
IN2	Light Industrial	100
N/A	Pasture (default)	5
R1	General Residential	80
R2	Low Density Residential	80
R3	Medium Density Residential	80
R5	Large Lot Residential	10
RE1	Public Recreation	5
RE2	Private Recreation	5
RU1	Primary Production	5
RU2	Rural Landscape	5
RU3	Forestry	0
RU4	Primary Production Small Lots	5
RU5	Village	40
SP2	Community Facility	40

Zoning (LEP)	Land Use (LEP)	Impervious Fraction (%)
SP2	Educational Establishment	50
SP2	Electricity Transmission & Distribution	100
SP2	Emergency Services Facility	50
SP2	Place of Public Worship	50
SP2	Road	90
SP2	Sewage Treatment Plant	90
SP2	Sewerage System	90
SP2	Telecommunications	0
SP2	Waste or Resource Management Facility	100
SP2	Water Supply System	5
SP2	Water Treatment Facility	5
SP3	Tourist	40
W1	Natural Waterways	100
W2	Recreational Waterways	100

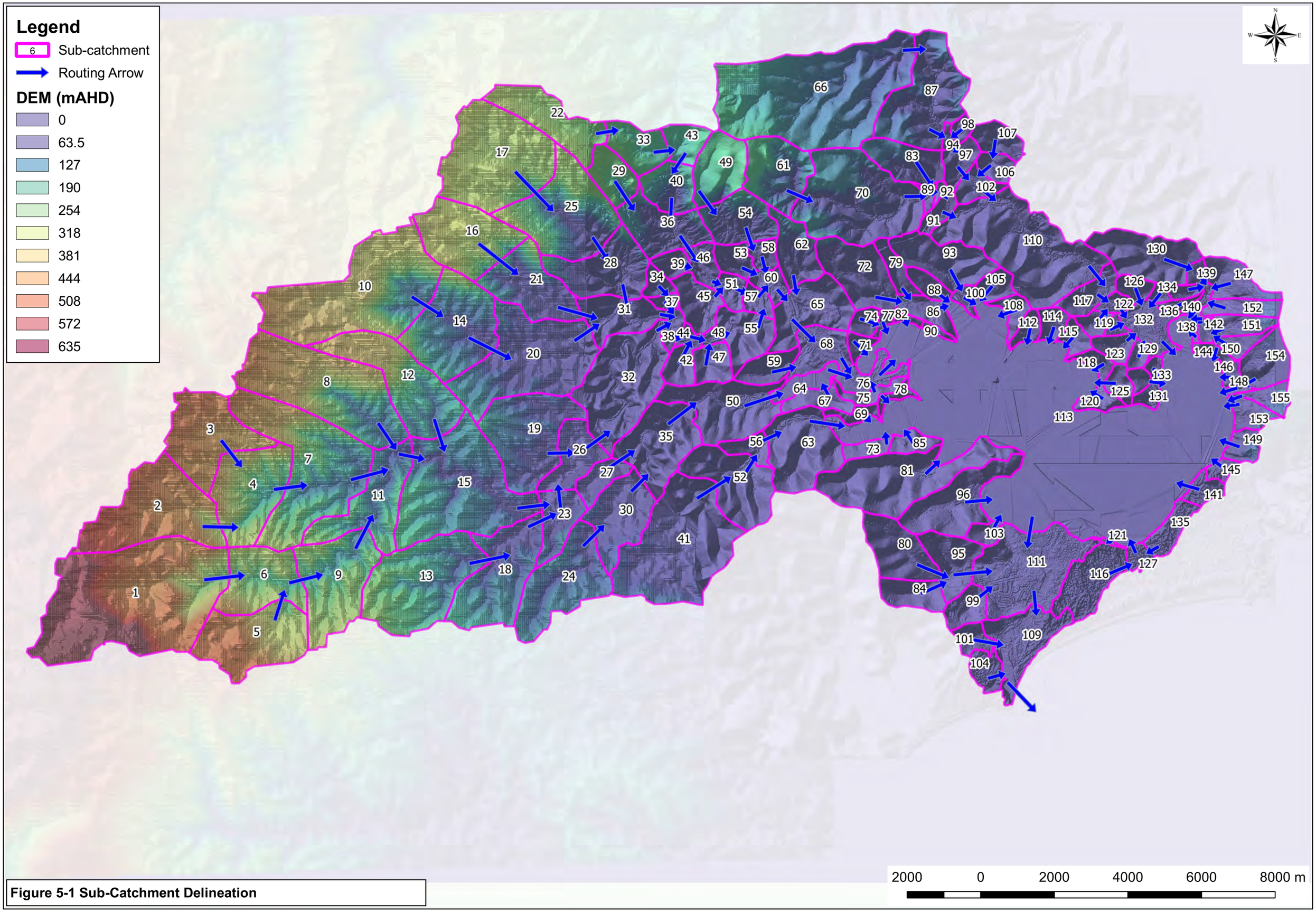


Figure 5-1 Sub-Catchment Delineation

5.1.4 Routing of Flows

The WBNM model was developed with complete routing of flows downstream to the ocean including the Basin storage relationship and Basin outlet discharge relationship. This allowed the ARR2019 ensemble approach simulations to be undertaken in WBNM without running all durations and temporal patterns through the hydraulic model. While for hydraulic modelling, TUFLOW utilises the WBNM model as inflow points (refer **Section 6.1.4** for more details) and undertakes its own hydraulic routing process.

5.1.5 Lag Parameter

WBNM uses a catchment lag (C) value to calculate the catchment response time for runoff. Based on *Details of the Theory Used in WBNM (2012)*, WBNM (2012) recommends a Lag Parameter of 1.3 to 1.8. It is noted that St Georges Basin Flood Study (2001) adopted 1.29 in the study. As a starting point Cardno adopted 1.3 for the C value, further sensitivity runs in the WBNM model found that changing the C value from 1.3 to 1.8 did not significantly influence the peak water level in the Basin (the primary level used for calibration). As such, C of 1.6 as the default WBNM value was adopted in the TUFLOW calibration runs.

5.1.6 Initial and Continuing Rainfall Losses

DPE *Floodplain Risk Management Guide: Incorporating 2016 Australian Rainfall and Runoff in studies*, (OEH, 2019) provides a hierarchical approach to guide the rainfall loss and pre-burst estimation with ARR2019. This hierarchy starts from 1 (most preferred) to 5 (least preferred) and is represented below.

1. *Use the average of calibration losses from the actual study on the catchment if available;*
2. *Use the average calibration losses from other studies in the catchment, if available and appropriate for the study;*
3. *Use the average calibration losses from other studies in the similar adjacent catchments, if available and appropriate for the study;*
4. *For catchments of 100 km^2 or less, use the NSW FFA-reconciled losses available through the ARR Data Hub;*
5. *For catchments of 100 km^2 or less, use default ARR data hub continuing losses with a multiplication factor of 0.4.*

A range of initial losses (IL) and continuing loss (CL) in WBNM were tested to check the sensitivity of the parameters and to select parameters which calibrate the model to historical events.

A range of IL values were tested, from 5 mm (used in St Georges Basin Flood Study, 2001) to a middle value of 15 mm (recommended ARR87 value) and to an upper value of 26 mm (ARR data hub value). It was found that the basin flood levels show no sensitivity to different values of IL.

CL values tested were 1.0 mm/hr, 1.6mm/hr (ARR data hub value 4mm/hr x multiplication factor of 0.4) and 2.5 mm/hr (used in St Georges Basin Flood Study, 2001). It was found from WBNM sensitivity runs that changing CL has the most impact on basin water level, while changing C value and IL has a small impact. Refer **Section 5.1.7** for more details. Adopted WBNM parameters are summarised in **Table 5-2**.

5.1.7 Adopted WBNM Parameters

A summary of the adopted WBNM parameters in the calibration and sensitivity runs are listed in **Table 5-2.**

Table 5-2 Adopted WBNM Parameters

Parameter	Sensitivity Tested in the WBNM model	Sensitivity Tested in the TUFLOW model	Adopted value in the Calibration and Validation
Initial loss (pervious surface)	5 mm, 15 mm & 26 mm	5 mm	5 mm
Initial loss (impervious surface)	0 mm	0 mm	0 mm
Continuing loss (pervious surface)	1.0 mm/hr, 1.6 mm/hr & 2.5 mm/hr	1.0 mm/hr, 1.6 mm/hr & 2.5 mm/hr	1.6 mm/hr
C (Catchment Lag parameter)	1.3, 1.6 & 1.8	1.6	1.6
Impervious Lag	0.1	0.1	0.1
Stream Lag	1	1	1

5.1.8 Hydrologic Model Calibration

There are no suitable streamflow gauges within the catchment to compare the modelled hydrograph with gauge records, and available water level gauge data is within the St Georges Basin or the tidal Sussex Inlet channel. Hence, the hydrology model cannot be calibrated in isolation. Rainfall data of historical storms was used in WBNM to determine inflows and volumes for the TUFLOW model. Water levels from the TUFLOW model were then compared to historical water level observations and gauge records in order to determine how well the model is calibrated. Various WBNM parameters were tested to achieve the best match between the modelled and recorded water levels. Refer **Section 7** for more details.

6 Hydraulics

6.1.1 Model Selection

Previous hydraulic modelling prepared for St Georges Basin Flood Study (2001) and the St Georges Basin Floodplain Risk Management Study (2006) was reviewed. This model was built based on a quasi-two-dimensional RUBICON model that was undertaken in the mid 1990's. The RUBICON model was not configured to define velocity around the Basin over bank areas. In addition, Tomerong Creek catchment was not included in the hydraulic model domain.

6.1.2 General Model Setup

TUFLOW is a grid based 2D hydrodynamic free-surface flow solver. The engines are suited for simulating flood, tide, storm tide, tsunamis and coastal hydraulics.

TUFLOW HPC (Version 2020-10-AA-iSP-w64) on GPU hardware was used, to take advantage of the significantly faster solution scheme, which has distinct advantages for the study area with adopting appropriate grid cell size.

Some test runs have been simulated in different grid sizes. A 5m grid model was established to achieve a reasonable balance between an appropriate grid cell size, overall run times and resolution of the input data. It is noted that model version TUFLOW HPC (2018-03-AC) was used for calibration events.

6.1.3 Model Geometry and 1D/2D Extents

The Digital Elevation Model (DEM) was developed from various sources, which include:

- The LiDAR data (taken from 2010 to 2011) sourced from NSW Government – Land and Property Information;
- A number of hydrographic surveys as part of Sussex Inlet entrance dredging program (2016-2017) provided by Council;
- Hydrographic survey of Sussex Inlet entrance in areas not covered by the dredging program were undertaken and provided by Council in 2018;
- Basin bathymetry survey data (1992) downloaded from DPE website;
- Cross-section data extract from St Georges Basin Flood Study (2001); and
- Detailed ground survey points sourced from structures survey (15 March 2019) undertaken by Allen Price & Scarratts Pty Ltd.

The adopted topographic data extents are presented in **Figure 6-1**.

The TUFLOW model extents consist of a 5m grid 2D domain, which covers the entire basin, major creeks flowing to the Basin, Sussex Inlet entrance, 2km of extension to the ocean and all floodplain areas. There are eight creek channels which were carved into Lidar DEM surface as 2D components. The carved creeks were derived from previous cross-section data of St Georges Basin Flood Study (2001) with minor extension further upstream of the critical hydraulic structures, e.g. Sussex Inlet Road bridge on Cow Creek (G_52) and Princes Highway bridge on Wandandian Creek (G_47). The cross-section data used in the channel was mainly extracted from the St Georges Basin Flood Study (2001) 1D model (with data obtained in 1999) supplemented with a small proportion derived from the structures survey data (2019). The 2D domains are presented in **Figure 6-2**. It is noted that the sensitivity runs (refer **Figure 7-13** & **Figure 7-14**) were undertaken prior to implementing the carved channels.

Legend

- Study Area
- Road Line
- Watercourse (DPI Water)

Topographic data extents

- Sussex inlet bathymetry(Council, 2018)
- Various Sussex Inlet Entrance Dredge Survey (Council, 2016-2017)
- Structure Survey Points (Allen Price & Scarratts, 2019)
- SGB Bathymetry (OEH, 1992)
- 1d Cross-sections (SGBFS 2001) [45]

TURPENTINE ROAD
TURPENTINE ROAD
ARRAN ROAD
PRINCES HIGHWAY
HAWKEN ROAD
PRINCES HIGHWAY
WARNE ROAD
ISLAND POINT ROAD
PARNELL ROAD
NAVAL COLLEGE ROAD
NAVAL COLLEGE ROAD
KALLAROO ROAD
WENTS ROAD
SUSSEX INLET ROAD
MOKAU ROAD
OLD BERRARA ROAD
SOUTHDOWN TRAIL
SLATYBOX ROAD
BERRARA ROAD
STRINGYBARK ROAD
SLATYBOX ROAD
GRASSTREE ROAD
BERRARA ROAD
ELLMOOS ROAD
BITOU LANE
CAVE BEACH ROAD
WRECK BAY ROAD

N
W
E
S

1000 0 1000 2000 3000 4000 m

Figure 6-1 Topographic Data Extents

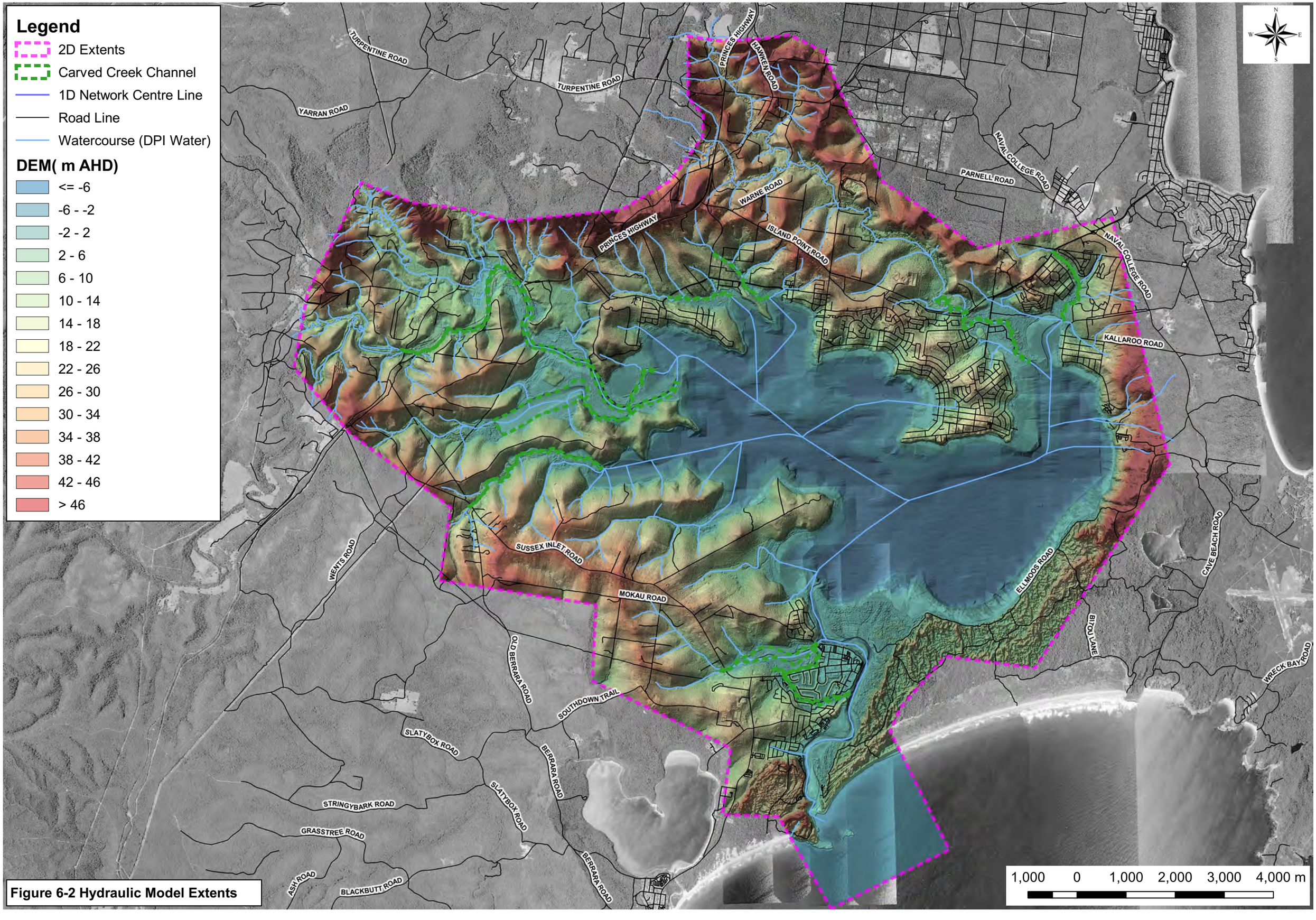


Figure 6-2 Hydraulic Model Extents

6.1.4 Boundary Conditions

Hydrographs determined using the WBNM model were applied as total inflow polygons at the upstream extent of the hydraulic model domain and as local inflow polygons within the hydraulic model. Inflow location and downstream tail water condition boundaries are shown in **Figure 6-3**.

The downstream boundary condition line has been located approximately 2km away from the coastline. Jervis Bay ocean tide gauge was used as the downstream tailwater condition in the 2015 and 2013 storm simulation (refer **Figure 7-4** and **Figure 7-18** for the data). The Sydney ocean tidal data (refer **Figure 7-28**) was retrieved from St Georges Basin Flood Study (2001) and was used for the 1971 storm. It is noted that this is the only water level gauge data available for the 1971 storm event.

6.1.5 Materials Mapping and Roughness

The roughness delineation was undertaken based on Land Zoning, Cadastre, Nearmap imagery and potential PMF flood extents derived from St Georges Basin Flood Study (2001). The rest of the model extents area was assigned with default type - pasture. It is noted that in the area where the main creek channel is covered by dense vegetation (refer U/S Creek Channel in **Figure 6-4**), an estimated creek channel polygon was adopted for roughness delineation. The polygon width was calculated by using Bank-Full Discharge equation (Williams, 1978). The equation gives a function of bank-full discharge, water surface slope and river width. A validation was undertaken to non-vegetation covered creek channel. The results indicate the estimated creek channel polygon is suitable for the hydraulic modelling. **Figure 6-4** shows the roughness mapping for the hydraulic modelling. The roughness values adopted in the hydraulic model and sensitivity runs are presented in **Table 6-1.**

Table 6-1 Adopted roughness values in the existing case

Surface Type	Manning's n Value
Pasture(default)	0.035
Downstream Creek Channel (Creek Bed)	0.03
Upstream Creek Channel (Creek Bed)	0.03
Sussex Inlet Channel	0.03
Water Body/Basin	0.03
Roads	0.025
Urban	0.08
Vegetation/Forest	0.12

Legend

- 2D Extents
- Road Line
- Watercourse (DPI Water)
- Sub-Catchment
- Tailwater Condition Line

Inflow SA Polygons [107]

- Local [99]
- Total [8]

TURPENTINE ROAD
YARRAN ROAD
PRINCES HIGHWAY
HAWKEN ROAD
WARNE ROAD
ISLAND POINT ROAD
PARNELL ROAD
NAVAL COLLEGE ROAD
WENTS ROAD
SUSSEX INLET ROAD
MOKAU ROAD
OLD BERRARA ROAD
SOUTHDOWN TRAIL
SLATYBOX ROAD
BERRARA ROAD
STRINGYBARK ROAD
GRASSTREE ROAD
ELMOOS ROAD
BITOU LANE
CAVE BEACH ROAD
WRECK BAY ROAD

1000 0 1000 2000 3000 4000 m

Figure 6-3 Inflow and Tailwater Locations

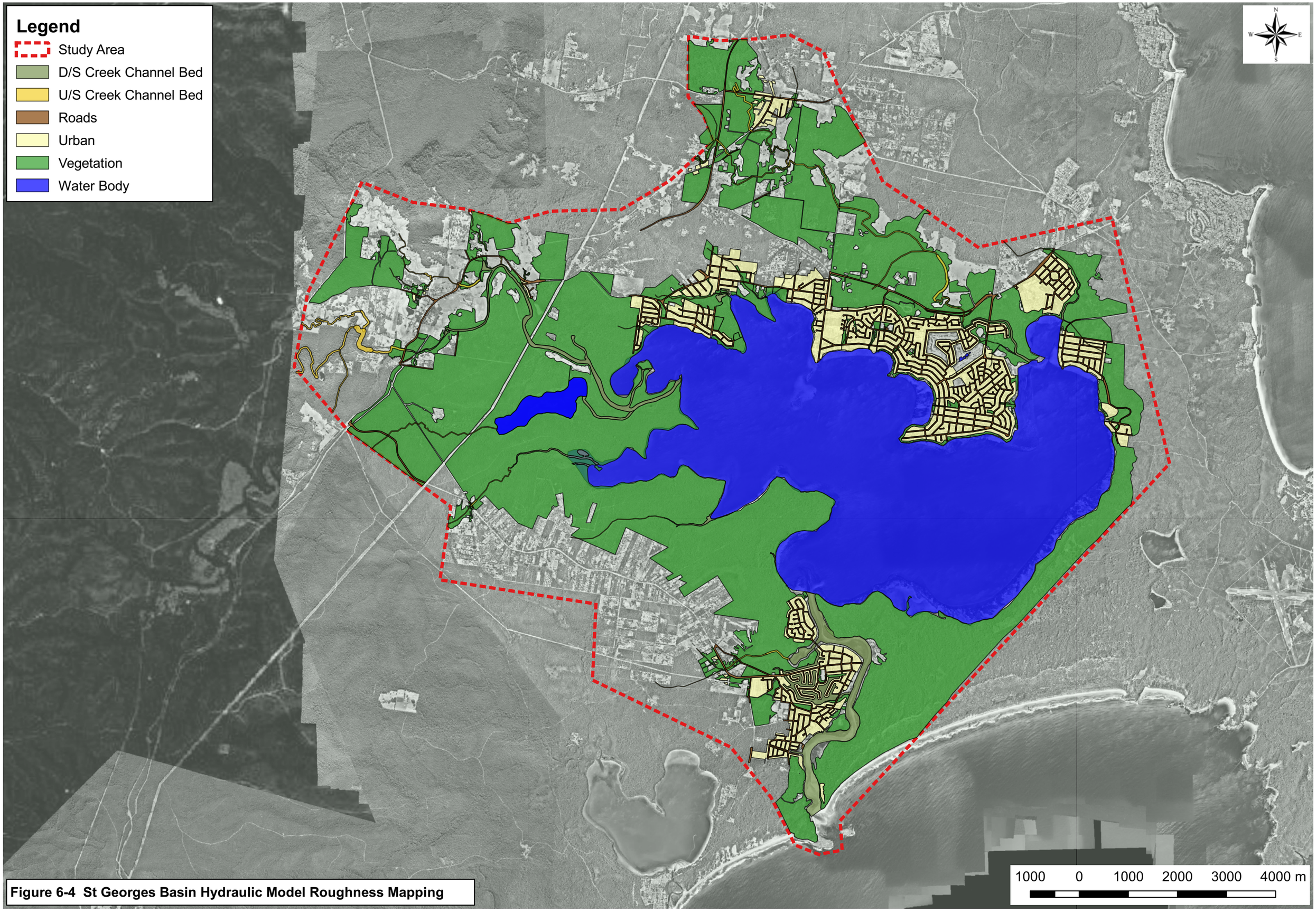


Figure 6-4 St Georges Basin Hydraulic Model Roughness Mapping

6.1.6 Structures and Blockage

There are 54 hydraulic structures that were modelled, which include 18 bridges, 20 culverts, 15 pipes and one spillway. Bridges were modelled as 2D flow constriction bridge elements in the 2D domain. Bridge piers, deck and handrail obstruction were calculated as form losses based on the *Incremental Backwater Coefficient for Piers (Hydraulics of Bridges and Waterways – Bradley, 1978)* and head loss equation for screens (refer QUDM, 2016 equation 12.2).

Culverts/ pipes were modelled in the 1d network. Where present, the handrails above culverts/pipes were modelled in the same manner as the bridge handrails. The blockage of all handrails was assumed to be 50%.

Unblocked bridges and culverts were adopted for the calibration and verification and for design events. This is due to lack of data to support selection of degree of blockage for individual structures. For the design event analysis different blockage scenarios are modelled as part of sensitivity testing.

It is noted that Council pit and pipe network in urban areas has not been included in the model.

6.1.7 Wind Wave Setup

Wind generated wave setup within St Georges Basin is not considered in the flood model and results presented are a “still water” level. St Georges Basin Flood Study (WMA, 2001) mentioned local residents reported that up to 0.5m difference in basin flood levels were observed in the 1971 flood due to the wind stress across the open water body. An assessment of wind/wave setup across the Basin has been undertaken for this study and is presented in **Section 9.8**.

7 Calibration and Validation

7.1 Methodology

Calibration is an iterative and complex process. It requires the investigation of many combinations of calibration parameters in a quest to achieve a suitable representation of the historical flood events. The August 2015 historical flood event was chosen for calibration and February 1971 and June 2013 storm events were selected in agreement with Council for validation. The selection of these historical storms is based on the following criteria:

- The event occurring within the period of record for rainfall and water level gauges or other flood observations/evidence;
- Minimum data gaps;
- The largest storm and the greatest recorded water level is preferred;
- Events to be as close as possible to the time of survey data (due to changes in creek alignment, sandbars, etc.).

The parameters used to calibrate the hydrologic/hydraulic models are the WBNM Lag Parameter ('C' value), the initial loss (IL) and continuing loss (CL) and the TUFLOW roughness (Manning's n). Sensitivity to changes in these parameters for the 2015 calibration event are discussed in **Section 7.2.9**. Sensitivity tests of parameters such as Manning's roughness, structure blockages and changes in tailwater and Sussex Inlet channel topography have been tested for design events and are discussed in **Section 9.6**.

Details and results for the historical calibration and validation events are discussed in **Sections 7.2** to **7.4**.

7.1.1 Entrance and Sussex Inlet Channel

Topographical data listed in **Section 5.1.3** were used in the storm event calibration. It is noted that limited data was available close to the time of each storm, therefore the topographical data used in the calibration may not appropriately reflect the actual terrain or other hydraulic conditions at the time of the event.

7.1.2 Culvert and Bridge Blockage Assumptions

Bridges and culverts were modelled as unblocked in the calibration scenarios. This is due to lack of data to support selection of degree of blockage for individual structures. For the design event analysis different blockage scenarios are modelled as part of sensitivity testing.

7.1.3 Model Parameters

A range of CL values were tested in the sensitivity runs. Adopted hydrologic model parameters of the calibration events are shown in **Table 7-1**. Manning's n values adopted are presented in **Table 7-2.**

Table 7-1 Adopted WBNM Parameters

Parameter	Adopted value in the Calibration
Initial loss (pervious surface)	5 mm
Continuing loss (pervious surface)	1.6 mm/hr
C (Catchment Lag parameter)	1.6

Table 7-2 Adopted Manning's n

Surface Type	Manning's n Value
Pasture (default)	0.035
Downstream Creek Channel (Creek Bed)	0.03
Upstream Creek Channel (Creek Bed)	0.03
Sussex Inlet Channel	0.03
Water Body/Basin	0.03
Roads	0.025
Urban Blocks	0.08
Dense Vegetation/Forest	0.12

7.2 August 2015 Storm Event

7.2.1 Description

The August 2015 storm is the most recent large flood event recorded in the study area. A peak water level at St Georges Basin was recorded as 1.8m AHD at 17:30 and 1.46m AHD at 21:30 on the 26 August 2015 at Island Point and Sussex Inlet gauges, respectively. Detailed flood level survey of the event is also available for the St Georges Basin catchment (Shoalhaven August 2015 Post Flood Survey Report).

7.2.2 Rainfall

Four daily rainfall gauges, Bendalong STP (68229), Nowra (68072), Sussex Inlet Bowling Club (68204) and Sanctuary Point (68088), along with Nowra RAN Air Station AWS (68072) had data available during the event. Isohyets of total event rainfall have been developed and presented in **Figure 7-1** which shows the distribution of rainfall across the catchment. The isohyets were developed through interpolation between the available rainfall gauge point data and is based on standard GIS inverse distance weighted (IDW) interpolation algorithm. It is noted that there is a lack of rainfall gauges in the western part of the catchment or outside the catchment to inform the rainfall in this part of the catchment. The Point Perpendicular gauge (68151) did not have reliable data available during this event.

Fifteen minute interval temporal patterns were derived from Nowra Ran Air Station AWS pluviometer data and applied to daily rainfall data at each gauge. The daily rainfall total was distributed over the temporal pattern at each gauge. The daily rainfall and temporal pattern data are plotted in **Figure 7-2** and **Figure 7-3,** respectively.

Rainfall data for each gauge was allocated to catchments nearest to that gauge as determined using Thiessen Polygons which draw polygons with sides equidistant from each gauge. The areas of the model within a polygon are therefore closest to the gauge within the polygon and assumed to have experienced rainfall similar to that gauge.

7.2.3 Entrance and Sussex Inlet Channel

Topographical data listed in **Section 6.1.3** were used in the storm event calibration. It is noted that limited data was available close to the time of the storm, therefore the topographical data used in the calibration may not appropriately reflect the actual terrain or other hydraulic conditions at the time of the August 2015 storm event.

7.2.4 Water Level Gauges & Downstream Boundary Levels

Water level data at Island Point and Sussex Inlet were used for hydraulic model calibration. The Jervis Bay ocean tide gauge was used as the downstream tailwater condition in the simulation. The locations of these three gauges are shown in **Figure 3-4**. The peak water level was recorded at 17:30 and 21:30 on the 26/08/2015 at Island Point and Sussex Inlet, respectively. The water level data during the event is plotted in **Figure 7-4.**

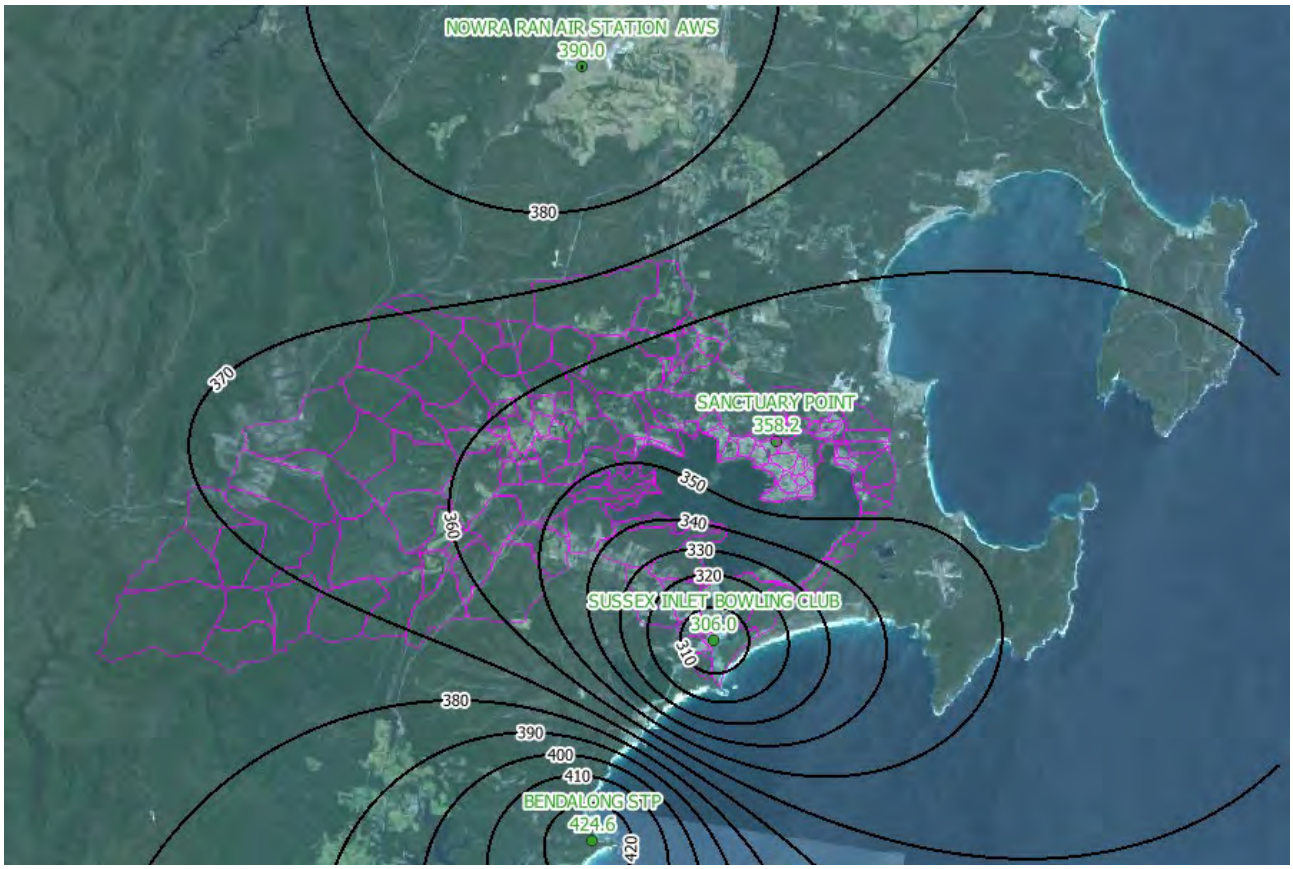


Figure 7-1 Rainfall Isohyet - 2015 event 48 Hours (24/08 – 25/08) Total Rainfall (mm)

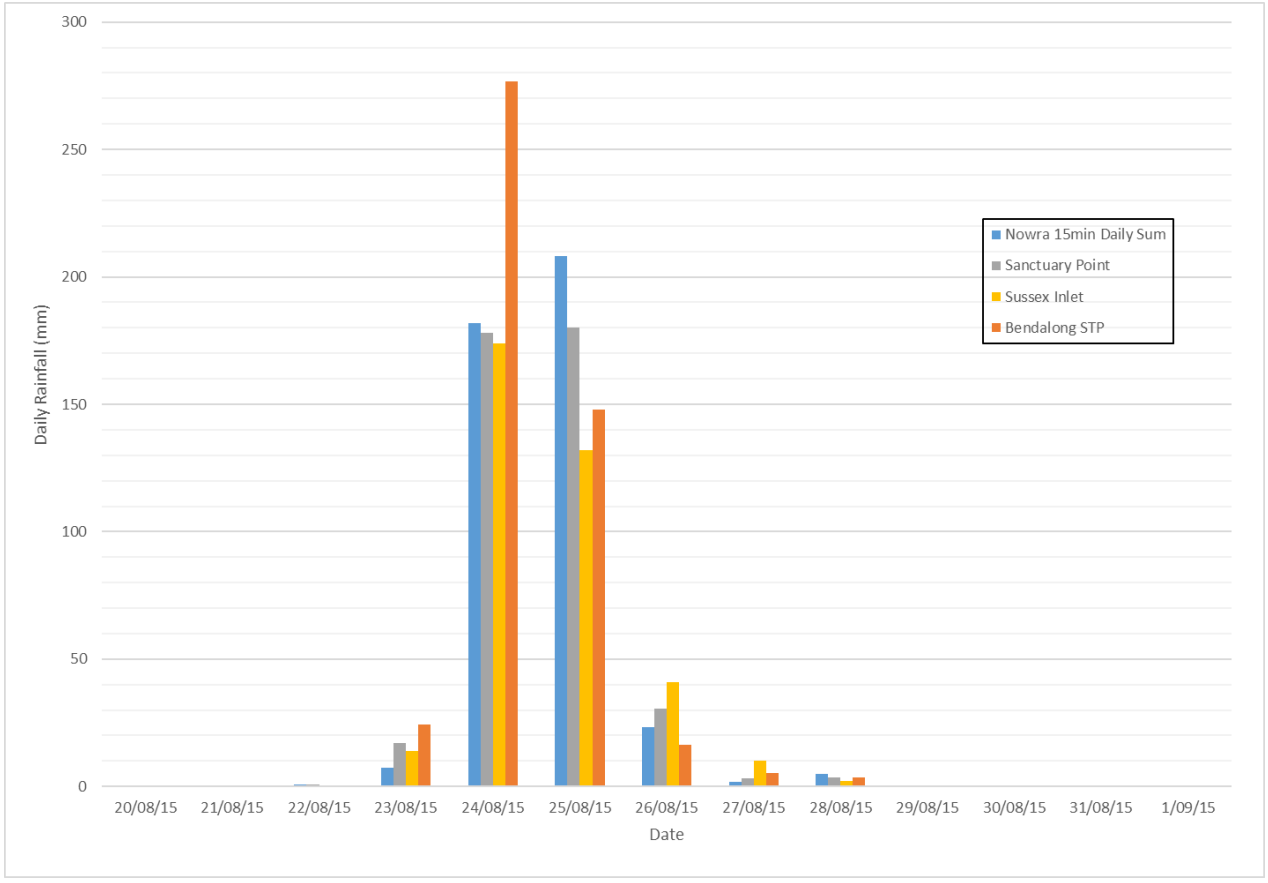


Figure 7-2 August 2015 Daily Rainfall Totals

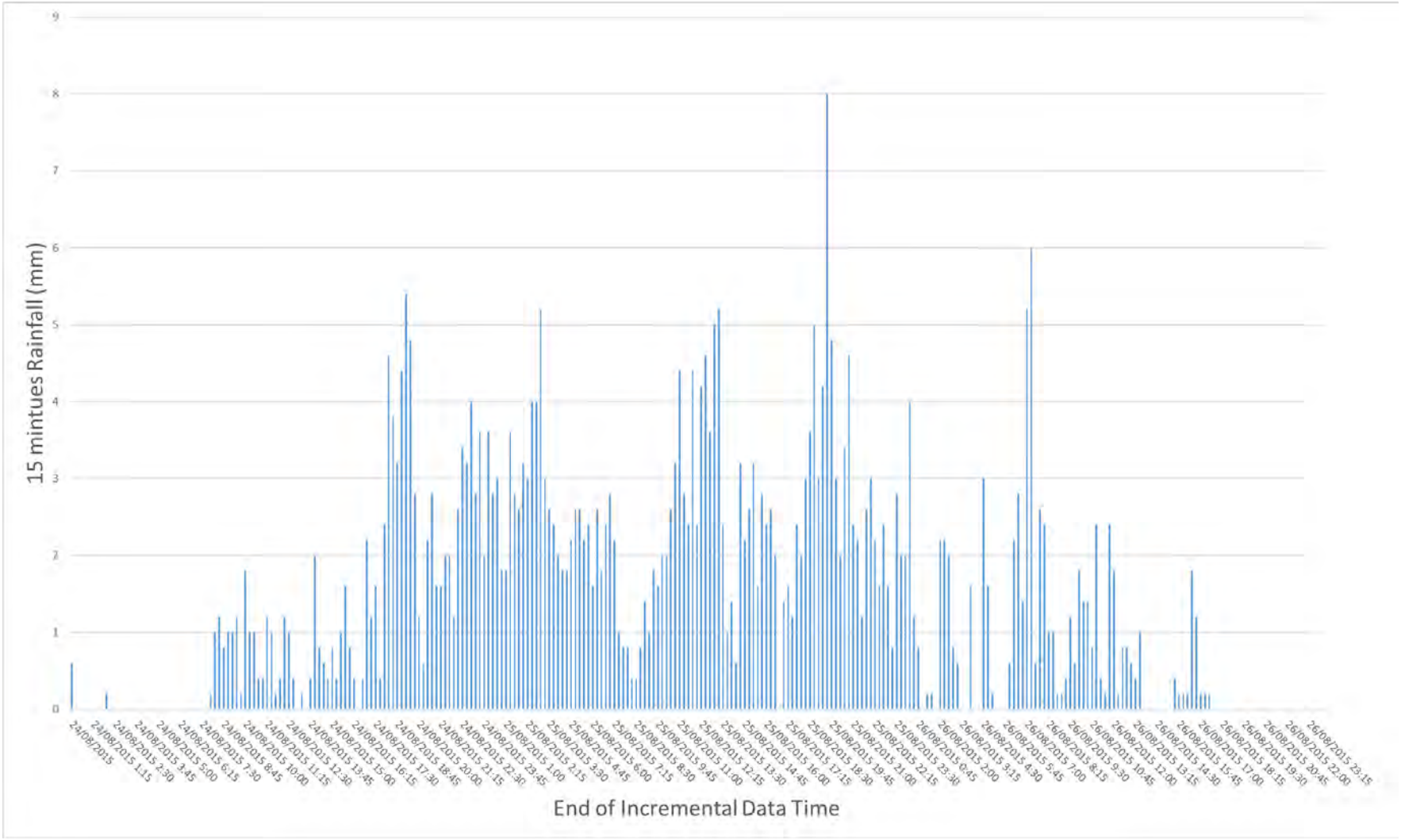


Figure 7-3 August 2015 Temporal Patterns – Nowra Ran Air Station AWS Pluviometer

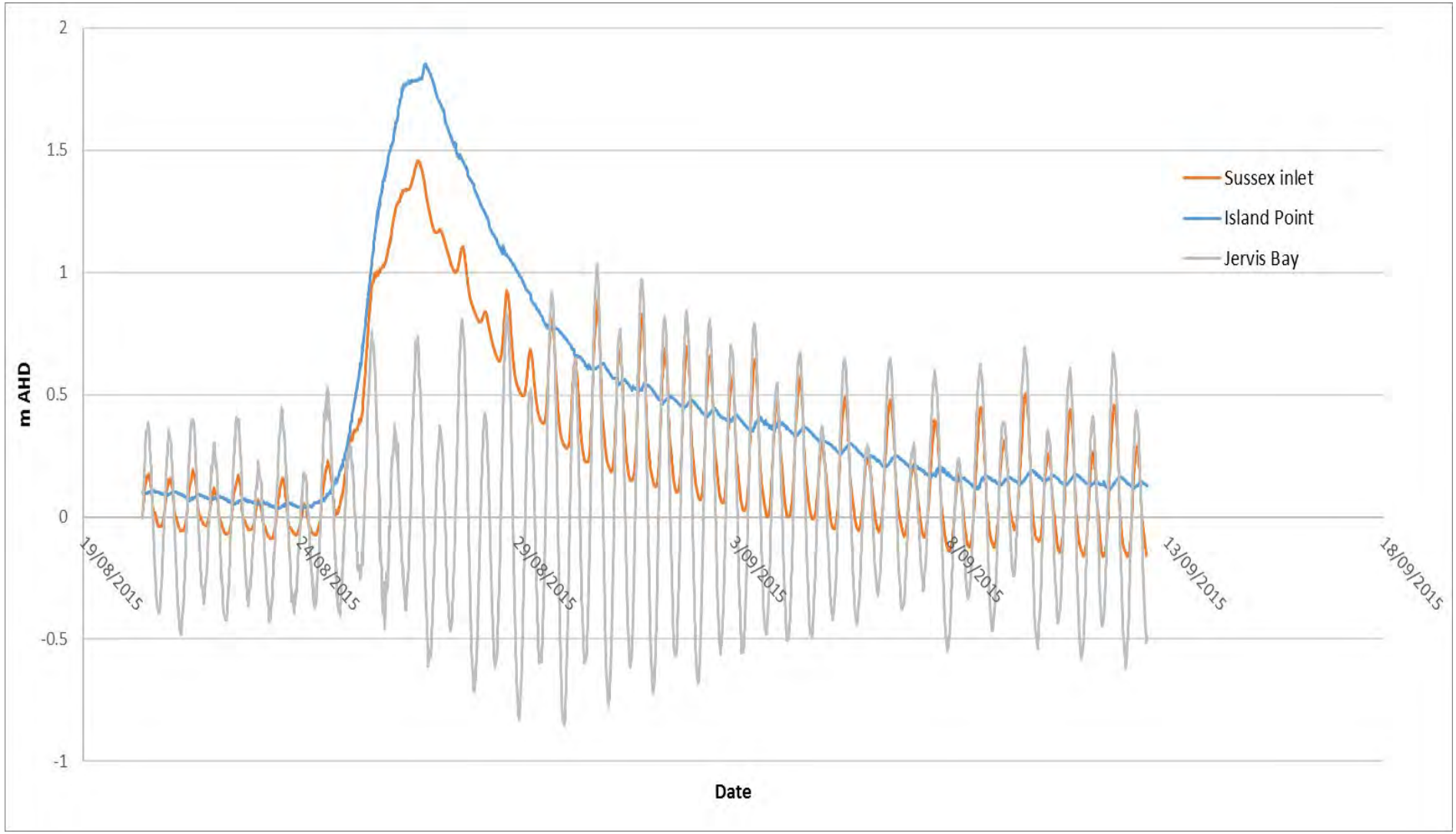


Figure 7-4 August 2015 Water Level Data (MHL)

7.2.5 Comparison to Recorded MHL Gauge Levels

Modelled flood levels of the August 2015 storm are plotted with the recorded MHL gauge levels at Sussex Inlet and Island Point in **Figure 7-5** and **Figure 7-6** respectively.

The Sussex inlet comparison shows a good correlation with gauged flood levels at both the start and end of the storm. Although some scour might have occurred at the end of event, the model is able to accurately represent the tidal response accurately before and after the flood flows begin. The peak is slightly underestimated in the model by 55 mm.

The modelled peak level is also slightly lower than recorded levels by approximately 100mm at Island Point, which represents the St Georges Basin flood level. This could be attributed to wind setup across the Basin as discussed in **Section 6.1.7.** An assessment of wind wave climate during the event (**Appendix K**) indicates that wind setup and wave runup for the prevailing wind conditions may have been expected to add up to 100mm at Island Point which when added to the modelled 'still water' levels would provide a closer match to the gauged water level.

7.2.6 Comparison to Surveyed Flood Marks

A comparison of modelled flood levels with surveyed flood levels at various locations around St Georges Basin for the August 2015 event are shown in **Figure 7-7** and tabulated in **Appendix E. Table 7-3** provides a summary of the average difference and the standard deviation between the modelled peak water levels and the surveyed data.

A good correlation of peak levels is achieved in Sussex Inlet Area except point 129 where detailed bathymetry data is not available. A consistent peak level (1.758 m AHD) is derived from the model across the entire basin area as the model does not account for water level variations due to wave setup. Various flood mark levels were surveyed in the basin area ranging from 1.638m AHD to 1.962m AHD. The Cardno modelled level of 1.758 m AHD in the basin appears to be 100-200mm lower than reported levels along the northern shore of the basin and approximately 100mm higher than levels on the southern shore. This indicates the likelihood of wind wave setup across the basin to explain the water level fluctuation observed between the southern shore and northern shore. An assessment of wind wave climate during the event (**Appendix K**) indicates that wind setup and wave runup for the prevailing wind conditions may be expected to add between 80mm at Basin View, 100mm at Island Point and up to 250mm at Paradise Beach.

Table 7-3 Summary of the Difference between Modelled and Surveyed Flood Level

	Predicted Peak minus Surveyed Peak Flood Level
Mean Difference	-0.060
Standard Deviation	0.112
Count	30

7.2.7 Comparison to Community Consultation Flood Depth

From the Community Consultation, a total of 55 responses were provided through the Survey Monkey Consultation questionnaire. Of the 55 respondents 33 indicated that their property had been affected by flooding, of these 10 respondents provided depths for the calibration events. Flood depths were provided by eight respondents for the August 2015 Event, four for the June 2013 Event and nil for the February 1971 Event. The location of these responses for the August 2015 event is shown in **Figure 7-8**.

Table 7-4 shows the comparison of the depths provided and the modelled results.

Table 7-4 Calibration to information received for the 2015 Event through Community Consultation

Respondent ID	Location	Provided Depth (m)	Modelled Depth (m)	Difference (m)	Comments
8	Tomerong Ck	0.10	0.159	0.059	Riparian area across the road from the property
9	Swan Lake	0.05	N/A	N/A	Not in the study area
10	Island Point	0.05	0.002-0.033	-0.048 to -0.017	In adjacent riparian area potentially subject to wave runup
12	Erowal Bay	1.0	0.89	-0.11	Good correlation
21	Tomerong Ck	0.30	0.33	0.03	Good correlation
22	Swan Lake	0.35	N/A	N/A	Not in the study area
26	Worrowing Ck	0.90	0.68	-0.23	Backyard – potential inaccuracy of ALS
44	Tomerong Ck	0.03	0.04	0.01	Good correlation

7.2.8 Time of inundation

Time of inundation for the major roads in the study area were estimated for each calibration event. The time was calculated based on water levels over the central line of the road crossing the water course. It takes account from the time water depth is greater than 200mm until flood water recedes to less than 200mm deep. Time and location of the road cut off for the August 2015 event is presented in Figure 7-9.

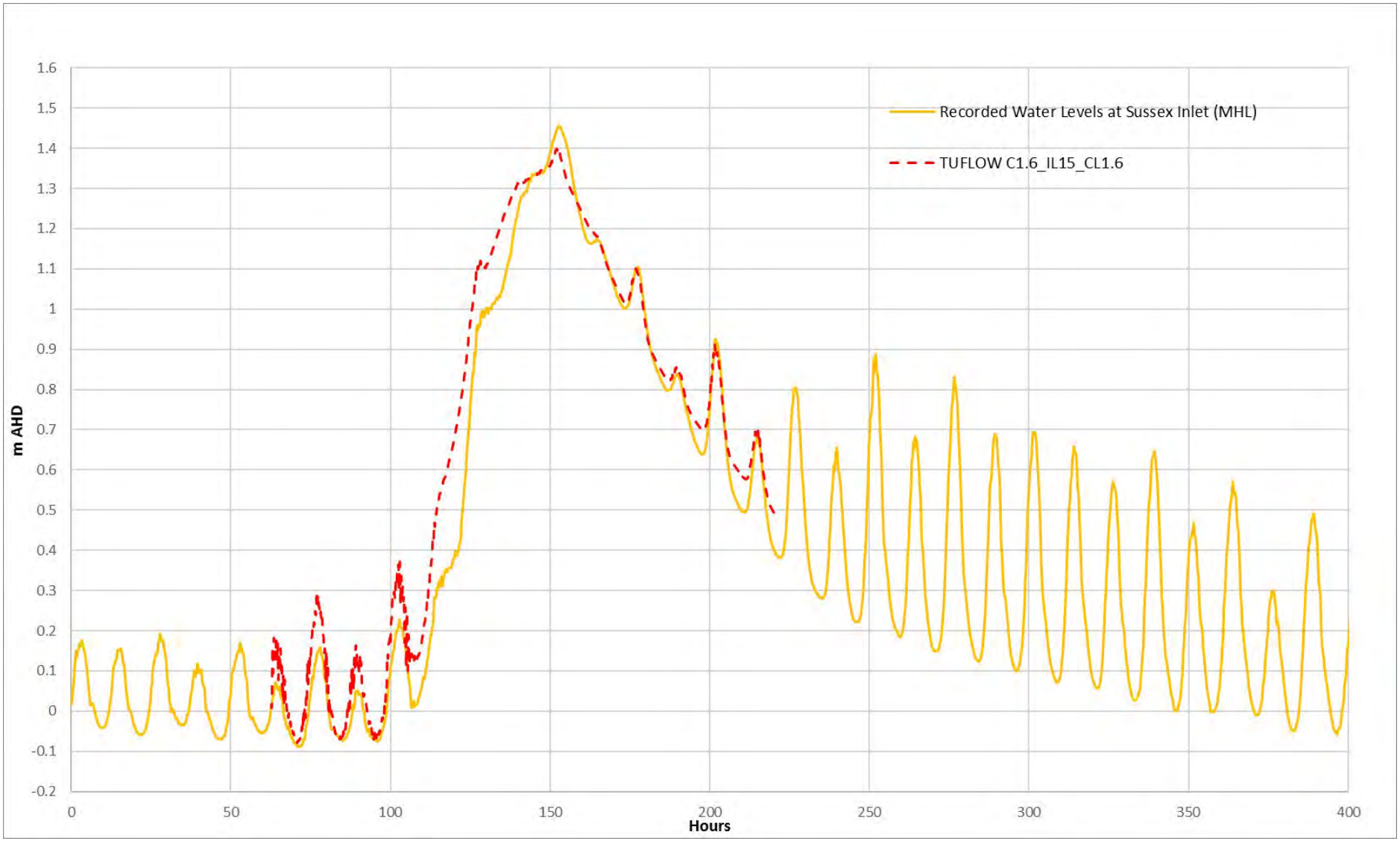


Figure 7-5 Modelled Flood Levels and Recorded MHL Gauge Levels at Sussex Inlet, 2015 Event

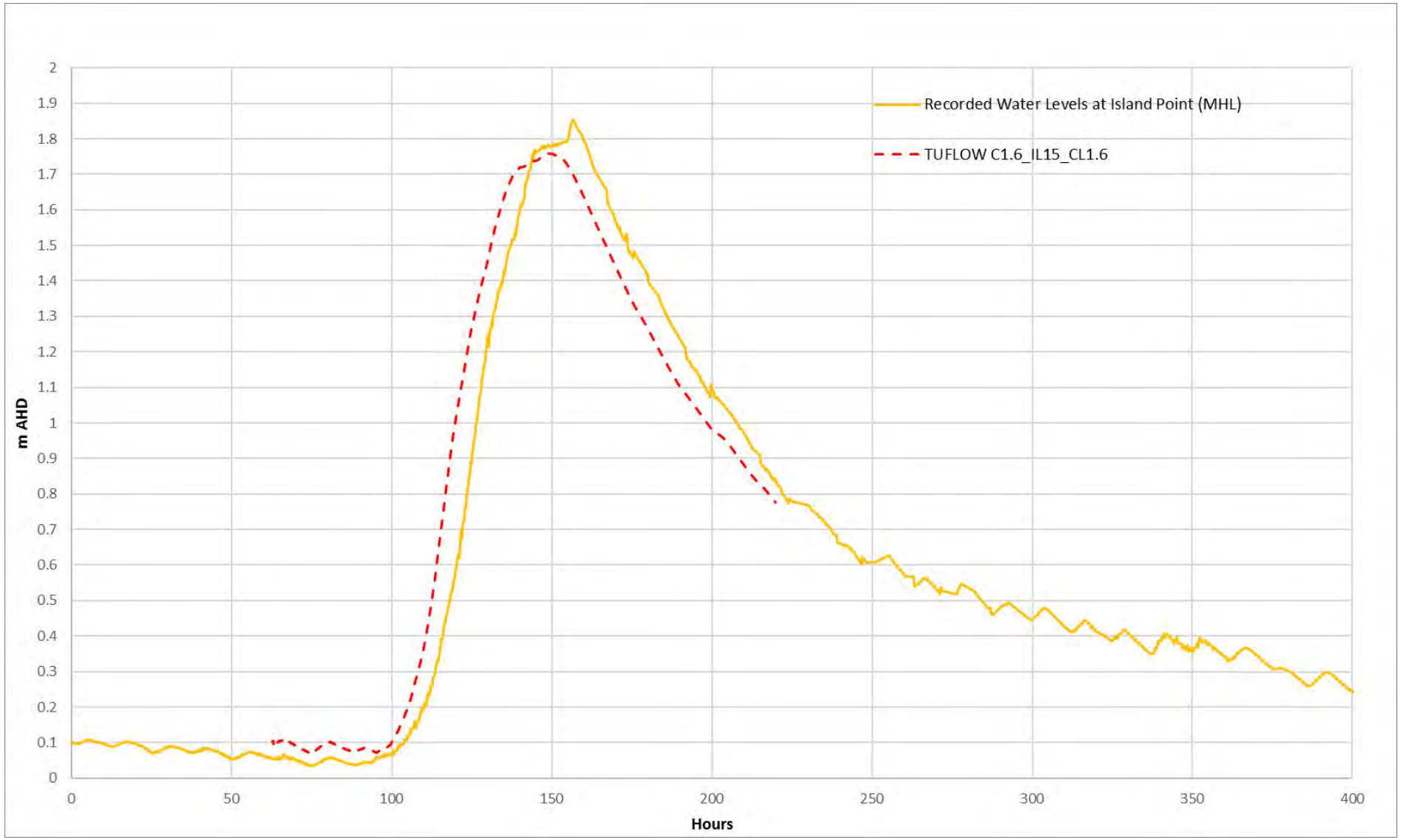


Figure 7-6 Modelled Flood Levels and Recorded MHL Gauge Levels at Island Point, 2015 Event

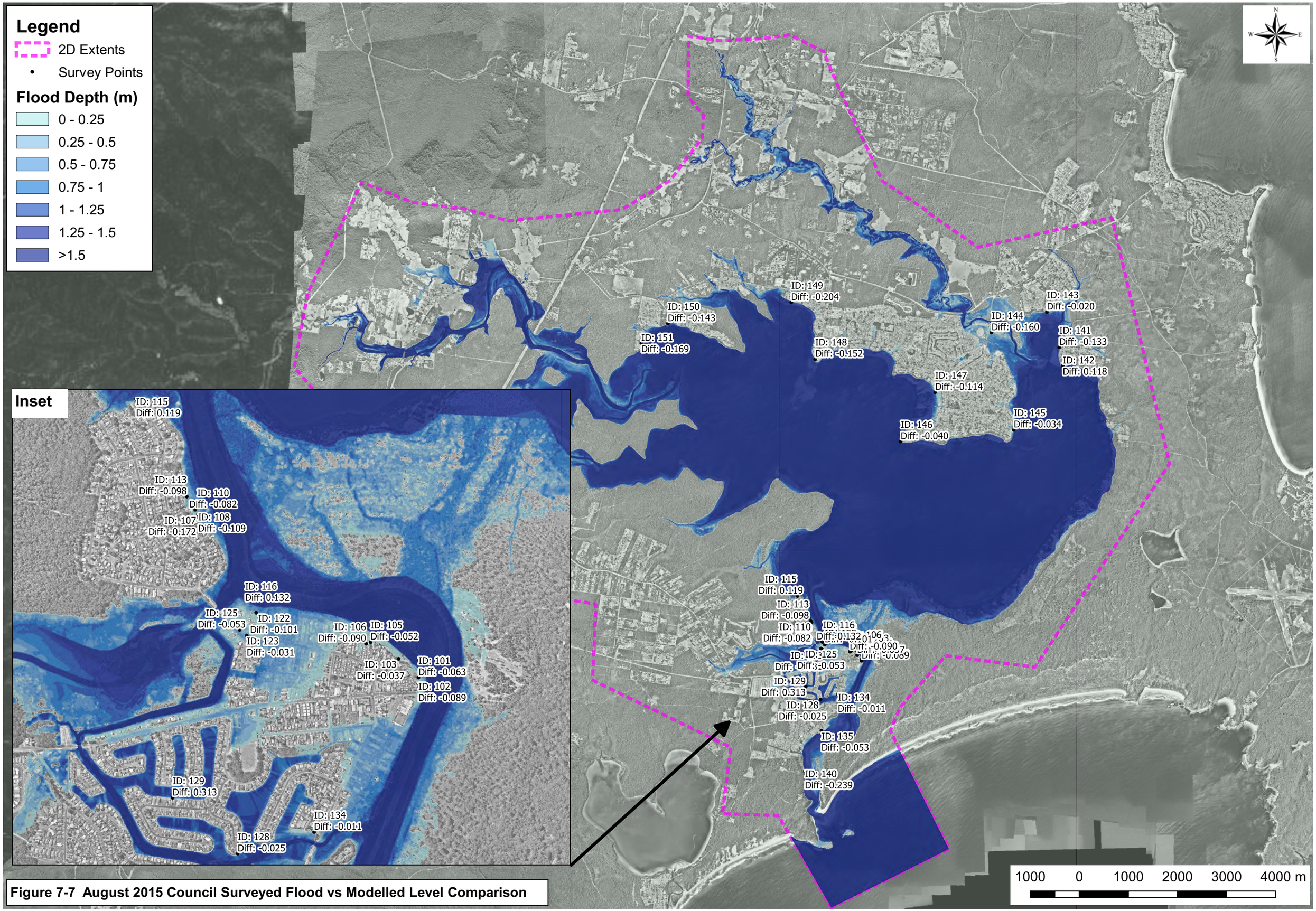


Figure 7-7 August 2015 Council Surveyed Flood vs Modelled Level Comparison

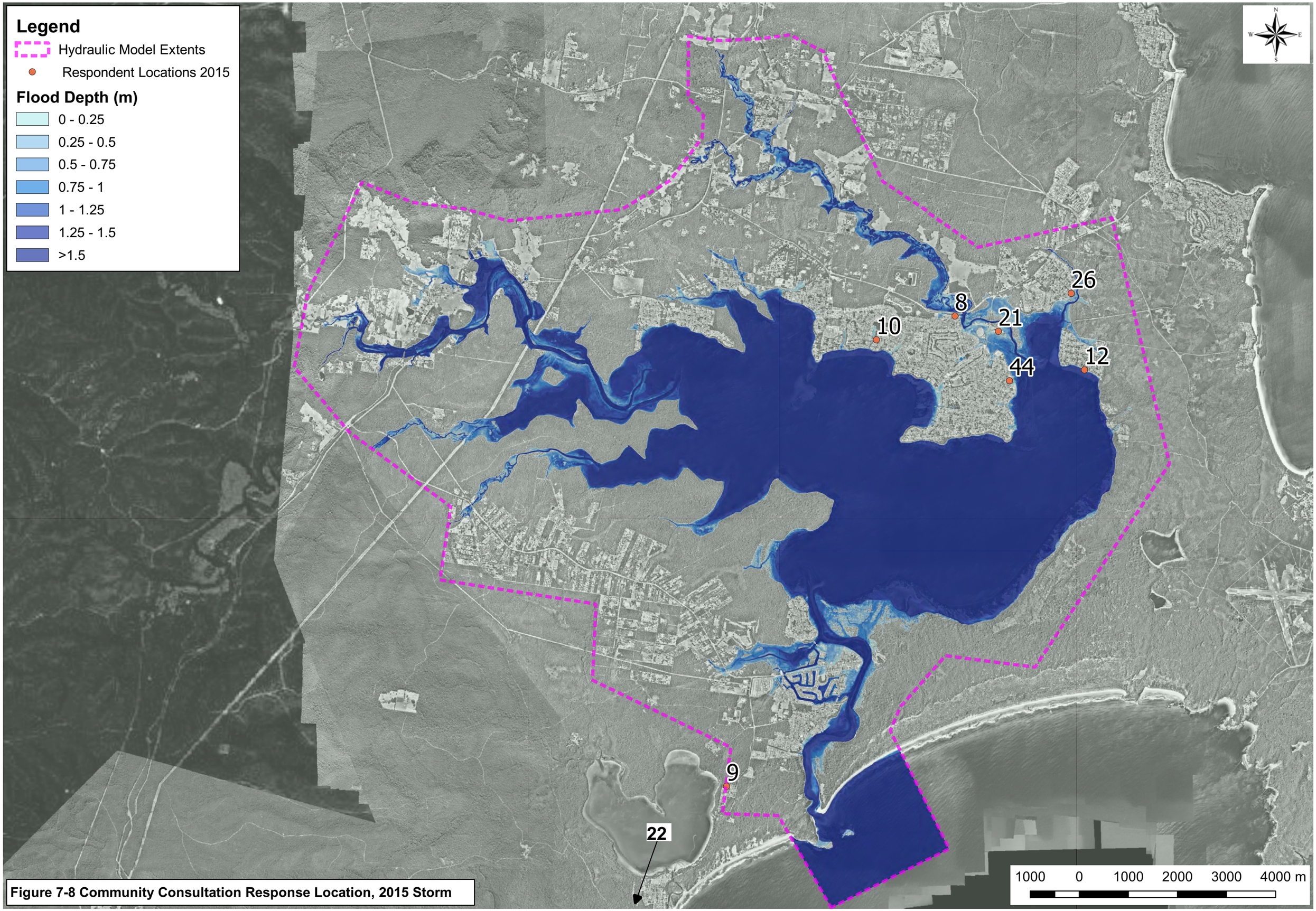


Figure 7-8 Community Consultation Response Location, 2015 Storm

Legend

- Model Extents
- Road Line
- Road & Estimated Time Flood Water over 200mm

~2 Days 10 Hours
William Bryce Rd.

~1 Day 4 Hours
Battunga Dr.

1Day 6 Hours
Windley Rd.

~1 Hour
The Wool Rd.

~21 Hours to 28 Hours
The Wool Rd. & Birriga Av

> 1 Day 21Hours
River Rd.

TURPENTINE ROAD
YARRAN ROAD
PRINCES HIGHWAY
HUSKISSON
TOMERONG
NAVAL COLLEGE ROAD
PARNELL ROAD
VINCENTIA
WARNE ROAD
ISLAND POINT ROAD
WORROWING HEIGHTS
OLD EROWAL BAY
COLLEGE ROAD
WANDANDIAN
BEWONG
ST GEORGES BASIN
BASIN VIEW
EROWAL BAY
KALLAROO ROAD
HYAMS BEACH
TULLARWALLA
SANCTUARY POINT
BREAM BEACH
WRIGHTS BEACH
JERRAWANGALA
WENTS ROAD
SUSSEX INLET ROAD
MOKAU ROAD
ELLMOOS ROAD
CAVE BEACH ROAD
BITOU LANE
CHRISTIANS MINDE
SUSSEX INLET
WRECK BAY ROAD
WRECK BAY
OLD BERRARA ROAD
SOUTHDOWN TRAIL
MONDAYONG
SUSSEX INLET SOUTH
TWELVE MILE PEG
SLATYBOX ROAD
BERRARA ROAD
SWANHAVEN
STRINGYBARK ROAD
GRASSTREE ROAD
CUDMIRRAH

22

1,000 0 1,000 2,000 3,000 4,000 m

Figure 7-9 Time of inundation, 2015 Storm Event

7.2.9 Model Parameter Sensitivity

Sensitivity tests were carried out for the 2015 storm event to determine the effects of varying parameters in both the hydrologic and hydraulic models. These runs were carried out during the calibration to improve the models' representation of the historical floods. The analyses of the hydrologic parameters are provided in the following sections. Hydraulic parameters, i.e. roughness, hydraulic structures blockage, tests have also been carried out.

Cardno incorporated basin storage in the hydrologic modelling and tested a range of C value, initial losses (IL) and continuing loss (CL) in WBNM to check the sensitivity of the parameters to the corresponding basin water levels. Three tests were undertaken for each of the three WBNM parameters (C, IL and CL) with other two parameters fixed. Details are presented in **Table 7-5, Table 7-6** and **Table 7-7.** Results are plotted along with the recorded water levels at Island Point MHL gauge (refer **Figure 7-10, Figure 7-11** and **Figure 7-12**).

Table 7-5 Check C sensitivity value in WBNM using IL of 5mm and CL of 1.6mm/hr

C	Comment
1.3	Lower bound recommendation and used in previous study
1.6	Default value
1.8	Upper bound value

Table 7-6 Check IL in WBNM using C of 1.6 and CL of 1.6mm/hr

IL	Comment
5	Used in previous study
15	Mid value
26	ARR data hub value

Table 7-7 Check CL in WBNM using C of 1.6 and IL of 15mm

CL	Comment
1.0	Lower bound value
1.6	ARR data hub value of 4mm/hr x 0.4
2.5	Used in previous flood study

It was found from the WBNM analysis, that changing CL has the greatest effect on Basin water level, while changing the C value and IL has a small impact. Cardno then simulated three different CL values (1.0, 1.6 and 2.5 mm/hr) in WBNM and TUFLOW with default C value of 1.6 and an IL of 5.0mm as was used in the previous study (St Georges Basin Flood Study, 2001). Results at Island Point and Sussex Inlet are plotted in **Figure 7-13** and **Figure 7-14** respectively. The results confirm that changing CL has the greatest impact on flood water levels.

Although the sensitivity assessment shows that a CL=1 mm/hr achieves the best match of the peak water levels in the basin, this continuing loss value is very low for pervious catchment areas compared with typical values. It is likely that adopting a higher value of 1.6 mm/hr is appropriate and the lower peak predicted in the calibration is attributed to either missing rainfall volume due to the fairly sparse distribution of data and/or wind/wave setup in the lake causing elevated water levels at the gauge location. A CL=1.6mm/hr is also consistent with the continuing loss guidance provided in ARR2019 and adopting a CL=1mm/hr for design events may lead to an overestimate of flood volumes.

Results of further sensitivity checks undertaken adjusting the allocation of rainfall gauge data across the catchment for both 2015 and 2013 storm events showed that adjusting the rainfall distribution was able to improve the match to the peak flood level in each event. This demonstrates that the rainfall amount and pattern are also integral to obtaining a good replication of flood behaviour in calibration. Lack of a good distribution of rainfall gauge data within a catchment can mean that some rainfall behaviour may not be well

represented by the available data. Hence, differences between modelled and gauged flood levels can be explained by actual rainfall data in certain parts of the catchment not being represented in the model.

It is observed that the TUFLOW model produces a closer match to the timing of the hydrograph for historical events than the WBNM hydrologic model. This is because the in-stream routing determined in the WBNM hydrologic model does not account for storage and roughness values reflected in the hydraulic model.

7.2.10 Conclusion

The overall response of the hydrologic and hydraulic model at the two MHL water level gauges show a good correlation with recorded data with peak water levels slightly lower than gauged. Although it is evident that scouring of the entrance and Sussex Inlet channel occur during the event, the adopted fixed model bathymetry is able to reasonably represent the tidal response, with some overestimation before and underestimation after the flood flows begin. This indicates that the Sussex Inlet channel was more constricted than assumed at the start of the event and scoured significantly during the event to become wider/deeper than assumed.

A good correlation of peak levels is achieved at the surveyed flood marks and levels/depths reported by the community. The average difference between predicted and surveyed peak levels is calculated to be -0.06m and the standard deviation is 0.11m for the August 2015 storm event.

Both the hydrologic and hydraulic models in combination have been able to represent the August 2015 flood event hydraulic behaviour reasonably accurately and the models are considered to be well calibrated for use in design flood estimation.

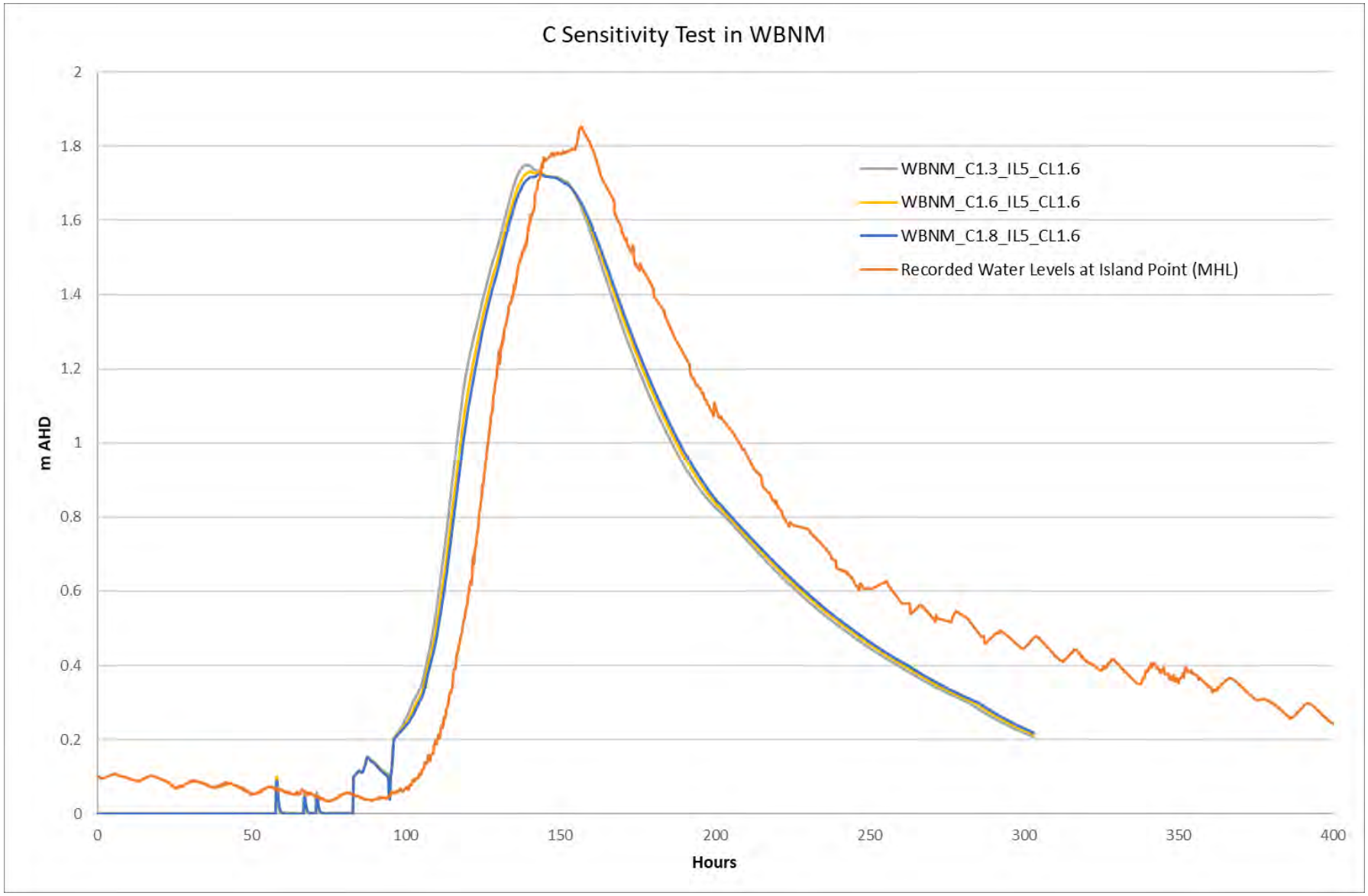


Figure 7-10 Sensitivity Test for lag parameter (C value) in WBNM at Island Point for the 2015 storm event

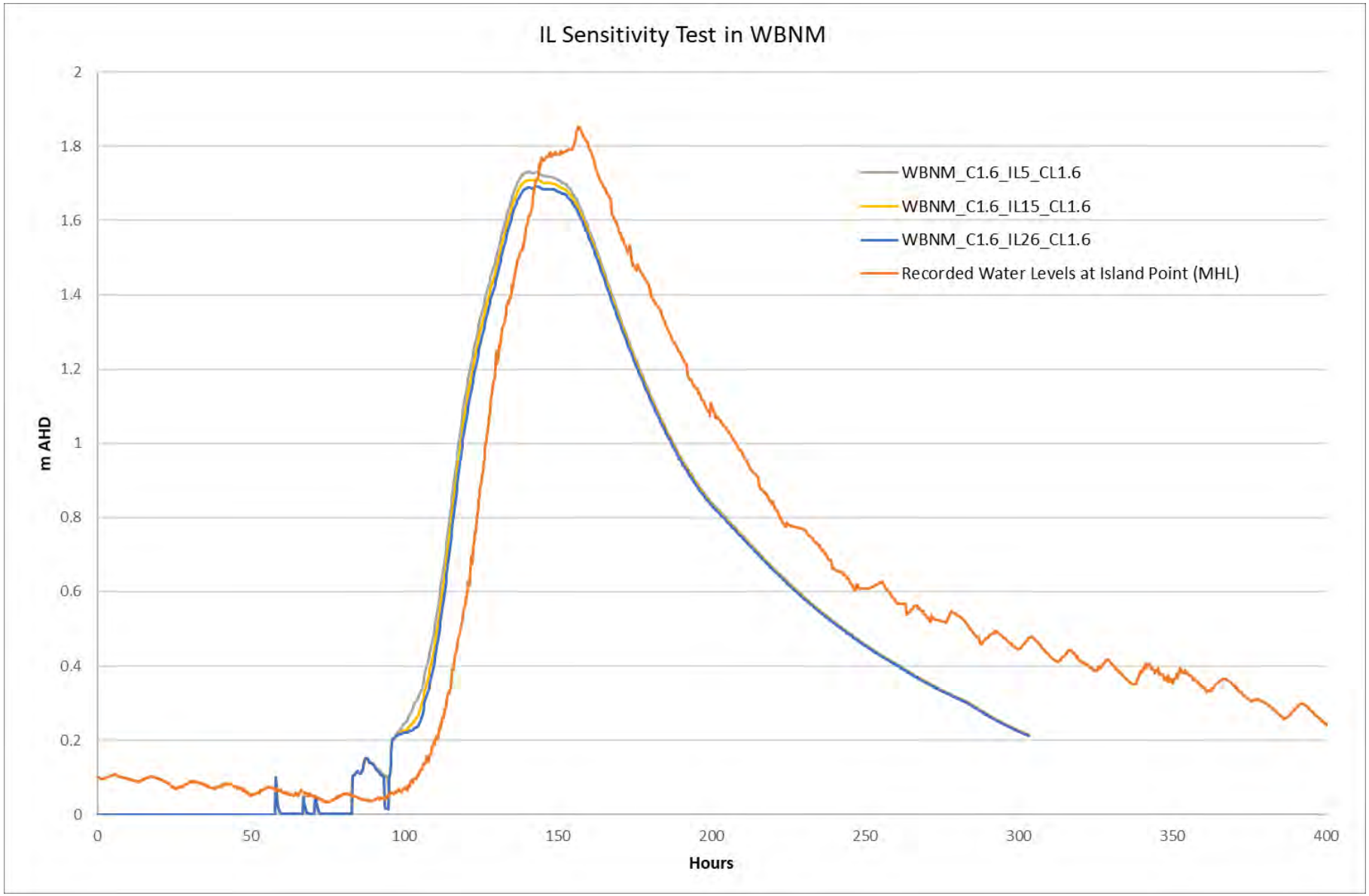


Figure 7-11 Sensitivity Test for Initial Loss (IL) in WBNM at Island Point for the 2015 storm event

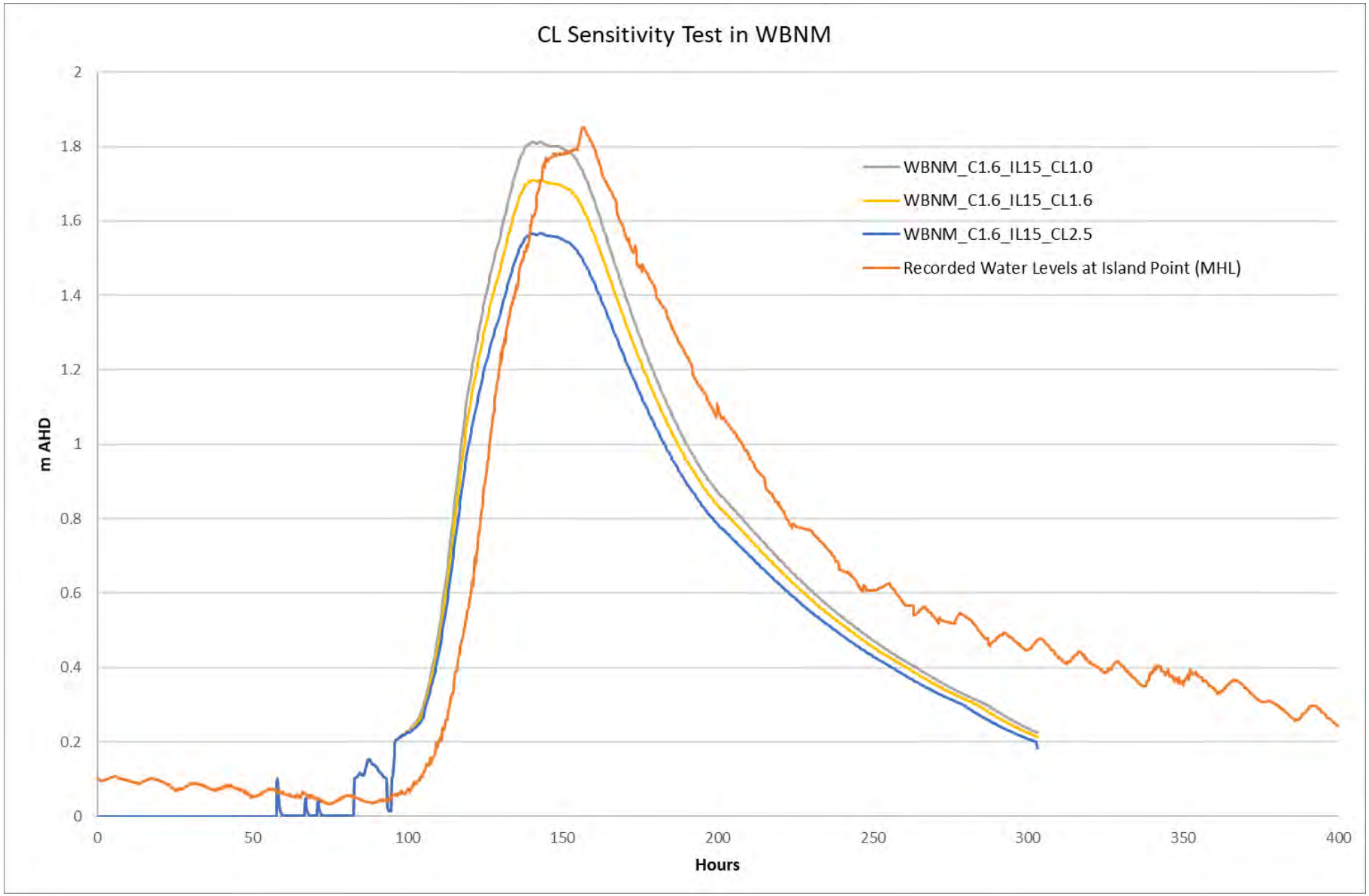


Figure 7-12 Sensitivity Test for Continuing Loss (CL) in WBNM at Island Point for the 2015 storm event

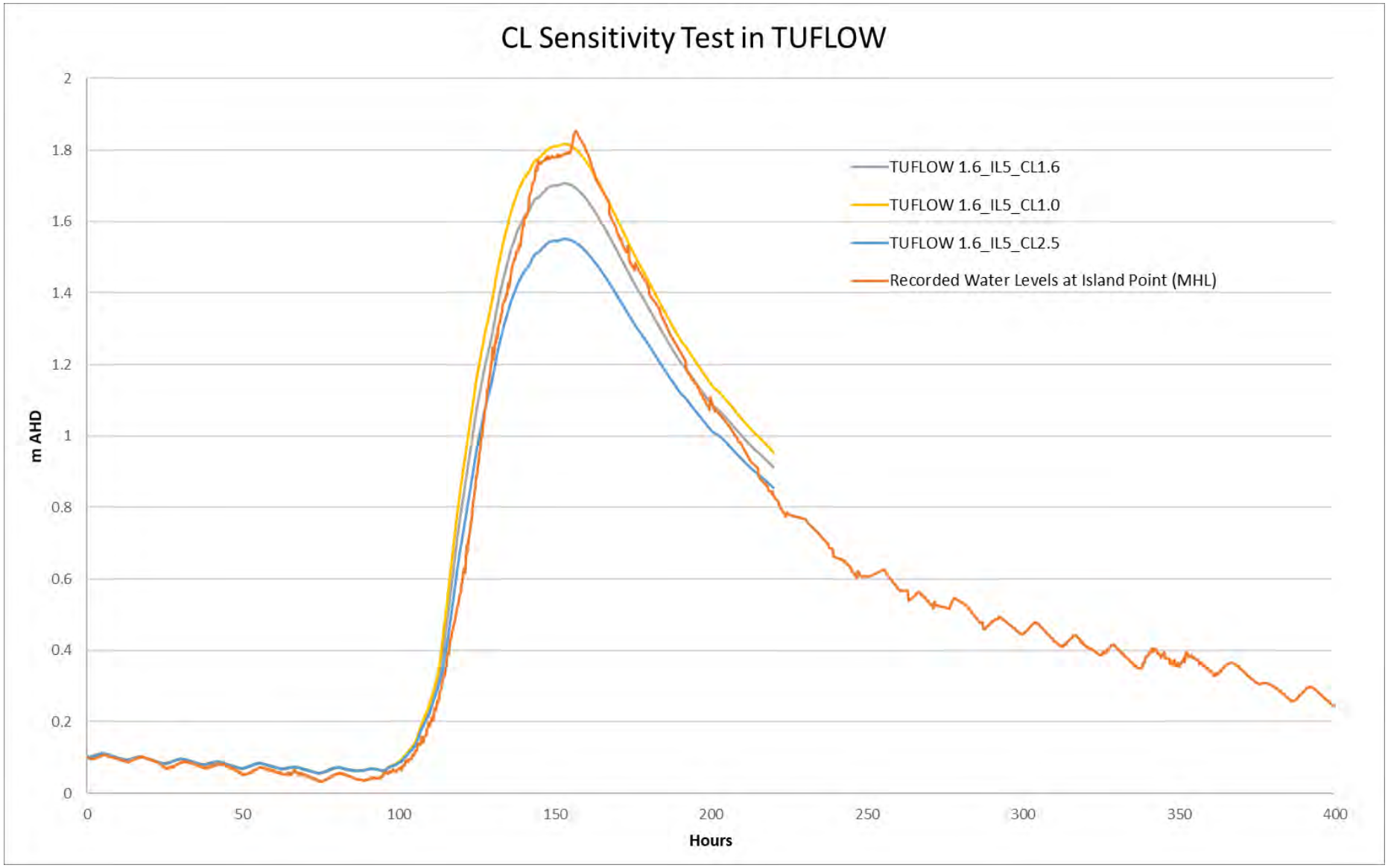


Figure 7-13 Sensitivity Test for Continuing Loss (CL) in TUFLOW at Island Point for the 2015 storm event

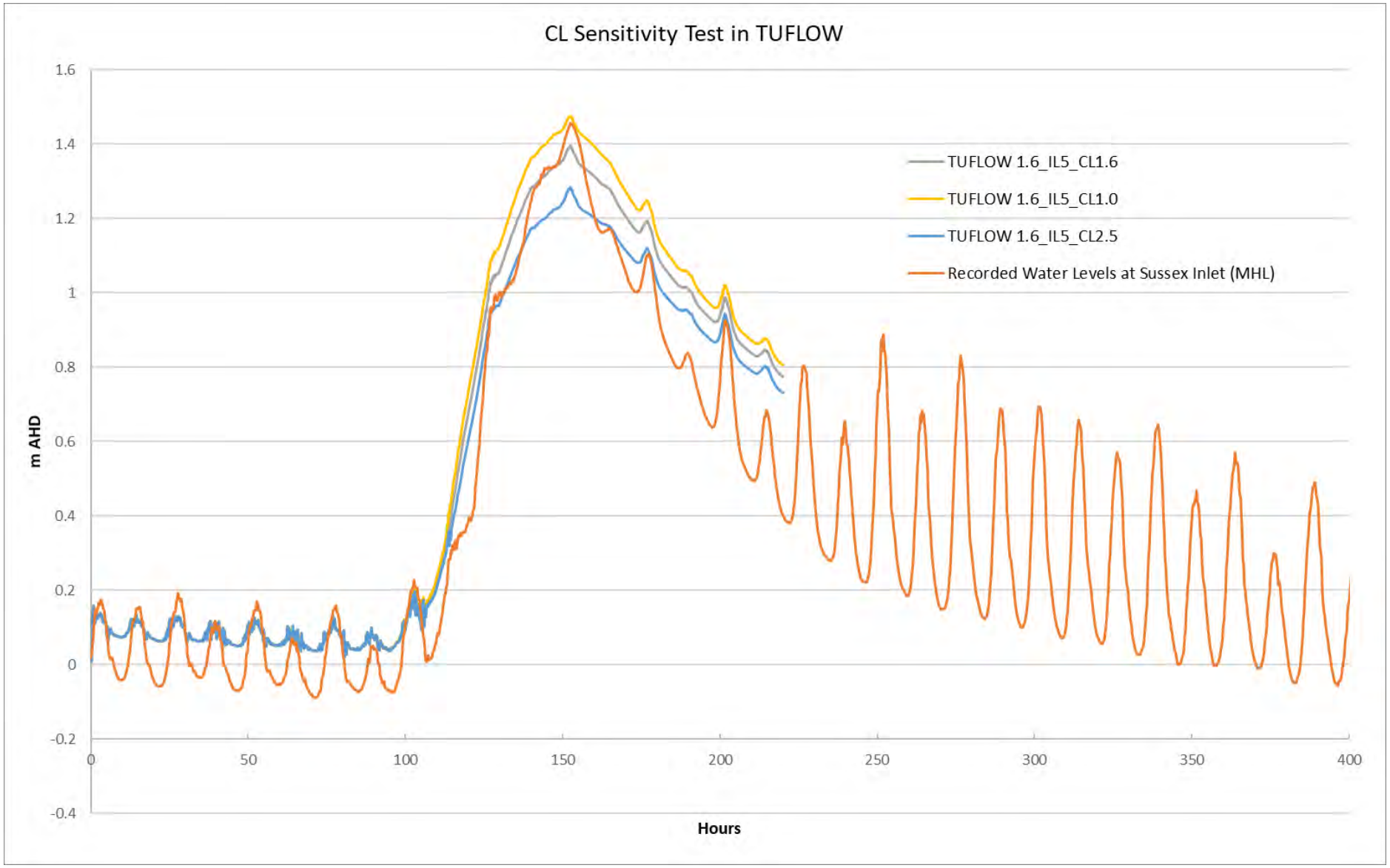


Figure 7-14 Sensitivity Test for Continuing Loss (CL) in TUFLOW at Sussex Inlet for the 2015 storm event

7.3 June 2013 Storm Event

7.3.1 Description

The June 2013 storm is the second largest event recorded by MHL gauges, with gauged data available in the study area. A peak water level at St Georges Basin was recorded as 1.418 m AHD and 1.243 m AHD at the Island Point and Sussex Inlet gauge, respectively. The peak was recorded at 22:00 on 25/06/2013 and 06:30 on 26/06/2013 at Island Point and Sussex Inlet, respectively. Detailed flood level survey of the event is not available for the St Georges Basin catchment.

7.3.2 Rainfall

Five daily rainfall gauges, Bendalong STP (68229), Nowra (68072), Point Perpendicular (68151), Sussex Inlet Bowling Club (68204), Sanctuary Point (68088) and Nowra RAN Air Station AWS (68072) had available data for the June 2013 event. In addition, due to a lack of rainfall gauges in the western part of the catchment, historical rain radar was assessed for the event, which showed that the western part of the catchment experienced similar rainfall to Nowra RAN Air Station AWS radar. The western part of the catchment also has similar topographic characteristics to the Nowra AWS as opposed to the more coastal gauges.

A Nowra Dummy gauge was adopted with identical rainfall data and pattern to Nowra AWS gauge and placed at the western extent of the catchment as representative of rainfall in this area. The approach was discussed with DPE and Council and was considered to be reasonable for the purpose of modelling the June 2013 event.

Isohyets of total event rainfall have been developed and presented in **Figure 7-15** which shows the distribution of rainfall across the catchment.

Fifteen minute interval temporal patterns were derived from Point Perpendicular (68151) pluviometer data and applied to Bendalong STP (68229), Sussex Inlet Bowling Club (68204) and Sanctuary Point (68088) gauges. Nowra RAN Air Station AWS (68072) temporal patterns were used on the Nowra (68072) and Nowra Dummy gauges. The daily rainfalls are plotted in **Figure 7-16,** and temporal pattern data at the two AWS gauges are plotted in **Figure 7-17**.

Rainfall data for each gauge was allocated to catchments nearest to that gauge as determined using Thiessen Polygons.

7.3.3 Water Level Gauges & Downstream Boundary Levels

Water level data at Island Point and Sussex inlet were used for hydraulic model validation. The Jervis Bay ocean tide gauge was used as the downstream tailwater condition in the simulation. The locations of these three gauges are shown in **Figure 3-4**. The water level data of the storm are plotted in **Figure 7-18.**

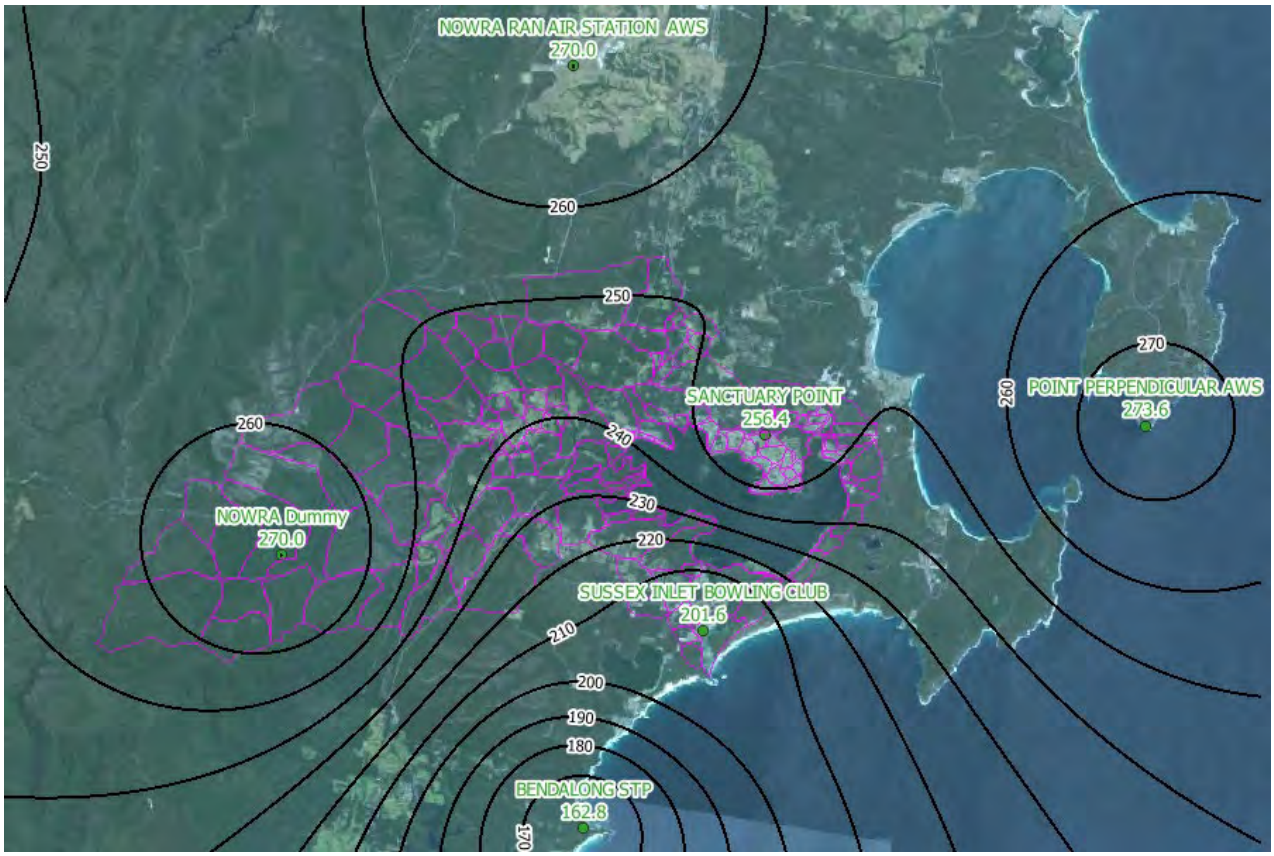


Figure 7-15 Rainfall Isohyet – 2013 Event 72 Hours (23/06 – 25/06) Total Rainfall (mm)

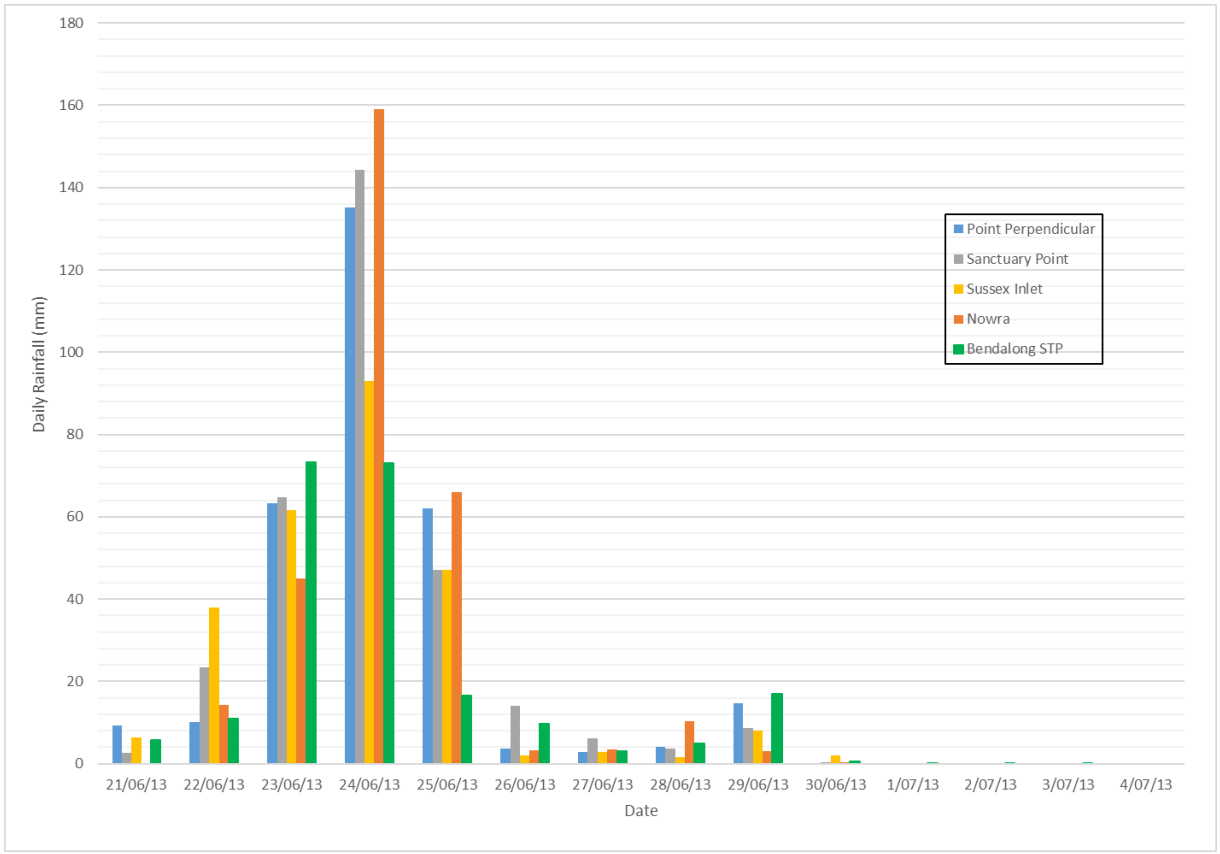


Figure 7-16 June 2013 Daily Rainfall Totals

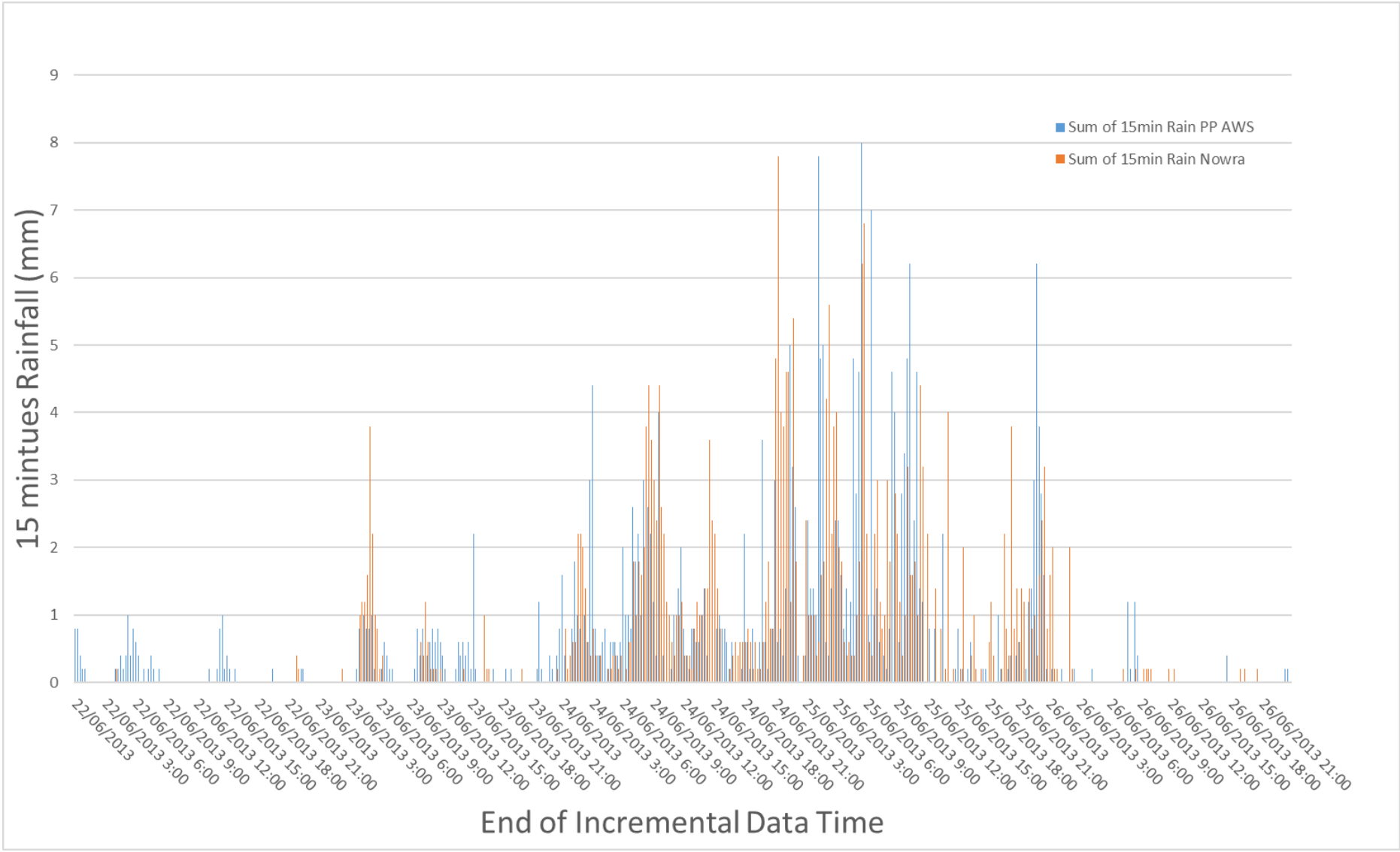


Figure 7-17 June 2013 Temporal Patterns – Point Perpendicular AWS & Nowra RAN Air Station AWS

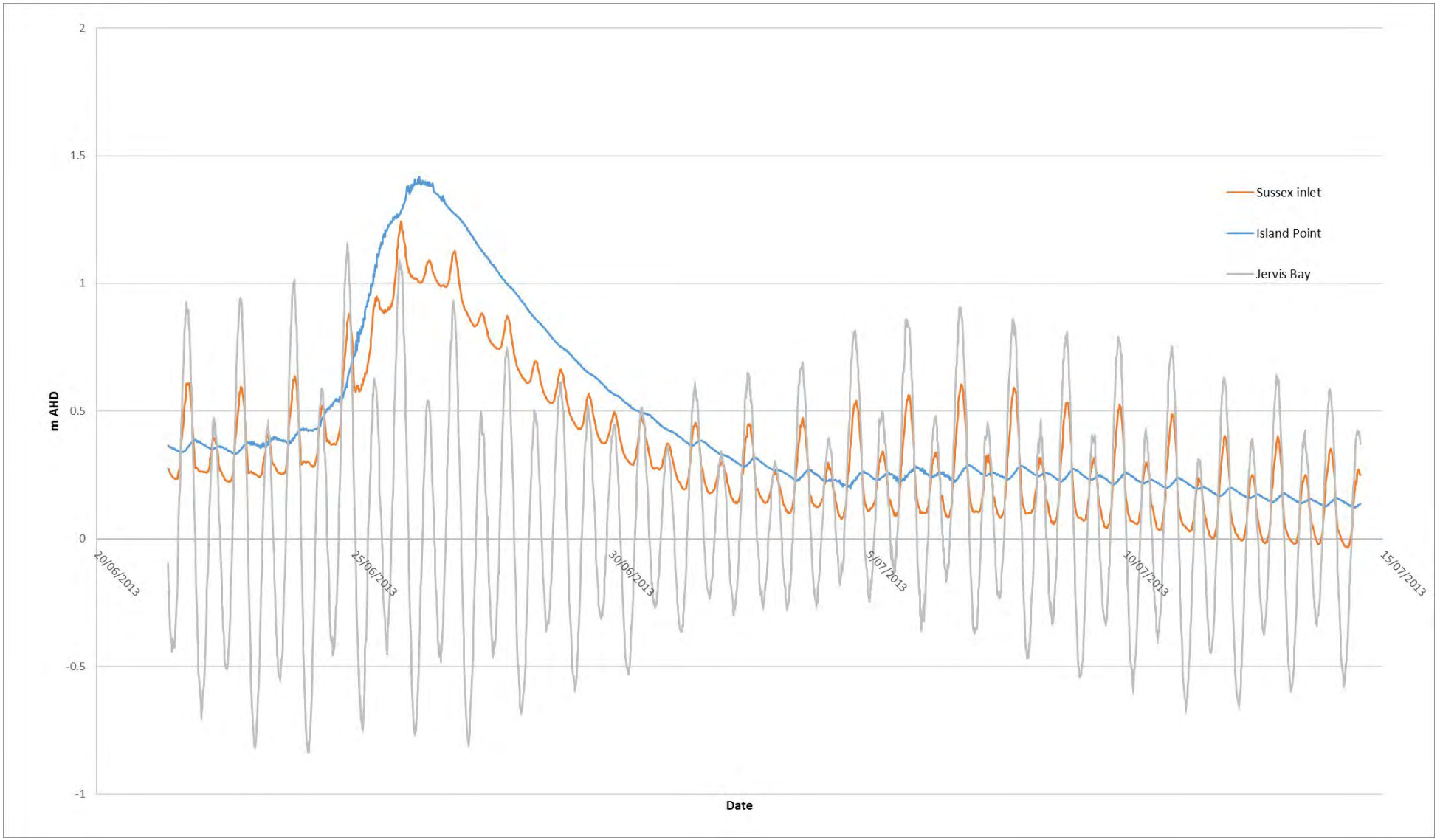


Figure 7-18 June 2013 Water Level Data (MHL)

7.3.4 Entrance and Sussex Inlet Channel Topography

Topographical data at the time of the storm event is not available. It is evident from the Sussex Inlet water level data that the tidal range is limited and appears to not reduce below approximate RL 0.25m. This indicates a constriction or berm within the entrance or channel preventing the full tidal range to be experienced at the gauge. In order to provide a match to the gauge data, assumptions regarding the entrance and channel bathymetry had to be made.

A sensitivity analysis was required to test the assumed bathymetry. Three scenarios were tested:

1. Same bathymetry as for the August 2015 event;
2. As for the August 2015 event with an additional berm at the entrance representative of pre-scour condition; and
3. As for the August 2015 event with an additional berm adjacent to Sussex Inlet representative of pre-scour condition.

The two locations tested for the berm as shown in **Figure 7-19**. Results of the entrance bathymetry sensitivity are presented in **Figure 7-20**.

Results show that even with the assumed berms, the model is unable to replicate the actual tidal response and is still over-estimating the tidal range experienced. The assumed berm at the entrance provided the best match to gauged water levels and was adopted for the validation exercise.

The sensitivity of the berm test shown in **Figure 7-20** and **Figure 7-21** suggest that the Sussex Inlet channel was more constricted than assumed at the start of the event and became increasingly constricted during the event. This may have been the case if there was more storm surge driving sand into the entrance than fresh flow scouring it out.



Figure 7-19 Location of the Assumed Berm for Entrance Sensitivity Scenarios

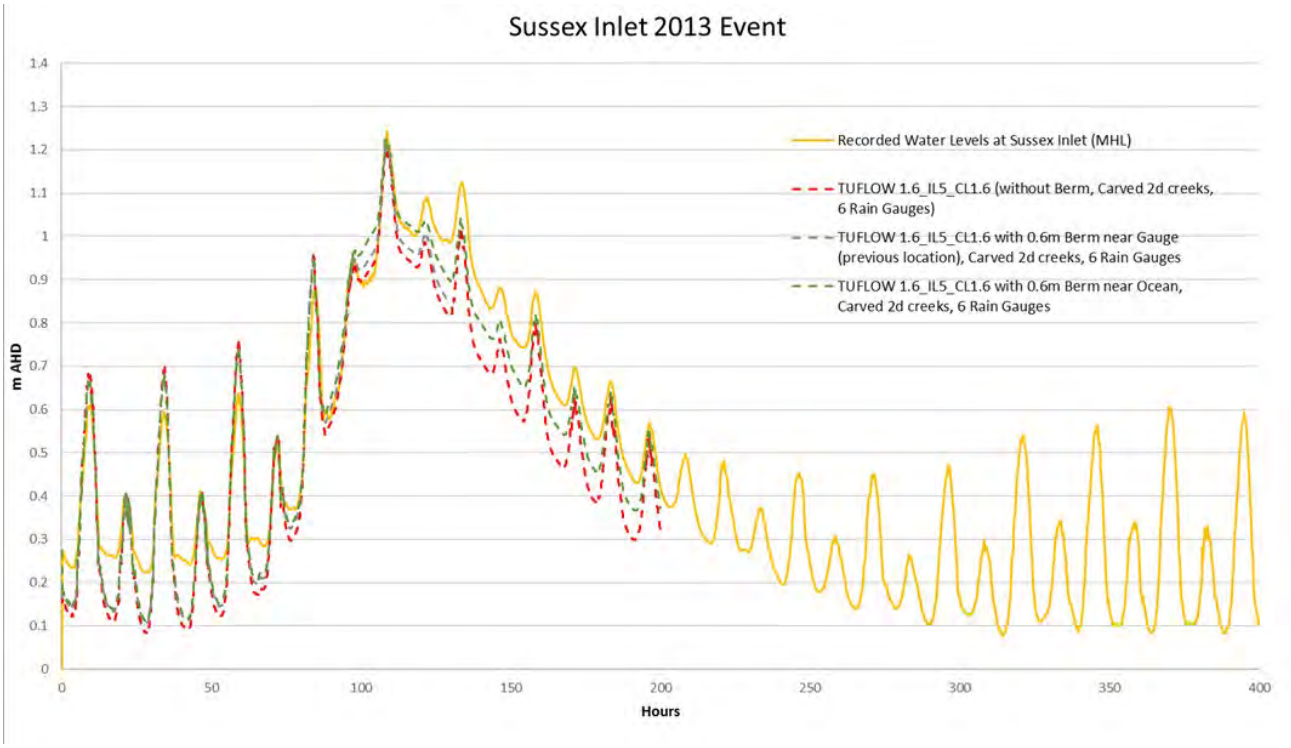


Figure 7-20 Entrance Bathymetry Sensitivity Results for 2013 Storm

7.3.5 Comparison to Recorded MHL Gauge Levels

Modelled flood levels of June 2013 storm event are plotted with the recorded MHL gauge levels at Sussex Inlet and Island Point in **Figure 7-21** and **Figure 7-22** respectively. The results show a good response to tides and the peak level in Sussex Inlet, although **Figure 7-21** suggests that the Sussex Inlet channel was more constricted than assumed at the start of the event and became increasingly constricted during the event. This may have been the case if there was more storm surge driving sand in than fresh flow driving it out.

Observation of **Figure 7-22** shows that the model is underestimating the peak level in St Georges Basin by approximately 80mm. This is potentially due to wave setup at the Island Point gauge location, or could be an artefact of the assumed channel constriction allowing more outflow from the basin or some missing rainfall volume from the limited data.

7.3.6 Comparison to Community Consultation Flood Depth

Four respondents provided valid flood information for the June 2013 event from the Community Consultation. The location of these responses for the June 2013 event is shown in **Figure 7-23**. **Table 7-8** shows the comparison of the depths provided and the modelled results.

Table 7-8 Calibration to Information received for the 2013 Event through Community Consultation

Respondent ID	Location	Provided Depth (m)	Modelled Depth (m)	Difference (m)	Comments
8	Tomerong Ck	0.15	N/A	N/A	not flooded in the model, likely local storm water flooding or due to wind/wave setup
9	Swan Lake	0.1	N/A	N/A	Not in the study area
25	Sussex Inlet	0.5	0.44	0.06	Good correlation
37	Tomerong Ck	knee height	0.497	N/A	backyard

7.3.7 Time of Inundation

Time of inundation for the major roads in the study area were estimated for the validation event. The time was calculated based on water levels over the central line of the road crossing the watercourse. It considers

the time from water depth becomes greater than 200mm to until flood water recedes to less than 200mm deep. Time and location of the road cut off for the June 2013 event is presented in **Figure 7-24**.

7.3.8 Conclusion and Discussion

The model's representation of the peak level of the June 2013 storm event is generally good. The TUFLOW modelled peak flood level of 1.326 m AHD (with berm) at Island Point is 92mm lower than MHL gauge recorded level (1.418m AHD). While at Sussex Inlet, the modelled peak flood level of 1.232 m AHD (with Berm) is 11mm lower than MHL gauge recorded level (1.243 m AHD).

Although the information about the Sussex Inlet channel or entrance topography is not available for the June 2013 storm event, the sensitivity shown between the scenarios (with and without a berm) indicates that while the assumed entrance and Sussex Inlet channel topography is still underestimating the channel constrictions, a reasonable correlation is achieved. A better match would be achieved if more accurate information about the entrance terrain was available.

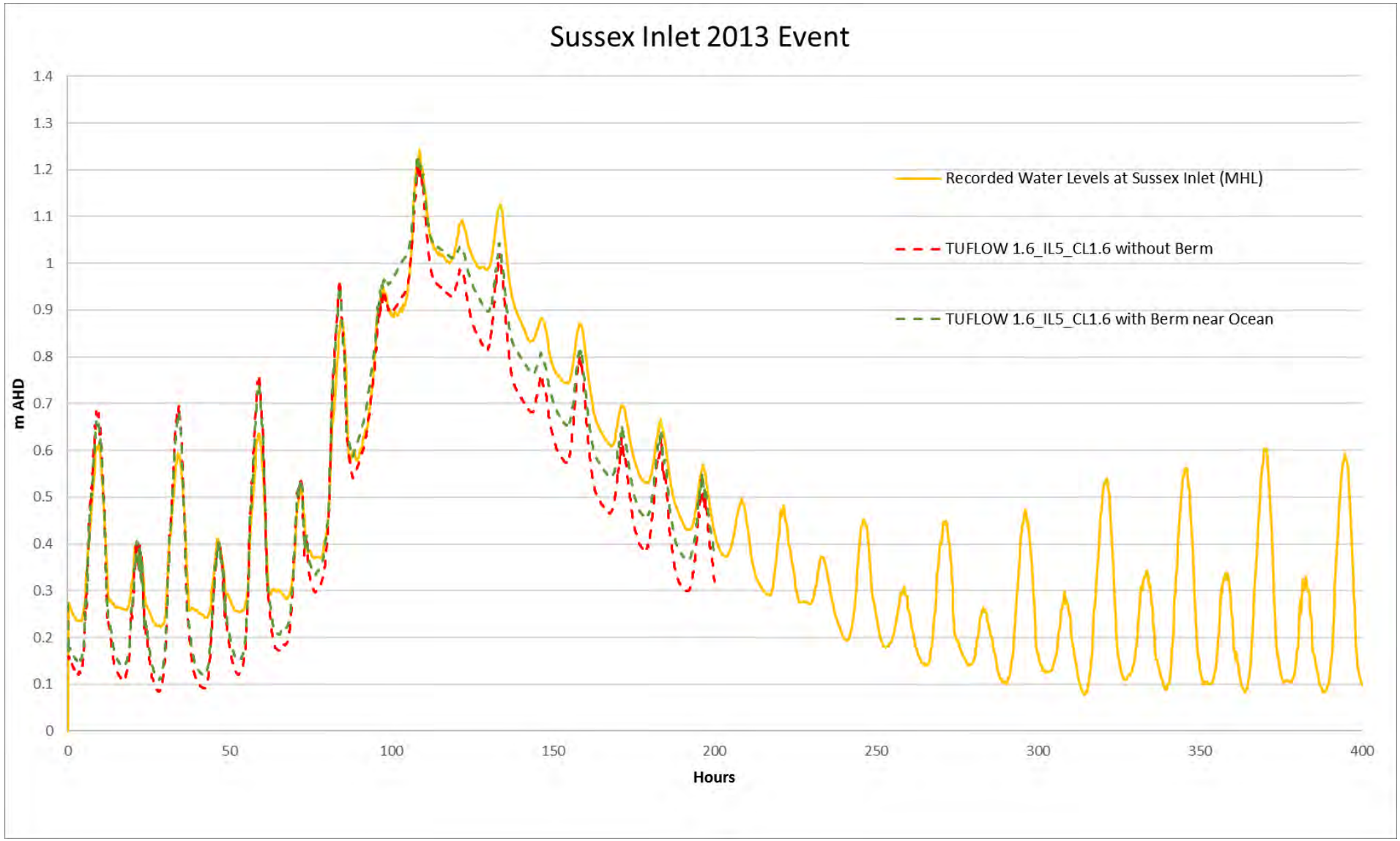


Figure 7-21 Modelled Flood Levels and Recorded MHL Gauge Levels at Sussex Inlet, 2013 Event

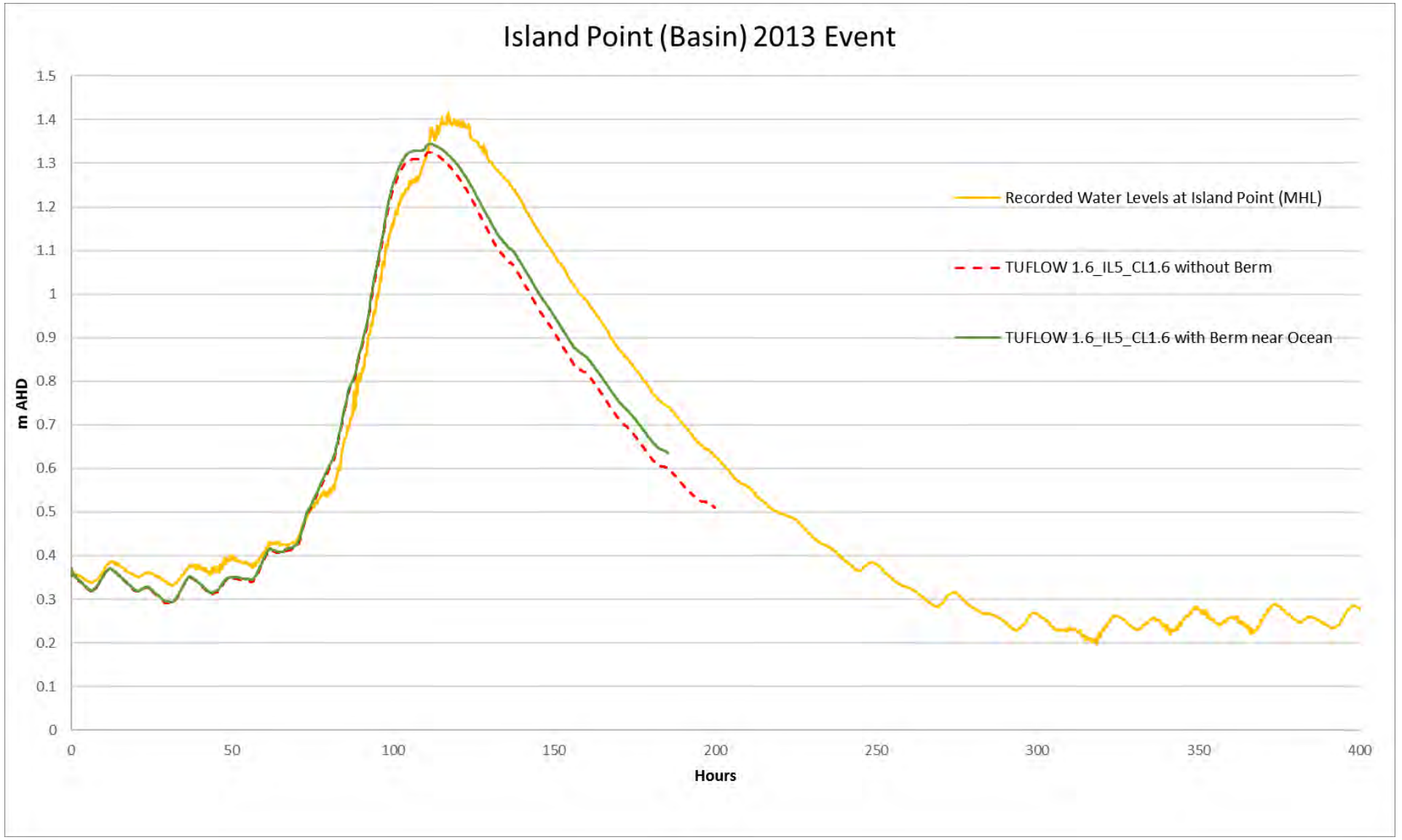


Figure 7-22 Modelled Flood Levels and Recorded MHL Gauge Levels at Island Point, 2013 Event

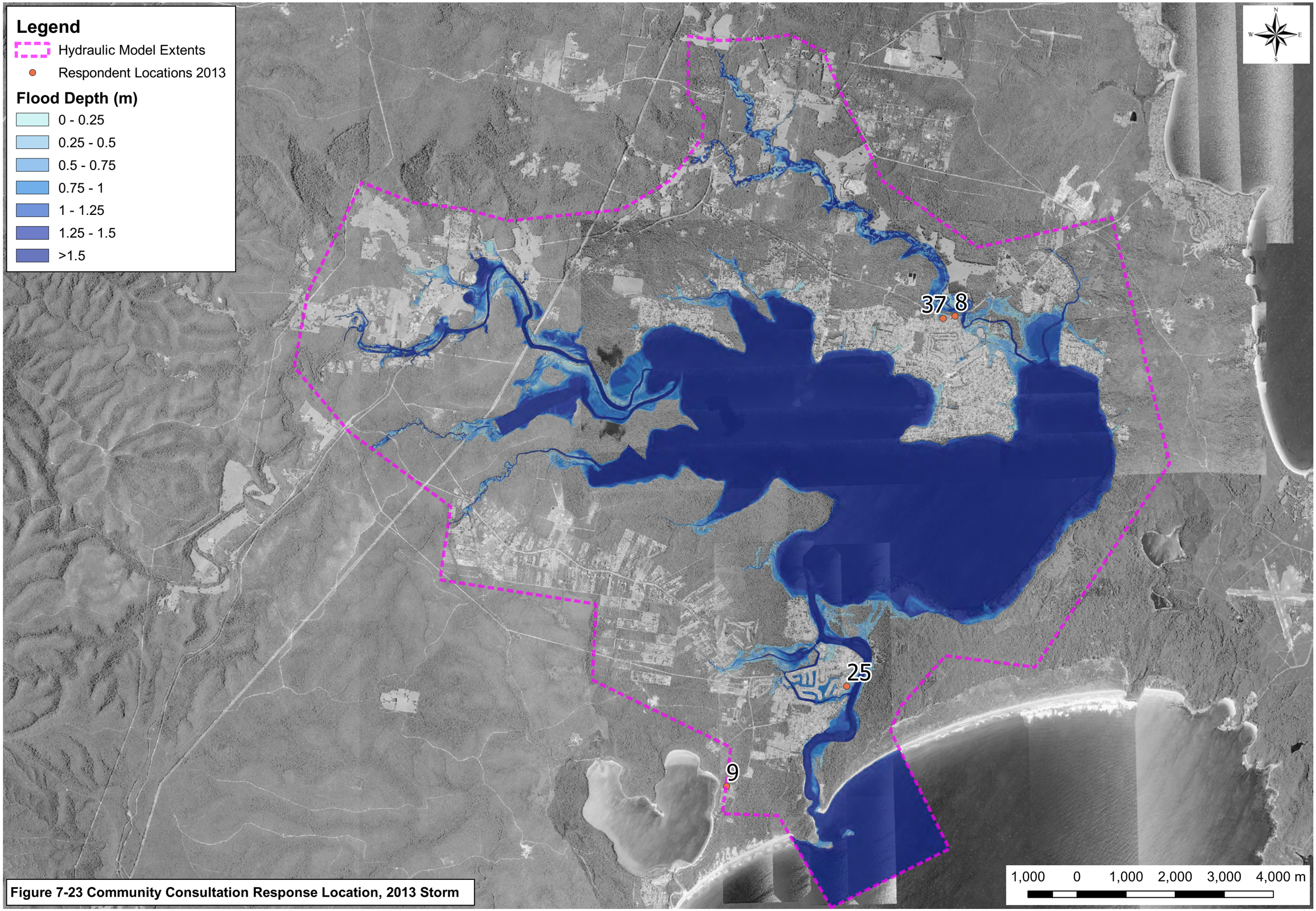


Figure 7-23 Community Consultation Response Location, 2013 Storm

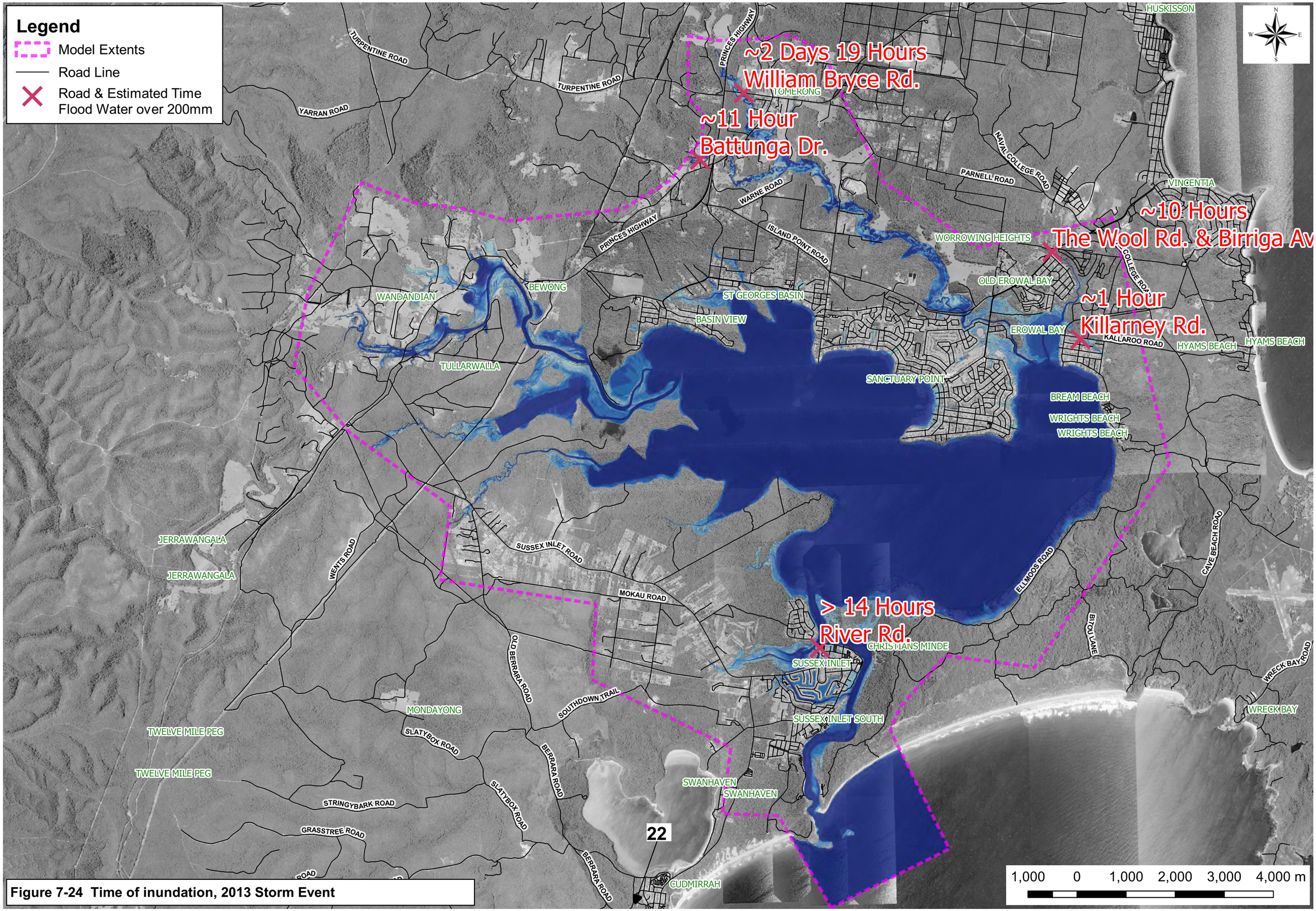


Figure 7-24 Time of inundation, 2013 Storm Event

7.4 Feb 1971 Storm Event

7.4.1 Description

As shown in **Table 3-4, the** February 1971 storm event was the most significant event in regards to the St Georges Basin peak water level of all recorded storms**.** This storm event was selected for validation of the flood model after discussion with Council and DPE. Weather data for this event is limited and mainly retrieved from St Georges Basin Flood Study (2001). Other model setup data, i.e. catchment details and geometry, were adopted directly from the August 2015 calibration event. Due to uncertainties with lack of data during this event, the model results may not accurately reflect the catchment at the time of the event.

7.4.2 Rainfall

Four daily rainfall gauges, Bendalong (69025), Sussex Inlet Bowling Club (68204/69068), HYAMS (68078) and Sassafras Ettrema (68203) had data available during the event. Isohyets of total event rainfall have been developed and presented in **Figure 7-25** which shows the distribution of rainfall across the catchment. Rainfall data for each gauge was allocated to catchments nearest to that gauge as determined using Thiessen Polygons.

Fifteen minutes interval temporal pattern was derived from Nowra Ran Air Station AWS pluviometer data. A separate temporal pattern was adopted for Sassafras Ettrema gauge using its 15 minutes pluviometer data. The daily rainfall and temporal pattern data are plotted in **Figure 7-26** and **Figure 7-27** respectively.

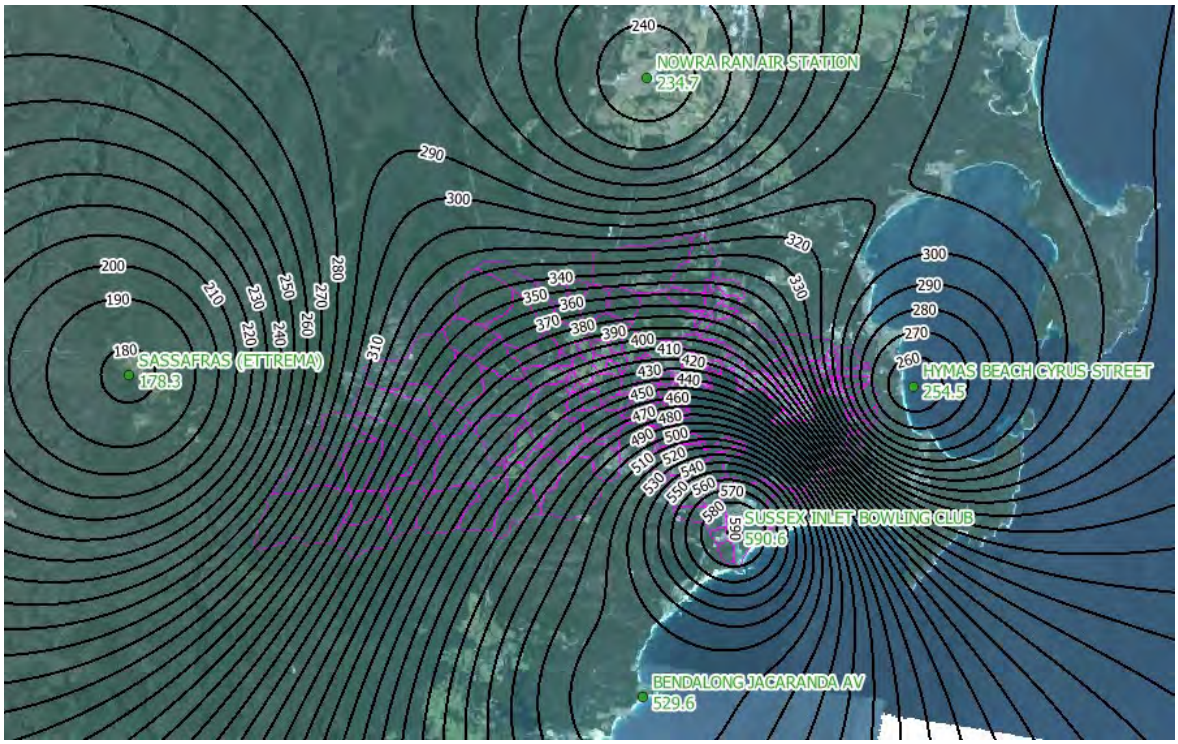


Figure 7-25 Rainfall Isohyet – February 1971 event 48 Hours (06/02 – 07/02) Total Rainfall(mm)

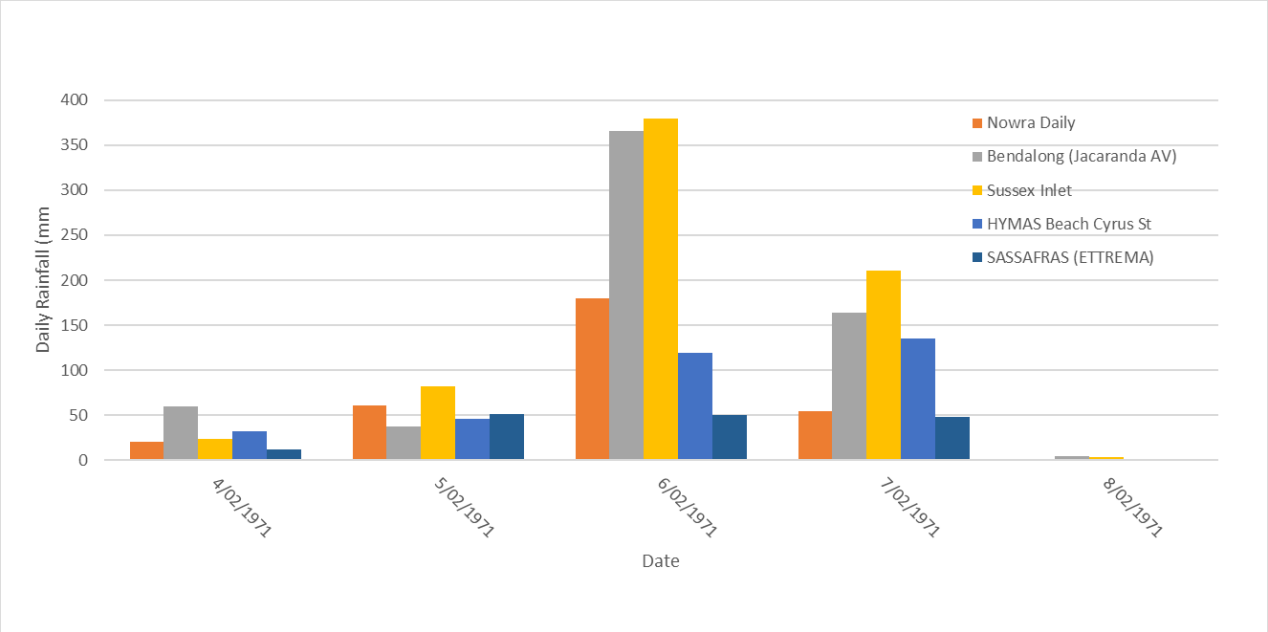


Figure 7-26 February 1971 Daily Rainfall Totals

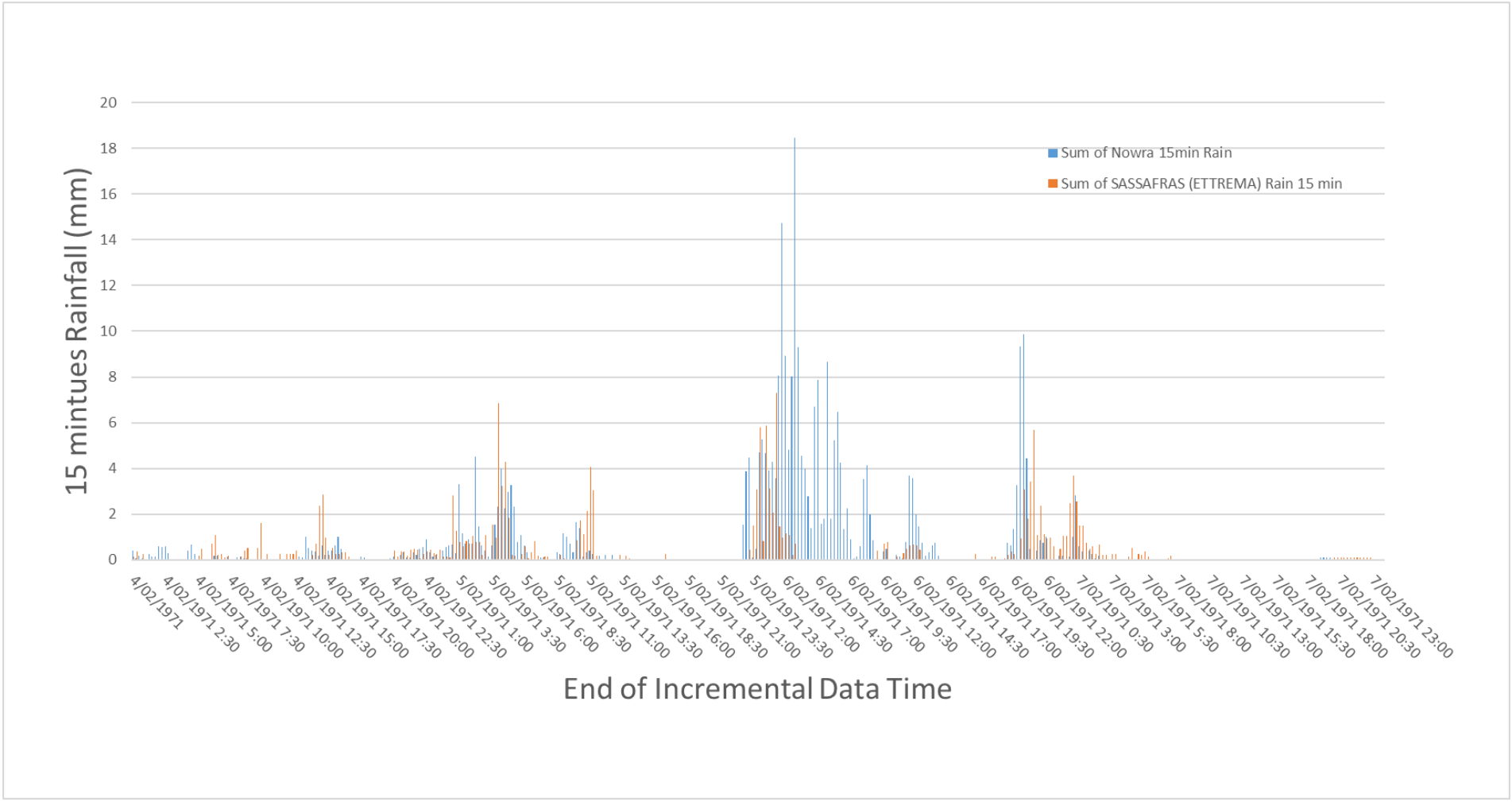


Figure 7-27 February 1971 Temporal Patterns – Nowra Ran Air Station AWS & Sassafras Ettrema Pluviometer

7.4.3 Water Level Gauge & Downstream Boundary Levels

Water Level gauge data is not available for the February 1971event. Flood level observations that were surveyed after the storm were used for verification of the flood model results. Sydney ocean tidal data (refer **Figure 7-28**) used in St Georges Basin Flood Study (2001), was retrieved from the study and used for the model downstream boundary tailwater condition.

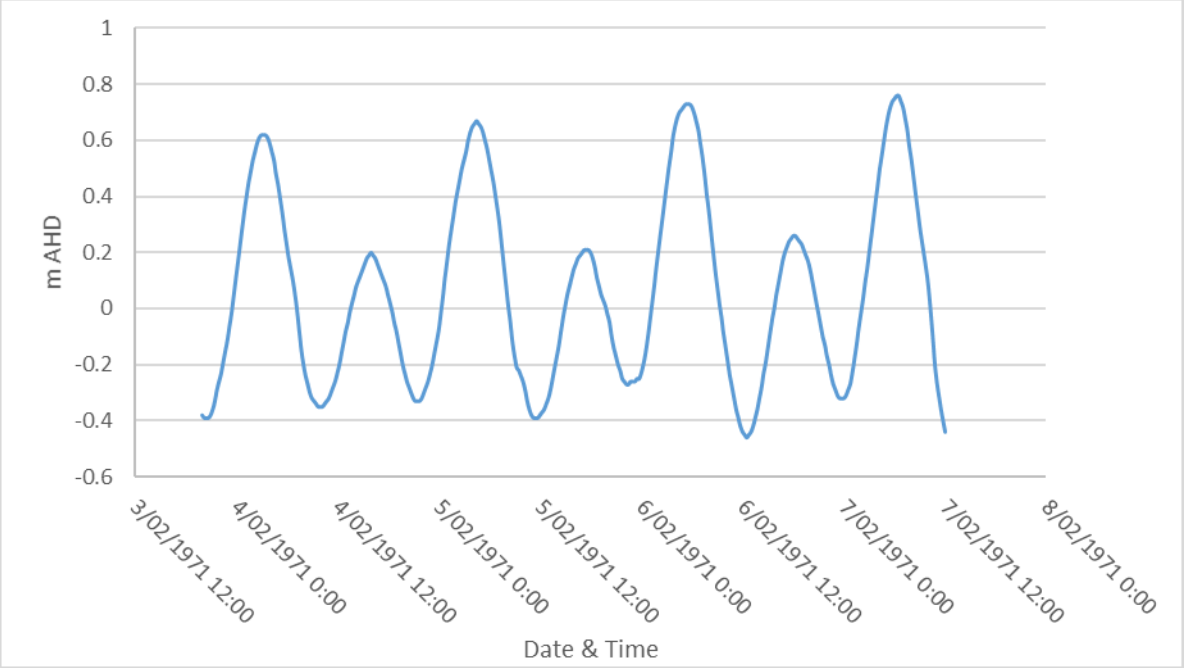


Figure 7-28 February 1971 Water Level Data (source: St Georges Basin Flood Study, 2001)

7.4.4 Entrance and Sussex Inlet Channel Topography

Topographical data at the time of the storm is not available. The same entrance and Sussex Inlet channel data used for the August 2015 calibration event were used in the February 1971 simulation.

7.4.5 Comparison to Recorded Levels

Locations where flood levels were surveyed for the February 1971 event and the water level difference between observed and modelled flood levels are shown in **Figure 7-29** and tabulated in **Appendix E**. A summary of the average difference and the standard deviation between the modelled peak water levels and the surveyed data are provided in **Table 7-10**. It is noted that gauged data is not available for the event, hence it is not possible to make a comparison of time series data to the modelled results.

7.4.6 Comparison with 2001 Flood Study model

Modelled flood levels from the current model and St Georges Basin Flood Study (WMA, 2001) at key locations are presented in **Table 7-9**. The comparison shows the current results are 137mm (near Basin) and 272mm (near Inlet) higher than the results in the 2001 flood study. It is noted that the current 2D model was calibrated to more recent storm events with more up-to-date data. As such, it is considered that this model is more representative of the current hydraulic state of the study area.

Table 7-9 February 1971 Event Results - comparison with 2001 Flood Study results

Key Locations	Modelled Flood Levels (m AHD)	2001 Flood Study Modelled Flood Levels (m AHD)
Island Point	2.37	2.23
Sussex Inlet	1.96	1.69

Table 7-10 Summary of the Difference between Predicted and Surveyed Flood Level – February 1971 Event

	Predicted Peak minus Surveyed Peak Flood Level
Mean Difference	-0.035
Standard Deviation	0.351
Count	21

7.4.7 Time of inundation

Time of inundation for the major roads in the study area were estimated for each calibration and validation event. The time was calculated based on water levels over the central line of the road crossing the water course. It takes account from the time once water depth is greater than 200mm to until flood water recedes to less than 200mm deep. The time and location of the road cut off for the February 1971 event is presented in **Figure 7-30**.

7.4.8 Conclusion and Discussion

As gauge data is not available for this event, modelled results were only compared to surveyed peak flood marks. Overall, the comparison of observed and modelled water levels shows that using the previously calibrated parameters of the August 2015 Calibration Event, a reasonable match with the recorded data is achieved for the February 1971 event. The greatest differences occur around the foreshore of the Basin, which is likely attributed to recorded water levels being affected by wind generated setup leading to water level variations across the Basin. St Georges Basin Flood Study (WMA, 2001) mentioned local residents reported that differences in flood levels of up to 0.5m were observed across the Basin in the February 1971 flood due to the wind stress across the open water body.

The modelled levels in this study are generally higher than previous results in St Georges Basin Flood Study (WMA, 2001). This may be attributed to, for instance, different mechanisms between 2D and 1D hydraulic model, Sussex Inlet bathymetry differences, differences in survey and data etc.

It is noted that the exercise of validating the model to the February 1971 flood is focussed on ensuring that the model accurately represents the flooding behaviour of the study area during a large event. The model quality also benefitted from the February 1971 event validation as the model setup was refined in the tributaries where the match wasn't as good, i.e. at upstream part of Wandandian Creek where flood marks were available, but there is no other data available for other events to guide model setup.

Legend

- 2D Extents
- Survey Points

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- >1.5

Inset

ID: 46
Diff: 0.124

ID: 44
Diff: -0.174

ID: 45
Diff: -0.290

ID: 42
Diff: -0.731

ID: 41
Diff: -0.761

ID: 37
Diff: 0.009

ID: 28
Diff: 0.159

ID: 27
Diff: -0.321

ID: 34
Diff: -0.431

ID: 10
Diff: -0.395

ID: 9
Diff: 0.251

ID: 8
Diff: 0.256

ID: 5
Diff: 0.125

ID: 6
Diff: 0.363

ID: 25
Diff: -0.036

ID: 20
Diff: 0.153

ID: 21
Diff: 0.291

ID: 4
Diff: -0.175

ID: 3
Diff: 0.542

ID: 13
Diff: 0.232

ID: 1
Diff: 0.079

1,000 0 1,000 2,000 3,000 4,000 m

Figure 7-29 Council February 1971 Flood vs Modelled Level Comparison

Legend

- Model Extents
- Road Line
- Road & Estimated Time Flood Water over 200mm

~2 Days 2 Hours
William Bryce Rd.

~3 Hours
Hawken Rd.

~1 Day 2 Hours
Battunga Dr.

~1 Hour
Hawken Rd.

~16.5 To 21 Hours
Windley Rd.

~7 To 8 Hours
Princes Hwy.

~ 2 Hours
Grange Rd.

~16 To 23 Hours
The Wool Rd. & Birriga Ave.

~11 To 20 Hours
Wandean Rd.

~1 Hour
Princes Hwy.

~11 To 22 Hours
The Wool Rd.

>1 Day 21 Hours
Larmer Ave.

~1 Hour
Harriss Ave.

~4 Hours
Princes Hwy.

~1 Day 18 Hours
Larmer Ave.

~13 To 22 Hours
Killarney Rd.

~1 Hour
Sussex Inlet Rd.

> 1 Day 20 Hours
River Rd.

HUSKISSON
TOMERONG
VINCENTIA
WORROWING HEIGHTS
BEWONG
BASIN VIEW
EROWAL BAY
SANCTUARY POINT
YAMS BEACH
HYAMS BEACH
BREAM BEACH
WRIGHTS BEACH
TULLARWALLA
JERRAWANGALA
MONDAYONG
TWELVE MILE PEG
SUSSEX INLET
SUSSEX INLET SOUTH
SWANHAVEN
CUDMIRRAH
WRECK BAY

TURPENTINE ROAD
YARRAN ROAD
PRINCES HIGHWAY
NAVAL COLLEGE ROAD
PARNELL ROAD
WENTS ROAD
SUSSEX INLET ROAD
MOKAU ROAD
OLD BERRARA ROAD
SOUTHDOWN TRAIL
SLATYBOX ROAD
BERRARA ROAD
STRINGYBARK ROAD
GRASSTREE ROAD
ELLMOOS ROAD
BITOU LANE
CAVE BEACH ROAD
WRECK BAY ROAD

22

1,000 0 1,000 2,000 3,000 4,000 m

Figure 7-30 Time of inundation, 1971 Storm Event

8 Hydrology – Design Flood Estimation

8.1 Hydrology – ARR2019 Update

The hydrologic modelling of the St Georges Basin catchment for determining design flood event flows has been undertaken in accordance with the new Australian Rainfall and Runoff 2019 (ARR2019) Guidelines. The new ARR2019 Guidelines includes updated Intensity-Frequency-Duration (IFD) data, areal reduction factors (ARFs), storm loss parameters, pre-burst rainfall and has introduced ensemble modelling methods to account for the variability in rainfall temporal patterns.

Data specific to the catchment has been obtained from the ARR Data Hub and Bureau of Meteorology (BoM) and is provided in **Appendix F**.

8.1.1 Intensity-Frequency-Duration Data

It was determined that due to the size of the catchment (355km^2) and from assessment of gridded rainfall depth data obtained from BoM that there is sufficient variability in rainfall depth/intensity across the catchment that multiple IFD zones would be required to appropriately represent the expected rainfall in the catchment. Three (3) IFD zones were chosen as representative of the areas surrounding the centroid of each zone. These are shown in **Figure 8-1**.

IFD data has been obtained from the BoM website and IFD data for each IFD zone is provided in **Appendix F.**

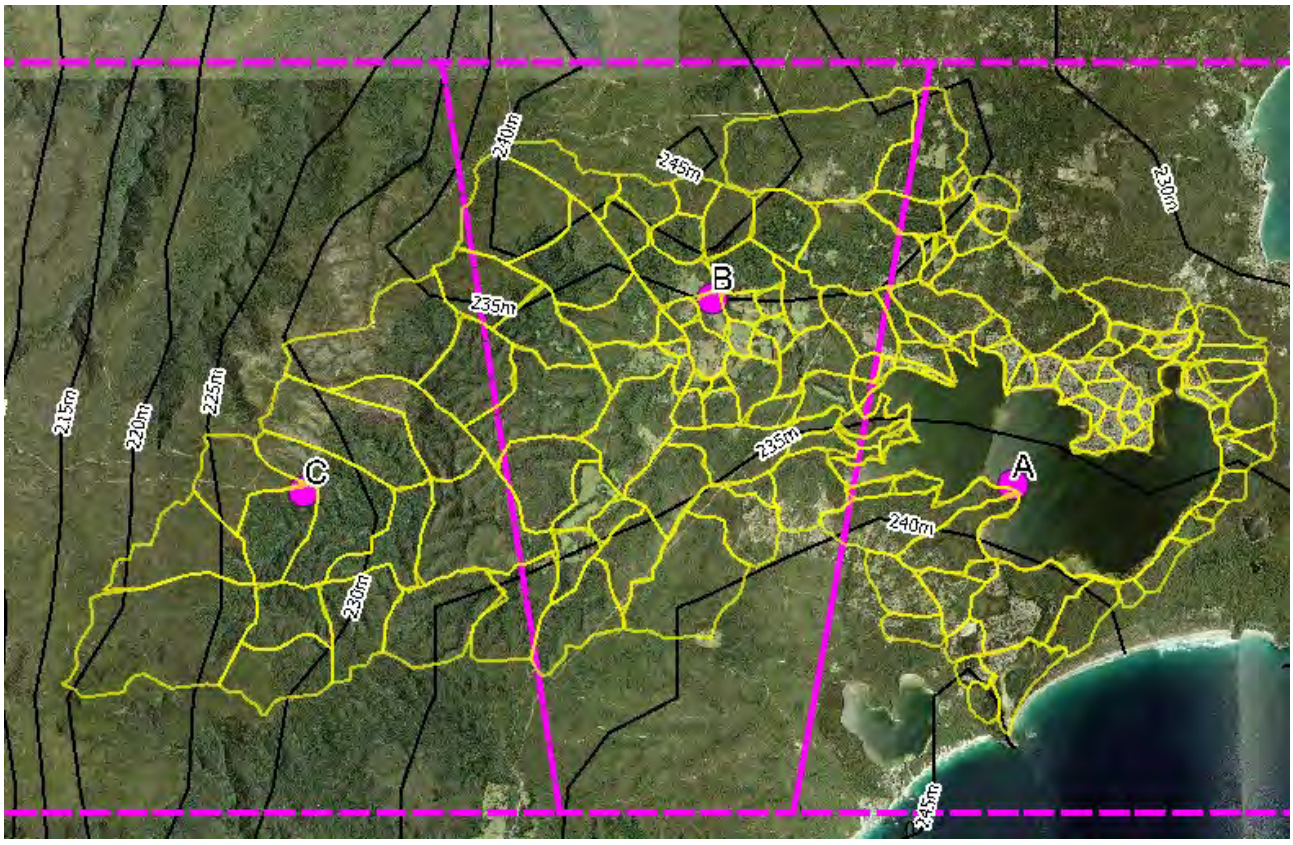


Figure 8-1 IFD location

8.1.2 Temporal Pattern Data

Ensemble modelling methods were employed in accordance with the ARR2019 Guidelines. Ensemble modelling involves modelling a set of 10 different temporal patterns for each design event and storm duration. The St Georges Basin catchment is within the *Southern Slopes Mainland* zone for selecting temporal patterns from the ARR Data Hub.

Design storms are sorted into three temporal pattern bins as shown in **Figure 8-2.** A different set of 10 temporal patterns are associated with each temporal pattern bin. The 1% AEP event, for example, falls within the ‘Rare’ temporal pattern bin.

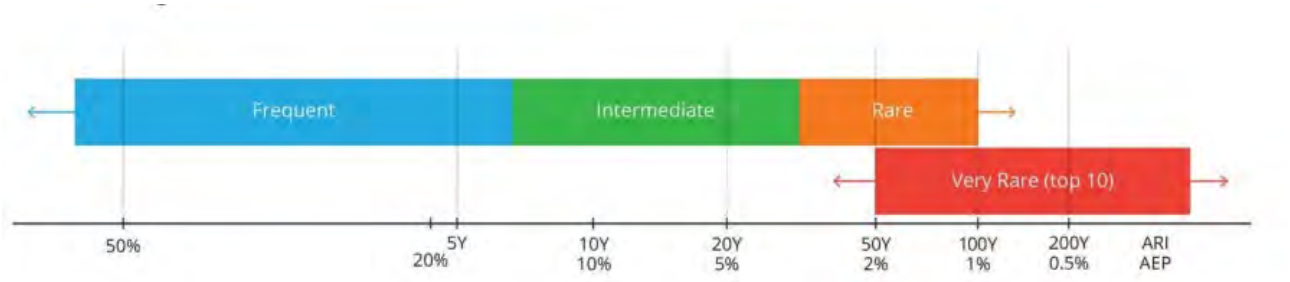


Figure 8-2 Bins for temporal patterns versus AEP (source: ARR Figure 2.5.12)

The temporal pattern that produces the flow closest to the mean flow of all temporal patterns (with a bias for the one above the mean) is then selected to represent that particular design event and storm duration.

For St Georges Basin, the peak level is determined by the peak volume and hence the temporal pattern that produces the peak volume/level in the WBNM model closest to the mean peak volume of all temporal patterns is then selected to represent that particular design event and storm duration.

Aerial temporal patterns are used for catchment areas >75km. Based on the size of the St Georges Basin catchment (355km^2), aerial temporal patterns are required to be used and the Partial Area Check method has been used in WBNM which determines the appropriate aerial temporal patterns to be used depending on the catchment area to the point of interest.

8.1.3 Areal Reduction Factors (ARFs)

ARR2019 states that Areal Reduction Factors are required for catchments that are sufficiently large. Design rainfall intensities at a point are not representative of the areal average rainfall intensity across the catchment. The ratio between the design values of areal average rainfall and point rainfall, computed for the same duration and Annual Exceedance Probability (AEP), is called the Areal Reduction Factor (ARF). This allows for the fact that larger catchments are less likely than smaller catchments to experience high intensity storms simultaneously over the whole of the catchment area.

It should be noted that the ARF provides a correction factor between the catchment rainfall depth (for a given combination of AEP and duration) and the mean of the point rainfall depths across a catchment (for the same AEP and duration combination). Applying an ARF is a necessary input to computation of design flood estimates from a catchment model that preserves a probability neutral transition between the design rainfall and the design flood characteristics. The ARF merely influences the average depth of rainfall across the catchment, it does not account for variability in the spatial and/or space-time patterns of its occurrence over the catchment.

Based on the size of the St Georges Basin catchment (355km^2), areal reduction factors are required to provide an accurate representation of rainfall intensity across the catchments and the resulting flows for the mainstream watercourses and the Basin. The ARF applied is based on ARF equations from the ARR Data Hub for the South East Coast (NSW), which uses relationship between ARF, catchment area and event AEP and duration. The ARF is applied to the IFD point rainfall depths from ARR DataHub.

Partial Area Check method has been used in WBNM which calculates the area to each point of interest and Calculates the aerial reduction factors for the contributing catchment based on the ARF equations from the ARR Data Hub. ARFs have been calculated based on the catchment area to St Georges Basin outlet, Wandandian Creek, Tomerong Creek, Worrowing Creek and local catchments.

8.1.4 Pre-burst rainfall

There are no stream flow gauges in the catchment to analyse the timing of flows in tributaries for historical events to gain a full appreciation of the likely pre-burst to apply to the design event modelling. As such, the recommended methods from ARR2019 and DPE Guidelines for NSW (OEH, 2019) have been used. This uses probability neutral pre-burst rainfall values across the range of storm events and durations coupled with the ARR Data Hub storm loss for the catchment.

8.1.5 Losses

There are no stream flow gauges in the catchment to analyse the timing of flows in tributaries for historical events to gain a full appreciation of the likely initial losses to apply to the design event modelling. Sensitivity of the Basin flood levels to initial loss values (**Section 5.1.6**) showed that flood levels were not sensitive to

chosen initial loss values. As such, it was decided to use the probability neutral burst loss approach from the ARR Data Hub as per recommendations in DPE Guidelines for NSW (OEH, 2019).

8.2 Probable Maximum Flood Estimation

Due to the longer durations of 24 hours or longer being critical to the Basin, the Generalised South East Australia Method (GSAM) (BoM, 2006) was used to estimate the rainfall intensity of the Probable Maximum Precipitation (PMP) for the St Georges Basin catchment.

Because shorter duration events are likely to be critical for the tributaries, the Generalised Short Duration Method (GSDM) (BoM, 2003) was used to estimate the rainfall intensity of the PMP for the Wandandian Creek tributary catchments.

A spatially distributed PMP rainfall intensity was adopted according to the GSDM. The GSDM ellipses were generated in GIS for the St Georges Basin catchment, oriented to align with the catchment and centred over the CBD area which is approximately in the middle of the Study Area. Each sub-catchment node in the WBNM hydrology model was then assigned a rainfall intensity that corresponded to its respective GSDM ellipse that it was located within.

8.3 Design Event Modelling

The hydrologic model was used to simulate ensembles for a range of design events and durations. The design events modelled for the Flood Study include the:

- 20% AEP event
- 10% AEP event;
- 5% AEP event;
- 2% AEP event;
- 1% AEP event;
- 0.2% AEP event; and,
- PMF.

8.3.1 Critical Duration

The critical durations for each temporal pattern bin was determined by simulating the full range of durations in the WBNM hydrologic model. The critical duration is determined by which duration has the highest mean flow from the ensemble of temporal patterns for each tributary and for peak volume/level in the Basin from the WBNM model results.

8.3.2 Design Event Flows

Table 8-1 shows design event flows calculated in the WBNM hydrologic model at key locations within the model Study Area.

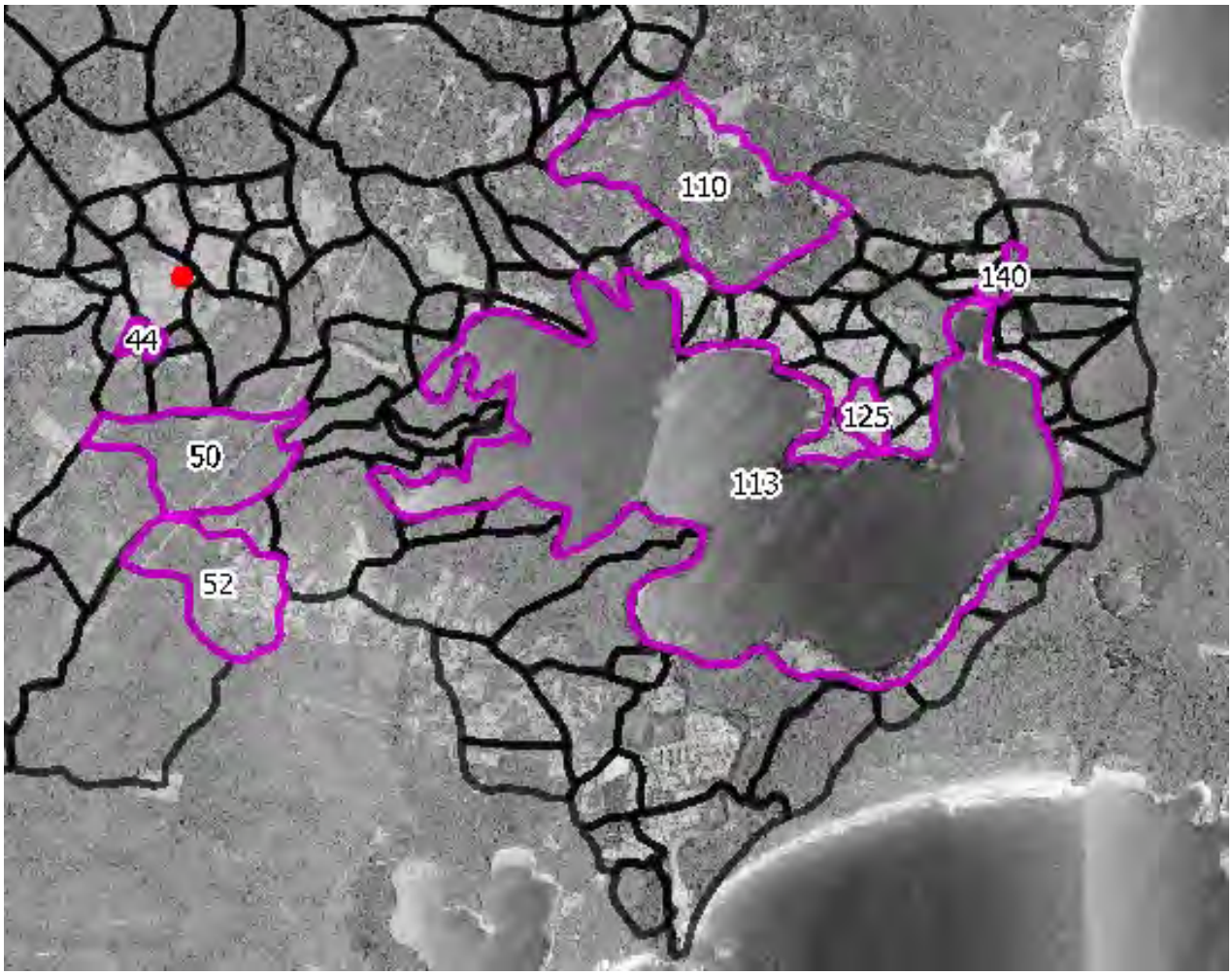


Figure 8-3 Key Flow Locations

Table 8-1 Design event flows and critical duration from WBNM Hydrology Model at Key Locations

Event	Location	A local small catchment	Wandandian Creek	Tullarwalla Creek	Cow Creek	Tomerong Creek	Worrowing Creek	Basin (Stage)
	WBNM Model Node	125	44	50	52	110	140	113
20% AEP	Critical Duration (hrs)	20 min	12	9	12	9	9	48
	TP	4	2	4	7	4	6	4
	Flow (m^3/s)	**6**	**358**	**50**	**39**	**117**	**27**	**1.18 (m AHD)**
10% AEP	Critical Duration (hrs)	45 min	12	9	9	9	4.5	48
	TP	3	7	4	7	2	1	4
	Flow (m^3/s)	**8**	**436**	**63**	**47**	**139**	**36**	**1.42 (m AHD)**
5% AEP	Critical Duration (hrs)	15 min	18	9	9	9	2	72
	TP	8	2	7	7	4	7	6
	Flow (m^3/s)	**9**	**530**	**77**	**57**	**178**	**44**	**1.69 (m AHD)**
2%AEP	Critical Duration (hrs)	20 min	12	9	9	12	2	72
	TP	5	9	4	7	9	7	1
	Flow (m^3/s)	**12**	**699**	**93**	**73**	**215**	**58**	**2.02 (m AHD)**
1% AEP	Critical Duration (hrs)	20 min	12	9	9	9	2	96
	TP	5	9	4	8	4	7	1
	Flow (m^3/s)	**15**	**813**	**110**	**87**	**255**	**69**	**2.25 (m AHD)**
0.2% AEP	Critical Duration (hrs)	10 min	168	9	9	168	1.5	96
	TP	5	5	4	8	5	9	1
	Flow (m^3/s)	**19**	**1137**	**139**	**109**	**328**	**91**	**2.84 (m AHD)**
PMP	Critical Duration (hrs)	30 min	4	3	3	4	1.5	24
	Method	GSDM	GSDM	GSDM	GSDM	GSDM	GSDM	GSAM
	Flow (m^3/s)	**28**	**4035**	**499**	**383**	**902**	**200**	**5.38 (m AHD)**

8.4 ARR87 Design flood estimation

This section of the report describes the application of ARR1987 methodologies in the WBNM hydrologic model. This assessment was undertaken for the purpose of comparing the ARR1987 1% AEP event peak flows from this study and previous studies in St Georges Basin, and to compare the resulting 1% AEP peak flows generated by ARR1987 and ARR2019.

8.4.1 Design Input Parameters

8.4.1.1 *Design Rainfall*

IFD data was adopted from the St Georges Basin Flood Study (WMAwater, 2001) provided by Council in the data handover at project commencement. The IFD has been provided in **Figure 8-4** for reference. The hydrologic model software used for 2001 Flood Study assessment was the Boyd model (predecessor to the Watershed Bounded Network Model (WBNM)).

Duration (h)	Frequency (AEP)							
	50%	20%	10%	5%	2%	1%	0.5%	0.2%
1	46	61	70	82	98	109	122	138
1.5	54	72	83	97	115	129	144	164
2	60	80	92	108	129	145	162	184
3	69	93	107	126	151	170	190	217
4.5	80	108	125	147	176	199	223	255
6	88	120	139	164	197	223	249	286
9	102	139	162	191	231	261	293	336
12	113	155	181	214	258	293	328	378
24	152	207	241	284	342	388	434	498
36	180	244	283	333	401	453	507	580
48	201	272	315	370	444	501	561	641
72	230	310	359	421	504	568	634	725

Note: Design rainfall depths derived from AR&R 1987 for the centroid of the catchment.

Figure 8-4 ARR87 Intensity-Frequency-Duration Rainfall Depths (mm) (St Georges Basin Flood Study WMA, 2001)

It is noted that it appears that a single set of IFD rainfall values has been applied to the entire St Georges Basin catchment.

8.4.1.2 *Design Losses*

For consistency with the 2001 Flood Study, the same initial and continuing losses were applied uniformly to the catchment:

- Initial Loss: 5.0 mm
- Continuing Loss: 2.5 mm/hr

8.4.1.3 *Model Parameters*

Model parameters are as per the calibrated WBNM model described in Section 5.1.7.

8.4.1.4 *Storm Events and Durations*

The model has been run for the 5% AEP and the 1% AEP event. The 2001 Flood Study notes the critical duration of peak flows at various locations as being the 2 hour, 4.5 hour and 9 hour for the tributaries and the 48 hour duration for the Basin. The same critical durations were determined for the current study.

8.4.2 ARR87 flows

The peak flows for the 1% AEP design event at various locations in the catchment are shown in **Table 8-2**. These are compared to the design peak flows reported in the 2001 Flood Study and the current study ARR2019 design flood estimates.

Table 8-2 ARR87 Peak 1% AEP flows at various locations

Location	ARR87 Critical Duration	2001 Flood Study 1% AEP Peak Flow ARR87 (m^3/s)	Current Study 1% AEP Peak Flow ARR87 (m^3/s)	Current Study 1% AEP Peak Flow ARR2019 (m^3/s)	% change from ARR87 to ARR2019
Wandandian Ck	9hr	1336	1300	813	-23%
Tullarwalla Ck	9hr	145	167	110	-30%
Cow Ck	9hr	123	128	87	-37%
Tomerong Ck	9hr	414	403	255	-34%
Worrowing Ck	4.5hr	51	95	69	-32%
Basin Level	48hr	2.35 (mAHD)	2.39 (m AHD)	2.25 (m AHD)	

A comparison was also made between the ARR87 IFD and ARR2019 IFD rainfall to examine the percentage difference and is presented in **Table 8-3**.

Table 8-3 IFD Comparison - ARR2019 rainfall change from ARR87 rainfall

DURATION	ARI / AEP	2 year	5 year	10 year	20 year	50 year	100 year
		0.5 EY	0.2 EY	9.49%	5%	2%	1%
5 mins		-28%	-25%	-20%	-17%	-12%	-8%
10 mins		-28%	-26%	-21%	-18%	-14%	-10%
20 mins		-32%	-31%	-27%	-25%	-22%	-19%
30 mins		-34%	-34%	-31%	-29%	-27%	-25%
1 hour		-37%	-38%	-36%	-35%	-33%	-32%
2 hours		-35%	-37%	-36%	-36%	-36%	-35%
3 hours		-31%	-35%	-34%	-35%	-35%	-35%
6 hours		-23%	-28%	-27%	-29%	-30%	-31%
12 hours		-15%	-21%	-20%	-21%	-23%	-24%
24 hours		-14%	-17%	-15%	-15%	-17%	-17%
48 hours		-20%	-19%	-16%	-14%	-14%	-14%
72 hours		-23%	-21%	-17%	-14%	-13%	-12%

It can be seen from the above analyses that the current study WBNM model produces similar results to the previous flood study when using the same ARR87 input parameters. The analyses show that ARR2019 IFD has some 30-35% reduction in rainfall and produces peak flows in the tributaries that are similarly 30-35% lower than ARR87. Some of the impact of significantly higher rainfall depths in ARR87 is masked by the higher adopted CL value of 2.5mm/hr. The change in critical duration and the temporal pattern play a role in the higher peak flow rates.

The ARR87 9-hour temporal pattern is known to have an embedded burst which may skew peak flow values for those creeks for which 9-hour duration is critical. An at-site IFD analysis was not undertaken for rainfall gauges within the catchment for this study and the western part of the catchment does not have good long term gauge records. However, ARR2019 IFD data includes a longer record of rainfall than the ARR87 IFD and an ensemble of temporal patterns and should in theory be more accurate.

8.5 Parameter Sensitivity Analysis

Sensitivity of the hydrologic model to a number of parameters was carried out as part of the calibration for historical events in determining the appropriate parameters to use to represent the catchment response. Sensitivity to catchment lag parameter C, initial loss, continuing loss and rainfall spatial distribution are discussed in **Section 7.2.9**. This showed that both lag parameter C and initial loss had negligible impact on Basin water levels while more variability was observed for continuing loss. Rainfall spatial distribution was also important and spatial distribution of rainfall IFD across the catchment has been adopted for design events.

Additional parameter sensitivity was undertaken to test the impact on flows and Basin water levels for the 1% AEP design event as discussed below.

8.5.1 ARR2019 Temporal Patterns

ARR2019 methods include the modelling of an ensemble of ten rainfall temporal patterns for each storm event and duration to determine a range of possible storm event patterns. The mean of the resulting peak flows from each temporal pattern is chosen as the representative flow for each design event. For the St Georges Basin, the temporal pattern that produced the basin/volume closest to the mean was adopted. Temporal patterns for the 1% AEP 48hr critical duration event from the WBNM hydrology model are shown in **Figure 8-5**.

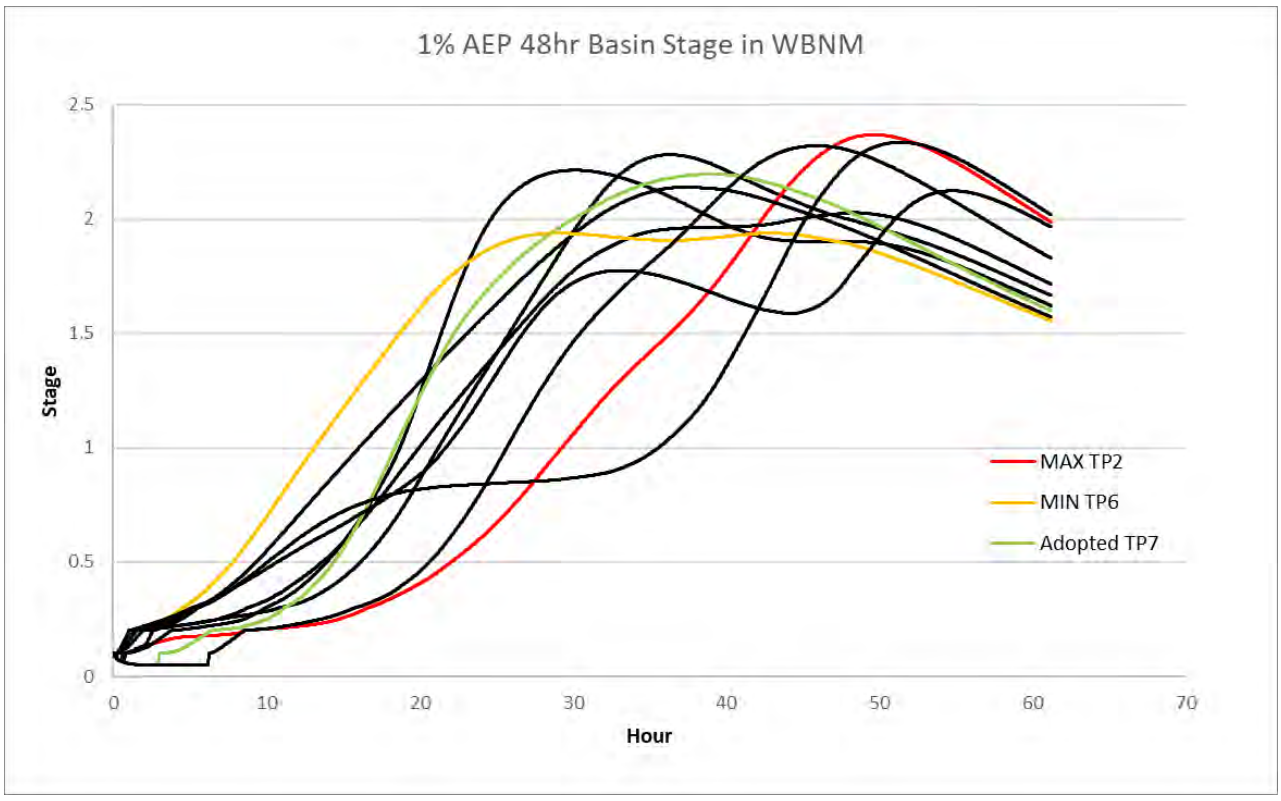


Figure 8-5 Basin Water levels for 1% AEP 48 hr temporal patterns from WBNM hydrologic model

To test the impact of the range of temporal patterns on Basin flood levels, the temporal patterns resulting in the minimum and maximum Basin water levels in the WBNM hydrologic model were also simulated with the hydraulic model.

8.5.2 Continuing Loss

The Continuing Loss value has the biggest impact on rainfall volumes and design flows. To test the sensitivity of increasing and decreasing continuing loss, the 1% AEP 48hour critical duration event was run using CL = 1.0 mm/hr and CL = 2.5mm/hr.

9 Model Scenarios

The following sections describe the model scenarios undertaken for the St Georges Basin flood study.

9.1 Design Events and Durations

The models have been run for the 20%, 10%, 5%, 2%, 1%, 0.2% AEP Storms and the PMF event.

The following table shows the durations simulated for each event.

Table 9-1 Design events and durations

AEP	Critical Durations Simulated
20%	20min, 12hr, 48hr
10%	45min, 9hr, 12hr, 48hr
5%	15min, 9hr, 12hr, 72hr
2%	20min, 9hr, 12hr, 72hr
1%	20min, 2hr, 9hr, 12hr, 48hr
0.2%	20min, 9hr, 12hr, 96hr
PMF	3hr, 4hr, 5hr, 24hr, 36hr

9.2 Tailwater Conditions

The adopted water levels at the downstream boundary of all hydraulic models were selected in accordance with the NSW Floodplain Risk Management Guide - Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways (NSW OEH, 2015) replicated in **Table 9-2**.

Table 9-2 Combinations of Catchment Flooding and Oceanic Inundation Scenarios (source: Table 8.1 OEH, 2015)

Design AEP for peak levels/velocities	Catchment Flood Scenario	Ocean Water Level Boundary Scenario	Comment/ Reference
50% AEP	50% AEP	HHWS(SS)	Dynamic hydrograph can be taken from Appendix C with peak flood to coincide with HHWS(SS) highest peak for highest water levels Peak HHWS(SS) 1.25m AHD
20%	20% AEP	HHWS(SS)	
10%	10% AEP	HHWS(SS)	
5%	5% AEP	HHWS(SS)	
2%	2% AEP	5% AEP	Dynamic ocean water level boundary hydrograph Appendices A or B for relevant waterway type
1% Envelope level	5% AEP	1% AEP	Envelope provides 1% AEP design flood estimate
1% Envelope level	1% AEP	5% AEP	Dynamic ocean water level boundary hydrograph Appendices A or B for relevant waterway type
1% Envelope velocity	1% AEP	ISLW	Dynamic hydrograph can be taken from Appendix C with peak flood to coincide with ISLW lowest trough for peak velocities in entrance. Fixed ISLW approx. -0.95m AHD
0.5%	0.5% AEP	1% AEP	Dynamic ocean water level boundary hydrograph Appendices A or B for relevant waterway type
0.2%	0.2% AEP	1% AEP	
PMF	PMF	1% AEP	
1% Catchment	1%	HHWS(SS)	Suggested envelopes for analysis of catchment flooding only
PMF Catchment	PMF	HHWS(SS)	

HHWS(SS) – High High Water Springs (Summer Solstice)

ISLW – Indian Springs Low Water

The relevant HHWSS, 5% AEP and 1% AEP dynamic tide hydrograph for Waterway Type B South of Crowdy Head has been used for the ocean boundary. The 1% AEP and 5% AEP comprises the ocean boundary time series Fort Denison May 1974 with 0.55m wave set up (South of Crowdy Head).

A summary of the adopted tailwater levels in **Table 9-3**.

Table 9-3 Hydraulic Model Tailwater Levels for Design Events

Event	Tailwater Scenario	Peak Level (m AHD)
PMF	1% AEP Tide (Waterway Type B)	2.00 m AHD
0.2% AEP		
1% AEP	5% AEP Tide (Waterway Type B)	1.90 m AHD
2% AEP		
5% AEP	MHWSS Tide (Waterway Type B)	1.03 m AHD
10% AEP		
20% AEP		
HAT	Highest Astronomical Tide Jervis Bay	1.12 m AHD

9.3 Basin Initial Water Levels

To determine the appropriate basin initial water levels for design events, the historical record of water level at Island Point gauge was assessed. The Basin is tidally influenced with a small tidal range and the long-term average water level in the Basin was found to be approximately 0.2m AHD. However, inspection of the water level prior to known elevated water level events showed that the initial water level was typically 0.3m AHD. The initial water level in the basin is important, particularly for more frequent events and to ensure that there is sufficient starting volume, 0.3m AHD was adopted for all design events.

9.4 Sea Level Rise Scenarios

NSW Flood Risk Management Guide – Incorporating sea level rise benchmarks in flood risk assessments (DECCW, 2010) references the NSW sea level rise planning benchmarks in the *NSW Sea Level Rise Policy Statement* (2009).

The NSW sea level rise planning benchmarks are an increase above 1990 mean sea levels of 40cm by 2050 and 90cm by 2100. These benchmark figures were established by considering the most credible national and international projections of sea level rise for the NSW coast and take into consideration the uncertainty associated with sea level rise projections. This policy was repealed by the NSW Government in 2012 and coastal councils were encouraged to adopt their own sea level rise projections.

Shoalhaven City Council, in partnership with Eurobodalla Shire Council, developed the *South Coast Regional Sea Level Rise Policy and Framework* (Whitehead & Associates, 2014) and Councillors adopted the following sea level rise projections on 10 February 2015,

- 100mm for 2030;
- 230mm for 2050; and
- 360mm for 2100.

These sea level rise projections have been adopted for modelling of the Projected 2050 and Projected 2100 scenarios for the full range of design events. The projected 2050 and projected 2100 scenarios are based on current BoM design event IFD rainfall data (without projected rainfall increases) and Council's SLR projections of 23cm by 2050 and 36cm by 2100. The Sea Level Rise scenarios adopted for this Study are provided in the **Table 9-4**:

Table 9-4 Sea Level Rise scenarios for Design Events

Scenario	Sea Level Rise	Events (AEP)
Projected 2050	SCC 2050 (+0.23m)	20%, 10%, 5%, 2%, 1%, 0.2%
Projected 2100	SCC 2100 (+0.36m)	20%, 10%, 5%, 2%, 1%, 0.2%
NSW Projected 2100	NSW 2100 (+0.90m)	1%

9.5 Tidal Inundation

Highest Astronomical Tide (HAT) levels have been obtained from Table 2.2 of MHL report "NSW Ocean And River Entrance Tidal Levels Annual Summary 2018–2019" Report MHL2693 November 2019. The Jervis Bay gauge is the closest gauge and the Jervis Bay HAT value of 1.12mAHD was selected.

The peak HHWSS in OEH Floodplain Risk Management Guide (2015) Figure C.1 is 1.03m. This HHWSS tide time series has been scaled up to match the Jervis Bay HAT of 1.12m AHD. No barometric setup or wave setup is considered in the boundary condition.

For the HAT +SLR scenarios, the relevant sea level rise has been added to the time series - i.e. +0.23m for 2050 and +0.36m for 2100.

9.6 Parameter Sensitivity Analysis

Sensitivity Analysis is undertaken to examine the effect that varying parameters in the model has on results such as changing model inputs or boundary conditions or to investigate potential future scenarios for prevailing catchment conditions.

Table 9-5 shows the Sensitivity Analysis Scenarios that were investigated for the Mainstream model for the Flood Study. Each analysis has been run for the critical duration events to capture the envelope of peak flood level results for comparison with the adopted model setup for a 1% AEP event using ARR2019.

Table 9-5 Sensitivity Analysis Scenarios

ID	Sensitivity Scenario	Description	Event
CL1.0	Continuing Loss 1.0 mm/hr	Inflows derived using continuing loss of 1.0 mm/hr in WBNM hydrology model	1% AEP
CL2.5	Continuing Loss 2.5 mm/hr	Inflows derived using continuing loss of 2.5 mm/hr in WBNM hydrology model	1% AEP
MinTP	Lowest peak temporal pattern	Inflows derived using the temporal pattern which produced the lowest peak volume/level in the basin for the critical duration	1% AEP
MaxTP	Highest peak temporal pattern	Inflows derived using the temporal pattern which produced the highest peak volume/level in the basin for the critical duration was selected	1% AEP
SenR2	+20% Manning's Roughness	Increase in the roughness value applied to the materials layer by 20% of adopted values	1% AEP
SenR1	-20% Manning's Roughness	Decrease in the roughness value applied to the materials layer by 20% of adopted values	1% AEP
BL1	Blockage Case1	Based off an ARR2019 blockage assessment, 50% blockage applied to all culverts, and bridge and culvert structures with a diagonal length of <1.5m 20% blockage to structures with a diagonal length of >1.5m 0% blockage to structures with a diagonal length of >6m	1% AEP
BL2	Blockage Case2	75% blockage applied to all culverts, and bridge and culvert structures with a diagonal length of <1.5m 40% blockage to structures with a diagonal length of >1.5m 0% blockage to structures with a diagonal length of >6m	1% AEP
1PC_HHWS	Tailwater - HHWSS	Adopted HHWSS for ocean boundary	1% AEP
SenO3	Entrance condition	Adjust entrance bathymetry to represent a more constricted entrance	1% AEP
Ex87	ARR87 – IFD and methods	ARR87 IFD data and temporal patterns used. Initial loss 5mm, continuing loss = 2.5mm/hr	5% AEP 1% AEP

9.7 Climate Change Sensitivity

It is widely accepted that Climate Change will lead to increases in global temperatures which will lead to increases in the intensity of rainfall along with sea level rise. The NSW Government's Floodplain Development Manual (NSW Government, 2005) requires that flood studies and floodplain risk management studies consider the impact of climate change (rainfall increase and sea level rise) on flood behaviour. This Study has assessed the impacts on flooding of both climate change induced rainfall increases and sea level rise using current industry guidelines.

Climate Change scenarios tested have been adopted from ARR2019 along with consideration of the *OEH Floodplain Risk Management Guides: Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways* (OEH, 2015) and Practical Consideration of Climate Change (DECC, 2007).

9.7.1 Rainfall Increase

Climate change predictions are made based on modelling changes to temperature and rainfall in global climate models for various Representative Concentration Pathways (RCPs), which consider projected increases in greenhouse gas concentrations. Temperature and rainfall for low, medium and high carbon emissions scenarios for years up to 2090 for the St Georges Basin catchment are shown in **Table 9-6**.

ARR2019 (Ball et al., 2019) recommends the use of RCP 4.5 and RCP 8.5 values. These values are available as a percentage that the rainfall should be factored by from the ARR Data Hub.

Table 9-6 ARR Data Hub recommended Climate Change Data

Year	RCP 4.5		RCP6.5		RCP 8.5	
	Temperature Increase (ºC)	Rainfall Increase	Temperature Increase (ºC)	Rainfall Increase	Temperature Increase (ºC)	Rainfall Increase
2030	0.648	3.20%	0.687	3.40%	0.811	4.00%
2040	0.878	4.40%	0.827	4.10%	1.084	5.40%
2050	1.081	5.40%	1.013	5.10%	1.446	7.30%
2060	1.251	6.30%	1.229	6.20%	1.862	9.50%
2070	1.381	7.00%	1.46	7.40%	2.298	11.90%
2080	1.465	7.40%	1.691	8.60%	2.719	14.20%
2090	1.496	7.60%	1.906	9.70%	3.09	16.30%

9.7.2 Sea Level Rise

The Shoalhaven City Council adopted sea level rise projections discussed in Section 9.4, i.e. 23cm by 2050 and 36cm by 2100 based on *South Coast Regional Sea Level Rise Policy and Planning Framework* (Whitehead & Associates, 2014) have been adopted in the Climate Change Scenarios model scenarios.

9.7.3 Climate Change Scenarios

Based on the above considerations, it was decided to run both the rainfall increase with no sea level rise as well as running rainfall increase in combination with the expected corresponding sea level rise for two future scenarios – 2050 and 2090. Both RCP 4.5 and RCP 8.5 rainfall increase has been run for each future scenario for both the 5% AEP and 1% AEP events.

Climate Change Scenarios assessed are provided in **Table 9-7**.

Table 9-7 Climate Change Scenarios

ID	Rainfall Scenario	Catchment Event	Ocean Tide	Rainfall Increase	Sea Level Rise (SLR)	Adopted Boundary Peak Water Surface Level
CC1	RCP4.5 – 2050	5% AEP	HHWSS tide – 1.03m AHD	5.40%	Existing	1.03m AHD
		1% AEP	5% AEP tide – 1.90m AHD			1.90m AHD
CC2	RCP8.5 – 2050	5% AEP	HHWSS tide – 1.03m AHD	7.30%	Existing	1.03m AHD
		1% AEP	5% AEP tide – 1.90m AHD			1.90m AHD
CC3	RCP4.5 – 2090	5% AEP	HHWSS tide – 1.03m AHD	7.60%	Existing	1.03m AHD
		1% AEP	5% AEP tide – 1.90m AHD			1.90m AHD
CC4	RCP8.5 – 2090	5% AEP	HHWSS tide – 1.03m AHD	16.30%	Existing	1.03m AHD
		1% AEP	5% AEP tide – 1.90m AHD			1.90m AHD
CC5	RCP4.5 – 2050	5% AEP	HHWSS tide – 1.03m AHD	5.40%	SCC 2050 (+0.23m)	1.26m AHD
		1% AEP	5% AEP tide – 1.90m AHD			2.13m AHD
CC6	RCP8.5 – 2050	5% AEP	HHWSS tide – 1.03m AHD	7.30%	SCC 2050 (+0.23m)	1.26m AHD
		1% AEP	5% AEP tide – 1.90m AHD			2.13m AHD
CC7	RCP4.5 – 2090	5% AEP	HHWSS tide – 1.03m AHD	7.60%	SCC 2100 (+0.36m)	1.39m AHD
		1% AEP	5% AEP tide – 1.90m AHD			2.26m AHD
CC8	RCP8.5 – 2090	5% AEP	HHWSS tide – 1.03m AHD	16.30%	SCC 2100 (+0.36m)	1.39m AHD
		1% AEP	5% AEP tide – 1.90m AHD			2.26m AHD

9.8 Wind Wave Setup Assessment

Design event flood levels calculated from hydraulic modelling represent the design ‘still’ water level in the St Georges Basin. However, the design event flood level applicable around the St Georges Basin foreshore may include the basin ‘still’ water level and the effect of waves created by wind forces acting across the surface of the Basin.

The size of the waves depends on the length of fetch, depth of water and the speed and duration of wind. Wave runup on the shoreline is influenced by the shore slope and the presence of any structures such as seawalls or revetments. A schematic representation of the wave runup process is shown in **Figure 9-1**.

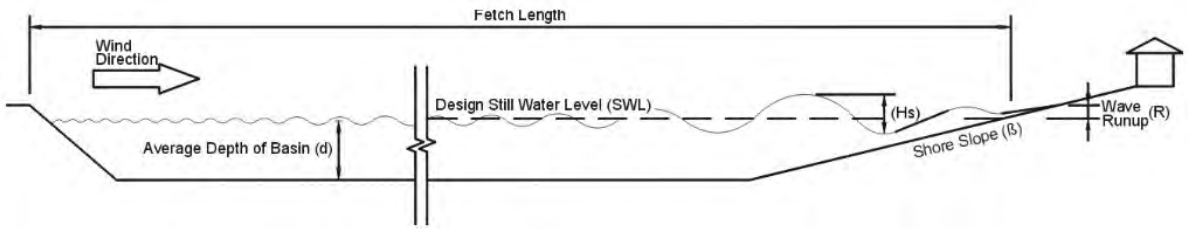


Figure 9-1 Schematic Representation of Wave Runup (WMA, 2001)

Estimated wave heights, wind set-up and indicative wave runup levels have been calculated at three nominated locations around the St Georges Basin foreshore. These sites replicate the locations assessed in the 2001 Flood Study (WMA, 2001) and were considered to represent the worst possible wind frequency/fetch combinations for the existing development areas of Paradise Beach, Island Point and Basin View. These analyses have been based on recorded wind data provided by the BoM at the following stations:

- Jervis Bay (Point Perpendicular AWS, Station 068151). Data is available between 2001 and 2021 and is collected at an elevation of 85m AHD;
- Nowra Station (stations 068076 and 068072). Data is available between 1986 and 2021 and is collected at an elevation of 109m AHD; and
- Port Kembla wind data from Australian Baseline Sea Level Monitoring Project. Data is available between 1991 and 2020 with some gaps in 2013, 2015, 2017 and 2019.

This data was corrected to be 10m above ground level and extremal analyses were undertaken using directional sectors of 45º to determine the 10-minute average peak event wind speeds. Wind speeds adopted in this assessment are the average of the extreme estimates from each site. The 20 year ARI (1 in 20 AEP) wind speed is selected as the magnitude likely to jointly occur with the 1% AEP design basin flood level. Bathymetry and LiDAR data of St Georges Basin was used to provide depth and fetch data for wind set-up and wave run-up calculations.

Calculations for wave heights, wind set-up and wave run-up are provided in **Appendix K**.

Results of the assessment are presented in **Section 10.10**.

10 Results

During catchment flooding, flows create rising water levels in the tributaries flowing into St Georges Basin as well as Badgee Lagoon/Sussex Inlet. Basin levels begin to rise when the rate of inflow to the Basin is greater than the outflow to the ocean via the Sussex Inlet channel. Outflows from the Basin are controlled by the capacity of the Sussex Inlet channel and then overtop the southern bank of the Basin when levels continue to rise. Flows and flooding in the Sussex Inlet area are driven by the Basin volume, however, there is also complex interaction with ocean conditions (tide levels, barometric setup, waves and entrance conditions) as well as local catchment inflows from Badgee Lagoon which can all compound the flood levels when experienced at the same time. The majority of flooding in the catchment is experienced in Sussex Inlet and around the St Georges Basin foreshore areas.

For short intense storm events, flooding is typically limited to overland flow in urban areas and tributary flooding with only small increases in Basin water levels as the total rainfall volume is insufficient to fill the Basin. Peak Basin levels are experienced during long, steady rainfall events typically occurring over days, where the large rainfall and runoff volume causes elevated Basin levels. Local wind conditions can also affect Basin water levels by generating waves and setup across the fetch of the Basin.

The following sections describe the flood modelling results and processing of results for determining various flood behaviour parameters.

10.1 Peak Flood Levels, Extents and Depths

Flood extent maps showing peak flood depths and peak flood levels for the 20%, 10%, 5%, 2%, 1%, 0.2% AEP and PMF design flood events are provided in **Figure G01** to **G14** in **Appendix G.** Flooding in the catchment largely affects Sussex Inlet and the Sanctuary Point area adjacent to Tomerong Creek with flooding of only a small number of properties in the 20% AEP. For events up to the 5% AEP, flows are largely contained within the channel banks of the Sussex Inlet and St Georges Basin tributaries, including Wandandian Creek and Tomerong Creek. However, flood extents change dramatically when flow is out of bank in the 2% AEP event and rarer events, affecting low-lying foreshore areas around St Georges Basin. The PMF affects large areas of the St Georges Basin floodplain as well as the tributaries and overland flow areas.

Flood levels for the full range of design events corresponding to the key locations in **Figure 10-1** are presented in **Table 10-1**.

Projected 2050 scenario including 0.23m Sea Level Rise flood extent maps showing peak flood depths and peak flood levels with contours are provided in **Figure G31** to **G40** in **Appendix G**, with flood levels presented in **Table 10-2**.

Projected 2100 scenario including 0.36m Sea Level Rise flood extent maps showing peak flood depths and peak flood levels with contours are provided in **Figure G59** to **G68** in **Appendix G**, with flood levels presented in **Table 10-3**.

Water level difference maps for the 10%, 5%, 2%, 1% AEP and PMF are shown in **Appendix G** in **Figures G54** to **G58** for the Projected 2050 scenario and **Figures G82** to **G86** for the Projected 2100 scenario**.** While **Figure G87** shows the 1% AEP water level difference maps for the NSW Projected 2100 Sea Level Rise (NSW +0.90m).

Sea Level Rise predominantly affects Sussex Inlet and the low lying areas around the Basin foreshore. There are no impacts as a result of Seal Level Rise to flood levels in Wandandian Creek beyond the Princes Highway or Tomerong Creek beyond the Wool Road.

NSW Projected 2100 Sea Level Rise (NSW +0.90m) does have slightly more impacts in the Basin (~30mm) and some impacts beyond the Princes Highway and Wool Road.

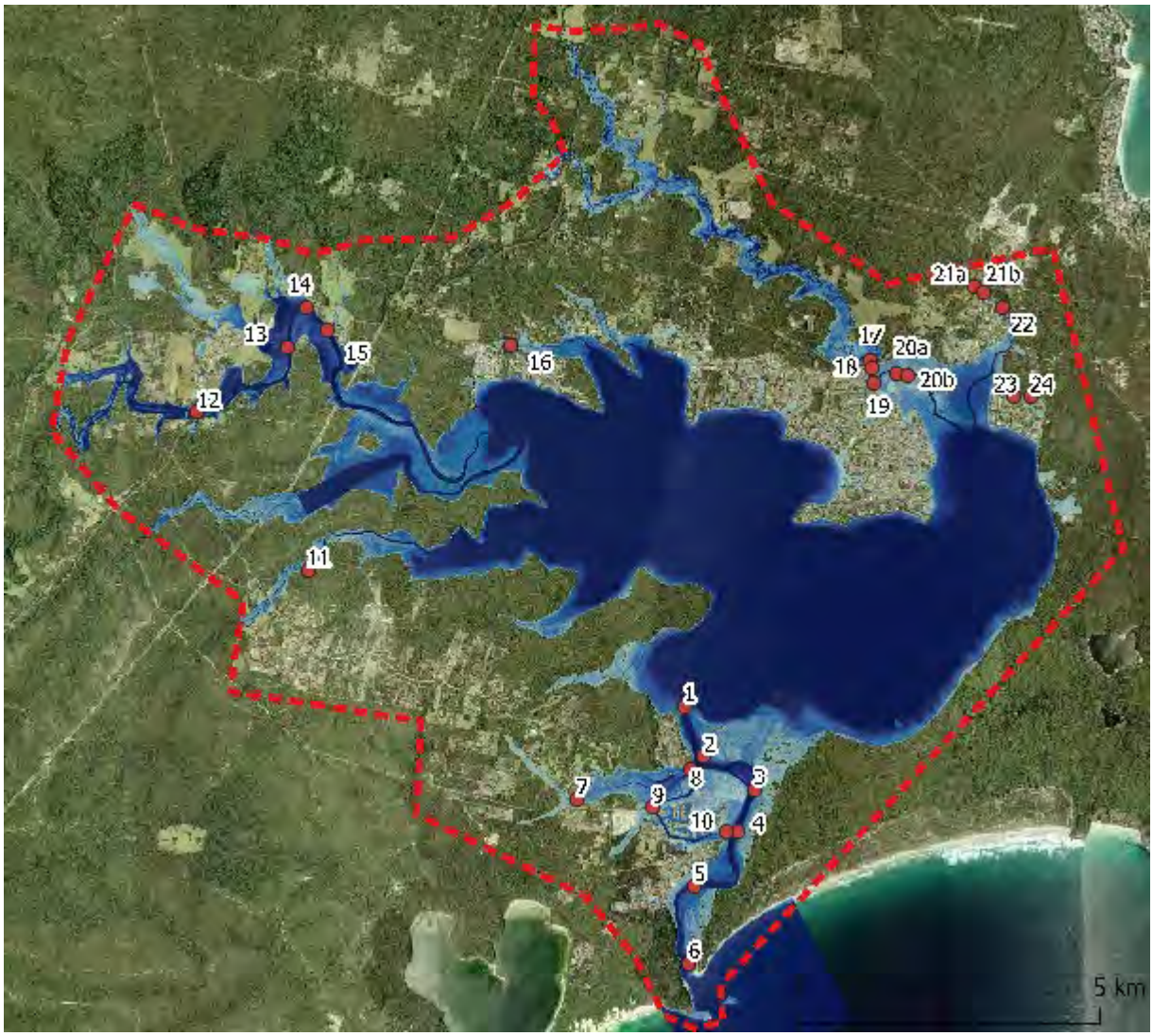


Figure 10-1 Key Locations

Table 10-1 Peak flood level at reference locations for design events – Existing Scenario

ID	Location	Creek	Water Level (mAHD)						
			20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.2% AEP	PMF
1	Basin	Inlet	1.08	1.30	1.60	2.12	2.30	2.84	5.60
2	Badgee Lagoon Jtn	Inlet	1.07	1.26	1.54	2.08	2.26	2.80	5.55
3	Jacobs Drive	Inlet	1.07	1.24	1.50	2.05	2.23	2.76	5.52
4	Cater Canal	Inlet	1.07	1.22	1.46	2.03	2.19	2.70	5.40
5	Coastal Patrol	Inlet	1.06	1.17	1.35	2.00	2.11	2.53	4.95
6	The Haven	Inlet	1.05	1.08	1.15	1.94	1.99	2.23	3.89
7	D/s Sussex Inlet Rd Bridge	Badgee	2.21	2.35	2.45	2.61	2.82	2.90	5.53
8	U/s Badgee Bridge	Badgee	1.07	1.26	1.53	2.08	2.26	2.79	5.55
9	Jacobs Dr Bridge	Cater	1.07	1.24	1.49	2.05	2.23	2.77	5.53
10	U/s Cater Bridge	Cater	1.07	1.22	1.46	2.03	2.19	2.71	5.43
11	1 km D/s Sussex Inlet Rd	Cow	4.07	4.16	4.26	4.38	4.50	4.76	5.99
12	200 m D/s Princes Highway	Wandandian	6.08	6.33	6.65	7.03	7.32	8.36	11.61
13	Sawmill U/s	Wandandian	3.46	3.75	4.10	4.62	4.82	5.93	9.01
14	Sawmill D/s	Wandandian	3.26	3.58	3.95	4.50	4.71	5.84	8.92
15	Bewong	Wandandian	2.92	3.23	3.59	4.16	4.35	5.50	8.41
16	Wool Rd	Pats	3.90	3.93	3.95	3.98	4.04	4.05	5.60
17	U/s Wool Rd	Home	3.22	3.32	3.53	3.71	3.89	4.44	5.80
18	Wool Rd	Tomerong	2.93	3.01	3.17	3.32	3.44	3.83	5.64
19	Boronia Ave	Tomerong	2.51	2.60	2.75	2.92	3.02	3.39	5.62
20a	U/s Larmer Ave	Tomerong	1.38	1.66	1.97	2.29	2.34	2.87	5.61
20b	D/s Larmer Ave	Tomerong	1.24	1.50	1.82	2.13	2.32	2.85	5.61
21a	U/s Wool Rd	Worrowing	7.53	7.60	7.65	7.73	7.85	7.89	8.31
21b	D/s Wool Rd	Worrowing	5.16	5.30	5.41	5.56	5.77	5.84	6.62
22	Fitzpatrick St	Worrowing	2.34	2.51	2.64	2.85	3.11	3.27	5.61
23	Killarney Rd	Erowal	3.91	3.93	3.93	3.99	4.09	4.09	5.60
24	Kallaroo Rd	Erowal	8.60	8.62	8.62	8.64	8.65	8.65	8.68

Refer to Figure 10-1 for reference locations.

Table 10-2 Peak flood level at reference locations for design events – Projected 2050 scenario

ID	Location	Creek	Projected 2050 Water Level (mAHD)				
			10% AEP	5% AEP	2% AEP	1% AEP	PMF
1	Basin	Inlet	1.38	1.66	2.24	2.38	5.62
2	Badgee Lagoon Jtn	Inlet	1.36	1.61	2.21	2.35	5.57
3	Jacobs Drive	Inlet	1.35	1.58	2.19	2.32	5.55
4	Cater Canal	Inlet	1.34	1.54	2.18	2.30	5.43
5	Coastal Patrol	Inlet	1.32	1.47	2.17	2.25	4.97
6	The Haven	Inlet	1.28	1.34	2.15	2.18	3.92
7	D/s Sussex Inlet Rd Bridge	Badgee	2.35	2.45	2.61	2.82	5.56
8	U/s Badgee Bridge	Badgee	1.36	1.60	2.21	2.35	5.57
9	Jacobs Dr Bridge	Cater	1.35	1.57	2.19	2.32	5.55
10	U/s Cater Bridge	Cater	1.34	1.55	2.18	2.30	5.46
11	1 km D/s Sussex Inlet Rd	Cow	4.16	4.26	4.38	4.50	5.99
12	200 m D/s Princes Highway	Wandandian	6.33	6.65	7.03	7.32	11.61
13	Sawmill U/s	Wandandian	3.75	4.10	4.62	4.82	9.01
14	Sawmill D/s	Wandandian	3.58	3.95	4.51	4.71	8.92
15	Bewong	Wandandian	3.24	3.59	4.16	4.35	8.41
16	Wool Rd	Pats	3.93	3.95	3.98	4.04	5.63
17	U/s Wool Rd	Home	3.32	3.53	3.71	3.89	5.82
18	Wool Rd	Tomerong	3.01	3.17	3.32	3.44	5.67
19	Boronia Ave	Tomerong	2.60	2.75	2.93	3.02	5.64
20a	U/s Larmer Ave	Tomerong	1.70	2.00	2.34	2.41	5.63
20b	D/s Larmer Ave	Tomerong	1.55	1.85	2.25	2.40	5.63
21a	U/s Wool Rd	Worrowing	7.60	7.65	7.73	7.85	8.31
21b	D/s Wool Rd	Worrowing	5.30	5.41	5.56	5.77	6.62
22	Fitzpatrick St	Worrowing	2.51	2.64	2.85	3.11	5.64
23	Killarney Rd	Erowal	3.93	3.93	3.99	4.09	5.63
24	Kallaroo Rd	Erowal	8.62	8.62	8.64	8.65	8.68

Refer to Figure 10-1 for reference locations.

Table 10-3 Peak flood level at reference locations for design events – Projected 2100 scenario

ID	Location	Creek	Projected 2100 Water Level (mAHD)				
			10% AEP	5% AEP	2% AEP	1% AEP	PMF
1	Basin	Inlet	1.43	1.70	2.31	2.44	5.64
2	Badgee Lagoon Jtn	Inlet	1.42	1.66	2.29	2.41	5.59
3	Jacobs Drive	Inlet	1.42	1.63	2.28	2.39	5.56
4	Cater Canal	Inlet	1.42	1.61	2.28	2.37	5.44
5	Coastal Patrol	Inlet	1.41	1.55	2.28	2.34	4.99
6	The Haven	Inlet	1.40	1.45	2.28	2.30	3.93
7	D/s Sussex Inlet Rd Bridge	Badgee	2.35	2.45	2.61	2.82	5.57
8	U/s Badgee Bridge	Badgee	1.42	1.65	2.29	2.40	5.59
9	Jacobs Dr Bridge	Cater	1.42	1.62	2.28	2.39	5.57
10	U/s Cater Bridge	Cater	1.42	1.61	2.28	2.37	5.47
11	1 km D/s Sussex Inlet Rd	Cow	4.16	4.26	4.38	4.50	5.99
12	200 m D/s Princes Highway	Wandandian	6.33	6.65	7.04	7.32	11.61
13	Sawmill U/s	Wandandian	3.75	4.10	4.63	4.82	9.01
14	Sawmill D/s	Wandandian	3.58	3.95	4.51	4.71	8.92
15	Bewong	Wandandian	3.24	3.59	4.17	4.35	8.41
16	Wool Rd	Pats	3.93	3.95	3.98	4.04	5.64
17	U/s Wool Rd	Home	3.32	3.53	3.71	3.89	5.84
18	Wool Rd	Tomerong	3.01	3.17	3.32	3.44	5.68
19	Boronia Ave	Tomerong	2.61	2.75	2.94	3.02	5.66
20a	U/s Larmer Ave	Tomerong	1.73	2.01	2.37	2.46	5.65
20b	D/s Larmer Ave	Tomerong	1.58	1.87	2.33	2.45	5.65
21a	U/s Wool Rd	Worrowing	7.60	7.65	7.73	7.85	8.31
21b	D/s Wool Rd	Worrowing	5.30	5.41	5.56	5.77	6.62
22	Fitzpatrick St	Worrowing	2.51	2.64	2.85	3.11	5.66
23	Killarney Rd	Erowal	3.93	3.93	3.99	4.09	5.64
24	Kallaroo Rd	Erowal	8.62	8.62	8.64	8.65	8.68

Refer to Figure 10-1 for reference locations.

10.2 Comparison with Previous Flood Study Results

The comparison to the previous 2001 St Georges Basin Flood Study (WMA, 2001) results are presented in **Table 10-4** for the 1% AEP event.

It is noted that water levels are similar to the previous flood study results. It is observed that:

- Water level differences are within +/-50mm in Sussex Inlet and in the Basin;
- Water levels are generally 60 to 200mm higher than previous flood study in Wandandian Creek; and
- Water level differences are generally within 0 to 20mm in Tomerong Creek

It is also noted that different methodologies are used in these two studies, i.e. different hydrology (data and methods), hydraulics (model setup and data) and tailwater ocean conditions. The current study has adopted lower ocean tidal boundary conditions than the previous study in accordance with DPE guidelines.

Locations with greater differences (Sites 7, 11, 12, 17, 22 and 24) can be explained due to the current study using more recent structures survey and terrain data which may be more accurate in those areas and the use of a 2-dimensional model grid means that all flowpaths follow the terrain and are not assumed or depth averaged across a cross-section as is the case with the previous flood study 1D/Quasi-2D model.

As discussed in **Section 7**, the current study has been calibrated to historical events and provides a good correlation with historical event stage frequency analysis of Basin water levels.

Table 10-4 Comparison to previous flood study – 1% AEP water level difference

ID	Location	Creek	Previous Flood Study 1% AEP	Current Study 1% AEP	
			WL (mAHD)	WL (mAHD)	Diff (m)
1	Basin	Inlet	2.35	2.30	-0.05
2	Badgee Lagoon Jtn	Inlet	2.30	2.26	-0.04
3	Jacobs Drive	Inlet	2.26	2.23	-0.03
4	Cater Canal	Inlet	2.18	2.19	0.01
5	Coastal Patrol	Inlet	2.05	2.11	0.06
6	The Haven	Inlet	1.96	1.99	0.03
7	D/s Sussex Inlet Rd Bridge	Badgee	2.30	2.82	0.52
8	U/s Badgee Bridge	Badgee	2.30	2.26	-0.04
9	Jacobs Dr Bridge	Cater	2.30	2.23	-0.07
10	U/s Cater Bridge	Cater	2.26	2.19	-0.07
11	1 km D/s Sussex Inlet Rd	Cow	3.47	4.50	1.03
12	200 m D/s Princes Highway	Wandandian	6.66	7.32	0.66
13	Sawmill U/s	Wandandian	4.7	4.82	0.12
14	Sawmill D/s	Wandandian	4.5	4.71	0.21
15	Bewong	Wandandian	4.29	4.35	0.06
16	Wool Rd	Pats	4.26	4.04	-0.22
17	U/s Wool Rd	Home	2.54	3.89	1.35
18	Wool Rd	Tomerong	3.44	3.44	0.00
19	Boronia Ave	Tomerong	3.02	3.02	0.00
20a	U/s Larmer Ave	Tomerong	2.36	2.34	-0.02
20b	D/s Larmer Ave	Tomerong	2.36	2.32	-0.04
21a	U/s Wool Rd	Worrowing	7.75	7.85	0.10
21b	D/s Wool Rd	Worrowing	5.66	5.77	0.11
22	Fitzpatrick St	Worrowing	2.56	3.11	0.55
23	Killarney Rd	Erowal	4.06	4.09	0.03
24	Kallaroo Rd	Erowal	7.08	8.65	1.57

Refer to Figure 10-1 for reference locations.

The 2001 St Georges Basin Flood Study did not report on projected sea level rise scenarios, however, Projected 2050 and Projected 2100 scenarios were assessed in the 2013 *St Georges Basin Floodplain Risk Management Study & Plan Climate Change Assessment* report (WMAwater, 2013). This study used a higher baseline ocean boundary water level and adopted the NSW government sea level rise projections of 0.4m by 2050 and 0.9m by 2100. The current study uses Council's policy adopted in 2015 for SLR projections of 23cm by 2050 and 36cm by 2100. As a result the current study Projected 2050 flood levels are approximately 400mm lower and Projected 2100 flood levels are 700-800mm lower. 5% AEP levels are

significantly lower than previous study results due to the much lower HHWSS tidal boundary water levels that have been adopted.

Table 10-5 Comparison with previous study - projected 2050 and projected 2100 flood levels

Projected 2050						
	Current Study			2013 FRMSP Climate Change Assessment		
Event	Adopted Peak TWL (mAHD)	Island Point WL (mAHD)	Sussex Inlet WL (mAHD)	Adopted Peak TWL (mAHD)	Island Point WL (mAHD)	Sussex Inlet WL (mAHD)
PMF/Extreme	2.23	5.62	4.97	2.70	5.40	4.68
1%	2.13	2.38	2.25	2.5	2.78	2.49
2%	2.13	2.24	2.17	2.45	2.64	2.31
5%	1.26	1.66	1.47	2.40	2.36	2.21
Projected 2100						
	Current Study			2013 FRMSP Climate Change Assessment		
Event	Adopted Peak TWL (mAHD)	Island Point WL (mAHD)	Sussex Inlet WL (mAHD)	Adopted Peak TWL (mAHD)	Island Point WL (mAHD)	Sussex Inlet WL (mAHD)
PMF/Extreme	2.36	5.64	4.99	3.20	5.66	4.94
1%	2.26	2.44	2.34	3.00	3.21	2.93
2%	2.26	2.31	2.28	2.95	3.10	2.77
5%	1.39	1.70	1.55	2.90	2.85	2.69

TWL - tail water level (ocean boundary)

WL – water level

10.3 Flow Velocities

Flow velocity maps are provided in **Figures G15** to **G17** for Design Events, **Figures G41** to **G42** for Projected 2050 and **Figures G69** to **G70** for Projected 2100 in **Appendix G.**

Flow velocities in the 1% AEP event are generally about 2 m/s within the main channel of the tributaries and about 0.8 m/s over the bank, while velocities are around 1 m/s within the Sussex Inlet channel. Low flow velocities are observed within St Georges Basin due to the water depths. Overland flow velocities across the Study Area are generally limited to less than 1 m/s.

Flow velocities in the Probable Maximum Flood generally vary from 4 to 6 m/s along the tributaries and the Sussex Inlet channel. Flow velocities within tributaries generally vary from 1 to 4 m/s. Most overland flow velocities are expected to be limited to less than 1.5 m/s, with a few localised roadway flows that exceed 3.5 m/s.

10.4 Hazard and Hydraulic Categories

10.4.1 Flood Hazard

Provisional flood hazard is determined through a relationship developed between the depth and velocity of floodwaters and is based strictly on hydraulic considerations.

Historically, the criteria for these relationships has been taken from the NSW Floodplain Development Manual (FDM) (Appendix L; NSW Government, 2005). The Manual defines two major categories for provisional hazard – high and low. A third minor transitional category is also included that requires further investigation of the site in question to define the hazard category. The FDM hazard curves are shown in **Figure 10-2**.

Recently, a new method of hazard categorisation has been developed by the revised AR&R manual (Book 6: Flood Hydraulics, Section 7.2.7). The classification is still based on depth and velocity, but utilises six categories based on the stability of children, adults, the elderly and vehicles in flood waters.

The ARR2019 hazard curves are shown in **Figure 10-3**.

The results based on the hazard mapping are provided in **Figures G18** to **G26** for Design Events, **Figures G43** to **G49** for Projected 2050 and **Figures G71** to **G77** for Projected 2100 in **Appendix G**.

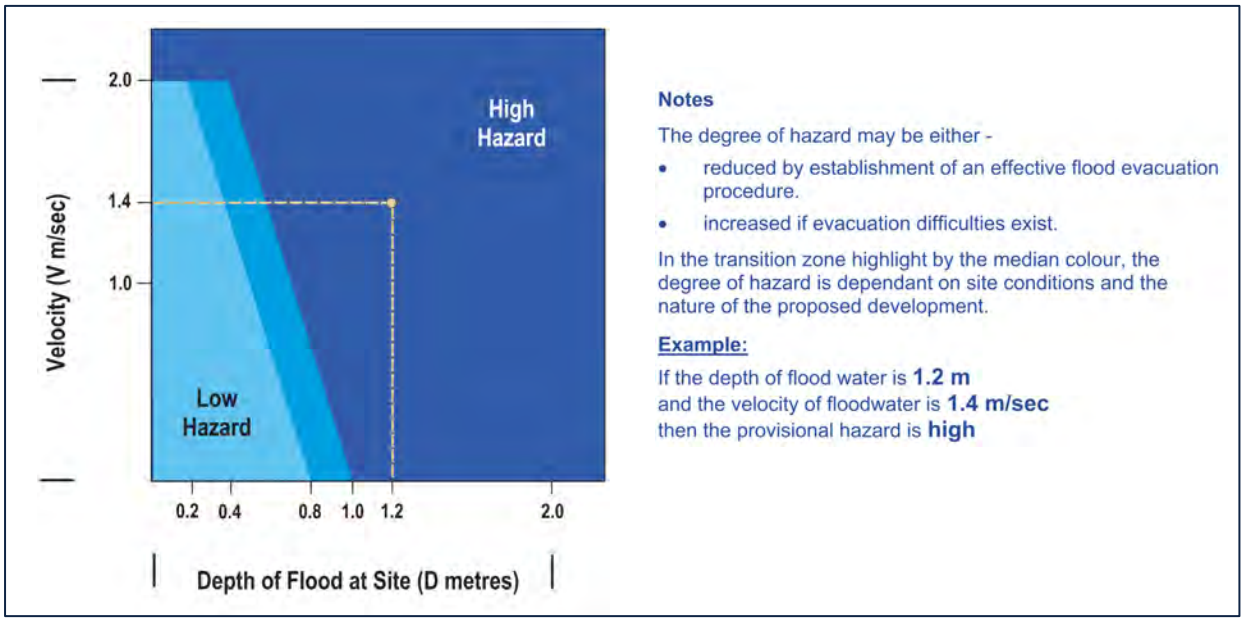


Figure 10-2 Provisional Hazard Categories from Appendix L of the Floodplain Development Manual

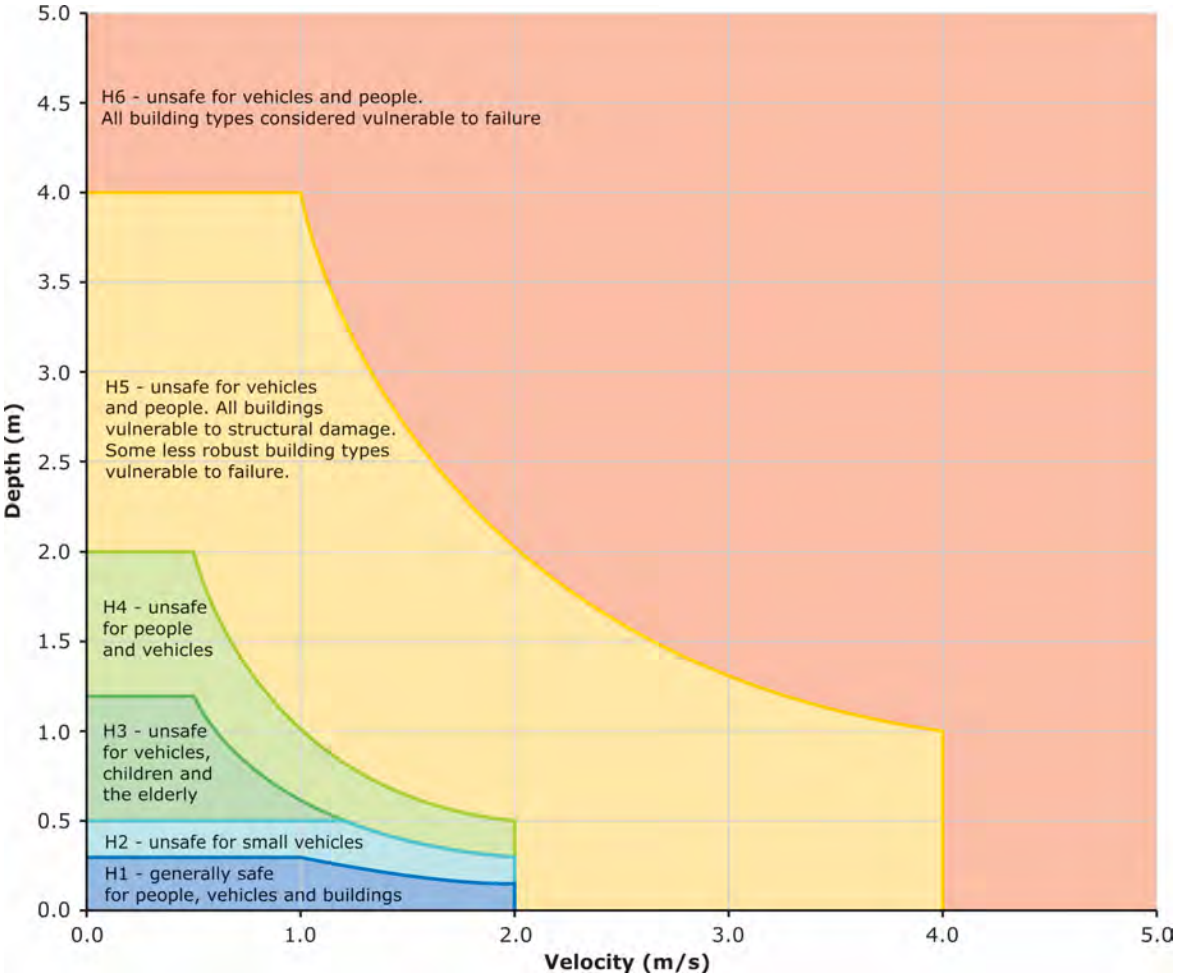


Figure 10-3 Hazard Categories from ARR 2019

Within the St Georges Basin, flood hazard is predominately classed as H6 as a result of the significant depths that occur. The tributaries and Sussex Inlet channel also experience H6 classified hazard due to the high velocities of the concentrated flow. The depths and velocity make flooding hazardous for both pedestrians and vehicles. As a result of the relatively steep banks around the Basin, the fringe of lower hazards is relatively small. That is, the transition from H6 hazard to flood-free occurs very quickly, with little lower hazard flooding occurring in between.

For the tributaries, the hazard mapping shows that 1% AEP H6 hazard areas are largely contained within creek and river systems. Most tributaries are fairly incised, resulting in overbank areas that are classified as H3 hazard or lower. However, H5 hazard is mapped in overbank areas along Wandandian Creek and Tomerong Creek (upstream of Island Point Road).

For most overland flowpaths, a H1 or H2 hazard is expected, and are generally safe for people, larger vehicles and buildings, based on the AR&R hazard categories.

In the PMF, H3 to H6 hazard regions dominate the flood extent, with only the outer flood fringe classed as H1 to H2 hazard. These H5 to H6 hazard regions may impact properties along Wandandian Creek, Tomerong Creek, Tullarwalla Creek, Cow Creek and Worrowing Creek. Other significant areas that are greatly affected by H5 to H6 hazards in the PMF is properties around the basin foreshore, Larmer Avenue near Tomerong Creek, Sussex Inlet area and Sussex Inlet South foreshore areas.

10.4.2 Hydraulic Categories

Hydraulic categorisation of the floodplain is used in the development of the Floodplain Risk Management Plan. The NSW Floodplain Development Manual (2005) defines flood prone land to be one of the following three hydraulic categories:

- **Floodway -** Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.
- **Flood Storage -** Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood Storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%.
- **Flood Fringe -** Remaining area of flood prone land, after Floodway and Flood Storage areas have been defined. Blockage or filling of this area will not have any significant effect on the flood pattern or flood levels.

Floodways were determined for the 1% AEP event by considering those model branches that conveyed a significant portion of the total flow. These branches, if blocked or removed, would cause a significant redistribution of the flow. The criteria used to define the floodways are described below (based on Howells et al, 2003).

As a minimum, the floodway was assumed to follow the creek line from bank to bank. In addition, the following depth and velocity criteria were used to define a floodway:

- Velocity x Depth product must be greater than 0.25 m^2/s and velocity must be greater than 0.25 m/s; OR,
- Velocity is greater than 1 m/s.

Flood storage was defined as those areas outside the floodway, which if completely filled would cause peak flood levels to increase by at least 0.1m and/or would cause peak discharge anywhere to increase by more than 10%. The criteria were applied to the model results as described below.

- Depth greater than 0.5m; and
- Not classified as floodway.

All areas that were not categorised as Floodway or Flood Storage, but still fell within the flood extent, are represented as Flood Fringe.

Encroachment analysis in the hydraulic model was undertaken to test that no impacts were caused by filling of flood fringe areas with various depth thresholds. The 0.5m depth was found to be the most appropriate for all areas of the catchment and the exercise also provided guidance for areas where floodway refinement was required.

Hydraulic Categories as determined by the above methods are provided in **Figures G27** and **G28** for Design Events, **Figures G50** and **G51** for Projected 2050 and **Figures G78** and **G79** for Projected 2100 in **Appendix G.**

10.5 Combined Hazard and Hydraulic Category

Council's Development Control Plan and flood certificates utilise the definition of land as within six categories:

- High Hazard Floodway
- Low Hazard Floodway
- High Hazard Flood Storage
- Low Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Flood Fringe

The above combined hazard and hydraulic categories have been mapped based on the combination of the NSW FDM (NSW Government, 2005) provisional hazard categories and the hydraulic categories. Note that the transition zone as per Figure L2 in the NSW FDM should be included with the high hazard zone. These are presented in **Figures G29** and **G30** for Design Events, **Figures G52** to **G53** for Projected 2050 and **Figures G80** to **G81** for Projected 2100 in **Appendix G**.

10.6 Tidal Inundation

The results for tidal inundation due to a Highest Astronomical Tide (HAT) and HAT plus projected Sea Level Rise (2050 and 2100) are shown in **Figures G88** to **G90** in **Appendix G**.

The tidal inundation from HAT events is predominantly limited to Sussex Inlet with only minor tidal influence in the Basin.

Table 10-6 Peak water level due to tidal inundation (HAT)

ID	Location	HAT	HAT+ SCC SLR 2050	HAT+ SCC SLR 2100
		WL (mAHD)	WL (mAHD)	WL (mAHD)
1	Basin	0.21	0.44	0.57
2	Badgee Lagoon Jtn	Not Affected	0.57	0.69
3	Jacobs Drive	0.50	0.73	0.85
4	Cater Canal	0.57	0.80	0.93
5	Coastal Patrol	0.78	1.00	1.13
6	The Haven	0.97	1.19	1.31
7	D/s Sussex Inlet Rd Bridge	Not Affected	Not Affected	Not Affected
8	U/s Badgee Bridge	0.39	0.60	0.72
9	Jacobs Dr Bridge	Not Affected	0.68	0.81
10	U/s Cater Bridge	0.56	0.78	0.90
11	1 km D/s Sussex Inlet Rd	Not Affected	Not Affected	Not Affected
12	200 m D/s Princes Highway	Not Affected	Not Affected	Not Affected
13	Sawmill U/s	Not Affected	Not Affected	Not Affected
14	Sawmill D/s	0.21	0.44	0.57
15	Bewong	0.21	0.44	0.57
16	Wool Rd	Not Affected	Not Affected	Not Affected
17	U/s Wool Rd	Not Affected	Not Affected	Not Affected
18	Wool Rd	Not Affected	Not Affected	Not Affected
19	Boronia Ave	Not Affected	Not Affected	Not Affected
20a	U/s Larmer Ave	0.21	0.44	0.57
20b	D/s Larmer Ave	0.21	0.44	0.57
21a	U/s Wool Rd	Not Affected	Not Affected	Not Affected
21b	D/s Wool Rd	Not Affected	Not Affected	Not Affected
22	Fitzpatrick St	Not Affected	Not Affected	Not Affected
23	Killarney Rd	Not Affected	Not Affected	Not Affected
24	Kallaroo Rd	Not Affected	Not Affected	Not Affected

Refer to Figure 10-1 for reference locations.

10.7 Parameter Sensitivity Analysis

Results of Sensitivity Analysis scenarios are presented in **Figures H1** to **H34** in **Appendix H** as water level difference plots compared with the adopted 1% AEP event peak water levels. Difference maps have been derived by subtracting the existing 1% AEP event water surface level from the Sensitivity Scenario water surface level. Areas that were dry in the existing 1% AEP, but experience flooding in the Sensitivity Scenario are indicated as “Was dry, now wet”. Areas that were flooded in the existing 1% AEP event, but are no longer flooded in the Sensitivity Scenario are indicated as “Was wet, now dry”.

Peak water levels for each Sensitivity Analysis scenario are shown in **Table 10-8** at the water level gauging stations and at reference locations along tributaries. The table also shows water level difference compared to the adopted 1% AEP peak water levels. Reference locations are shown in **Figure 10-1**.

The below sections describe the impacts on flood levels through varying parameters as part of the analysis.

10.7.1 Hydrology Parameter Sensitivity

The results for hydrology parameter sensitivity (changes to continuing loss and temporal patterns) discussed in **Section 8.5** are shown in **Figures H17** to **H20** in **Appendix H**. Peak 1% AEP (48 hour event) water levels and water level difference for each Sensitivity Analysis scenario are shown in **Table 10-7.** It is noted that the sensitivity is limited to the 48 hour event which is the critical duration for the Basin and Sussex Inlet areas. Variability in tributaries is not fully examined for all durations which are critical to each tributary.

Table 10-7 Hydrology Parameter Sensitivity – 1% AEP (48 hour duration) water level difference

ID	Location	1% AEP (48 hour)	CL = 1mm/hr		CL=2.5mm/hr		Min TP		Max TP	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)
1	Basin	2.30	2.33	0.03	2.26	-0.05	2.13	-0.17	2.44	0.14
2	Badgee Lagoon Jtn	2.26	2.28	0.02	2.22	-0.04	2.08	-0.19	2.40	0.14
3	Jacobs Drive	2.23	2.24	0.02	2.19	-0.04	2.03	-0.20	2.36	0.14
4	Cater Canal	2.19	2.20	0.01	2.16	-0.03	1.98	-0.21	2.31	0.13
5	Coastal Patrol	2.11	2.12	0.01	2.09	-0.02	1.96	-0.15	2.21	0.10
6	The Haven	1.99	1.99	0.00	1.98	-0.01	1.93	-0.06	2.03	0.04
7	D/s Sussex Inlet Rd Bridge	2.40	2.40	0.00	2.37	-0.02	2.28	-0.12	2.40	0.00
8	U/s Badgee Bridge	2.26	2.28	0.02	2.21	-0.04	2.07	-0.19	2.39	0.14
9	Jacobs Dr Bridge	2.23	2.24	0.02	2.19	-0.04	2.02	-0.20	2.36	0.13
10	U/s Cater Bridge	2.19	2.20	0.01	2.16	-0.03	1.98	-0.21	2.32	0.13
11	1 km D/s Sussex Inlet Rd	4.32	4.35	0.03	4.26	-0.06	4.16	-0.16	4.26	-0.06
12	200 m D/s Princes Highway	7.05	7.22	0.18	6.70	-0.35	6.38	-0.67	6.86	-0.19
13	Sawmill U/s	4.64	4.85	0.21	4.30	-0.34	3.97	-0.67	4.48	-0.16
14	Sawmill D/s	4.52	4.74	0.22	4.17	-0.35	3.83	-0.69	4.37	-0.16
15	Bewong	4.18	4.39	0.22	3.83	-0.35	3.51	-0.67	4.04	-0.14
16	Wool Rd	3.93	3.93	0.00	3.93	-0.01	3.90	-0.03	3.92	-0.01
17	U/s Wool Rd	3.77	3.83	0.07	3.65	-0.12	3.43	-0.34	3.67	-0.10
18	Wool Rd	3.36	3.41	0.05	3.27	-0.09	3.10	-0.26	3.30	-0.07
19	Boronia Ave	2.95	2.99	0.05	2.86	-0.08	2.72	-0.23	2.92	-0.02
20a	U/s Larmer Ave	2.34	2.36	0.03	2.29	-0.05	2.19	-0.15	2.47	0.14
20b	D/s Larmer Ave	2.32	2.35	0.03	2.28	-0.05	2.16	-0.16	2.46	0.14
21a	U/s Wool Rd	7.63	7.64	0.00	7.61	-0.02	7.56	-0.07	7.60	-0.03
21b	D/s Wool Rd	5.37	5.38	0.01	5.34	-0.03	5.22	-0.14	5.31	-0.06
22	Fitzpatrick St	2.59	2.61	0.01	2.55	-0.04	2.41	-0.18	2.59	-0.01
23	Killarney Rd	3.92	3.92	0.00	3.92	0.00	3.91	-0.01	3.91	0.00
24	Kallaroo Rd	8.61	8.61	0.00	8.61	0.00	8.60	-0.01	8.61	0.00

Refer to Figure 10-1 for reference locations.

Sensitivity to continuing loss shows that the Basin 1% AEP level is increased by 30mm with using a lower continuing loss (1mm/hr) and decreased by 50mm if a higher continuing loss rate (2.5mm/hr) were used. While within the tributaries, changes are up to 220mm and 350mm higher and lower, respectively for the 48 hour duration.

Comparing to the adopted temporal pattern closest to the mean, the minimum and maximum temporal patterns would result in flood levels that are up to 170mm lower and up to 140mm higher in the Basin and Sussex Inlet area. The impact in the tributaries is less clear from this sensitivity because the adopted temporal pattern based on volume in the Basin is actually the maximum or close to the maximum for the 48 hour flow in the tributaries. Hence the temporal pattern which produces the maximum Basin volume actually produces a lower flow and flood level in the tributaries for this event.

10.7.2 Mannings Roughness

Table 10-8 provides peak water levels and water level difference for +/- 20% Manning Roughness values for the 1% AEP design event and **Figures H21** and **H22 in Appendix H** show the 1% AEP water level difference maps.

For increased Mannings Roughness:

- Flood levels increase generally by ~50mm in the basin
- Flood levels increase generally by 250mm to 350mm in Wandandian Creek
- Flood levels increase generally by ~150mm in the other tributaries

For decreased Mannings Roughness:

- Flood levels decrease generally by ~50 mm in the basin
- Flood levels decrease generally by 250mm to 350mm in Wandandian Creek
- Flood levels decrease generally by ~150mm in the other tributaries

10.7.3 Tailwater Level and Inlet Bathymetry

Table 10-8 provides peak water levels and water level difference for tailwater sensitivity using HHWSS for the 1% AEP design event. Entrance bathymetry data from 2016 to 2021 were checked against the 2018 data, which is adopted in the existing scenario. No significant change of entrance capacity is found. As such, a constricted entrance bathymetry is adopted to seek greater sensitivity. A berm is set at RL 0 m AHD in the entrance (at the same location as used for the June 2013 storm event validation) as shown (red line) in **Figure 10-4**, 1% AEP water level differences are presented in **Figures H23** and **H24 in Appendix H.**

The results show that:

- With HHWSS tailwater:
  - Flood levels decrease generally by 160mm in Sussex Inlet area;
  - Flood levels decrease generally by 150mm in the basin and surrounding low lying area; and
  - No significant changes in all tributaries.
- With constricted entrance bathymetry:
  - Flood levels increase generally by about 20mm in Sussex Inlet, the basin and surrounding low lying area; and
  - No changes in all tributaries.

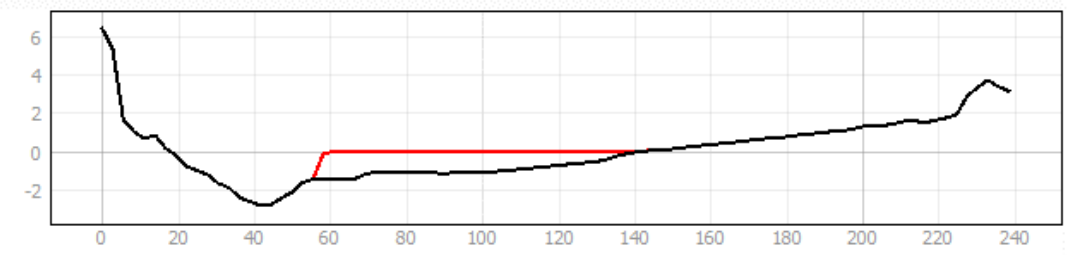


Figure 10-4 Modified Sussex Inlet entrance bathymetry cross-section

10.7.4 Blockage

Table 10-8 provides peak water levels and water level difference for blockage sensitivity for the 1% AEP design event. 1% AEP water level differences are presented in **Figures H25** and **H26 in Appendix H.**

A blockage assessment is undertaken across some types of the structures in the study area. Based on the assessment results, the blockage scenario 1 involves applying 50% blockage to pits, pipe culverts, and bridge and culvert structures with a diagonal opening of less than 1.5m, 20% blockage to structures with a diagonal opening of greater than 1.5m and unblocked for those greater than 6m. As the majority of bridges are large with large spans, blockage sensitivity does not apply at these structures. Also given most of culverts and pipes are submerged in the 1% AEP, this is reflected in the results, where there are almost no difference observed along the creeks at those crossings.

Areas with the greatest sensitivity to blockage are areas with a culvert or bridge under roads.

This is observed in the following areas:

- Sussex Inlet South (37mm)
- Basin View(100mm)
- Erowal Bay near Larmer Ave (50mm)

A second blockage scenario applies 75% blockage to pipe culverts, and 40% blockage to bridge and culvert structures with a diagonal opening of less than 1.5m and greater along tributaries respectively. Greater sensitivity is observed as expected at the same locations as blockage scenario 1, elsewhere is not sensitive:

- Sussex Inlet South (54mm)
- Basin View(150mm)
- Erowal Bay near Larmer Ave (600mm)

Table 10-8 Sensitivity Analysis – water level difference at reference locations

ID	Location	1% AEP	+ 20% Roughness		- 20% Roughness		50% Blockage		75% Blockage		HHWSS		Entrance Bathymetry	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)
1	Basin	2.30	2.35	0.04	2.26	-0.05	2.30	0.00	2.30	0.00	2.17	-0.14	2.33	-0.02
2	Badgee Lagoon Jtn	2.26	2.30	0.04	2.22	-0.04	2.26	0.00	2.26	0.00	2.10	-0.16	2.29	-0.02
3	Jacobs Drive	2.23	2.26	0.03	2.19	-0.04	2.23	0.00	2.23	0.00	2.04	-0.19	2.25	-0.02
4	Cater Canal	2.19	2.21	0.03	2.16	-0.03	2.19	0.00	2.19	0.00	1.96	-0.23	2.21	-0.02
5	Coastal Patrol	2.11	2.12	0.01	2.10	-0.01	2.11	0.00	2.11	0.00	1.78	-0.33	2.13	-0.02
6	The Haven	1.99	1.98	0.00	1.99	0.00	1.99	0.00	1.99	0.00	1.38	-0.61	2.01	-0.02
7	D/s Sussex Inlet Rd Bridge	2.68	2.73	0.05	2.61	-0.07	2.68	0.00	2.68	0.00	2.68	0.00	2.68	0.00
8	U/s Badgee Bridge	2.26	2.29	0.04	2.22	-0.04	2.26	0.00	2.26	0.00	2.09	-0.17	2.28	-0.02
9	Jacobs Dr Bridge	2.23	2.26	0.04	2.19	-0.04	2.23	0.00	2.23	0.00	2.04	-0.19	2.25	-0.02
10	U/s Cater Bridge	2.19	2.22	0.03	2.16	-0.03	2.19	0.00	2.19	0.00	1.97	-0.22	2.21	-0.02
11	1 km D/s Sussex Inlet Rd	4.50	4.59	0.09	4.41	-0.10	4.50	0.00	4.50	0.00	4.50	0.00	4.50	0.00
12	200 m D/s Princes Highway	7.32	7.64	0.32	6.98	-0.34	7.32	0.00	7.33	0.00	7.32	0.00	7.32	0.00
13	Sawmill U/s	4.82	5.09	0.27	4.52	-0.30	4.82	0.00	4.83	0.01	4.82	0.00	4.82	0.00
14	Sawmill D/s	4.71	4.97	0.27	4.40	-0.30	4.71	0.00	4.71	0.01	4.71	0.00	4.71	0.00
15	Bewong	4.35	4.62	0.27	4.04	-0.31	4.35	0.00	4.35	0.01	4.35	0.00	4.35	0.00
16	Wool Rd	4.02	4.05	0.03	3.99	-0.03	4.02	0.00	4.02	0.00	4.01	-0.01	4.01	0.01
17	U/s Wool Rd	3.89	4.01	0.13	3.74	-0.14	3.89	0.00	3.88	-0.01	3.89	0.00	3.89	0.00
18	Wool Rd	3.44	3.55	0.11	3.32	-0.12	3.44	0.00	3.45	0.00	3.44	0.00	3.44	0.00

ID	Location	1% AEP	+ 20% Roughness		- 20% Roughness		50% Blockage		75% Blockage		HHWSS		Entrance Bathymetry	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)
19	Boronia Ave	3.02	3.09	0.07	2.94	-0.08	3.02	0.00	3.02	0.00	3.02	0.00	3.02	0.00
20a	U/s Larmer Ave	2.34	2.38	0.05	2.28	-0.05	2.34	0.00	2.33	0.00	2.25	-0.09	2.36	-0.02
20b	D/s Larmer Ave	2.32	2.37	0.05	2.27	-0.05	2.32	0.00	2.32	0.00	2.20	-0.13	2.34	-0.02
21a	U/s Wool Rd	7.77	7.80	0.03	7.74	-0.03	7.78	0.01	7.78	0.01	7.77	0.00	7.77	0.00
21b	D/s Wool Rd	5.63	5.75	0.12	5.49	-0.14	5.63	0.00	5.63	0.00	5.63	0.00	5.63	0.00
22	Fitzpatrick St	2.94	3.09	0.15	2.77	-0.17	2.94	0.00	2.94	0.00	2.94	0.00	2.94	0.00
23	Killarney Rd	4.09	4.12	0.03	4.06	-0.03	4.15	0.06	4.20	0.11	4.06	-0.03	4.06	0.03
24	Kallaroo Rd	8.65	8.66	0.01	8.63	-0.03	8.65	0.00	8.65	0.00	8.65	0.00	8.65	0.00

Refer to Figure 10-1 for reference locations.

10.7.5 ARR87 IFD and Temporal Patterns

Figures H27 to **H34** in **Appendix H** present the flood depths, levels, hazard, hydraulic categories and water level difference for the ARR87 5% and 1% AEP design events. **Table 10-9** provides peak water levels and water level difference for ARR87 sensitivity for the 5% and 1% AEP design events.

Flood levels are typically 200-300mm higher using ARR87 hydrology data and methods to determine the design flood flows, although some significant level differences of up to 0.6m in Tomerong Creek and almost 0.9m in Wandandian Creek are observed in the tributaries due to differences in flow estimates between the two methods. This is associated with greater flood extents across the Study Area. At St Georges Basin, the ARR2019 1% AEP level is 2.30m AHD, while for the ARR87 1% AEP level is 2.52 m AHD. In the main inflow from Wandandian Creek the ARR2019 1% AEP flow is 860m^3/s, while for ARR87 the 1% AEP flow is 1280m^3/s, which is some 30% higher. This is in line with the differences observed in the design rainfall IFD data. ARR2019 IFD has some 35% reduction in rainfall compared with ARR87 IFD data and produces peak flows in the tributaries that are similarly 30-35% lower than ARR87.

Table 10-9 Sensitivity Analysis – ARR87 water level difference at reference locations

ID	Location	ARR2019 5% AEP	ARR87 5% AEP		ARR2019 1% AEP	ARR87 1% AEP	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	WL (mAHD)	Diff (m)
1	Basin	1.60	1.81	0.21	2.30	2.52	0.22
2	Badgee Lagoon Jtn	1.54	1.75	0.20	2.26	2.48	0.22
3	Jacobs Drive	1.50	1.69	0.19	2.23	2.44	0.21
4	Cater Canal	1.46	1.63	0.18	2.19	2.38	0.20
5	Coastal Patrol	1.35	1.50	0.15	2.11	2.26	0.15
6	The Haven	1.15	1.22	0.07	1.99	2.05	0.06
7	D/s Sussex Inlet Rd Bridge	2.45	2.81	0.36	2.82	3.09	0.27
8	U/s Badgee Bridge	1.53	1.73	0.20	2.26	2.47	0.22
9	Jacobs Dr Bridge	1.49	1.68	0.19	2.23	2.44	0.21
10	U/s Cater Bridge	1.46	1.64	0.18	2.19	2.39	0.20
11	1 km D/s Sussex Inlet Rd	4.26	4.54	0.28	4.50	4.79	0.29
12	200 m D/s Princes Highway	6.65	7.40	0.75	7.32	8.19	0.87
13	Sawmill U/s	4.10	5.00	0.90	4.82	5.66	0.84
14	Sawmill D/s	3.95	4.89	0.94	4.71	5.56	0.86
15	Bewong	3.59	4.55	0.96	4.35	5.20	0.86
16	Wool Rd	3.95	4.04	0.09	4.04	4.11	0.07
17	U/s Wool Rd	3.53	3.96	0.44	3.89	4.45	0.56
18	Wool Rd	3.17	3.51	0.34	3.44	3.82	0.38
19	Boronia Ave	2.75	3.08	0.33	3.02	3.36	0.34
20a	U/s Larmer Ave	1.97	2.34	0.37	2.34	2.68	0.34
20b	D/s Larmer Ave	1.82	2.07	0.25	2.32	2.54	0.21
21a	U/s Wool Rd	7.65	7.84	0.18	7.85	7.97	0.12
21b	D/s Wool Rd	5.41	5.76	0.35	5.77	6.01	0.23
22	Fitzpatrick St	2.64	3.10	0.46	3.11	3.42	0.32
23	Killarney Rd	3.93	4.12	0.19	4.09	4.23	0.14
24	Kallaroo Rd	8.62	8.65	0.03	8.65	8.66	0.01

Refer to Figure 10-1 for reference locations.

10.8 Climate Change Scenarios

Results of Climate Change scenarios are presented in **Figures H1 to H16 in Appendix H** showing water level difference plots compared with the adopted 1% AEP event peak water levels. Difference maps have been derived by subtracting the existing 1% AEP event water surface level (presented in **Appendix G**) from the Climate Change Scenario water surface level. Areas that were dry in the existing 1% AEP, but experience flooding in the Climate Change Scenario are indicated as “Was dry, now wet”. Areas that were flooded in the existing 1% AEP event, but are no longer flooded in the Climate Change Scenario are indicated as “Was wet, now dry”.

10.8.1 Increased Rainfall

Peak water levels for each Climate Change Scenario at the water level gauging stations and reference locations are shown in **Table 10-10** for the 5% AEP event and **Table 10-11** for the 1% AEP event. The tables also show water level difference compared to the adopted 5% AEP and 1% AEP peak water levels. Reference locations are shown in **Figure 10-1**.

Increased rainfall due to climate change has the biggest impact in the tributaries as the increased flow in the constrained channel capacity leads to increase water levels. For the 5% AEP, a 5.4% rainfall increase (2050 RCP 4.5) will have increased flood levels of typically less than 100mm, but this reduces to <50 mm towards the ocean. Slightly higher increases of up to 150mm are observed in Wandandian Creek. The 2050 RCP8.5 and 2090 RCP4.5, have very similar 7.3% and 7.6% rainfall increases, respectively, and show increases of up to 120mm in the Basin, and up to 180mm in Wandandian Creek. A 16.3% rainfall increase (2090 RCP8.5) would lead to up to 400mm increase in flood level in Wandandian Creek, typically up to 250mm at Sussex Inlet and in the Basin, reducing to approximately 100mm near the ocean.

For the 1% AEP, a similar trend is observed where increased flows due to increased rainfall leads to increases in flood levels in the Basin by up to almost 300mm, and up to 450mm in Wandandian Creek for a 16.3% rainfall increase. Increases are generally less than 150mm for all tributaries up to 7.6% rainfall increase with increases typically 150 – 250 mm for the 16.3% (2090 RCP 8.5) rainfall increase.

10.8.2 Increased Rainfall and SLR Scenarios

Peak water levels for each Climate Change Scenario at the water level gauging stations and reference locations are shown in **Table 10-12** for the 5% AEP event and **Table 10-13** for the 1% AEP event. The tables also show water level difference compared to the adopted 1% AEP peak water levels. Reference locations are shown in **Figure 10-1**.

For 5% AEP event 2050 projections of increased rainfall (up to 7.3%) and sea level rise (+0.23m) in combination, the increased flow dominates changes in expected flood levels in the tributaries, while sea level rise impacts the Basin and Sussex Inlet areas. Results in the tributaries remain the same as for increased rainfall without sea level rise.

Similar behaviour is observed for the 1% AEP event 2050 projections of increased rainfall (up to 7.3%) and sea level rise (+0.23m) in combination, with increases of approximately 200mm in Wandandian Creek from increased rainfall, increases of up to 200mm in the Basin and sea level rise dominating in the Sussex Inlet channel near the entrance (up to 220mm).

While for 1% AEP event 2100 projections of increased rainfall (up to 16.3%) and sea level rise (+0.36m) in combination, increases in water level of up to 400mm in the Basin are observed with sea level rise dominating near the entrance (up to 400mm increases). Again, no additional impacts due to sea level rise are expected in Wandandian Creek where the 450mm increase is the result of increased rainfall only.

Table 10-10 Climate Change – 5% AEP Rainfall Increase (Existing sea level) water level difference

ID	Location	5% AEP	CC 2050 RCP4.5		CC 2050 RCP8.5		CC 2090 RCP4.5		CC 2090 RCP8.5	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)
1	Basin	1.60	1.69	0.09	1.72	0.12	1.72	0.12	1.86	0.26
2	Badgee Lagoon Jtn	1.54	1.63	0.08	1.66	0.11	1.66	0.12	1.80	0.25
3	Jacobs Drive	1.50	1.58	0.08	1.61	0.11	1.61	0.11	1.74	0.24
4	Cater Canal	1.46	1.53	0.07	1.55	0.10	1.56	0.10	1.68	0.22
5	Coastal Patrol	1.35	1.41	0.06	1.43	0.08	1.43	0.08	1.54	0.19
6	The Haven	1.15	1.18	0.03	1.19	0.04	1.19	0.04	1.24	0.09
7	D/s Sussex Inlet Rd Bridge	2.45	2.49	0.04	2.50	0.05	2.50	0.05	2.56	0.11
8	U/s Badgee Bridge	1.53	1.62	0.08	1.65	0.11	1.65	0.12	1.78	0.25
9	Jacobs Dr Bridge	1.49	1.56	0.08	1.59	0.11	1.60	0.11	1.72	0.24
10	U/s Cater Bridge	1.46	1.53	0.07	1.56	0.10	1.57	0.11	1.69	0.23
11	1 km D/s Sussex Inlet Rd	4.26	4.29	0.03	4.30	0.05	4.30	0.05	4.35	0.10
12	200 m D/s Princes Highway	6.65	6.76	0.11	6.80	0.15	6.81	0.16	6.99	0.34
13	Sawmill U/s	4.10	4.23	0.13	4.27	0.17	4.28	0.18	4.48	0.38
14	Sawmill D/s	3.95	4.09	0.13	4.14	0.18	4.14	0.19	4.35	0.40
15	Bewong	3.59	3.72	0.14	3.77	0.18	3.78	0.19	3.99	0.40
16	Wool Rd	3.95	3.96	0.01	3.96	0.01	3.96	0.01	3.97	0.03
17	U/s Wool Rd	3.53	3.60	0.08	3.63	0.11	3.63	0.11	3.75	0.23
18	Wool Rd	3.17	3.23	0.06	3.25	0.08	3.25	0.09	3.34	0.17
19	Boronia Ave	2.75	2.81	0.06	2.83	0.08	2.83	0.08	2.91	0.17
20a	U/s Larmer Ave	1.97	2.05	0.08	2.07	0.10	2.07	0.10	2.18	0.22
20b	D/s Larmer Ave	1.82	1.89	0.08	1.92	0.10	1.92	0.10	2.03	0.21
21a	U/s Wool Rd	7.65	7.67	0.02	7.68	0.03	7.68	0.03	7.71	0.06
21b	D/s Wool Rd	5.41	5.45	0.04	5.46	0.05	5.46	0.05	5.52	0.11
22	Fitzpatrick St	2.64	2.69	0.05	2.71	0.07	2.71	0.07	2.79	0.15
23	Killarney Rd	3.93	3.94	0.01	3.94	0.01	3.94	0.01	3.95	0.02
24	Kallaroo Rd	8.62	8.62	0.00	8.62	0.00	8.62	0.00	8.63	0.01

Refer to Figure 10-1 for reference locations.

Table 10-11 Climate Change – 1% AEP Rainfall Increase (Existing sea level) water level difference

ID	Location	1% AEP	CC 2050 RCP4.5		CC 2050 RCP8.5		CC 2090 RCP4.5		CC 2090 RCP8.5	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)
1	Basin	2.30	2.39	0.09	2.43	0.12	2.43	0.13	2.58	0.28
2	Badgee Lagoon Jtn	2.26	2.35	0.09	2.38	0.12	2.39	0.13	2.54	0.27
3	Jacobs Drive	2.23	2.31	0.09	2.35	0.12	2.35	0.12	2.49	0.27
4	Cater Canal	2.19	2.27	0.08	2.30	0.11	2.30	0.11	2.43	0.25
5	Coastal Patrol	2.11	2.17	0.06	2.19	0.08	2.20	0.09	2.30	0.19
6	The Haven	1.99	2.01	0.03	2.02	0.03	2.02	0.04	2.07	0.08
7	D/s Sussex Inlet Rd Bridge	2.68	2.71	0.03	2.72	0.05	2.73	0.05	2.79	0.12
8	U/s Badgee Bridge	2.26	2.35	0.09	2.38	0.12	2.38	0.13	2.53	0.27
9	Jacobs Dr Bridge	2.23	2.31	0.09	2.34	0.12	2.35	0.12	2.49	0.27
10	U/s Cater Bridge	2.19	2.27	0.08	2.30	0.11	2.31	0.11	2.44	0.25
11	1 km D/s Sussex Inlet Rd	4.50	4.54	0.04	4.55	0.05	4.55	0.05	4.61	0.11
12	200 m D/s Princes Highway	7.32	7.47	0.14	7.52	0.19	7.53	0.20	7.76	0.43
13	Sawmill U/s	4.82	4.97	0.15	5.02	0.20	5.03	0.21	5.26	0.44
14	Sawmill D/s	4.71	4.86	0.15	4.91	0.21	4.92	0.21	5.16	0.45
15	Bewong	4.35	4.50	0.15	4.55	0.21	4.56	0.22	4.80	0.45
16	Wool Rd	4.02	4.03	0.01	4.04	0.02	4.04	0.02	4.06	0.04
17	U/s Wool Rd	3.89	3.96	0.07	3.98	0.10	3.99	0.10	4.10	0.22
18	Wool Rd	3.44	3.50	0.05	3.52	0.07	3.52	0.08	3.60	0.16
19	Boronia Ave	3.02	3.07	0.05	3.08	0.07	3.09	0.07	3.16	0.14
20a	U/s Larmer Ave	2.34	2.42	0.09	2.46	0.12	2.46	0.13	2.61	0.27
20b	D/s Larmer Ave	2.32	2.41	0.09	2.45	0.12	2.45	0.13	2.60	0.28
21a	U/s Wool Rd	7.77	7.79	0.02	7.80	0.03	7.80	0.03	7.83	0.07
21b	D/s Wool Rd	5.63	5.67	0.04	5.68	0.05	5.69	0.06	5.75	0.12
22	Fitzpatrick St	2.94	2.99	0.05	3.01	0.07	3.02	0.08	3.10	0.16
23	Killarney Rd	4.09	4.11	0.03	4.12	0.03	4.13	0.04	4.16	0.07
24	Kallaroo Rd	8.65	8.66	0.00	8.66	0.00	8.66	0.00	8.66	0.01

Refer to Figure 10-1 for reference locations.

Table 10-12 Climate Change – 5% AEP Rainfall Increase + SLR water level difference

ID	Location	5% AEP	CC 2050 RCP4.5 + SLR2050 (SCC)		CC 2050 RCP8.5 + SLR2050 (SCC)		CC 2090 RCP4.5 + SLR 2100 (SCC)		CC 2090 RCP8.5 + SLR 2100 (SCC)	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)
1	Basin	1.60	1.74	0.14	1.77	0.17	1.81	0.21	1.93	0.33
2	Badgee Lagoon Jtn	1.54	1.69	0.15	1.72	0.17	1.76	0.22	1.89	0.34
3	Jacobs Drive	1.50	1.65	0.15	1.68	0.18	1.73	0.23	1.84	0.35
4	Cater Canal	1.46	1.61	0.16	1.63	0.18	1.69	0.24	1.80	0.34
5	Coastal Patrol	1.35	1.52	0.17	1.54	0.19	1.61	0.26	1.70	0.35
6	The Haven	1.15	1.36	0.21	1.37	0.22	1.48	0.33	1.51	0.36
7	D/s Sussex Inlet Rd Bridge	2.45	2.49	0.04	2.50	0.05	2.50	0.05	2.56	0.11
8	U/s Badgee Bridge	1.53	1.68	0.15	1.71	0.17	1.75	0.22	1.88	0.34
9	Jacobs Dr Bridge	1.49	1.64	0.15	1.66	0.18	1.72	0.23	1.83	0.35
10	U/s Cater Bridge	1.46	1.62	0.16	1.64	0.18	1.70	0.24	1.80	0.34
11	1 km D/s Sussex Inlet Rd	4.26	4.29	0.03	4.30	0.05	4.30	0.05	4.35	0.10
12	200 m D/s Princes Highway	6.65	6.76	0.11	6.80	0.15	6.81	0.16	6.99	0.34
13	Sawmill U/s	4.10	4.23	0.13	4.28	0.17	4.28	0.18	4.48	0.38
14	Sawmill D/s	3.95	4.09	0.14	4.14	0.18	4.14	0.19	4.35	0.40
15	Bewong	3.59	3.72	0.14	3.77	0.18	3.78	0.19	3.99	0.40
16	Wool Rd	3.95	3.96	0.01	3.96	0.01	3.96	0.01	3.97	0.03
17	U/s Wool Rd	3.53	3.60	0.08	3.63	0.11	3.63	0.11	3.75	0.23
18	Wool Rd	3.17	3.23	0.06	3.25	0.08	3.25	0.09	3.34	0.18
19	Boronia Ave	2.75	2.81	0.06	2.83	0.08	2.83	0.08	2.92	0.17
20a	U/s Larmer Ave	1.97	2.07	0.10	2.09	0.12	2.11	0.14	2.22	0.25
20b	D/s Larmer Ave	1.82	1.92	0.10	1.94	0.13	1.97	0.15	2.07	0.25
21a	U/s Wool Rd	7.65	7.67	0.02	7.68	0.03	7.68	0.03	7.71	0.06
21b	D/s Wool Rd	5.41	5.45	0.04	5.46	0.05	5.46	0.05	5.52	0.11
22	Fitzpatrick St	2.64	2.69	0.05	2.71	0.07	2.71	0.07	2.79	0.15
23	Killarney Rd	3.93	3.94	0.01	3.94	0.01	3.94	0.01	3.95	0.02
24	Kallaroo Rd	8.62	8.62	0.00	8.62	0.00	8.63	0.01	8.63	0.01

Refer to Figure 10-1 for reference locations.

Table 10-13 Climate Change – 1% AEP Rainfall Increase + SLR water level difference

ID	Location	1% AEP	CC 2050 RCP4.5 + SLR2050 (SCC)		CC 2050 RCP8.5 + SLR2050 (SCC)		CC 2090 RCP4.5 + SLR 2100 (SCC)		CC 2090 RCP8.5 + SLR 2100 (SCC)	
		WL (mAHD)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)	WL (mAHD)	Diff (m)
1	Basin	2.30	2.47	0.17	2.50	0.20	2.55	0.25	2.68	0.38
2	Badgee Lagoon Jtn	2.26	2.43	0.17	2.46	0.20	2.52	0.26	2.65	0.38
3	Jacobs Drive	2.23	2.40	0.18	2.43	0.20	2.49	0.26	2.62	0.39
4	Cater Canal	2.19	2.37	0.18	2.39	0.21	2.46	0.27	2.57	0.39
5	Coastal Patrol	2.11	2.30	0.19	2.32	0.21	2.40	0.30	2.49	0.38
6	The Haven	1.99	2.20	0.22	2.21	0.22	2.32	0.34	2.36	0.37
7	D/s Sussex Inlet Rd Bridge	2.68	2.71	0.03	2.72	0.05	2.73	0.05	2.79	0.12
8	U/s Badgee Bridge	2.26	2.43	0.17	2.46	0.20	2.51	0.26	2.64	0.38
9	Jacobs Dr Bridge	2.23	2.40	0.18	2.43	0.21	2.49	0.26	2.62	0.39
10	U/s Cater Bridge	2.19	2.37	0.18	2.40	0.21	2.46	0.27	2.58	0.39
11	1 km D/s Sussex Inlet Rd	4.50	4.54	0.04	4.55	0.05	4.55	0.05	4.61	0.11
12	200 m D/s Princes Highway	7.32	7.47	0.14	7.52	0.19	7.53	0.20	7.76	0.43
13	Sawmill U/s	4.82	4.97	0.15	5.02	0.20	5.03	0.21	5.26	0.44
14	Sawmill D/s	4.71	4.86	0.15	4.91	0.21	4.92	0.22	5.16	0.45
15	Bewong	4.35	4.50	0.15	4.55	0.21	4.56	0.22	4.80	0.45
16	Wool Rd	4.02	4.03	0.01	4.04	0.02	4.04	0.02	4.06	0.04
17	U/s Wool Rd	3.89	3.96	0.07	3.98	0.10	3.99	0.10	4.10	0.22
18	Wool Rd	3.44	3.50	0.05	3.52	0.07	3.52	0.08	3.60	0.16
19	Boronia Ave	3.02	3.07	0.05	3.09	0.07	3.09	0.07	3.16	0.14
20a	U/s Larmer Ave	2.34	2.49	0.16	2.52	0.19	2.57	0.24	2.70	0.37
20b	D/s Larmer Ave	2.32	2.48	0.16	2.52	0.19	2.56	0.24	2.70	0.37
21a	U/s Wool Rd	7.77	7.79	0.02	7.80	0.03	7.80	0.03	7.83	0.07
21b	D/s Wool Rd	5.63	5.67	0.04	5.68	0.05	5.69	0.06	5.75	0.12
22	Fitzpatrick St	2.94	2.99	0.05	3.01	0.07	3.02	0.08	3.10	0.16
23	Killarney Rd	4.09	4.11	0.03	4.12	0.03	4.13	0.04	4.16	0.07
24	Kallaroo Rd	8.65	8.66	0.00	8.66	0.00	8.66	0.00	8.66	0.01

Refer to Figure 10-1 for reference locations.

10.9 Validation of design event results

The St Georges Basin has sparse historical observed data. The historical flood levels are largely dependent on tidal levels and volume rather than peak flow, making it unsuitable for a traditional flood frequency analysis.

While there is no long term stream record in the basin there is a partial record that can be used to assign plotting positions to water levels. The 2001 Flood Study has an incomplete list of flood events from 1958. While many events do not have actual flood levels, the 1971 event has a level of approximately 2.2 m AHD which appears not to have been exceeded since. All large events since 1991 appear to have been captured. This allows plotting positions to be calculated for the 1971 (largest event from 1971 – 2020) and six events that have occurred since 1991 (**Figure 10-5**). This provides a check on design estimates up to the 2% AEP event and possibly the 1% AEP event. While the relationship appears linear it is unlikely to be linear for larger events if the storage relationship in the basin changes with increasing level. It is also important to understand that entrance and connection channel conditions have changed, and this will affect the reliability.

To validate the current study ARR2019 design flood event peak basin water levels, a number of design flood event estimates of water levels have been plotted against the Basin stage frequency analysis (**Figure 10-5**) including:

1. Current study ARR2019 Design flood event peak basin water levels (including sensitivity result for 5% AEP event with a 5% ocean tide);
2. Current study ARR87 Design flood event peak basin water levels;
3. Calibration model results versus historical events;
4. 2001 Flood Study Design flood event basin peak water levels (ARR87); and
5. 2013 WMA FRMS&P Climate Change Assessment revised Design flood event basin peak water levels (ARR87) (Revised baseline, no sea level rise).

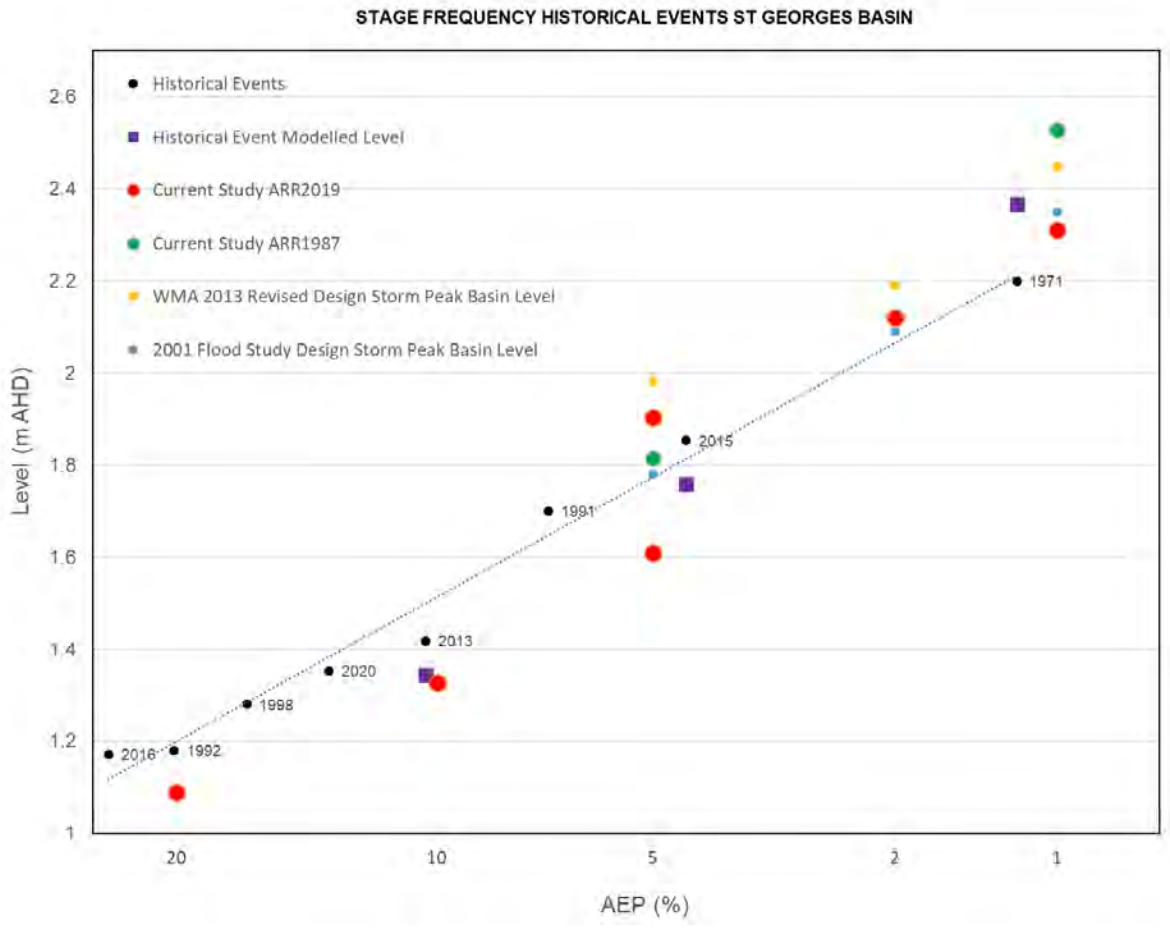


Figure 10-5 Comparison of flood model results with Basin historical event stage frequency analysis

It is also noted that the historical event records may not be a homogeneous record due to the effect of set-up across the basin and varying ocean conditions and pre-event basin conditions prevailing at the time of each event. This Basin setup would be variable for each event and the records do not reflect the basin still water level (which the modelled results do). The 1971 value is not at the Island Point gauge site and likely doesn't include any setup. All other events likely do include some amount of wind and wave setup and would need to be adjusted down by some amount to determine a still water level for comparison.

Despite the above, the current study ARR2019 modelled water levels follow the same trend as the frequency analysis, noting that the 10% and 5% events are approximately 100mm below expected levels. Similarly for the historical calibration events model results being approximately 50-100mm below recorded levels. It is noted this could be explained by a small amount of wind wave set up across the basin at the gauge location. The current study ARR2019 results for the 1% and 2% AEP are higher than expected from the frequency analysis. All previous study results and the current study ARR87 results produce peak basin levels that are higher than suggested by the frequency analysis. It is noted that the modelled basin peak levels are sensitive to adopted ocean tailwater level, which is the main reason for the differences seen between the various study results. The 5% AEP event shows the difference in basin level adopting a HHWSS tide as per DPE guidelines (lower orange dot) and using a 5% AEP ocean tide (upper orange dot) (noting all previous studies have adopted a higher tailwater level of at 1.8m – 2.0m AHD for the 5%).

Given the above comparison with the stage frequency analysis, it appears that ARR87 produces levels which are higher than expected compared with historical events and hence may be deemed to be conservative and overestimate flows and basin levels. There are other potential reasons for differences between previous flood study results and the current ARR87 basin levels such as the assumptions on the basin outlet capacity in the Rubicon model may be different given it is a Quasi-2d model versus the TUFLOW full 2d model and the current study uses more up to date data.

Results of the current study are therefore consistent with expected results and similar to previous study results, albeit slightly lower which is likely attributable to some wind wave setup across the basin. The model is well calibrated to historical events despite the paucity of rainfall data across the catchment.

10.10 Wind Wave Climate

The results for the estimated wave heights, wind set-up and indicative wave runup levels at the three nominated locations within St Georges Basin (described in **Section 9.8**) are shown in **Table 10-14**. Site locations and calculations are shown in **Appendix K**.

Table 10-14 Calculated wind setup and wave runup

		Site 1 - Paradise Beach	Site 2 - Island Point	Site 3 - Basin View
Fetch length	km	7.3	5.3	9
Average shoreline slope	m/m	0.100	0.059	0.111
Wind Parameters				
Average Depth	m	7.4	10.4	7.4
Wind direction	° TN	270	180	135
Wind Speed	km/hr	64	59	49
Wind setup and wave runup				
Significant Wave Height (Hs)	m	0.95	0.83	0.79
Wind Setup	m	0.056	0.025	0.041
Wave Runup	m	0.69	0.42	0.61
Basin Levels				
Basin Still level	mAHD	2.30	2.30	2.30
Design Basin level	mAHD	3.00	2.75	2.90

Wind setup may be expected to add 50 – 100mm to the basin levels and, while wave runup is site specific dependent on local shoreline slope and structures, indicative calculations show that wave runup between 0.4m to 0.7m may be expected at sites exposed to long wind fetch lengths.

11 Impacts of Flooding on the Community

11.1 Impacts of Flooding

The community within the St Georges Basin catchment is susceptible to flooding, most notably in Sussex Inlet and Sanctuary Point near Tomerong Creek as well as properties around Worrowing waterway and Old Erowal Bay. Properties around the Basin foreshore are typically only impacted in rare events larger than the 1% AEP event. Numbers and types of properties affected and associated damages are presented in **Section 11.4.5** and flood emergency response classifications are discussed in **Section 11.5**.

Table 11-1 summarises the number of affected properties in areas within the St Georges Basin Catchment. The number of buildings with predicted overfloor flooding for each design flood event has been calculated based on a database of actual surveyed floor levels which has been supplemented with some assumed floor levels based on building type for buildings where the actual floor level was unknown at the time of this Flood Study preparation. The number of buildings with predicted overfloor flooding for each design flood event can be updated as part of the Floodplain Risk Management Study & Plan following the completion of additional floor level survey.

Table 11-1 Flood affected properties by location

Event	20% AEP		10% AEP		5% AEP		2% AEP		1% AEP		0.2% AEP		PMF	
Location	B	Y	B	Y	B	Y	B	Y	B	Y	B	Y	B	Y
Sussex Inlet	2	538	6	627	28	756	200	1025	336	1051	627	1089	1212	1280
Sanctuary Point	13	360	19	411	52	473	92	519	110	539	190	572	627	758
Basin View	0	21	0	21	0	27	0	36	0	38	6	47	42	69
St Georges Basin	2	152	3	159	4	164	5	185	9	187	15	192	149	217
Bewong And Wandandian	0	16	0	18	0	19	1	21	1	23	3	27	42	44
Worrowing Heights & Erowal	1	103	1	120	5	147	17	161	21	165	46	173	148	210
Jervis Bay Territory	0	1	0	1	0	1	1	2	1	2	2	2	2	2

B – Buildings with overfloor flooding

Y – Yards with flooding

11.1.2 Sussex Inlet

Flows largely remain within the Sussex Inlet channel for flows up to the 20% AEP event, with some minor flooding of properties along River Road between Thora Street and Gordon Street, but there is no overfloor flooding of properties other than the Sussex Inlet Marine Centre at the end of Jacobs Drive. In a 10% AEP event, six properties are affected by overfloor flooding east of River Road and around Wunda Ave. This number increases to 28 in these areas in a 5% AEP as flood depths increase. Extensive overfloor flooding occurs in the 2% AEP with some 200 properties impacted as the Sussex Inlet channel swells to inundate the areas north of Jacobs Drive and east of Sandpiper Way and along Fairview Crescent. Evacuation would become cut off from these areas as Jacobs Drive and River Road become inundated.

More than 335 properties would have overfloor flooding in the 1% AEP and in rarer events up to the PMF, the vast majority of properties in Sussex Inlet are impacted (more than 1200) with the exception of high ground areas north of Badgee Lagoon and west of Merison Road/Lyons Road.

Some properties in Jervis Bay Territory on the eastern side of Sussex Inlet channel are also identified as being impacted in the 2% AEP event.

11.1.3 Sanctuary Point

Sanctuary Point is an area with existing flood risk and damages in frequent events with 13 properties affected in the 20% AEP event, primarily on The Park Drive adjacent to Tomerong Creek upstream of Larmer

Avenue bridge. In this area, water backs up behind the Larmer Avenue bridge, inundating properties and bypassing to the south through properties and via channels either side of the oval. As flood depths increase in rarer events, more properties are impacted with 52 properties having over floor flooding in the 5% AEP event. As Basin levels begin to rise, properties on The Park Drive east of Larmer Avenue also become impacted. In a 1% AEP event some 110 properties will become affected, primarily along The Park Drive and Mountain Street.

In general, properties along the foreshore areas of Sanctuary Point remain unaffected by flooding up to at least the 2% AEP event, with a small number of properties expected to have overfloor flooding in the 2% and 1% AEP events in the Paradise Beach foreshore area along Walmer Avenue south of Paradise Beach Road. Modelling indicates there are isolated properties along local overland flowpaths/tributaries that experience overfloor flooding in a 5% AEP event and greater.

In the PMF event, large numbers of properties along the Basin Foreshore and Tomerong Creek will be affected.

11.1.4 Worrowing Heights, Erowal Bay and Old Erowal Bay

Properties in Old Erowal Bay are affected by flooding from the Worrowing Waterway with five properties with overfloor flooding in the 5% AEP event along Prentice Avenue and McGowen Street. The number of impacted properties increases to approximately 20 in the 2% and 1% AEP events. A small number of properties in Erowal Bay also become impacted in the 2% and 1% AEP events along the foreshore areas and along Erowal Creek. Some 150 properties would be affected in the PMF.

11.1.5 Basin Foreshore areas

The foreshore areas around Basin View, St Georges Basin and Wrights Beach remain largely unaffected by flooding up to at least the 2% AEP event, with a small number of properties expected to have overfloor flooding in the 2% and 1% AEP events. Most properties have floor levels above the 0.2% AEP flood level, however, large numbers of properties along the Basin foreshore will be affected in the PMF event. Properties may also be impacted by wind-wave action locally increasing flood levels.

11.1.6 Wandandian and Bewong

Wandandian and Bewong areas will only be impacted in the PMF event with the exception of one property which will experience flooding above floor level in a 2% AEP event.

11.2 Flood Intelligence

The following table provides a summary of key flood levels and flood map figure numbers for ease of reference by emergency services.

Table 11-2 Flood intelligence summary information

Event	Design Flood Level (m AHD)		Map Figure Number			
	Basin (Island Point Gauge)	Sussex Inlet Gauge	Flood Depth	Water Level	Hazard	Hydraulic Category
20%	1.08	1.06	G01	G08	G18	-
10%	1.30	1.17	G02	G09	G19	-
5%	1.60	1.35	G03	G10	G20	-
2%	2.12	2.00	G04	G11	G21	-
1%	2.30	2.11	G05	G12	G22	G27
0.2%	2.84	2.53	G06	G13	G23	-
PMF	5.60	4.95	G07	G14	G24	G28

11.3 Flood Planning Area

The Flood Planning Level (FPL) is a combination of flood levels and freeboards selected for planning purposes to manage risk to properties susceptible to flood risk to life and damage to property. Freeboard is applied to the selected planning flood to account for uncertainties in flood model accuracy, potential

increases due to rainfall increases associated with Climate Change and other factors such as impacts of structure blockage or localised water level differences due to wave action.

The FPL is typically defined as the 1% AEP flood event plus 500mm freeboard for most residential and commercial developments.

The Flood Planning Area (FPA) mapping for this study has been determined by adding 500mm freeboard to the 1% AEP flood level and extending the surface laterally to intersect with the adjacent terrain to define the area within the FPL. The FPA has been determined for current day flood results and with Projected 2050 and Projected 2100 sea level rise and RCP8.5 increase in rainfall.

Draft Flood Planning Areas maps are provided in **Figures I01** to **I03** in **Appendix I**.

In determining appropriate FPLs, consideration may be given to ensuring areas sensitive to sea level rise, blockage and Climate Change impacts are fully considered in the Flood Planning Area.

Various hydrological input parameters have been tested to obtain a good correlation with historical flood event behaviour and validation of Basin water levels estimates against a statistical Flood Frequency Analysis of historical Basin water levels during flood events. Sensitivity analysis in the hydraulic model has provided the magnitude of flood level differences that can be expected through uncertainty of input parameters and changes to tailwater conditions, or if structures were to become blocked. All of these results show that for a 1% AEP, increases in flood levels due to uncertainties are expected to be in the order of 350mm or less and the 1% AEP is not sensitive to blockage of structures.

Climate Change leading to increased rainfall plus sea level rise is predicted to raise water levels in Sussex Inlet and the Basin by up to 450mm in about 70 to 80 years' time. Water levels in upstream tributaries are expected to increase by 150mm to 250mm.

On this basis, adopting a 500mm freeboard on 1% AEP flood levels may not be sufficient to account for uncertainties in flood model accuracy, potential rainfall increases associated with Climate Change and other factors such as blockage or wave action. Consideration of increases in rainfall due to Climate Change is appropriate for the FPL in both the Basin and the tributaries including Wandandian, Tomerong, Cow, Tullarwalla, Pats, Home, Worrowing and Erowal Creeks.

To ensure new developments in areas susceptible to sea level rise (Sussex Inlet and Basin foreshore areas), do not incur a higher level of flood risk, an FPL based on the Projected 2050 or Projected 2100 levels may be able to account for the predicted Sea Level Rise and increase in rainfall due to Climate Change.

Taking into consideration the different flood processes and to simplify the adoption of different flood planning levels and freeboard in different areas, it is recommended to adopt the 1% AEP 2090 Climate Change scenario (RCP8.5 16.3% rainfall increase and 0.36m Sea Level Rise) as the planning flood with a standard 500mm freeboard as the FPL. Thus, for example, a house with a life span of 70 years would have an FPL based on the flood level estimated to be applicable in about 80 years' time.

It is also worth considering adding additional freeboard to properties positioned along the northern foreshore of the Basin including Basin View, Island Point and Paradise Beach to accommodate wind wave setup across Basin. The St Georges Basin Flood Study (WMA, 2001) mentioned local residents reported that differences in flood levels of up to 0.5m were observed across the Basin in the 1971 historical flood due to the wind stress across the open water body. The current study has estimated indicative wave runup of up to 400mm at Island Point, 600mm at Basin View and 700mm at Paradise Beach. While an additional freeboard is recommended, this should be assessed on a site-specific basis using equations presented in **Appendix K** as the wave runup potential is dependent on the local foreshore slope and any structures present.

11.4 Flood Damages

The economic impact of flooding can be defined by what is commonly referred to as flood damages. Flood damages are generally categorised as either tangible (direct and indirect) or intangible damage types; these types are summarised in **Table 11-3**.

Table 11-3 Types of Flood Damages

Type of Flood Damage	Description
Direct	Building contents (internal) Structure (building repair and clean) External items (vehicles, contents of sheds etc.)
Indirect	Clean-up (immediate removal of debris)

Type of Flood Damage	Description
	Financial (loss of revenue, extra expenditure) Opportunity (non-provision of public services)
Intangible	Social – increased levels of insecurity, depression, stress General inconvenience in post-flood stage

The direct damage costs, as indicated in **Table 11-3**, are just one component of the entire cost of a flood event. There are also indirect costs. Together, direct and indirect costs are referred to as tangible costs. In addition to tangible costs, there are intangible costs such as social distress. The flood damage values discussed in this report are the tangible damages and do not include an assessment of the intangible costs which are difficult to calculate in economic terms.

Flood damages can be assessed by a number of methods including the use of computer programs such as FLDamage or ANUFLOOD, or via more generic methods using spreadsheets. For the purposes of this project, an in-house developed program has been used based on a combination of NSW DPE residential damage curves and FLDamage processes.

A flood damage assessment for the existing catchment conditions has been completed as part of this study.

The assessment is based on damage curves that relate the depth of flooding on a property to the likely damage within the property. Ideally, the damage curves should be prepared for the particular catchment for which the study is being carried out. However, damage data in most catchments is not available and as such, damage curves from other catchments, and available research in the area, is used as a substitute.

DPE has conducted research and prepared a methodology (draft) to develop damage curves based on state-wide historical data. This methodology is only for residential properties and does not cover industrial or commercial properties. The DPE methodology is only a recommendation and there are currently no strict guidelines regarding the use of damage curves in NSW.

11.4.2 Input Data

11.4.2.1 *Floor Level Assessment*

A floor level database was developed by Council (2021) for all the properties within the PMF flood extent. The floor level database includes actual surveyed floor levels where available and some assumed floor levels based on building type for buildings where the actual floor level was unknown at the time of this Flood Study preparation. The database included data from the ground level and floor level survey undertaken by Council in 2001. The database categorised the properties as below:

Residential Properties:

- R1: Single storey high set (i.e. on piers/footings);
- R2: Single storey slab on ground;
- R3: Two storey;
- R4: Vacant blocks;
- R5: Residential apartments; and
- R6: Other residential buildings, including houses in two main categories:
- Houses that are too far away from a road to identify the building type using Google street view; and
- Relatively new houses that were visible in the latest Nearmap imagery but not in Google street view.

Commercial and Industrial Properties:

- C1: Commercial in urban areas;
- C2: Commercial in rural areas. This type includes one point for each farm property (at the biggest shed) for inclusion as a commercial premise;);
- C3: Industrial; and
- C4: Schools.

Floor level data within the previous 2001 Flood Study extreme flood event extent were provided by Council. The data consists of re-evaluated (by Council) floor level survey data from the last flood investigations in the

study area and google street view visual estimation for the rest. Considering the age of the data provided, a desktop floor level assessment was undertaken to assign average building heights for properties within the PMF extent based on the property types identified above, using the following assumptions:

- R1: Floor Level = Ground Level from Lidar Data + 0.8 m;
- R2, R3 and R4: Floor Level = Ground Level from Lidar Data + 0.3 m;
- R5 and C4: Floor Level = Ground Level from Lidar Data + 0.3 m; and
- R6, C1, C2 and C3: Floor Level = Ground Level from Lidar Data + 0.3 m.

The above assumptions were guided by comparison of the ground levels and floor levels for different property types where survey data was available. However, for R5 and C4 properties the assumption was made based on Google Street views images from Google Maps™ since there was no survey data for these type of properties to be used as a reference.

11.4.2.2 *Hydraulic Model Result Inputs*

To inform the damages analysis, water level results are required to determine the depth of overfloor flooding and over-ground flooding for each flood affected lot. To inform this assessment, the maximum depth of flooding at each flood affected lot was calculated using the flood depth grid and cadastre and adopted as the inundation for that lot. Flood levels were extracted from the water level grids at each building entrance point (these points were identified in Council database).

11.4.3 Damage Analysis Methodology

11.4.3.1 *Residential Damage Curves*

Ideally, the damage curves should be prepared for the particular catchment for which the study is being carried out. However, damage data in most catchments are not available and recourse is generally made to damage curves from other catchments. NSW DPE has carried out research and prepared a methodology to develop damage curves based on state-wide historical data. This methodology is only for residential properties and does not cover industrial or commercial properties.

The DPE methodology is only a recommendation and there are currently no strict guidelines regarding the use of damage curves in NSW. DPE guidelines include a template spreadsheet program that determines damage curves for residential properties including:

- Single storey, slab on ground;
- Two storey, slab on ground; and
- Single storey, high set.

Several input parameters are required to use the DPE curves, such as floor area and level of flood awareness. The following parameters were adopted in developing the residential damage curves for the study area:

- Damages are generally incurred on a property prior to any overfloor flooding. The DPE curves allow for a damage of $17,207 (2021 dollars) to be incurred when the water level reaches the base of the house, with the base of a slab on ground house assumed to be 0.3 m below the floor level. It has been assumed that this remains constant until overfloor flooding occurs. This may occur on steeper properties and larger properties where the garden and fences may be impacted, but the flood waters do not reach the house;
- A value of 240 m^2 was adopted as a conservative estimate of the floor area for residential dwellings in the floodplain based on aerial imagery. With a floor area of 240 m^2, the contents value is estimated at $60,000; and
- The effective warning time has been assumed to be zero due to the rural nature of the area and possible low flood awareness as a conservative approach. A long effective warning time allows residents to prepare for flooding by moving valuable household contents and hence reducing the potential damages to household contents.

11.4.3.1.1 Average Weekly Earnings

DPE damage curves were derived for late 2001. To convert damages to today's dollars, it is recommended that values in residential damage curves are adjusted by Average Weekly Earnings (AWE) rather than by the

inflation rate as measured by the Consumer Price Index (CPI). AWE is considered a better representation of societal wealth, and hence an indirect measure of the building and contents value of a home.

The most recent data from the Australian Bureau of Statistics (www.abs.gov.au) at the time of this study was for May 2021. The November 2001 AWE is shown in Table D1 of the NSW Department of Environment and Climate Change (DECC) guidelines. Both are shown in **Table 11-4.** Consequently, all ordinates in the residential flood damage curves were updated to May 2021 dollars. In addition, all damage curves include GST as per DPE recommendations.

Table 11-4 Average Weekly Earnings (AWE) Statistics for Residential Damage Curves

Month	Year	AWE
November	2001	$676.40
May	2021	$ 1737.10 *

**Source: Australian Bureau of Statistics (2021)*

11.4.3.2 *Commercial Damage Curves*

Commercial damage curves were adopted from the FLDamage Manual (Water Studies Pty Ltd, 1992). FLDamage allows for three types of commercial properties:

- Low value commercial;
- Medium value commercial; and
- High value commercial.

For the purpose of this assessment all commercial properties have been classified as low value commercial, as no other information was available in the survey obtained for this project. In determining these damage curves, it has been assumed that the effective warning time is approximately zero, and the loss of trading days as a result of the flooding has been taken as 10.

These curves are determined based on the floor area of the property. An indicative value of 400 m^2 was adopted based on a random review of floor areas using aerial imagery.

The Consumer Price Index (CPI) was used to bring the 1990 data to March 2021 dollars (**Table 11-5**), using data from the Australian Bureau of Statistics (2021). It was assumed that the FLDamage data was in June 1990 dollars.

Table 11-5 CPI Statistics for Commercial Damage Curves

Month	Year	CPI
June	1990	$102.50
March	2021	$212.38

11.4.3.3 *Industrial Damage Curves*

Cardno, as a part of a previous floodplain management study (Cardno, 1998), conducted a survey of industrial properties in 1998 for Wollongong City Council. The damage curves derived from that survey are more recent than those presented in FLDamage and have been used in several previous studies. Therefore, these damage curves are considered the most appropriate for use in this study.

The curves were prepared for three categories:

- Low value industrial;
- Medium value industrial; and
- High value industrial.

Industrial areas comprise a very small part of the study area. A low value industrial classification was applied to all the properties within the industrial area. An indicative value of 400 m^2 was adopted as the floor areas.

The survey conducted only accounts for structural and contents damage to the property. Clean-up costs and indirect financial costs were estimated based on the FLDamage Manual (Water Studies Pty Ltd, 1992). Actual internal damage could be estimated, along with potential internal damage, using various factors within FLDamage. Using both the actual and potential internal damages, estimation of both the clean-up costs and

indirect financial costs could be made. The values were adjusted to March 2021 dollars using the CPI statistics shown in **Table 11-6**.

Table 11-6 CPI Statistics for Industrial Damage Curves

Month	Year	CPI
June	1998	$121.00
March	2021	$212.38

11.4.4 Adopted Damages Curves

The adopted damage curves are shown in **Figure 11-1** and **Figure 11-2**.

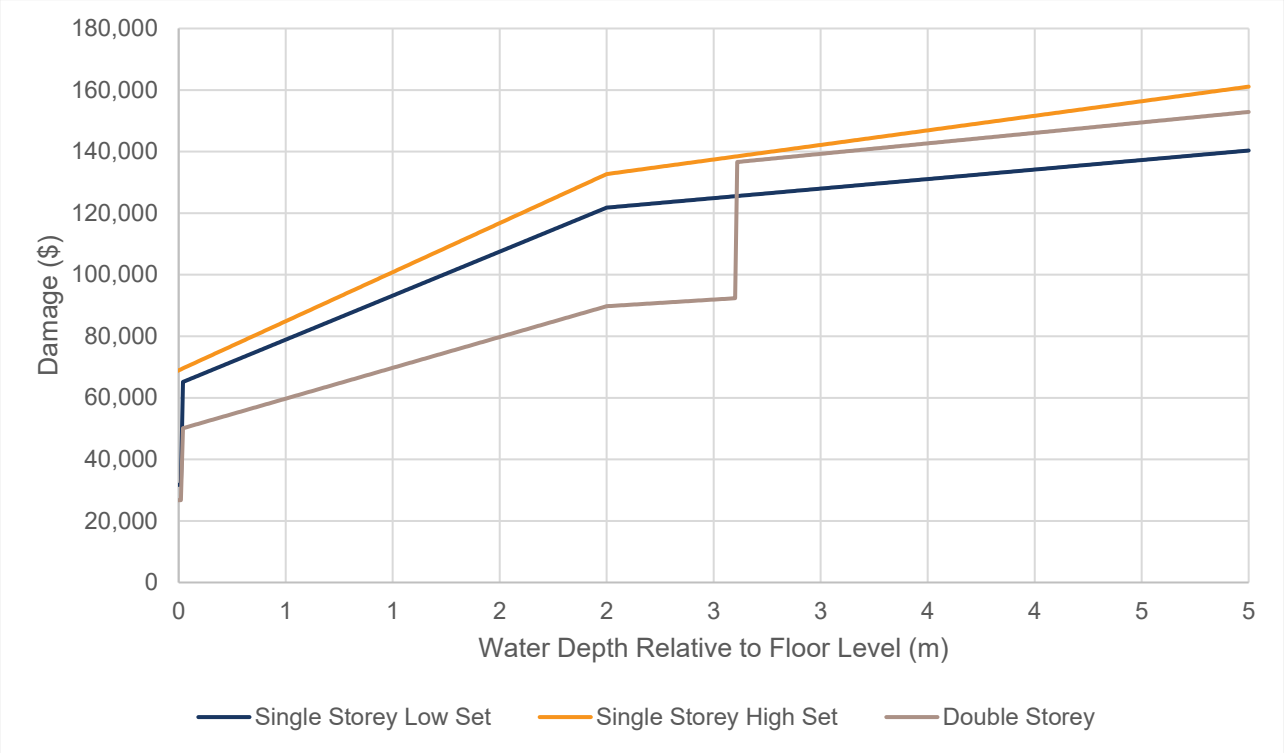


Figure 11-1 Residential Damage Curves

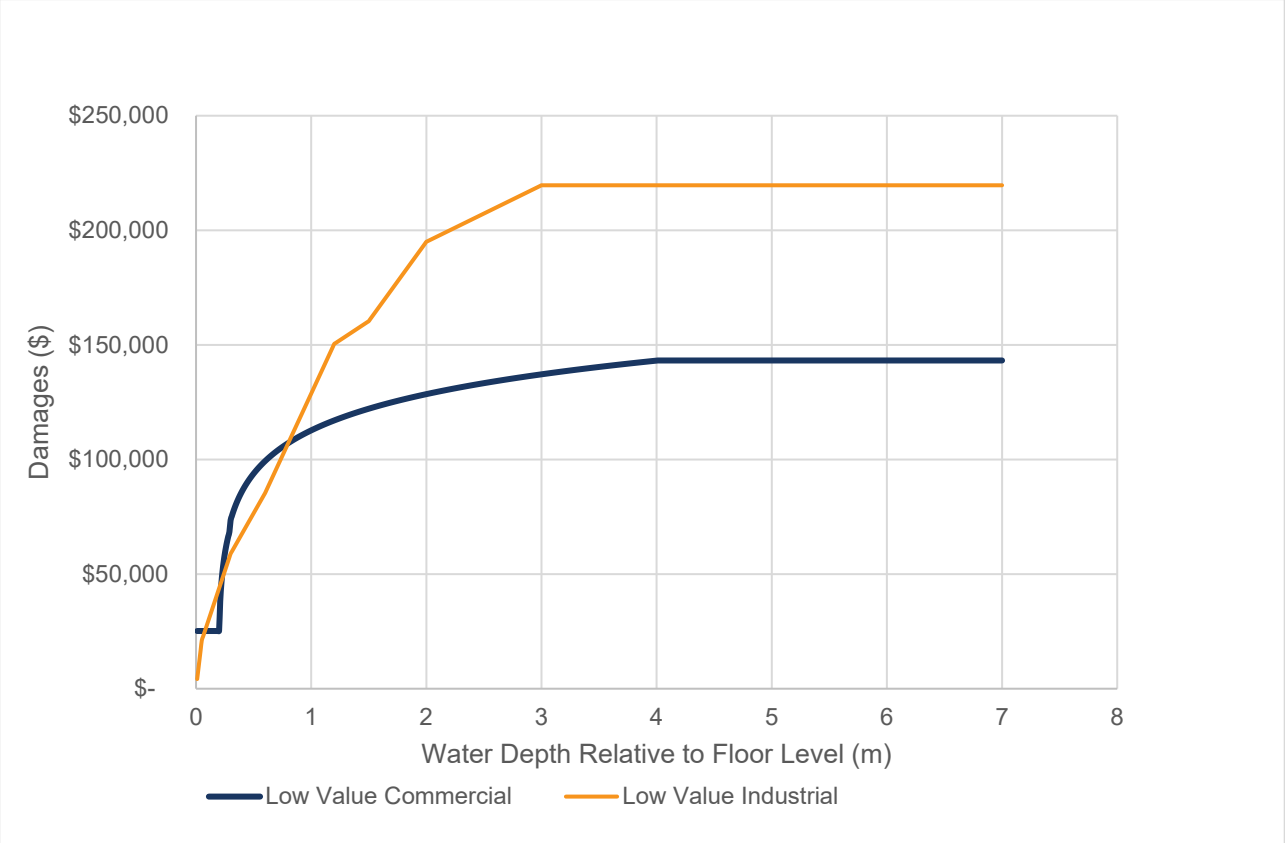


Figure 11-2 Low Value Industrial and Low Value Commercial Damage Curves

11.4.5 Total Damages

A summary of the total damage incurred for the St Georges Basin catchment is shown in **Table 11-7.** This includes:

- The number of residential, commercial and industrial properties with overfloor flooding;
- The average depth of overfloor flooding for residential, commercial and industrial properties;
- The maximum depth of overfloor flooding for residential, commercial and industrial properties;
- The number of residential, commercial and industrial properties with overground flooding; and
- Total damage value for the catchment.

The above results are listed for all design events: 20%, 10%, 5%, 2%, 1%, 0.2% AEP and the PMF events.

The existing scenario total damage curve for the St Georges Basin catchment is shown in **Figure 11-3**.

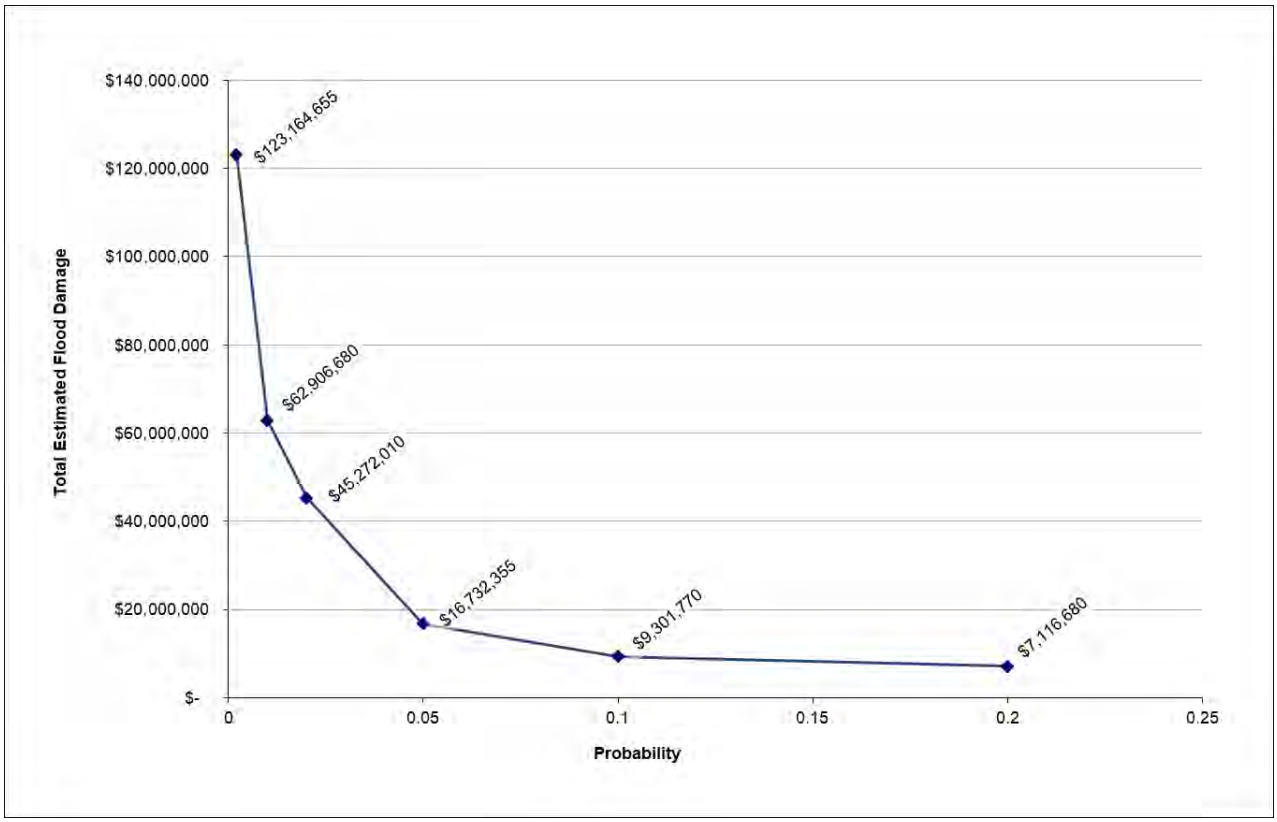


Figure 11-3 Total Damage Curve (Existing Condition) for St Georges Basin

Table 11-7 Flood Damages Assessment Summary

Property Type	Properties with Overfloor Flooding	Average Overfloor Flooding Depth (m)	Maximum Overfloor Flooding Depth (m)	Properties with Overground Flooding		Total Damage ($May 2021)
PMF						
Residential	2135	2.23	4.70	2490	$	396,550,255
Commercial	80	3.04	4.76	83	$	10,661,710
Industrial	7	2.36	3.27	7	$	1,255,295
Total	**2222**			**2580**	**$**	**408,467,260**
0.2% AEP						
Residential	818	0.57	1.95	2018	$	116,356,990
Commercial	67	0.68	2.00	77	$	6,471,375
Industrial	4	0.55	0.91	7	$	336,290
Total	**889**			**2102**	**$**	**123,164,655**
1% AEP						
Residential	428	0.34	1.41	1922	$	60,250,510
Commercial	49	0.29	1.48	76	$	2,558,975
Industrial	1	0.53	0.53	7	$	97,200
Total	**478**			**2005**	**$**	**62,906,680**
2% AEP						
Residential	286	0.30	1.22	1867	$	43,584,815
Commercial	29	0.25	1.31	75	$	1,600,610
Industrial	1	0.41	0.41	7	$	86,590
Total	**316**			**1949**	**$**	**45,272,010**
5% AEP						
Residential	83	0.17	0.71	1550	$	16,380,375
Commercial	5	0.20	0.75	30	$	281,170
Industrial	1	0.26	0.26	7	$	70,815
Total	**89**			**1587**	**$**	**16,732,355**
10% AEP						
Residential	27	0.13	0.41	1327	$	9,095,305
Commercial	1	0.50	0.50	23	$	159,830
Industrial	1	0.10	0.10	7	$	46,630
Total	**29**			**1537**	**$**	**9,301,770**
20% AEP						
Residential	16	0.13	0.31	1166	$	6,961,050
Commercial	1	0.33	0.33	18	$	129,205
Industrial	1	0.02	0.02	7	$	26,430
Total	**18**			**1191**	**$**	**7,116,680**

11.4.6 Average Annual Damage

Average Annual Damage (AAD) is calculated using a probability approach based on the flood damages calculated for each design event. Flood damages (for a design event) are calculated by using the damage curves described above. These damage curves attempt to define the damage experienced on a property for varying depths of flooding. The total damage for a design event is determined by adding all the individual property damages for that event.

AAD attempts to quantify the flood damage that a floodplain would receive on average during a single year. It does this using a probability approach. A probability curve is drawn, based on the flood damages calculated for each design event. For example, the 1% AEP design event has a probability of occurrence of 1% in any given year, and as such the 1% AEP flood damage is plotted at this point (0.01) on the AAD curve. AAD is then calculated by determining the area under the plotted curve.

While the PMF event has a theoretical probability of almost 0% of occurring, to inform the calculation of AAD a representative probability of 0.0001 (or 0.01%) has been adopted for the PMF event (equivalent to a 1 in 10,000 AEP event). Through this method, the PMF accounts for extremely rare flood events in the AAD calculation.

Further information of the calculation of AAD can be found in Appendix M of the *Floodplain Development Manual* (NSW Government, 2005).

Based on the analysis described above, the total AAD for the St Georges Basin catchment under existing conditions is **$7,062,670**.

11.5 Flood Emergency Response Classification of the Floodplain

To inform emergency response management in the study area, floodplain areas have been classified in regards to isolation and access considerations in accordance with Australian Disaster Resilience (ADR) Handbook 7. ADR guideline 7-2 has defined the classifications as shown in **Table 11-8**. This classification provides the basis for understanding the nature, seriousness and scale of isolation problems.

The flood emergency response classifications in a PMF event for the floodplain are mapped in **Appendix J**. Flood affected properties in Sussex Inlet and low lying areas around the basin are predominantly classified as “Submerged” due to no access to a road exit route in the PMF.

Emergency response classification of the floodplain has been undertaken by classifying cadastral lots into one of the tertiary classifications categories in **Table 11-8**. Where the flood extent spans a cadastral lot such that part of the lot is within the flood extent and part of the lot is outside the flood extent, the lot is classified based on the location of habitable buildings on the lot. So if a residential dwelling on a lot is located outside the flood extent, this is tagged as “flood free”, even though part of the lot is within the flood extent. This allows emergency response agencies to focus on properties that will become isolated or have evacuation needs.

Main evacuation routes, evacuation centres and major infrastructure have been identified and impacts to these are considered in the classification. Evacuation routes are assessed to determine where an evacuation route from an area continues rising out of the flood allowing continuous evacuation or when it will become cut off by floodwaters during an event due to a low point in the road.

Table 11-8 Flood Emergency Response Classification (source ADR guideline 7-2)

Primary classification	Description	Secondary classification	Description	Tertiary classification	Description	Example figures
Flooded (F)	The area is flooded in the PMF	Isolated (I)	Areas that are isolated from community evacuation facilities (located on flood-free land) by floodwater and/ or impossible terrain as waters rise during a flood event up to and including the PMF. These areas are likely to lose electricity, gas, water, sewerage and telecommunications during a flood.	Submerged (FIS)	Where all the land in the isolated area will be fully submerged in a PMF after becoming isolated.	Figure 1 Figure 7 with levee Figure 8 with impassable terrain
				Elevated (FIE)	Where there is a substantial amount of land in isolated areas elevated above the PMF.	Figure 2
		Exit Route (E)	Areas that are not isolated in the PMF and have an exit route to community evacuation facilities (located on flood-free land).	Overland Escape (FEO)	Evacuation from the area relies upon overland escape routes that rise out of the floodplain.	Figure 3
				Rising Road (FER)	Evacuation routes from the area follow roads that rise out of the floodplain.	Figure 4, Figure 6 with levee
Not Flooded (N)	The area is not flooded in the PMF			Indirect Consequence (NIC)	Areas that are not flooded but may lose electricity, gas, water, sewerage, telecommunications and transport links due to flooding.	Figure 5
				Flood free	Areas that are not flood affected and are not affected by indirect consequences of flooding.	

The following locations are listed in the Shoalhaven Local Flood Plan 2014 as suitable for use as evacuation centres or assembly areas dependent on the scale and type of the event:

- Sanctuary Point:
  - Community Centre, Paradise Beach Road
  - Sanctuary Point, Primary School
- St Georges Basin:
  - Community Centre, Meriton Street
  - St Georges Basin Country Club
- Erowal Bay:
  - Progress Hall
- Sussex Inlet:
  - Community Facilities, Thomson Street
  - Sussex Inlet RSL Club
  - Sussex Inlet Bowling Club

Sussex Inlet RSL Club would become surrounded by floodwaters but may provide high ground above floodwaters up to the 1% AEP event. Sussex Inlet Bowling Club would remain flood free up to the 0.2% AEP but would be within the edge of the PMF flood extent.

The majority of basin foreshore areas affected by flooding either have rising road egress or an overland escape route to evacuate to higher ground or an evacuation centre. Most foreshore areas can evacuate to the Wool Road, Naval College Road or Island Point Road either to the Princes Highway or to the St Georges Basin Country Club evacuation centre. Some foreshore areas, particularly around Basin View can evacuate to higher ground to flood free areas, however, some flood free areas have their egress routes cut by flooding.

Old Erowal Bay and Worrowing Heights are largely flood free, however, the Wool Road may be cut for short periods in both directions. Sections of the Princes Highway and Hawken Road would also be cut at Tomerong Creek, removing evacuation to the north. Sections of the Princes Highway would also become cut during a PMF event and some areas around Wandandian would be without an evacuation route leaving them isolated.

Sussex Inlet and Sanctuary Point near Tomerong Creek become inundated in as frequent as a 5% AEP event initially with rising road egress, however, the evacuation routes become inundated with rarer events. Evacuation from affected parts of Sanctuary Point are via The Park Drive and Larmer Avenue to higher ground. Evacuation from Sussex Inlet is either via Jacobs Drive and Sussex Inlet Road or Thomson Street and the Springs Road to Sussex Inlet Road. The urban area to the north of Badgee Lagoon has a gated flood free access road (FFAR) to Sussex Inlet Road through the Badgee Urban Release Area. However, Sussex Inlet Road would be cut off in a PMF event at tributary crossings for some duration of peak tributary flooding.

11.6 Impacts of development in the floodplain

The hydrology model has been setup to include the catchment impervious percentage from the current LEP land use zones mapping assuming full development within these zones. As such, there is not expected to be any increase in flows as a result of future development within these areas.

There are two known urban release areas/planning proposals within the catchment –

- Badgee Urban Release area on the western edge of Sussex Inlet; and,
- Nebraska Estate Planning Proposal – to the north of the western part of St Georges Basin township.

Both these developments would be subject to Council's on-site detention policy and any increase in runoff as a result of these developments would only have a localised impact in the area immediately downstream of any outlets. Even without on-site detention, both are very close to the Basin and any increase in runoff would be insignificant compared to the total catchment and would have no impacts on Basin levels.

12 Conclusion

The WBNM hydrologic model and TUFLOW hydraulic model have been setup and successfully calibrated; with a combined calibration/validation to three historical events. As such, the models can be used with confidence in assessing design flood behaviour. Design flood estimates have been validated against a Flood Frequency Analysis of observed annual peak St Georges Basin flood levels to provide confidence in the modelled design event Basin level estimates.

The study uses the current industry standard methods and guidelines in flood estimation using Australian Rainfall and Runoff 2019 and a series of DPE floodplain management guidelines to define flood behaviour in the St Georges Basin area for a range of representative design flood events.

The 1% AEP design flood levels in the current Flood Study are similar to those derived from the previous 2001 flood study modelling that Council has adopted. Differences are explained by the use of updated data and ARR2019 methods in the current study along with differences in model setup and more up-to-date survey and catchment conditions.

The models have been run for the 20%, 10%, 5%, 2%, 1%, 0.2% AEP storms and Probable Maximum Flood (PMF) event for the existing, Projected 2050 and Projected 2100 scenarios and flood levels, depths and velocities mapped. Provisional hazard, hazard, hydraulic categories and combined hazard and hydraulic categories have also been mapped.

Assessment of the impacts of rainfall increases and sea level rise due to climate change was undertaken along with assessment of tidal inundation and sensitivity to various model parameters.

The report also provides guidance on the adoption of Flood Planning Levels and Emergency Response parameters for use in planning and by the NSW SES.

The study will be used by Council and various stakeholders to inform flood planning and emergency management in the Study Area. The outputs of the Flood Study will provide information on current and future flood risk which is important for increasing community awareness and for building resilience.

12.1 Next Stage in Floodplain Risk Management Process

Following Council, DPE and NSW SES review and acceptance of the flood study results, the following steps will be undertaken:

- Present to the floodplain management committee;
- Undertake flood modification options assessment; and
- Develop floodplain risk management study.

This will provide an understanding of potential emergency response, planning and flood modification measures for managing flood risk in the catchment, benefit cost analysis and development of the floodplain risk management plan.

13 References

AIDR (2017), *Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*, Australian Institute for Disaster Resilience (AIDR), Commonwealth Government.

AIDR (2017a), *Australian Disaster Resilience Guideline 7-2 Flood Emergency Response Classification of the Floodplain*, Australian Institute for Disaster Resilience (AIDR), Commonwealth Government.

AIDR (2017b), *Australian Disaster Resilience Guideline 7-5 Flood Information to Support Land Use Planning Activities*, Australian Institute for Disaster Resilience (AIDR), Commonwealth Government.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) (2019), *Australian Rainfall and Runoff: A Guide to Flood Estimation*, © Commonwealth of Australia (Geoscience Australia), 2019.

Bureau of Meteorology (2006), *Guidebook of the Estimation of Probable Maximum Precipitation: Generalised Southeast Australia Method*, Hydrometeorological Advisory Service, Bureau of Meteorology, October 2006

Bureau of Meteorology (2003), *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method*, Bureau of Meteorology, Melbourne, Australia, June 2003

DECC (2007), *Floodplain Risk Management Guideline – Practical Consideration of Climate Change*, NSW Government, OEH 2016/0740.

DECCW (2010), *Flood Risk Management Guide – Incorporating sea level rise benchmarks in flood risk assessments*, NSW Government.

MHL (2019), *NSW Ocean And River Entrance Tidal Levels Annual Summary 2018–2019*, Report MHL2693 November 2019.

New South Wales Government (2005), *NSW Floodplain Development Manual, The management of flood liable land*, 1 April 2005.

OEH (2015), *Floodplain Risk Management Guide: Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways*, Office of Environment and Heritage, Sydney, November 2015, Document No. OEH 2015/0769.

OEH (2016), *Floodplain Risk Management Guide: Flood Emergency Response Planning Classification of Communities*, NSW Government, Document No. OEH 2016/0732.

OEH (2019), *Floodplain Risk Management Guide: Incorporating 2016 Australian Rainfall and Runoff in studies*, NSW Government, Document No. OEH 2019/0527.

Pilgrim, D.H. (ed.) (1987), *Australian Rainfall and Runoff: A guide to flood estimation*, Institution of Engineers Australia.

Webb, McKeown & Associates (WMA) (2001), *St Georges Basin Flood Study*, prepared for Shoalhaven City Council, October 2001.

Webb, McKeown & Associates (WMA) (2006), *St Georges Basin Floodplain Risk Management Study,* prepared for Shoalhaven City Council, December 2006.

Whitehead & Associates (2014), *South Coast Regional Sea Level Rise Policy and Framework* for Eurobodalla Shire Council and Shoalhaven City Council. Whitehead & Associates Environmental Consultants Project 1213, October 2014.

WMAwater (2013), *St Georges Basin Floodplain Risk Management Study and Plan Climate Change Assessment*, prepared for Shoalhaven City Council, January 2013.

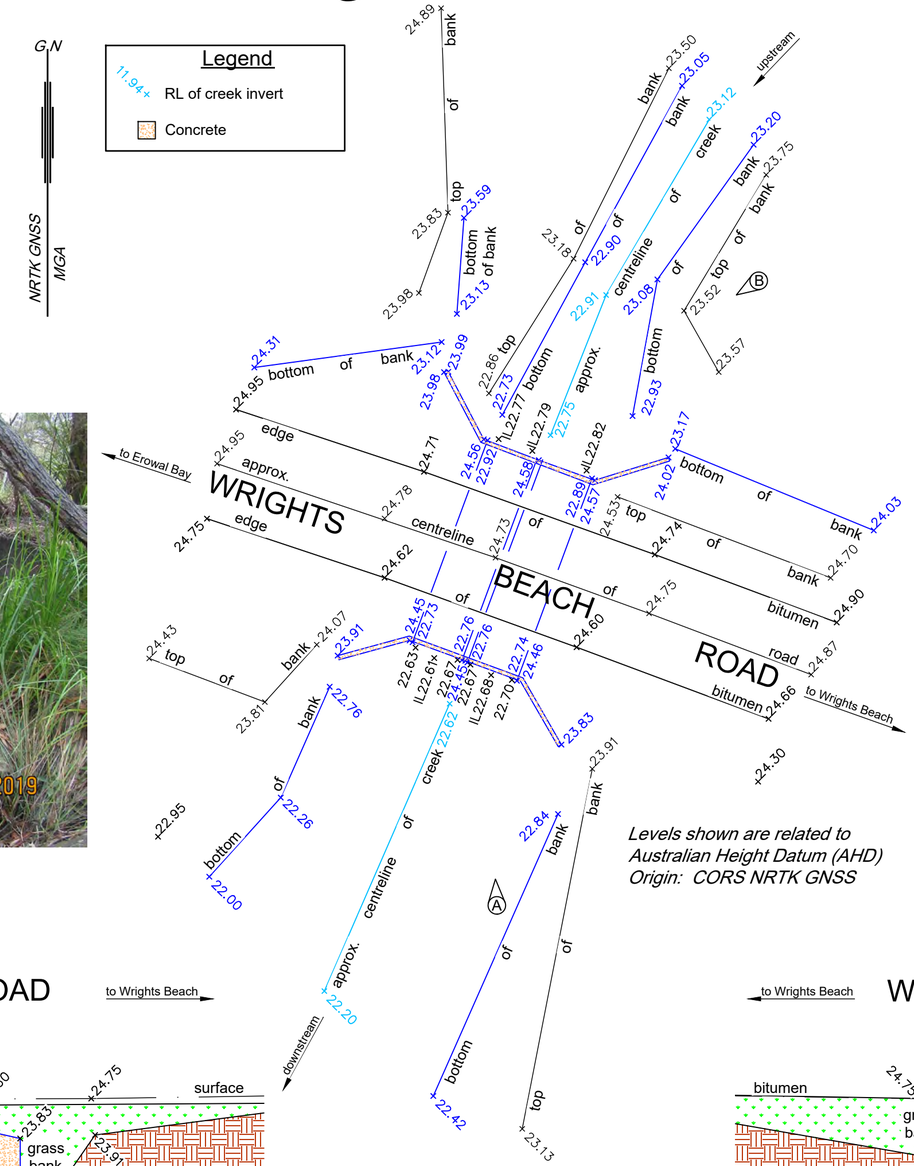
APPENDIX A

STRUCTURES SURVEY PLANS

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G1



CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



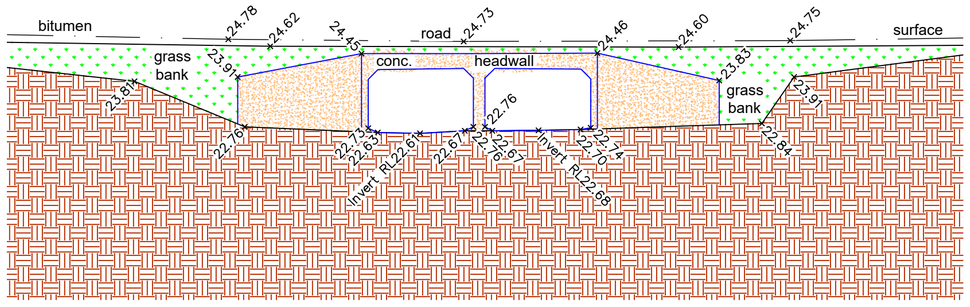
PHOTO A - DOWNSTREAM OUTLET



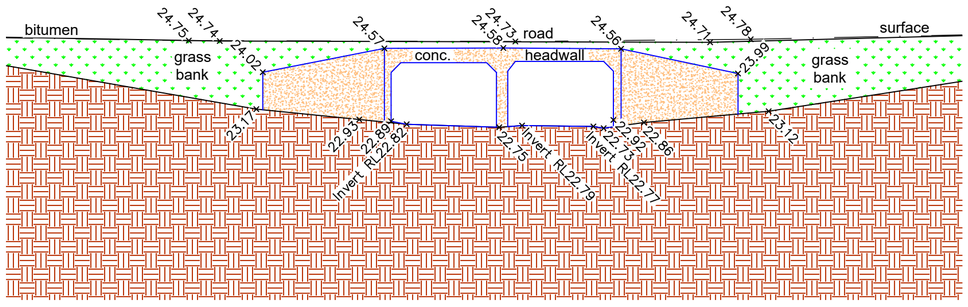
PHOTO B - UPSTREAM INLET

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW
REDUCTION RATIO 1:200



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 29.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER: N27670-G1

SHEET 1 OF 1

REVISION: -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

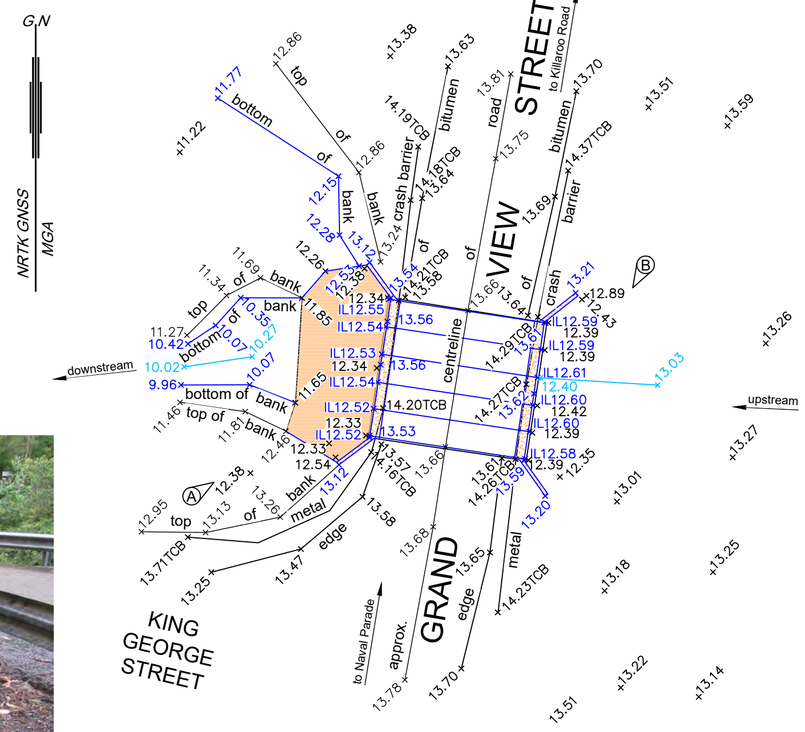
St. Georges Basin - Site G3

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

Legend

- 11.94+ RL of approx. creek invert
- Concrete headwall
- Concrete apron
- 11.94TCB+ Top of Crash Barrier
- IL11.94+ Invert of Culvert



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

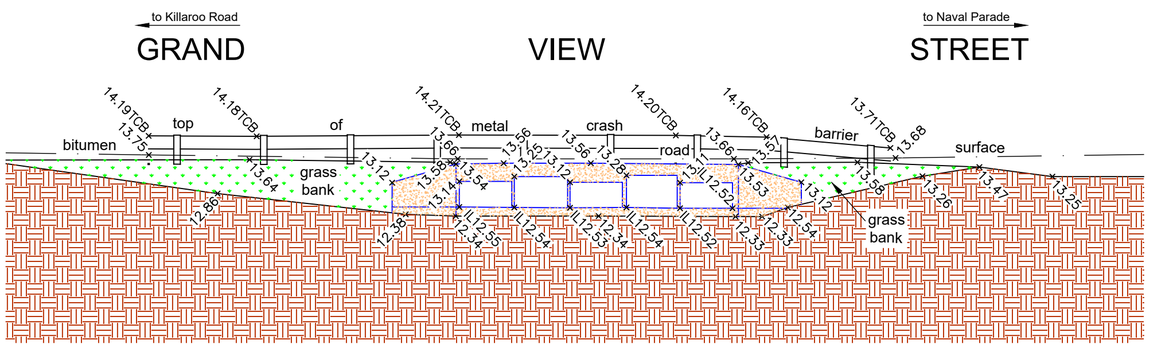
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



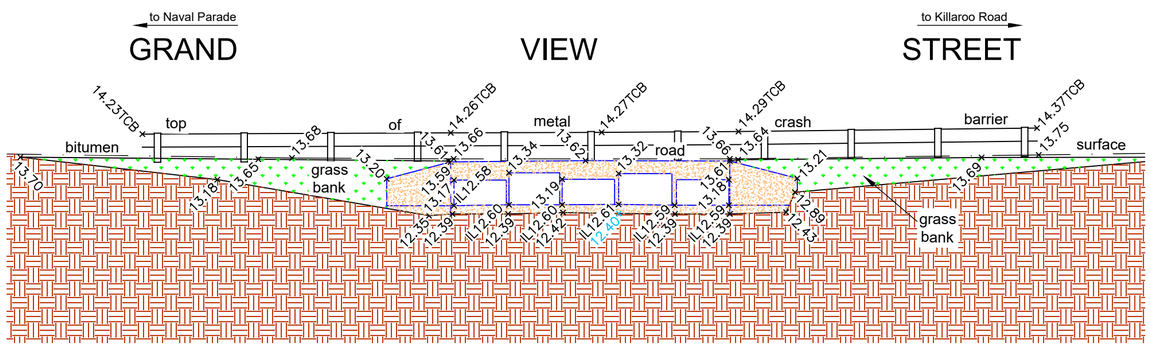
PHOTO A - DOWNSTREAM OUTLET



PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 07.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G3

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G4

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

Legend

11.94= RL of creek invert

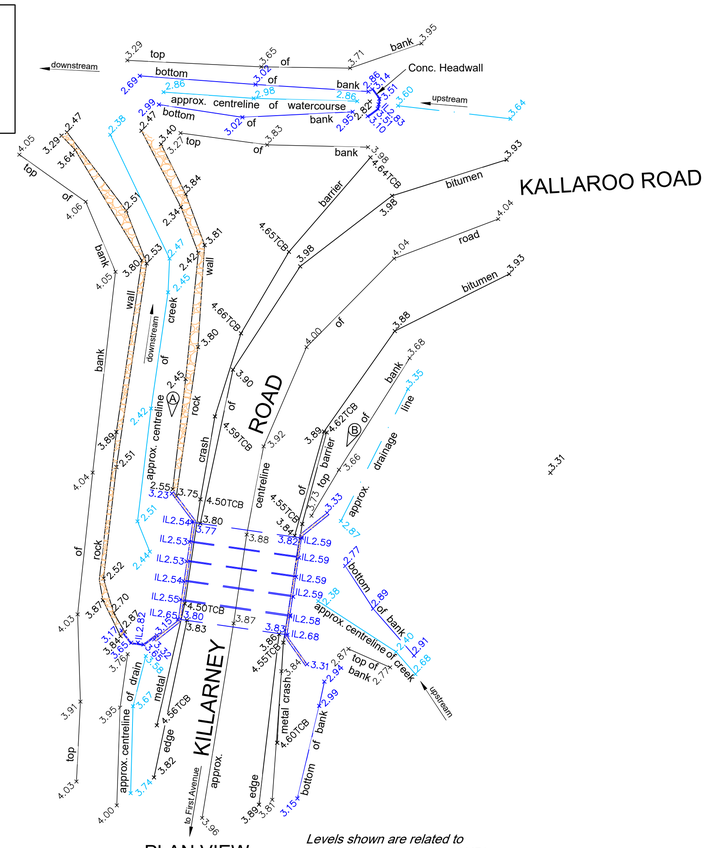
11.94TCB= RL of top of metal crash barrier

Concrete

Rock wall

G,N

NRTK GNSS MGA



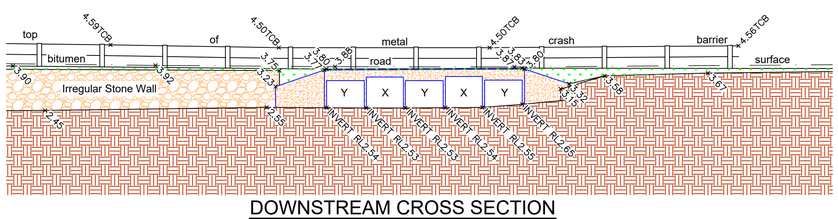
PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PHOTO B - UPSTREAM INLET

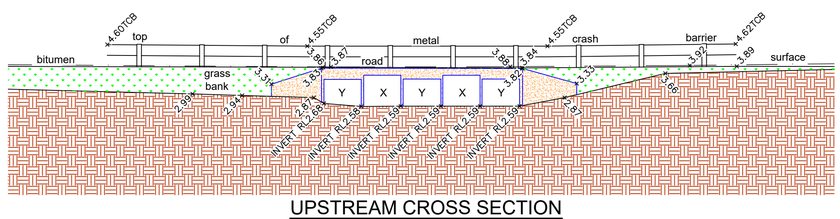


DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

Approx. Box Culvert Dimensions

X = 1.0 High x 1.22 Wide
Y = 0.89 High x 1.20 Wide
All 7.17 Long



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:			REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A1 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	SURVEY	FK	=			
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A				
		DRAWN	AG				
	DATE OF PLAN: 29.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G4

SHEET 1 OF 1

REVISION -

M:\Projects\200\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G5

Liability limited by a scheme approved under Professional Standards Legislation.

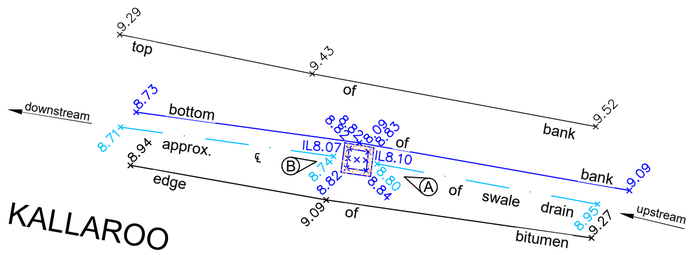
COVER OF EXCELLENCE®

Legend

- 11.94+ RL of swale drain invert
- 11.94IL× RL of pipe invert
- Concrete

GN

NRTK GNSS MGA



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

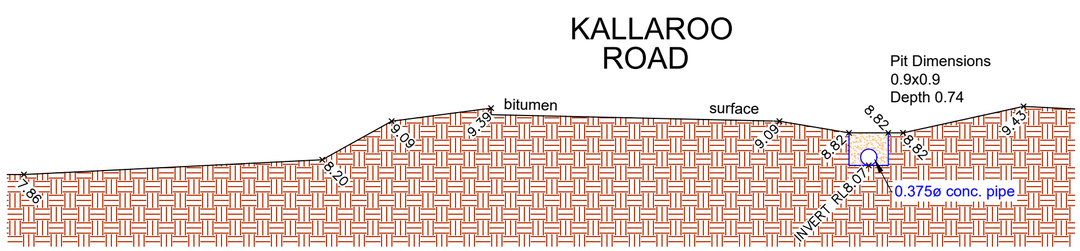
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM



PHOTO B - UPSTREAM



CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 29.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G5

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G6

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

Legend

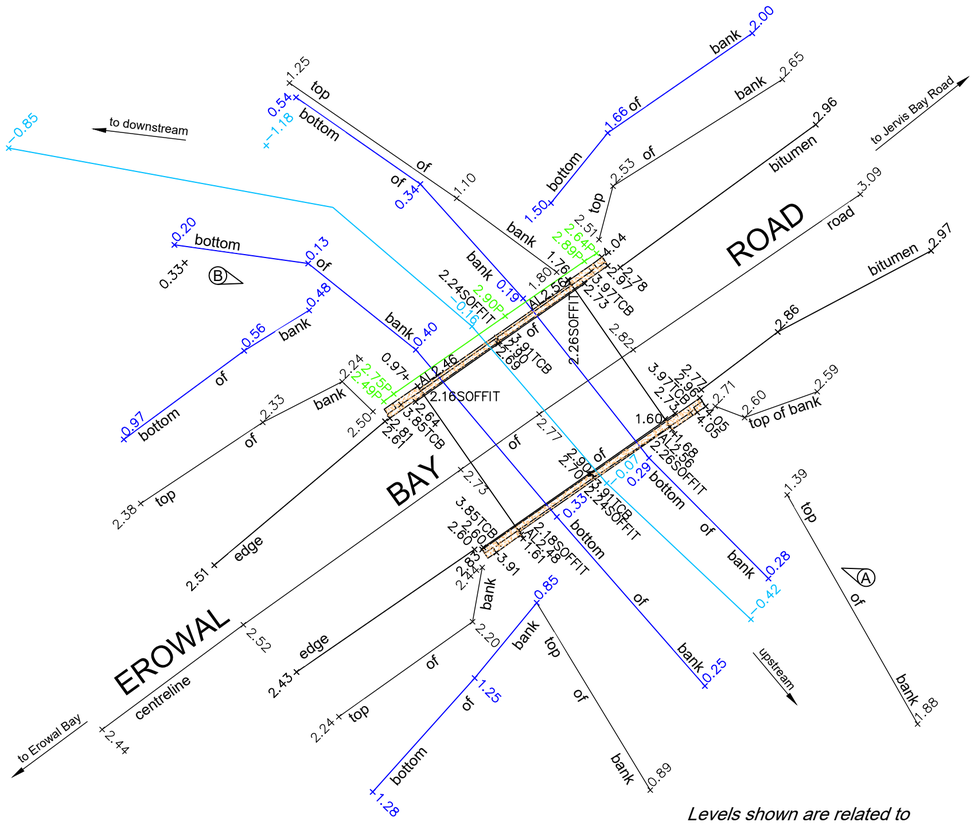
- 11.94+ — RL of approx. creek invert
- 11.94P+ — RL of top of 0.36Ø unknown metal pipe
- AL11.94+ — RL of abutment
- 11.94TCB+ — RL of top of crash barrier
- 11.94SOFFIT+ — RL of Soffit
- Concrete

GN

NRTK GNSS MGA



PHOTO A - UPSTREAM INLET



PLAN VIEW

REDUCTION RATIO 1:200

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

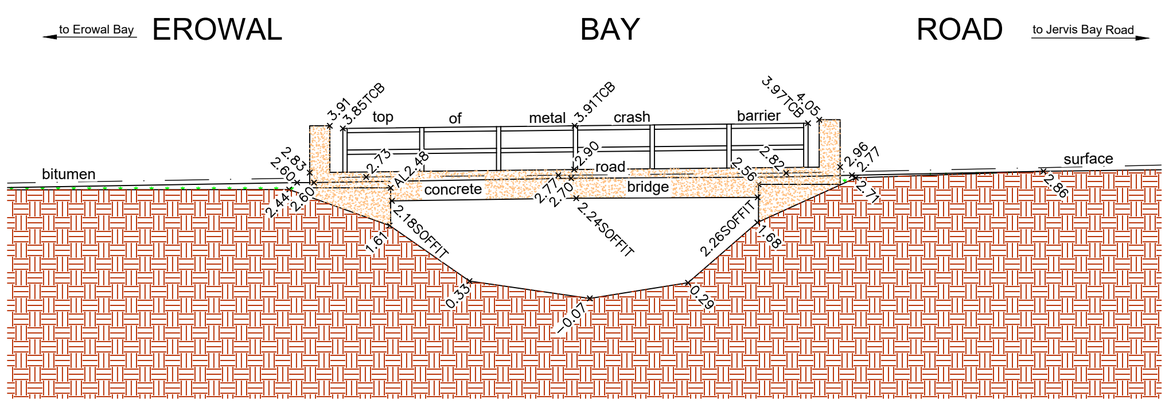
   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

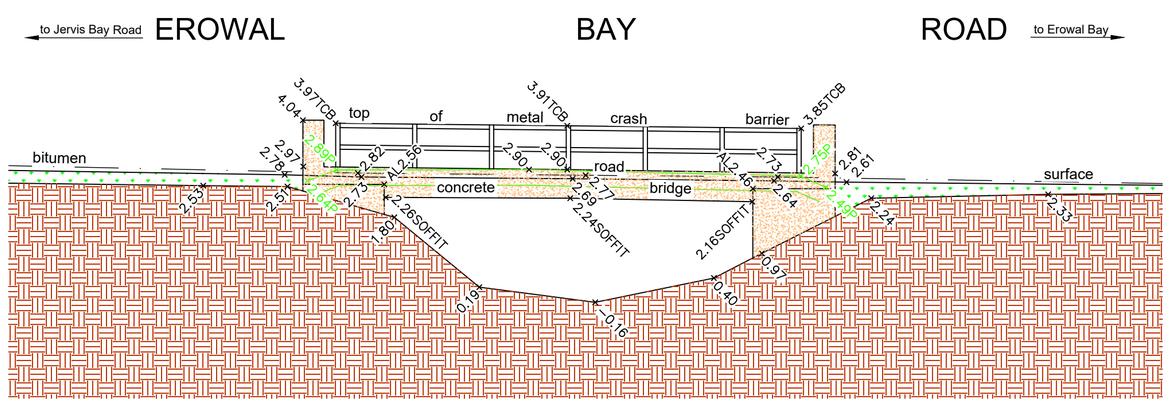


PHOTO B - DOWNSTREAM OUTLET



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM						
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 08.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G6

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

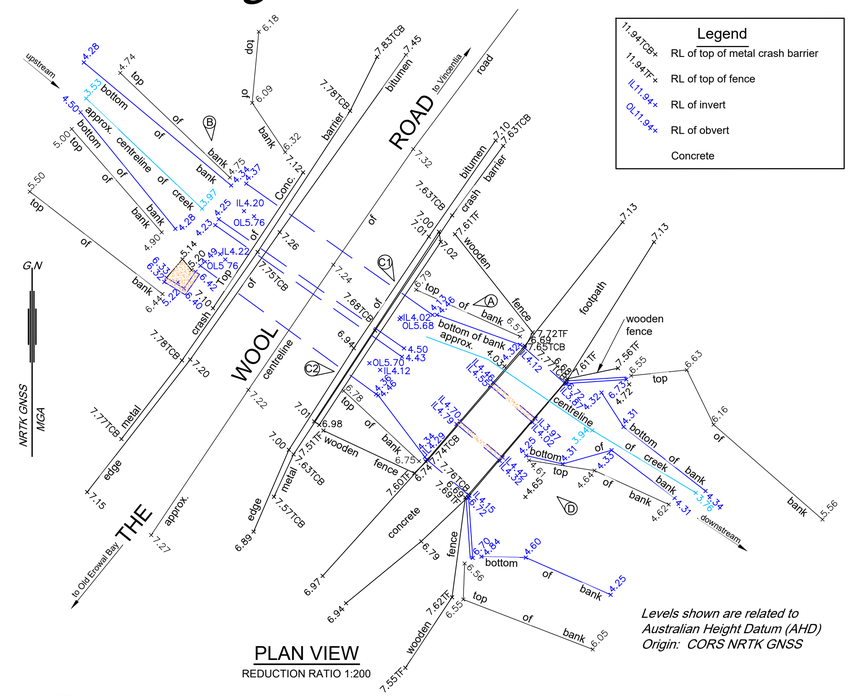
St. Georges Basin - Site G7



PHOTO A - DOWNSTREAM OUTLET



PHOTO C1 & C2 - DOWNSTREAM OUTLET



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

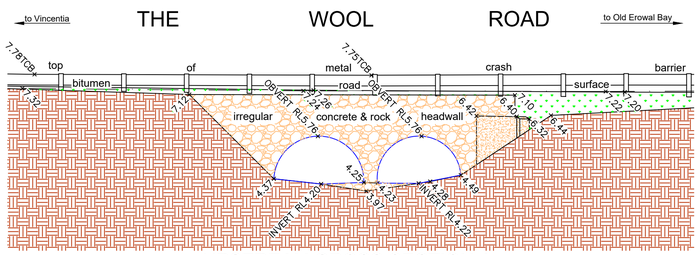
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B - UPSTREAM INLET



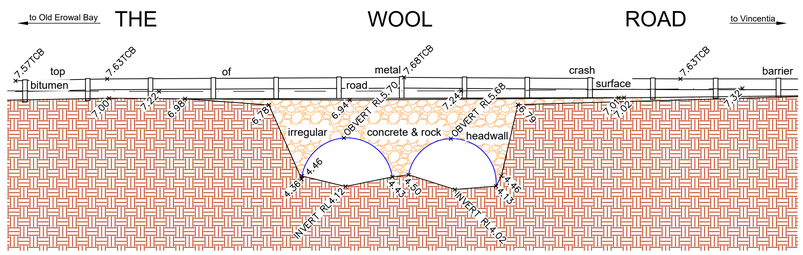
PHOTO D - DOWNSTREAM OUTLET



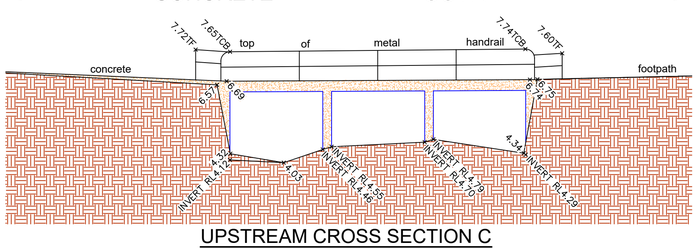
UPSTREAM CROSS SECTION A
REDUCTION RATIO 1:100

Approx. Pipe Culvert Dimensions
2.9 Wide x 1.5 high

Approx. Pipe Culvert Length 11.6 to Obverts



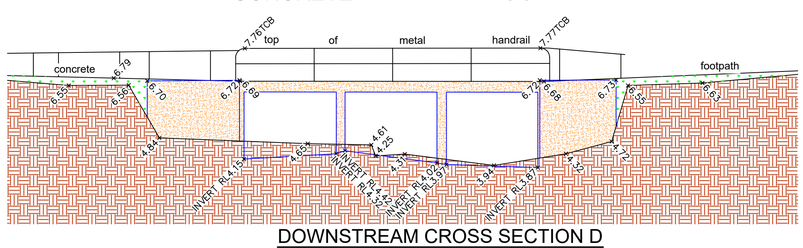
DOWNSTREAM CROSS SECTION B
REDUCTION RATIO 1:150



UPSTREAM CROSS SECTION C
REDUCTION RATIO 1:100

Approx. Box Culvert Dimensions
3.03 Wide x 2.1 high

Approx. Box Culvert Length 3.6



DOWNSTREAM CROSS SECTION D
REDUCTION RATIO 1:150

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS DATE OF PLAN: 31.01.2019	SURVEY	FK	REV	DESCRIPTION	BY	DATE
		DESIGN	N/A	=			
		DRAWN	AG				
		CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G7

SHEET 1 OF 1

REVISION -

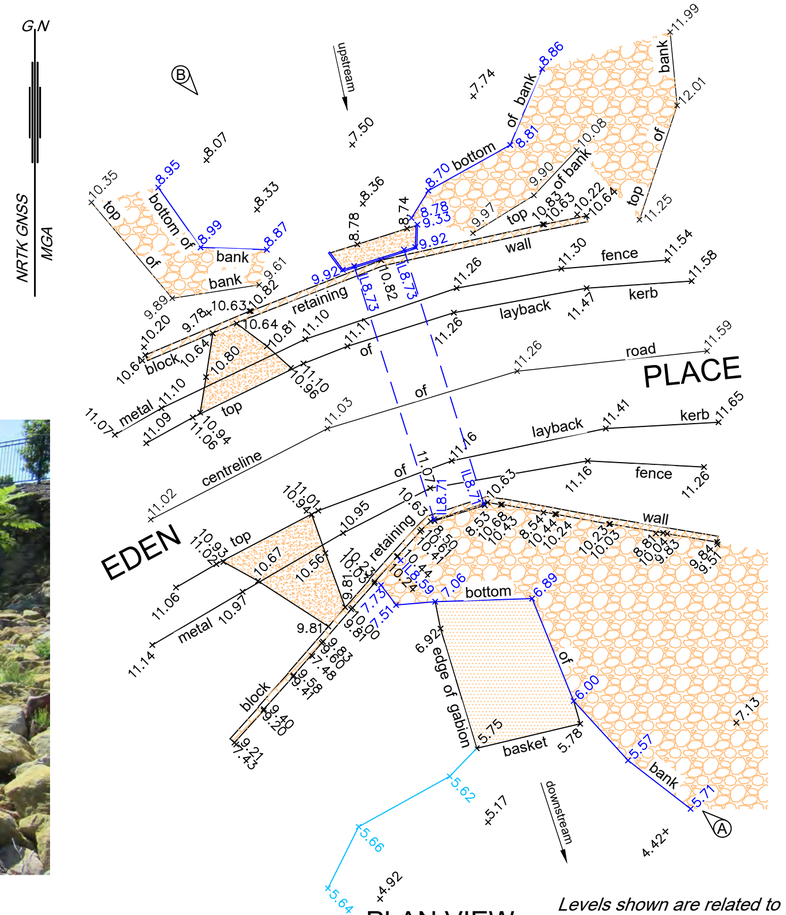
M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G8

Legend

- RL of creek invert
- Invert of Culvert
- Irregular stone bank
- Concrete
- Stone gabion basket
- masonry block retaining wall



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

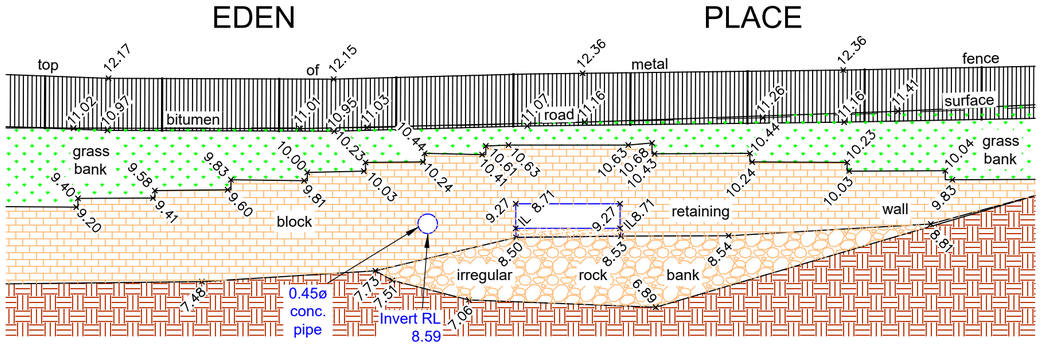
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



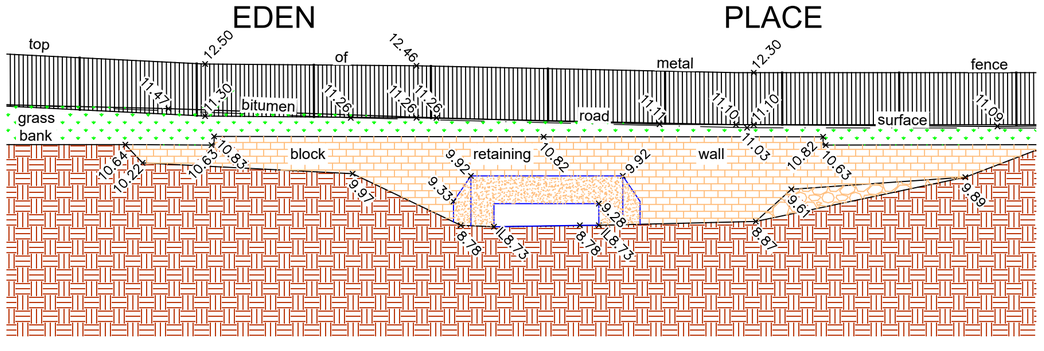
PHOTO A - DOWNSTREAM OUTLET



PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 08.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G8 | SHEET 1 OF 1 | REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G11

Legend

- 11.94TCB× RL of top of metal crash barrier
- 11.94TPC× RL of top of pier cap
- 11.94BPC× RL of bottom of pier cap
- 11.95SOFFIT× RL of soffit
- 11.94P× RL of top of 0.425Ø metal pipe
- concrete pier cap
- concrete column

CAUTION

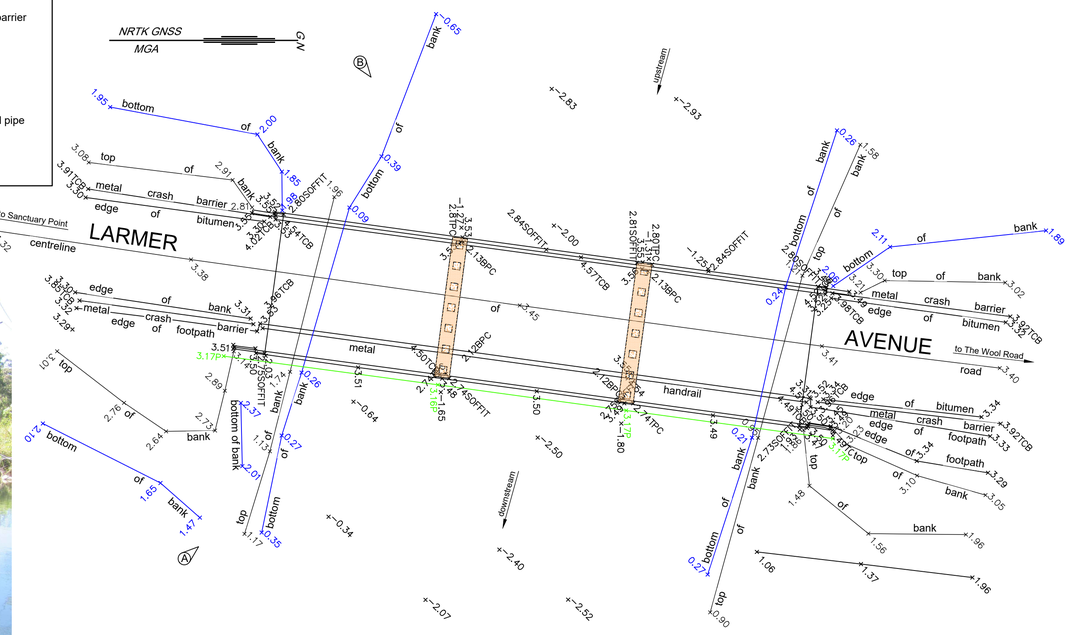
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

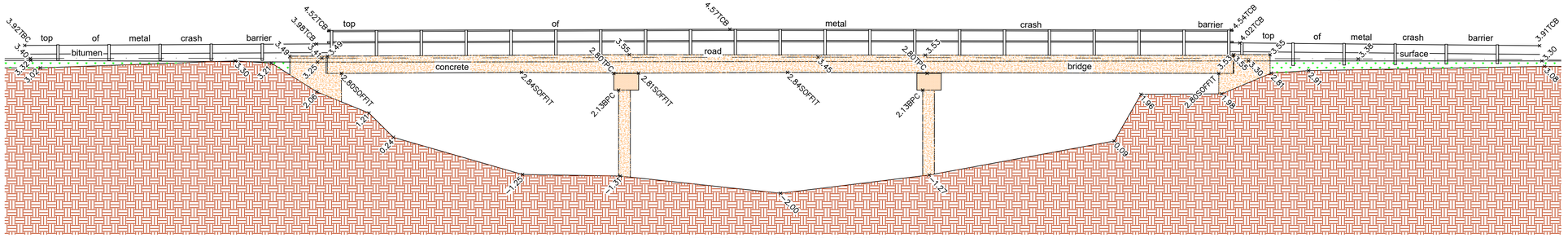


PLAN VIEW
REDUCTION RATIO 1:200

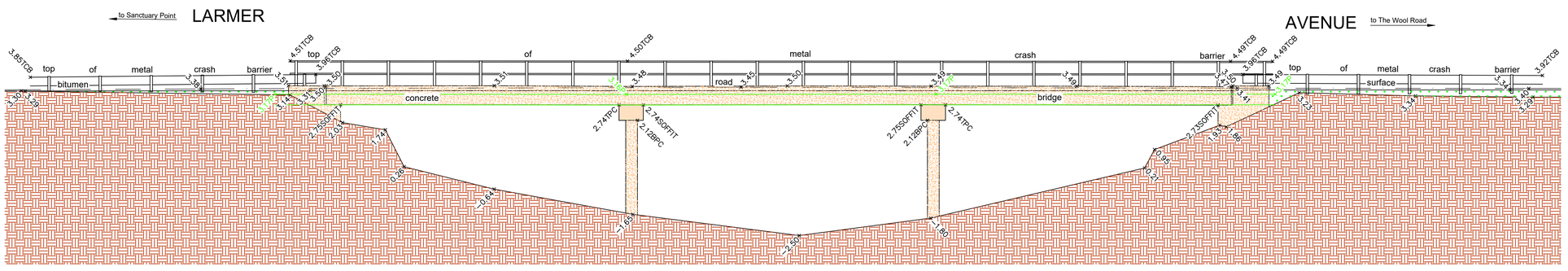
Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PHOTO B - UPSTREAM INLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:150



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:150

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS DATE OF PLAN: 08.11.2018	SURVEY	FK	REV	DESCRIPTION	BY	DATE
		DESIGN	N/A	=			
		DRAWN	AG				
		CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G11 | SHEET 1 OF 1 | REVISION -

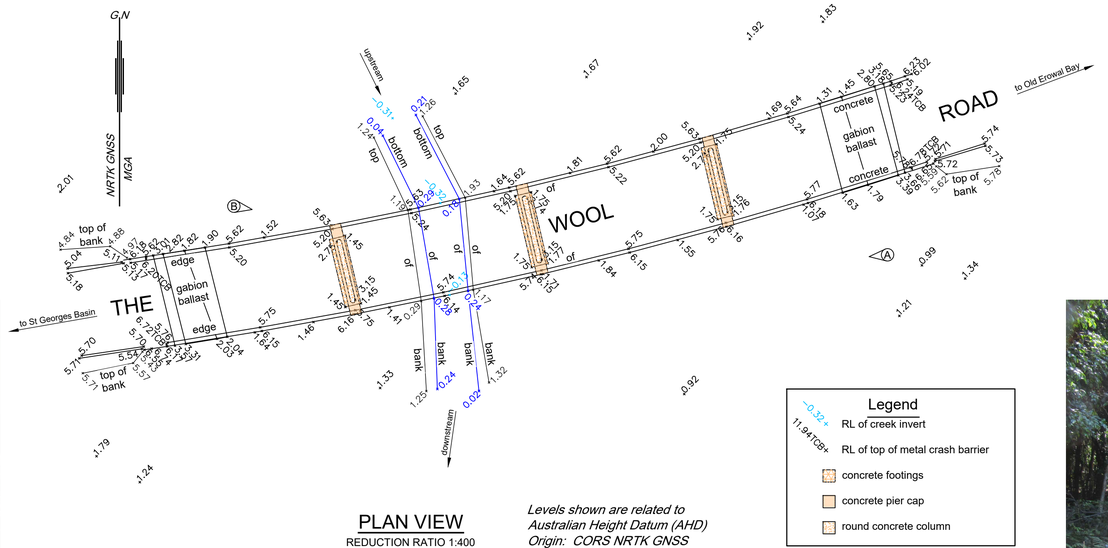
M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G12



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW
REDUCTION RATIO 1:400

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

Legend
- ~0.32× RL of creek invert
- 11.947CB× RL of top of metal crash barrier
- concrete footings
- concrete pier cap
- round concrete column



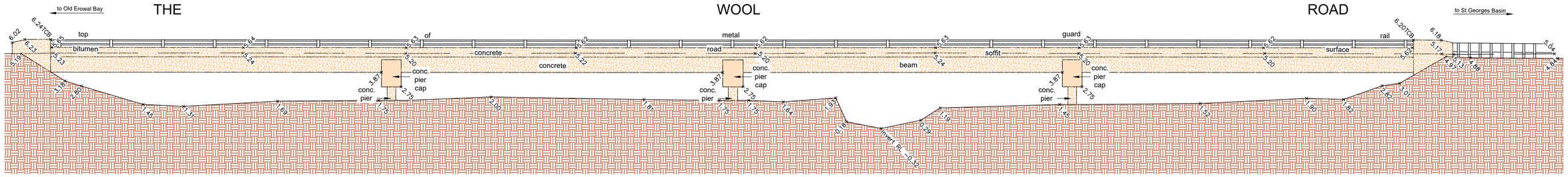
PHOTO B - UPSTREAM INLET

CAUTION

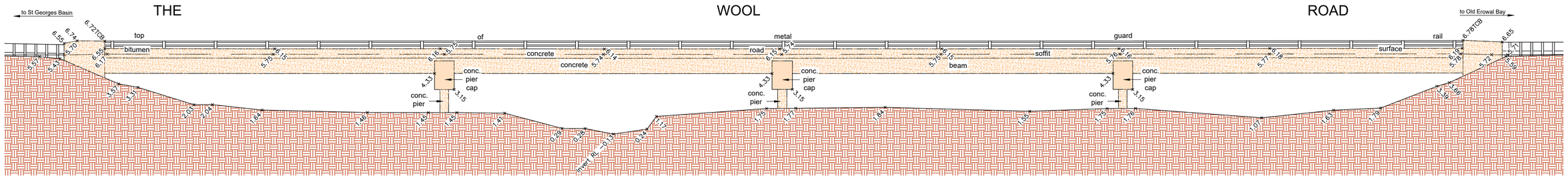
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:150



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:150

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS DATE OF PLAN: 30.10.2018	SURVEY	FK	REV	DESCRIPTION	BY	DATE
		DESIGN	N/A	=			
		DRAWN	AG				
		CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G12 | SHEET 1 OF 1 | REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G13

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

CAUTION

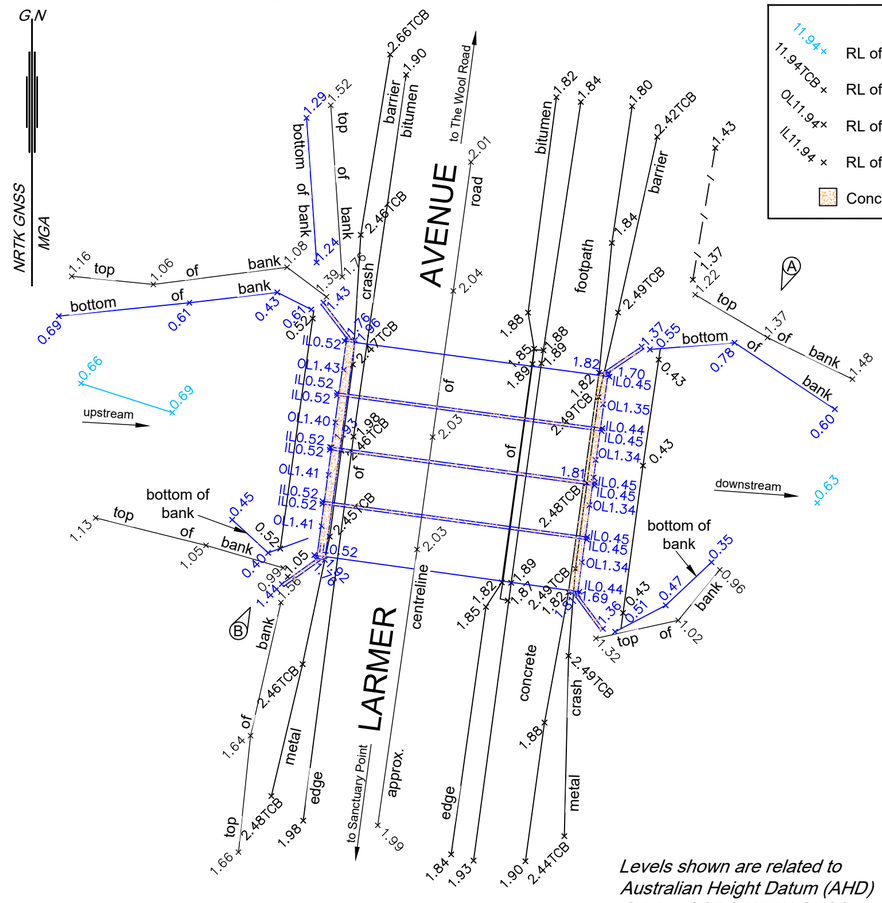
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET



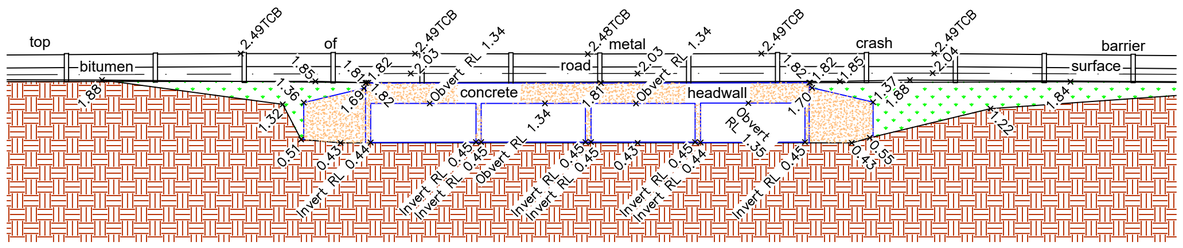
PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

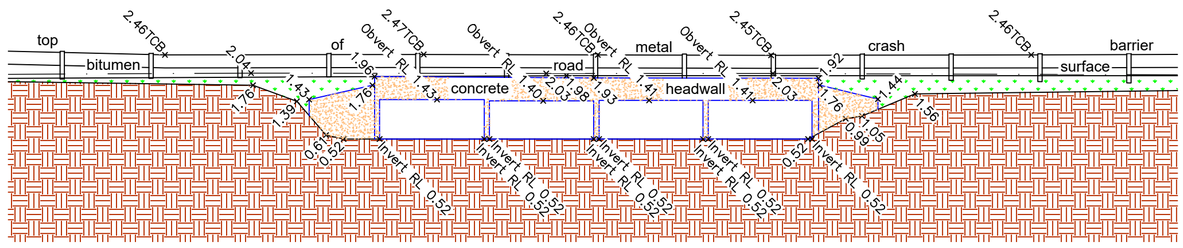


PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 27.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G13

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G14

Liability limited by a scheme approved under Professional Standards Legislation.

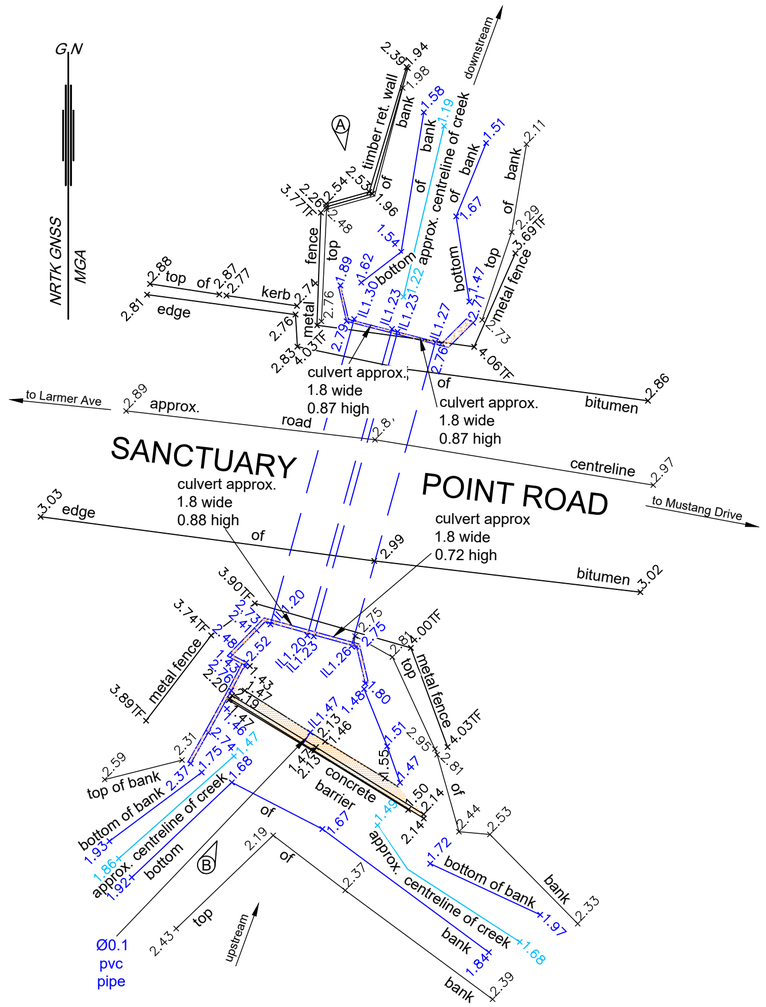
COVER OF EXCELLENCE®

Legend

- 11.94+ — RL of creek invert
- IL11.94+ — RL of pipe invert
- 11.94TF+ — Top of Metal Fence
- Concrete



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

Approx. Box Culvert Length 14.5

CAUTION

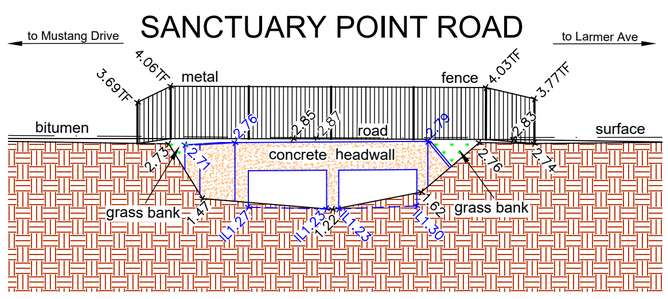
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

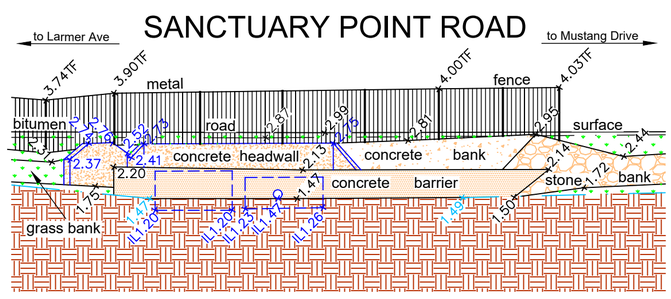


PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AE				
	DATE OF PLAN: 31.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G14

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G15

Liability limited by a scheme approved under Professional Standards Legislation.

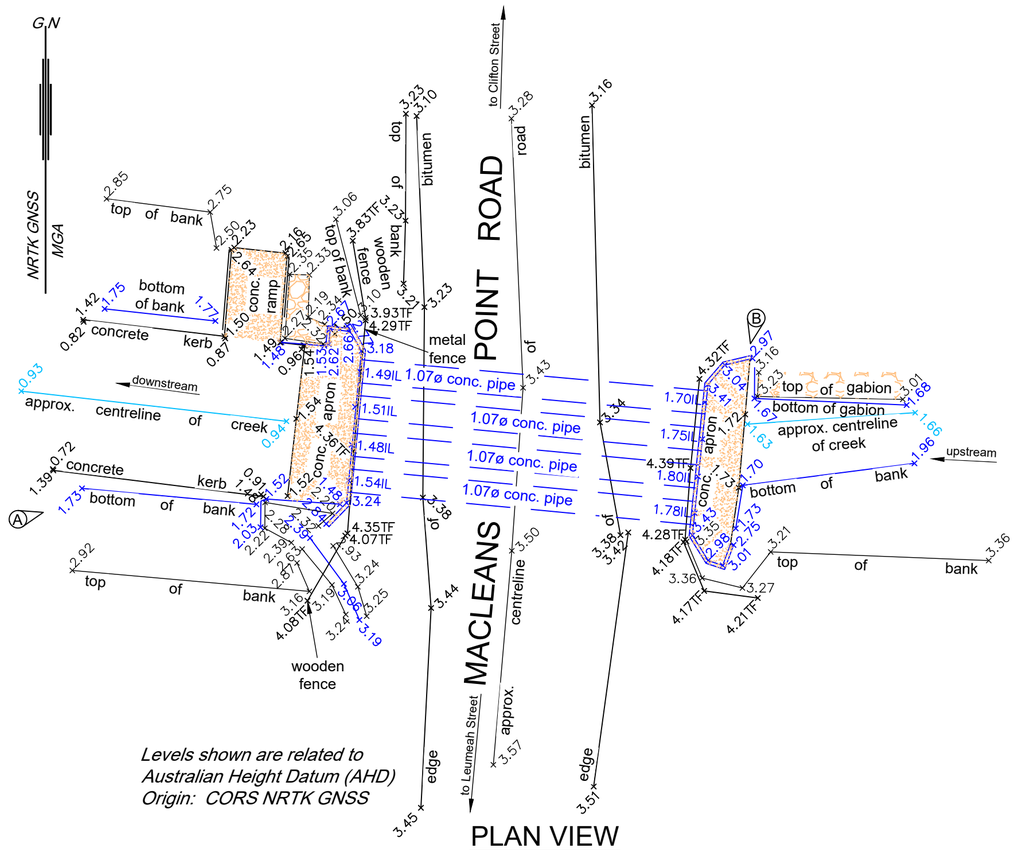
COVER OF EXCELLENCE®

Legend

- 11.94+ RL of creek invert
- 11.94IL+ RL of pipe invert
- 11.94TF+ Top of Fence
- Concrete
- Gabion rock basket



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200

CAUTION

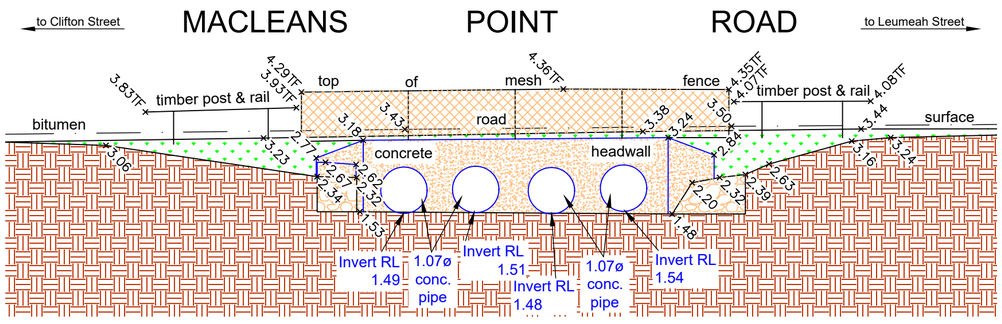
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



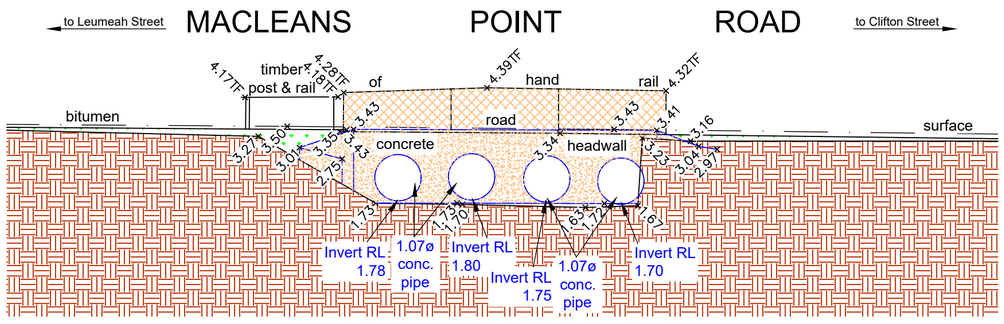
PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

approx. pipe culvert length 16m



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 01.02.19	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G15

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G16

Liability limited by a scheme approved under Professional Standards Legislation.

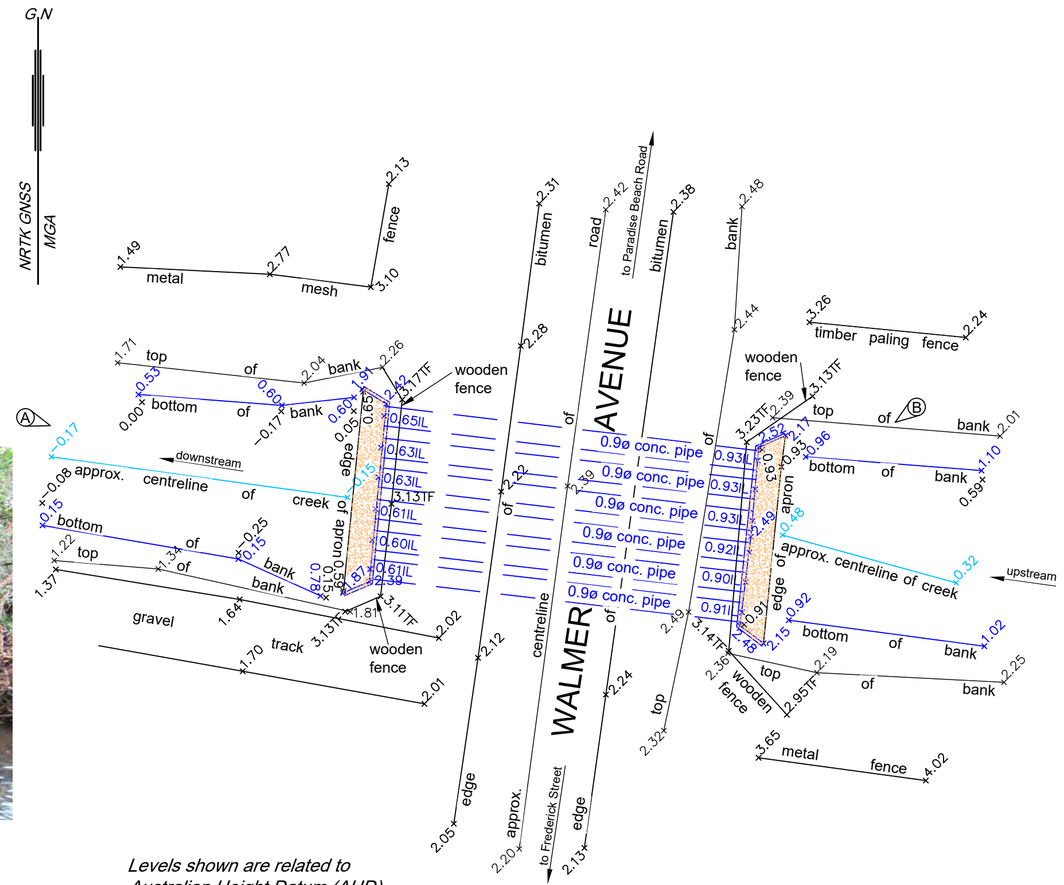
COVER OF EXCELLENCE®

Legend

- 11.94× RL of creek invert
- 11.94IL× RL of pipe invert
- 11.94TF× RL of top of fence
- Concrete



PHOTO A - DOWNSTREAM OUTLET



Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW

REDUCTION RATIO 1:200



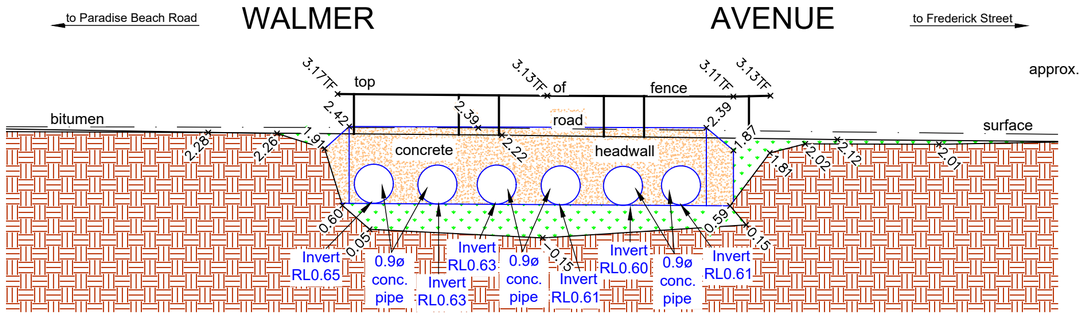
PHOTO B - UPSTREAM INLET

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

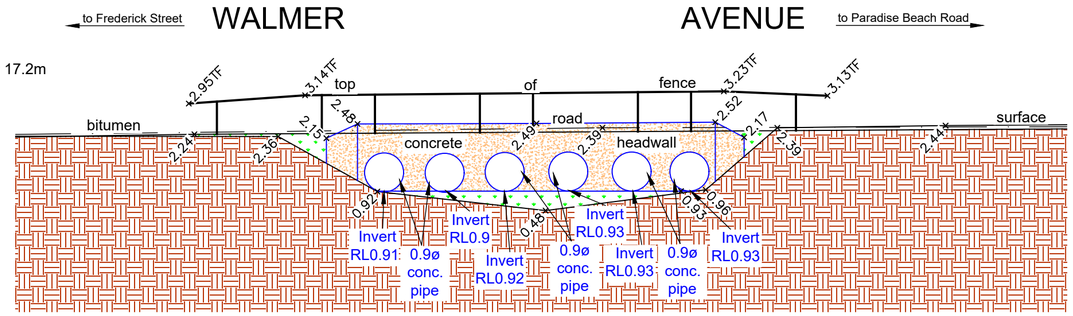
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

approx. pipe length 17.2m



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 04.02.219	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G16

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

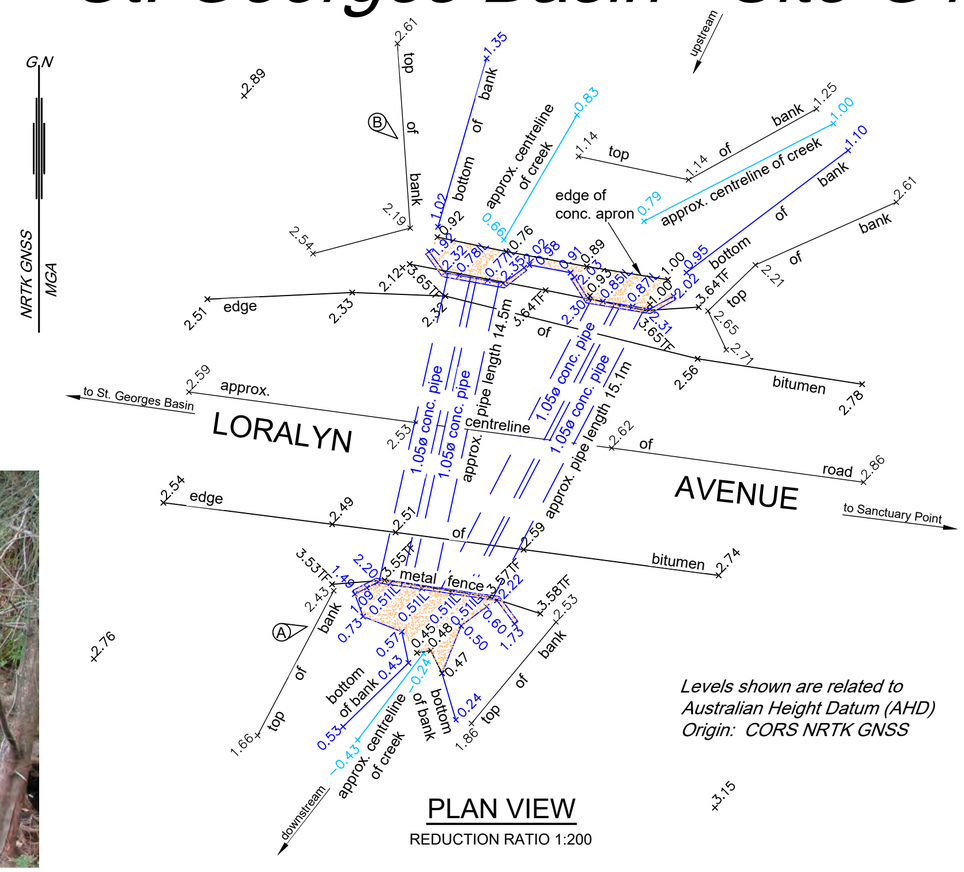
St. Georges Basin - Site G17

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

Legend

- 11.94+ RL of creek invert
- 11.94IL+ RL of pipe invert
- 11.94TF+ Top of Fence
- Concrete



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

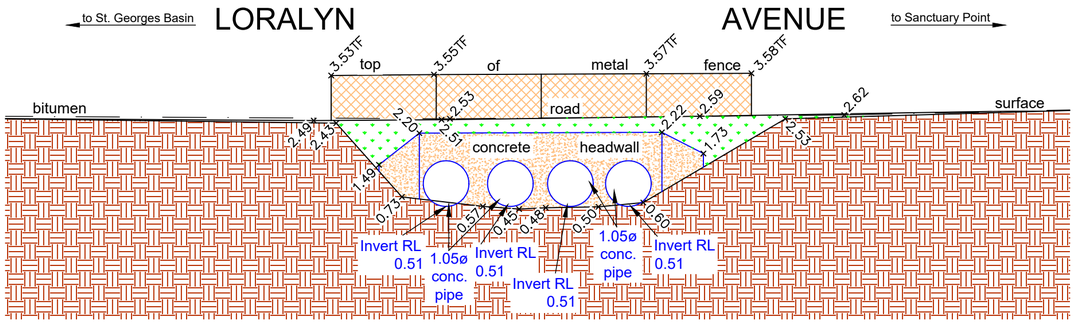
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

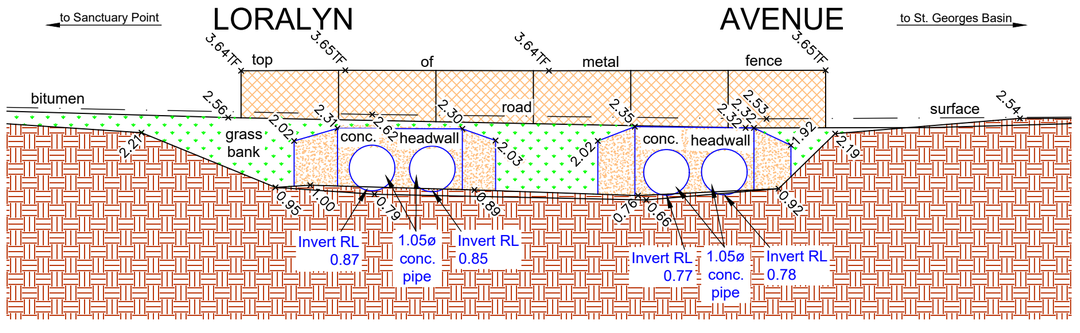


PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 04.02.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER: N27670-G17

SHEET 1 OF 1

REVISION: -

M:\Projects\27000\27700s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G18

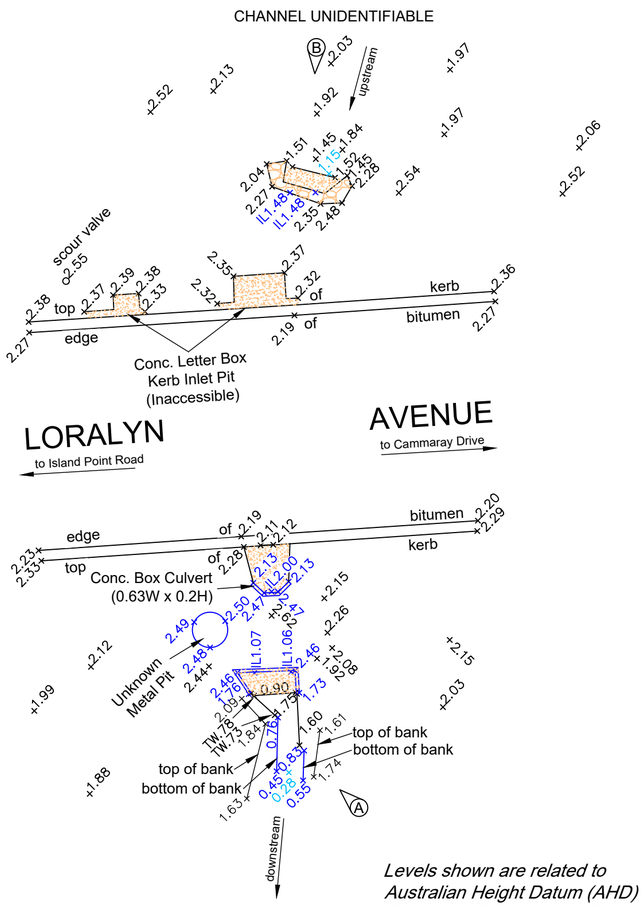
Legend

- ~0.32+ RL of creek invert
- IL0.32+ RL of pipe invert
- 11.94TW+ RL of top of timber wall
- irregular stone wall
- concrete

GN — NRTK GNSS — MGA



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD) Origin: CORS NRTK GNSS

CAUTION

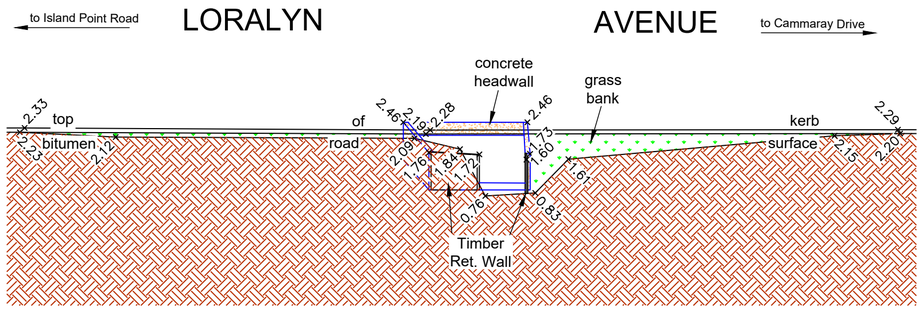
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

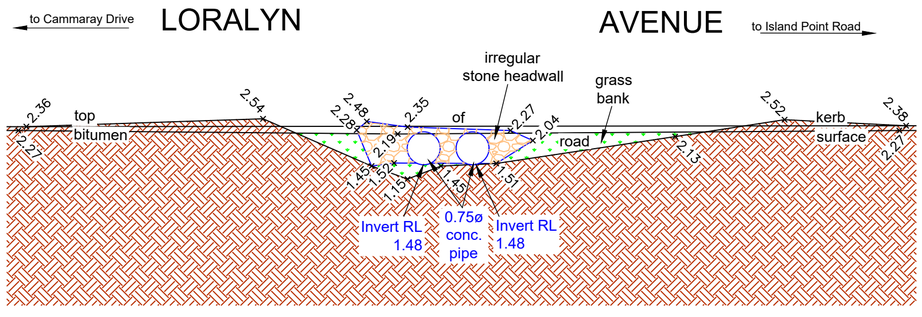


PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 29.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G18

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

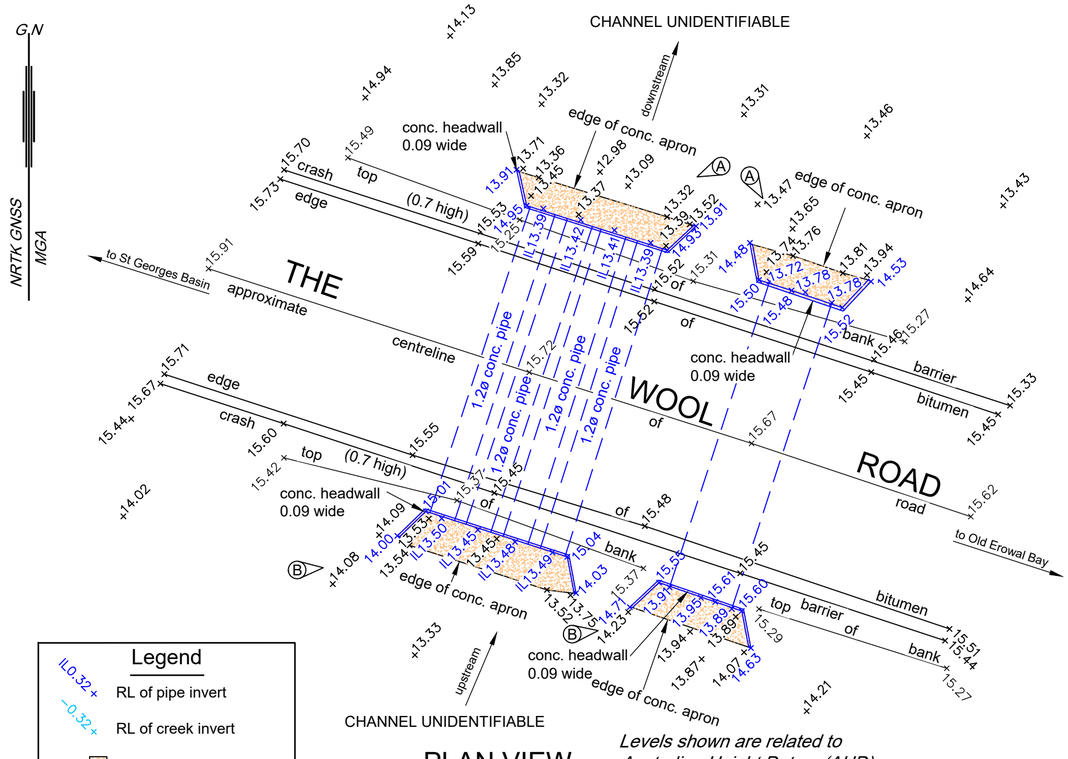
Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G19





PHOTO A - DOWNSTREAM OUTLET



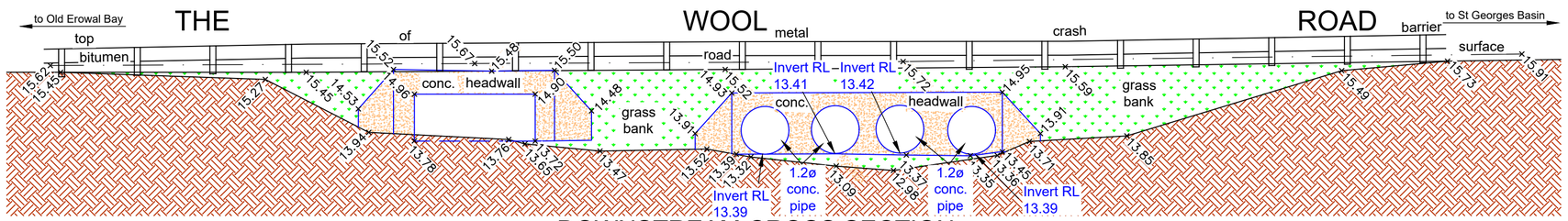
PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

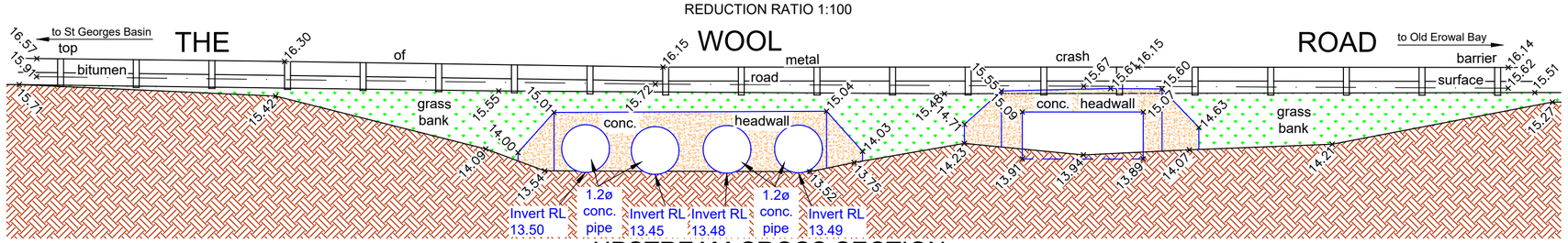




PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 29.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G19

SHEET 1 OF 1

REVISION -

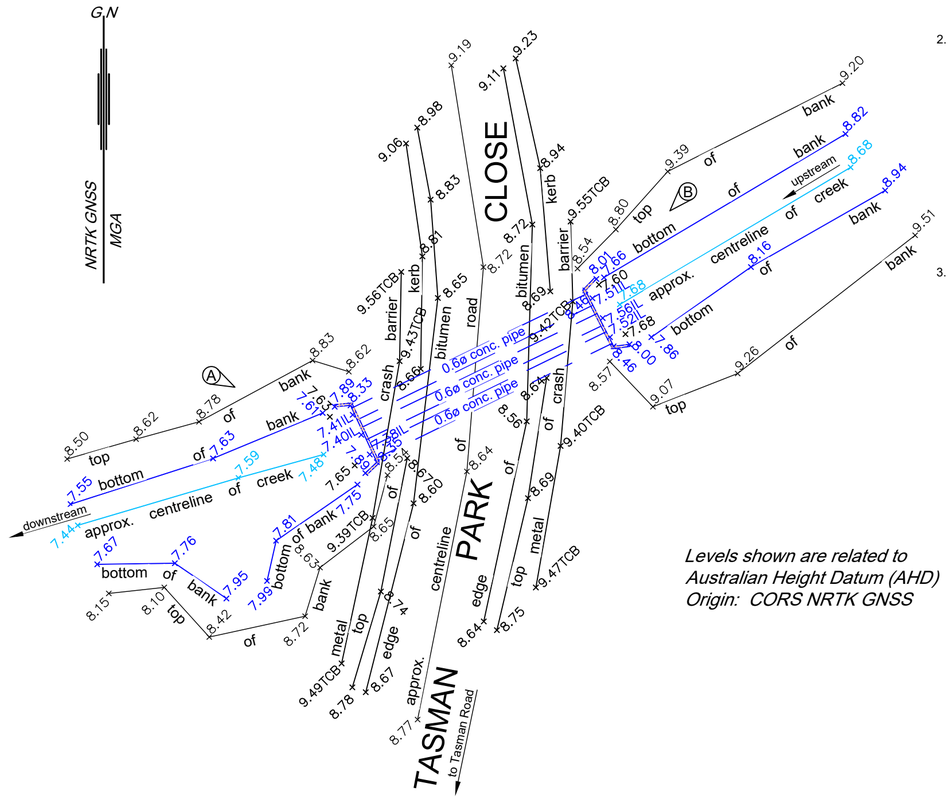
M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G20

Legend

- 11.94+ RL of creek invert
- 11.94IL+ RL of pipe invert
- 11.94TCB+ Top of crash barrier
- Concrete


GRID NORTH
NRTK GNSS
MGA
CLOSE
PARK
TASMAN
to Tasman Road
A
B
0.6ø conc. pipe
0.6ø conc. pipe
0.6ø conc. pipe
0.6ø conc. pipe
downstream
approx. centreline of creek
approx. centreline of creek
upstream
bottom of bank
top of bank
bottom of bank
top of bank
top of bank
bottom of bank
top of bank
top of bank
top of bank
bottom of bank
top of bank
top of bank
top of bank
bottom of bank
top

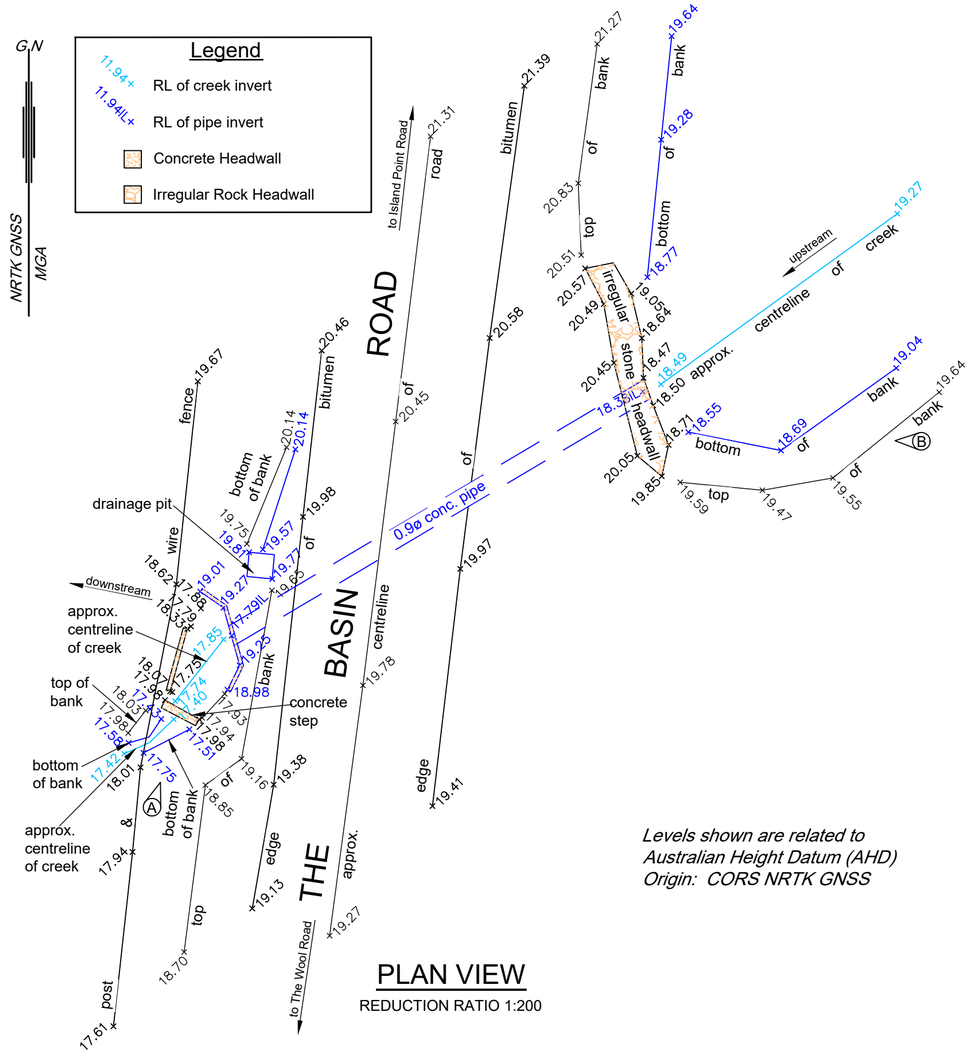
St. Georges Basin - Site G21

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

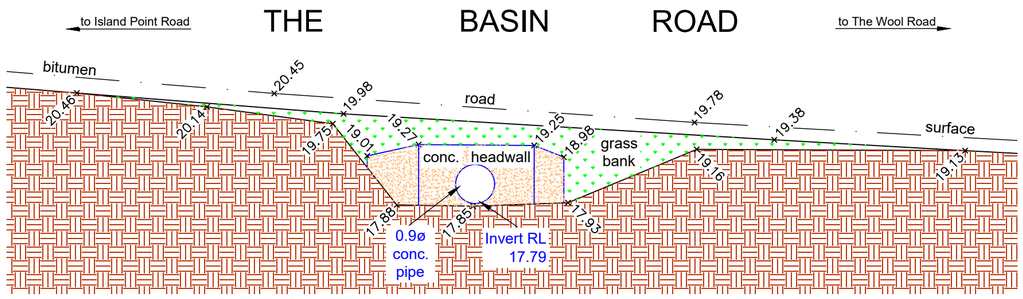
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



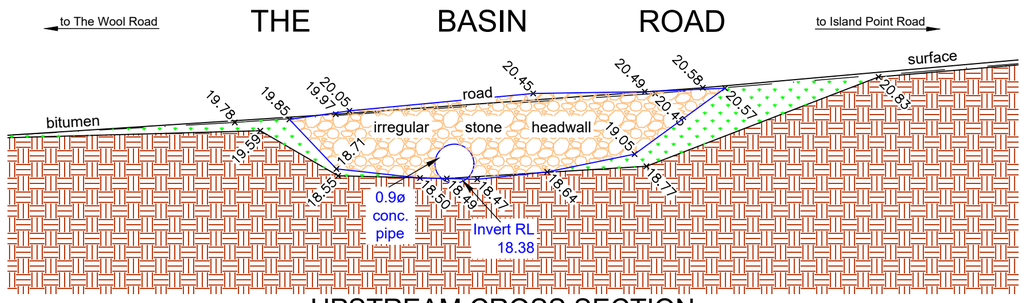
PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

approx. pipe length 22.05m



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 23.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER: N27670-G21

SHEET 1 OF 1

REVISION: -

M:\Projects\20000\27000\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G22

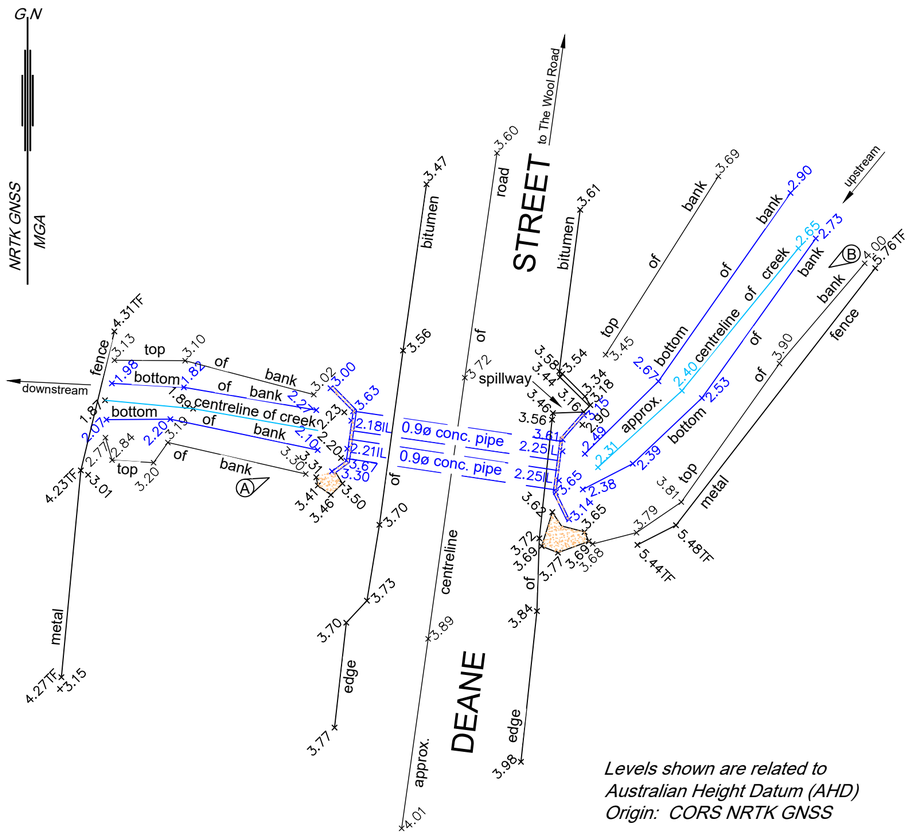
COVER OF EXCELLENCE®
Liability limited by a scheme approved under Professional Standards Legislation.

Legend

- 11.94+ RL of creek invert
- 11.94IL+ RL of pipe invert
- 11.94TF+ RL of top of fence
- Concrete



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

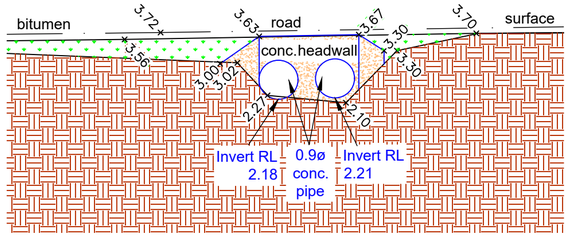
   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B - UPSTREAM INLET

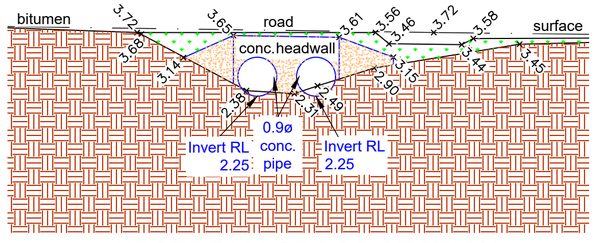
to The Wool Road DEANE STREET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

approx. pipe length 9.75m

DEANE STREET to The Wool Road



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 16.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G22 | SHEET 1 OF 1 | REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

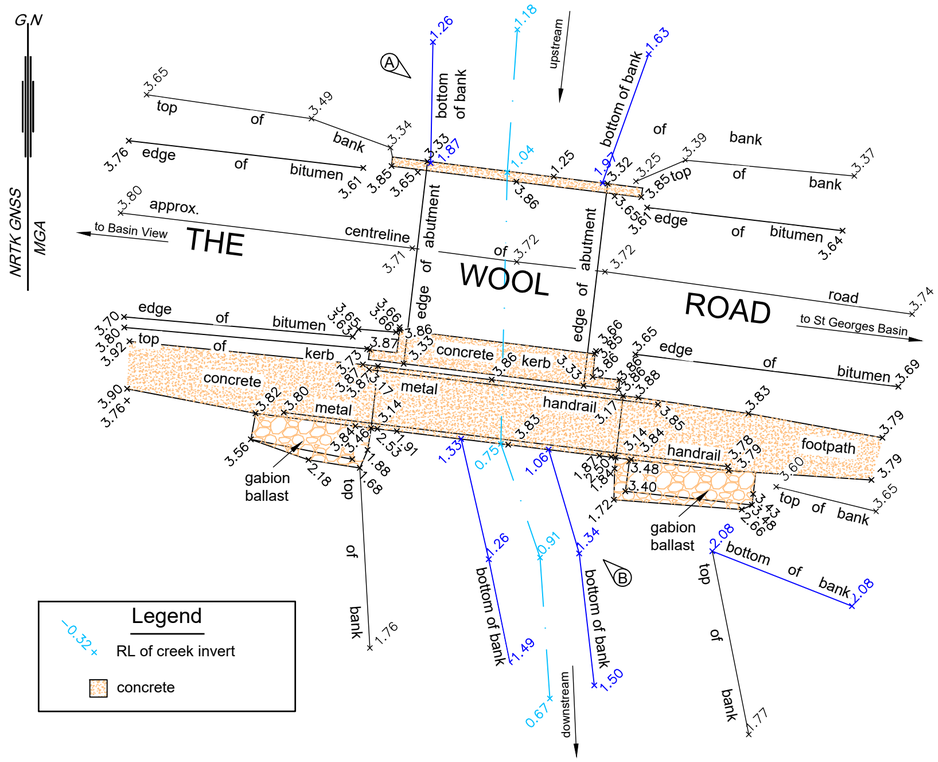
Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G23



PHOTO A - UPSTREAM



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

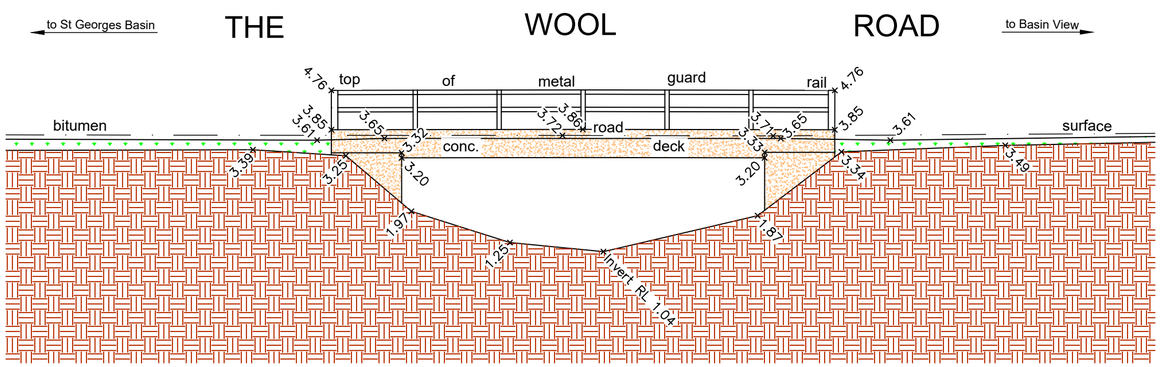
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

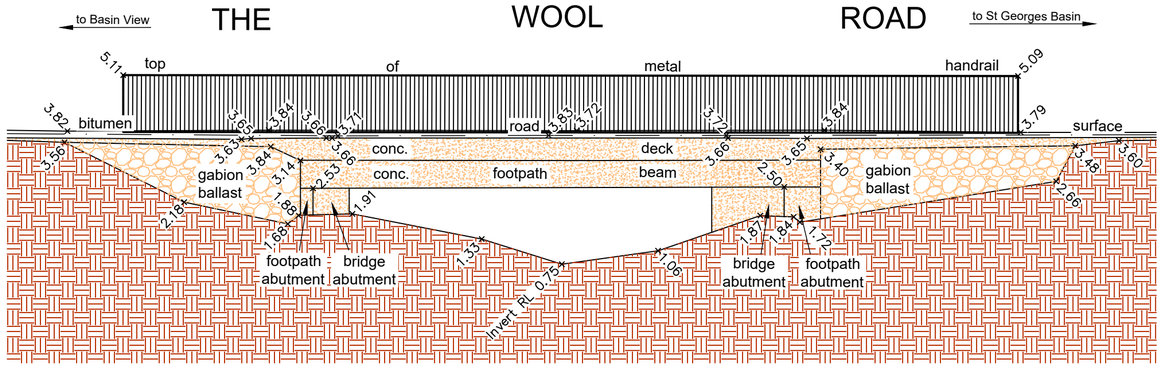
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B - DOWNSTREAM



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 29.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G23

SHEET 1 OF 1

REVISION -

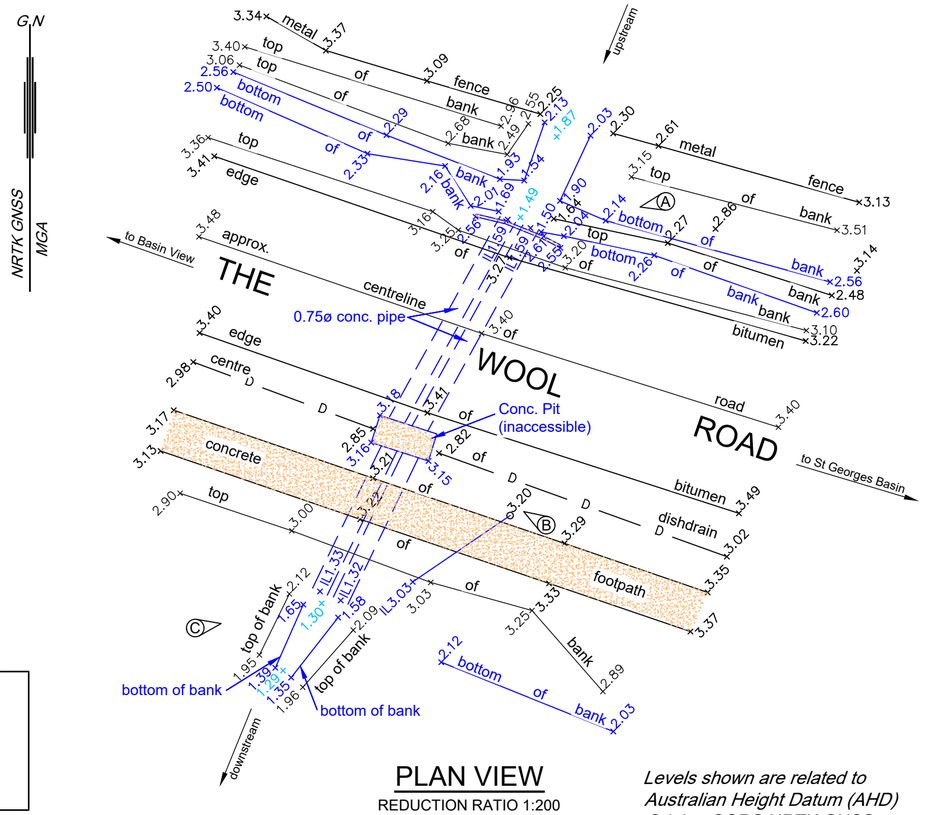
M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G24



PHOTO A - UPSTREAM



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



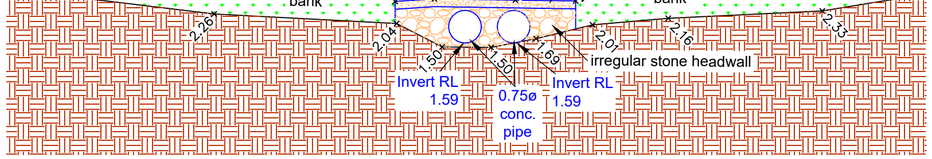
PHOTO B - DOWNSTREAM



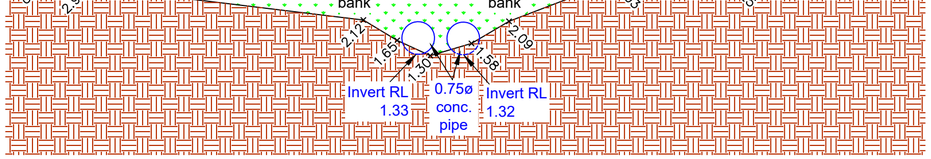
PHOTO C - DOWNSTREAM

Legend

- RL of creek invert
- RL of pipe invert
- concrete



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 26.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G24

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

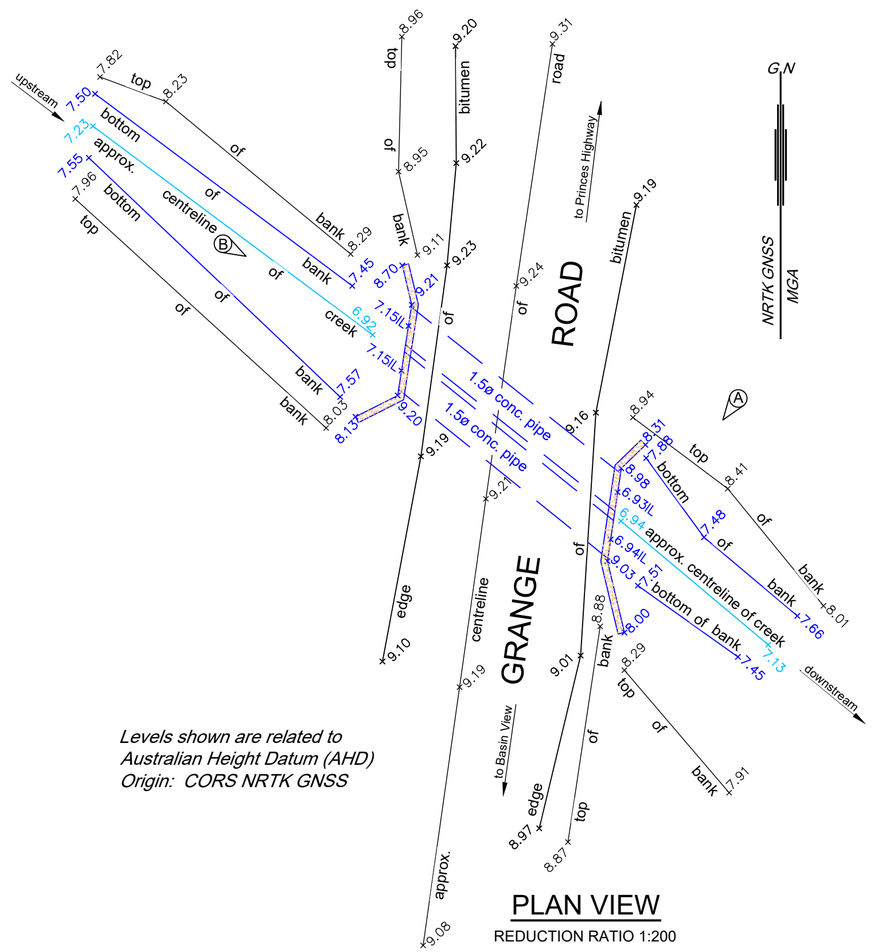
St. Georges Basin - Site G26

Legend

- 11.94+ RL of creek invert
- 11.94IL+ RL of pipe invert
- Concrete



PHOTO A - DOWNSTREAM OUTLET



Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW

REDUCTION RATIO 1:200

CAUTION

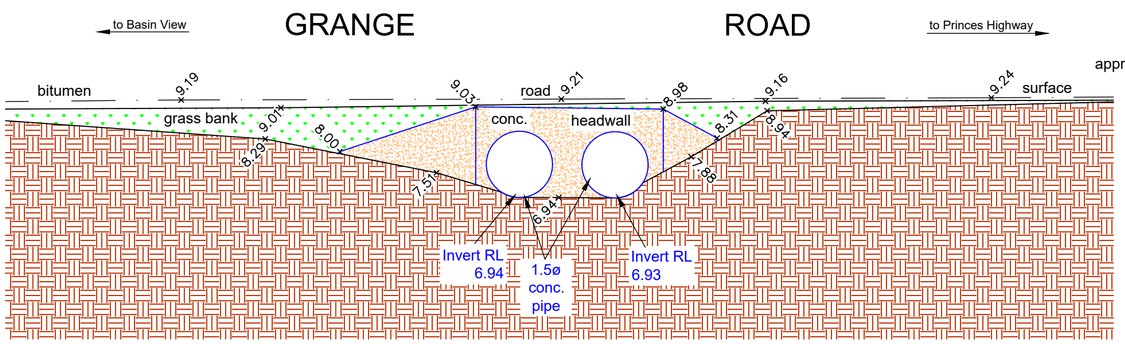
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



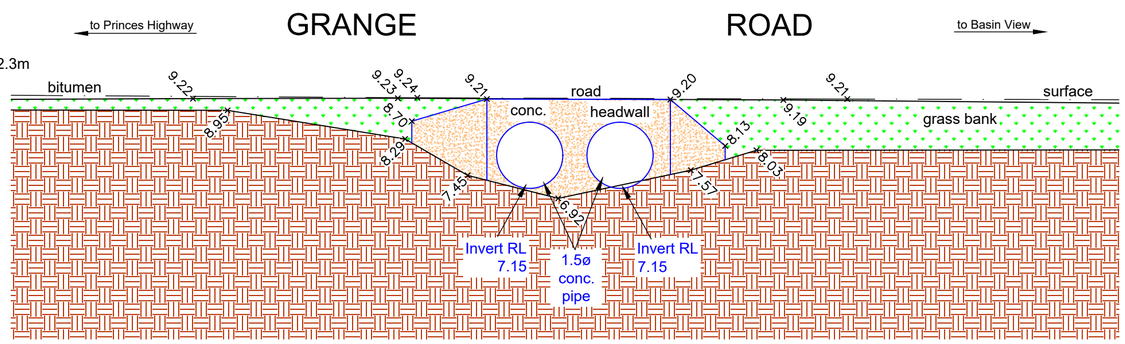
PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

approx.pipe length 12.3m



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 25.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G26

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to by any underground service or any loss or injury suffered.

St. Georges Basin - Site G27

Liability limited by a scheme approved under Professional Standards Legislation.

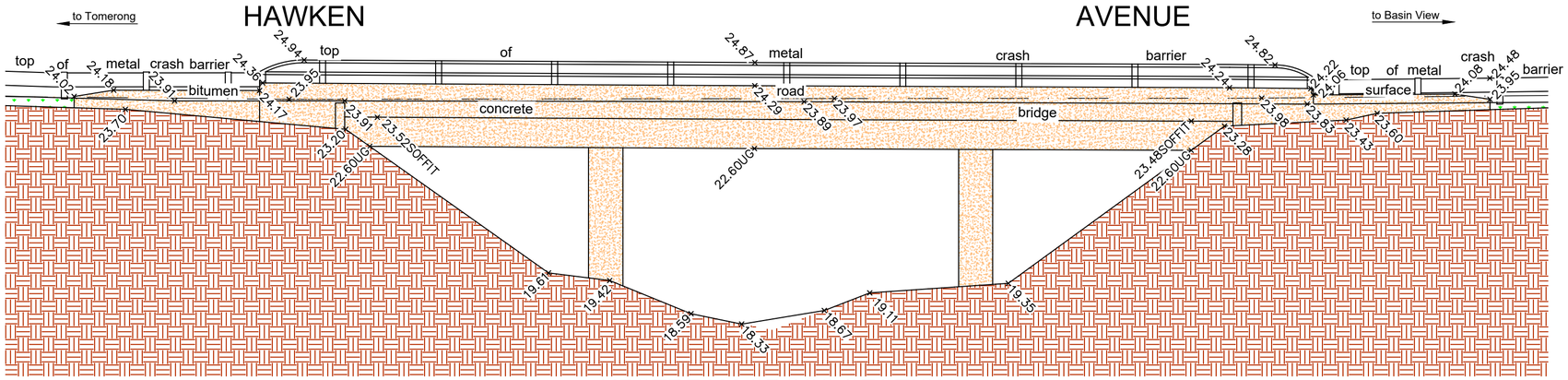
COVER OF EXCELLENCE®



PHOTO A - DOWNSTREAM OUTLET

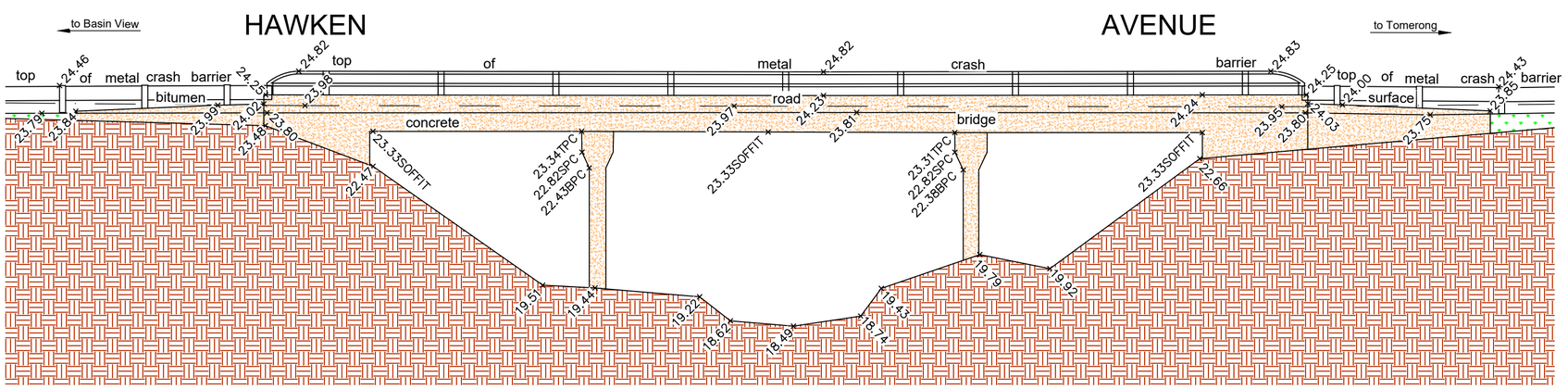


PHOTO B - UPSTREAM INLET



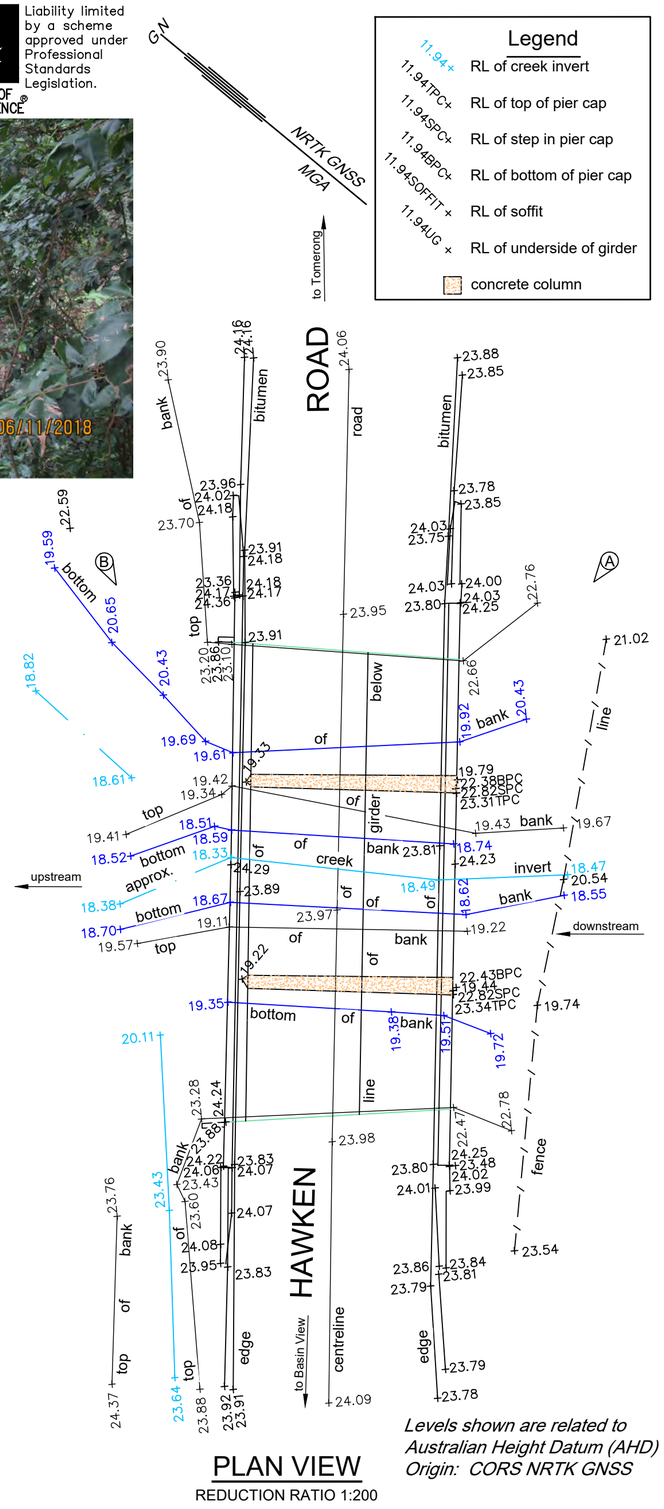
UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 24.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G27

SHEET 1 OF 1

REVISION -

M:\Projects\270000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G28

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

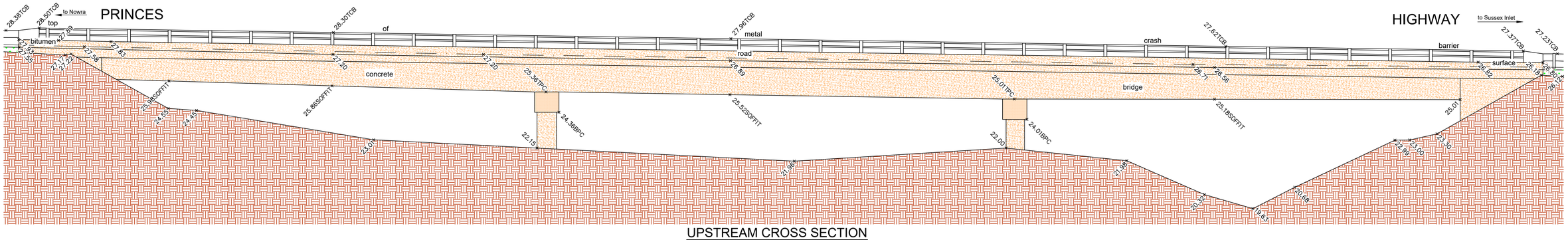


PHOTO B - UPSTREAM INLET

PLAN VIEW

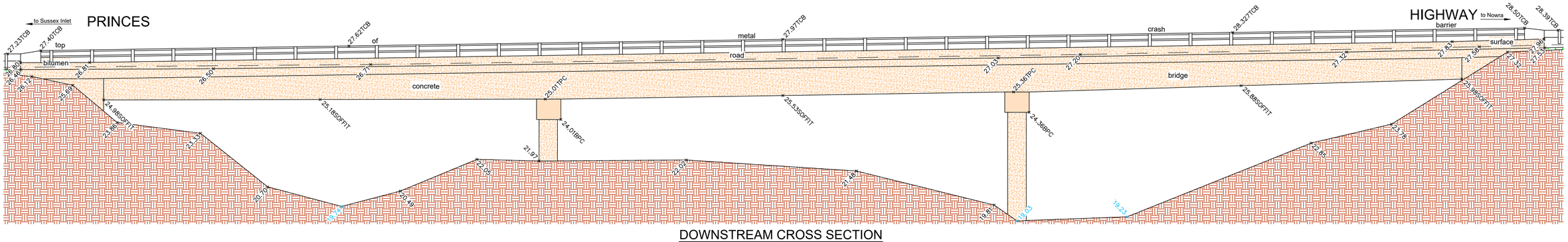
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:150



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:150

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM	SURVEY	FK	REV	DESCRIPTION	BY	DATE
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 08.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G28

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SCB.dwg

St. Georges Basin - Site G31

Liability limited by a scheme approved under Professional Standards Legislation.

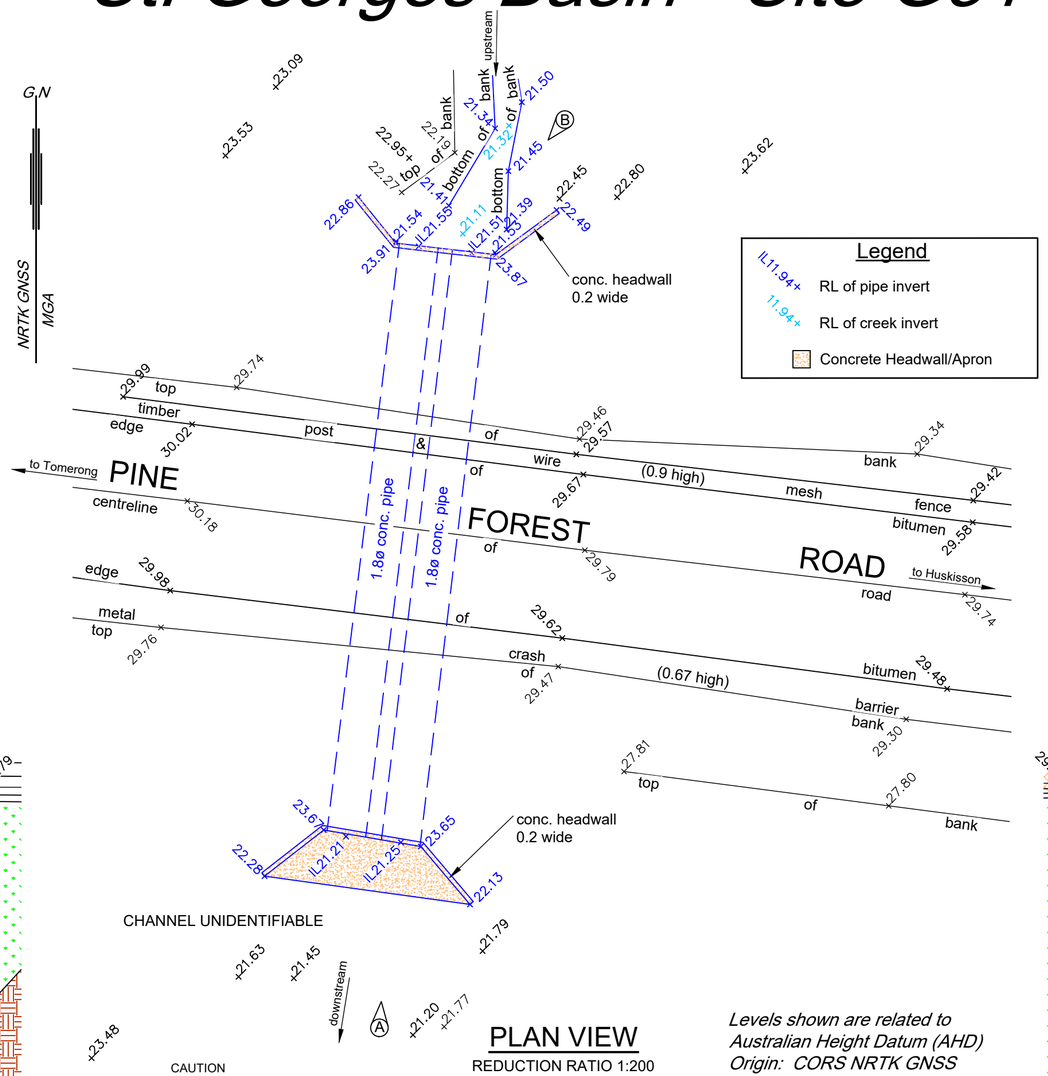
COVER OF EXCELLENCE®



PHOTO A - DOWNSTREAM OUTLET



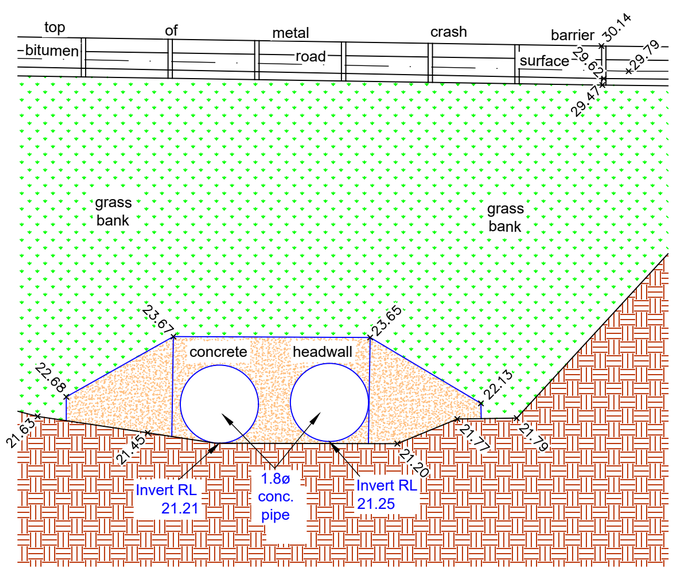
PHOTO B - UPSTREAM INLET



PLAN VIEW

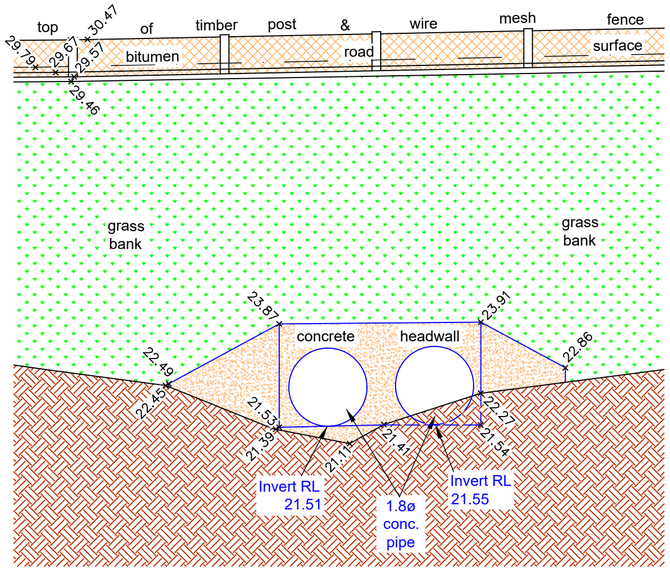
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 23.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G31

SHEET 1 OF 1

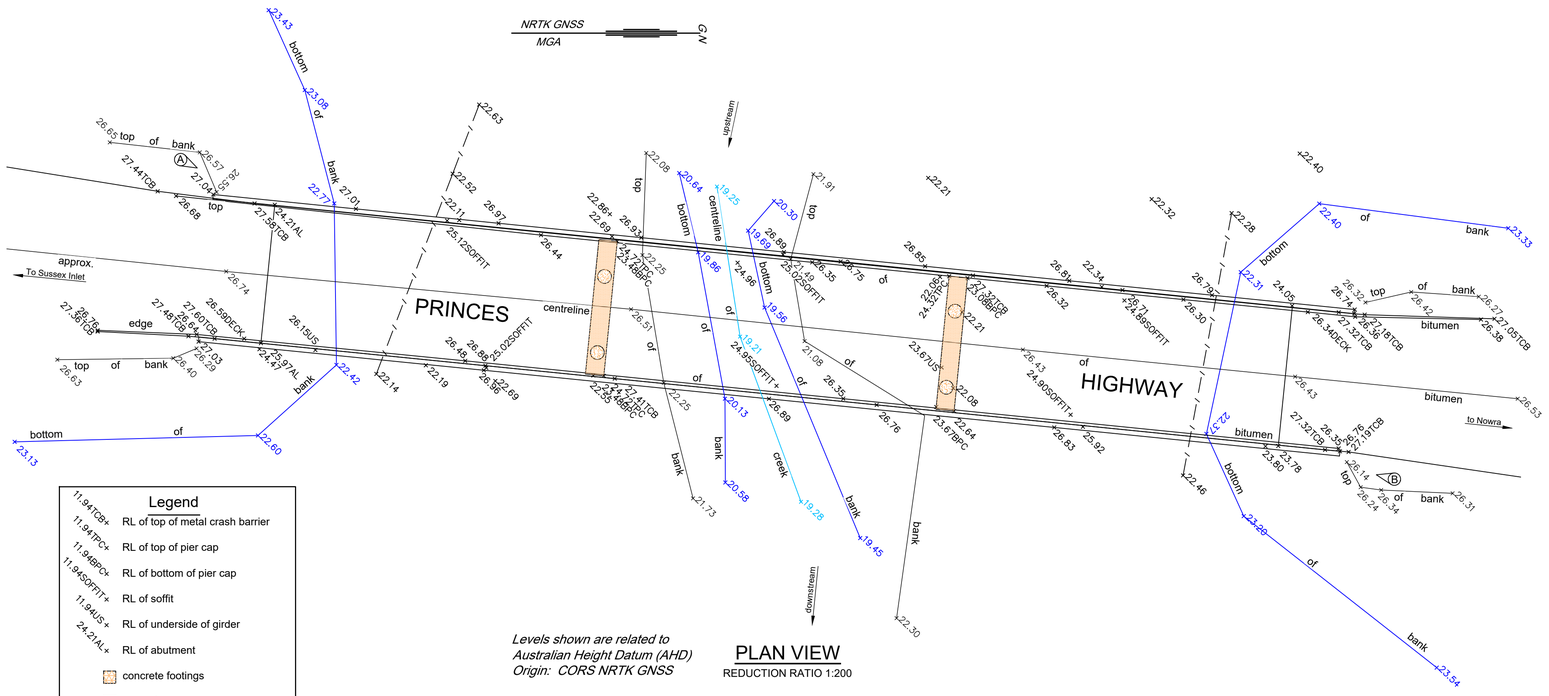
REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G32

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®



PLAN VIEW
REDUCTION RATIO 1:200

Legend

- RL of top of metal crash barrier
- RL of top of pier cap
- RL of bottom of pier cap
- RL of soffit
- RL of underside of girder
- RL of abutment
- concrete footings
- concrete pier cap
- concrete column

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

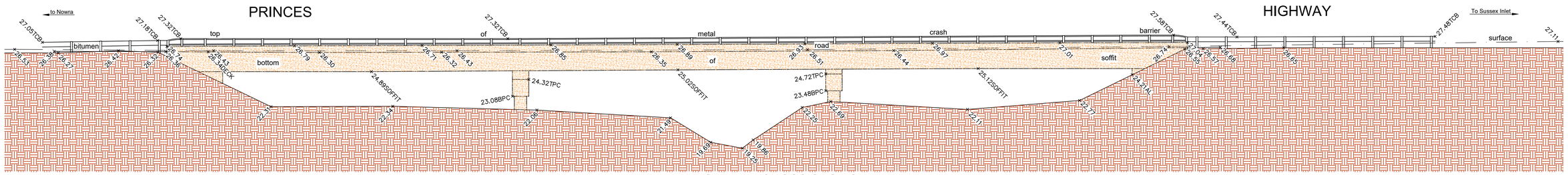
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



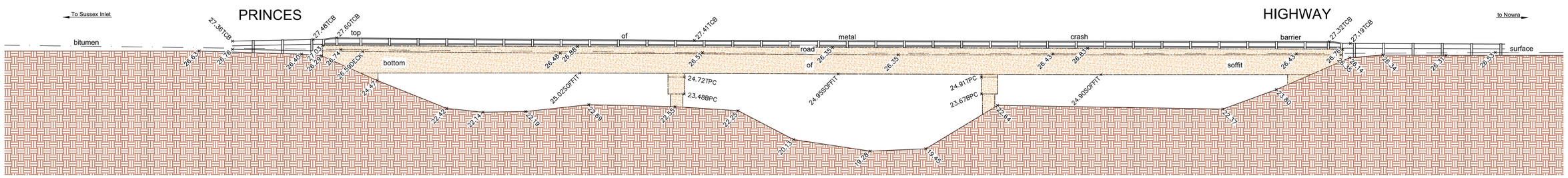
PHOTO A - UPSTREAM INLET



PHOTO B - DOWNSTREAM OUTLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:150



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:150

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM	SURVEY	FK	REV	DESCRIPTION	BY	DATE
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 01.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G32 | SHEET 1 OF 1 | REVISION -

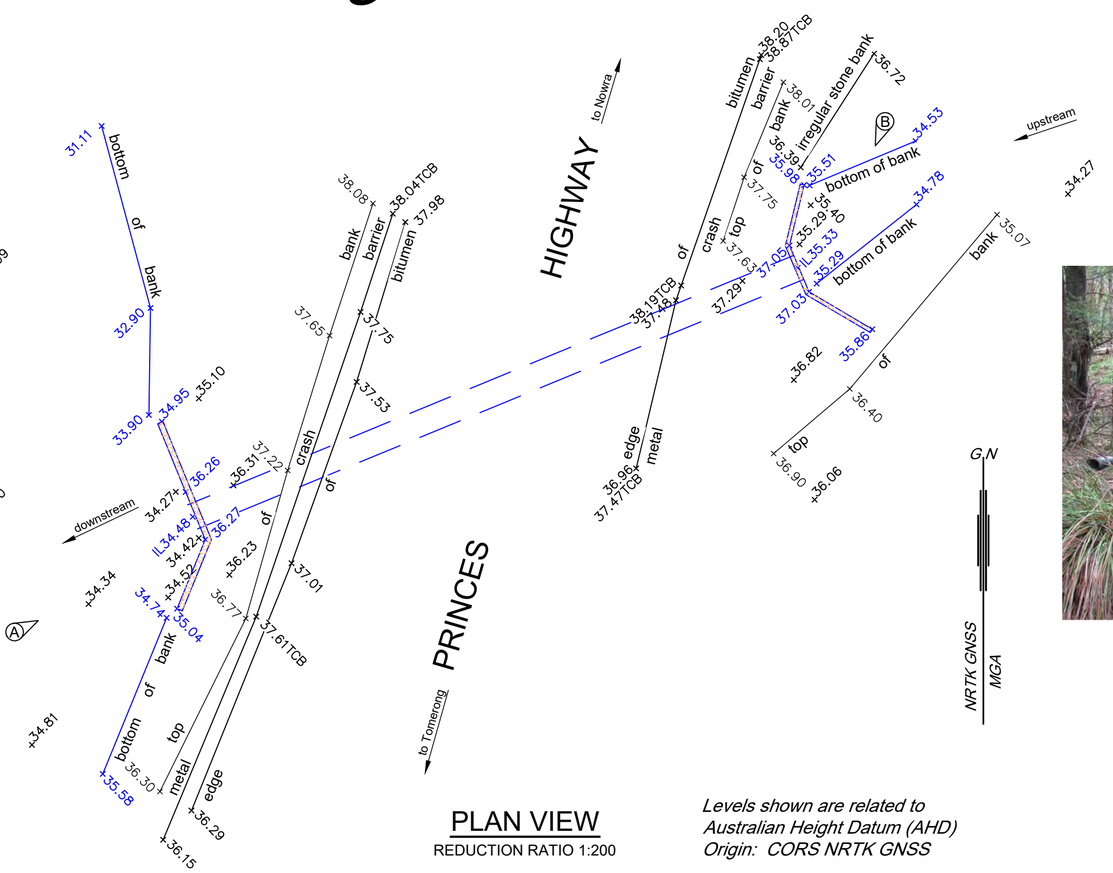
M:\Projects\27000\27000s\N27670\Drawings\N27670-SCB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G33



PHOTO A - DOWNSTREAM OUTLET



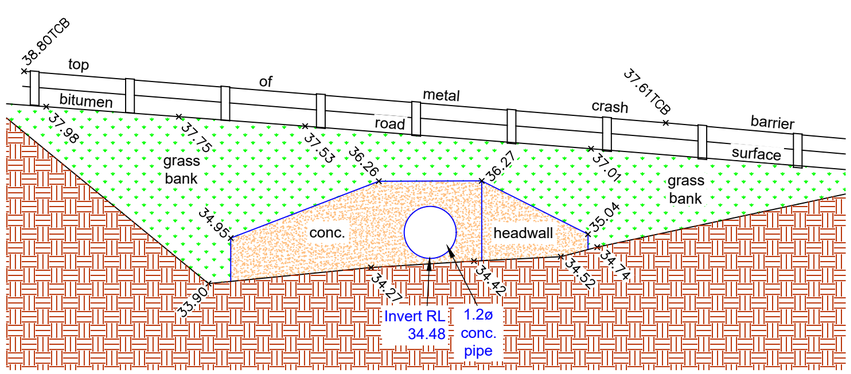
PLAN VIEW
REDUCTION RATIO 1:200

Legend
- 11.94TCB+ Top of Crash Barrier
- IL11.94+ Invert of Pipe
- Concrete

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PHOTO B - UPSTREAM INLET



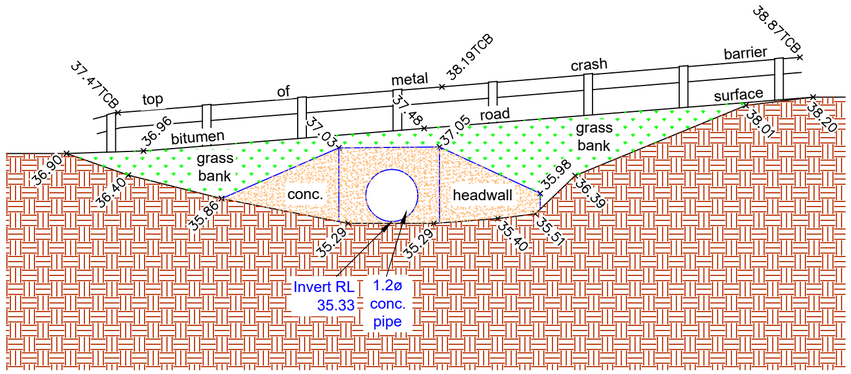
DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
	DATE OF PLAN: 06.11.2018	DRAWN	AG				
		CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G33

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G35



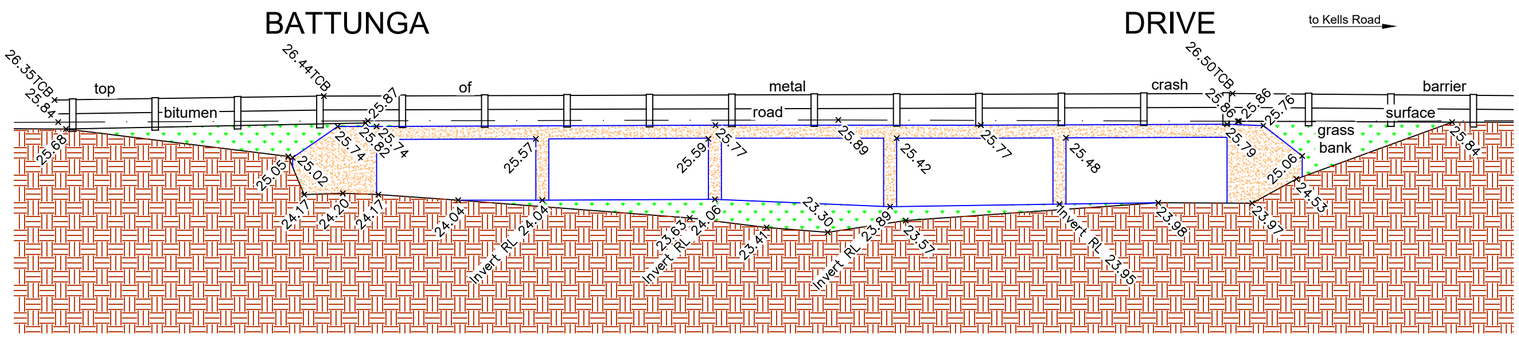
PHOTO A - DOWNSTREAM OUTLET



PHOTO B - UPSTREAM INLET

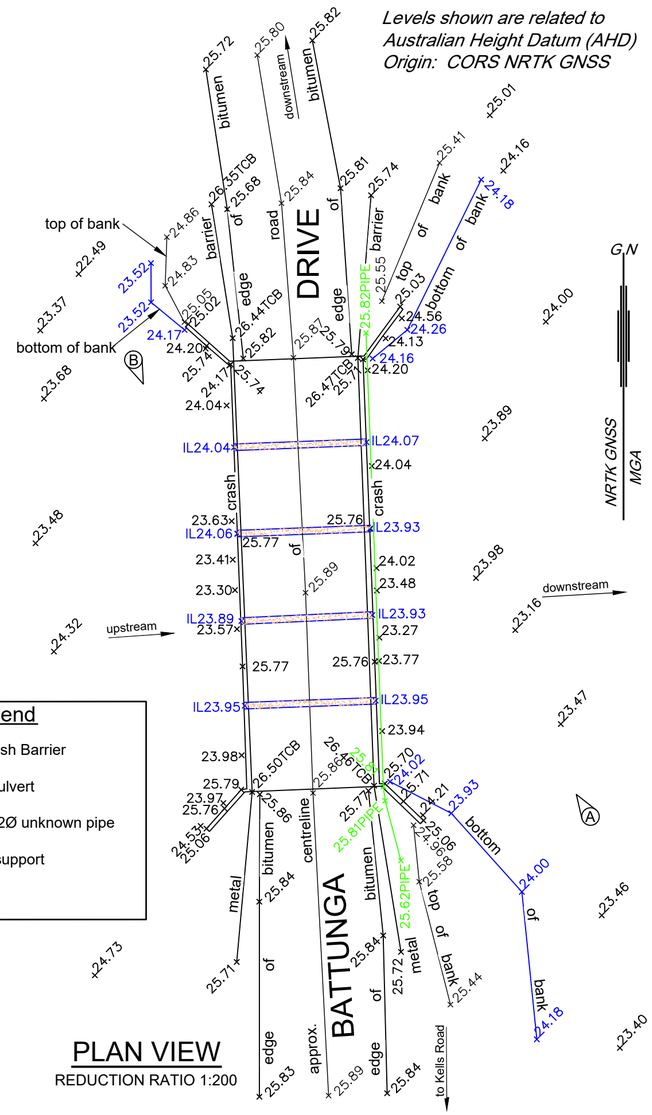
DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100



PLAN VIEW

REDUCTION RATIO 1:200

Legend

- Top of Crash Barrier
- Invert of Culvert
- Top of 0.12Ø unknown pipe
- Concrete support

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 25.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER: N27670-G35

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G39

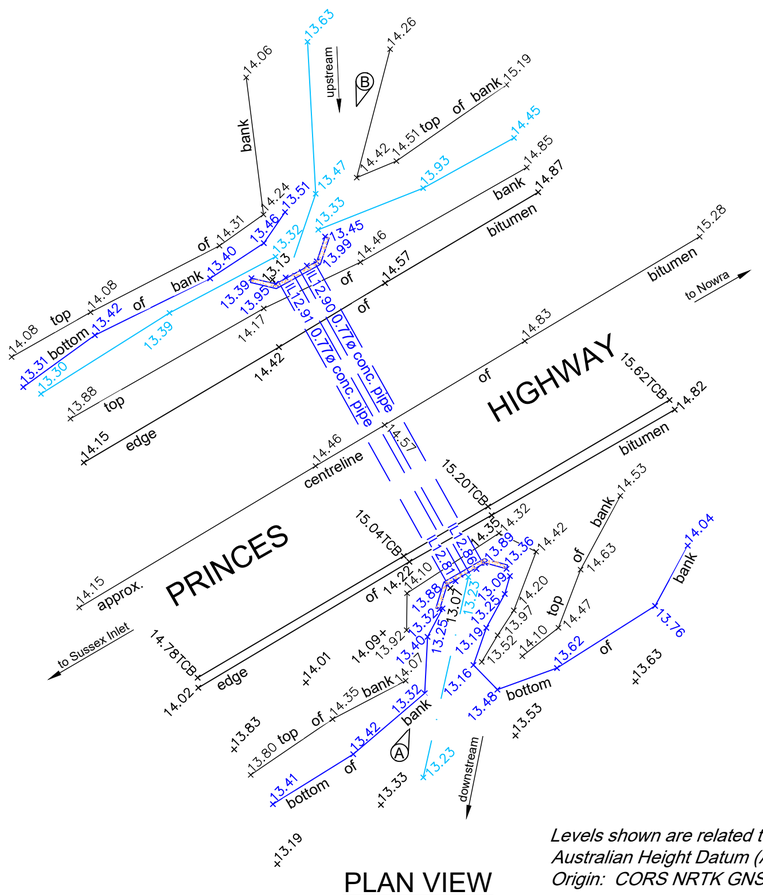
Legend

- 11.94+ — RL of creek centre line
- 11.94TCB+ — RL of top of crash barrier
- Concrete

G N
NRTK GNSS MGA



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

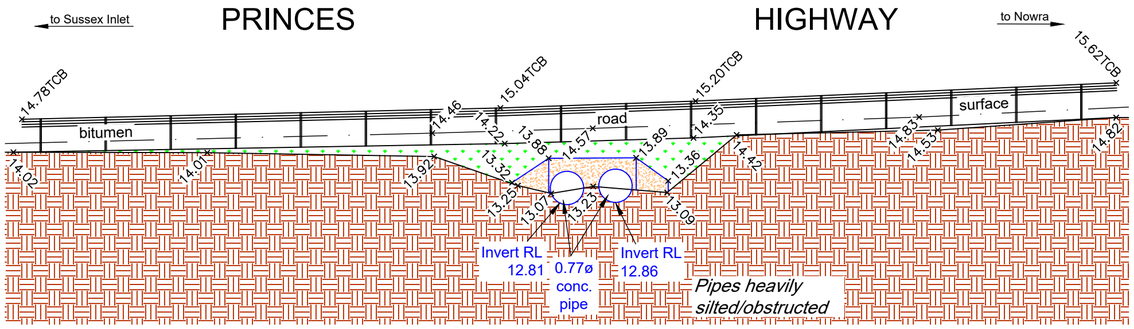
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

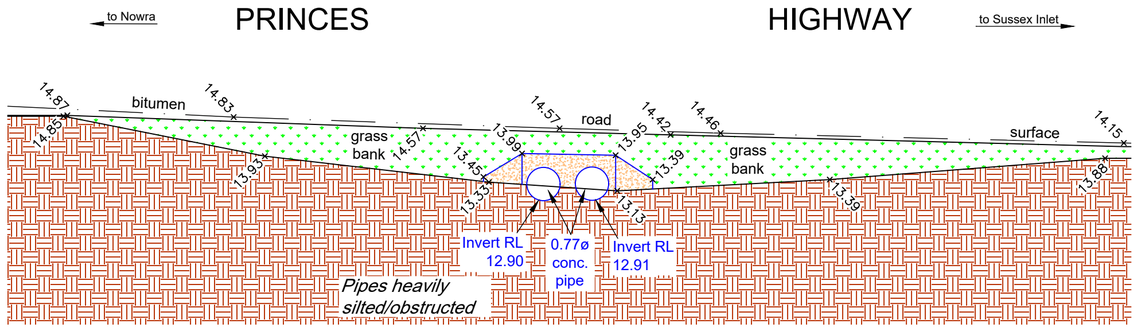
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 06.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G39 | SHEET 1 OF 1 | REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G40

Legend

- 11.94TCB× — RL of top of metal crash barrier
- OL11.94× — Obvert Level of culvert
- 11.94+ — approx. centre line of creek
- concrete headwall

CAUTION

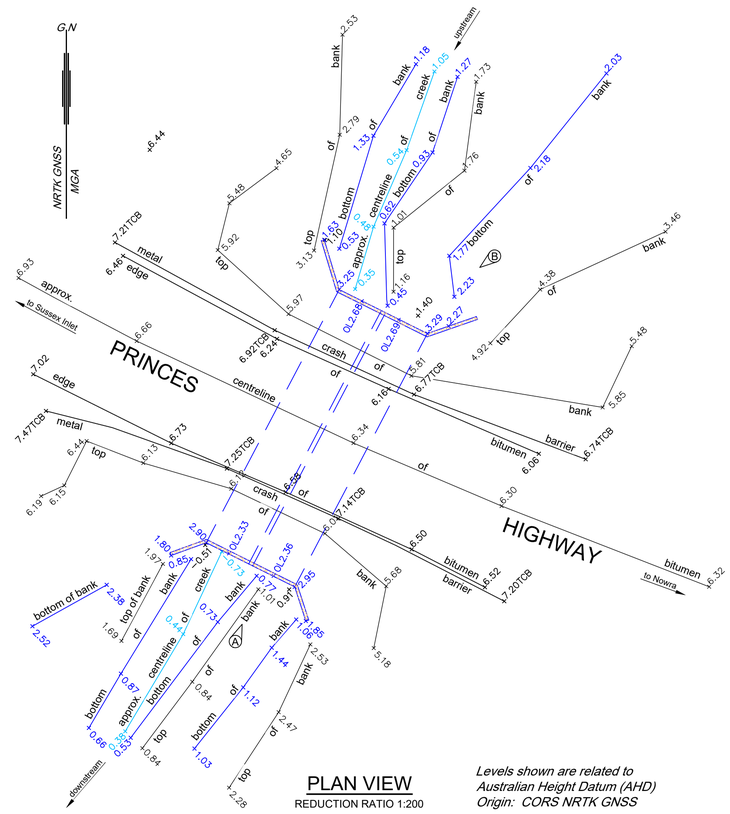
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

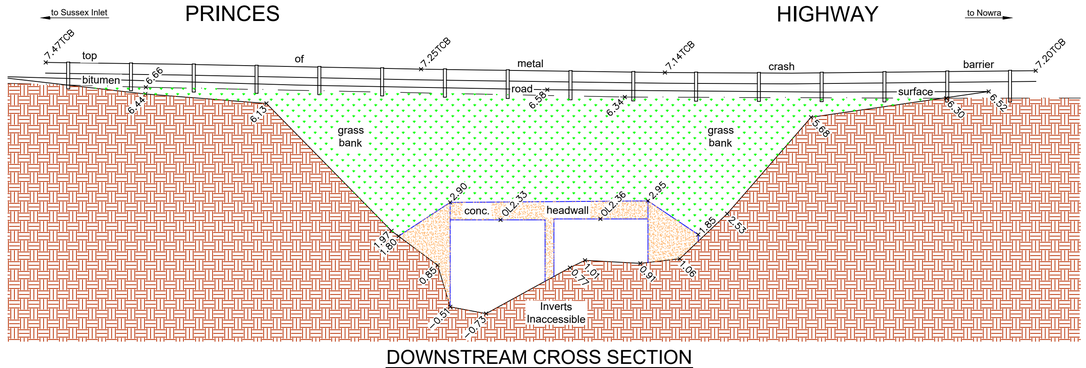


PLAN VIEW
REDUCTION RATIO 1:200

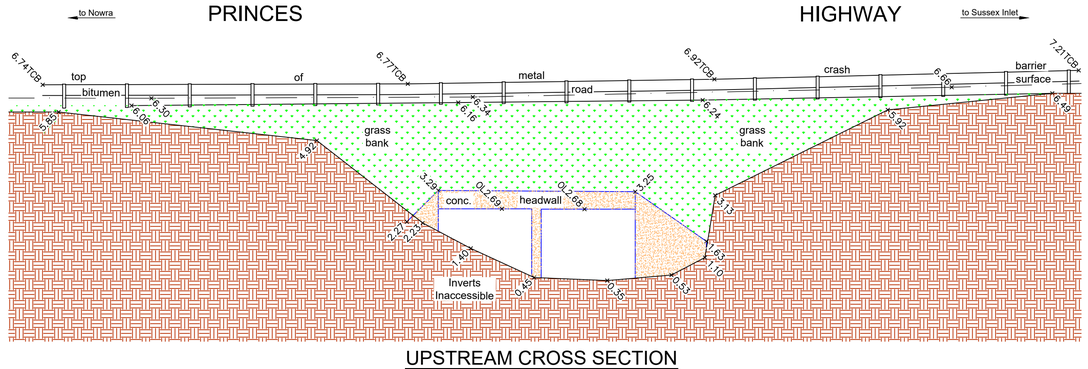
Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM	SURVEY	FK	REV	DESCRIPTION	BY	DATE
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 30.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G40 | SHEET 1 OF 1 | REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

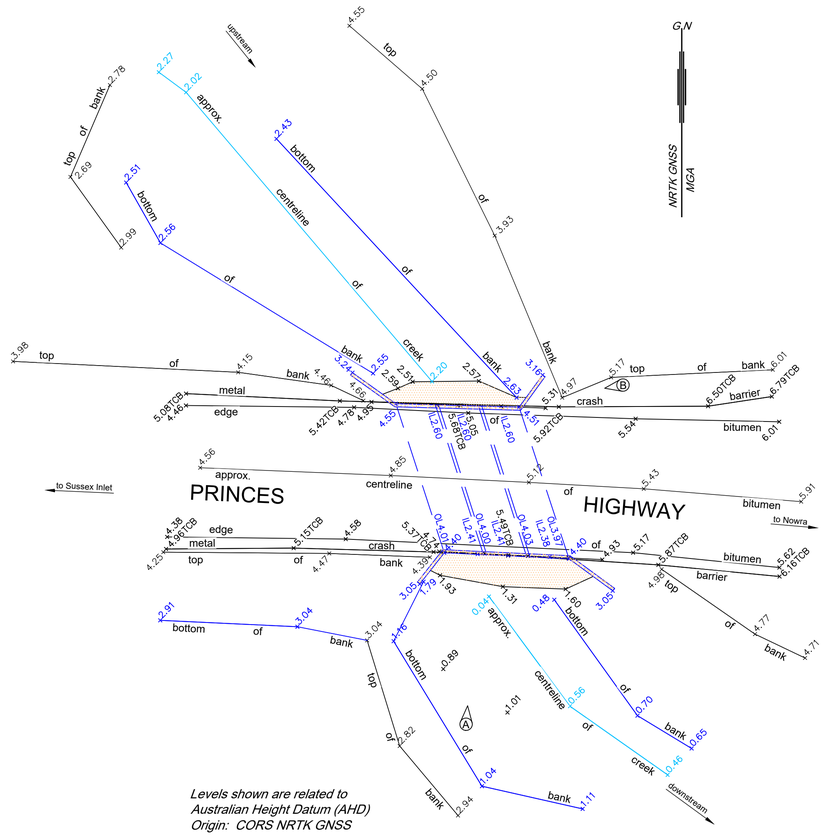
St. Georges Basin - Site G41

Legend

- 11.94TCB× — RL of top of metal crash barrier
- OL11.94× — Obvert Level of culvert
- IL11.94× — Invert Level of culvert
- 11.94× — approx. centre line of creek
- concrete headwall
- concrete apron



PHOTO A - DOWNSTREAM OUTLET



Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW
REDUCTION RATIO 1:200



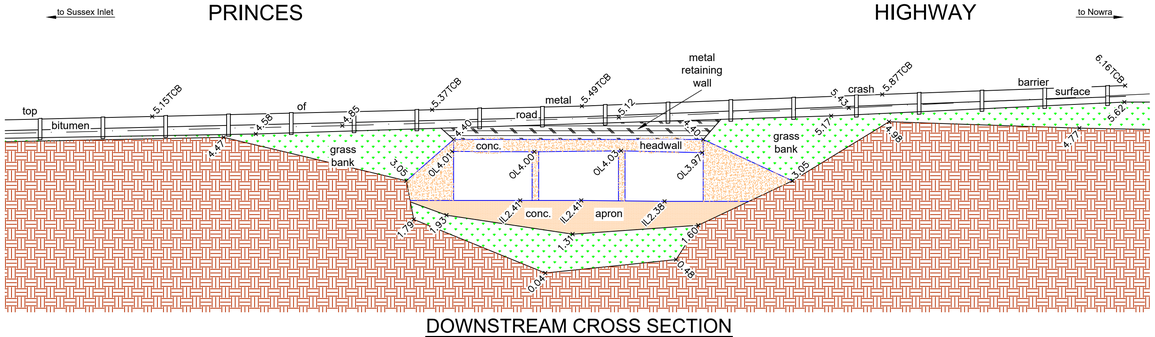
PHOTO B - UPSTREAM INLET

CAUTION

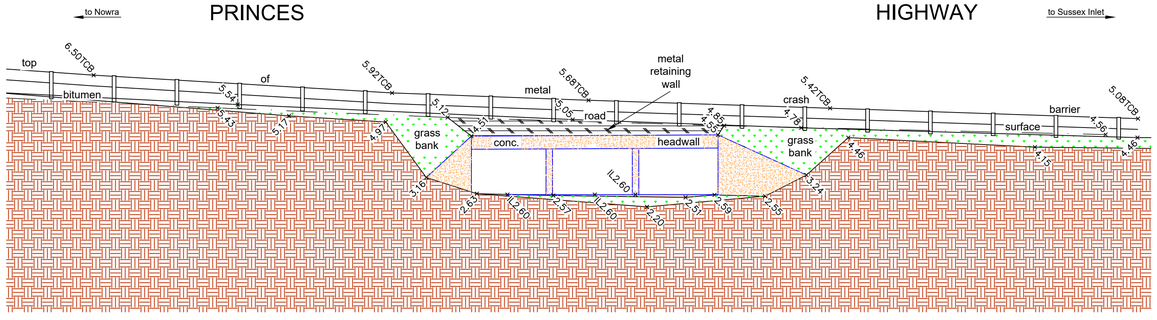
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A1 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
		CHECK'D	BD				
	DATE OF PLAN: 29.11.2018						

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G41 | SHEET 1 OF 1 | REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G42

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

Legend

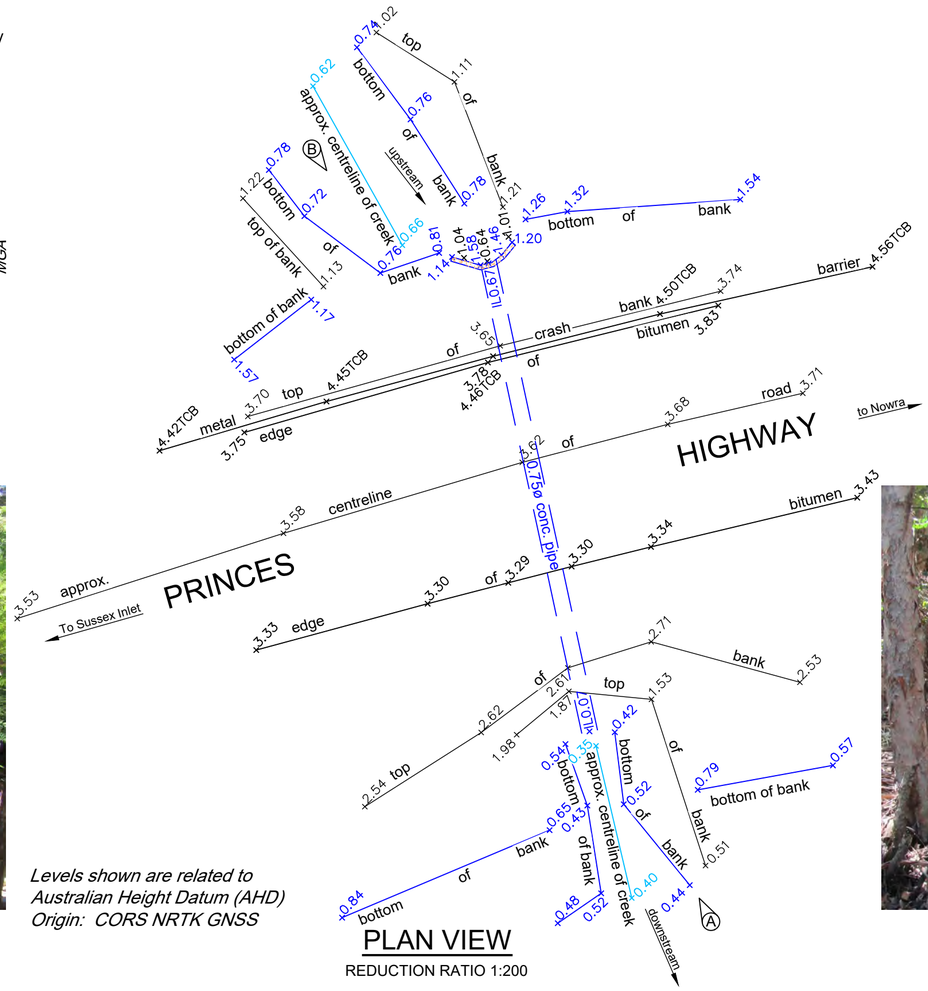
- 11.947TCB× — RL of top of metal crash barrier
- 11.94+ — RL of approx. centre line of creek
- IL11.94 × — RL of pipe invert
- Concrete

G N
NRTK GNSS
MGA



PHOTO A - DOWNSTREAM OUTLET

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PLAN VIEW
REDUCTION RATIO 1:200



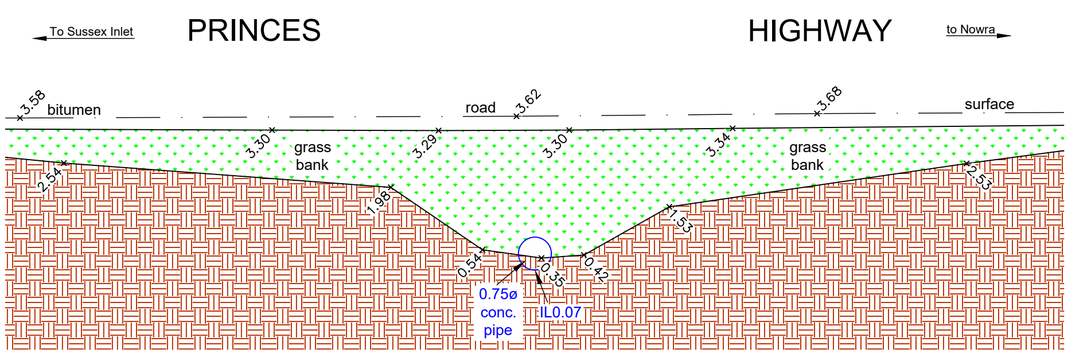
PHOTO B - UPSTREAM INLET

CAUTION

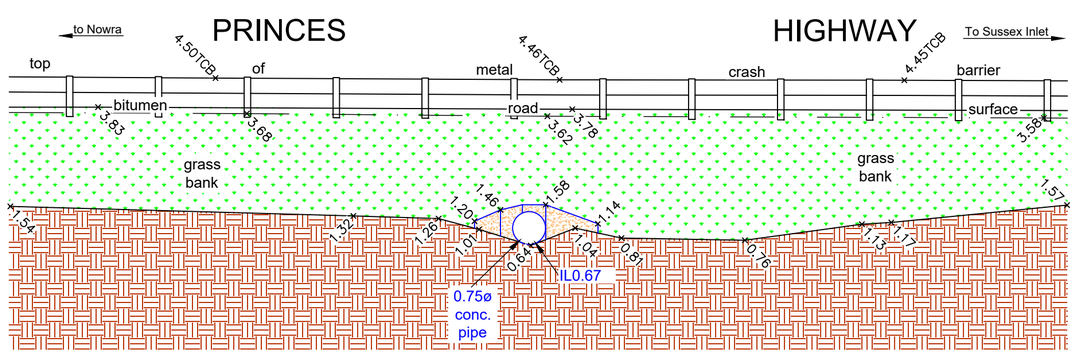
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 03.12.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G42

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000sIN27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G43

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.

2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.

3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.

4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.

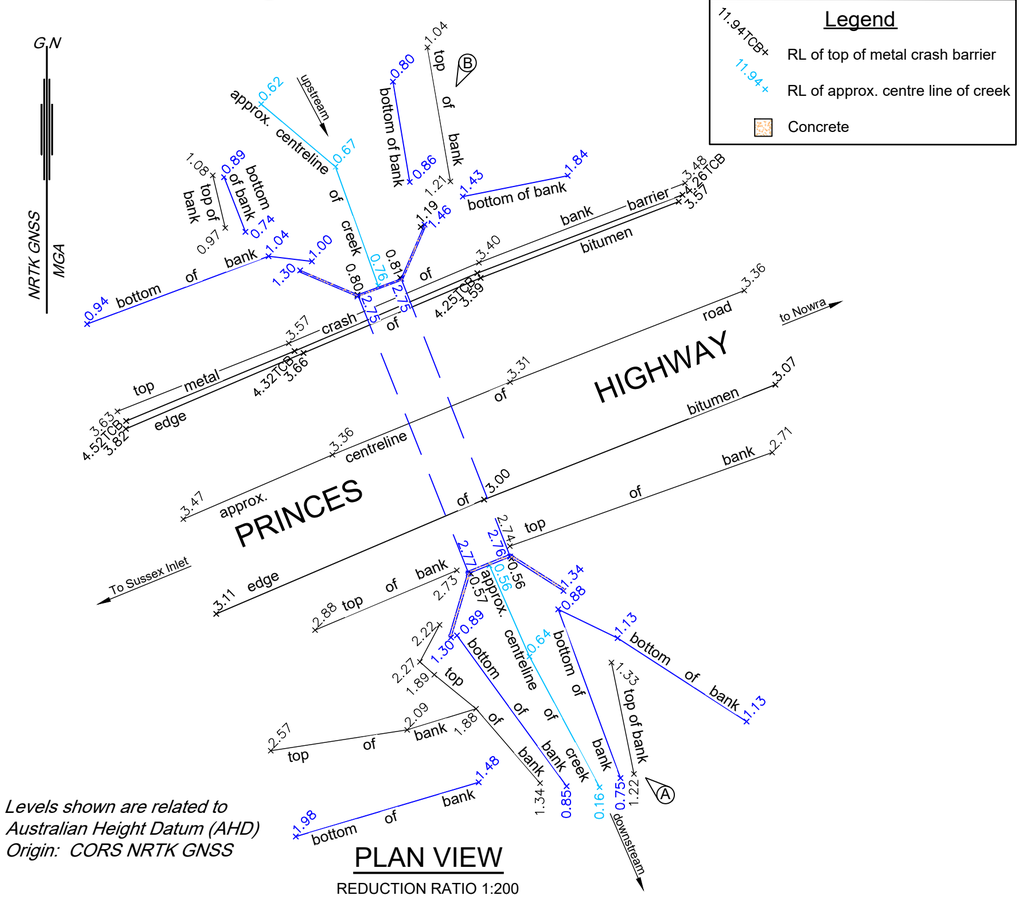
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.

6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.

7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

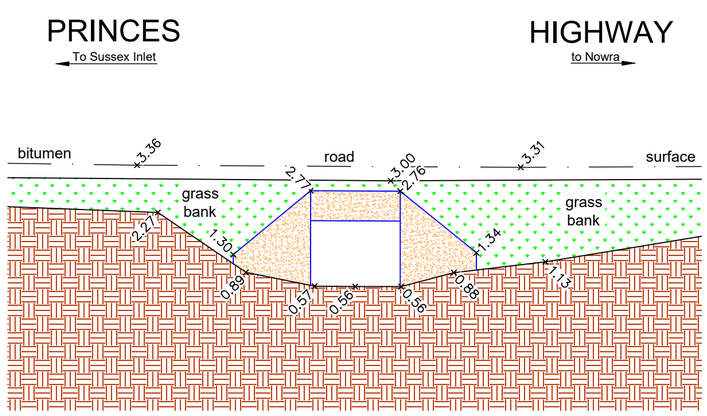


Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

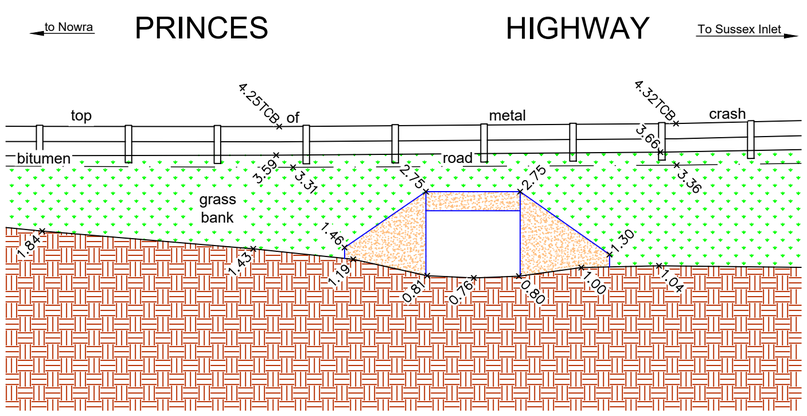
PLAN VIEW
REDUCTION RATIO 1:200



PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 03.12.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G43

SHEET 1 OF 1

REVISION -

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G45

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE

Legend

- RL of top of metal crash barrier
- RL of bottom of pier cap
- RL of soffit
- RL of unknown service pipe 0.15Ø
- concrete pier cap
- concrete column

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

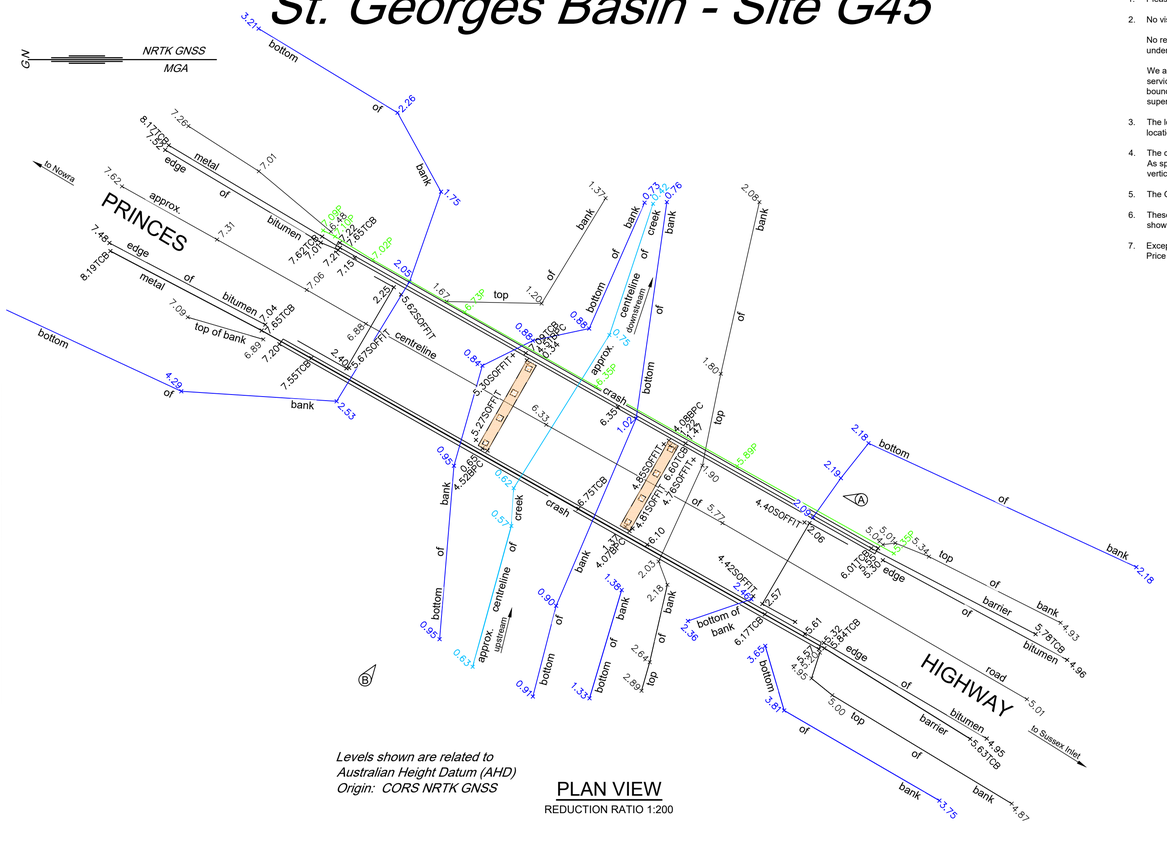
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to by any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

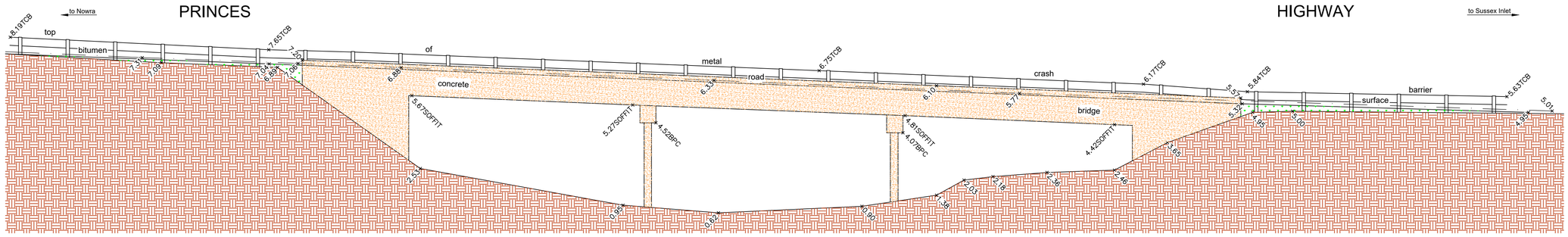


PHOTO B - UPSTREAM INLET

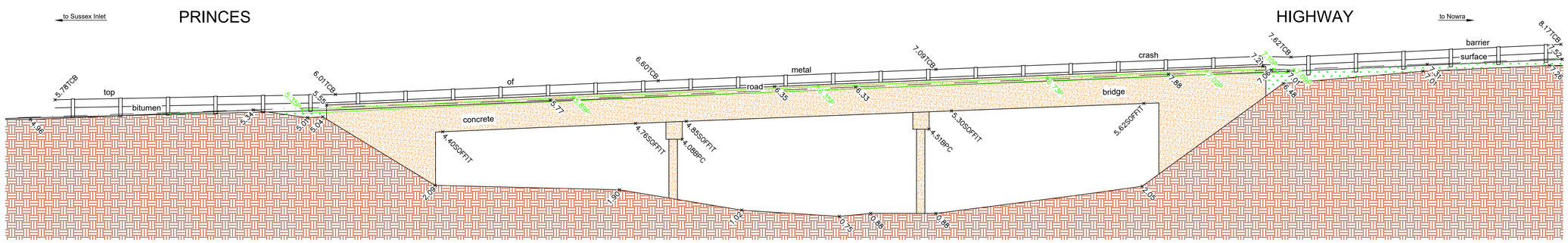


PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS DATE OF PLAN: 03.12.2018	SURVEY	FK	REV	DESCRIPTION	BY	DATE	DRAWING STATUS
		DESIGN	N/A	=				
		DRAWN	AG					
		CHECK'D	BD					

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING NUMBER N27670-G45 | SHEET 1 OF 1 | REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

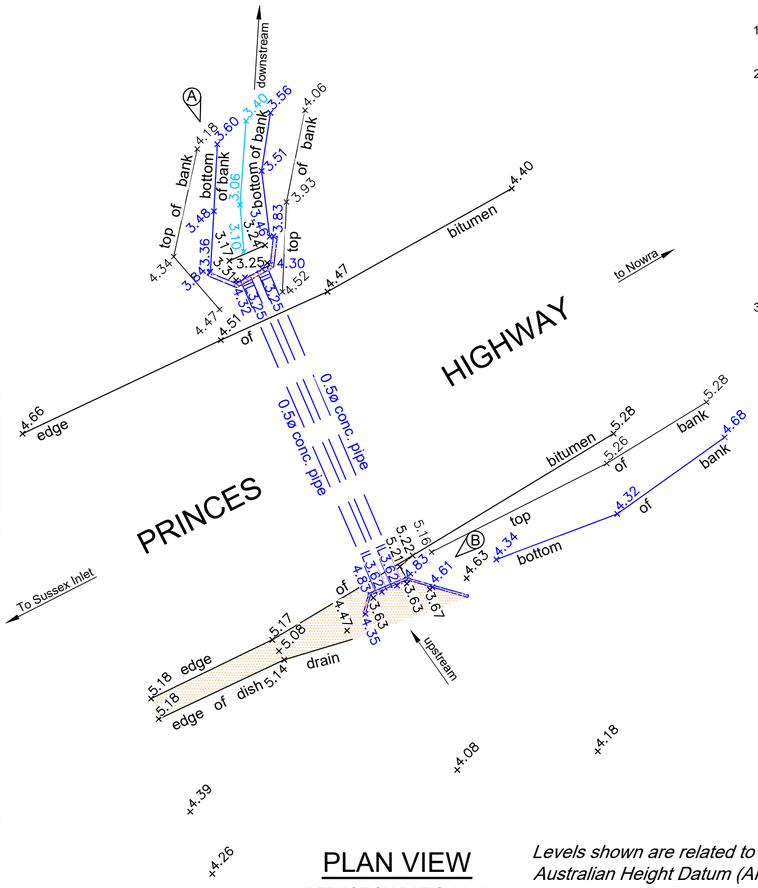
COVER OF EXCELLENCE®

St. Georges Basin - Site G46

Legend

- IL3.62 × — RL of pipe invert
- 3.62 × — RL of approx. centre line of creek
- Concrete head wall
- Concrete apron and dish drain

G N — NRTK GNSS — MGA



CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET

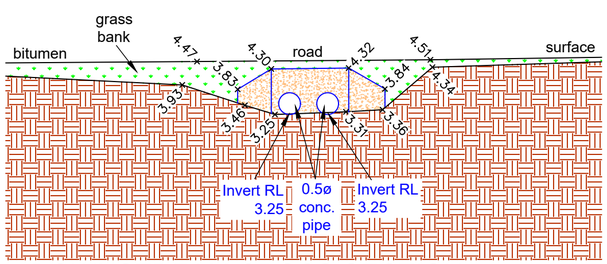
PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



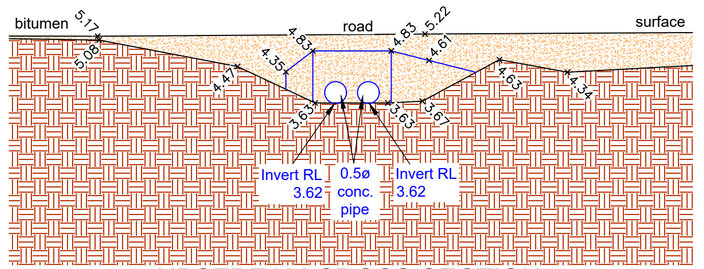
PHOTO B - UPSTREAM INLET

to Nowra PRINCES HIGHWAY To Sussex Inlet



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

To Sussex Inlet PRINCES HIGHWAY to Nowra



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 04.12.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G46

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G47

COVER OF EXCELLENCE®

Liability limited by a scheme approved under Professional Standards Legislation.

Legend

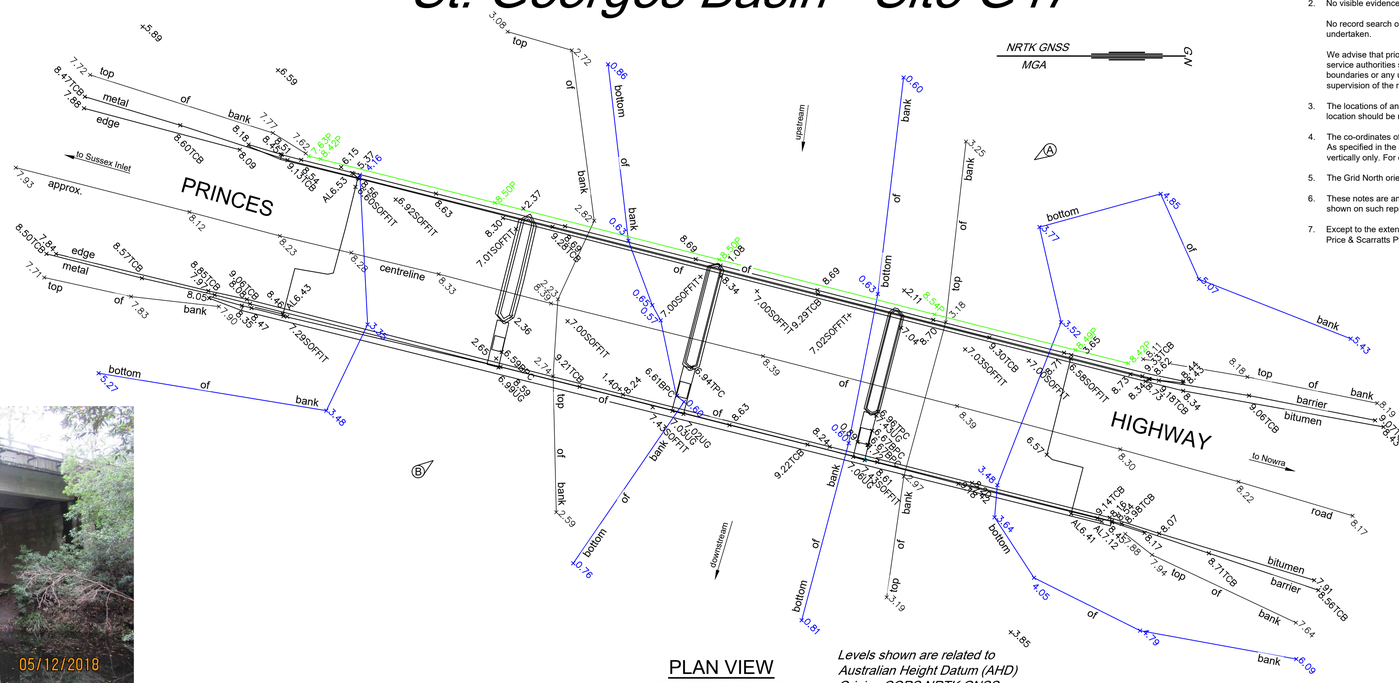
- RL of top of metal crash barrier
- RL of top of pier cap
- RL of bottom of pier cap
- RL of soffit
- RL of abutment
- RL of underside of girder
- RL of unknown service pipe
- concrete footings
- concrete pier cap
- concrete column
- grass bank

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PLAN VIEW
REDUCTION RATIO 1:200

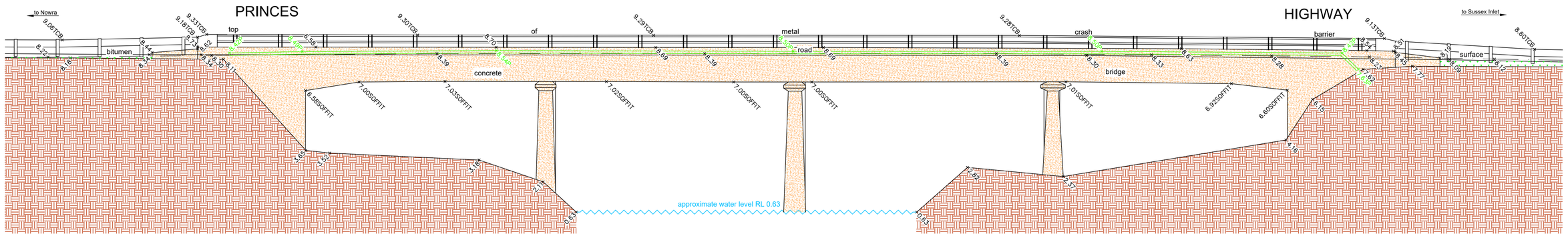
Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



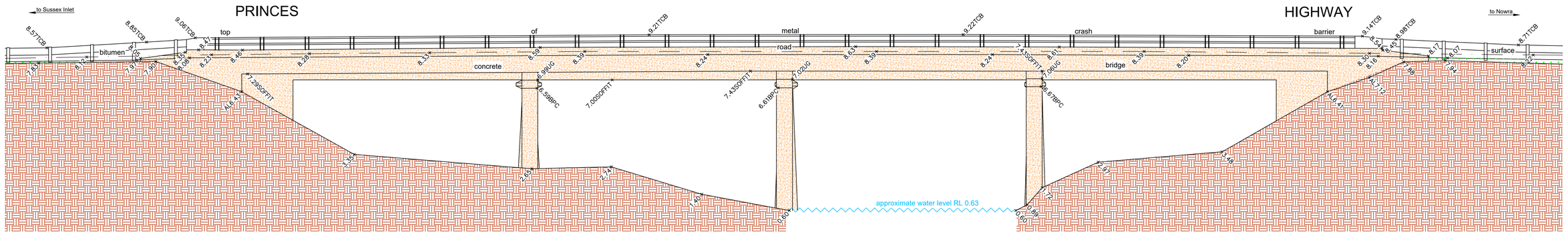
PHOTO A -UPSTREAM INLET



PHOTO B - DOWNSTREAM OUTLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM	SURVEY	FK	REV	DESCRIPTION	BY	DATE
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 04.12.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G47

SHEET 1 OF 1

REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G49

Liability limited by a scheme approved under Professional Standards Legislation.

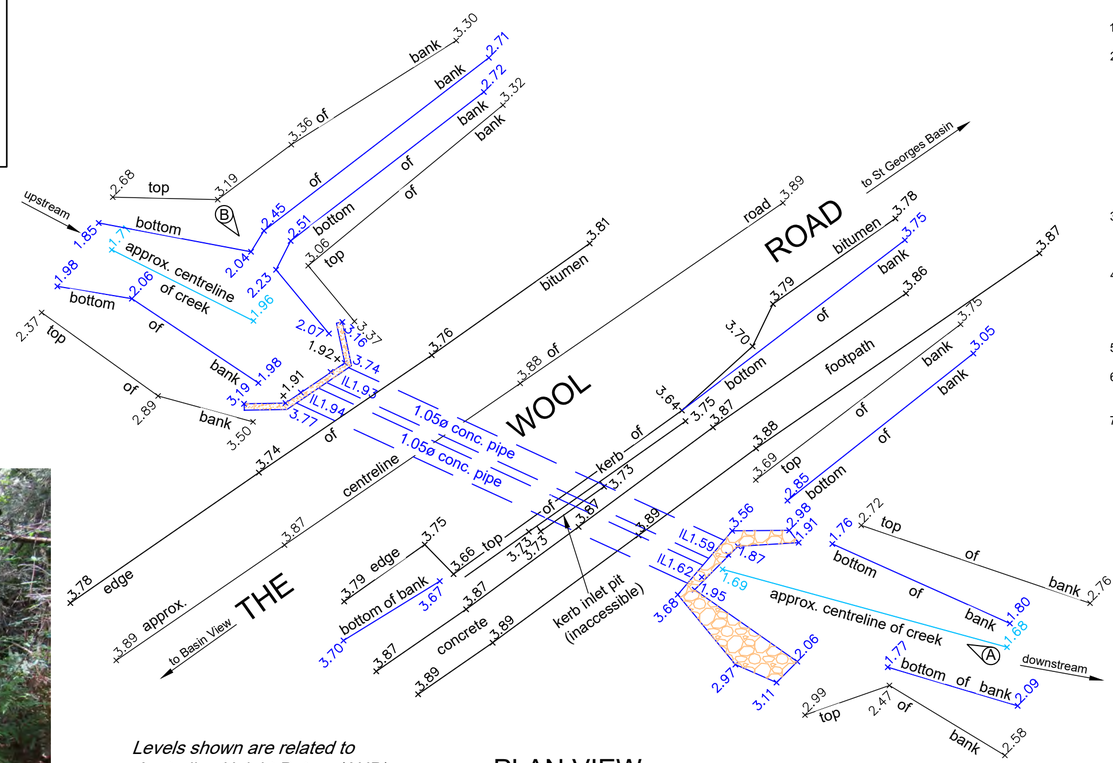
COVER OF EXCELLENCE®

Legend

- RL of creek invert
- RL of pipe invert
- Concrete headwall
- Irregular stone headwall



PHOTO B - UPSTREAM INLET



Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW
REDUCTION RATIO 1:200

CAUTION

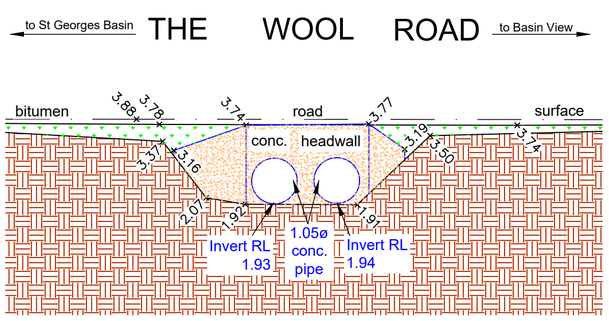
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

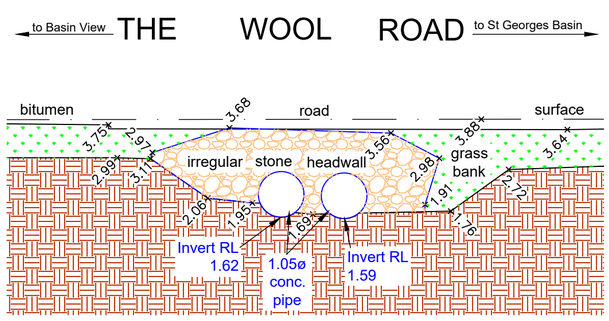
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 16.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G49

SHEET 1 OF 1

REVISION -

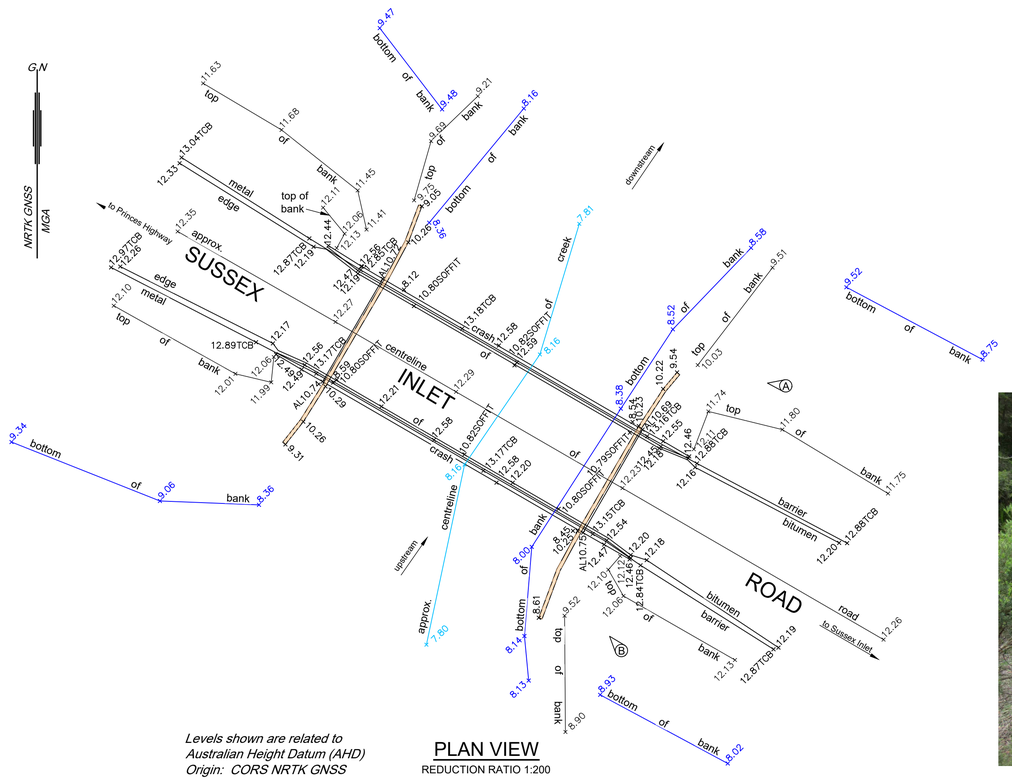
M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G51

Legend

- RL of top of metal crash barrier
- RL of abutment
- RL of soffit
- RL of centre line of creek
- concrete retaining wall



Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW
REDUCTION RATIO 1:200

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

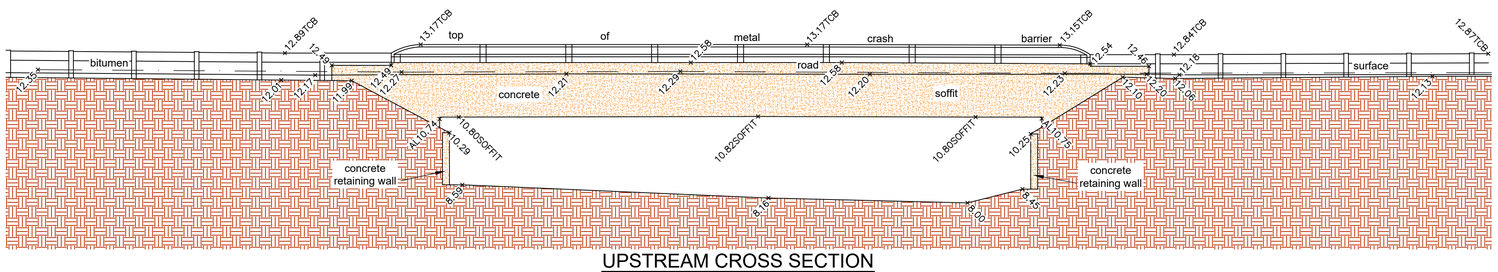
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



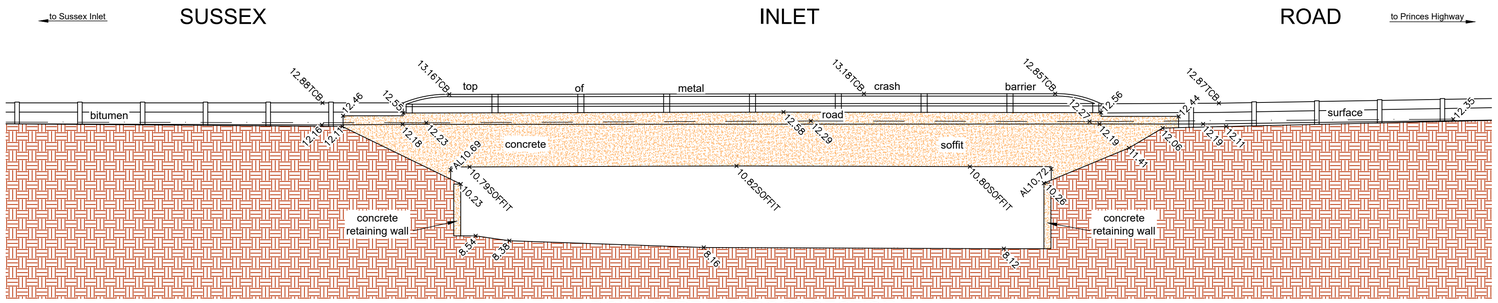
PHOTO A - DOWNSTREAM OUTLET



PHOTO B - UPSTREAM INLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS DATE OF PLAN: 11.12.2018	SURVEY	FK	REV	DESCRIPTION	BY	DATE	allen price & scarratts pty ltd land and development consultants Nowra Branch: 75 Plunkett Street, Nowra NSW 2541 Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533 phone:(02) 4421 6544 consultants@allenprice.com.au www.allenprice.com.au
		DESIGN	N/A	=				PLAN OF SELECTED STORMWATER STRUCTURES FOR FLOOD RISK MANAGEMENT STUDY AND PLAN OVER THE ST. GEORGES BASIN FOR CARDNO AND SHOALHAVEN CITY COUNCIL
		DRAWN	AG					
		CHECK'D	BD					

DRAWING STATUS

DRAWING NUMBER N27670-G51 | SHEET 1 OF 1 | REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G52

CAUTION

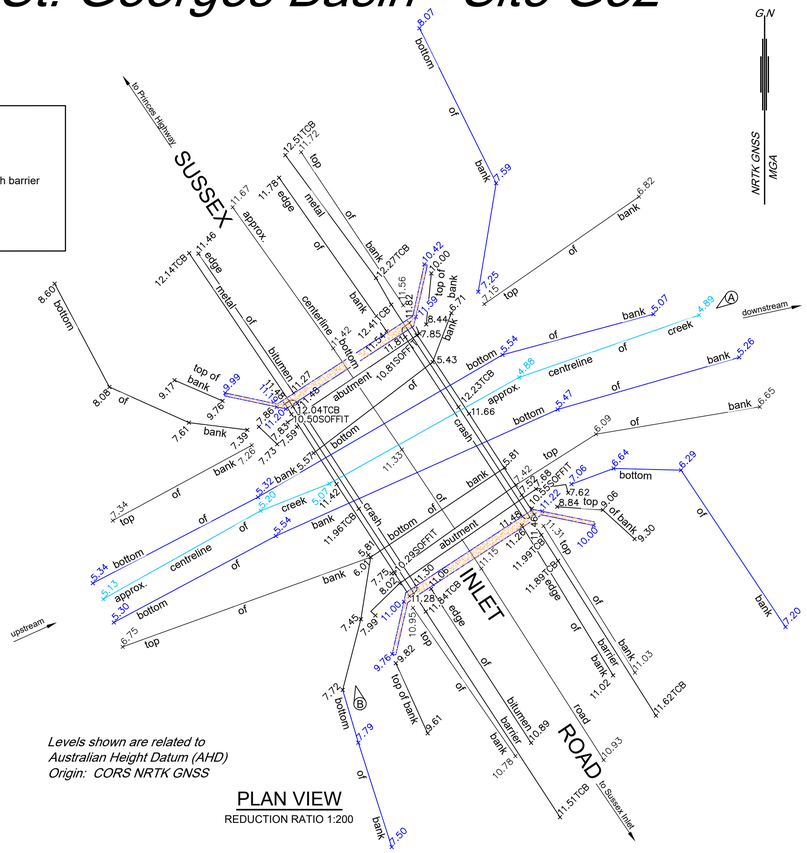
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B - UPSTREAM INLET

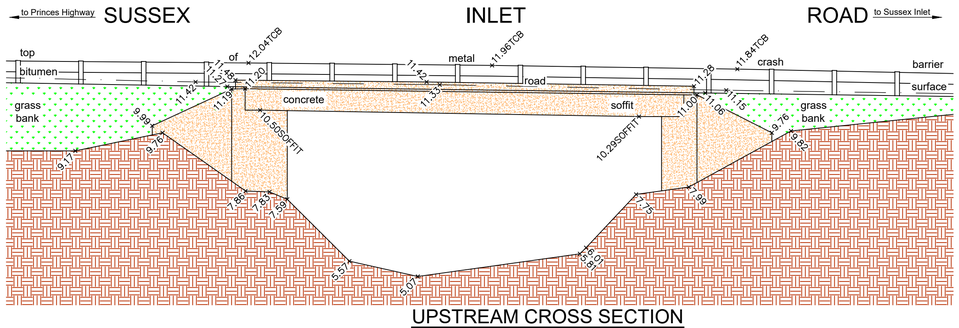


PLAN VIEW
REDUCTION RATIO 1:200

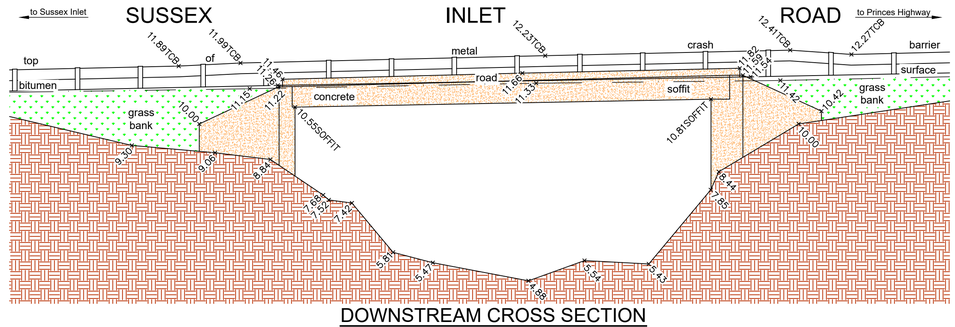
Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PHOTO A - DOWNSTREAM OUTLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A1 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 10.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G52 | SHEET 1 OF 1 | REVISION -

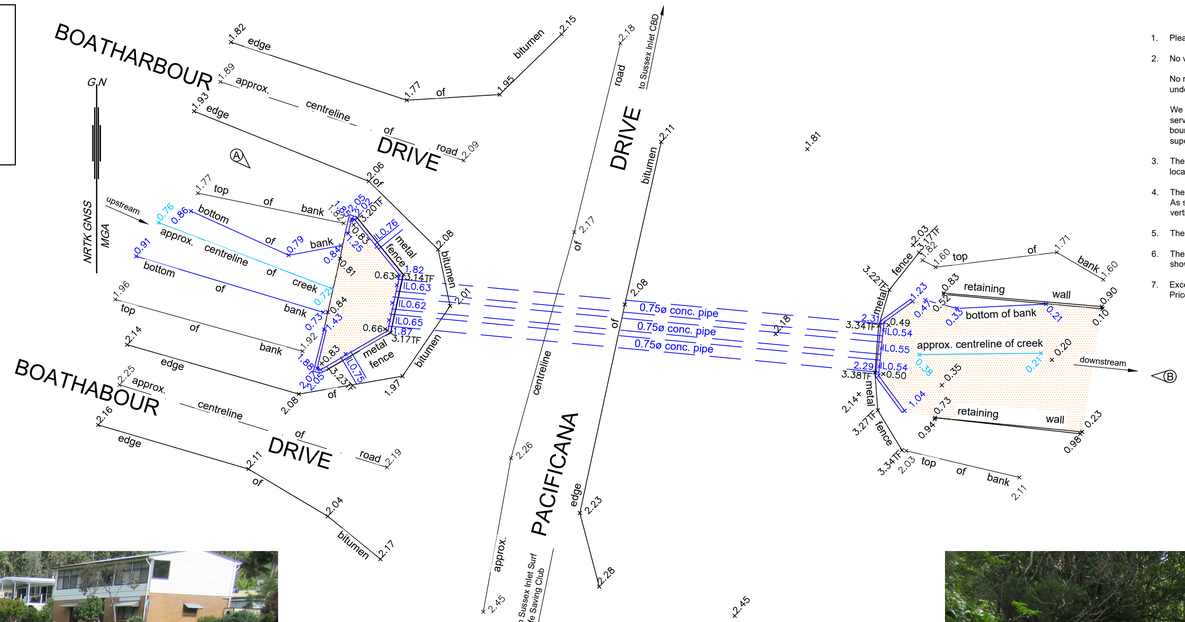
M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE

St. Georges Basin - Site G53

Legend

- 11.94TF+ RL of top of metal fence
- IL11.94 + RL of pipe invert
- 11.94 + RL of approx. centre line of creek
- concrete apron
- concrete headwall



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

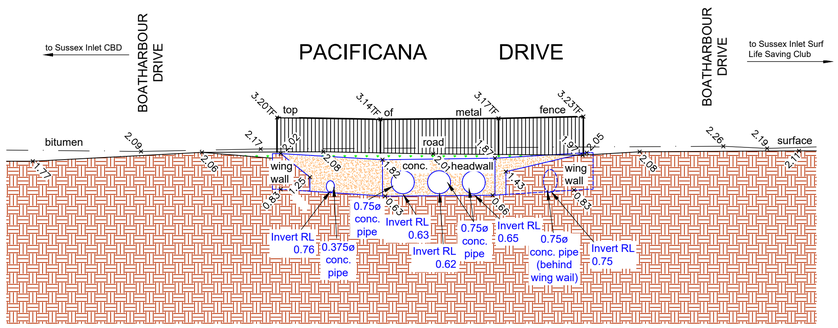
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



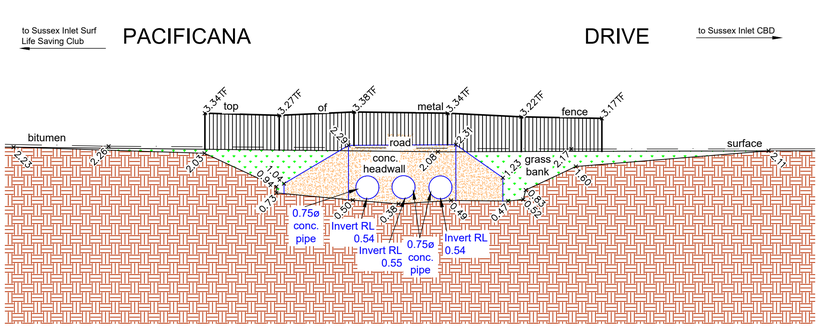
PHOTO A - UPSTREAM INLET



PHOTO B - DOWNSTREAM OUTLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A1 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
		CHECK'D	BD				
	DATE OF PLAN: 08.01.2019						

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G53 | SHEET 1 OF 1 | REVISION -

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G54

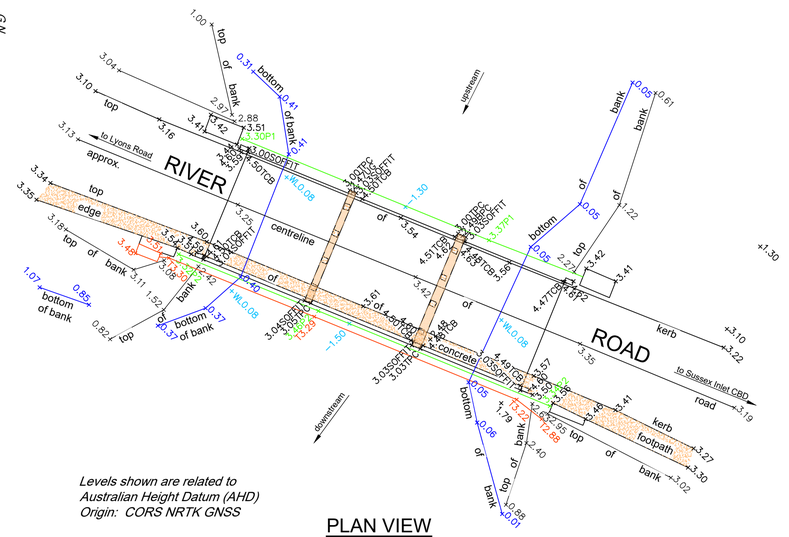
Legend

- 11.94TCB+ RL of top of metal crash barrier
- 11.94TPC+ RL of top of pier cap
- 11.94BPC+ RL of bottom of pier cap
- 11.94SOFFIT+ RL of soffit
- 11.94P1+ RL of unknown pipe 0.35Ø
- 11.94P2+ RL of unknown pipe 0.4Ø
- WL1.94+ RL of water level
- T11.94+ RL of Telstra Conduit 0.26 metal box
- concrete pier cap
- concrete column

NRTK GNSS MGA GN



PHOTO A - DOWNSTREAM OUTLET



Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW
REDUCTION RATIO 1:200

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

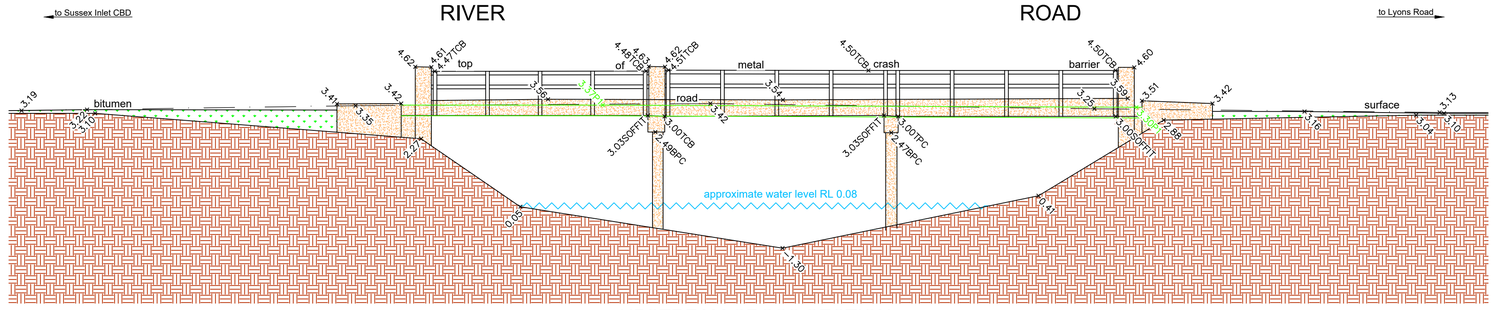
   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

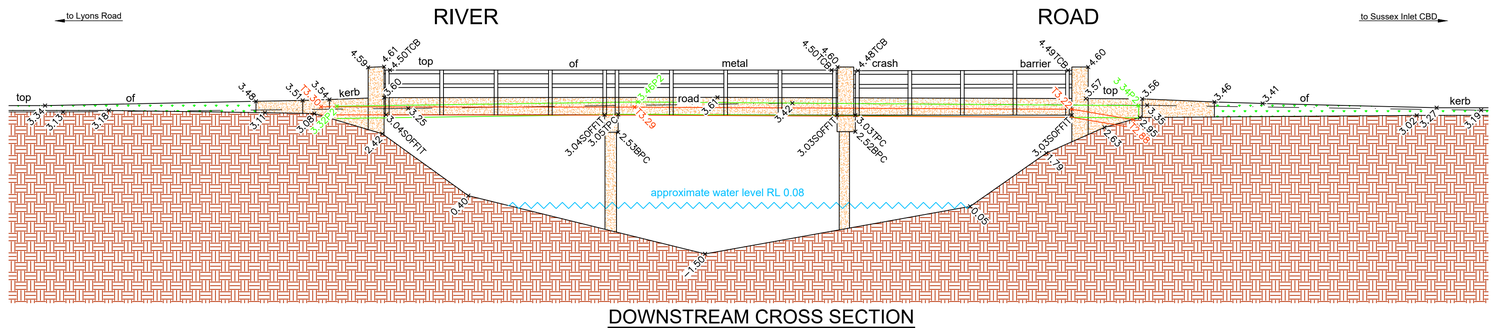


PHOTO B - UPSTREAM INLET

NOTE: APPROXIMATE WATER LEVEL SHOWN IS AS OBSERVED AT THE TIME OF SURVEY ONLY. NO INVESTIGATION OF TIDES & THEIR POTENTIAL IMPACT ON THIS APPROXIMATE WATER LEVEL HAS BEEN UNDERTAKEN.



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM	SURVEY	FK	REV	DESCRIPTION	BY	DATE
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 12.12.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G54 | SHEET 1 OF 1 | REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G55

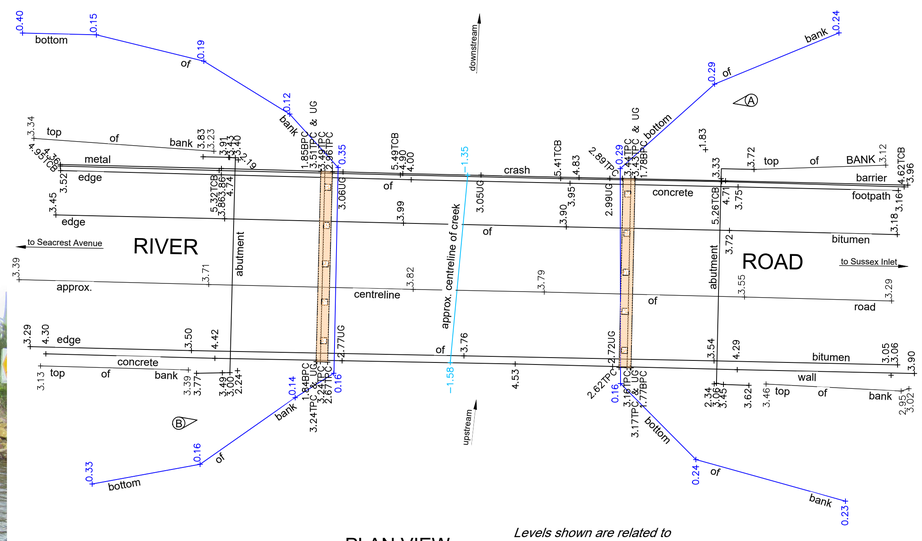
Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

Legend

- 11.94TCB× RL of top of crash barrier
- 11.94TPC× RL of top of pier cap
- 11.94BPC× RL of bottom of pier cap
- 11.94UG× RL of underside of girder
- concrete pier cap
- concrete column

G N — NRTK GNSS MGA



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

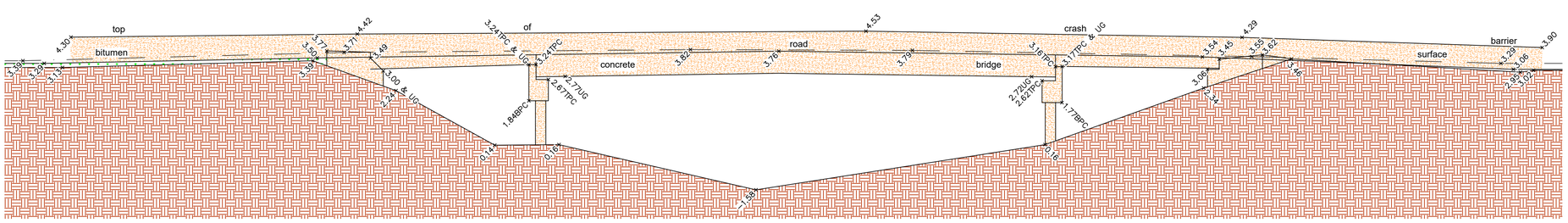
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



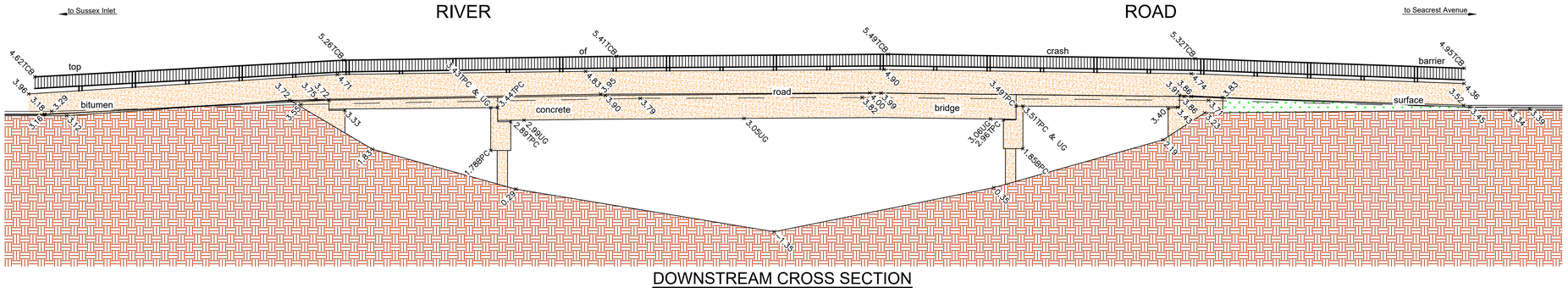
PHOTO A - DOWNSTREAM OUTLET



PHOTO B - UPSTREAM INLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM	SURVEY	FK	REV	DESCRIPTION	BY	DATE
	ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 12.12.2018	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G55

SHEET 1 OF 1

REVISION -

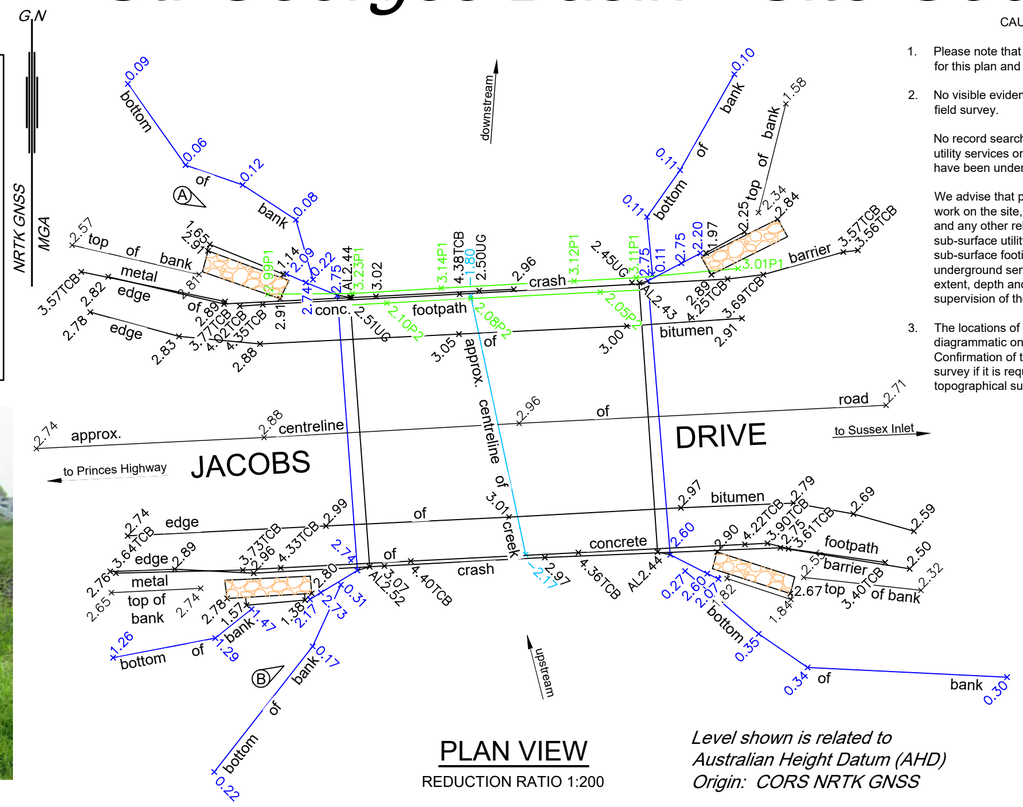
M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G56

Legend

- 11.94+ — RL of creek invert
- 11.94TCB+ — RL of top of crash barrier
- 11.94UG+ — RL of underside of girder
- 11.94P1+ — RL of top of unknown service Ø0.12
- 11.94P2+ — RL of bottom of unknown service Ø0.4
- 11.94AL+ — RL of abutment level
- Concrete headwall
- Stone gabion basket



PLAN VIEW
REDUCTION RATIO 1:200

Level shown is related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

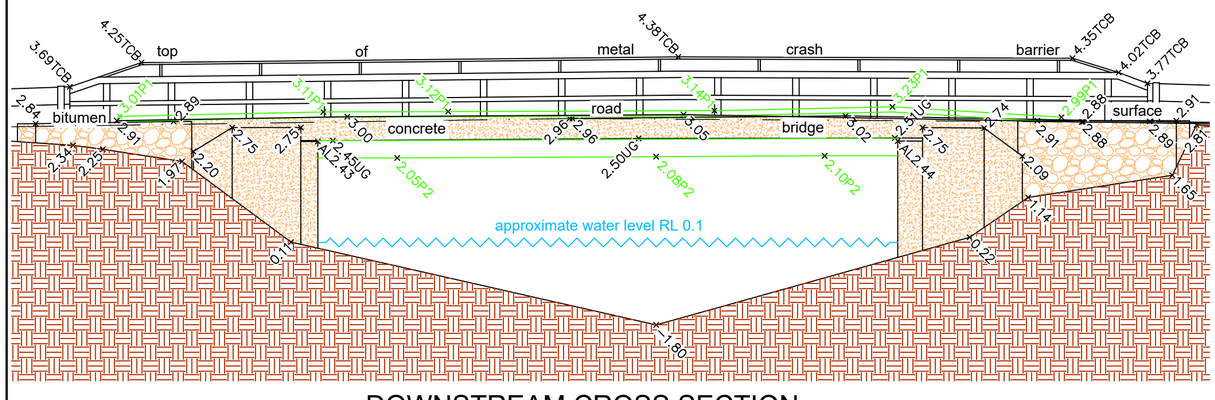
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



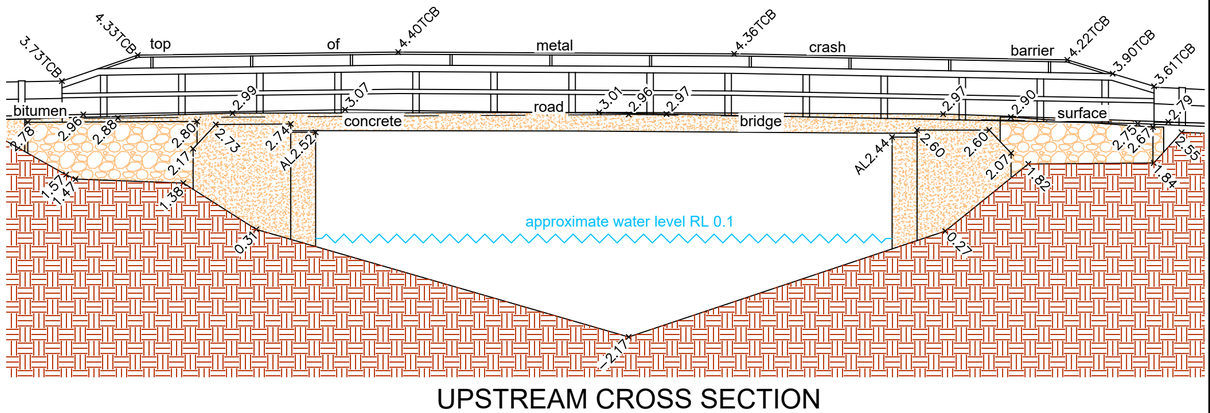
PHOTO A - DOWNSTREAM OUTLET



PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
	DATE OF PLAN: 09.01.2019	DRAWN	AG				
		CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

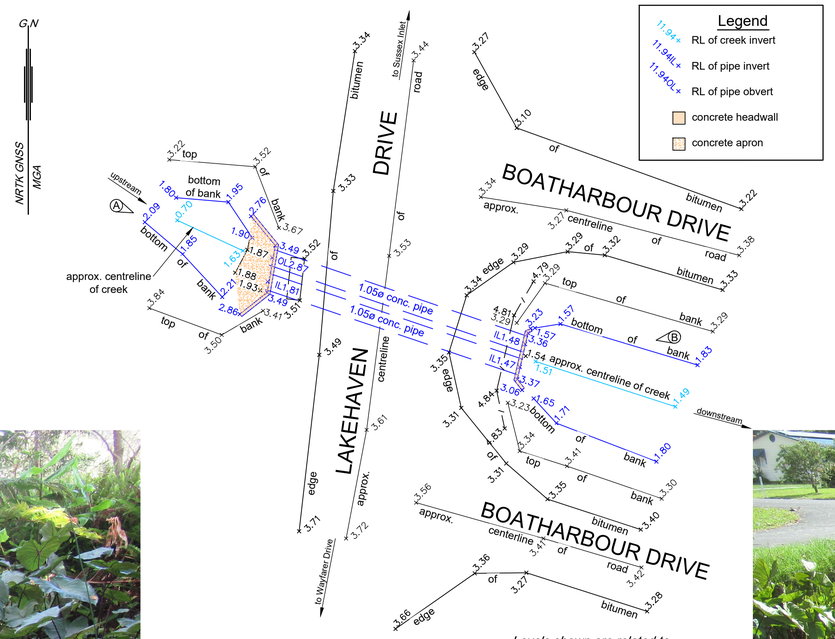
DRAWING STATUS

DRAWING NUMBER N27670-G56 | SHEET 1 OF 1 | REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G57



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

Legend

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

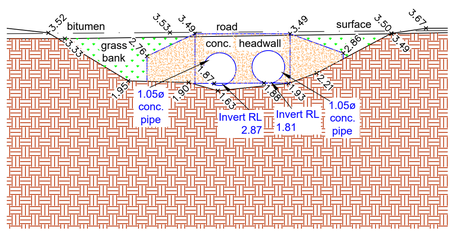


PHOTO A - UPSTREAM INLET



PHOTO B - DOWNSTREAM OUTLET

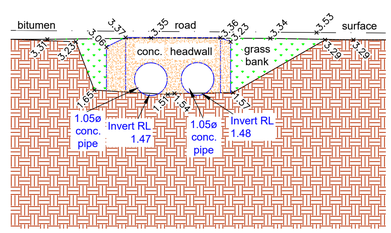
to Sussex Inlet LAKEHAVEN DRIVE to Wayfarer Drive



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:150

approx. pipe length 17.4m

to Wayfarer Drive LAKEHAVEN DRIVE to Sussex Inlet



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:150

RATIO: AS SHOWN (AT A1 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS DATE OF PLAN: 08.01.2019	SURVEY	FK	REV	DESCRIPTION	BY	DATE
		DESIGN	N/A	=			
		DRAWN	AG				
		CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

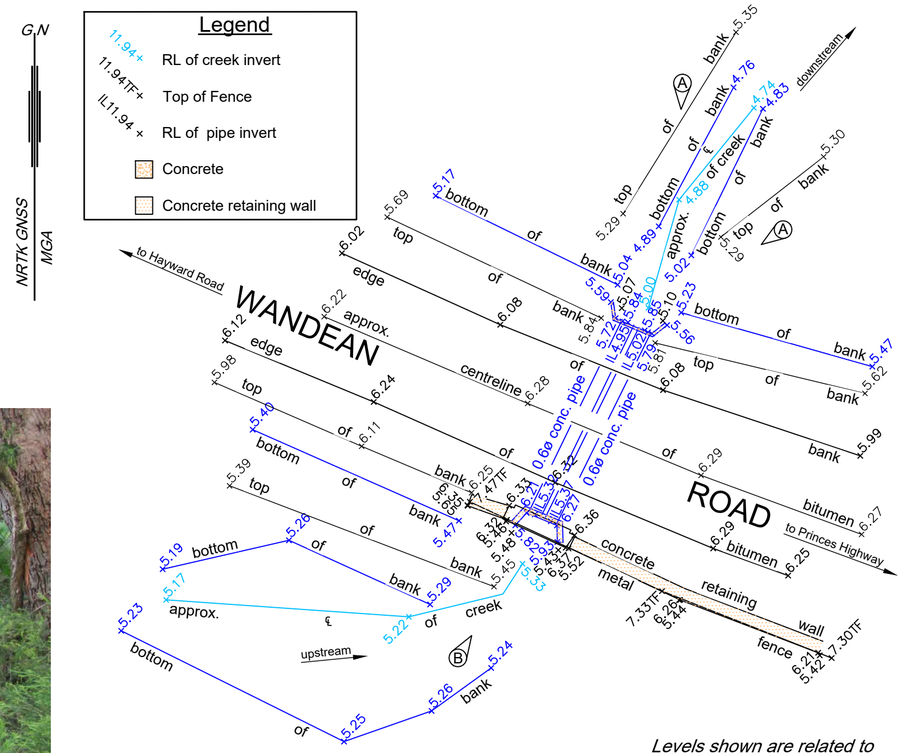
DRAWING NUMBER N27670-G57 | SHEET 1 OF 1 | REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G68



PLAN VIEW

REDUCTION RATIO 1:200

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

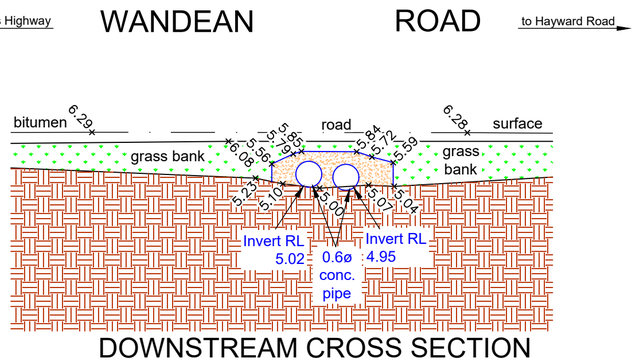
Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PHOTO A - DOWNSTREAM OUTLET

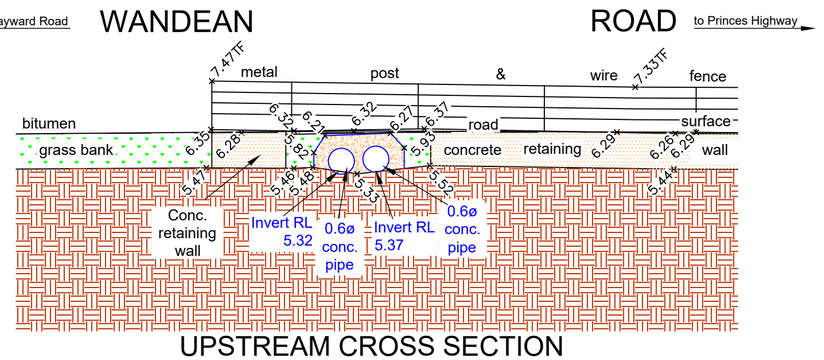


PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 14.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G68

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

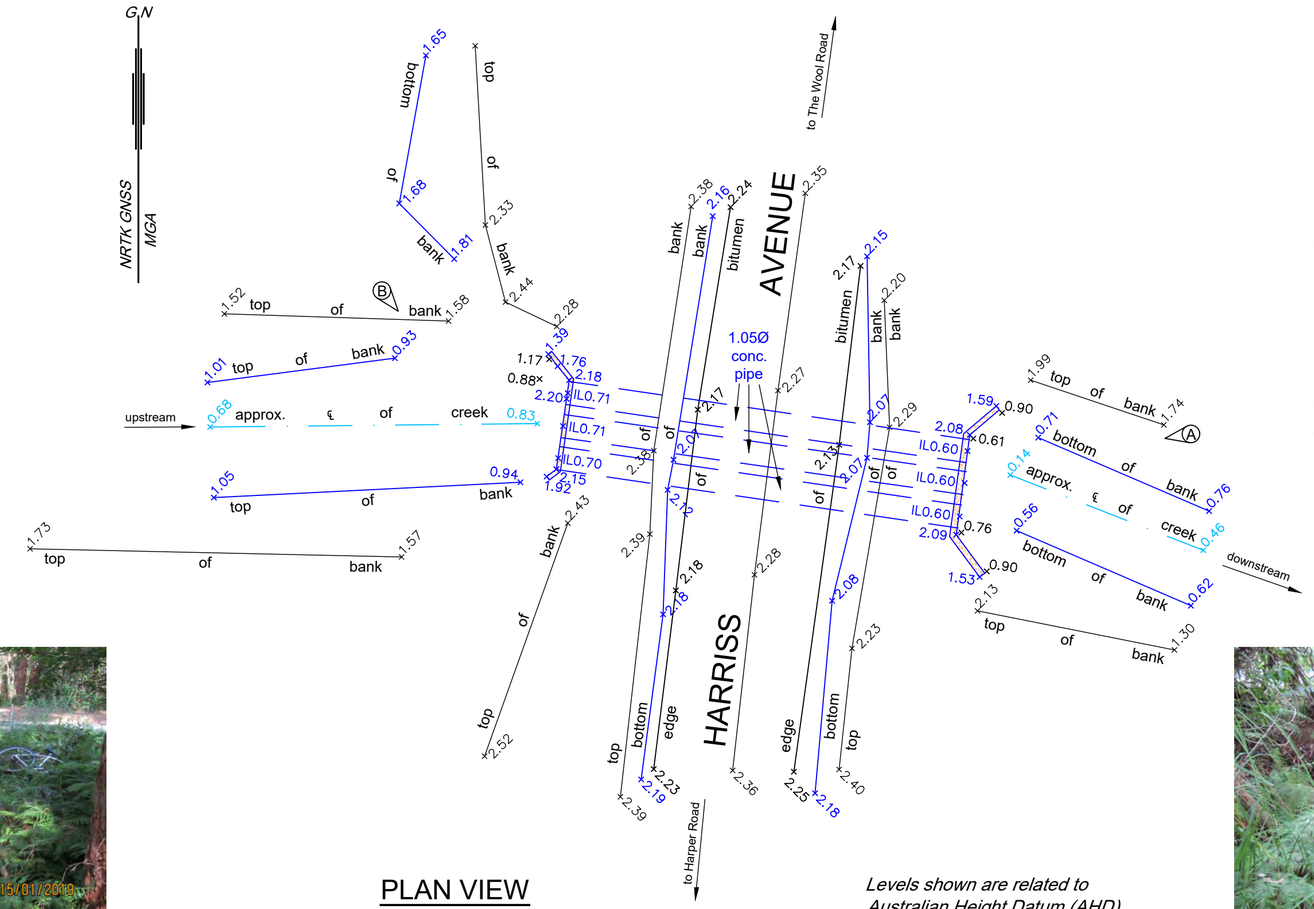
COVER OF EXCELLENCE®

St. Georges Basin - Site G73

Legend

IL0.60 × RL of pipe invert

Concrete



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

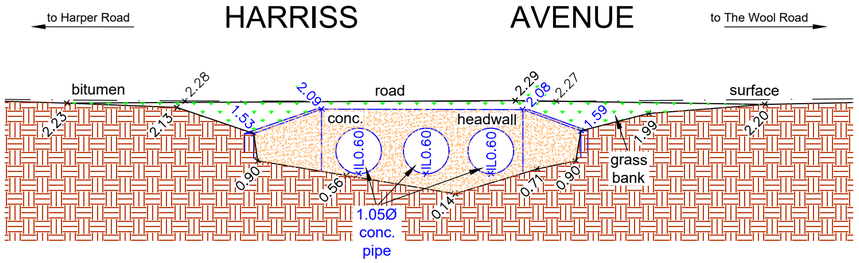
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM OUTLET



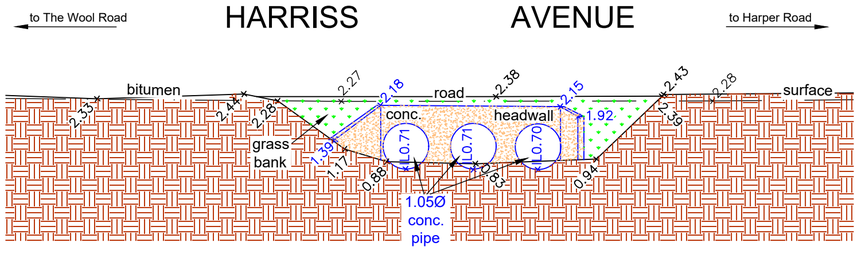
PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

Approx. pipe length 18.6m



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

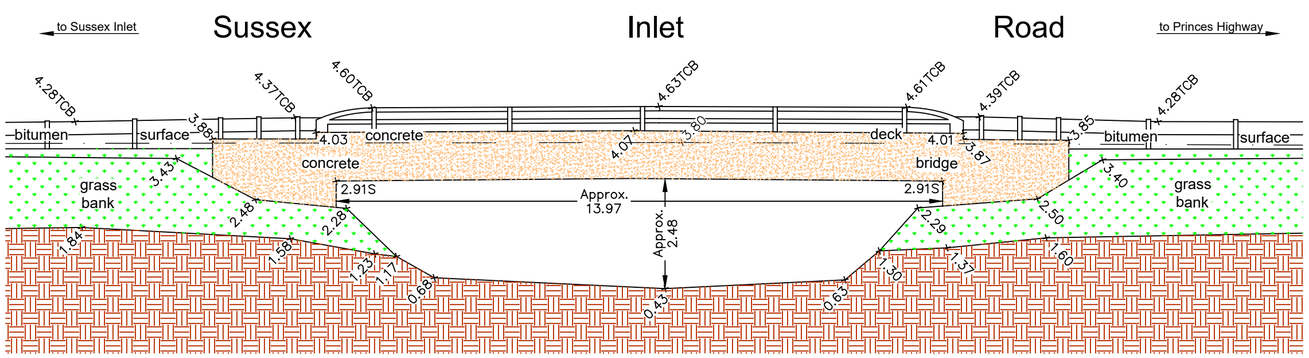
RATIO: AS SHOWN (AT A2 ORIGINAL)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS DATE OF PLAN: 15.01.2019	SURVEY	FK	REV	DESCRIPTION	BY	DATE	allen price & scarratts pty ltd land and development consultants Nowra Branch: 75 Plunkett Street, Nowra NSW 2541 Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533 phone:(02) 4421 6544 consultants@allenprice.com.au www.allenprice.com.au
		DESIGN	N/A	=				PLAN OF SELECTED STORMWATER STRUCTURES FOR FLOOD RISK MANAGEMENT STUDY AND PLAN OVER THE ST. GEORGES BASIN FOR CARDNO AND SHOALHAVEN CITY COUNCIL
		DRAWN	AE					DRAWING STATUS
		CHECK'D	GW					DRAWING NUMBER N27670-G73 · SHEET 1 OF 1 · REVISION -

M:\Projects\2000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G74

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®



DOWNSTREAM CROSS SECTION

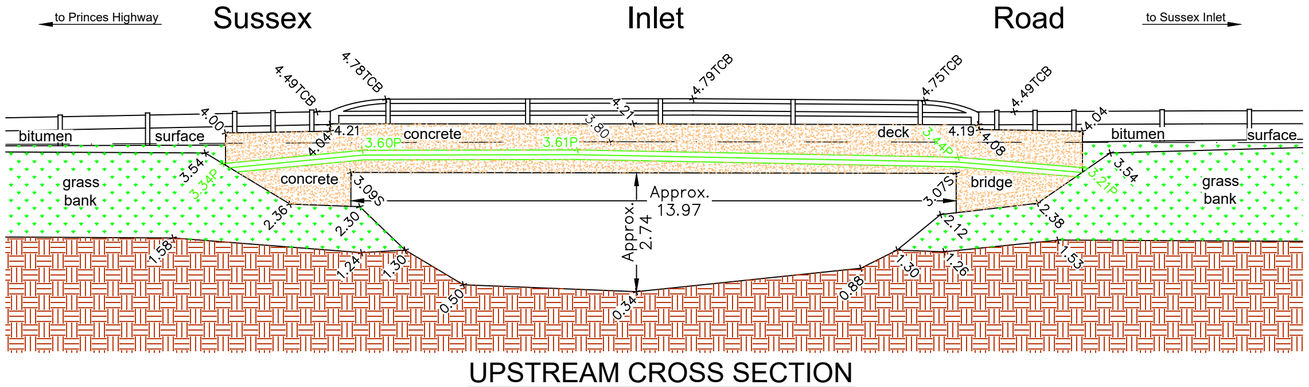
REDUCTION RATIO 1:100



PHOTO A - DOWNSTREAM OUTLET



PHOTO B - UPSTREAM INLET



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AE				
	DATE OF PLAN: 10.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G74

SHEET 1 OF 1

REVISION -

M:\Projects\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G80

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

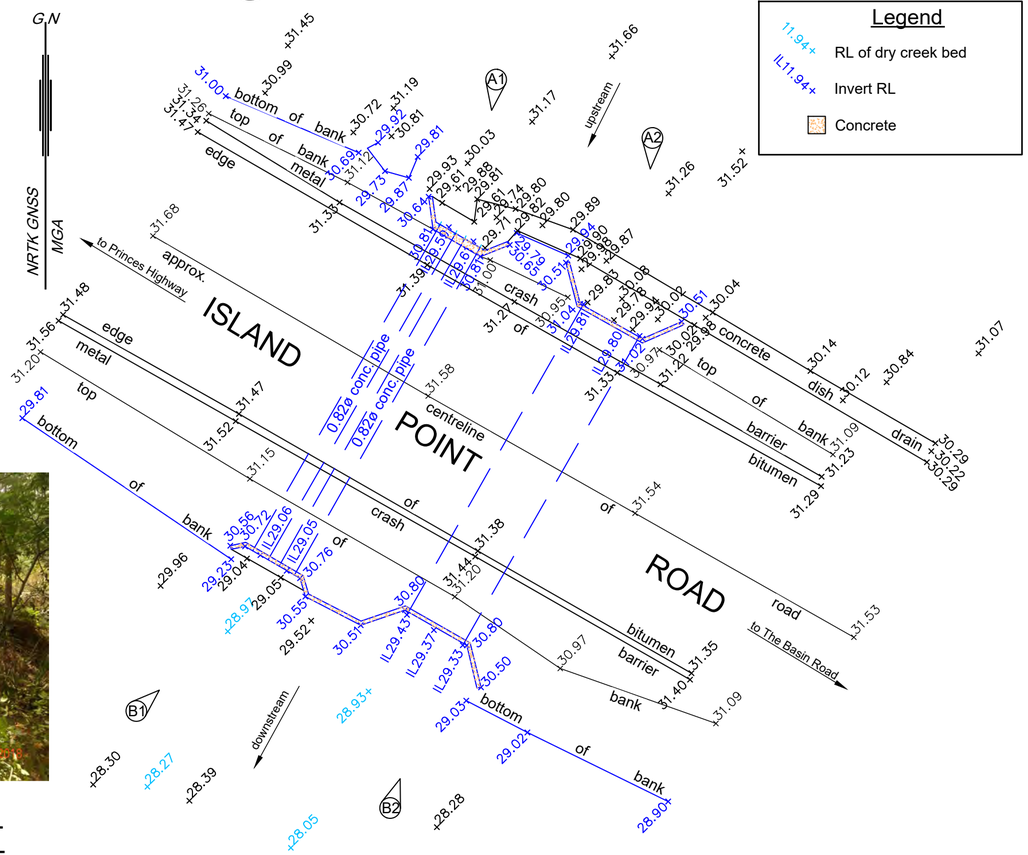
   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B1 - DOWNSTREAM OUTLET

PHOTO B2 - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200

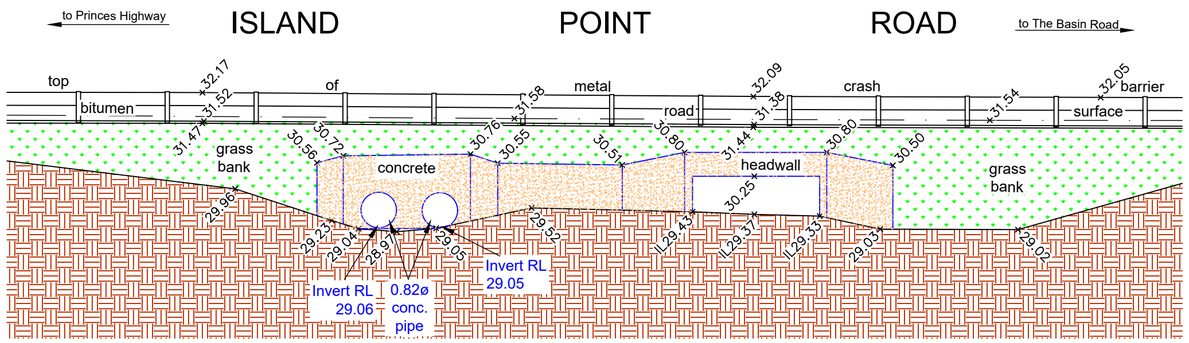
Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



PHOTO A1 - UPSTREAM INLET

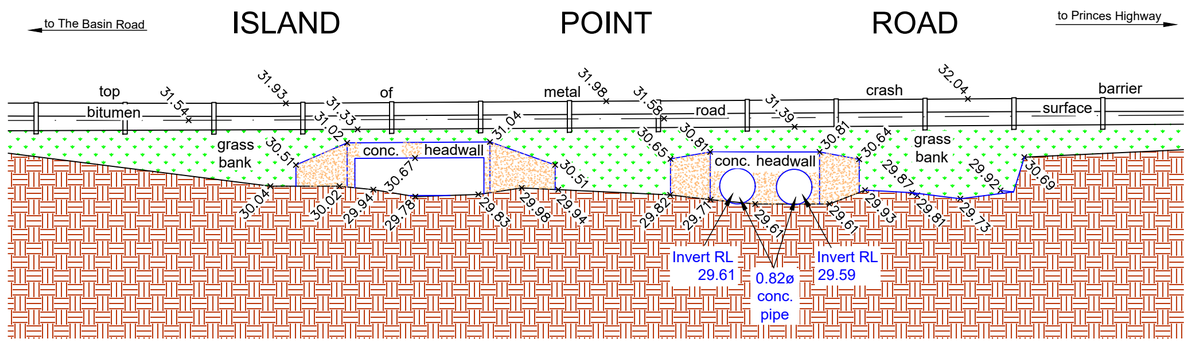


PHOTO A2 - UPSTREAM INLET



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:			REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	SURVEY	FK	=			
		DESIGN	N/A				
		DRAWN	AG				
	DATE OF PLAN: 26.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G80

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

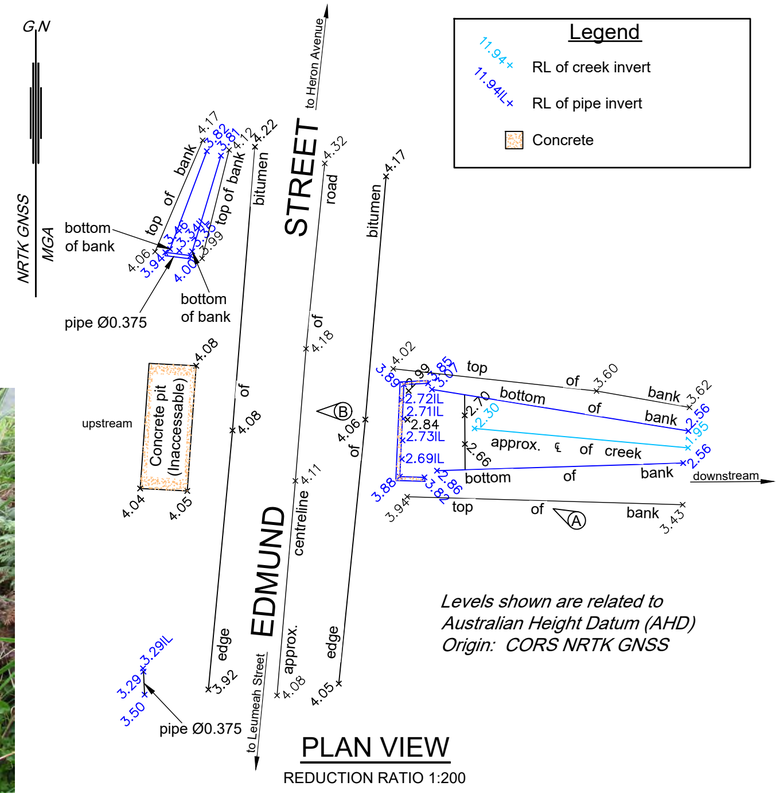
Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G82



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

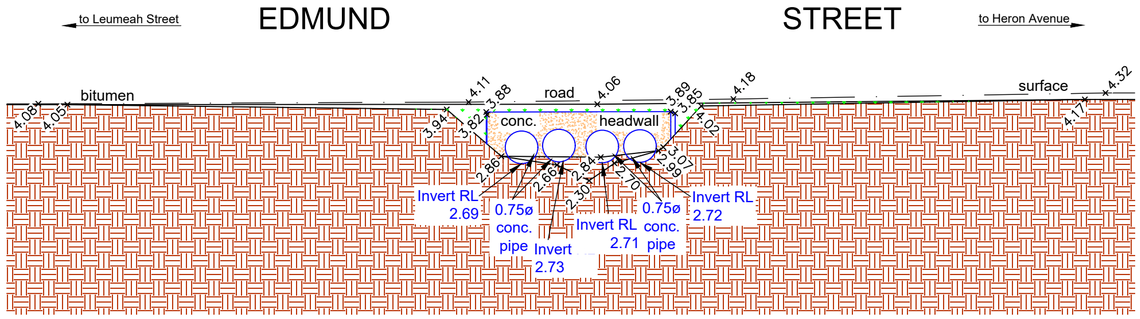
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B - UPSTREAM INLET
(NO CROSS SECTION AVAILABLE)



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 31.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G82

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

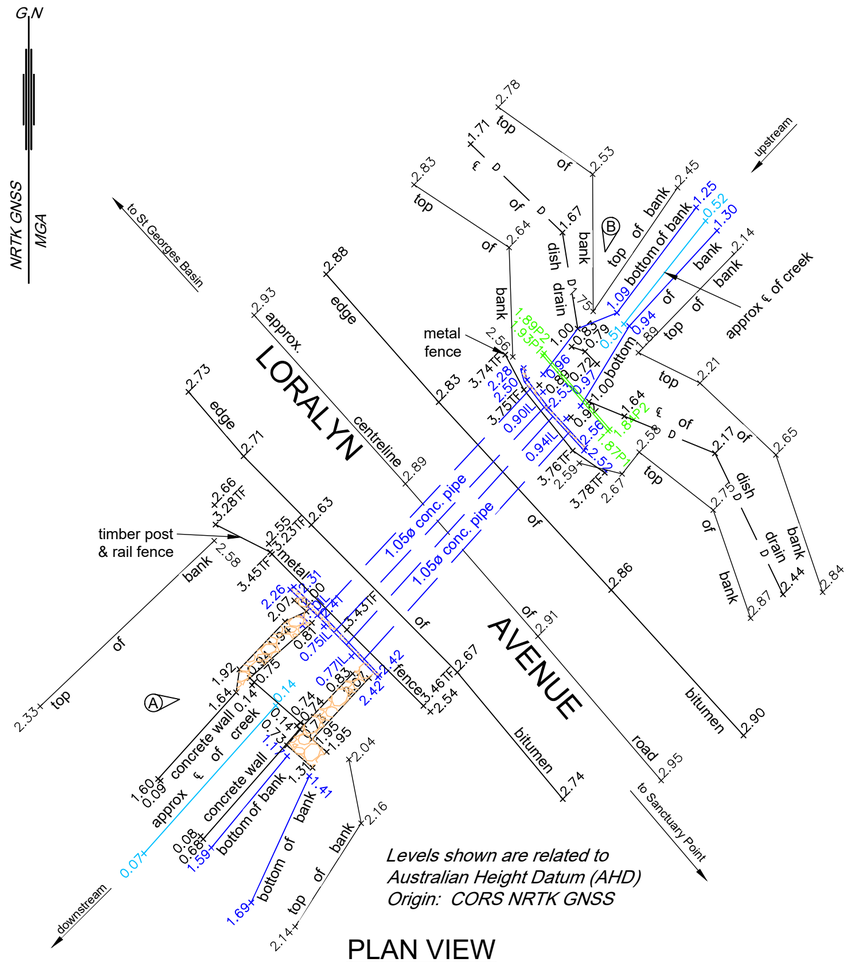
St. Georges Basin - Site G83

Legend

- 11.94+ RL of creek invert
- 11.94IL+ RL of pipe invert
- 11.94TF+ Top of Fence
- 11.94P1+ RL of underside of unknown pipe 0.11Dia
- 11.94P2+ RL of underside of unknown pipe 0.11Dia
- Concrete & Stone headwall
- Gabion basket



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200



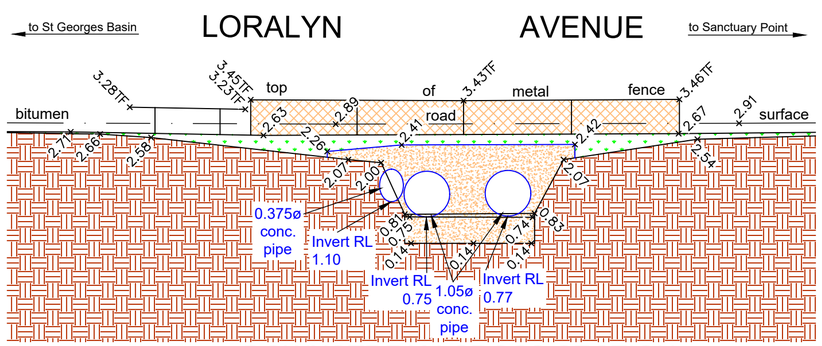
PHOTO B - UPSTREAM INLET

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

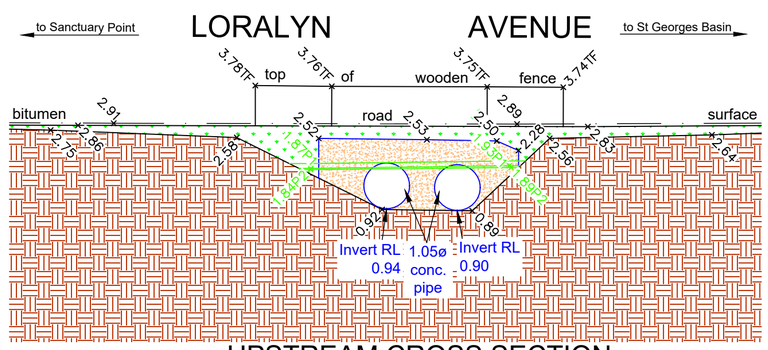
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

approx. pipe length 14.3m



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 04.02.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G83

SHEET 1 OF 1

REVISION -

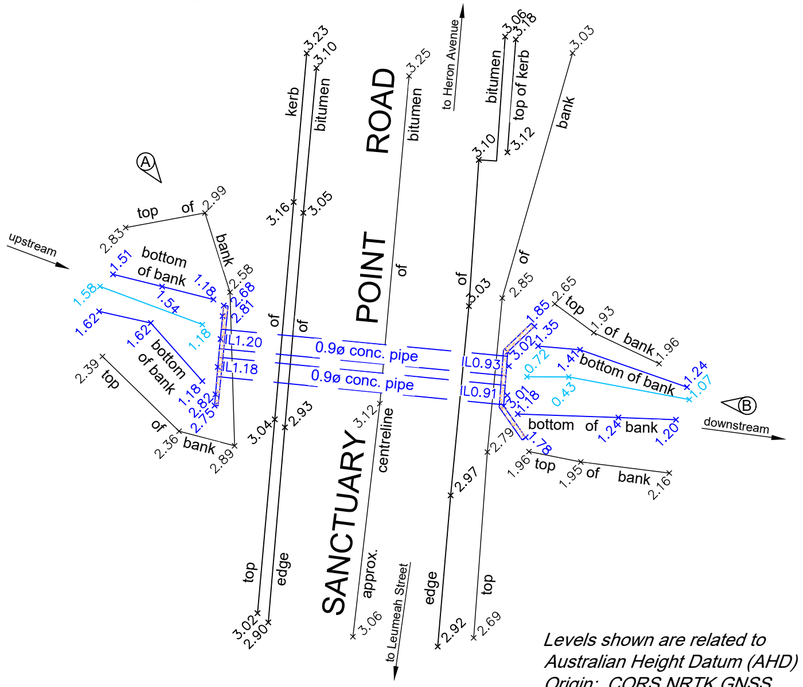
M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G84

Legend
- 11.94+ RL of creek invert
- Concrete

G N
NRTK GNSS MGA



PLAN VIEW
REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

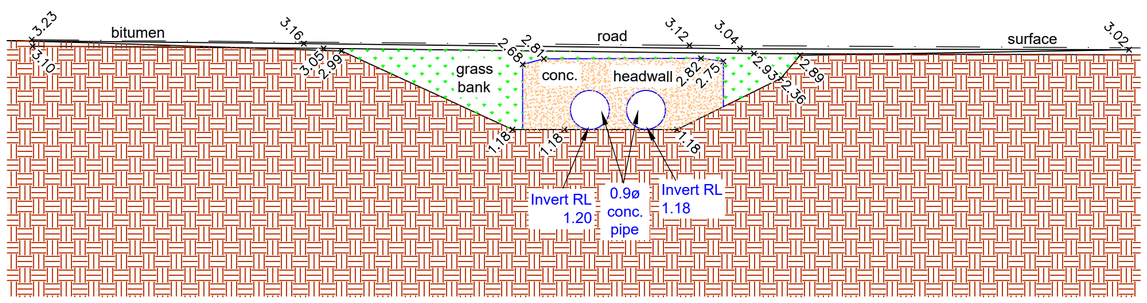
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



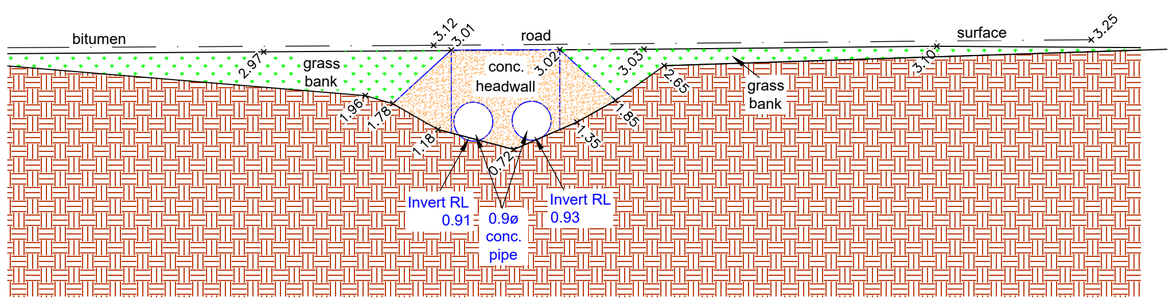
PHOTO A - UPSTREAM INLET



PHOTO B - DOWNSTREAM OUTLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 27.11.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G84

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G85

Liability limited by a scheme approved under Professional Standards Legislation.

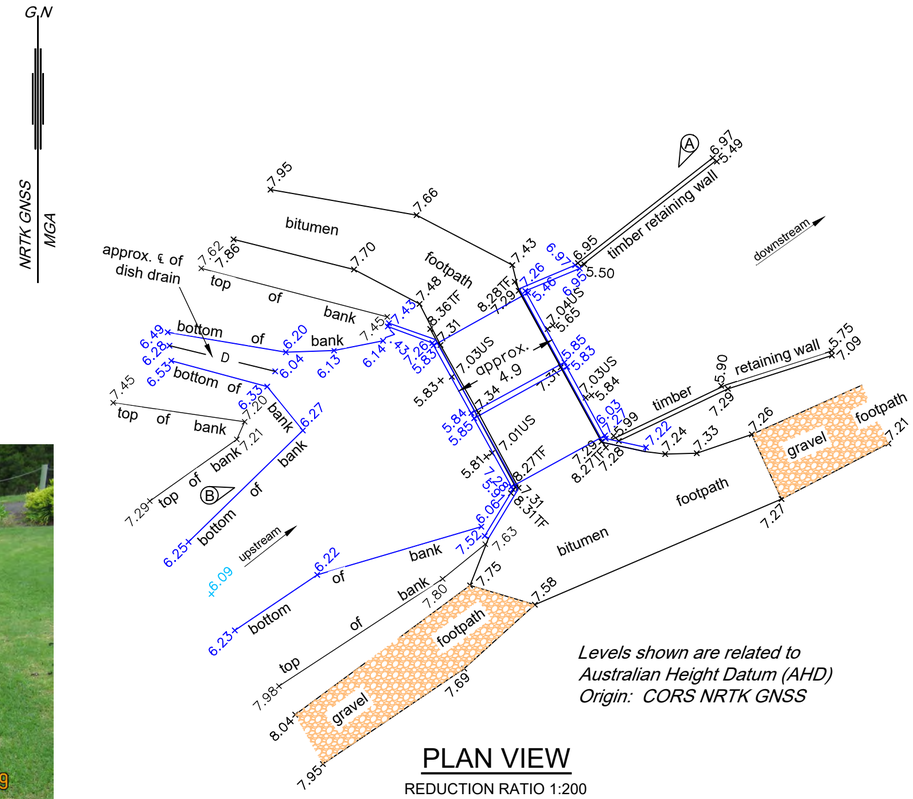
COVER OF EXCELLENCE®

Legend

- 11.94× RL of creek invert
- 11.94TF× Top of Fence
- 11.94US× Underside of culvert
- Gravel footpath



PHOTO A - DOWNSTREAM OUTLET



Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW
REDUCTION RATIO 1:200

CAUTION

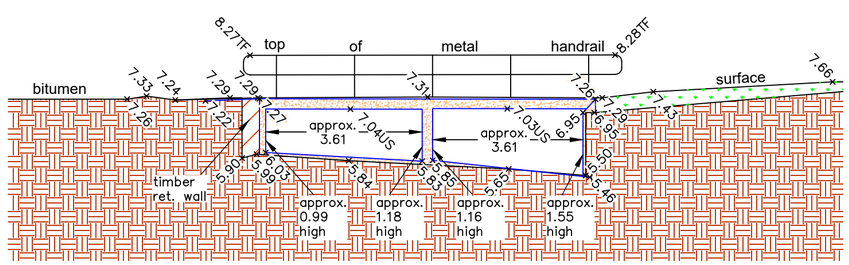
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

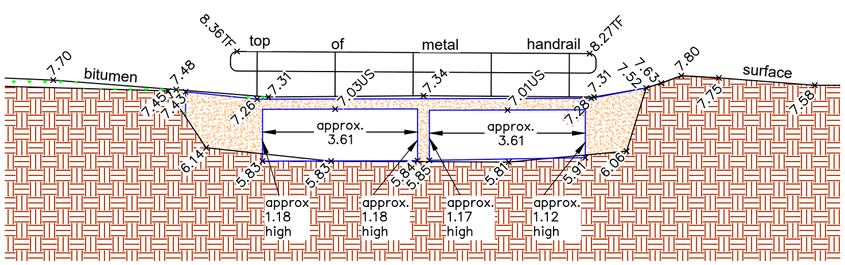
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO B - UPSTREAM INLET



DOWNSTREAM CROSS SECTION
REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 05.02.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G85

SHEET 1 OF 1

REVISION -

M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G86

CAUTION

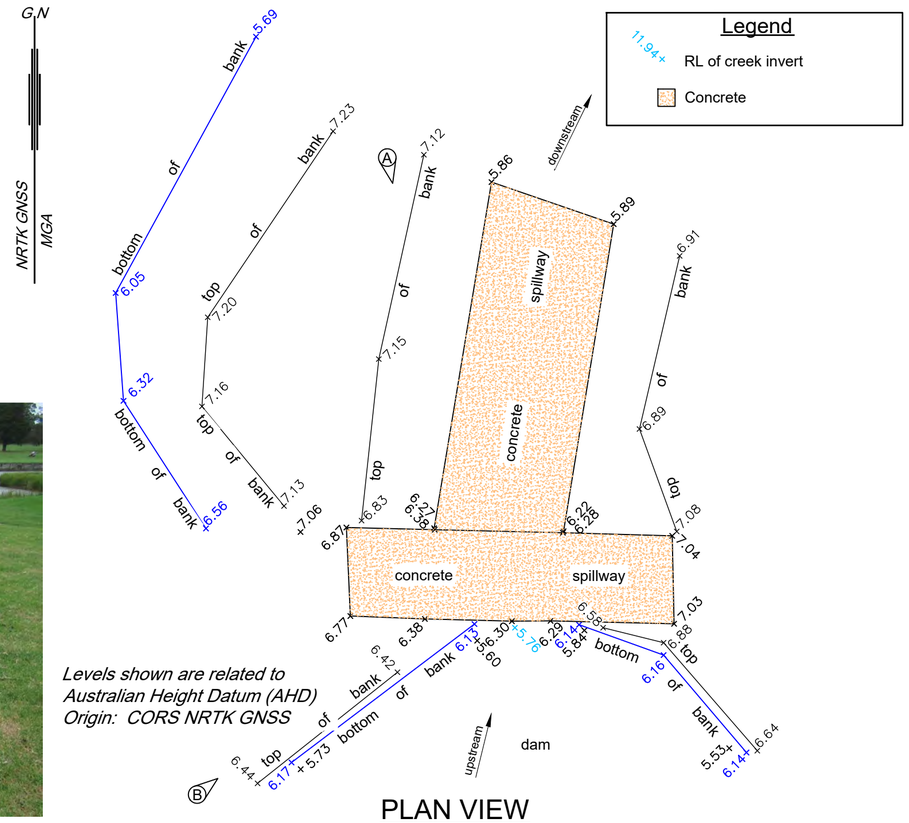
1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



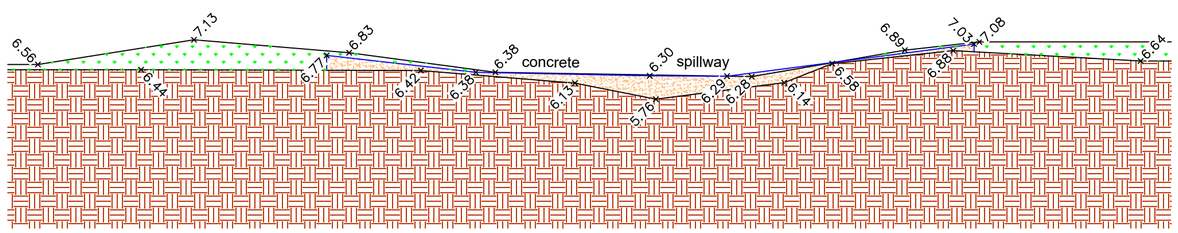
PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW
REDUCTION RATIO 1:200



PHOTO B - UPSTREAM INLET



UPSTREAM CROSS SECTION
REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM ORIGIN: CORS NRTK GNSS	DESIGN	N/A	=			
		DRAWN	AG				
	DATE OF PLAN: 05.02.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G86

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000sIN27670\Drawings\IN27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.

COVER OF EXCELLENCE®

St. Georges Basin - Site G92

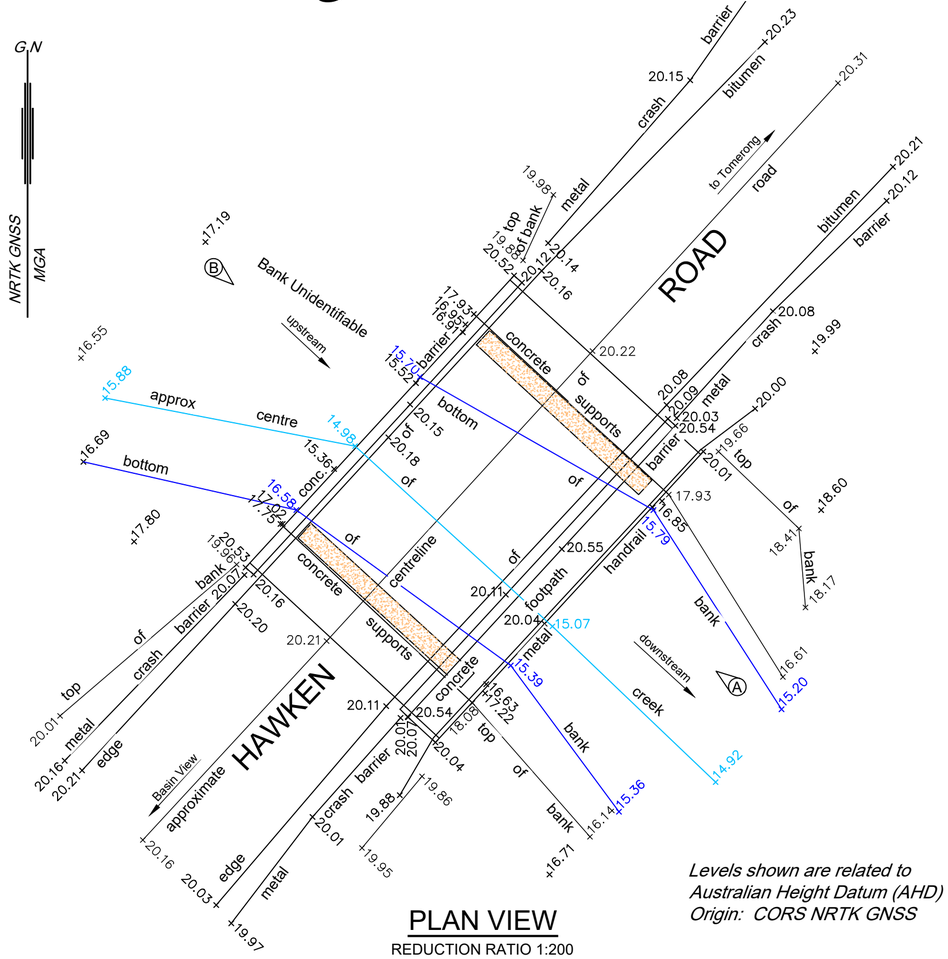
Legend

11.94+ RL of creek invert

Concrete



PHOTO A - DOWNSTREAM OUTLET



PLAN VIEW

REDUCTION RATIO 1:200

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

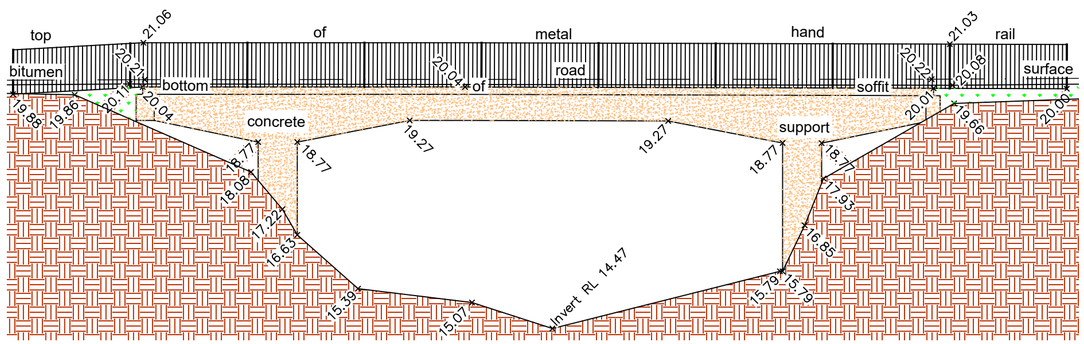
   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



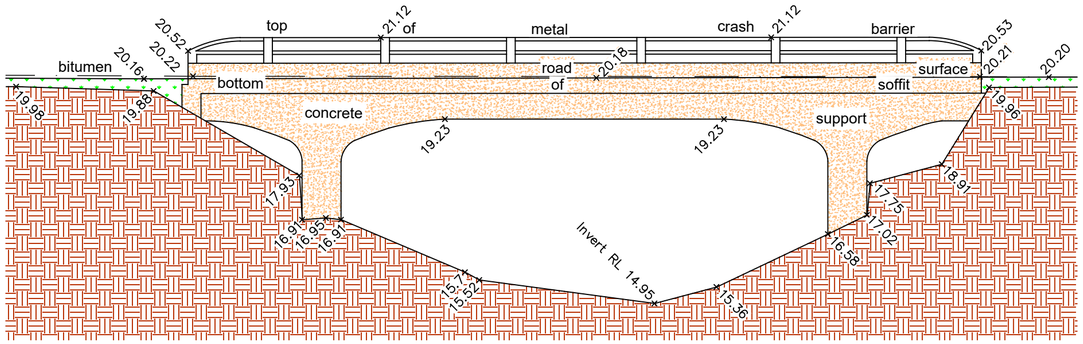
PHOTO B - UPSTREAM INLET

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 24.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G92

SHEET 1 OF 1

REVISION -

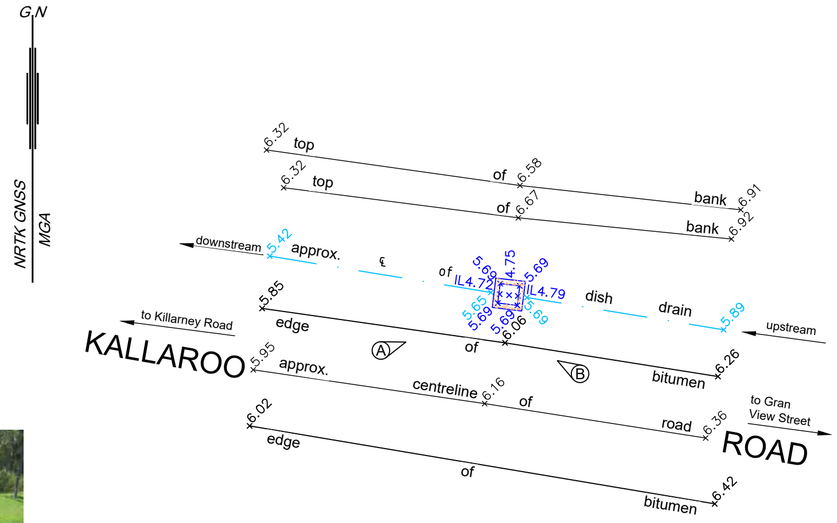
M:\Projects\20000\27000s\N27670\Drawings\N27670-SGB.dwg

Liability limited by a scheme approved under Professional Standards Legislation.
COVER OF EXCELLENCE®

St. Georges Basin - Site G93

Legend

- 11.94+ — RL of swale drain invert
- IL11.94+ — RL of pipe invert
- Concrete



PLAN VIEW

REDUCTION RATIO 1:200

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

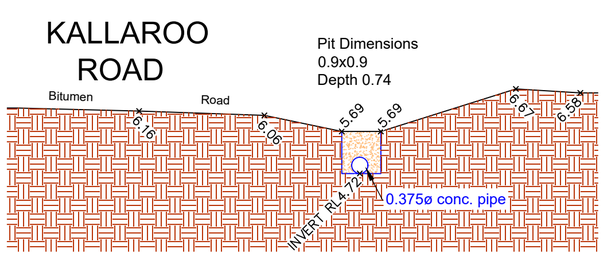
   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



PHOTO A - DOWNSTREAM



PHOTO B - UPSTREAM



CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 29.01.2019	CHECK'D	GW				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G93

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

St. Georges Basin - Site G94

Liability limited by a scheme approved under Professional Standards Legislation.

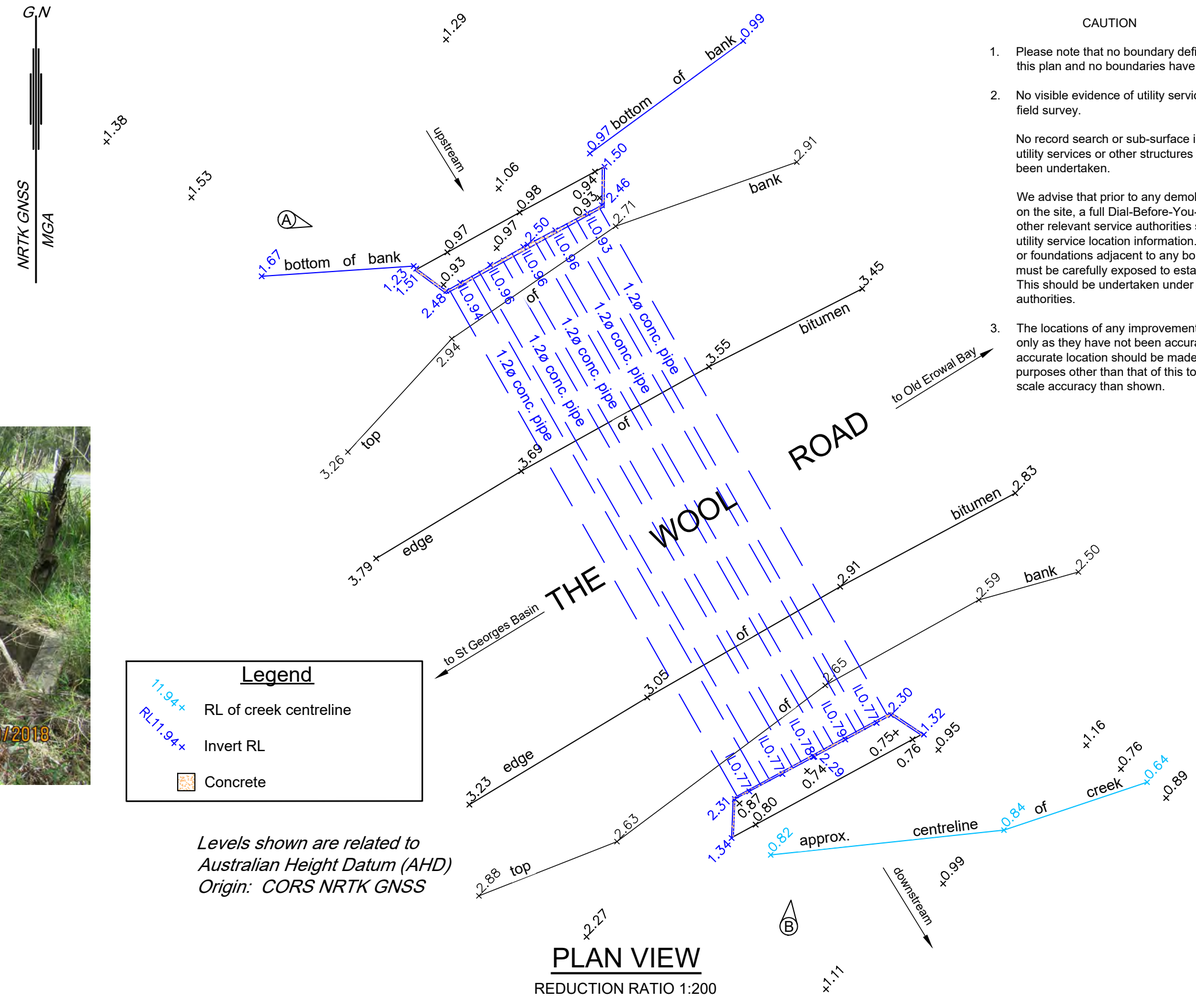
COVER OF EXCELLENCE®



PHOTO A - UPSTREAM INLET



PHOTO B - DOWNSTREAM OUTLET



Legend

- 11.94+ RL11.94+ — RL of creek centreline / Invert RL
- Concrete

Levels shown are related to Australian Height Datum (AHD)
Origin: CORS NRTK GNSS

PLAN VIEW

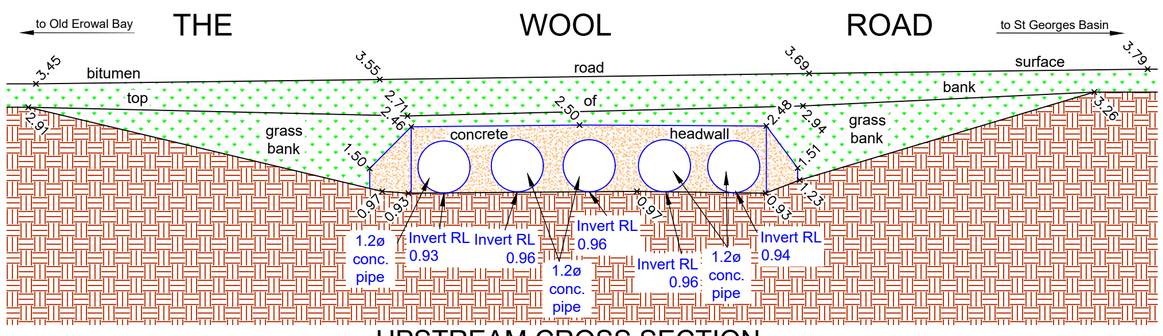
REDUCTION RATIO 1:200

CAUTION

1. Please note that no boundary definition survey has been undertaken for this plan and no boundaries have been marked.
2. No visible evidence of utility services have been located at the time of field survey.

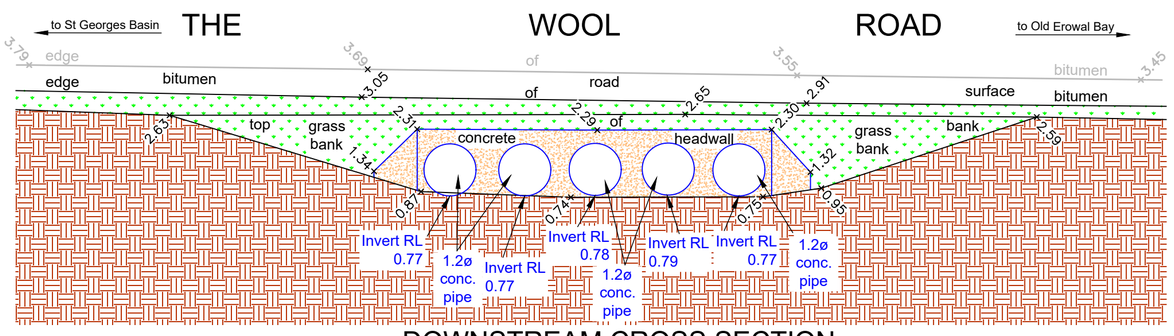
   No record search or sub-surface investigation as to the location of any utility services or other structures (such as footings or foundations) have been undertaken.

   We advise that prior to any demolition, excavation or construction work on the site, a full Dial-Before-You-Dig search must be obtained and any other relevant service authorities should be contacted for sub-surface utility service location information. In addition, any sub-surface footings or foundations adjacent to any boundaries or any underground services must be carefully exposed to establish their extent, depth and location. This should be undertaken under the supervision of the relevant authorities.
3. The locations of any improvements shown on the plan are diagrammatic only as they have not been accurately determined. Confirmation of their accurate location should be made by further survey if it is required for purposes other than that of this topographical survey or at a greater scale accuracy than shown.
4. The co-ordinates of the features were determined by a combination of Network Real Time Kinematic (NRTK) GNSS and Total Station surveying techniques. As specified in the survey brief by Cardno, dated: August 2018, the minimum positional accuracy of the co-ordinates is +/- 100mm horizontally and +/- 10mm vertically only. For confirmation of any information shown in this plan at a greater accuracy then the above, further survey will be required.
5. The Grid North orientation shown hereon has been calculated from the NRTK GNSS coordinates.
6. These notes are an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and unsuitable for use.
7. Except to the extent required by the Competition & Consumer Act 2010, or similar consumer protection legislation, no responsibility can be accepted by Allen Price & Scarratts Pty Ltd for any damage caused to any underground service or any loss or injury suffered.



UPSTREAM CROSS SECTION

REDUCTION RATIO 1:100



DOWNSTREAM CROSS SECTION

REDUCTION RATIO 1:100

RATIO:	DATUM:	SURVEY	FK	REV	DESCRIPTION	BY	DATE
AS SHOWN (AT A2 ORIGINAL)	AUSTRALIAN HEIGHT DATUM	DESIGN	N/A	=			
	ORIGIN: CORS NRTK GNSS	DRAWN	AG				
	DATE OF PLAN: 31.10.2018	CHECK'D	BD				

allen price & scarratts pty ltd
land and development consultants
Nowra Branch: 75 Plunkett Street, Nowra NSW 2541
Kiama Branch: 5/125 Terralong Street, Kiama NSW 2533
phone:(02) 4421 6544
consultants@allenprice.com.au www.allenprice.com.au

PLAN OF
SELECTED STORMWATER STRUCTURES
FOR FLOOD RISK MANAGEMENT STUDY AND PLAN
OVER THE ST. GEORGES BASIN
FOR CARDNO AND SHOALHAVEN CITY COUNCIL

DRAWING STATUS

DRAWING NUMBER N27670-G94

SHEET 1 OF 1

REVISION -

M:\Projects\27000\27000s\N27670\Drawings\N27670-SGB.dwg

APPENDIX B

COMMUNITY QUESTIONNAIRE

St Georges Basin Floodplain Risk Management Study and Plan

Information Brochure 2018

Shoalhaven City Council has engaged Cardno to assist with the preparation of the St Georges Basin Floodplain Risk Management Study and Plan. The purpose of this Risk Management Study and Plan is to identify and recommend appropriate measures to manage flood risks in the St Georges Basin catchment.

This is an introduction to the Risk Management Study and Plan. Further details can be obtained from the Council's website at INSERT COUNCIL WEBSITE LINK.

As part of this study, we are seeking community input in the form of a questionnaire. Please find the questionnaire online at **www.surveymonkey.com/r/StGeorgesBasinFRMSP**

Alternatively, you may request a hard copy of the questionnaire if you prefer.

Study Area

The study area comprises the St Georges Basin itself, the estuary, Sussex Inlet and upstream residential areas on the tributary creeks. The entire catchment covers an area of approximately 358 square kilometres, of which approximately 10% is the Basin itself. The Basin catchment has a number of tributary creeks including Wandandian Creek, Tomerong/Cockrow Creek, Cow Creek, Tullarwalla Creek and Warrowing Creek. The upstream end of the catchment rises approximately at height of 650 m (AHD) and is 24 kilometres away from the Basin. The catchment starts from east of Braidwood Road and follows an easterly direction to the St Georges Basin. The Basin connects to the ocean through the Sussex Inlet Channel and there are no recorded periods of closure of the basin's entrance. The Study Area is outlined in the diagram below.



Floodplain Management Process

Local councils have lead responsibility for managing flood prone areas, and the State Government assists local council by providing financial and technical support under the Floodplain Management Program.

Council's Shoalhaven River Natural Resource and Floodplain Risk Management Committee (the Committee) oversees the Floodplain Management process for the Shoalhaven Local Government Area. The Committee meets regularly and includes representatives from Council, the NSW Office of Environment and Heritage (OEH), State Emergency Service (SES), NSW Department of Primary Industries (DPI) and the local community.

Updated Flood Study

Previous flood information available for the catchment was undertaken using older software and methods. Council are taking the opportunity to update the flood models using the latest software and survey information and expanding the model extents to improve the accuracy and currency of the flood information. This can then be used as the basis for assessing flood risk in the study area and assessing the performance of proposed flood mitigation measures which will be developed as part of the Floodplain Risk Management Study.

Floodplain Risk Management Study and Plan Objectives

The preparation and implementation of a Floodplain Risk Management Plan is the culmination of the NSW Government Floodplain Management Program. Management plans can eliminate the ad-hoc decision making process which has contributed to many present day flooding problems. The Floodplain Risk Management Study and Plan is the focus of the current project. The objectives of the Study and Plan are:

Floodplain Risk Management Study

Find an appropriate mix of management measures and strategies to effectively manage the full range of flood risks in accordance with the NSW Government Floodplain Development Manual (2005) through an effective public participation and community consultation program. The information from this study will enable Council to formulate a Floodplain Risk Management Plan for the study area.

The Floodplain Risk Management Process

- ✓ Formation of a Committee
- ⇩
- **Data Collection**
- ⇩
- **Flood Study**
- ⇩
- **Flood Risk Management Study**
- ⇩
- **Flood Risk Management Plan**
- ⇩
- **Implementation of Plan**

This project is supported by the NSW Government's Floodplain Management Program

Floodplain Risk Management Plan

Formulate a cost effective plan for the study area based on the findings of the Floodplain Risk Management Study and provide a priority program for implementation of the recommended works and measures in accordance with the NSW Government Floodplain Development Manual. The plan will detail how the existing and future flood risk within the study area will be managed.

What does this mean for me?

The outcomes of this project can help provide protection of you, your family and your property from flooding.

This may mean there are works undertaken in the future near your home or work, or you may have to incorporate flood compatible design into any future development. At the very least you will receive advice and information to assist you in making your home or work 'flood safe', or what to do during a flood event.

Floodplain Risk Management Options

The following list of Floodplain Risk Management options represent some of the strategies that could be considered to minimise the risk and reduce the impact of flooding throughout the floodplain. These options will be considered in further detail during the preparation of the Management Study and Plan.

Examples of Flood Management Options:	
Flood Modification Options	• Construction of levees where properties are most at risk. • Upgrading of drainage systems • Revision of entrance management procedures.
Property Modification and Planning Control Options	• Building and development controls • Voluntary house raising program (for selected properties) • Voluntary house rebuilding subsidy scheme (for selected properties) • Voluntary property purchase program (for selected properties).
Emergency Response Modification Options	• Revision of the Local Disaster Plan (DISPLAN) • Public awareness and education—locality based flooding information for residents • Public awareness and education—flooding information for schools • Flood depth markers at major (flood affected) road crossings • Continuation of existing public awareness and education campaigns • Data collection strategies for future floods

Ground Level and Property Level Survey

As part of the study, a survey team from Council will be collecting flood levels and ground levels of properties within the St Georges Basin floodplain. This data is being collected to enable us to accurately determine how properties are affected by flooding. The levels will also be used to calculate damages resulting from flood events and to assess the effectiveness of proposed flood mitigation options. The survey will be conducted from now until end of 2018.

Consultation

During the Floodplain Risk Management Study and Plan process, consultation will be undertaken with the community.

The first consultation stage is a questionnaire in order to:

- Understand how residents and businesses are impacted by flooding.
- Canvas which types of flood management options are most preferred by the community.

We would appreciate your input to this project by completing the questionnaire which can be accessed online at the details below.

In addition to the questionnaire, you will have further opportunities to comment on the direction of the project during community workshops.

The workshops will introduce the study, and discuss potential mitigation strategies with the community. Any comments received during the workshops will be taken into account before finalisation of the study and plan.

The final community consultation stage will occur during the public exhibition periods of the Draft Floodplain Risk Management Study and Plan that will be accompanied by community workshops conducted by Council and Cardno.

I have questions. Who can I contact?

For further information regarding this project please see Council's website: INSERT PROJECT WEBSITE or contact Shoalhaven City Council via the details below.

Mir Abdus Subhan Floodplain & Stormwater Quality Engineer Shoalhaven City Council P: (02) 4429 3354 (9am - 5pm; Mon-Fri) Mirabdus.subhan@shoalhaven.nsw.gov.au	Rory Hentschel Manager - Water Cardno P: 4231 9600 (9am - 5pm; Mon-Fri) rory.hentschel@cardno.com.au

Please complete the survey online at www.surveymonkey.com/r/StGeorgesBasinFRMSP

Resident / Landowner Survey 2018

Shoalhaven City Council is carrying out a Floodplain Risk Management Study and plan for the St Georges Basin catchments.

This survey will help us collect information about flooding in the area through community experiences. The survey will also allow you to tell us about the flooding issues that are important to you and collect your ideas and preferences on how flood risk can be managed within the St Georges Basin catchments. Please take a few minutes to complete the survey.

1. Please provide us with the following details, as this allows us to locate specifically where your comments and responses relate to. This information will not be shared without your consent.

Name	
Address	
Address 2	
Email Address	
Phone Number	

2. Do you give permission for someone from Council or Cardno to contact you to discuss any of the information you have provided us?

- ◯ Yes
- ◯ No

A. General information about your household

To begin with, we just need some information to help us understand whether you live or work in the St Georges Basin study area and to gain information about your building to assist with the floodplain risk management study.

3. Is your property (please select all that apply):

- [ ] Residential – Owner occupied
- [ ] A business
- [ ] Residential – Occupied by a tenant
- [ ] Farmland
- [ ] Holiday Home
- [ ] Other (please specify)

4. What is your property?

- ( ) House
- ( ) Commercial
- ( ) Unit/Flat/Apartment
- ( ) Industrial
- ( ) Other (please specify)

5. Which of the following construction materials best describes the building?

- ( ) Full brick
- ( ) Timber
- ( ) Brick veneer
- ( ) Concrete
- ( ) Weatherboard or fibro
- ( ) Steel
- ( ) Other (please specify)

6. How long have you lived, worked at and/or owned your property?

Years

Months

7. How long have you lived in the St Georges Basin area?

Years

Months

8. How many people occupy your property?

People

9. Is there anyone in your household who:

- ◯ Requires care (e.g. infants, elderly or has a disability)
- ◯ Requires assistance with speaking or reading English
- ◯ None of the above

B. Flood Experience

A focus of this survey is to hear about any flooding you or members of your household have ever experienced in the study area. This provides useful information on where are the most frequently flooded areas and also provides data to compare with model results.

* 10. Have you or anyone in your household ever experienced flooding since living / working / owning your property? (please select all that apply)

- ◯ Never experience flooding
- ◯ Yes, I have been impacted by flooding

11. What were the areas of flooding (select all that apply)

- [ ] Flooding over the floor of a living or working area
- [ ] Water entry to a garage or shed
- [ ] Access to the property was cut off
- [ ] Flooding of the street or footpaths
- [ ] Yard/surrounding property flooded
- [ ] Flooding of parks and open spaces
- [ ] Other (please specify)

12. Please provide as much detail of the time and date as possible for up to 5 events *(your best estimate is fine – but the more accurate the date and time information the more valuable the data is for the flood modelling)*

Event 1

Event 2

Event 3

Event 4

Event 5

13. If your property was ever flooded above the house/garage floor level, please specify the depth above floor level and date(s) of the flood event(s):

- ( ) No, property never flooded above floor level
- ( ) Yes, please specify depth and date (as best as you can remember)

14. If your property grounds were ever flooded, please specify the depth and date(s) of the flood event(s):

- ( ) No, property grounds never flooded
- ( ) Yes, please specify depth and date (as best as you can remember)

* 15. In any flood event you have experienced in the past, did you have to take action to protect your property or business against flood damage?

- ( ) No
- ( ) Yes

16. What action did you take to protect your property or business against flood damage (Select all that apply)?

- [ ] Moved vehicles
- [ ] Used sandbags to try to prevent water entering the premises
- [ ] Moved furniture or possessions
- [ ] Evacuated property
- [ ] Lifted or moved stock and equipment
- [ ] Other (please specify)

17. In any flood event you have experienced in the past, what was the approximate cost to you (at the time) from the damage caused by the flood?

- ( ) No damage
- ( ) Yes, damages caused, please specify approximate cost and date

18. Do you have any photographs or video footage taken during or after any flooding event that you would like to share with Council? (Please select all that apply)

- [ ] Yes, photos (please attach below or provide to council)
- [ ] Yes, videos (please provide to council separately)
- [ ] No

19. If you have any photos, please attach them here or provide to council.
(Labels or descriptions with this information will assist)

Choose File No file chosen

C. Flood Risk and Management

The objective of the study is to define flood risk and develop a plan for managing risk through a combination of structural mitigation measures, planning and property measures and emergency response. The information you provide will help guide this process to develop the best solutions for managing flood risk for this community.

20. In your opinion, what is the greatest flood risk in the catchment?

- ◯ Risk to property
- ◯ Inconvenience (e.g. difficulties travelling)
- ◯ Risk to life
- ◯ Other (please specify)

21. Do you think your property may be flooded sometime in the future?

- ◯ No
- ◯ Yes, but only a small part of my yard/outdoor areas could be flooded
- ◯ Yes, most of my yard/outdoor areas could be flooded
- ◯ Yes, my house/office/business could flood over the floor

22. Are there any works that you think Council should consider to reduce the flood risk at your property?

- ◯ No
- ◯ Yes, please specify

23. As a local resident, who has witnessed flooding/drainage problems, you may have your own ideas on how to reduce flood risks. Which of the following management options would you prefer? Please rank them where '1' is most preferable. *(You can drag the options to rank them)*

- Road raising
- Improved flood flow paths
- Detention basins (they temporarily hold water and reduce flood flows)
- Culvert/bridge/pipe enlarging
- Flood gates
- Levee banks
- Entrance management strategy
- Environmental channel improvements, including removal of weeds and bank stabilisation
- Planning and flood related development controls
- Education of community, providing greater awareness of potential hazards
- Flood forecasting, flood warning, evacuation planning and emergency response
- Other option. Please specify this at the end of the survey

24. What level of control do you consider Council should place on new development to minimise flood – related risk?

- ◯ Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)
- ◯ Stop all new development on land with any potential to flood
- ◯ Place restrictions on development on flood prone land (e.g. minimum floor levels, use of flood – compatible materials)
- ◯ Advise people of flood risks and allow individuals to choose how they would reduce flood damage
- ◯ There should be no control on development in flood affected areas

D. Further Information

* 25. Would you like to receive more information from Council regarding flooding in your catchment?

- ◯ I do not wish to receive further information
- ◯ Yes

26. How would you like to receive that information? (please select all that apply)

- [ ] Council Website
- [ ] Email Newsletters
- [ ] Mail
- [ ] Other (please specify)
- [ ] Public displays or exhibitions
- [ ] Phone call

27. If you have any further comments that relate to flooding in this catchment, please express them below:

Thank you for your time in completing the survey.

For further information regarding this project please contact:

Ali Sevenler
Senior Floodplain Engineer
Shoalhaven City Council
P: (02) 4429 3237 (9am - 5pm; Mon-Fri)
E: Ali.Sevenler@shoalhaven.nsw.gov.au

Q20. As a local resident, who has witnessed flooding/drainage problems, you may have your own ideas on how to reduce flood risks. Which of the following management options would you prefer? Please rank them where '1' is most preferable and '5' is least preferable.	☐ Road raising ☐ Improved flood flow paths ☐ Detention basins (they temporarily hold water and reduce flood flows) ☐ Culvert/bridge/pipe enlarging ☐ Flood gates ☐ Levee banks ☐ Entrance management strategy ☐ Environmental channel improvements, including removal of weeds and bank stabilisation ☐ Planning and flood related development controls ☐ Education of community, providing greater awareness of potential hazards ☐ Flood forecasting, flood warning, evacuation planning and emergency response ☐ Other, please specify: …… ……
Q21. What level of control do you consider Council should place on new development to minimise flood – related risk?	☐ Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing) ☐ Stop all new development on land with any potential to flood ☐ Place restrictions on development on flood prone land (e.g. minimum floor levels, use of flood – compatible materials) ☐ Advise people of flood risks and allow individuals to choose how they would reduce flood damage ☐ There should be no control on development in flood affected areas

D. Further Information

Q22. If you would like to receive more information, how would you like to receive that information? *(please select all that apply)*	☐ I do not wish to receive further information ☐ Council Website ☐ Email Newsletters ☐ Mail ☐ Public displays or exhibitions ☐ Phone call ☐ Other, please specify: ……

Q23. If you have any further comments that relate to flooding in this catchment, please express them below:

……

……

……

Thank you for your time in completing the survey



St Georges Basin Floodplain Risk Management Study and Plan

Resident / Landowner Survey | 2018

Shoalhaven City Council has engaged Cardno to assist with the preparation of a Floodplain Risk Management Study and Plan for the St Georges Basin catchments.

This survey will help us collect information about riverine flooding in the area through community experiences. The survey will also allow you to tell us about the flooding issues that are important to you and collect your ideas and preferences on how flood risk can be managed within the St Georges Basin catchments.

Please take a few minutes to complete the survey and return it in the reply paid envelope provided. Please note that you can also complete this survey online by going to Council's website and accessing the survey at this link:
https://www.surveymonkey.com/r/StGeorgesBasinFRMSP

Q1. Please provide us with the following details, as this allows us to locate specifically where your comments and responses relate to. This information will not be shared without your consent.	Name: …… Street Address: …… …… Phone Number: …… Email: ……
Q2. Do you give permission for someone from Council or Cardno to contact you to discuss any of the information you have provided us?	☐ Yes ☐ No

This project is supported by the NSW Government's Floodplain Management Program.

A. General Information about your household/business

Q3. Is your property (please select all that apply):

- ☐ Residential – Owner occupied
- ☐ Residential – Occupied by a tenant
- ☐ Holiday Home
- ☐ A business
- ☐ Farmland
- ☐ Other, please specify: ……

Q4. What is your property?

- ☐ House
- ☐ Unit/Flat/Apartment
- ☐ Commercial
- ☐ Industrial
- ☐ Other, please specify: ……

Q5. Which of the following construction materials best describes the building?

- ☐ Full brick
- ☐ Brick veneer
- ☐ Weatherboard or fibro
- ☐ Timber
- ☐ Concrete
- ☐ Steel
- ☐ Something else (please specify): ……

Q6. How long have you lived, worked at and/or owned your property?

_____Years
_____ Months

Q7. How long have you lived in the St Georges Basin area?

_____ Years
_____ Months

Q8. How many people occupy your property?

____ People

Q9. Is there anyone in your household who:

- ☐ Requires care (e.g. infants, elderly or has a disability)
- ☐ Requires assistance with speaking or reading English
- ☐ None of the above

B. Flood Experience

Q10. Have you or anyone in your household ever experienced flooding since living / working / owning your property? (please select all that apply)

- ☐ Never experience flooding
- ☐ Flooding over the floor of a living or working area
- ☐ Access to the property was cut off
- ☐ Yard/surrounding property flooded
- ☐ Water entry to a garage or shed
- ☐ Flooding of the street or footpaths
- ☐ Flooding of parks and open spaces
- ☐ Other, please specify ……

Q11. Please provide as much detail of the time and date as possible for up to 3 events or attach additional information for more than 3 events [your best estimate is fine – but the more accurate the date and time information the more valuable the data is for the flood modelling]

Event	Year	Month	Date	Time
1				
2				
3				

Q12. If your property was ever flooded above the house/garage floor level, please specify the depth above floor level and date(s) of the flood event(s):

- ☐ No, property never flooded above floor level
- ☐ Yes, please specify depth and date (as best as you can remember) ……

Q13. If your property grounds were ever flooded, please specify the depth and date(s) of the flood event(s):

- ☐ No, property grounds never flooded
- ☐ Yes, please specify depth and date (as best as you can remember) ……

Q14. In any flood event you have experienced in the past, what action did you take to protect your property or business against flood damage?

- ☐ None
- ☐ Moved vehicles
- ☐ Moved furniture or possessions
- ☐ Lifted or moved stock and equipment
- ☐ Used sandbags to try to prevent water entering the premises
- ☐ Evacuated property
- ☐ Other, please specify ……

Q15. In any flood event you have experienced in the past, what was the approximate cost to you (at the time) from the damage caused by the flood?

- ☐ No damage
- ☐ Yes, damages caused, please specify approximate cost and date ……

Q16. Do you have any photographs or video footage taken during or after any flooding event that you would like to share with Council?

- ☐ Yes, please attach or send through to Council (Labels or descriptions with this information will assist)
- ☐ No

C. Flood Risk and Management

Q17. In your opinion, what is the greatest flood risk in the catchment?

- ☐ Risk to property
- ☐ Risk to life
- ☐ Inconvenience (e.g. difficulties travelling)
- ☐ Other, please specify: ……

Q18. Do you think your property may be flooded sometime in the future?

- ☐ No
- ☐ Yes, but only a small part of my yard/outdoor areas could be flooded
- ☐ Yes, most of my yard/outdoor areas could be flooded
- ☐ Yes, my house/office/business could flood over the floor

Q19. Are there any works that you think Council should consider to reduce the flood risk at your property?

- ☐ No
- ☐ Yes, please specify: ……

APPENDIX C

RESPONSES TO COMMUNITY QUESTIONNAIRE

ID	Do you give permission for someone from Council or Cardno to contact you to discuss any of the information you have provided us?	Is your property (please select all that apply):	What is your property?	Which of the following construction materials best describes the building?	How long have you lived. worked at and/or owned your property?		How long have you lived in the St Georges Basin area?		How many people occupy your property?	Is there anyone in your household who:	Have you or anyone in your household ever experienced flooding since living / working / owning your property? (please select all that apply)	What were the areas of flooding (select all that apply)	Please provide as much detail of the time and date as possible for up to 5 events (your best estimate is fine – but the more accurate the date and time information the more valuable the data is for the flood modelling)	If your property was ever flooded above the house/garage floor level. please specify the depth above floor level and date(s) of the flood event(s):	If your property grounds were ever flooded. please specify the depth and date(s) of the flood event(s):
	Response	Response	Response	Response	Years	Months	Years	Months	People	Response	Response	Response	Response	Response	Response
1	Yes	Residential – Owner occupied	House	Brick veneer	8	Not Provided	0	Not Provided	2	None of the above	Never experience flooding	Not Provided	Not Provided	No. property never flooded above floor level.	Not Provided
2	Yes	Residential – Owner occupied	House	Weatherboard or fibro	2	6	2	6	2	None of the above	Never experience flooding	Not Provided	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
3	Yes	Residential – Owner occupied	House	Weatherboard or fibro	2	Not Provided	3	Not Provided	4	Requires care (e.g. infants. elderly or has a disability)	Never experience flooding	Not Provided	2015 family property 3 houses up was affected.	No. property never flooded above floor level.	No. property grounds never flooded.
4	Yes	Residential – Owner occupied	House	Full brick	2	1	3	4	2	None of the above	Never experience flooding	Not Provided	Not Provided	Not Provided	Not Provided
5	Yes	Residential – Owner occupied	House	Brick veneer	3	Not Provided	3	Not Provided	2	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	.Access to the property was cut off.Flooding of the street or footpaths.Flooding of parks and open spaces.We were looking at suburbs that suited us when the 2015 floods were subsiding and my wife took a lot of convincing to come back for a second look. I can't describe how much we love it here at Sussex Inlet and I would hate to think where we might of ended up if we didn't return to see it in all it's beauty.	August 2015 sussex inlet .2015 Picton.2004 Sth. West Rocks/Jerseyville.1984 Chipping Norton.1986 Lansvale	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).500mm Lansvale 1986
6	No	Residential – Owner occupied	House	Steel	1	8	4	Not Provided	2	None of the above	Never experience flooding	Not Provided	Not Provided	Not Provided	Not Provided
7	Yes	Residential – Owner occupied	House	Brick veneer	5	Not Provided	5	9	2	None of the above	Never experience flooding	Not Provided	26 Aug 2015 - Basin high water- not affecting us.	No. property never flooded above floor level.	No. property grounds never flooded.
8	Yes	Residential – Owner occupied	House	Weatherboard or fibro	10	Not Provided	5	Not Provided	2	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.	Aug 2015.June 2013.	Yes. please specify depth and date (as best as you can remember).100mm	Yes. please specify depth and date (as best as you can remember).150mm
9	Yes	Residential – Owner occupied	House	Weatherboard or fibro	10	Not Provided	5	Not Provided	2	None of the above	Yes. I have been impacted by flooding	Flooding over the floor of a living or working area.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.	June 2013.August 2015.	Yes. please specify depth and date (as best as you can remember).about 50mm in shed and granny flat	Yes. please specify depth and date (as best as you can remember).approx 100mm
10	Yes	Residential – Owner occupied	House	Full brick	12	Not Provided	5	Not Provided	2	None of the above	Yes. I have been impacted by flooding	Flooding over the floor of a living or working areaYard/surrounding property flooded.Water entry to a garage or shed.our boathouse was flooded	2015 approx	Yes. please specify depth and date (as best as you can remember).the boat house had 50cm of water inside.	Yes. please specify depth and date (as best as you can remember).Up to 1m from ground level where the sea water normally gives way to land
11	Yes	Residential – Owner occupied	House	Weatherboard or fibro	7	10	7	10	1	None of the above	Never experience flooding	Not Provided	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
12	Yes	Holiday Home	House	Brick veneer	7	6	7	6	4	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut off.Yard/surrounding property floodedFlooding of the street or footpaths	2015	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).1 metre above normal high tide 2015
13	Yes	Residential – Owner occupied	House	Full brick	22	Not Provided	8	5	2	None of the above	Never experience flooding	Not Provided	Not Provided	Not Provided	Not Provided
14	Yes	Residential – Owner occupied	House	Full brick	9	Not Provided	9	Not Provided	Not Provided	None of the above	Never experience flooding	Not Provided	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
15	Yes	Residential – Owner occupied	House	Full brick	10	Not Provided	10	Not Provided	1	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.	Approx 2 years	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).20 cms
16	Yes	Residential – Owner occupied	House	Brick veneer	10	Not Provided	10	Not Provided	2	None of the above	Yes. I have been impacted by flooding	Flooding over the floor of a living or working area.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.	2013.2014.2015	Yes. please specify depth and date (as best as you can remember).Approx 1 mtr	Yes. please specify depth and date (as best as you can remember).1mtr waist height
17	Yes	Residential – Owner occupied	House	Brick veneer	10	Not Provided	10	Not Provided	2	None of the above	Yes. I have been impacted by flooding	Not Provided	Not Provided	Not Provided	Not Provided
18	Yes	Residential – Owner occupied	House	Weatherboard or fibro	10	Not Provided	10	Not Provided	2	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut offFlooding of parks and open spaces.	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
19	No	Residential – Owner occupied	Relocatable home	Cladding	3	Not Provided	11	Not Provided	1	None of the above	Yes. I have been impacted by flooding	Flooding of the street or footpaths.Flooding of parks and open spaces.	Main access road at sanctuary point flooded at Cockrow Creek.Access to Palm Beach Sanctuary Point restricted.	No. property never flooded above floor level.	No. property grounds never flooded.
20	Yes	Residential – Owner occupied	House	Timber	4	Not Provided	12	Not Provided	2	None of the above	Never experience flooding	Not Provided	August 2015 opened Evacuation centre for those involvedTeam Leader in RedCross emergency Services. High tides and rain from the basin is unable to go to the sea from the inlet causing flooding	No. property never flooded above floor level.	No. property grounds never flooded.
21	Yes	Residential – Owner occupied	House	Weatherboard or fibro	12	11	12	11	2	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	.Water entry to a garage or shed.	Approx July 2015	Yes. please specify depth and date (as best as you can remember).As above/ 30cms	Yes. please specify depth and date (as best as you can remember).At least 30 cms
22	Yes	Residential – Owner occupied	House	brick ground level weatherboard top level	12	Not Provided	12	Not Provided	2	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	Flooding over the floor of a living or working area.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.	August 26th 2015	Yes. please specify depth and date (as best as you can remember).About 35cm	Yes. please specify depth and date (as best as you can remember).Any week that has 2 days or more over 40ml per day will make the yard hold water and it has nowhere to drain as there is no stormwater infrastructure. Interestingly this happened 3 to 4 times a year before 2015 but not since
23	Yes	Residential – Owner occupied	House	Weatherboard or fibro	12	Not Provided	12	Not Provided	2	None of the above	Yes. I have been impacted by flooding	.Water entry to a garage or shed.	Not Provided	Not Provided	Not Provided

ID	Do you give permission for someone from Council or Cardno to contact you to discuss any of the information you have provided us?	Is your property (please select all that apply):	What is your property?	Which of the following construction materials best describes the building?	How long have you lived. worked at and/or owned your property?		How long have you lived in the St Georges Basin area?		How many people occupy your property?	Is there anyone in your household who:	Have you or anyone in your household ever experienced flooding since living / working / owning your property? (please select all that apply)	What were the areas of flooding (select all that apply)	Please provide as much detail of the time and date as possible for up to 5 events (your best estimate is fine – but the more accurate the date and time information the more valuable the data is for the flood modelling)	If your property was ever flooded above the house/garage floor level. please specify the depth above floor level and date(s) of the flood event(s):	If your property grounds were ever flooded. please specify the depth and date(s) of the flood event(s):
	Response	Response	Response	Response	Years	Months	Years	Months	People	Response	Response	Response	Response	Response	Response
24	Yes	Residential – Owner occupied	House	Brick veneer	13	2	14	0	2	None of the above	Yes. I have been impacted by flooding	Flooding over the floor of a living or working areaYard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.	16 Decemeber 2015 - house was flooded by several inches of water right throughout the house. Water came from blocked stormwater pipes in Frederick StreetApril. 2013 - flooding of yard and water entry into main garage.July 2005 - flooding of yard and water entry into main garage.2013 - 2015 - ongoing issues with drainiage on my adjacent property (145 Frederick Street) which receives water from Frederick Street. Khan Street where there is no kerbing and guttering. This was resolved by water management installation on my own property. at major expense to myself	Yes. please specify depth and date (as best as you can remember).4 inches right through house & garage	Yes. please specify depth and date (as best as you can remember).up to 6 inches frequently over the period from 2005 (when I bought the property) to 2016 when it became necessary to take preventive action when council were unable (or refused) to assist.
25	Yes	Residential – Owner occupied	House	Full brick	2	Not Provided	15	Not Provided	4	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	Yard/surrounding property flooded	2015.2013.	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).0.5m
26	Yes	Residential – Owner occupied	House	Brick veneer	14	6	15	6	5	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.We are on bearers and joists above ground level	2013 approx june.2015 August.2007 june	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).2015 the highest backyard apprx 90cm
27	Yes	Residential – Occupied by a tenant	House	Weatherboard or fibro	5	Not Provided	16	Not Provided	4	Requires care (e.g. infants. elderly or has a disability)	Never experience flooding	Not Provided	2014	No. property never flooded above floor level.	No. property grounds never flooded.
28	Yes	Residential – Owner occupied	House	Brick veneer	17	10	17	10	2	None of the above	Never experience flooding	Not Provided	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
29	Yes	Residential – Owner occupied	House	Full brick	20	Not Provided	18	Not Provided	2	Requires care (e.g. infants. elderly or has a disability)	Never experience flooding	Not Provided	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
30	Yes	Residential – Owner occupied	House	Weatherboard or fibro	5	10	19	Not Provided	1	None of the above	Yes. I have been impacted by flooding	Yard/surrounding property flooded.Water entry to a garage or shedFlooding of parks and open spaces.	June 2013.Winter 2017?.	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).about 3-4 cms.
31	Yes	Residential – Owner occupied	House	Block work downstairs + timber upstairs	2	1	20	Not Provided	3	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut off.Flooding of the street or footpathsAt the time of flooding land was vacant	2014 shortly after purchase	Yes. please specify depth and date (as best as you can remember).If house had been constructed. water about 300mm in garage	Yes. please specify depth and date (as best as you can remember).2014 about 500mm over ground
32	Yes	Residential – Owner occupied	I also work in Sussex Inlet and have experienced the last 2 floods	No longer applicable in my situation	7	6	23	2	No longer applicable	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut off.Yard/surrounding property floodedFlooding of the street or footpaths.Flooding of parks and open spaces.entry to Sussex Inlet CBD closed off in both directions --- entry to shopping precinct except walking or cycling was not permitted	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
33	Yes	Residential – Owner occupied. Residential – Occupied by a tenant.Holiday Home	House	Weatherboard or fibro	25	Not Provided	25	Not Provided	2 to 6	None of the above	Yes. I have been impacted by flooding	.Water entry to a garage or shed.Some access roads cut off	August 2015.Periodic water flows over property during heavy storms due to lack of proper drainage on road/s above property.	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).Periodic water flows over property during heavy storms due to lack of proper drainage on road/s above property
34	Yes	Residential – Owner occupied	House	Full brick	24	0	26	Not Provided	3	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	Not Provided	Not Provided	Not Provided	Not Provided
35	Yes	Residential – Owner occupied	House	Concrete	2	Not Provided	30	Not Provided	4	Requires care (e.g. infants. elderly or has a disability)	Never experience flooding	Not Provided	It will never flood here	No. property never flooded above floor level.	No. property grounds never flooded.
36	Yes	Residential – Owner occupied	House	Timber	3	Not Provided	30	Not Provided	2	None of the above	Never experience flooding	Not Provided	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
37	Yes	Residential – Owner occupied	House	Full brick	25	Not Provided	30	Not Provided	3	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.Majority of flooding came from Larmer Avenue into backyards of homes in Mountain st Sanctuary Point.	August 1990 have photos storm and flood.June 1991 have photos 8 days consent rain.1999 have photos.2000.2013	Yes. please specify depth and date (as best as you can remember).garage about a foot or more	Yes. please specify depth and date (as best as you can remember).1990. 1991 3 bricks high or more canoeing around house. 2013 knee height.
38	No	Residential – Owner occupied	House	Combination of materials. Brick lower storey. Fibro upper storey	30	Not Provided	30	Not Provided	2	None of the above	Yes. I have been impacted by flooding	Not Provided	Not Provided	Not Provided	Not Provided
39	No	Residential – Owner occupied	House	Full brick	50	Not Provided	35	Not Provided	3	Requires care (e.g. infants. elderly or has a disability)	Never experience flooding	Not Provided	NO FLOOD.NO FLOOD.NO FLOOD	No. property never flooded above floor level.	No. property grounds never flooded.
40	Yes	Residential – Owner occupied	House	Full brick	9	Not Provided	36	Not Provided	2	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	.Access to the property was cut off.Flooding of the street or footpaths.Flooding of parks and open spaces.	2015	No. property never flooded above floor level.	No. property grounds never flooded.

ID	Do you give permission for someone from Council or Cardno to contact you to discuss any of the information you have provided us?	Is your property (please select all that apply):	What is your property?	Which of the following construction materials best describes the building?	How long have you lived. worked at and/or owned your property?		How long have you lived in the St Georges Basin area?		How many people occupy your property?	Is there anyone in your household who:	Have you or anyone in your household ever experienced flooding since living / working / owning your property? (please select all that apply)	What were the areas of flooding (select all that apply)	Please provide as much detail of the time and date as possible for up to 5 events (your best estimate is fine – but the more accurate the date and time information the more valuable the data is for the flood modelling)	If your property was ever flooded above the house/garage floor level. please specify the depth above floor level and date(s) of the flood event(s):	If your property grounds were ever flooded. please specify the depth and date(s) of the flood event(s):
	Response	Response	Response	Response	Years	Months	Years	Months	People	Response	Response	Response	Response	Response	Response
41	No	Residential – Occupied by a tenant	House	Full brick	25	8	42	Not Provided	2	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	Yard/surrounding property flooded	Not Provided	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember)5m
42	Yes	Residential – Owner occupied	House	Weatherboard or fibro	47	Not Provided	47	Not Provided	2	None of the above	Yes. I have been impacted by flooding	Yard/surrounding property flooded	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
43	Yes	Residential – Owner occupied	House	Weatherboard or fibro	3	Not Provided	54	Not Provided	2	None of the above	Yes. I have been impacted by flooding	Flooding of non-habitable lower level of the house	1974 (uncertain about year).1991.2013.2015.2016	No. property never flooded above floor level.	Yes. please specify depth and date (as best as you can remember).Up to 1 metre in parts
44	Yes	Residential – Owner occupied. Residential – Occupied by a tenant.Holiday Home	Unit/Flat/Apartment	Full brick	56	Not Provided	56	Not Provided	0	None of the above	Yes. I have been impacted by flooding	Flooding over the floor of a living or working area.Access to the property was cut off.Yard/surrounding property flooded.Water entry to a garage or shed.Flooding of the street or footpaths.Flooding of parks and open spaces.	1974.1991.june 2013.august 2015.november 2015	Yes. please specify depth and date (as best as you can remember).2015 above floor 30mil. 1974 above floor 61cm	Yes. please specify depth and date (as best as you can remember).1 meter above foundation
45	Yes	Residential – Owner occupied	House	Brick veneer	23	Not Provided	59	Not Provided	2	Requires care (e.g. infants. elderly or has a disability)	Yes. I have been impacted by flooding	Not Provided	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
46	Yes	Residential – Owner occupied	House	Weatherboard or fibro	28	Not Provided	62	Not Provided	2	None of the above	Yes. I have been impacted by flooding	The 1971 flood in Sussex Inlet saw the apron in front of the service station flooded (corner Jacobs drive and Sussex Inlet Road). In the same flood the greens of the Bowling Club were under water. The 2015 floods saw water at the boundary of Inasmuch Retirement village closest to the river. My property in Glanville Road has never flooded.	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
47	Yes	Residential – Owner occupied	House	Weatherboard or fibro	46	Not Provided	66	9	2	None of the above	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
48	Yes	Residential – Owner occupied	House	Brick and weatherboard	26	Not Provided	68	Not Provided	2	None of the above	Yes. I have been impacted by flooding	.Access to the property was cut off.Flooding of the street or footpaths.Flooding of parks and open spaces.	1960.1971.1990.Late 1990's.2014 and 2016	No. property never flooded above floor level.	No. property grounds never flooded.
49	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Yes. I have been impacted by flooding	Yard/surrounding property flooded	Not Provided	No. property never flooded above floor level.	No. property grounds never flooded.
50	Yes	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
51	Yes	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
52	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Never experience flooding	Not Provided	Not Provided	Not Provided	Not Provided
53	Yes	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
54	Yes	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
55	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Yes. I have been impacted by flooding	Not Provided	Not Provided	Not Provided	Not Provided

ID	In any flood event you have experienced in the past, did you have to take action to protect your property or business against flood damage?	What action did you take to protect your property or business against flood damage (Select all that apply)?	In any flood event you have experienced in the past, what was the approximate cost to you (at the time) from the damage caused by the flood?	Do you have any photographs or video footage taken during or after any flooding event that you would like to share with Council? (Please select all that apply)	In your opinion, what is the greatest flood risk in the catchment?	Do you think your property may be flooded sometime in the future?	Are there any works that you think Council should consider to reduce the flood risk at your property?	As a local resident, who has witnessed flooding/drainage problems, you may have your own ideas on how				
	Response	Response	Response	Yes, photos (please attach below or provide to council)	Response	Response	Response	Road raising	Improved flood flow paths	Detention basins (they temporarily hold water and reduce flood flows)	Culvert/bridge/pipe enlarging	Flood gates
1	No	Not Provided	Not Provided	No	The choke points at the ntrance to the Basin &the river at the entrance from the sea	No	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
2	No	Not Provided	No damage.	No	Risk to property	Yes, but only a small part of my yard/outdoor areas could be flooded	Ensure all building catchment drainage is plumbed to the road	10	1	9	8	6
3	No	Not Provided	No damage.	No	Risk to life	No	No	1	2	3	4	8
4	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
5	Yes	Moved vehicles.Moved furniture or possessionsUsed sandbags to try to prevent water entering the premises	Yes, damages caused, please specify approximate cost and date.No damage to structure but how do you put a price on weeks and weeks of cleaning mud and then dirt.	No	Inconvenience (e.g. difficulties travelling)	Yes, but only a small part of my yard/outdoor areas could be flooded	Regular dredging of the main Sussex Inletand learn from previous failures to get it done correctly.	6	4	11	9	10
6	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
7	No	Not Provided	No damage.	Yes, photos (please attach below or provide to council)	Risk to property	No	No	11	8	1	9	12
8	Yes	Moved vehicles.Moved furniture or possessions.Lifted or moved stock and equipment.	Yes, damages caused, please specify approximate cost and date.$5000	Yes, photos (please attach below or provide to council)	Risk to property	Yes, my house/office/business could flood over the floor	No	Not Provided	Not Provided	10	Not Provided	Not Provided
9	Yes	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
10	Yes	.Moved furniture or possessions	Yes, damages caused, please specify approximate cost and date.Rebuild the interior of the boathouse, reposition piers underneath boathouse which had been knocked down, replace cabinetry and some furniture. Approx $50.000	Yes, photos (please attach below or provide to council)	Risk to property	Yes, my house/office/business could flood over the floor	Im not an expert.	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
11	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	Yes, but only a small part of my yard/outdoor areas could be flooded	Adequate run off and keep trees.	11	1	8	5	10
12	No	Not Provided	No damage.	No	Risk to property	Yes, most of my yard/outdoor areas could be flooded	keeping sussex inlet as deep and as clear as possible	10	2	7	6	5
13	No	Not Provided	Not Provided	Not Provided	all of the above	No	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
14	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	No	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
15	Yes	Moved vehicles.Moved furniture or possessions	No damage.	No	Risk to property	Yes, my house/office/business could flood over the floor	Stop clearing land for new homes. restrictions on chopping down trees	Not Provided	1	Not Provided	Not Provided	Not Provided
16	Yes	Moved vehicles.Moved furniture or possessionsUsed sandbags to try to prevent water entering the premises.Evacuated property.	Yes, damages caused, please specify approximate cost and date.$100000	No	Risk to property	Yes, my house/office/business could flood over the floor	Clear cockrow creek. Stop water run off from street drains. It's too much for the creek to handle	6	2	4	10	7
17	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
18	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	No	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
19	No	Not Provided	No damage.	No	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
20	No	Not Provided	No damage.	No	Risk to property	No	No	3	2	Not Provided	4	Not Provided
21	Yes	Moved vehicles.Moved furniture or possessions	Yes, damages caused, please specify approximate cost and date.July 2015 $2000	No	Risk to property	Yes, most of my yard/outdoor areas could be flooded	The 'creek' at the back of the property is totally overgrown with trees and undergrowth	8	2	4	5	6
22	Yes	Moved vehicles.Moved furniture or possessionsUsed sandbags to try to prevent water entering the premises	Yes, damages caused, please specify approximate cost and date.About $24.000 for the 2015 flood	No	Risk to property	Yes, my house/office/business could flood over the floor	i have contacted council about storm water pooling on the road directly out front of my property and i was told the water is supposed to flow to the western end of mountain st into the storm water drain on Larmer Ave. This does not happen as water cannot run up hill.The council zoning map of this street shows that on the opposite side of the road between 5 and 7 mountain st there is an allotment for a drainage easement that currently has large trees and no council works on it. I would encourage council engineers to do what needs to be done to provide practical and necessary storm water drainage via this easement to greatly reduce the flood risk to the houses around it.	10	1	9	3	8
23	Yes	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided

ID	In any flood event you have experienced in the past, did you have to take action to protect your property or business against flood damage?	What action did you take to protect your property or business against flood damage (Select all that apply)?	In any flood event you have experienced in the past, what was the approximate cost to you (at the time) from the damage caused by the flood?	Do you have any photographs or video footage taken during or after any flooding event that you would like to share with Council? (Please select all that apply)	In your opinion, what is the greatest flood risk in the catchment?	Do you think your property may be flooded sometime in the future?	Are there any works that you think Council should consider to reduce the flood risk at your property?	As a local resident, who has witnessed flooding/drainage problems, you may have your own ideas on how				
	Response	Response	Response	Yes, photos (please attach below or provide to council)	Response	Response	Response	Road raising	Improved flood flow paths	Detention basins (they temporarily hold water and reduce flood flows)	Culvert/bridge/pipe enlarging	Flood gates
24	Yes	Moved vehicles.Moved furniture or possessions.Lifted or moved stock and equipmentEvacuated property.	Yes. damages caused. please specify approximate cost and date.Thankfully covered by a generous insurance policy so minimal actual cost to me. but the actual total repair costs would have exceeded $30.000	Yes. photos (please attach below or provide to council)	Risk to property	Yes. my house/office/business could flood over the floor	Kerb & Guttering and stormwater management in Frederick Street. Khan Street and ano other street which has a higher elevation than my property. Better management of stormwater beyond my property to allow water to flow 'away' and not 'into' my propoerty.	8	2	3	1	6
25	No	Not Provided	Yes. damages caused. please specify approximate cost and date.$2.000 clean up	Yes. photos (please attach below or provide to council)	Inconvenience (e.g. difficulties travelling)	Yes. but only a small part of my yard/outdoor areas could be flooded	Dredging of the Sussex Inlet mouth and the only reason St George's Basin floods as documented in numerous prior flood study's is the king tides acting as a plug stopping the storm water run off from leaving the basin during prolonged rain events. This is why flooding in the St. George's basin normally occurs infrequent as tides and weather need to be conducive. Localised flooding of roads and road related areas are a direct reflection on maintenance of road drains and storm water management. In my view more residents in flood risk areas should have to install storm water retention / management pits this will cut down on the amount being released into the water ways.	11	3	2	5	10
26	Yes	Moved vehicles.Moved furniture or possessions.Lifted or moved stock and equipment.Used sandbags to try to prevent water entering the premisesTurned power off before it was cut off.	Yes. damages caused. please specify approximate cost and date.2015 we had to replace water tank and pool pump cleaning of area approx 3000	Yes. videos (please provide to council separately)	Risk to property	Yes. most of my yard/outdoor areas could be flooded	Managing water ways supplying sandbags in a timely manner through SES look at easements on properties as our neighbour has built there yard up and therefore we are now lower than them which sees there run off impact our property. Ensure storm water drains are not blocked. Ensure when roads are blocked that vehicles do not travel in these waters as it further impacts properties. After flood events fix road surfaces with permanent resealing rather than patch up jobs.	11	2	1	7	3
27	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	Clean out and formalise the storm water drainage canals along Tasman Road. Currently overgrown weed beds and a risk to children	1	2	7	4	8
28	No	Not Provided	No damage.	No	Risk to property	No	No	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
29	No	Not Provided	No damage.	Yes. photos (please attach below or provide to council)	Risk to property	Yes. but only a small part of my yard/outdoor areas could be flooded	Upgrade & maintain the drains	Not Provided	Not Provided	1	2	Not Provided
30	No	Not Provided	Yes. damages caused. please specify approximate cost and date.Tools in boxes on she'd floor. No insurance claim	Yes. photos (please attach below or provide to council)	Risk to property	Yes. most of my yard/outdoor areas could be flooded	Don't know.each property would have different needs.	Not Provided	1	3	4	5
31	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	Yes. my house/office/business could flood over the floor	Cleaning drains so they are open and free flowing at the bottom of the catchment. removing rushes and trees etc. Maintaining tail outs from roadways	9	5	4	10	8
32	No	Not Provided	No damage.	Yes. photos (please attach below or provide to council).Yes. videos (please provide to council separately)	Risk to property	Yes. my house/office/business could flood over the floor	Safe Navigation Action Group has offered many suggestions since the 2013 and 2015 floods to SCC. The Central Shoalhaven Flood Plain Committee which have been thrown out the door but the worst was a comment from a State Govt representative who said " WELL . JUST DON'T LIVE THERE GO AND LIVE UP THE HILL" We found this degrading. belittling. totally non-empathetic and highly unprofessional---you wonder why we don't take this 6th or 7th time on the merry-go-around seriously. We even suggested at one of our meetings to the former Assets and Works Director that if they improved the Sussex Inlet entrance and the channel it would assist future flood mitigation.after mumbling a mathematical equation for about 2 minutes he informed that this would only have a positive impact on around 20 houses.and as I stated to him that's 20 more than this time. If you leave the tap running in the bathtub and it begins to overflow the 1st thing to consider is turning off the tap.but the tap is old and has seized.so what is the next solution.pull the bloody plug out. mate!!!! So if we were to remove the restriction at the entrance to the Inlet permanently and deepen or widen the channel with rock barriers and groins at key high risk bends it has to improve the opportunity for flood waters to escape and mitigate some of the flood risk to the township. Yuor own opening statement indicates 4 occasions that studies have been carried out before with no positive consequence and total waste of taxpayers & reatepayers monies	Not Provided	2	4	Not Provided	Not Provided
33	Yes	.Diverted water to area on property where no damage would be caused	No damage.	No	Risk to property	Yes. but only a small part of my yard/outdoor areas could be flooded	Proper drainage measures above my property to manage overland flow. Mainly kerb & guttering on roads above property.	8	1	5	3	6
34	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
35	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	No	2	1	5	4	6
36	Yes	.prepared property by cleaning gutters and drainage points and tidying up	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	improve street drainage and gutters. enforce soft landscaping and not concrete yards	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
37	Yes	Moved vehicles.Moved furniture or possessionsUsed sandbags to try to prevent water entering the premises	Yes. damages caused. please specify approximate cost and date.garage tools and electrical garden products building materials. Cost $1000 aprox	Yes. photos (please attach below or provide to council)	Risk to property	Yes. most of my yard/outdoor areas could be flooded	The drain that takes in water from Larmer and supposedly runs into a man made canal/drain which was put onto private land by council and was to be maintained by council documentaion I have. As it stands now it is non existant overgrown and the last time it was cleared 2000. This is where most of our flooding comes from for residents in Mountain St. photos I have. This land can not be built up due to the fact an error in the orthophoto from Lands dept was in error of 1.0 metre higher than what is. this error was detected after many houses were built from this point on new regulations came into place. documents from council re error I have.It can only help these residents if a more constructed draine was put into place. My family built here in the 1970s and we have lived here most of our lives this is why I have much knowledge and if i can help in anyway willing to do so.	Not Provided	1	Not Provided	Not Provided	Not Provided
38	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
39	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	No	8	3	2	Not Provided	Not Provided
40	No	Not Provided	No damage.	No	Risk to property and life	Yes. but only a small part of my yard/outdoor areas could be flooded	Reduce the restrictions to the river entrance to the ocean. this will enable the water to flow out faster and will hopefully take with it the area of siltation in the Sussex Inlet River that's holding back the water flow. The installation of Detention Basins in the Tullawulla Catchment area. to reduce the level of flooding and to control the duration of the flows to a more tolerable level of duration. and as such will help mitigate and lessen the impact of the flooding. Remove the ballast rock from the river entrance to enable the river to flow as it did in the early 1800's.	8	5	1	4	10

ID	In any flood event you have experienced in the past. did you have to take action to protect your property or business against flood damage?	What action did you take to protect your property or business against flood damage (Select all that apply)?	In any flood event you have experienced in the past. what was the approximate cost to you (at the time) from the damage caused by the flood?	Do you have any photographs or video footage taken during or after any flooding event that you would like to share with Council? (Please select all that apply)	In your opinion. what is the greatest flood risk in the catchment?	Do you think your property may be flooded sometime in the future?	Are there any works that you think Council should consider to reduce the flood risk at your property?	As a local resident. who has witnessed flooding/drainage problems. you may have your own ideas on ho				
	Response	Response	Response	Yes. photos (please attach below or provide to council)	Response	Response	Response	Road raising	Improved flood flow paths	Detention basins (they temporarily hold water and reduce flood flows)	Culvert/bridge/pipe enlarging	Flood gates
41	Yes	Moved vehicles.Used sandbags to try to prevent water entering the premises	No damage.	No	Inconvenience (e.g. difficulties travelling)	Yes. but only a small part of my yard/outdoor areas could be flooded	Clearing of drainages to allow water to flow into basin	9	3	1	4	7
42	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	No	1	3	8	2	6
43	Yes	.Moved furniture or possessionsUsed sandbags to prevent wave damage to doors	Yes. damages caused. please specify approximate cost and date.Minor with no significant cost	Yes. photos (please attach below or provide to council)	Risk to property	Yes. but only a small part of my yard/outdoor areas could be flooded	No	Not Provided	Not Provided	2	Not Provided	Not Provided
44	Yes	Moved vehicles.Moved furniture or possessions.Lifted or moved stock and equipmentEvacuated property.	Yes. damages caused. please specify approximate cost and date.10.000.00	No	Inconvenience (e.g. difficulties travelling)	Yes. my house/office/business could flood over the floor	clearing sand from the inlet	4	3	Not Provided	Not Provided	Not Provided
45	Yes	.modified drainage on property. flooding was caused by stormwater	No damage.	No	Inconvenience (e.g. difficulties travelling)	Yes. but only a small part of my yard/outdoor areas could be flooded	improved storm water drainage and catchment on Mernie St and Christinsen Ave	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
46	No	Not Provided	No damage.	No	Risk to property	No	Follow the recommendations in the document (Sussex Inlet Dredging Plan 2017 - published by the SAFE NAVIGATION ACTION GROUP Inc.)	10	2	4	9	12
47	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
48	No	Not Provided	No damage.	Yes. photos (please attach below or provide to council)	Risk to property	No	Drainage at eastern side of Badgee barge and dredging of river Chanel and build up of sand sediment and weed bed on river side of Badgee bridge at canal entrance at Badgee Lagoon	4	2	6	5	9
49	No	Not Provided	No damage.	No	Inconvenience (e.g. difficulties travelling)	No	No	Not Provided	Not Provided	Not Provided	1	Not Provided
50	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
51	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
52	No	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
53	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
54	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
55	Yes	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided

ID	v to reduce flood risks. Which of the following management options would you prefer? Please rank them where '1' is most preferable. (You can drag the options to rank them)							What level of control do you consider Council should place on new development to minimise flood – related risk?	Would you like to receive more information from Council regarding flooding in your catchment?	How would you like to receive that information? (please select all that apply)	If you have any further comments that relate to flooding in this catchment. please express them below:
	Levee banks	Entrance management strategy	Environmental channel improvements. including removal of weeds and bank stabilisation	Planning and flood related development controls	Education of community. providing greater awareness of potential hazards	Flood forecasting. flood warning. evacuation planning and emergency response	Other option. Please specify this at the end of the survey	Response	Response	Council Website	Open-Ended Response
1	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	1	Not Provided	Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)	Yes	mail Newsletters	The removal of ballast rocks from entrance should be first. followed by the dredging of sand from the entrance to the Basin
2	2	7	3	4	5	11	12	Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)	Yes	mail Newsletters	Not Provided
3	9	6	5	7	10	11	12	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	Yes	mail Newsletters	If our property flooded and reached the street from the Basin. that would be an incredible flood and Nowra should be worried. I don't believe there are any issues with flooding on our property.
4	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
5	8	1	2	3	7	5	12	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	Council Websitemail Newsletters	I love the wild life we are fortunate to have within the Basin vicinity. I have Roo's. Parrots. rabbits I'm fortunate to see every afternoon in the reserve across from me. but we can never allow a human life to be at risk over the concerns of Gods little creaturesIf a rescue boat can't get from point A to point B in the effort of saving lives in the quickest possible time. then we are heading down a very sad path.
6	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
7	2	6	10	4	7	3	Not Provided	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	The 2015 event was exacerbated by high tide and build-up from strong southerly winds along the south-facing (northern) Basin shoreline. Much of Sanctuary Point is less than 2m above high tide level and therefore at chronic and regular flood risk. Council should ensure that all residents and owners in these defined areas are well-informed of these risks. especially at point-of-sale/purchase (though the RE sales folk will be opposed). that flood risk warnings are timely and that exit roads are well above the chosen flood-risk level. Warnings need to be accurate and property-specific. unlike in the past. EG some properties along Loralyn are flood prone. others will seldom. if ever. be affected. being more than 5 or 6 metres above high tide level. Blanket evacuation warnings are inappropriate. will be counterproductive. and warnings need to be targetted at high-risk properties. Each property owner/resident should be made aware of the flood-risk status of their residence - ie something like A= 1.0 m. B=1.0-2.0m. C=2.0-3.0m etc. A bit like fire-hazard warnings? The impact on property values may be an issue. but caveat emptor. An updated and readily accessible flood-risk map may be the solution. but without any hyped sea-level-rise assumptions that will negate its utility and acceptance. Let residents and buyers be well-informed and left to work out their own risk preferences - and accept the consequences.
8	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	12	Not Provided	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	Apart from property damage the major risks at Sussex Inlet in sewerage in the floodwater and damage caused to roads
9	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
10	Not Provided	Not Provided	Not Provided	1	Not Provided	2	Not Provided	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	I do not wish to receive further information	Not Provided	Not Provided
11	9	6	7	4	2	3	12	Stop all new development on land with any potential to flood	Yes	Council Website.	The main concern for me is being able to evacuate.
12	11	1	3	4	9	8	12	Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)	Yes	mail Newsletters	Not Provided
13	Not Provided	1	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Stop all new development on land with any potential to flood	Yes	mail Newsletters	All flood control in the Basin is useless unless the ballast rocks in the entrance to Sussex Inlet river are removed first. This would then allow the water to get away faster and hopefully reduce flooding.
14	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Stop all new development on land with any potential to flood	I do not wish to receive further information	Not Provided	Not Provided
15	Not Provided	Not Provided	3	2	Not Provided	Not Provided	Not Provided	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	What effect will the proposed bird wetlands have on flooding for residences in Mountain St .and The Park Drive?
16	1	3	8	9	11	5	12	Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)	Yes	Council Websitemail Newsletters	The more houses the more storm run off the more the creek can't cope. Poor clearing of creek water flow effected. You can't use creeks as a dumping ground of water run off and expect them to cope when they already flood. Each time the water levels are increasing in the creeks
17	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
18	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Yes	Council Websitemail NewslettersPublic displays or exhibitions	Not Provided
19	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
20	Not Provided	5	Not Provided	1	6	7	Not Provided	Stop all new development on land with any potential to flood	Yes	mail Newsletters	Over development in the area without the proper infrastructure supplied
21	7	3	1	9	10	11	12	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	Yes	Mail.	Not Provided
22	4	6	2	5	12	11	Not Provided	Stop all new development on land with any potential to flood	Yes	mail Newsletters	As i previously mentioned please urgently consider allocating works to the easement between 5 and 7 Mountain St Sanctuary Point. as there is a pending D.A to build on 6 mountain st and this means the water that sits on that property now will have nowhere to go other than onto mine and surrounding properties on this side of the street.
23	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided

ID	w to reduce flood risks. Which of the following management options would you prefer? Please rank them where '1' is most preferable. (You can drag the options to rank them)							What level of control do you consider Council should place on new development to minimise flood – related risk?	Would you like to receive more information from Council regarding flooding in your catchment?	How would you like to receive that information? (please select all that apply)	If you have any further comments that relate to flooding in this catchment. please express them below:
	Levee banks	Entrance management strategy	Environmental channel improvements. including removal of weeds and bank stabilisation	Planning and flood related development controls	Education of community. providing greater awareness of potential hazards	Flood forecasting. flood warning. evacuation planning and emergency response	Other option. Please specify this at the end of the survey	Response	Response	Council Website	Open-Ended Response
24	7	5	4	9	10	11	12	Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)	Yes	mail Newsletters	At times of heavy rain. the stormwater systems within several blocks of my home fail to cope with the excessive flow of water from land which has a higher elevation than mine. Major revision to stormwater management is required. All residential streets should be kerbed and guttered enabling water to flow into an effective and integrated stormwater management system.
25	12	1	4	6	7	8	9	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	Yes	mail NewslettersPublic displays or exhibitions	Q23 I feel should have an other option current DCP106 has very stringent conditions contained within for building in a flood prone area. Personally having just built on the water front with these conditions being implemented I believe these are a fair set of control principles. To stop building in a flood prone area is insane given the fact that current flood mapping and historical events shows when St. George's basin floods areas on the foreshore may only see a rise of .5mt however areas further inland upto 1km in st Sanctuary Point and some areas of Sussex inlet will flood to 1+ Being in local emergency services I played an active role over the last 3 floods in the bay and basin area with extremely strong feelings about poor planning and inadequate response from the SES in relation to wait and see attitude rather than proactive approach based on current mapping and predictions on flood levels. I emailed SES and the response was even further disopointing due to the fact their response was lies advising crews were busy however they were staged in a watch and wait situation. As advised current DCPS are adequate with a few prevention strategies such as entrance management. retention systems on property's as well as larger retention systems. Areas such as removal of foreshore sewer pump out stations and pipelines are key to reduced contamination during floods as a large percentage of St. George's basin has sewer along the foreshore.
26	8	4	5	6	10	9	12	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	Mail.	In the 2015 flood i understand that the SES were stretched resource wise but i feel council should have provided earlier intervention and financial support to SES and rural fire services to help residents. My husband went to his job site and collected sand and we made pur own sandbags as there were none available for us. Had he not done this we would have been further impacted. We had SES arrive 2 days after the peak of the flood offering sandbags. too little too late. Council needs to act faster and provide financial support to get more services in faster.
27	5	9	3	6	10	11	12	Stop all new development on land with any potential to flood	Yes	mail Newsletters	Not Provided
28	Not Provided	Not Provided	Not Provided	5	Not Provided	Not Provided	Not Provided	Stop all new development on land with any potential to flood	Yes	mail Newsletters	Not Provided
29	Not Provided	7	3	5	6	4	8	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	Not Provided
30	6	7	9	10	8	11	12	Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)	Yes	mail Newsletters	My experiences were related to the Basin. Residents on Cockrow Creek would have different responses. I have 3 more photos but couldn't upload them
31	7	3	1	6	11	2	12	Stop all new development only in areas where flooding is most severe (i.e. deep and fast flowing)	Yes	mail Newsletters	Not Provided
32	5	1	3	Not Provided	Not Provided	Not Provided	Not Provided	Stop all new development on land with any potential to flood	Yes	mail Newsletters	The constructions of retention ponds (lakes) in the Tallawalla Lagoon Area where a number of local creeks converge and where it seems about 70% of the flooding waters generate has been suggested by a SNAG colleague. This idea bore merit and the construction of the lakes could also double as a water sports facility similar to Penrith lakes constructed for the Olympic Games. Construction of accommodation in the surrounding villages and towns in conjunction and Hey Presto we have a fine international / national sporting tourism facility bring $$$$$'s to the Shoalhaven and assisting our economy while at the same time providing one of the flood mitigation systems. So there is an opportunity to obtain an ROI over time for its construction costs. it will require a combination of the Lakes. Channel & entrance improvements to really get the best result Think BIGPut your hands in Deep Pockets as the Dutch have done and do a real job not a half baked effort that will need redoing in a short time
33	7	12	11	2	4	9	10	Stop all new development on land with any potential to flood	Yes	mail Newsletters	Not Provided
34	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
35	7	3	8	9	11	10	12	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	Yes	mail Newsletters	Not Provided
36	Not Provided	Not Provided	3	Not Provided	1	2	Not Provided	Stop all new development on land with any potential to flood	I do not wish to receive further information	Not Provided	Not Provided
37	Not Provided	Not Provided	Not Provided	2	Not Provided	Not Provided	Not Provided	There should be no control on development in flood affected areas	Yes	Council Website.	I have many photos as residents have moved out the file is passed onto another resident this helps people know what our concerns have been mostly in protecting our homes from the adjoining paddock. I do not have mobile phone and unable to send thru photos of floods. I am happy to go to the library copy and send them to you.
38	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
39	Not Provided	7	1	6	4	5	Not Provided	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	I do not wish to receive further information	Not Provided	Not Provided
40	9	2	3	11	7	6	12	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	Yes	Council Websitemail NewslettersPublic displays or exhibitions	As President of the Safe Navigation Action Group Inc - Sussex Inlet. we are currently working with SCC and the staff to formulate a plan of action to restore the Sussex Inlet River/Channel to a near to it's original state as can be. Because of man made blockages (Ballast Rock. Old Cars etc.) the river entrance adjacent to the ARU Caravan Park and the area of ballast rock deposited there by the early coastal vessels entering the river to travel to the timber mills in the St. Georges Basin . The Boat ramp at the ARU and Bay of Plenty Holiday resort. had at one time a depth of 30 plus feet. until old dune buggies and other items were driven off the ramp to (what people thought) create a fish habitat This has assisted in the serious siltation of the area. We ask that the report take into account that a lot of the problems have been man made by diposing of material in the waterways. this has attracted the sand to collect. and changed the course of the river flow to meander and create sand bars and islands.

ID	w to reduce flood risks. Which of the following management options would you prefer? Please rank them where '1' is most preferable. (You can drag the options to rank them)							What level of control do you consider Council should place on new development to minimise flood – related risk?	Would you like to receive more information from Council regarding flooding in your catchment?	How would you like to receive that information? (please select all that apply)	If you have any further comments that relate to flooding in this catchment. please express them below:
	Levee banks	Entrance management strategy	Environmental channel improvements. including removal of weeds and bank stabilisation	Planning and flood related development controls	Education of community. providing greater awareness of potential hazards	Flood forecasting. flood warning. evacuation planning and emergency response	Other option. Please specify this at the end of the survey	Response	Response	Council Website	Open-Ended Response
41	5	6	2	12	8	10	11	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	I do not wish to receive further information	Not Provided	Not Provided
42	12	5	4	9	10	7	11	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	Yes	Council Website.	Not Provided
43	Not Provided	1	Not Provided	3	Not Provided	Not Provided	Not Provided	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	Not able to supply photos with this survey but have some if the SCC wants to contact me.
44	Not Provided	1	2	Not Provided	Not Provided	Not Provided	5	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	kerb and guttering to Fairview crescent
45	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	As a life time resident I consider that there are a number of issues that contribute to localised flooding in the area. Storm water run off. with minimal curb and guttering and poor drainage. Storm water collects and then pours into the waterways in large volumes. While not Council's fault. I have noticed that the incidence of significant flooding 'events'. has increased as the numerous creeks such Cockcrow Ck become silted up and their flow obstructed by rubbish and debris blown. washed or thrown into them. The numerous creeks that feed into Jervis Bay and are now silted up also and ad to the issue. As an example the late Alf Settry dredged Currambene Ck for decades. As Council would know. this was stopped when the Marine Park was founded. In my opinion. Council needs to take are more 'whole of Government' approach to our flooding issues and involve Council's road works. parks and gardens and major works departments. along with the NSW National Parks and the Marine Park management and Crown Lands Department. as well as resident reps (at risk of sounding discriminatory. the residents need to have lived here long enough to have witnessed a 'flood or two'. to have a appropriate input). I would further suggest that a conference involving all the 'stake holders'' as mentioned. would be an effective way of starting the process and making certain that everybody understands their responsibilities. when it comes to Flood Mitigation in the Basin area.
46	11	5	3	6	7	8	1	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	mail Newsletters	The highest priority for action in Sussex Inlet is to develop a strategy/maintenance plan to remove on a regular basis the sand that constantly acts as a barrier to flood water egress. These sands typically accumulate in the river between the Lakehaven Drive boat ramp and the entrance. The logic is that the duration of a flood event would be reduced if these sands were removed prior to flooding. With these sand shoals removed prior to a flood event it would leave only the sand spit at the entrance to be punched out by the head of water trying to escape the river system on the first ebb tide. The community of Sussex Inlet look forward to this Study accurately modeling this concept.
47	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
48	8	3	1	7	10	11	12	Place restrictions on development on flood prone land (e.g. minimum floor levels. use of flood – compatible materials)	Yes	Council Websitemail Newsletterssmail.Public displays or exhibitions	Sussex inlet needs to have a focussed plan that deals with what can be done to retain waters headed for the basin How about Wandandian. Waters retenion lakes The ever growing development of our surrounds and the run off of nutrient rich water has certainly slowed the flow of water in and along the inlet to the point where flooding will occur more often and the waterways becoming unnavigable due to siltstoon erosion and algal and weed growth
49	Not Provided	Not Provided	2	Not Provided	Not Provided	Not Provided	Not Provided	Advise people of flood risks and allow individuals to choose how they would reduce flood damage	I do not wish to receive further information	Not Provided	Not Provided
50	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
51	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
52	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Yes	Not Provided	Not Provided
53	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
54	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided
55	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided

APPENDIX D

WBNM CATCHMENTS DETAILS

Subarea Name	D/S Subarea	Area [ha]	CGE	CGN	Out E	Out N	Imp Fraction
143	113	3.248	286115.47	6113952.19	0	0	34.0
85	113	63.505	278174.63	6110551.93	0	0	3.2
73	113	54.599	276922.2	6110390.76	0	0	2.4
96	113	326.359	279369.81	6108972.45	0	0	1.7
103	113	49.4	280122.92	6108104.88	0	0	37.1
141	113	63.93	286077.18	6109293.09	0	0	1.8
121	113	6.833	283474.09	6107865.95	0	0	6.5
81	113	535.229	277843.37	6109614.94	0	0	1.8
145	113	35.958	286552.54	6109830.97	0	0	1.8
149	113	70.19	287149.66	6110458.2	0	0	1.1
74	77	51.394	276864.92	6113839.62	0	0	6.4
77	113	22.184	277367.11	6113826.27	0	0	59.7
82	113	18.371	278025.24	6113910.01	0	0	60.2
90	113	16.652	278828.4	6113589.23	0	0	61.3
151	142	84.478	287111.95	6113758.67	0	0	6.8
150	142	59.847	287051.88	6113255.47	0	0	12.2
142	113	28.312	286146.46	6113589.87	0	0	41.1
71	113	39.643	276705.52	6113206.58	0	0	2.1
112	113	50.755	281286.66	6113635.14	0	0	74.7
114	113	60.437	281956.1	6113803.91	0	0	65.3
115	113	56.678	282577.54	6113386.16	0	0	71.5
118	113	47.452	283141.17	6112733.74	0	0	67.7
133	113	23.993	284734.88	6112587.77	0	0	64.0
128	113	32.094	284314.24	6112279.4	0	0	76.9
120	113	55.288	283226.96	6111688.97	0	0	64.8
131	113	39.173	284585.51	6111827.34	0	0	61.6
125	113	58.848	283792.2	6112148.46	0	0	69.7
59	68	108.957	274224.06	6112588	0	0	0.0
49	54	230.733	272911.26	6117986.51	0	0	0.0
54	58	224.527	273445.55	6116615.33	0	0	0.0
58	60	57.078	274111.47	6115673.54	0	0	0.0
12	15	484.9	264273.46	6112214.89	0	0	0.0
3	4	424.734	258995.38	6110741.19	0	0	1.5
2	4	606.009	257559.74	6108669.32	0	0	0.0
4	7	434.858	260148.97	6109251.57	0	0	0.0
7	11	802.195	261655.2	6109926.59	0	0	0.0
8	11	771.48	262156.39	6112030.67	0	0	0.1
1	6	1322.557	256961.51	6106308.43	0	0	0.0
5	6	454.154	260249.95	6105240.96	0	0	0.0
6	9	342.981	260451.4	6106809.03	0	0	0.0
9	11	470.569	262474.67	6106793.35	0	0	0.0
11	15	377.767	263463.73	6108950.87	0	0	0.0

Subarea Name	D/S Subarea	Area [ha]	CGE	CGN	Out E	Out N	Imp Fraction
15	23	832.518	265804.93	6109310.91	0	0	0.0
13	18	611.165	264773.99	6106767.49	0	0	0.0
18	23	468.092	266914.01	6106938.46	0	0	0.2
23	26	170.097	268526.65	6108450.08	0	0	2.3
19	26	479.506	267710.71	6110758.01	0	0	0.0
26	32	194.957	268940.36	6110181.97	0	0	0.4
32	38	538.333	270273.06	6112157.07	0	0	0.4
34	37	50.454	271217.14	6114878.32	0	0	0.0
37	38	29.596	271451.73	6114387.55	0	0	0.0
17	25	684.269	266830.32	6118260.65	0	0	0.8
25	28	547.342	268718.38	6116790.18	0	0	0.0
28	31	330.821	269785.74	6115259.94	0	0	0.0
10	14	935.268	263102.22	6114621.56	0	0	1.5
14	20	514.427	265679.98	6113679.09	0	0	0.0
20	31	695.323	267684.52	6112791.6	0	0	0.0
16	21	409.253	266019.53	6116128.28	0	0	0.2
21	31	336.8	267772.79	6114812.08	0	0	0.0
31	38	209.076	270165.28	6114003.51	0	0	0.0
38	44	47.232	271644.04	6113641.56	0	0	0.0
42	44	81.46	271836.4	6112611.65	0	0	4.4
44	48	30.986	272100.34	6113400.45	0	0	2.3
47	48	100.568	272726.41	6112696.22	0	0	0.8
48	55	20.559	272711.7	6113408.56	0	0	9.4
55	57	185.948	273596.9	6113476.2	0	0	3.8
29	36	145.107	270008.89	6117799.99	0	0	0.0
22	33	300.769	268336.09	6119333.9	0	0	1.1
33	43	172.328	270681.35	6118599.51	0	0	0.0
43	40	105.586	271988.37	6118716.57	0	0	1.4
40	36	167.493	271570.51	6117485.12	0	0	0.0
36	46	260.873	271332.31	6116418.61	0	0	0.0
39	46	57.478	271614.35	6115421.69	0	0	0.0
46	51	83.562	272471.18	6115400.93	0	0	0.0
45	51	140.047	272310.1	6114350.55	0	0	6.5
51	57	64.426	273241.31	6114687.95	0	0	8.1
57	60	54.958	273944.93	6114391.11	0	0	8.0
53	60	81.709	273321.06	6115528.03	0	0	0.5
60	65	66.674	274312.85	6114858	0	0	11.6
62	65	181.766	274971.74	6115759.68	0	0	0.4
65	68	280.99	275396.09	6114132.08	0	0	6.6
68	76	167.625	275649.97	6113060.05	0	0	9.6
24	30	430.029	268651.9	6106748.69	0	0	2.6
30	35	299.512	270205.85	6108558.72	0	0	0.0

Subarea Name	D/S Subarea	Area [ha]	CGE	CGN	Out E	Out N	Imp Fraction
27	35	98.783	269680.24	6109572.4	0	0	7.4
35	50	362.561	271287.33	6110540.89	0	0	1.9
50	64	375.156	273104.78	6111501.98	0	0	2.2
67	64	87.96	275599.02	6111698.94	0	0	0.6
64	76	85.651	275267.47	6112175.06	0	0	93.8
75	76	57.66	276996.98	6111925.29	0	0	0.1
76	113	104.814	276996.36	6112364.78	0	0	27.5
41	52	786.176	271779.86	6107768.36	0	0	0.0
52	56	343.029	273303.78	6109445.78	0	0	2.8
56	63	71.985	273733.98	6110405.97	0	0	5.8
63	113	363.898	275148.1	6110381.79	0	0	2.8
69	113	43.544	276590.14	6111343.5	0	0	0.3
78	113	32.857	277707.58	6111823.07	0	0	0.2
138	113	9.501	285855.29	6113564.72	0	0	61.8
144	113	33.848	286307.94	6113024.62	0	0	67.4
146	113	30.143	286800.85	6112430.44	0	0	12.1
154	148	159.285	287759.9	6112737.68	0	0	1.4
148	113	16.484	287015.23	6112031.68	0	0	16.7
155	113	67.257	287898.66	6111782.67	0	0	0.8
153	113	80.951	287317.32	6111349.43	0	0	11.1
79	86	76.137	277707.76	6115270.48	0	0	13.3
72	86	283.985	276683.36	6115160.66	0	0	11.1
86	113	97.168	278548.28	6114116.7	0	0	36.2
108	113	61.058	280891.67	6114101.08	0	0	74.9
88	113	61.627	278580.46	6114850.11	0	0	24.3
93	100	263.524	278999.72	6115529.07	0	0	8.2
100	113	36	279603.8	6114480.66	0	0	7.8
119	122	48.695	283099.53	6113813.52	0	0	61.4
107	106	101.909	280479.69	6118779.43	0	0	7.1
106	102	66.702	280416.69	6118051.8	0	0	9.5
66	87	1186.326	275495.36	6120027.27	0	0	1.6
87	94	488.947	278495.93	6119937.79	0	0	5.8
98	94	32.232	279493.82	6119072.25	0	0	0.9
94	97	19.497	279125.26	6118835.53	0	0	10.1
97	102	89.384	279426.71	6118188.26	0	0	13.1
102	110	81.065	279889.27	6117507.33	0	0	2.5
83	89	191.675	277975.97	6118201.29	0	0	3.0
61	70	289.072	274476.3	6117909.84	0	0	0.0
70	89	673.217	276624.76	6117155.59	0	0	0.8
89	92	25.263	278569.72	6117246.77	0	0	27.6
92	91	15.411	278920.71	6117381.64	0	0	26.3
91	110	58.716	278859.99	6116782.82	0	0	18.4

Subarea Name	D/S Subarea	Area [ha]	CGE	CGN	Out E	Out N	Imp Fraction
110	117	744.555	281162.05	6115868.6	0	0	6.0
117	122	113.705	282978.88	6114602.5	0	0	32.6
122	132	38.403	283645.41	6114326.64	0	0	11.1
124	132	24.741	283677.06	6113697.25	0	0	61.6
123	132	68.645	283657.01	6113165.38	0	0	43.3
129	132	35.373	284292.84	6112922.18	0	0	72.6
126	132	57.383	284178.39	6114753.87	0	0	3.3
136	132	30.145	285381.41	6114322.48	0	0	32.8
134	132	24.492	284879.69	6114597.66	0	0	5.1
132	113	147.776	284625.88	6113715.88	0	0	18.8
130	139	303.936	284524.46	6115636.73	0	0	3.1
139	140	31.361	285886.59	6115163.43	0	0	31.1
137	140	31.663	285547.15	6114671.71	0	0	55.8
152	140	92.233	287139.35	6114224.57	0	0	5.6
147	140	143.707	286897.38	6114948.96	0	0	2.4
140	113	33.536	285988.75	6114392.42	0	0	25.2
105	113	70.13	280407.47	6114808.47	0	0	28.1
135	127	99.867	285171.91	6108224.53	0	0	1.9
116	127	237.826	282971.21	6106815.94	0	0	0.0
127	113	41.997	284298.77	6107473.09	0	0	0.1
113	111	3766.132	282003.52	6111069.18	0	0	98.1
80	95	240.222	277772.77	6107633.65	0	0	3.8
84	95	128.918	278178.31	6106460.91	0	0	11.1
95	111	185.18	279228.2	6107367.48	0	0	27.7
99	111	98.807	279626.97	6106081.02	0	0	53.6
111	109	543.802	281266.84	6107149.52	0	0	35.9
101	109	68.156	279823.76	6105238.36	0	0	31.2
104	109	82.362	280169.55	6104386.48	0	0	2.7
109	SINK	279.815	281139.64	6105163.21	0	0	34.0

APPENDIX

E

CALIBRATION EVENTS PEAK LEVELS COMPARISON

2015 Storm Event						
ID	**Quality (+/-mm)**	**Survey Comments**	**Recorded Peak Flood Levels (mAHD)**	**Modelled Levels**	**Diff(M-R)**	**Cardno Comments**
101	0.027	Reserve at end of Jacob St, Sussex Inlet	1.658	1.595	-0.063	< 40mm of Quality Tolerance
102	0.029	Sussex House Caravan Park & Holiday Cottages, Jacob St	1.68	1.591	-0.089	< 60mm of Quality Tolerance
103	0.028	Front fence of 'Calm Waters' cottages, Sussex Inlet	1.671	1.634	-0.037	< 10mm of Quality Tolerance
105	0.04	Holiday Cottage, Sussex Inlet	1.688	1.636	-0.052	< 12mm of Quality Tolerance
106	0.018	Holiday Cottage, Sussex Inlet	1.726	1.636	-0.090	< 100mm of Quality Tolerance
107	0.036	27 Fairway Crescent, Sussex Inlet - on fence line	1.875	1.703	-0.172	Good correlation achieved at its surrounding survey points
108	0.04	27 Fairway Crescent, Sussex Inlet - on driveway	1.813	1.704	-0.109	< 100mm of Quality Tolerance
110	0.043	23 Fairway Crescent, Sussex Inlet	1.788	1.706	-0.082	< 100mm of Quality Tolerance
113	0.027	15 Fairway Crescent, Sussex Inlet	1.809	1.711	-0.098	< 100mm of Quality Tolerance
115	0.049	38 River Road, Sussex Inlet	1.638	1.757	0.119	< 100mm of Quality Tolerance
116	0.031	Entrance to Badgee Lagoon	1.559	1.691	0.132	Model over estimate peak level at this location but under estimate at another location (ID 122) just across the road
122	0.022	Riveria Caravan Park Office - mark made by owner	1.79	1.689	-0.101	< 100mm of Quality Tolerance
123	0.033	148 River Road, Sussex Inlet	1.704	1.673	-0.031	Within Quality Tolerance
125	0.044	148 River Road, Sussex Inlet	1.727	1.674	-0.053	< 50mm of Quality Tolerance
128	0.027	14 Wimberal Drive, Sussex Inlet	1.63	1.605	-0.025	Within Quality Tolerance
129	0.028	33 Wimberal Drive, Sussex Inlet	1.298	1.611	0.313	Bathymetry data is not available at the location. ALS data adopted reflects the water surface at the location instead of channel invert.
134	0.035	253 Harbord Street, Sussex Inlet	1.612	1.601	-0.011	Within Quality Tolerance
135	0.023	Sussex Rd, Top of car park outside 'Southside marine centre'	1.46	1.407	-0.053	Within Quality Tolerance
140	0.022	Alamenin caravan park, Sussex Inlet	1.49	1.251	-0.239	Surveyed level higher than MHL gauge peak level upstream. Surveyed Peak Level is likely to be affected by Wind Waves
141	0.033	Naval Parade, Erowal Bay, St Georges Basin	1.891	1.758	-0.133	< 100mm of Quality Tolerance. Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
142	0.023	Boat ramp at SW end of Naval Parade, Erowal Bay	1.64	1.758	0.118	< 100mm of Quality Tolerance
143	0.026	Prentice Avenue Reserve, Old Erowal Bay	1.778	1.758	-0.020	Within Quality Tolerance
144	0.038	No. 9 Mountain Street, Sanctuary Point	1.924	1.764	-0.160	Modelled water levels at this location is largely affected by the tailwater downstream in the basin
145	0.036	Boat ramp in SE Corner of Sanctuary Point, Sanctuary Pt Rd	1.792	1.758	-0.034	Within Quality Tolerance. Surveyed Peak Level is likely to be not affected by Wind Waves around Basin area
146	0.044	SW end of Greville Avenue, Sanctuary Point	1.798	1.758	-0.040	Within Quality Tolerance. Surveyed Peak Level is likely to be not affected by Wind Waves around Basin area
147	0.028	Paul Bland Reserve at end of Paradise Beach Rd, Sanctuary Pt	1.872	1.758	-0.114	< 100mm of Quality Tolerance. Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
148	0.02	End of Island Point Rd, St Georges Basin	1.91	1.758	-0.152	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
149	0.034	End of Basin Rd, St Georges Basin	1.962	1.758	-0.204	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
150	0.036	Boat ramp off 'Basin View Parade', Basin View	1.901	1.758	-0.143	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
151	0.044	NE end of Boat Haven Avenue	1.927	1.758	-0.169	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area

1971 Storm Event						
ID	**Quality (+/-mm)**	**Survey Comments**	**Recorded Peak Flood Levels (mAHD)**	**Modelled Levels**	**Diff(M-R)**	**Cardno Comments**
1	Fair	?	1.82	1.899	0.079	Good correlation
3	Good	280 River - on house	1.59	2.132	0.542	Overestimate
4	Good	RSL - carpet level	2.34	2.165	-0.175	
5	Good	Lot 12 - Kullindi. Level good, datum?	2.11	2.235	0.125	
6	Good	Caravan park - door of green house	1.87	2.233	0.363	
8	Good	Lot 41 - Holiday house across inlet. Level good, datum?	1.99	2.246	0.256	
9	V.Good	Boathouse - near SE corner Fairview - scum mark	2.04	2.291	0.251	ID9 and ID10 are close to each other, water level difference between these two indicates one of them is unreliable
10	Good	122 River - top step house next door	2.69	2.295	-0.395	ID9 and ID10 are close to each other, water level difference between these two indicates one of them is unreliable
13	Good	“Fish trap” - 1m west of cage	2.11	2.342	0.232	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
20	Good	10 Banksia - inside house, adjusting for house raising	2.1	2.253	0.153	
21	Good	181 Jacobs (butcher) - pen mark on equipment	1.9	2.191	0.291	
25	Fair	129 River - granny flat at back	2.3	2.264	-0.036	Good correlation
27	Fair	159 Naval - under window sill, 2nd hand info Basin	2.69	2.369	-0.321	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
28	V.Good	101 Naval - board nailed onto fence	2.21	2.369	0.159	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
34	Good	3 Marie	2.8	2.369	-0.431	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
37	Fair	122 Loralyn	2.36	2.369	0.009	Surveyed Peak Level is likely to be not affected by Wind Waves around Basin area
41	V.Good	Tennis court path - south of 11 Rauch	3.13	2.369	-0.761	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
42	V.Good	11 Rauch - top of winch	3.1	2.369	-0.731	Surveyed Peak Level is likely to be affected by Wind Waves around Basin area
44	V. Good	4 Bottlebrush - steps	4.58	4.406	-0.174	Bathymetry data adopted from 1991 cross-sections may not reflect the actual creek channel at the time of the 1971 flood
45	Good	Cross-section WAN5 - P. Brown	4.68	4.390	-0.290	Bathymetry data adopted from 1991 cross-sections may not reflect the actual creek channel at the time of the 1971 flood
46	V.Good	T. Bridge’s residence - 0.2m above floor level - cross-section WAN7 - P. Brown	4.85	4.974	0.124	Overestimate at the location while underestimate ~1km downstream at ID 44 and ID 45

APPENDIX

F

ARR IFD AND DATA HUB RECORD

Gauge A

```
Results - ARR Data Hub
[STARTTXT]

Input Data Information
[INPUTDATA]
Latitude,-35.125000
Longitude,150.596000
[END_INPUTDATA]

River Region
[RIVREG]
Division,South East Coast (NSW)
River Number,16
River Name,Clyde River-Jervis Bay
[RIVREG_META]
Time Accessed,24 September 2021 11:52PM
Version,2016_v1
[END_RIVREG]

ARF Parameters
[LONGARF]
Zone,SE Coast
a,0.06
b,0.361
c,0.0
d,0.317
e,8.11e-05
f,0.651
g,0.0
h,0.0
i,0.0
[LONGARF_META]
Time Accessed,24 September 2021 11:52PM
Version,2016_v1
[END_LONGARF]

Storm Losses
[LOSSES]
ID,17707.0
Storm Initial Losses (mm),32.0
Storm Continuing Losses (mm/h),5.0
[LOSSES_META]
Time Accessed,24 September 2021 11:52PM
Version,2016_v1
[END_LOSSES]

Temporal Patterns
[TP]
code,SSmainland
Label,Southern Slopes (Vic/NSW)
[TP_META]
Time Accessed,24 September 2021 11:52PM
Version,2016_v2
[END_TP]

Areal Temporal Patterns
[ATP]
code,SSmainland
arealabel,Southern Slopes (Vic/NSW)
[ATP_META]
Time Accessed,24 September 2021 11:52PM
Version,2016_v2
[END_ATP]

Median Preburst Depths and Ratios
[PREBURST]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),4.5 (0.167),4.2 (0.106),4.0 (0.082),3.7 (0.065),1.9 (0.027),0.5 (0.006)
```

Gauge A

```
90 (1.5),2.5 (0.078),5.1 (0.110),6.8 (0.120),8.4 (0.125),4.2 (0.051),1.1 (0.011)
120 (2.0),4.2 (0.117),7.1 (0.135),9.0 (0.140),10.8 (0.142),5.8 (0.062),2.1 (0.020)
180 (3.0),13.0 (0.300),12.0 (0.191),11.3 (0.148),10.6 (0.118),9.6 (0.088),8.9 (0.071)
360 (6.0),8.8 (0.144),17.3 (0.198),23.0 (0.217),28.4 (0.228),21.1 (0.141),15.6 (0.092)
720 (12.0),5.2 (0.061),12.3 (0.099),16.9 (0.113),21.3 (0.122),26.3 (0.126),29.9 (0.127)
1080 (18.0),6.3 (0.060),9.9 (0.066),12.4 (0.068),14.7 (0.069),23.8 (0.094),30.6 (0.107)
1440 (24.0),1.2 (0.010),6.3 (0.037),9.7 (0.047),12.9 (0.053),17.9 (0.062),21.6 (0.066)
2160 (36.0),0.1 (0.001),1.8 (0.009),3.0 (0.012),4.1 (0.014),7.0 (0.020),9.2 (0.023)
2880 (48.0),0.0 (0.000),0.2 (0.001),0.3 (0.001),0.4 (0.001),1.8 (0.005),2.9 (0.007)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.7 (0.002),1.3 (0.003)
[PREBURST_META]
Time Accessed,24 September 2021 11:52PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST]From preburst class

10% Preburst Depths
[PREBURST10]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST10_META]
Time Accessed,24 September 2021 11:52PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST10]From preburst class

25% Preburst Depths
[PREBURST25]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.5 (0.009),0.8 (0.012),1.0 (0.014),0.4 (0.005),0.0 (0.000)
180 (3.0),0.5 (0.012),0.3 (0.005),0.1 (0.002),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.7 (0.011),0.8 (0.009),0.9 (0.009),1.0 (0.008),0.4 (0.003),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),1.6 (0.006),2.8 (0.010)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST25_META]
Time Accessed,24 September 2021 11:52PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST25]From preburst class

75% Preburst Depths
[PREBURST75]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),34.8 (1.286),35.1 (0.895),35.4 (0.733),35.6 (0.617),35.3 (0.496),35.1 (0.427)
90 (1.5),39.7 (1.243),46.3 (1.000),50.6 (0.893),54.8 (0.812),47.4 (0.572),41.9 (0.439)
120 (2.0),41.8 (1.157),50.5 (0.967),56.3 (0.881),61.8 (0.815),54.9 (0.592),49.7 (0.466)
180 (3.0),47.1 (1.084),49.0 (0.783),50.3 (0.659),51.5 (0.571),66.8 (0.609),78.3 (0.625)
360 (6.0),45.1 (0.741),66.0 (0.756),79.9 (0.754),93.2 (0.748),94.4 (0.631),95.3 (0.563)
720 (12.0),26.4 (0.306),44.4 (0.359),56.4 (0.377),67.9 (0.387),84.3 (0.403),96.6 (0.411)
1080 (18.0),23.6 (0.225),33.7 (0.224),40.4 (0.222),46.8 (0.219),60.7 (0.238),71.1 (0.249)
```

```
1440 (24.0),18.0 (0.151),28.6 (0.167),35.6 (0.172),42.4 (0.174),52.4 (0.180),59.9 (0.183)
2160 (36.0),7.7 (0.055),19.8 (0.098),27.9 (0.114),35.6 (0.123),43.7 (0.126),49.9 (0.128)
2880 (48.0),5.0 (0.032),9.7 (0.044),12.8 (0.047),15.8 (0.049),19.8 (0.051),22.7 (0.052)
4320 (72.0),0.0 (0.000),1.0 (0.004),1.7 (0.006),2.3 (0.006),22.7 (0.051),37.9 (0.076)
[PREBURST75_META]
Time Accessed,24 September 2021 11:52PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST75]From preburst class

90% Preburst Depths
[PREBURST90]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),74.2 (2.742),98.4 (2.505),114.4 (2.371),129.8 (2.251),124.8 (1.755),121.0 (1.473)
90 (1.5),108.0 (3.379),129.3 (2.795),143.5 (2.530),157.1 (2.326),146.0 (1.762),137.7 (1.443)
120 (2.0),92.3 (2.553),130.6 (2.499),155.9 (2.440),180.2 (2.375),163.1 (1.759),150.3 (1.412)
180 (3.0),107.4 (2.473),142.1 (2.270),165.0 (2.163),187.1 (2.073),188.2 (1.718),189.1 (1.511)
360 (6.0),89.1 (1.464),122.0 (1.396),143.7 (1.357),164.6 (1.322),174.8 (1.169),182.5 (1.078)
720 (12.0),80.3 (0.931),102.3 (0.827),116.9 (0.782),130.9 (0.746),164.1 (0.785),189.0 (0.804)
1080 (18.0),69.5 (0.663),88.3 (0.587),100.7 (0.553),112.6 (0.528),145.2 (0.571),169.7 (0.594)
1440 (24.0),60.6 (0.509),72.4 (0.423),80.2 (0.386),87.7 (0.360),110.6 (0.381),127.8 (0.391)
2160 (36.0),52.7 (0.377),57.7 (0.286),61.0 (0.249),64.2 (0.222),91.2 (0.264),111.5 (0.286)
2880 (48.0),22.8 (0.149),38.3 (0.172),48.5 (0.179),58.3 (0.182),72.9 (0.189),83.7 (0.192)
4320 (72.0),9.8 (0.057),18.9 (0.076),24.9 (0.081),30.6 (0.084),81.0 (0.184),118.8 (0.237)
[PREBURST90_META]
Time Accessed,24 September 2021 11:52PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST90]From preburst class

Interim Climate Change Factors
[CCF]
,RCP 4.5,RCP6,RCP 8.5
2030,0.648 (3.2%),0.687 (3.4%),0.811 (4.0%)
2040,0.878 (4.4%),0.827 (4.1%),1.084 (5.4%)
2050,1.081 (5.4%),1.013 (5.1%),1.446 (7.3%)
2060,1.251 (6.3%),1.229 (6.2%),1.862 (9.5%)
2070,1.381 (7.0%),1.460 (7.4%),2.298 (11.9%)
2080,1.465 (7.4%),1.691 (8.6%),2.719 (14.2%)
2090,1.496 (7.6%),1.906 (9.7%),3.090 (16.3%)

[CCF_META]
Time Accessed,24 September 2021 11:52PM
Version,2019_v1
Note,ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values
that can be found on the climate change in Australia website.
[END_CCF]

Probability Neutral Burst Initial Loss
[BURSTIL]
min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0
60 (1.0),11.9,9.1,9.4,9.3,9.3,6.4
90 (1.5),12.1,9.1,9.2,8.8,8.6,5.5
120 (2.0),12.1,9.1,9.0,8.6,9.0,6.0
180 (3.0),11.1,9.3,9.6,9.3,9.2,4.1
360 (6.0),12.6,8.8,9.0,8.1,9.5,3.1
720 (12.0),16.0,11.2,11.7,9.6,10.9,3.2
1080 (18.0),17.0,13.4,14.1,11.5,12.0,3.8
1440 (24.0),19.5,15.1,15.4,13.4,14.5,4.5
2160 (36.0),22.2,17.0,17.4,15.6,17.2,7.2
2880 (48.0),24.8,20.3,19.7,20.9,20.4,10.4
4320 (72.0),27.4,24.3,24.7,24.6,23.2,7.7
[BURSTIL_META]
Time Accessed,24 September 2021 11:52PM
Version,2018_v1
Note,As this point is in NSW the advice provided on losses and pre-burst on the <a
href="./nsw_specific">NSW Specific Tab of the ARR Data Hub</a> is to be considered.  In NSW losses
```

are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.
[END_BURSTIL]
Transformational Pre-burst Rainfall
[PREBURST_TRANS]
min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0
60 (1.0),20.1,22.9,22.6,22.7,22.7,25.6
90 (1.5),19.9,22.9,22.8,23.2,23.4,26.5
120 (2.0),19.9,22.9,23.0,23.4,23.0,26.0
180 (3.0),20.9,22.7,22.4,22.7,22.8,27.9
360 (6.0),19.4,23.2,23.0,23.9,22.5,28.9
720 (12.0),16.0,20.8,20.3,22.4,21.1,28.8
1080 (18.0),15.0,18.6,17.9,20.5,20.0,28.2
1440 (24.0),12.5,16.9,16.6,18.6,17.5,27.5
2160 (36.0),9.8,15.0,14.6,16.4,14.8,24.8
2880 (48.0),7.2,11.7,12.3,11.1,11.6,21.6
4320 (72.0),4.6,7.7,7.3,7.4,8.8,24.3
[PREBURST_TRANS_META]
The tranformational pre-burst is intended for software suppliers in the NSW area and is simply the Initial Loss - Burst Initial Loss. It is not appropriate to use these values if considering a calibrated initial loss.
[END_PREBURST_TRANS]

Baseflow Factors
[BASEFLOW]
Downstream,0
Area (km2),838.345984
Catchment Number,10707
Volume Factor,0.245158
Peak Factor,0.102911
[BASEFLOW_META]
Time Accessed,24 September 2021 11:52PM
Version,2016_v1
[END_BASEFLOW]

[ENDTXT]

Gauge A

Australian Government
Bureau of Meteorology

Location

Label: Not provided

Latitude: -35.125 [Nearest grid cell: 35.1125 (S)]

Longitude: 150.596 [Nearest grid cell: 150.5875 (E)]

IFD Design Rainfall Depth (mm)

Issued: 24 September 2021

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	2.03	2.34	3.40	4.19	5.01	6.20	7.18
2 min	3.40	3.93	5.69	6.99	8.33	10.3	11.9
3 min	4.69	5.42	7.86	9.65	11.5	14.2	16.4
4 min	5.84	6.74	9.78	12.0	14.4	17.7	20.5
5 min	6.85	7.91	11.5	14.1	16.9	20.8	24.1
10 min	10.6	12.2	17.7	21.9	26.2	32.4	37.5
15 min	13.0	15.0	21.9	27.0	32.4	40.1	46.5
20 min	14.9	17.2	25.0	30.9	37.1	45.9	53.2
25 min	16.4	19.0	27.6	34.0	40.8	50.6	58.6
30 min	17.7	20.5	29.8	36.7	44.0	54.5	63.2
45 min	20.9	24.1	35.0	43.1	51.6	63.8	73.9
1 hour	23.4	27.0	39.3	48.3	57.7	71.1	82.2
1.5 hour	27.6	31.9	46.3	56.7	67.5	82.9	95.4
2 hour	31.3	36.1	52.2	63.9	75.9	92.7	106
3 hour	37.6	43.4	62.6	76.3	90.2	110	125
4.5 hour	45.6	52.7	75.8	92.1	109	131	149
6 hour	52.6	60.9	87.4	106	125	150	169
9 hour	64.6	74.7	107	130	152	182	205
12 hour	74.6	86.3	124	150	175	209	235
18 hour	90.5	105	150	182	213	254	286
24 hour	103	119	171	208	244	291	327
30 hour	113	130	188	228	268	321	361
36 hour	120	140	202	245	289	346	390
48 hour	132	154	223	272	321	386	437
72 hour	147	171	249	305	363	441	501
96 hour	155	181	264	326	389	474	541
120 hour	161	187	275	339	406	497	568

144 hour	165	192	282	349	419	513	587
168 hour	168	195	287	356	429	524	600

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

This page was created at **23:56 on Friday 24 September 2021 (AEST)**

© Copyright Commonwealth of Australia 2021, Bureau of Meteorology (ABN 92 637 533 532) | CRICOS Provider 02015K | Disclaimer | Privacy | Accessibility

Gauge B

```
Results - ARR Data Hub
[STARTTXT]

Input Data Information
[INPUTDATA]
Latitude,-35.074830
Longitude,150.504520
[END_INPUTDATA]

River Region
[RIVREG]
Division,South East Coast (NSW)
River Number,16
River Name,Clyde River-Jervis Bay
[RIVREG_META]
Time Accessed,24 September 2021 11:58PM
Version,2016_v1
[END_RIVREG]

ARF Parameters
[LONGARF]
Zone,SE Coast
a,0.06
b,0.361
c,0.0
d,0.317
e,8.11e-05
f,0.651
g,0.0
h,0.0
i,0.0
[LONGARF_META]
Time Accessed,24 September 2021 11:58PM
Version,2016_v1
[END_LONGARF]

Storm Losses
[LOSSES]
ID,2215.0
Storm Initial Losses (mm),32.0
Storm Continuing Losses (mm/h),4.7
[LOSSES_META]
Time Accessed,24 September 2021 11:58PM
Version,2016_v1
[END_LOSSES]

Temporal Patterns
[TP]
code,SSmainland
Label,Southern Slopes (Vic/NSW)
[TP_META]
Time Accessed,24 September 2021 11:58PM
Version,2016_v2
[END_TP]

Areal Temporal Patterns
[ATP]
code,SSmainland
arealabel,Southern Slopes (Vic/NSW)
[ATP_META]
Time Accessed,24 September 2021 11:58PM
Version,2016_v2
[END_ATP]

Median Preburst Depths and Ratios
[PREBURST]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),2.0 (0.073),2.3 (0.061),2.6 (0.055),2.8 (0.051),1.5 (0.022),0.5 (0.006)
```

Gauge B

```
90 (1.5),2.0 (0.062),4.2 (0.092),5.6 (0.101),7.0 (0.107),3.8 (0.048),1.5 (0.016)
120 (2.0),2.7 (0.075),5.9 (0.114),8.0 (0.127),10.0 (0.135),5.9 (0.066),2.9 (0.028)
180 (3.0),9.8 (0.223),9.8 (0.157),9.8 (0.130),9.7 (0.110),9.2 (0.087),8.9 (0.073)
360 (6.0),7.8 (0.126),18.5 (0.209),25.5 (0.240),32.3 (0.259),23.5 (0.158),16.9 (0.100)
720 (12.0),6.9 (0.078),13.7 (0.108),18.2 (0.118),22.5 (0.125),28.8 (0.134),33.5 (0.139)
1080 (18.0),7.2 (0.066),10.4 (0.066),12.5 (0.066),14.5 (0.065),22.7 (0.086),28.8 (0.097)
1440 (24.0),1.1 (0.009),6.2 (0.035),9.6 (0.044),12.8 (0.050),17.8 (0.058),21.5 (0.063)
2160 (36.0),0.4 (0.002),2.4 (0.011),3.7 (0.014),5.0 (0.016),7.1 (0.019),8.7 (0.021)
2880 (48.0),0.0 (0.000),0.2 (0.001),0.3 (0.001),0.4 (0.001),2.4 (0.006),3.9 (0.008)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST_META]
Time Accessed,24 September 2021 11:58PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST]From preburst class

10% Preburst Depths
[PREBURST10]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST10_META]
Time Accessed,24 September 2021 11:58PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST10]From preburst class

25% Preburst Depths
[PREBURST25]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.2 (0.003),0.3 (0.004),0.4 (0.005),0.2 (0.002),0.0 (0.000)
180 (3.0),0.3 (0.006),0.2 (0.002),0.1 (0.001),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.0 (0.000),0.1 (0.001),0.1 (0.001),0.1 (0.001),0.1 (0.000),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),1.1 (0.004),2.0 (0.007)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST25_META]
Time Accessed,24 September 2021 11:58PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST25]From preburst class

75% Preburst Depths
[PREBURST75]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),18.7 (0.690),22.4 (0.581),24.8 (0.529),27.1 (0.488),30.1 (0.442),32.3 (0.413)
90 (1.5),16.4 (0.510),29.0 (0.638),37.4 (0.677),45.5 (0.696),41.5 (0.522),38.6 (0.423)
120 (2.0),43.7 (1.197),55.8 (1.081),63.8 (1.021),71.4 (0.970),55.5 (0.620),43.5 (0.426)
180 (3.0),53.3 (1.210),52.5 (0.843),51.9 (0.690),51.4 (0.581),71.5 (0.671),86.6 (0.714)
360 (6.0),41.9 (0.672),65.3 (0.739),80.8 (0.759),95.7 (0.767),98.3 (0.659),100.3 (0.596)
720 (12.0),28.6 (0.321),46.5 (0.366),58.4 (0.380),69.8 (0.388),84.4 (0.394),95.3 (0.396)
1080 (18.0),30.7 (0.284),36.6 (0.235),40.5 (0.214),44.2 (0.199),56.3 (0.213),65.4 (0.220)
```

Gauge B

1440 (24.0),17.6 (0.143),28.6 (0.160),35.9 (0.165),42.9 (0.168),53.1 (0.174),60.8 (0.178)
2160 (36.0),7.3 (0.051),20.3 (0.097),29.0 (0.112),37.2 (0.122),41.0 (0.112),43.8 (0.106)
2880 (48.0),4.9 (0.031),9.4 (0.040),12.4 (0.043),15.2 (0.045),18.1 (0.044),20.3 (0.044)
4320 (72.0),0.0 (0.000),1.2 (0.004),1.9 (0.006),2.7 (0.007),21.9 (0.047),36.2 (0.068)
[PREBURST75_META]
Time Accessed,24 September 2021 11:58PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.
[END_PREBURST75]From preburst class

90% Preburst Depths
[PREBURST90]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),87.4 (3.226),85.9 (2.230),84.8 (1.810),83.8 (1.508),100.6 (1.479),113.2 (1.447)
90 (1.5),77.4 (2.409),106.0 (2.331),125.0 (2.263),143.2 (2.193),135.7 (1.706),130.1 (1.426)
120 (2.0),114.9 (3.152),140.7 (2.729),157.8 (2.526),174.2 (2.365),159.2 (1.780),147.9 (1.447)
180 (3.0),102.4 (2.324),132.5 (2.129),152.5 (2.027),171.6 (1.942),174.6 (1.637),176.8 (1.457)
360 (6.0),76.1 (1.222),114.9 (1.301),140.6 (1.320),165.2 (1.325),177.2 (1.188),186.2 (1.106)
720 (12.0),75.2 (0.846),103.4 (0.813),122.1 (0.794),140.0 (0.778),164.6 (0.768),183.1 (0.761)
1080 (18.0),79.7 (0.737),94.6 (0.607),104.5 (0.552),113.9 (0.513),144.9 (0.548),168.1 (0.567)
1440 (24.0),62.0 (0.504),72.9 (0.409),80.2 (0.370),87.2 (0.341),108.9 (0.357),125.2 (0.366)
2160 (36.0),45.9 (0.319),53.6 (0.254),58.7 (0.228),63.6 (0.208),87.5 (0.239),105.4 (0.256)
2880 (48.0),25.7 (0.163),37.5 (0.161),45.3 (0.158),52.8 (0.155),69.9 (0.170),82.7 (0.178)
4320 (72.0),10.0 (0.057),18.8 (0.073),24.6 (0.077),30.2 (0.078),77.9 (0.166),113.6 (0.213)
[PREBURST90_META]
Time Accessed,24 September 2021 11:58PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.
[END_PREBURST90]From preburst class

Interim Climate Change Factors
[CCF]
,RCP 4.5,RCP6,RCP 8.5
2030,0.648 (3.2%),0.687 (3.4%),0.811 (4.0%)
2040,0.878 (4.4%),0.827 (4.1%),1.084 (5.4%)
2050,1.081 (5.4%),1.013 (5.1%),1.446 (7.3%)
2060,1.251 (6.3%),1.229 (6.2%),1.862 (9.5%)
2070,1.381 (7.0%),1.460 (7.4%),2.298 (11.9%)
2080,1.465 (7.4%),1.691 (8.6%),2.719 (14.2%)
2090,1.496 (7.6%),1.906 (9.7%),3.090 (16.3%)

[CCF_META]
Time Accessed,24 September 2021 11:58PM
Version,2019_v1
Note,ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.
[END_CCF]

Probability Neutral Burst Initial Loss
[BURSTIL]
min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0
60 (1.0),19.6,12.0,11.5,11.7,10.6,9.1
90 (1.5),19.3,12.5,11.3,10.5,11.4,8.3
120 (2.0),15.0,10.7,10.8,10.2,9.9,7.2
180 (3.0),14.5,11.4,12.1,11.0,10.1,4.9
360 (6.0),16.6,11.6,10.4,9.2,10.1,3.2
720 (12.0),19.2,14.8,14.1,12.0,12.5,3.2
1080 (18.0),20.5,17.1,17.3,15.1,15.4,5.2
1440 (24.0),24.3,19.9,18.7,17.1,16.4,6.0
2160 (36.0),27.4,22.7,22.1,20.0,21.7,9.1
2880 (48.0),30.5,25.7,25.6,27.0,23.6,15.9
4320 (72.0),34.1,30.3,30.6,31.3,26.1,12.4
[BURSTIL_META]
Time Accessed,24 September 2021 11:58PM
Version,2018_v1
Note,As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub is to be considered. In NSW losses

Gauge B

are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.
[END_BURSTIL]
Transformational Pre-burst Rainfall
[PREBURST_TRANS]
min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0
60 (1.0),12.4,20.0,20.5,20.3,21.4,22.9
90 (1.5),12.7,19.5,20.7,21.5,20.6,23.7
120 (2.0),17.0,21.3,21.2,21.8,22.1,24.8
180 (3.0),17.5,20.6,19.9,21.0,21.9,27.1
360 (6.0),15.4,20.4,21.6,22.8,21.9,28.8
720 (12.0),12.8,17.2,17.9,20.0,19.5,28.8
1080 (18.0),11.5,14.9,14.7,16.9,16.6,26.8
1440 (24.0),7.7,12.1,13.3,14.9,15.6,26.0
2160 (36.0),4.6,9.3,9.9,12.0,10.3,22.9
2880 (48.0),1.5,6.3,6.4,5.0,8.4,16.1
4320 (72.0),0.0,1.7,1.4,0.7,5.9,19.6
[PREBURST_TRANS_META]
The tranformational pre-burst is intended for software suppliers in the NSW area and is simply the Initial Loss - Burst Initial Loss. It is not appropriate to use these values if considering a calibrated initial loss.
[END_PREBURST_TRANS]

Baseflow Factors
[BASEFLOW]
Downstream,0
Area (km2),838.345984
Catchment Number,10707
Volume Factor,0.245158
Peak Factor,0.102911
[BASEFLOW_META]
Time Accessed,24 September 2021 11:58PM
Version,2016_v1
[END_BASEFLOW]

[ENDTXT]

Gauge B

Australian Government
Bureau of Meteorology

Location

Label: Not provided

Latitude: -35.0748 [Nearest grid cell: 35.0625 (S)]

Longitude: 150.5045 [Nearest grid cell: 150.5125 (E)]

IFD Design Rainfall Depth (mm)

Issued: 24 September 2021

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	2.04	2.34	3.34	4.08	4.86	5.97	6.88
2 min	3.45	3.94	5.56	6.75	7.99	9.79	11.3
3 min	4.76	5.44	7.70	9.36	11.1	13.6	15.6
4 min	5.92	6.76	9.60	11.7	13.9	17.0	19.6
5 min	6.93	7.93	11.3	13.8	16.3	20.0	23.1
10 min	10.6	12.2	17.5	21.3	25.4	31.3	36.1
15 min	13.1	15.0	21.5	26.3	31.4	38.6	44.6
20 min	15.0	17.2	24.6	30.1	35.9	44.1	51.0
25 min	16.5	18.9	27.0	33.1	39.4	48.5	56.0
30 min	17.8	20.4	29.2	35.7	42.5	52.2	60.3
45 min	21.1	24.1	34.3	41.9	49.8	61.0	70.3
1 hour	23.7	27.1	38.5	46.9	55.6	68.0	78.3
1.5 hour	28.1	32.1	45.5	55.2	65.3	79.6	91.2
2 hour	31.9	36.5	51.6	62.5	73.7	89.4	102
3 hour	38.5	44.0	62.2	75.2	88.4	107	121
4.5 hour	46.9	53.8	76.1	91.8	108	129	146
6 hour	54.2	62.3	88.3	106	125	149	168
9 hour	66.6	76.8	109	132	154	184	207
12 hour	76.9	88.9	127	154	180	214	241
18 hour	93.3	108	156	189	222	264	297
24 hour	106	123	178	217	256	305	342
30 hour	116	135	196	239	283	338	380
36 hour	123	144	211	258	306	366	413
48 hour	135	158	232	286	341	410	464
72 hour	150	175	260	322	387	469	532
96 hour	158	185	276	343	414	505	575
120 hour	164	192	286	357	433	529	604

Gauge B

144 hour	168	197	294	368	447	546	625
168 hour	172	201	301	377	458	560	640

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

This page was created at **23:59 on Friday 24 September 2021 (AEST)**

© Copyright Commonwealth of Australia 2021, Bureau of Meteorology (ABN 92 637 533 532) | CRICOS Provider 02015K | Disclaimer | Privacy | Accessibility

Gauge C

```
Results - ARR Data Hub
[STARTTXT]

Input Data Information
[INPUTDATA]
Latitude,-35.121550
Longitude,150.376578
[END_INPUTDATA]

River Region
[RIVREG]
Division,South East Coast (NSW)
River Number,16
River Name,Clyde River-Jervis Bay
[RIVREG_META]
Time Accessed,25 September 2021 12:00AM
Version,2016_v1
[END_RIVREG]

ARF Parameters
[LONGARF]
Zone,SE Coast
a,0.06
b,0.361
c,0.0
d,0.317
e,8.11e-05
f,0.651
g,0.0
h,0.0
i,0.0
[LONGARF_META]
Time Accessed,25 September 2021 12:00AM
Version,2016_v1
[END_LONGARF]

Storm Losses
[LOSSES]
ID,14810.0
Storm Initial Losses (mm),39.0
Storm Continuing Losses (mm/h),5.2
[LOSSES_META]
Time Accessed,25 September 2021 12:00AM
Version,2016_v1
[END_LOSSES]

Temporal Patterns
[TP]
code,SSmainland
Label,Southern Slopes (Vic/NSW)
[TP_META]
Time Accessed,25 September 2021 12:00AM
Version,2016_v2
[END_TP]

Areal Temporal Patterns
[ATP]
code,SSmainland
arealabel,Southern Slopes (Vic/NSW)
[ATP_META]
Time Accessed,25 September 2021 12:00AM
Version,2016_v2
[END_ATP]

Median Preburst Depths and Ratios
[PREBURST]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),2.3 (0.088),2.5 (0.068),2.6 (0.058),2.7 (0.052),1.3 (0.020),0.2 (0.002)
```

Gauge C

```
90 (1.5),1.3 (0.043),4.2 (0.096),6.1 (0.115),7.9 (0.127),4.8 (0.064),2.5 (0.029)
120 (2.0),4.7 (0.131),5.9 (0.120),6.8 (0.114),7.6 (0.108),5.3 (0.063),3.6 (0.038)
180 (3.0),13.7 (0.320),10.5 (0.175),8.4 (0.116),6.3 (0.075),7.0 (0.070),7.6 (0.066)
360 (6.0),9.8 (0.163),19.5 (0.230),25.9 (0.255),32.0 (0.270),24.2 (0.171),18.3 (0.115)
720 (12.0),5.8 (0.068),12.9 (0.106),17.6 (0.120),22.1 (0.129),27.4 (0.134),31.4 (0.137)
1080 (18.0),6.9 (0.067),11.6 (0.078),14.7 (0.081),17.7 (0.083),25.3 (0.100),31.0 (0.109)
1440 (24.0),1.2 (0.010),7.4 (0.043),11.5 (0.055),15.4 (0.063),19.3 (0.066),22.2 (0.067)
2160 (36.0),0.4 (0.003),2.5 (0.012),3.8 (0.016),5.2 (0.017),7.9 (0.022),10.0 (0.025)
2880 (48.0),0.0 (0.000),0.2 (0.001),0.3 (0.001),0.4 (0.001),2.1 (0.005),3.3 (0.007)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.2 (0.000),0.3 (0.001)
[PREBURST_META]
Time Accessed,25 September 2021 12:00AM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST]From preburst class

10% Preburst Depths
[PREBURST10]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST10_META]
Time Accessed,25 September 2021 12:00AM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST10]From preburst class

25% Preburst Depths
[PREBURST25]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
180 (3.0),0.5 (0.011),0.3 (0.005),0.1 (0.002),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.7 (0.011),0.7 (0.009),0.8 (0.008),0.8 (0.007),0.4 (0.003),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),2.7 (0.011),4.8 (0.017)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST25_META]
Time Accessed,25 September 2021 12:00AM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point
values remain unchanged.
[END_PREBURST25]From preburst class

75% Preburst Depths
[PREBURST75]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),28.3 (1.068),24.4 (0.655),21.8 (0.483),19.4 (0.363),21.6 (0.334),23.3 (0.314)
90 (1.5),17.0 (0.542),34.5 (0.786),46.2 (0.870),57.3 (0.919),44.9 (0.594),35.5 (0.413)
120 (2.0),51.5 (1.450),56.2 (1.130),59.2 (0.989),62.2 (0.886),50.5 (0.597),41.8 (0.434)
180 (3.0),60.5 (1.414),57.9 (0.967),56.1 (0.781),54.5 (0.648),65.2 (0.646),73.3 (0.641)
360 (6.0),48.1 (0.798),68.4 (0.809),81.9 (0.806),94.9 (0.800),98.3 (0.695),101.0 (0.634)
720 (12.0),26.1 (0.305),44.5 (0.366),56.7 (0.386),68.4 (0.398),84.6 (0.413),96.8 (0.421)
1080 (18.0),30.0 (0.290),46.2 (0.310),56.8 (0.314),67.1 (0.315),69.9 (0.275),72.0 (0.252)
```

Gauge C

1440 (24.0),18.5 (0.158),29.3 (0.172),36.6 (0.176),43.5 (0.177),55.6 (0.189),64.8 (0.196)
2160 (36.0),7.3 (0.054),19.9 (0.099),28.2 (0.114),36.1 (0.122),49.8 (0.140),60.0 (0.150)
2880 (48.0),5.1 (0.034),9.6 (0.043),12.6 (0.046),15.4 (0.047),25.9 (0.065),33.8 (0.075)
4320 (72.0),0.0 (0.000),0.9 (0.004),1.6 (0.005),2.1 (0.006),26.9 (0.059),45.4 (0.088)
[PREBURST75_META]
Time Accessed,25 September 2021 12:00AM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.
[END_PREBURST75]From preburst class

90% Preburst Depths
[PREBURST90]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),72.5 (2.734),66.3 (1.776),62.2 (1.376),58.2 (1.092),91.2 (1.408),115.9 (1.564)
90 (1.5),79.8 (2.544),113.5 (2.582),135.8 (2.560),157.2 (2.521),138.6 (1.837),124.7 (1.449)
120 (2.0),118.3 (3.330),138.5 (2.785),151.8 (2.536),164.6 (2.344),151.8 (1.792),142.1 (1.476)
180 (3.0),121.0 (2.828),134.1 (2.241),142.8 (1.986),151.1 (1.798),162.5 (1.610),170.9 (1.496)
360 (6.0),87.2 (1.448),118.6 (1.401),139.4 (1.371),159.3 (1.343),175.5 (1.241),187.7 (1.179)
720 (12.0),76.3 (0.893),104.5 (0.859),123.3 (0.839),141.2 (0.821),167.7 (0.819),187.6 (0.816)
1080 (18.0),67.4 (0.652),89.6 (0.601),104.3 (0.576),118.4 (0.556),149.0 (0.586),171.9 (0.602)
1440 (24.0),62.5 (0.533),73.9 (0.434),81.5 (0.392),88.8 (0.361),110.5 (0.376),126.8 (0.383)
2160 (36.0),46.0 (0.337),60.6 (0.301),70.2 (0.284),79.5 (0.269),102.8 (0.289),120.3 (0.300)
2880 (48.0),25.7 (0.172),36.9 (0.166),44.3 (0.161),51.4 (0.155),72.9 (0.183),89.1 (0.197)
4320 (72.0),10.1 (0.061),24.2 (0.098),33.6 (0.109),42.6 (0.113),99.1 (0.217),141.4 (0.273)
[PREBURST90_META]
Time Accessed,25 September 2021 12:00AM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.
[END_PREBURST90]From preburst class

Interim Climate Change Factors
[CCF]
,RCP 4.5,RCP6,RCP 8.5
2030,0.648 (3.2%),0.687 (3.4%),0.811 (4.0%)
2040,0.878 (4.4%),0.827 (4.1%),1.084 (5.4%)
2050,1.081 (5.4%),1.013 (5.1%),1.446 (7.3%)
2060,1.251 (6.3%),1.229 (6.2%),1.862 (9.5%)
2070,1.381 (7.0%),1.460 (7.4%),2.298 (11.9%)
2080,1.465 (7.4%),1.691 (8.6%),2.719 (14.2%)
2090,1.496 (7.6%),1.906 (9.7%),3.090 (16.3%)

[CCF_META]
Time Accessed,25 September 2021 12:00AM
Version,2019_v1
Note,ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.
[END_CCF]

Probability Neutral Burst Initial Loss
[BURSTIL]
min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0
60 (1.0),26.7,15.2,15.0,16.2,16.7,13.3
90 (1.5),31.1,15.3,13.1,12.5,12.5,10.7
120 (2.0),23.9,13.5,13.3,12.3,13.0,10.5
180 (3.0),21.0,14.4,14.7,14.1,13.5,9.0
360 (6.0),23.8,16.0,15.5,13.2,11.6,7.2
720 (12.0),30.8,22.6,20.2,18.1,15.0,7.4
1080 (18.0),31.3,25.2,22.9,20.9,19.6,8.0
1440 (24.0),35.8,29.4,27.8,26.2,25.5,11.8
2160 (36.0),40.5,33.5,32.7,32.2,28.2,12.4
2880 (48.0),44.2,38.6,38.5,41.8,32.3,19.3
4320 (72.0),48.5,42.6,41.7,46.4,31.9,13.1
[BURSTIL_META]
Time Accessed,25 September 2021 12:00AM
Version,2018_v1
Note,As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub is to be considered. In NSW losses

Gauge C

are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.
[END_BURSTIL]
Transformational Pre-burst Rainfall
[PREBURST_TRANS]
min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0
60 (1.0),12.7,24.2,24.4,23.2,22.7,26.1
90 (1.5),8.3,24.1,26.3,26.9,26.9,28.7
120 (2.0),15.5,25.9,26.1,27.1,26.4,28.9
180 (3.0),18.4,25.0,24.7,25.3,25.9,30.4
360 (6.0),15.6,23.4,23.9,26.2,27.8,32.2
720 (12.0),8.6,16.8,19.2,21.3,24.4,32.0
1080 (18.0),8.1,14.2,16.5,18.5,19.8,31.4
1440 (24.0),3.6,10.0,11.6,13.2,13.9,27.6
2160 (36.0),0.0,5.9,6.7,7.2,11.2,27.0
2880 (48.0),0.0,0.8,0.9,0.0,7.1,20.1
4320 (72.0),0.0,0.0,0.0,0.0,7.5,26.3
[PREBURST_TRANS_META]
The tranformational pre-burst is intended for software suppliers in the NSW area and is simply the Initial Loss - Burst Initial Loss. It is not appropriate to use these values if considering a calibrated initial loss.
[END_PREBURST_TRANS]

Baseflow Factors
[BASEFLOW]
Downstream,0
Area (km2),838.345984
Catchment Number,10707
Volume Factor,0.245158
Peak Factor,0.102911
[BASEFLOW_META]
Time Accessed,25 September 2021 12:00AM
Version,2016_v1
[END_BASEFLOW]

[ENDTXT]

Gauge C

Australian Government
Bureau of Meteorology

Location

Label: Not provided

Latitude: -35.1216 [Nearest grid cell: 35.1125 (S)]

Longitude: 150.3766 [Nearest grid cell: 150.3875 (E)]

IFD Design Rainfall Depth (mm)

Issued: 25 September 2021

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	2.02	2.31	3.28	3.98	4.72	5.76	6.61
2 min	3.41	3.88	5.42	6.54	7.71	9.35	10.7
3 min	4.71	5.36	7.51	9.08	10.7	13.0	14.9
4 min	5.85	6.67	9.38	11.4	13.4	16.3	18.7
5 min	6.86	7.83	11.0	13.4	15.8	19.3	22.1
10 min	10.5	12.0	17.1	20.8	24.7	30.1	34.6
15 min	13.0	14.8	21.1	25.7	30.5	37.2	42.8
20 min	14.8	16.9	24.0	29.3	34.7	42.5	48.8
25 min	16.3	18.6	26.4	32.1	38.1	46.6	53.6
30 min	17.6	20.1	28.4	34.6	41.0	50.1	57.5
45 min	20.7	23.6	33.3	40.5	47.8	58.3	66.8
1 hour	23.3	26.5	37.3	45.2	53.3	64.8	74.1
1.5 hour	27.5	31.4	44.0	53.1	62.4	75.5	86.0
2 hour	31.2	35.5	49.7	59.9	70.2	84.7	96.3
3 hour	37.5	42.8	59.8	71.9	84.1	101	114
4.5 hour	45.6	52.1	73.0	87.6	102	122	138
6 hour	52.6	60.2	84.6	102	119	141	159
9 hour	64.3	74.0	105	126	147	175	197
12 hour	74.0	85.4	122	147	172	205	230
18 hour	89.2	103	149	181	213	254	286
24 hour	101	117	170	208	246	294	331
30 hour	110	128	187	230	273	327	369
36 hour	117	136	201	248	296	355	401
48 hour	128	149	222	275	330	399	452
72 hour	141	165	247	309	375	456	519
96 hour	148	174	262	330	402	490	560
120 hour	154	180	272	343	420	513	586

Gauge C

144 hour	158	185	280	353	432	528	604
168 hour	162	190	286	361	442	540	617

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

This page was created at **00:00 on Saturday 25 September 2021 (AEST)**

© Copyright Commonwealth of Australia 2021, Bureau of Meteorology (ABN 92 637 533 532) | CRICOS Provider 02015K | Disclaimer | Privacy | Accessibility

APPENDIX G

DESIGN EVENT FLOOD MAPS

Figure List:

Figure G01 Existing 20% AEP Flood Depth
Figure G02 Existing 10% AEP Flood Depth
Figure G03 Existing 5% AEP Flood Depth
Figure G04 Existing 2% AEP Flood Depth
Figure G05 Existing 1% AEP Flood Depth
Figure G06 Existing 0.2% AEP Flood Depth
Figure G07 Existing PMF Flood Depth
Figure G08 Existing 20% AEP Water Level
Figure G09 Existing 10% AEP Water Level
Figure G10 Existing 5% AEP Water Level
Figure G11 Existing 2% AEP Water Level
Figure G12 Existing 1% AEP Water Level Overview
Figure G12.1 Existing 1% AEP Water Level Sussex Inlet
Figure G12.2 Existing 1% AEP Water Level Basin View
Figure G12.3 Existing 1% AEP Water Level Sanctuary Point
Figure G12.4 Existing 1% AEP Water Level Erowal Bay
Figure G12.5 Existing 1% AEP Water Level Wrights Beach
Figure G12.6 Existing 1% AEP Water Level Wandandian
Figure G12.7 Existing 1% AEP Water Level Tomerong
Figure G13 Existing 0.2% AEP Water Level
Figure G14 Existing PMF Water Level Overview
Figure G14.1 Existing PMF Water Level Sussex Inlet
Figure G14.2 Existing PMF Water Level Basin View
Figure G14.3 Existing PMF Water Level Sanctuary Point
Figure G14.4 Existing PMF Water Level Erowal Bay
Figure G14.5 Existing PMF Water Level Wrights Beach
Figure G14.6 Existing PMF Water Level Wandandian
Figure G14.7 Existing PMF Water Level Tomerong
Figure G15 Existing 1% AEP Velocity Overview
Figure G15.1 Existing 1% AEP Velocity Sussex Inlet
Figure G15.2 Existing 1% AEP Velocity Basin View
Figure G15.3 Existing 1% AEP Velocity Sanctuary Point
Figure G15.4 Existing 1% AEP Velocity Erowal Bay
Figure G15.5 Existing 1% AEP Velocity Wrights Beach
Figure G15.6 Existing 1% AEP Velocity Wandandian
Figure G15.7 Existing 1% AEP Velocity Tomerong
Figure G16 Existing 0.2% AEP Velocity
Figure G17 Existing PMF Velocity
Figure G18 Existing 20% AEP Hazard
Figure G19 Existing 10% AEP Hazard
Figure G20 Existing 5% AEP Hazard
Figure G21 Existing 2% AEP Hazard
Figure G22 Existing 1% AEP Hazard Overview
Figure G22.1 Existing 1% AEP Hazard Sussex Inlet
Figure G22.2 Existing 1% AEP Hazard Basin View
Figure G22.3 Existing 1% AEP Hazard Sanctuary Point
Figure G22.4 Existing 1% AEP Hazard Erowal Bay
Figure G22.5 Existing 1% AEP Hazard Wrights Beach
Figure G22.6 Existing 1% AEP Hazard Wandandian
Figure G22.7 Existing 1% AEP Hazard Tomerong
Figure G23 Existing 0.2% AEP Hazard
Figure G24 Existing PMF Hazard
Figure G25 Existing 1% AEP Provisional Hazard Overview
Figure G25.1 Existing 1% AEP Provisional Hazard Sussex Inlet
Figure G25.2 Existing 1% AEP Provisional Hazard Basin View
Figure G25.3 Existing 1% AEP Provisional Hazard Sanctuary Point
Figure G25.4 Existing 1% AEP Provisional Hazard Erowal Bay
Figure G25.5 Existing 1% AEP Provisional Hazard Wrights Beach
Figure G25.6 Existing 1% AEP Provisional Hazard Wandandian
Figure G25.7 Existing 1% AEP Provisional Hazard Tomerong
Figure G26 Existing PMF Provisional Hazard
Figure G27 Existing 1% AEP Hydraulic Categories Overview
Figure G27.1 Existing 1% AEP Hydraulic Categories Sussex Inlet
Figure G27.2 Existing 1% AEP Hydraulic Categories Basin View
Figure G27.3 Existing 1% AEP Hydraulic Categories Sanctuary Point
Figure G27.4 Existing 1% AEP Hydraulic Categories Erowal Bay
Figure G27.5 Existing 1% AEP Hydraulic Categories Wrights Beach
Figure G27.6 Existing 1% AEP Hydraulic Categories Wandandian
Figure G27.7 Existing 1% AEP Hydraulic Categories Tomerong
Figure G28 Existing PMF Hydraulic Categories
Figure G29 Existing 1% AEP Combined Hazard and Hydraulic Category Overview
Figure G29.1 Existing 1% AEP Combined Hazard and Hydraulic Category Sussex Inlet
Figure G29.2 Existing 1% AEP Combined Hazard and Hydraulic Category Basin View
Figure G29.3 Existing 1% AEP Combined Hazard and Hydraulic Category Sanctuary Point
Figure G29.4 Existing 1% AEP Combined Hazard and Hydraulic Category Erowal Bay
Figure G29.5 Existing 1% AEP Combined Hazard and Hydraulic Category Wrights Beach
Figure G29.6 Existing 1% AEP Combined Hazard and Hydraulic Category Wandandian
Figure G29.7 Existing 1% AEP Combined Hazard and Hydraulic Category Tomerong
Figure G30 Existing PMF Combined Hazard and Hydraulic Category
Figure G31 Projected 2050 10% AEP Flood Depth
Figure G32 Projected 2050 5% AEP Flood Depth
Figure G33 Projected 2050 2% AEP Flood Depth
Figure G34 Projected 2050 1% AEP Flood Depth
Figure G35 Projected 2050 PMF Flood Depth
Figure G36 Projected 2050 10% AEP Water Level
Figure G37 Projected 2050 5% AEP Water Level
Figure G38 Projected 2050 2% AEP Water Level
Figure G39 Projected 2050 1% AEP Water Level Overview
Figure G39.1 Projected 2050 1% AEP Water Level Sussex Inlet
Figure G39.2 Projected 2050 1% AEP Water Level Basin View
Figure G39.3 Projected 2050 1% AEP Water Level Sanctuary Point
Figure G39.4 Projected 2050 1% AEP Water Level Erowal Bay
Figure G39.5 Projected 2050 1% AEP Water Level Wrights Beach

Figure G39.6 Projected 2050 1% AEP Water Level Wandandian
Figure G39.7 Projected 2050 1% AEP Water Level Tomerong
Figure G40 Projected 2050 PMF Water Level Overview
Figure G40.1 Projected 2050 PMF Water Level Sussex Inlet
Figure G40.2 Projected 2050 PMF Water Level Basin View
Figure G40.3 Projected 2050 PMF Water Level Sanctuary Point
Figure G40.4 Projected 2050 PMF Water Level Erowal Bay
Figure G40.5 Projected 2050 PMF Water Level Wrights Beach
Figure G40.6 Projected 2050 PMF Water Level Wandandian
Figure G40.7 Projected 2050 PMF Water Level Tomerong
Figure G41 Projected 2050 1% AEP Velocity Overview
Figure G41.1 Projected 2050 1% AEP Velocity Sussex Inlet
Figure G41.2 Projected 2050 1% AEP Velocity Basin View
Figure G41.3 Projected 2050 1% AEP Velocity Sanctuary Point
Figure G41.4 Projected 2050 1% AEP Velocity Erowal Bay
Figure G41.5 Projected 2050 1% AEP Velocity Wrights Beach
Figure G41.6 Projected 2050 1% AEP Velocity Wandandian
Figure G41.7 Projected 2050 1% AEP Velocity Tomerong
Figure G42 Projected 2050 PMF Velocity
Figure G43 Projected 2050 10% AEP Hazard
Figure G44 Projected 2050 5% AEP Hazard
Figure G45 Projected 2050 2% AEP Hazard
Figure G46 Projected 2050 1% AEP Hazard Overview
Figure G46.1 Projected 2050 1% AEP Hazard Sussex Inlet
Figure G46.2 Projected 2050 1% AEP Hazard Basin View
Figure G46.3 Projected 2050 1% AEP Hazard Sanctuary Point
Figure G46.4 Projected 2050 1% AEP Hazard Erowal Bay
Figure G46.5 Projected 2050 1% AEP Hazard Wrights Beach
Figure G46.6 Projected 2050 1% AEP Hazard Wandandian
Figure G46.7 Projected 2050 1% AEP Hazard Tomerong
Figure G47 Projected 2050 PMF Hazard
Figure G48 Projected 2050 1% AEP Provisional Hazard Overview
Figure G48.1 Projected 2050 1% AEP Provisional Hazard Sussex Inlet
Figure G48.2 Projected 2050 1% AEP Provisional Hazard Basin View
Figure G48.3 Projected 2050 1% AEP Provisional Hazard Sanctuary Point
Figure G48.4 Projected 2050 1% AEP Provisional Hazard Erowal Bay
Figure G48.5 Projected 2050 1% AEP Provisional Hazard Wrights Beach
Figure G48.6 Projected 2050 1% AEP Provisional Hazard Wandandian
Figure G48.7 Projected 2050 1% AEP Provisional Hazard Tomerong
Figure G49 Projected 2050 PMF Provisional Hazard
Figure G50 Projected 2050 1% AEP Hydraulic Categories Overview
Figure G50.1 Projected 2050 1% AEP Hydraulic Categories Sussex Inlet
Figure G50.2 Projected 2050 1% AEP Hydraulic Categories Basin View
Figure G50.3 Projected 2050 1% AEP Hydraulic Categories Sanctuary Point
Figure G50.4 Projected 2050 1% AEP Hydraulic Categories Erowal Bay
Figure G50.5 Projected 2050 1% AEP Hydraulic Categories Wrights Beach
Figure G50.6 Projected 2050 1% AEP Hydraulic Categories Wandandian
Figure G50.7 Projected 2050 1% AEP Hydraulic Categories Tomerong
Figure G51 Projected 2050 PMF Hydraulic Categories
Figure G52 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Overview
Figure G52.1 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Sussex Inlet
Figure G52.2 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Basin View
Figure G52.3 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Sanctuary Point
Figure G52.4 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Erowal Bay
Figure G52.5 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Wrights Beach
Figure G52.6 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Wandandian
Figure G52.7 Projected 2050 1% AEP Combined Hazard and Hydraulic Category Tomerong
Figure G53 Projected 2050 PMF Combined Hazard and Hydraulic Category
Figure G54 Projected 2050 10% AEP Water Level Difference
Figure G55 Projected 2050 5% AEP Water Level Difference
Figure G56 Projected 2050 2% AEP Water Level Difference
Figure G57 Projected 2050 1% AEP Water Level Difference
Figure G58 Projected 2050 PMF Water Level Difference
Figure G59 Projected 2100 10% AEP Flood Depth
Figure G60 Projected 2100 5% AEP Flood Depth
Figure G61 Projected 2100 2% AEP Flood Depth
Figure G62 Projected 2100 1% AEP Flood Depth
Figure G63 Projected 2100 PMF Flood Depth
Figure G64 Projected 2100 10% AEP Water Level
Figure G65 Projected 2100 5% AEP Water Level
Figure G66 Projected 2100 2% AEP Water Level
Figure G67 Projected 2100 1% AEP Water Level Overview
Figure G67.1 Projected 2100 1% AEP Water Level Sussex Inlet
Figure G67.2 Projected 2100 1% AEP Water Level Basin View
Figure G67.3 Projected 2100 1% AEP Water Level Sanctuary Point
Figure G67.4 Projected 2100 1% AEP Water Level Erowal Bay
Figure G67.5 Projected 2100 1% AEP Water Level Wrights Beach
Figure G67.6 Projected 2100 1% AEP Water Level Wandandian
Figure G67.7 Projected 2100 1% AEP Water Level Tomerong
Figure G68 Projected 2100 PMF Water Level Overview
Figure G68.1 Projected 2100 PMF Water Level Sussex Inlet
Figure G68.2 Projected 2100 PMF Water Level Basin View
Figure G68.3 Projected 2100 PMF Water Level Sanctuary Point
Figure G68.4 Projected 2100 PMF Water Level Erowal Bay
Figure G68.5 Projected 2100 PMF Water Level Wrights Beach
Figure G68.6 Projected 2100 PMF Water Level Wandandian
Figure G68.7 Projected 2100 PMF Water Level Tomerong
Figure G69 Projected 2100 1% AEP Velocity Overview
Figure G69.1 Projected 2100 1% AEP Velocity Sussex Inlet
Figure G69.2 Projected 2100 1% AEP Velocity Basin View
Figure G69.3 Projected 2100 1% AEP Velocity Sanctuary Point
Figure G69.4 Projected 2100 1% AEP Velocity Erowal Bay
Figure G69.5 Projected 2100 1% AEP Velocity Wrights Beach
Figure G69.6 Projected 2100 1% AEP Velocity Wandandian

Figure G69.7 Projected 2100 1% AEP Velocity Tomerong
Figure G70 Projected 2100 PMF Velocity
Figure G71 Projected 2100 10% AEP Hazard
Figure G72 Projected 2100 5% AEP Hazard
Figure G73 Projected 2100 2% AEP Hazard
Figure G74 Projected 2100 1% AEP Hazard Overview
Figure G74.1 Projected 2100 1% AEP Hazard Sussex Inlet
Figure G74.2 Projected 2100 1% AEP Hazard Basin View
Figure G74.3 Projected 2100 1% AEP Hazard Sanctuary Point
Figure G74.4 Projected 2100 1% AEP Hazard Erowal Bay
Figure G74.5 Projected 2100 1% AEP Hazard Wrights Beach
Figure G74.6 Projected 2100 1% AEP Hazard Wandandian
Figure G74.7 Projected 2100 1% AEP Hazard Tomerong
Figure G75 Projected 2100 PMF Hazard
Figure G76 Projected 2100 1% AEP Provisional Hazard Overview
Figure G76.1 Projected 2100 1% AEP Provisional Hazard Sussex Inlet
Figure G76.2 Projected 2100 1% AEP Provisional Hazard Basin View
Figure G76.3 Projected 2100 1% AEP Provisional Hazard Sanctuary Point
Figure G76.4 Projected 2100 1% AEP Provisional Hazard Erowal Bay
Figure G76.5 Projected 2100 1% AEP Provisional Hazard Wrights Beach
Figure G76.6 Projected 2100 1% AEP Provisional Hazard Wandandian
Figure G76.7 Projected 2100 1% AEP Provisional Hazard Tomerong
Figure G77 Projected 2100 PMF Provisional Hazard
Figure G78 Projected 2100 1% AEP Hydraulic Categories Overview
Figure G78.1 Projected 2100 1% AEP Hydraulic Categories Sussex Inlet
Figure G78.2 Projected 2100 1% AEP Hydraulic Categories Basin View
Figure G78.3 Projected 2100 1% AEP Hydraulic Categories Sanctuary Point
Figure G78.4 Projected 2100 1% AEP Hydraulic Categories Erowal Bay
Figure G78.5 Projected 2100 1% AEP Hydraulic Categories Wrights Beach
Figure G78.6 Projected 2100 1% AEP Hydraulic Categories Wandandian
Figure G78.7 Projected 2100 1% AEP Hydraulic Categories Tomerong
Figure G79 Projected 2100 PMF Hydraulic Categories
Figure G80 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Overview
Figure G80.1 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Sussex Inlet
Figure G80.2 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Basin View
Figure G80.3 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Sanctuary Point
Figure G80.4 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Erowal Bay
Figure G80.5 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Wrights Beach
Figure G80.6 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Wandandian
Figure G80.7 Projected 2100 1% AEP Combined Hazard and Hydraulic Category Tomerong
Figure G81 Projected 2100 PMF Combined Hazard and Hydraulic Category
Figure G82 Projected 2100 10% AEP Water Level Difference
Figure G83 Projected 2100 5% AEP Water Level Difference
Figure G84 Projected 2100 2% AEP Water Level Difference
Figure G85 Projected 2100 1% AEP Water Level Difference
Figure G86 Projected 2100 PMF Water Level Difference
Figure G87 NSW Projected 2100 Sea Level Rise (+0.90m) 1% AEP Water Level Difference
Figure G88 Tidal Inundation Flood Depth and Water Level Contours Overview
Figure G88.1 Tidal Inundation Flood Depth and Water Level Contours Sussex Inlet
Figure G88.2 Tidal Inundation Flood Depth and Water Level Contours Basin View
Figure G88.3 Tidal Inundation Flood Depth and Water Level Contours Sanctuary Point
Figure G88.4 Tidal Inundation Flood Depth and Water Level Contours Erowal Bay
Figure G88.5 Tidal Inundation Flood Depth and Water Level Contours Wrights Beach
Figure G88.6 Tidal Inundation Flood Depth and Water Level Contours Wandandian
Figure G88.7 Tidal Inundation Flood Depth and Water Level Contours Tomerong
Figure G89 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Overview
Figure G89.1 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Sussex Inlet
Figure G89.2 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Basin View
Figure G89.3 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Sanctuary Point
Figure G89.4 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Erowal Bay
Figure G89.5 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Wrights Beach
Figure G89.6 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Wandandian
Figure G89.7 Tidal Inundation Projected 2050 Flood Depth and Water Level Contours Tomerong
Figure G90 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Overview
Figure G90.1 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Sussex Inlet
Figure G90.2 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Basin View
Figure G90.3 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Sanctuary Point
Figure G90.4 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Erowal Bay
Figure G90.5 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Wrights Beach
Figure G90.6 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Wandandian
Figure G90.7 Tidal Inundation Projected 2100 Flood Depth and Water Level Contours Tomerong

Existing
20% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G01

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 10% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G02

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 5% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G03

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing
2% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G04

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing
1% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G05

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 0.2% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G06

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G07

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 20% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G08

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 10% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G09

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 5% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G10

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 2% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G11

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Water Level Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G12

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Water Level Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G12.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Water Level Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G12.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Water Level Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G12.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Water Level Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

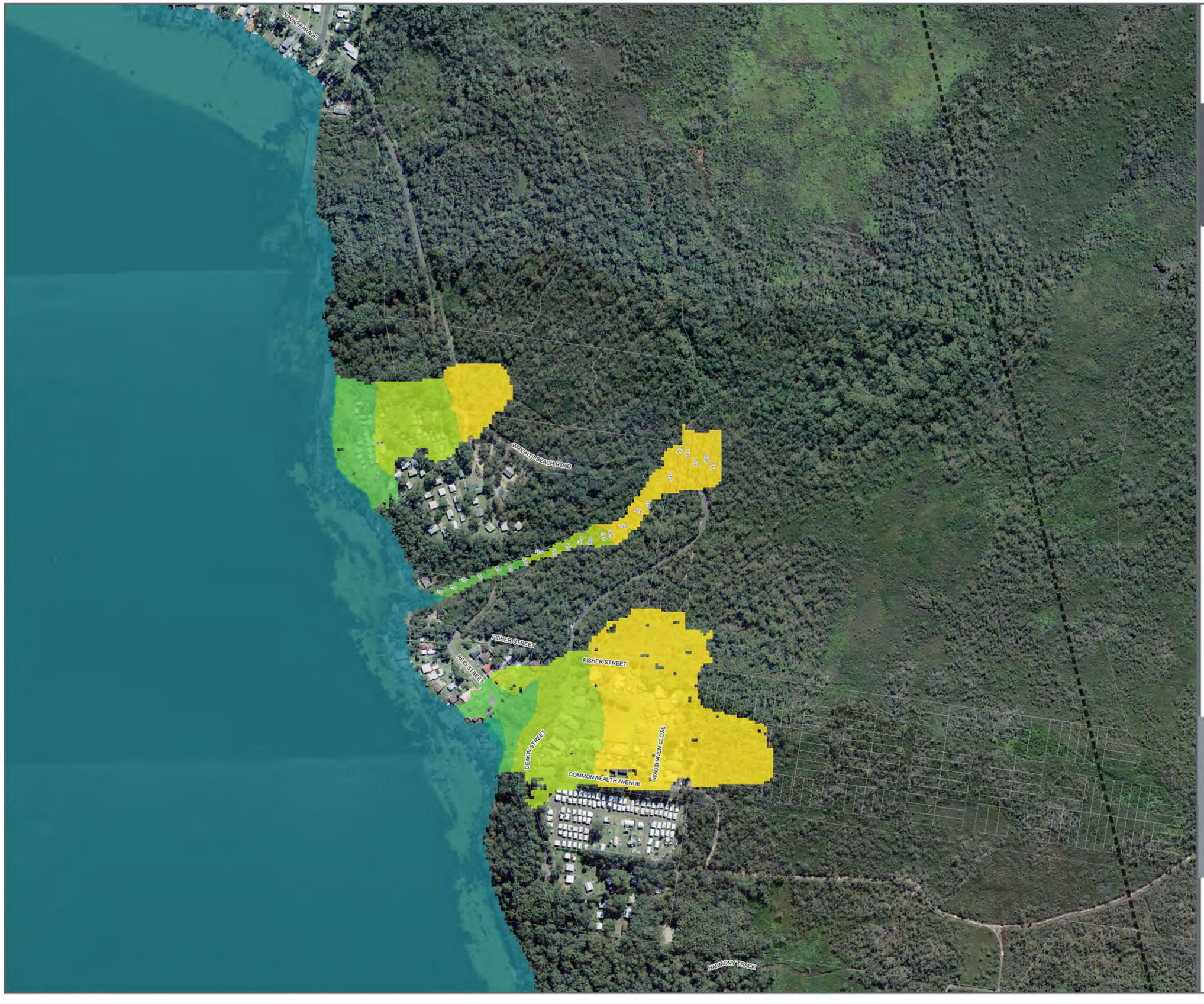
FIGURE G12.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Water Level Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

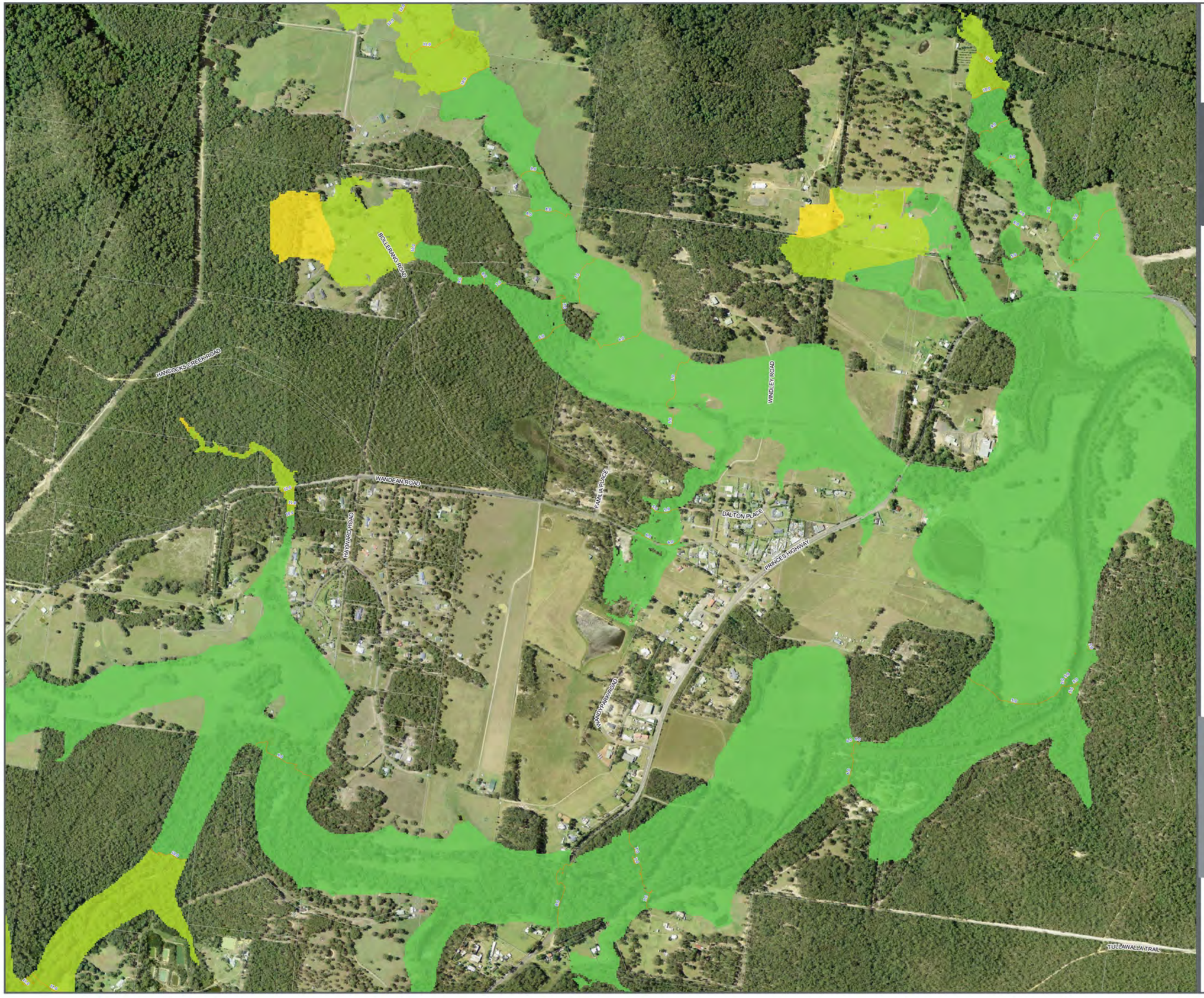
FIGURE G12.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Water Level Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G12.6

1:12,000 Scale at A3

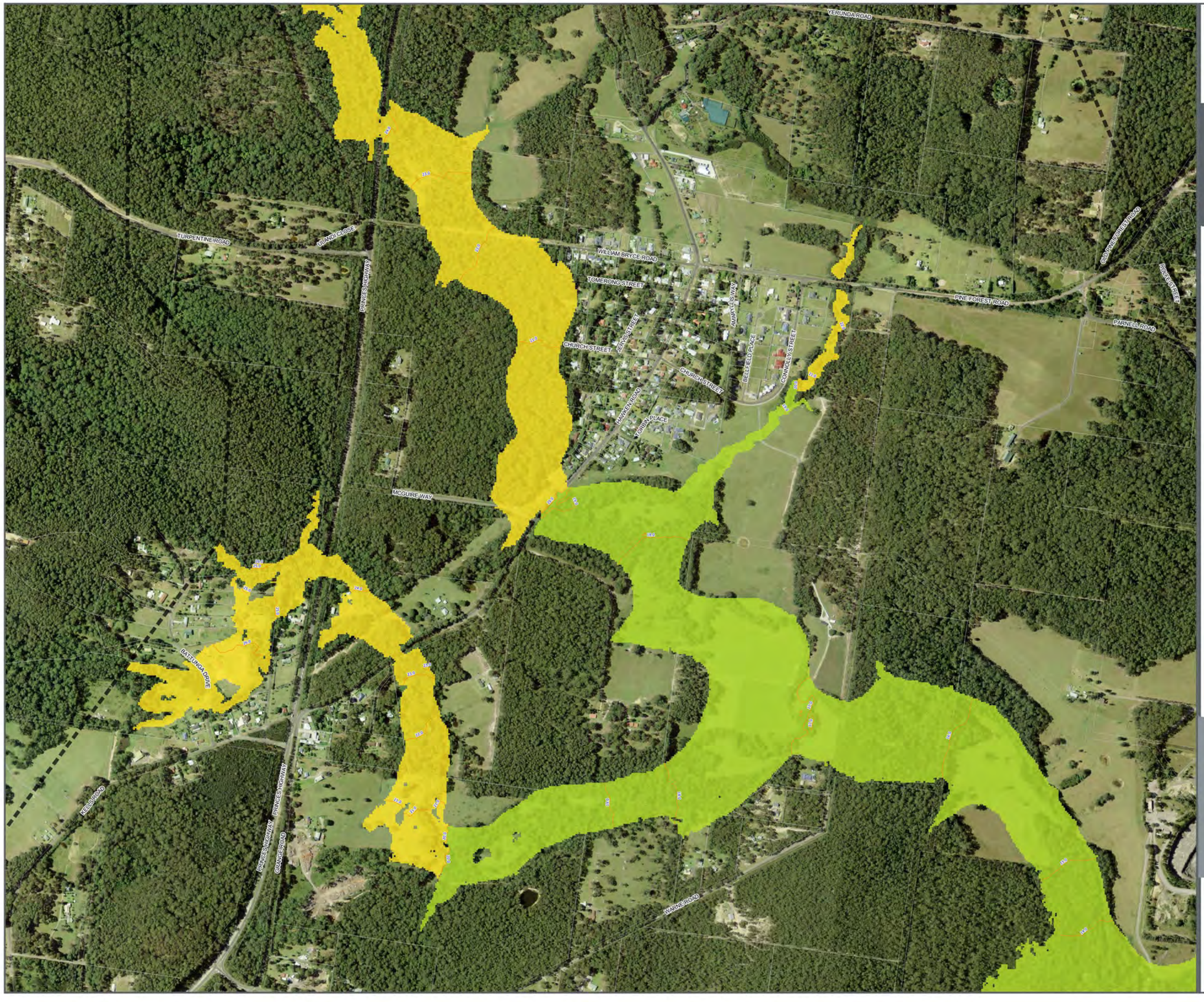
0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Water Level Tomerong

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G12.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 0.2% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G13

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Water Level Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Basin View

Erowal Bay

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G14

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Water Level Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G14.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Water Level Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G14.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Water Level Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G14.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Water Level Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G14.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Water Level Wrights Beach

St Georges Basin Flood Study

NAVAL PARADE
WRIGHTS BEACH ROAD
FISHER STREET
RED STREET
FISHER STREET
DEAKIN STREET
WASSHAVEN CLOSE
COMMONWEALTH AVENUE
HARMONY TRACK

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

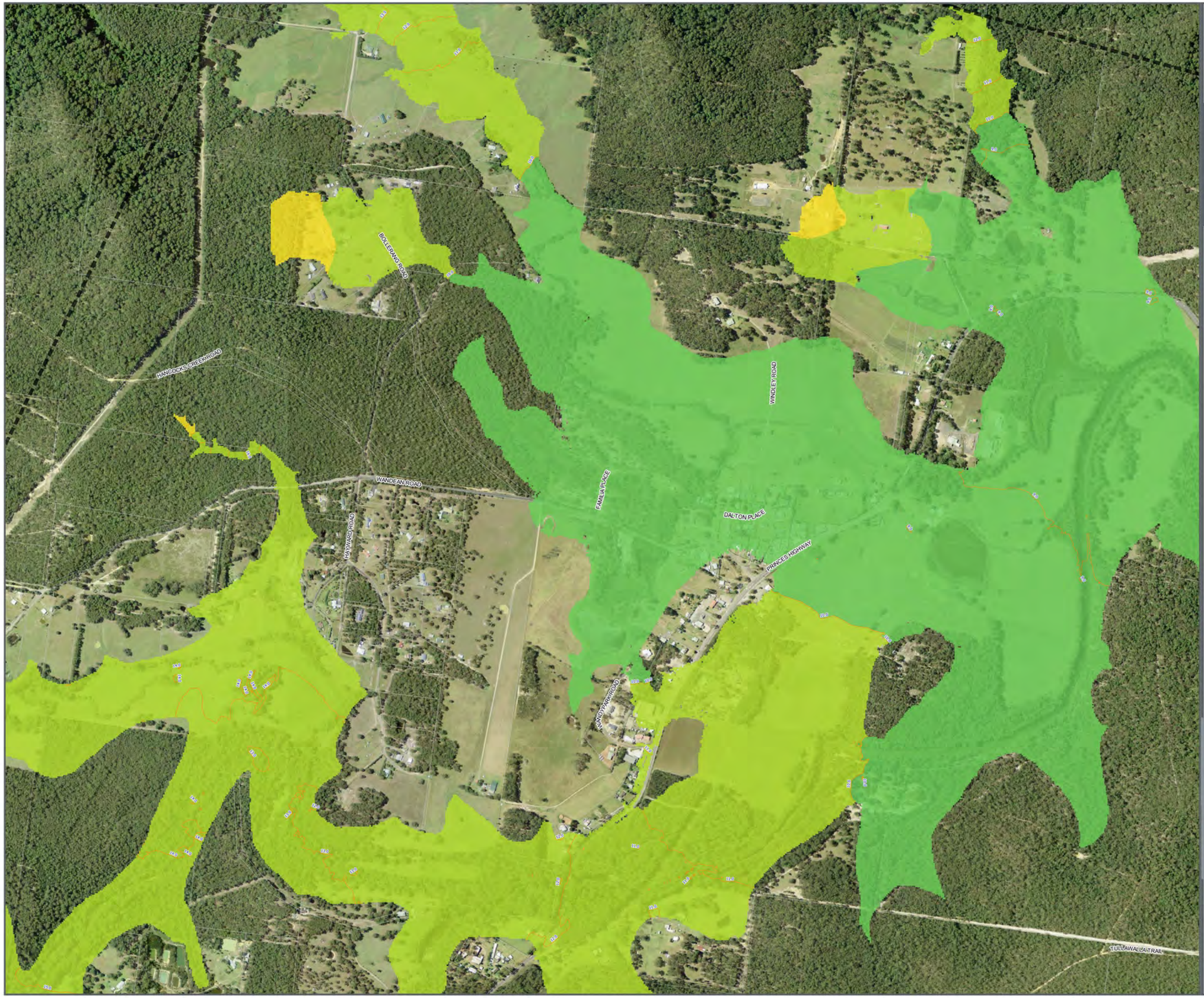
FIGURE G14.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing PMF Water Level Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G14.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Water Level Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G14.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Velocity Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G15

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Velocity Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G15.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Velocity Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G15.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Velocity Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G15.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Velocity Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G15.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Velocity Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

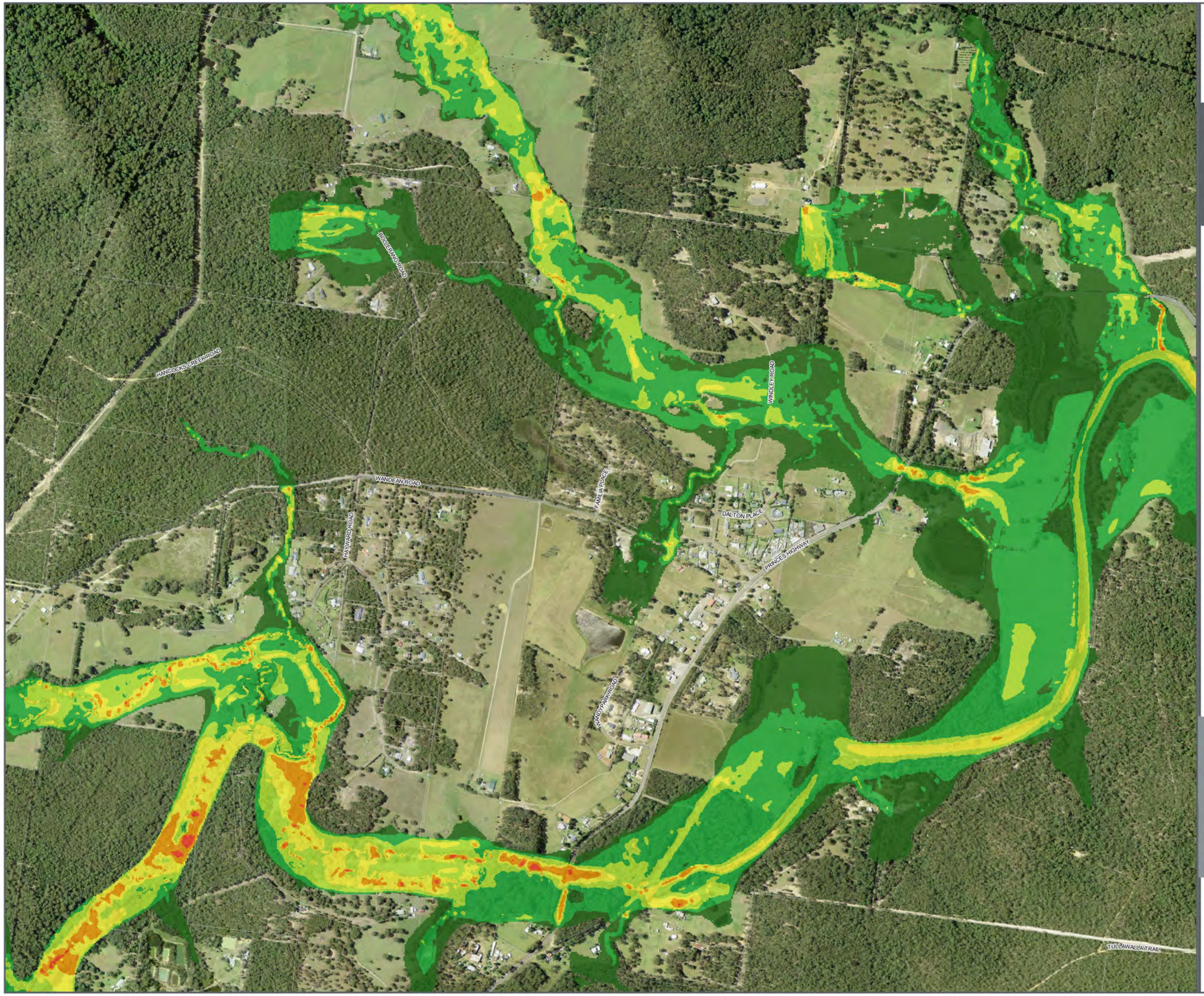
FIGURE G15.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Velocity Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G15.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Velocity Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G15.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 0.2% AEP Velocity

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G16

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Velocity

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G17

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 20% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G18

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 10% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G19

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 5% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G20

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 2% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G21

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hazard Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

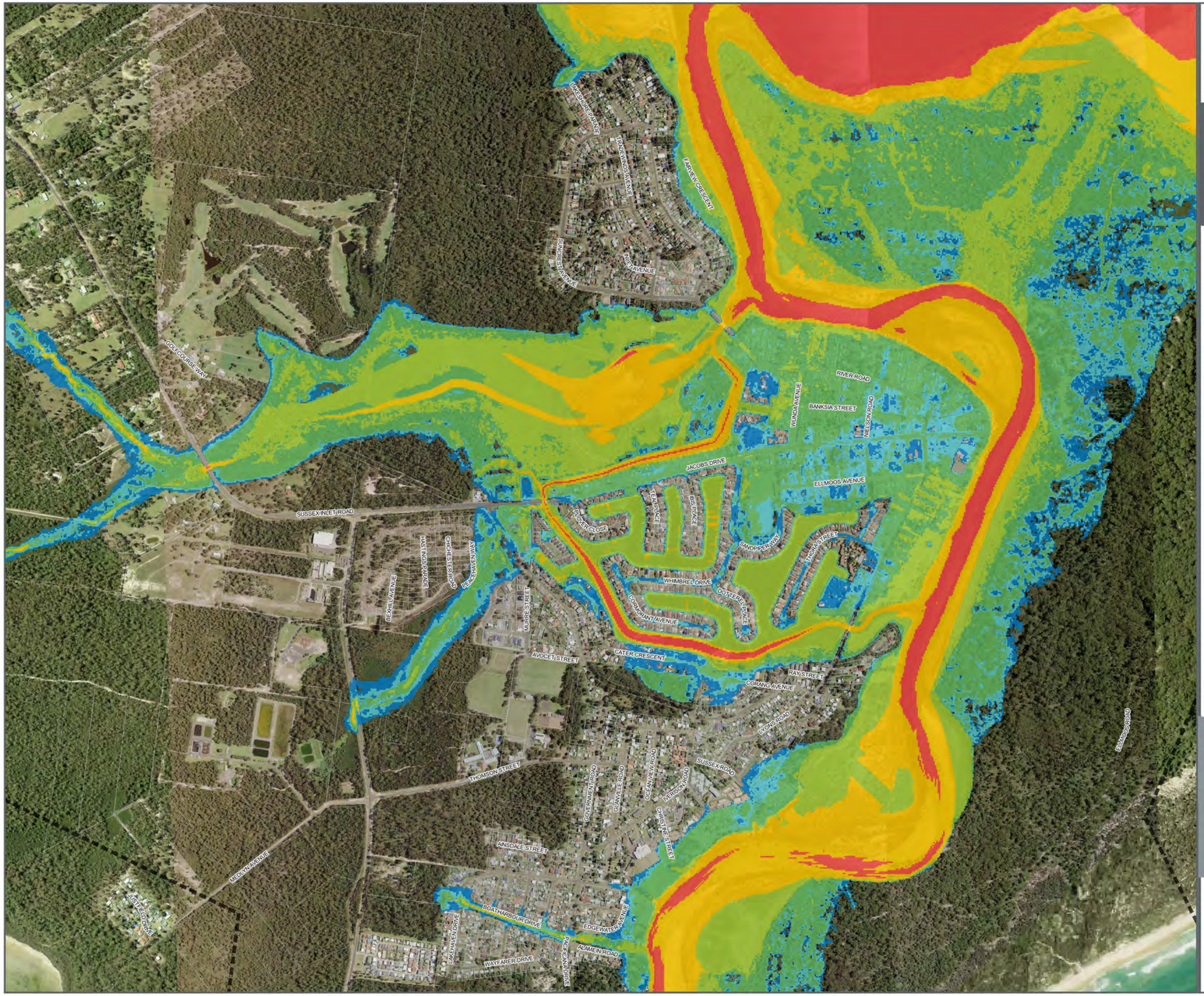
FIGURE G22

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Hazard Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G22.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hazard Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G22.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hazard Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G22.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hazard Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

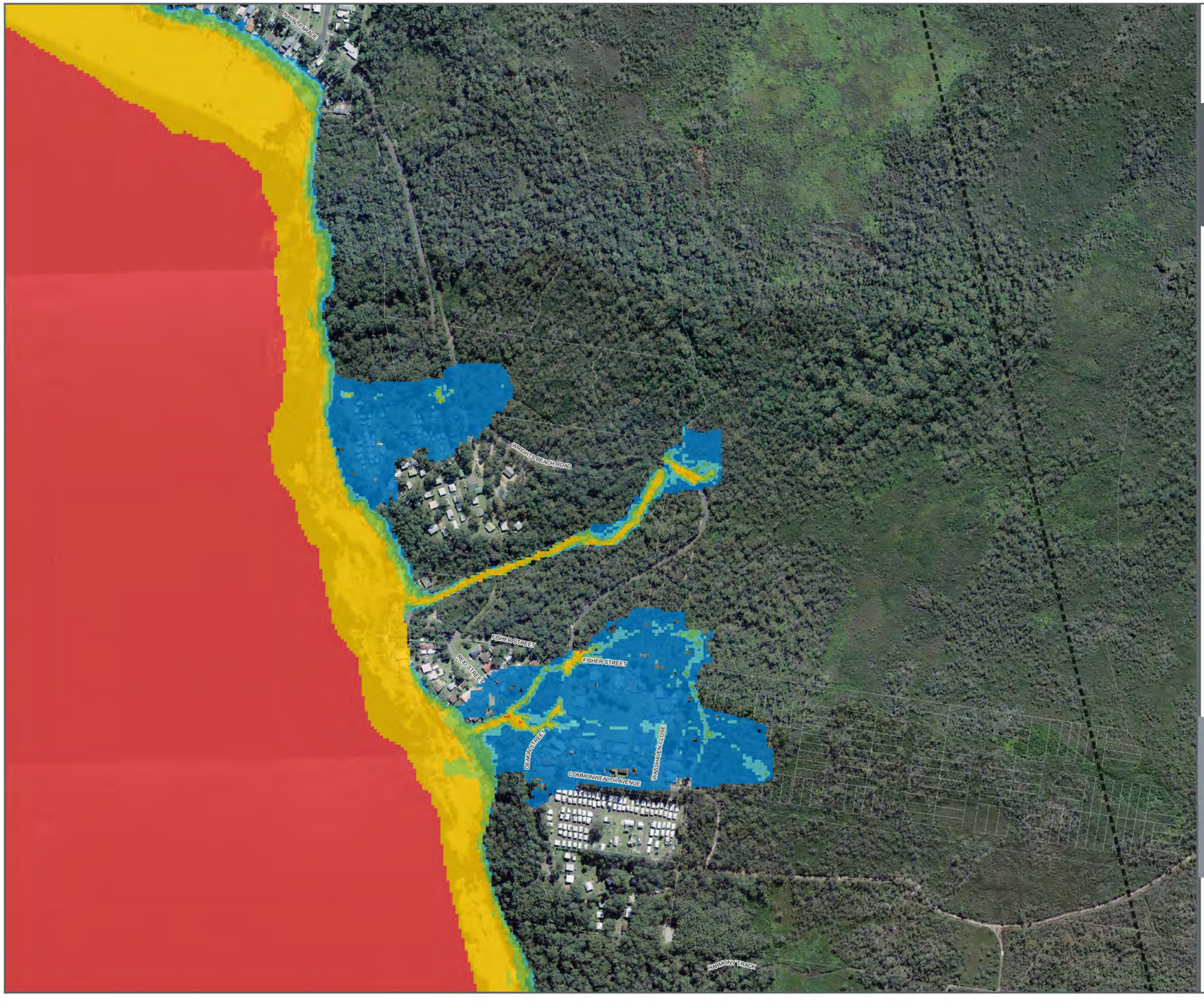
FIGURE G22.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Hazard Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

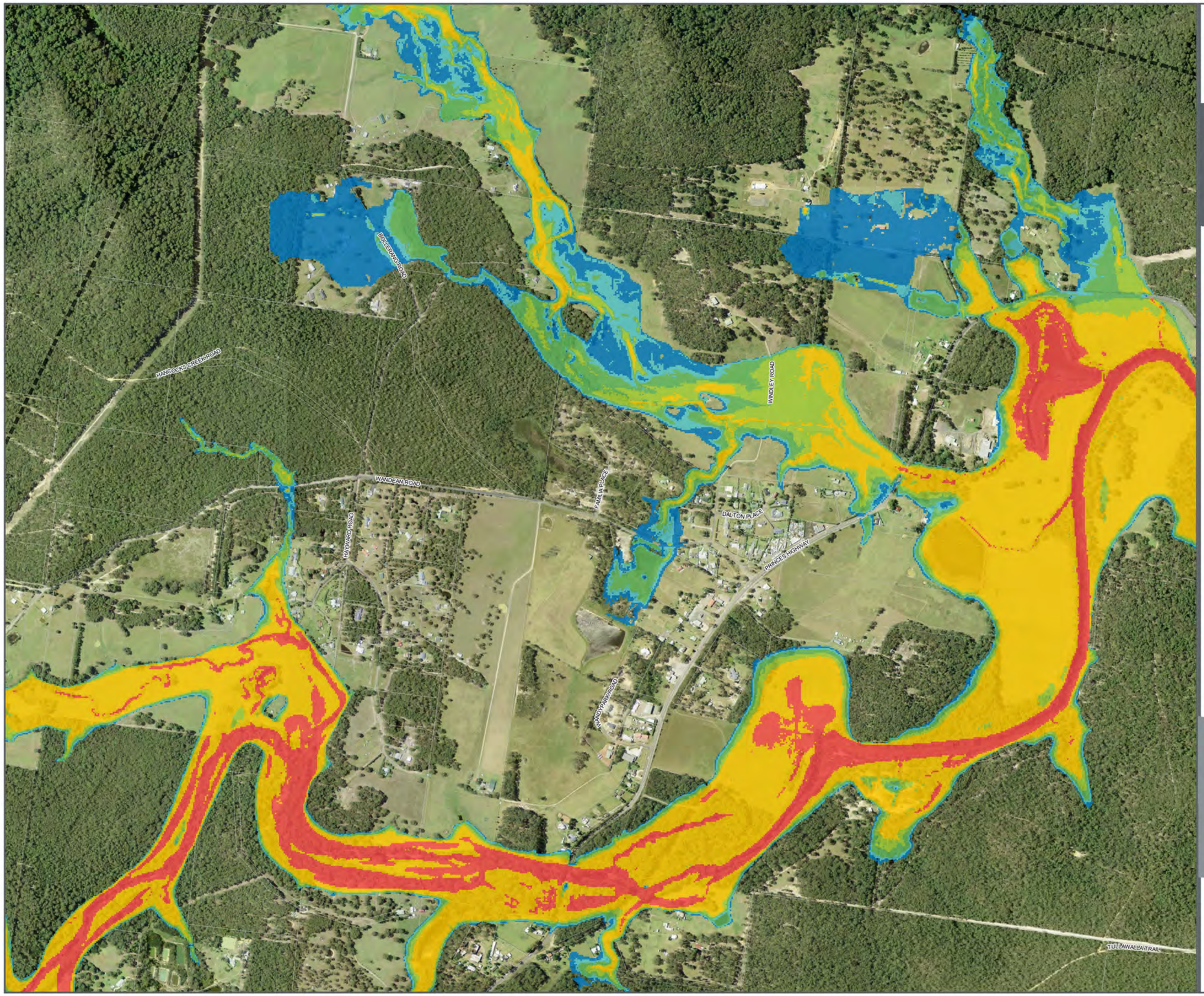
FIGURE G22.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Hazard Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

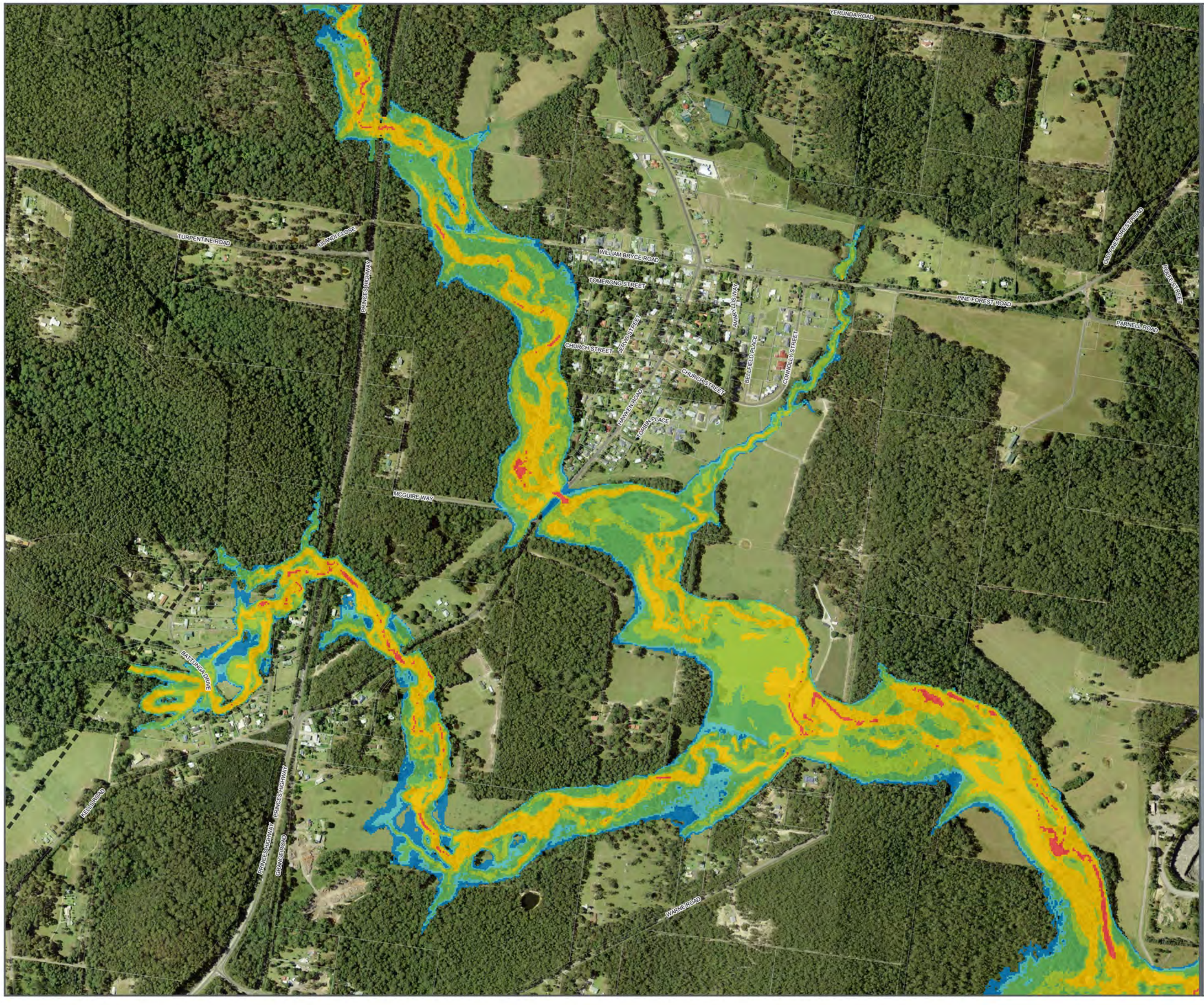
FIGURE G22.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Hazard Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G22.7

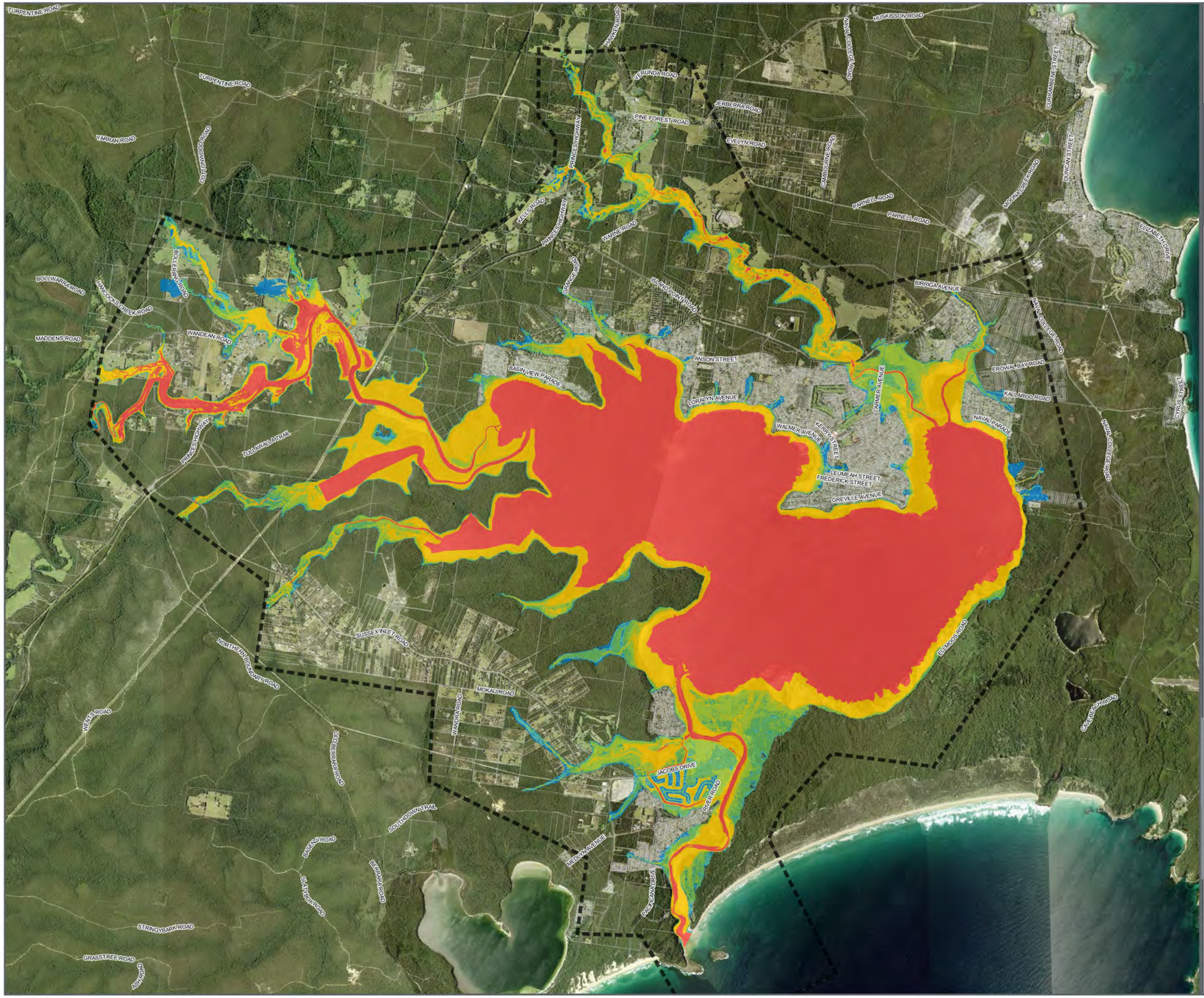
1:11,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 0.2% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G23

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G24

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Provisional Hazard Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G25

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Provisional Hazard Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G25.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Provisional Hazard Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G25.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Provisional Hazard Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G25.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Provisional Hazard Erowal Bay

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

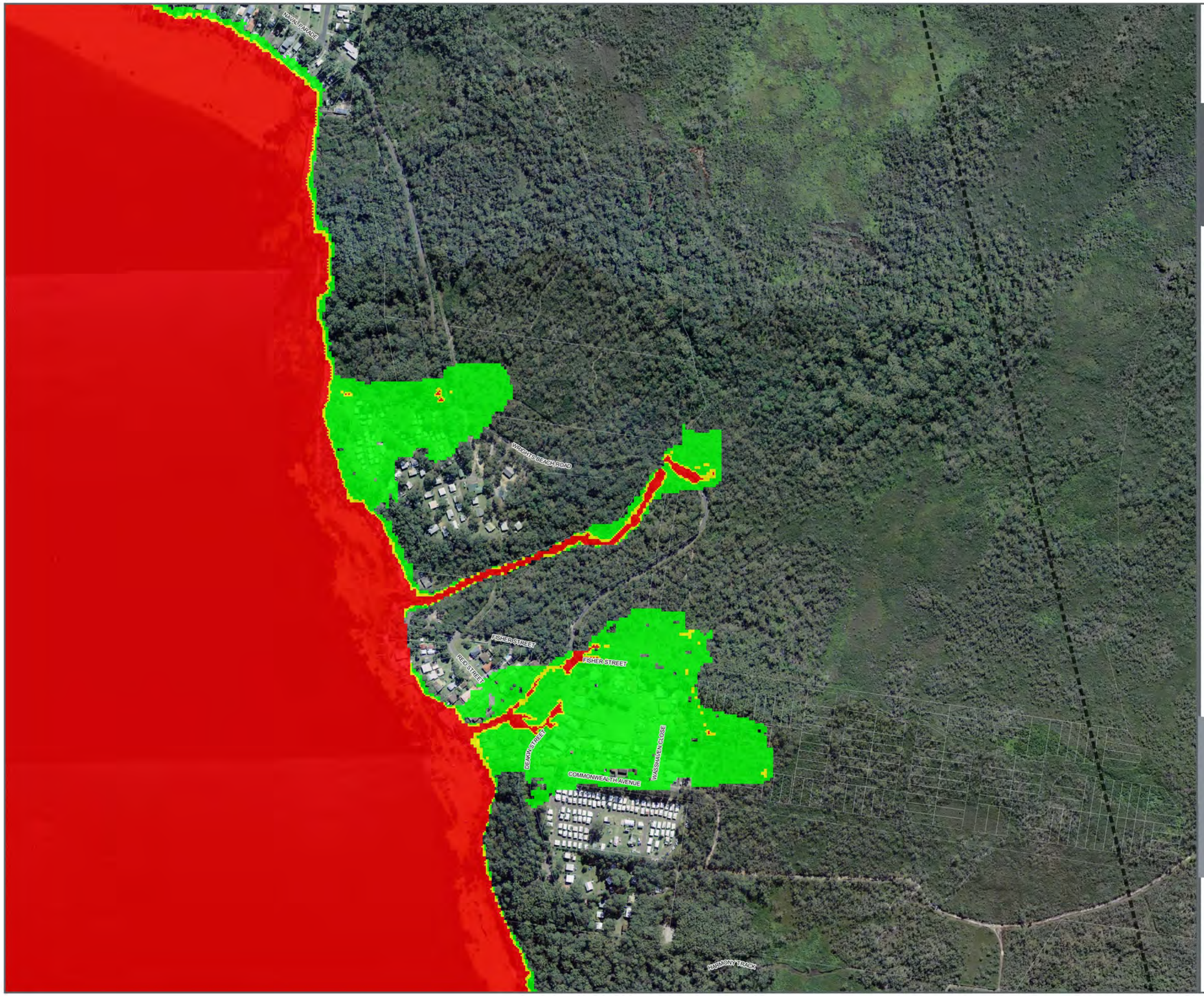
FIGURE G25.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Provisional Hazard Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

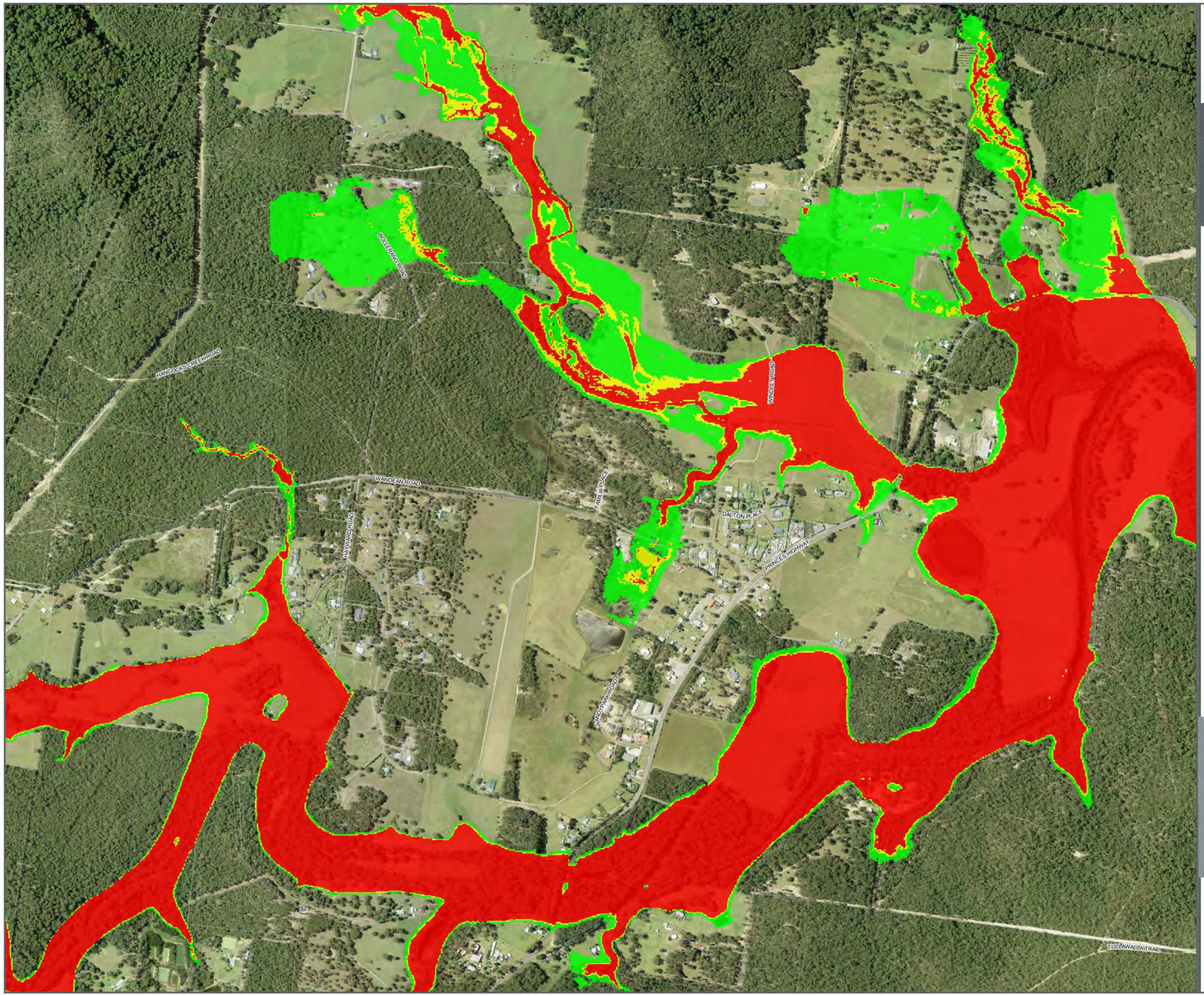
FIGURE G25.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Provisional Hazard Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G25.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

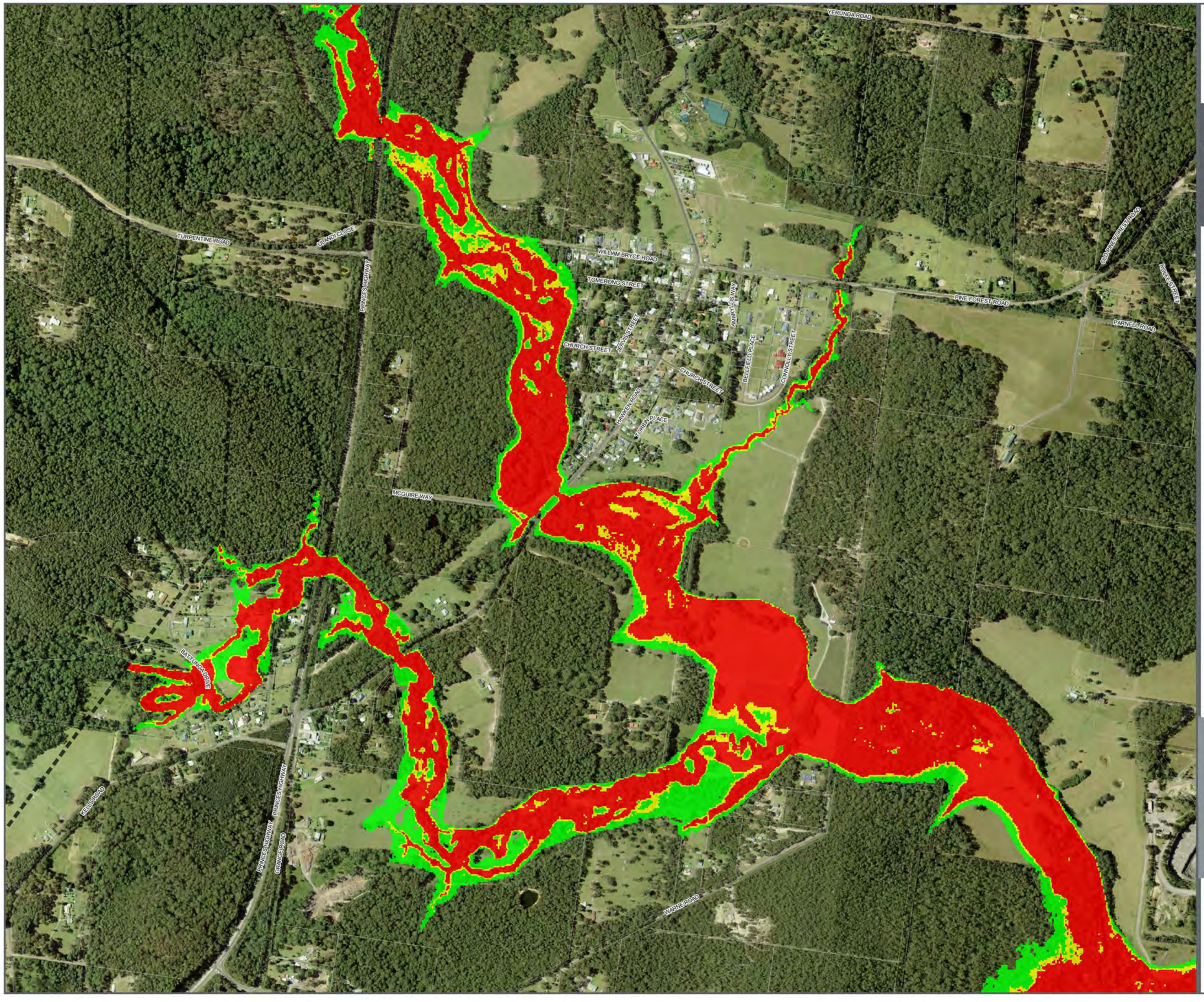
N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Provisional Hazard Tomerong

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G25.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Provisional Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G26

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hydraulic Categories Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Erowal Bay

Basin View

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G27

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hydraulic Categories Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G27.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hydraulic Categories Basin View

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G27.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hydraulic Categories Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G27.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hydraulic Categories Erowal Bav

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

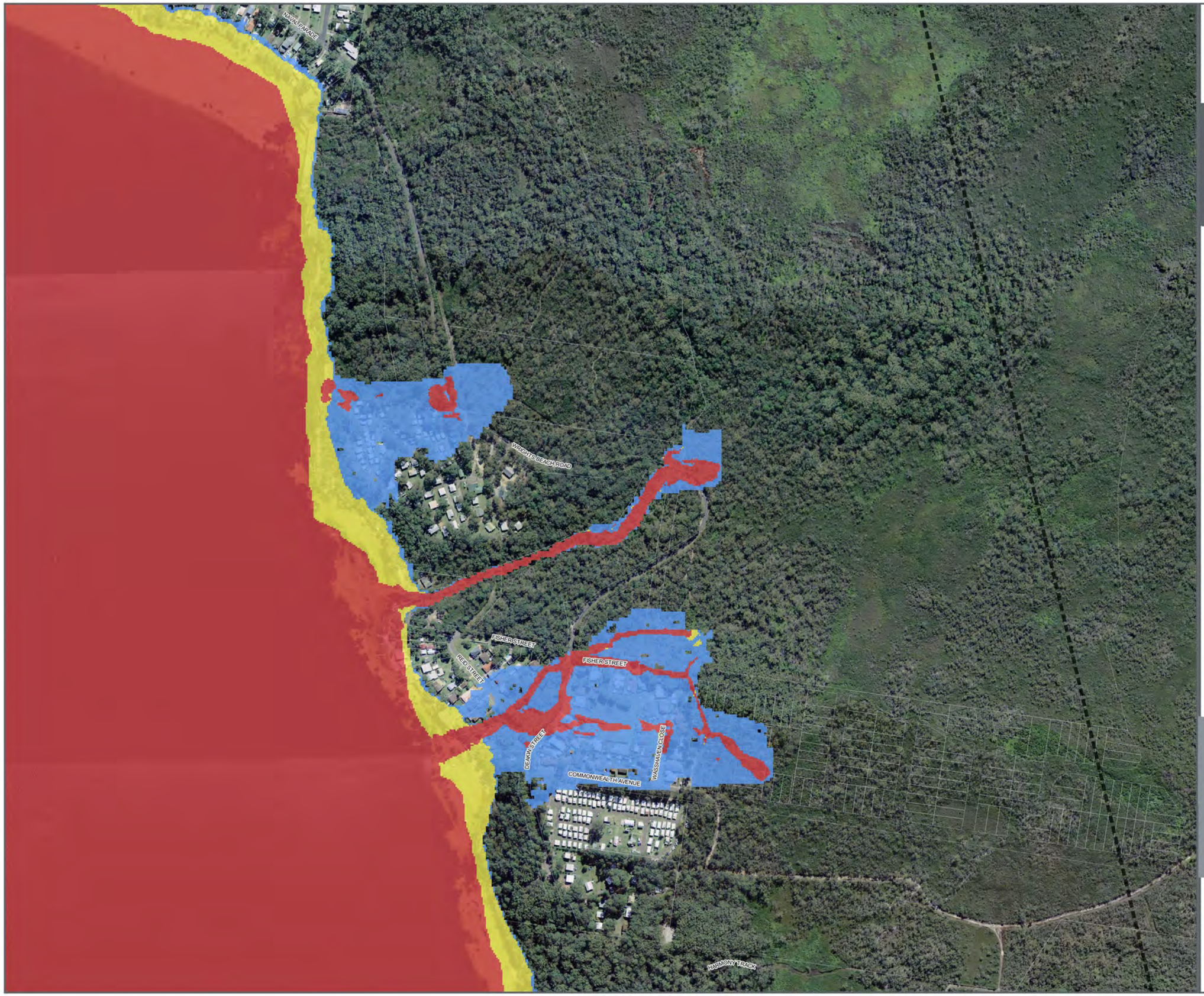
FIGURE G27.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Hydraulic Categories Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

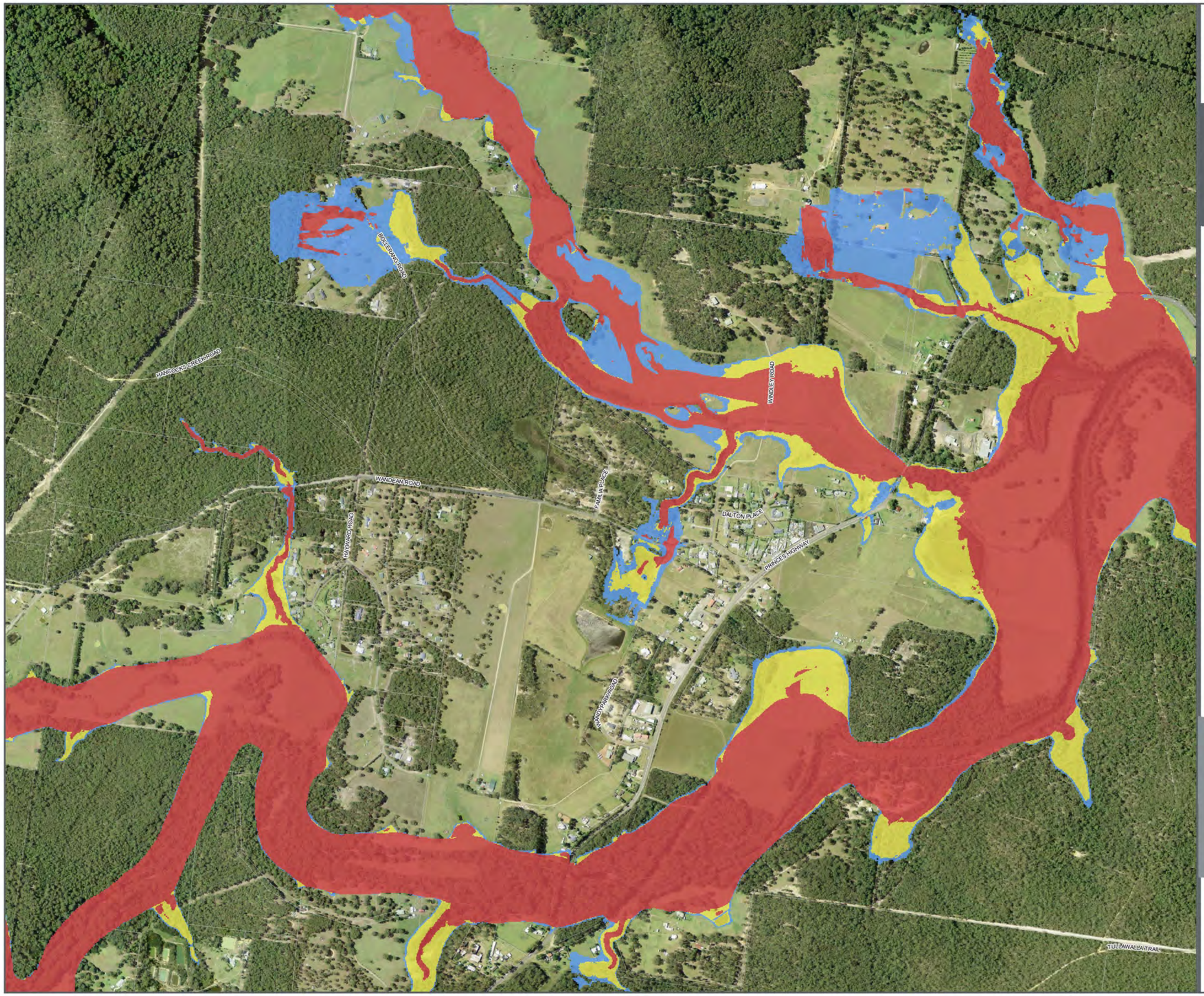
FIGURE G27.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing 1% AEP Hydraulic Categories Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G27.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

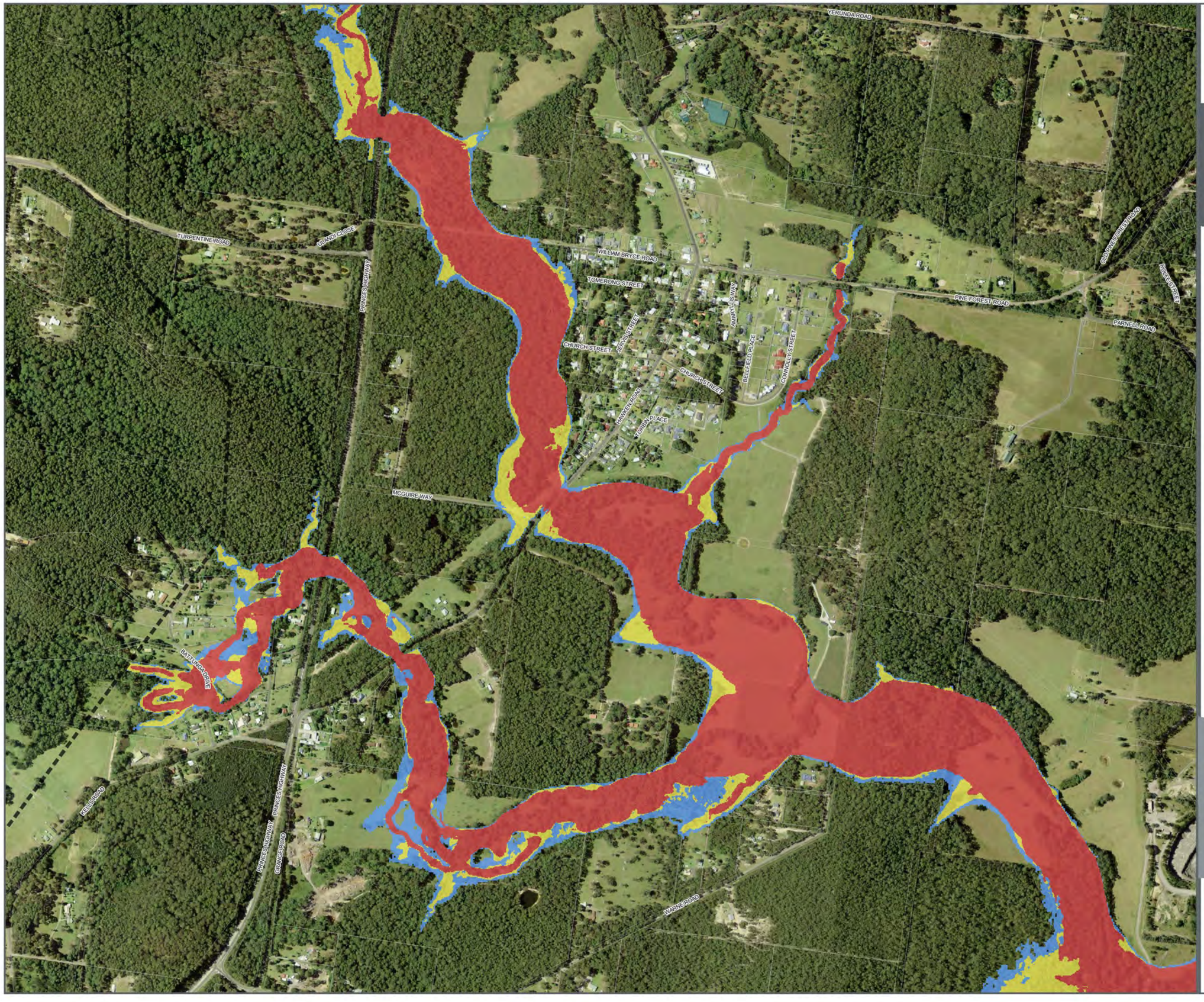
N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Hydraulic Categories Tomerong

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G27.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Hydraulic Categories

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G28

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Basin View

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Erowal Bav

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Wrights Beach

St Georges Basin Flood Study

NAVAL PARADE
WRIGHTS BEACH ROAD
FISHER STREET
RED STREET
FISHER STREET
DENKIN STREET
WASSHAVEN CLOSE
COMMONWEALTH AVENUE
HARMONY TRACK

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing 1% AEP Combined Hazard and Hydraulic Category Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G29.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing PMF Combined Hazard and Hydraulic Category

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G30

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 10% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G31

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 5% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G32

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 2% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G33

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G34

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G35

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 10% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G36

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 5% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G37

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 2% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G38

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Water Level Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Basin View

Erowal Bay

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G39

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Water Level Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G39.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Water Level Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G39.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Water Level Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G39.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Water Level Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

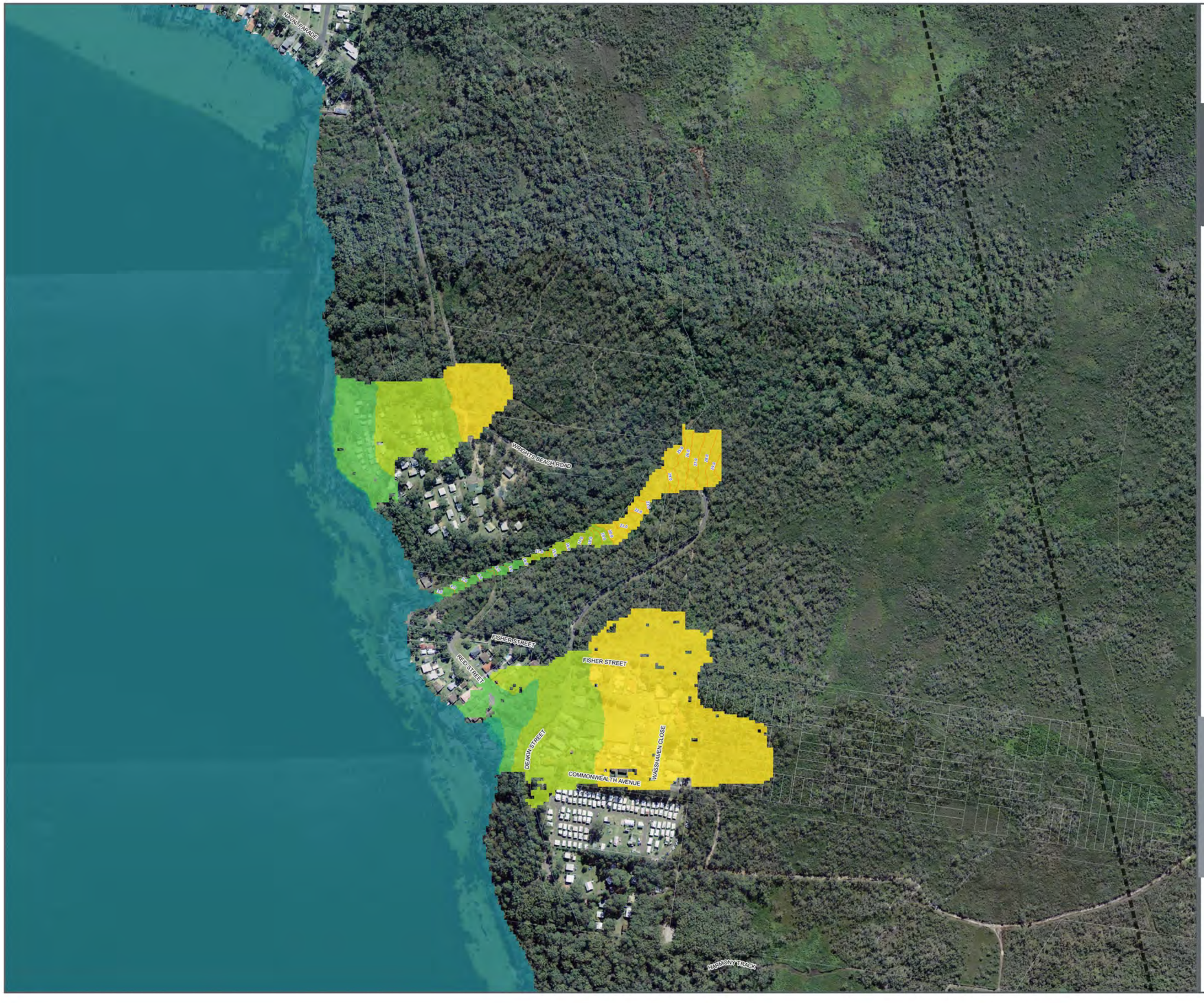
FIGURE G39.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Water Level Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

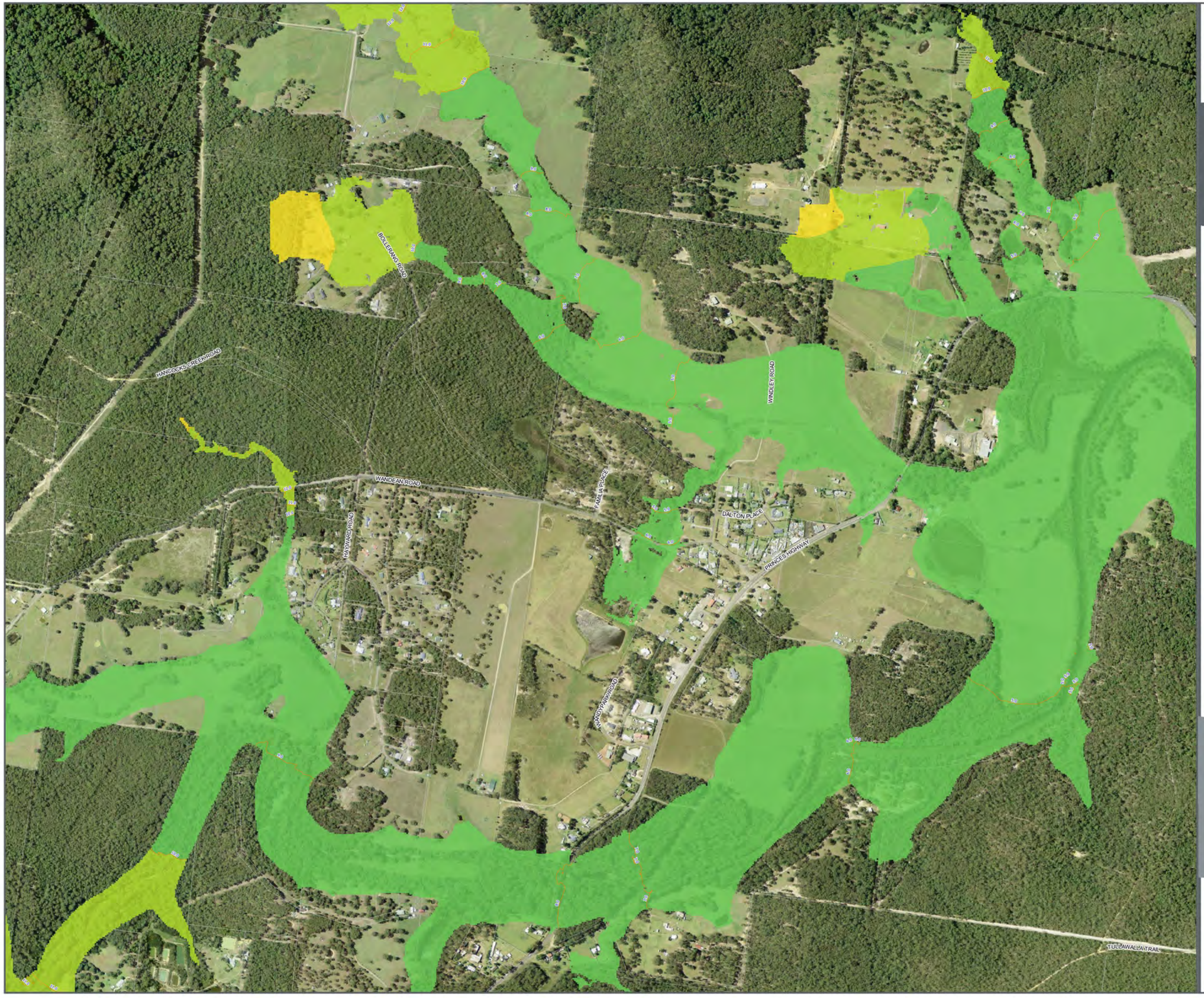
FIGURE G39.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Water Level Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G39.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Water Level Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G39.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Water Level Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Basin View

Erowal Bay

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Water Level Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 PMF Water Level Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Water Level Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Water Level Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 PMF Water Level Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Water Level Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Water Level Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G40.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Velocity Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G41

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Velocity Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G41.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Velocity Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G41.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Velocity Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G41.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Velocity Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G41.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Velocity Wrights Beach

St Georges Basin Flood Study

NAVAL PARADE
WRIGHTS BEACH ROAD
FISHER STREET
RED STREET
FISHER STREET
DEKIN STREET
COMMONWEALTH AVENUE
WESSHAVEN CLOSE
HARMONY TRACK

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

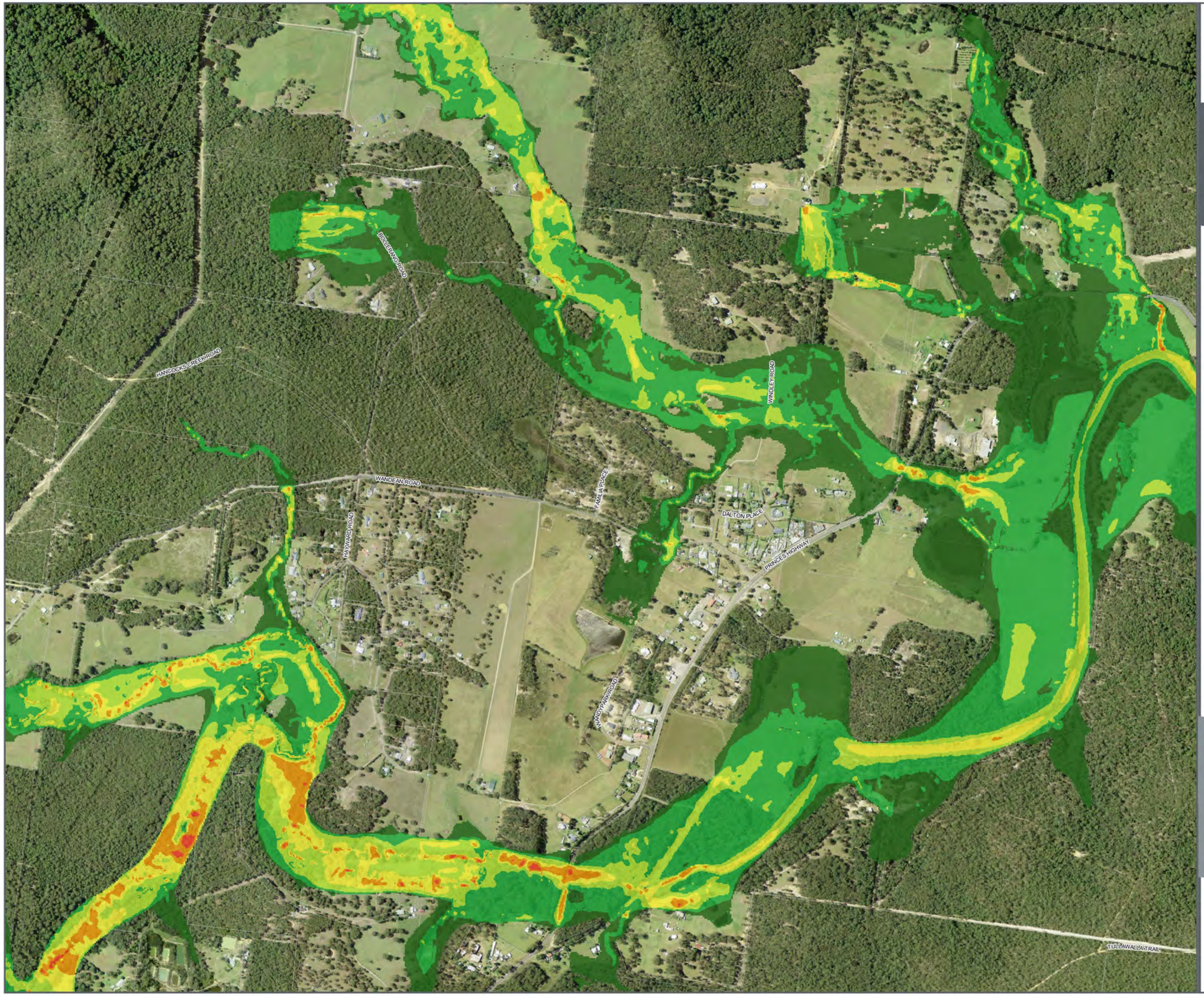
FIGURE G41.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Velocity Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G41.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Velocity Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G41.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Velocity

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G42

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 10% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G43

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 5% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G44

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 2% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G45

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hazard Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

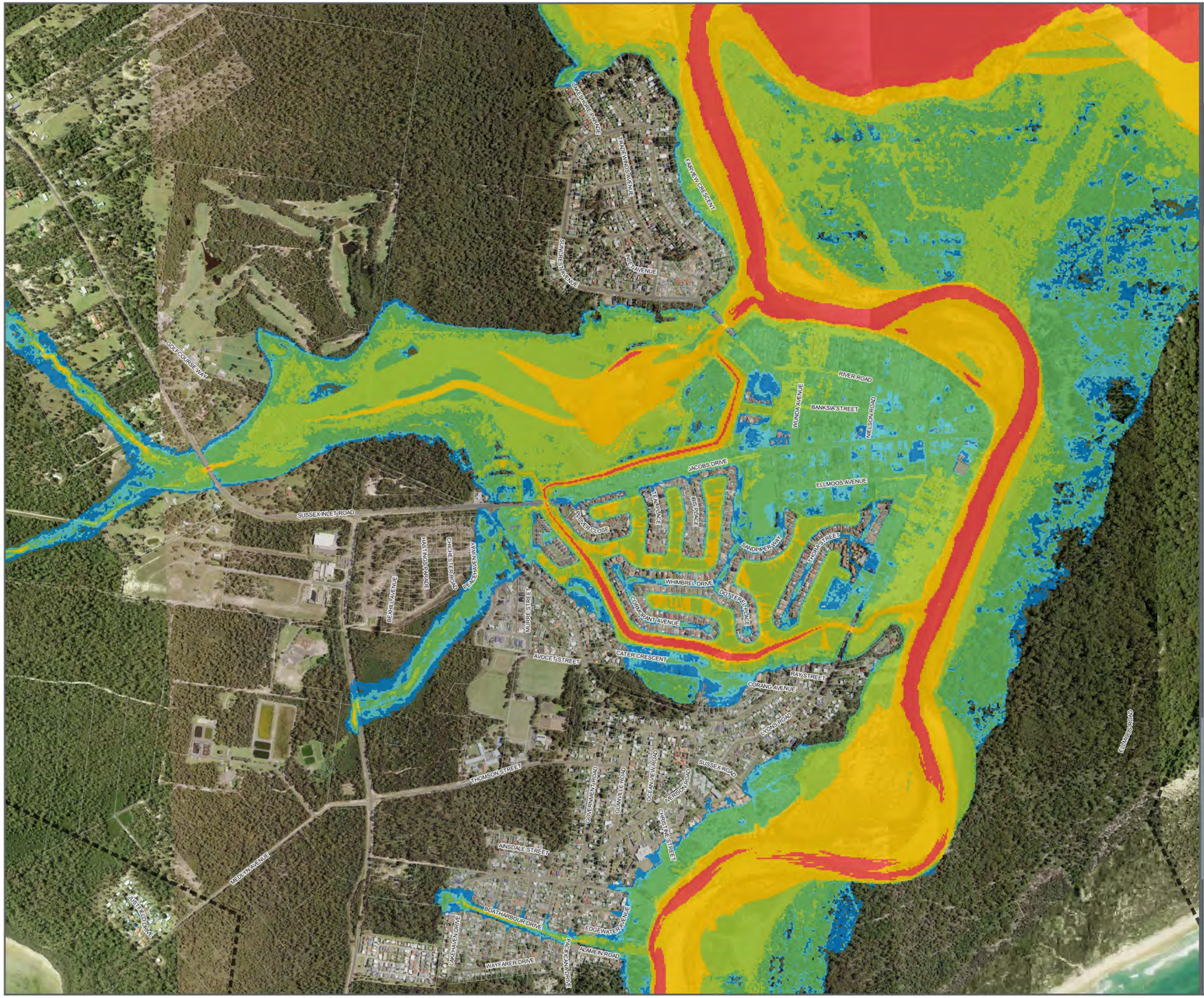
FIGURE G46

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Hazard Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G46.1

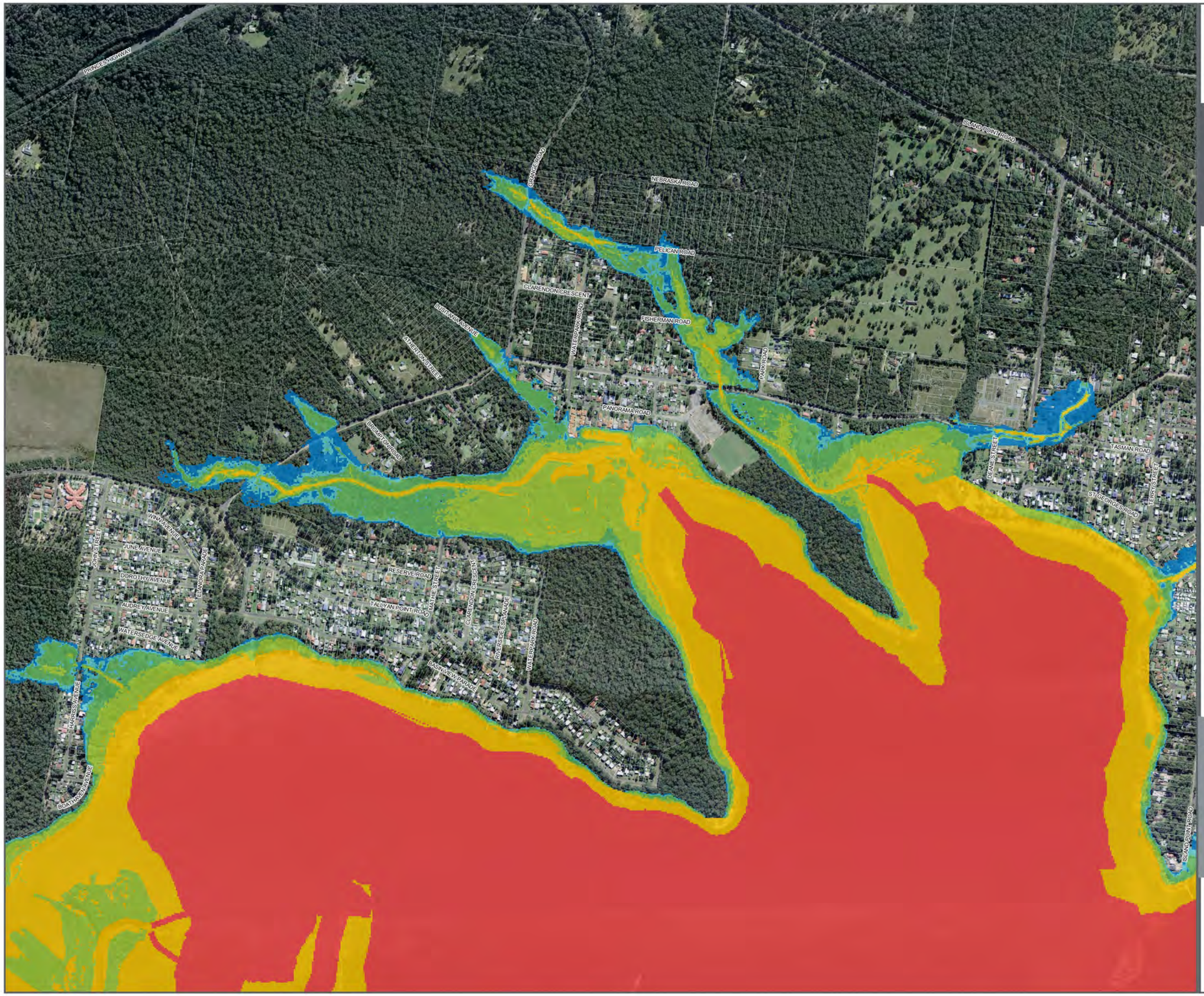
1:13,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Hazard Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G46.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hazard Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G46.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hazard Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G46.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hazard Wrights Beach

St Georges Basin Flood Study

NAVAL PARADE
WRIGHTS BEACH ROAD
FISHER STREET
RED STREET
FISHER STREET
BENNY STREET
WASSHAVEN CLOSE
COMMONWEALTH AVENUE
HARMONY TRACK

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

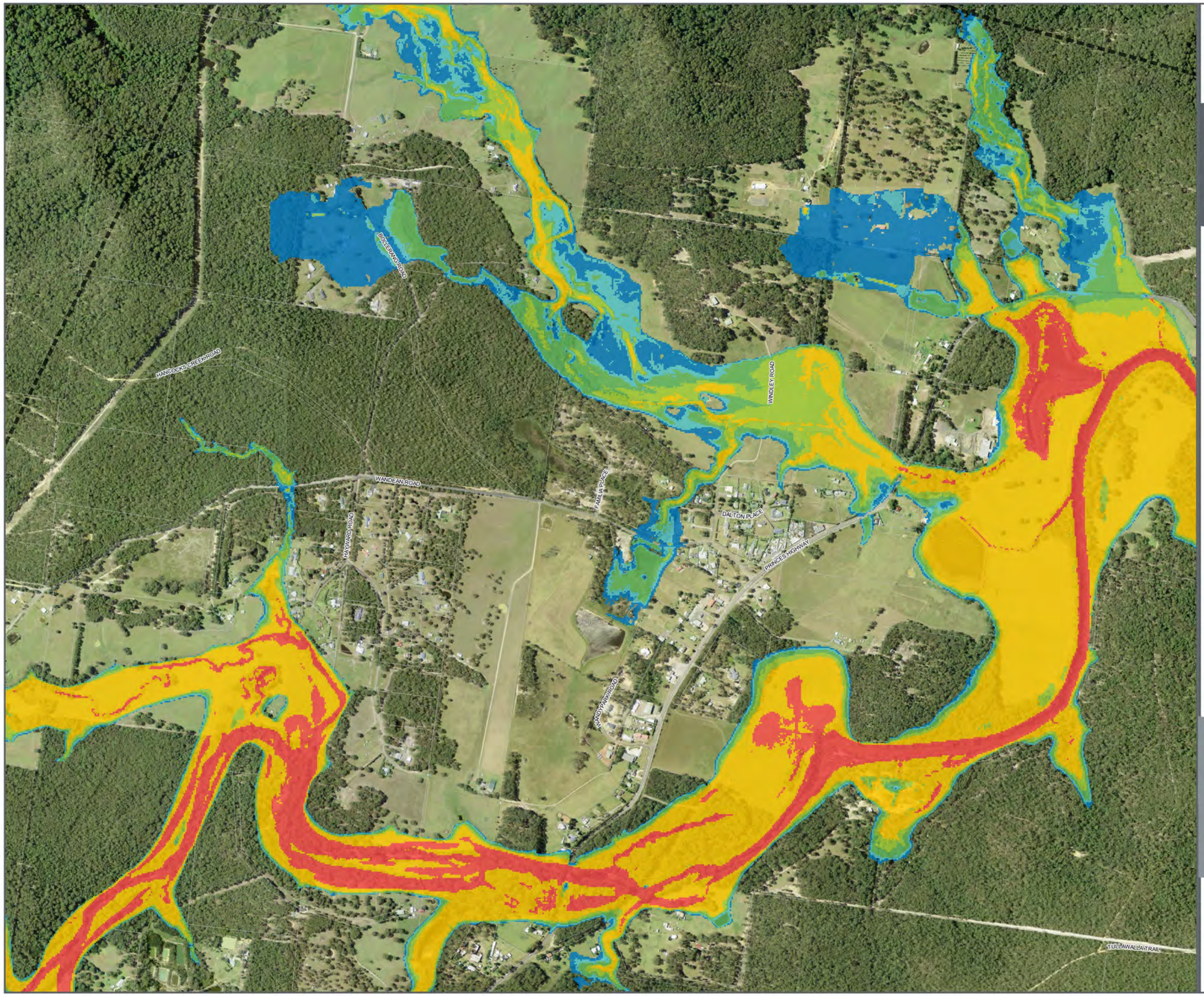
FIGURE G46.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Hazard Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

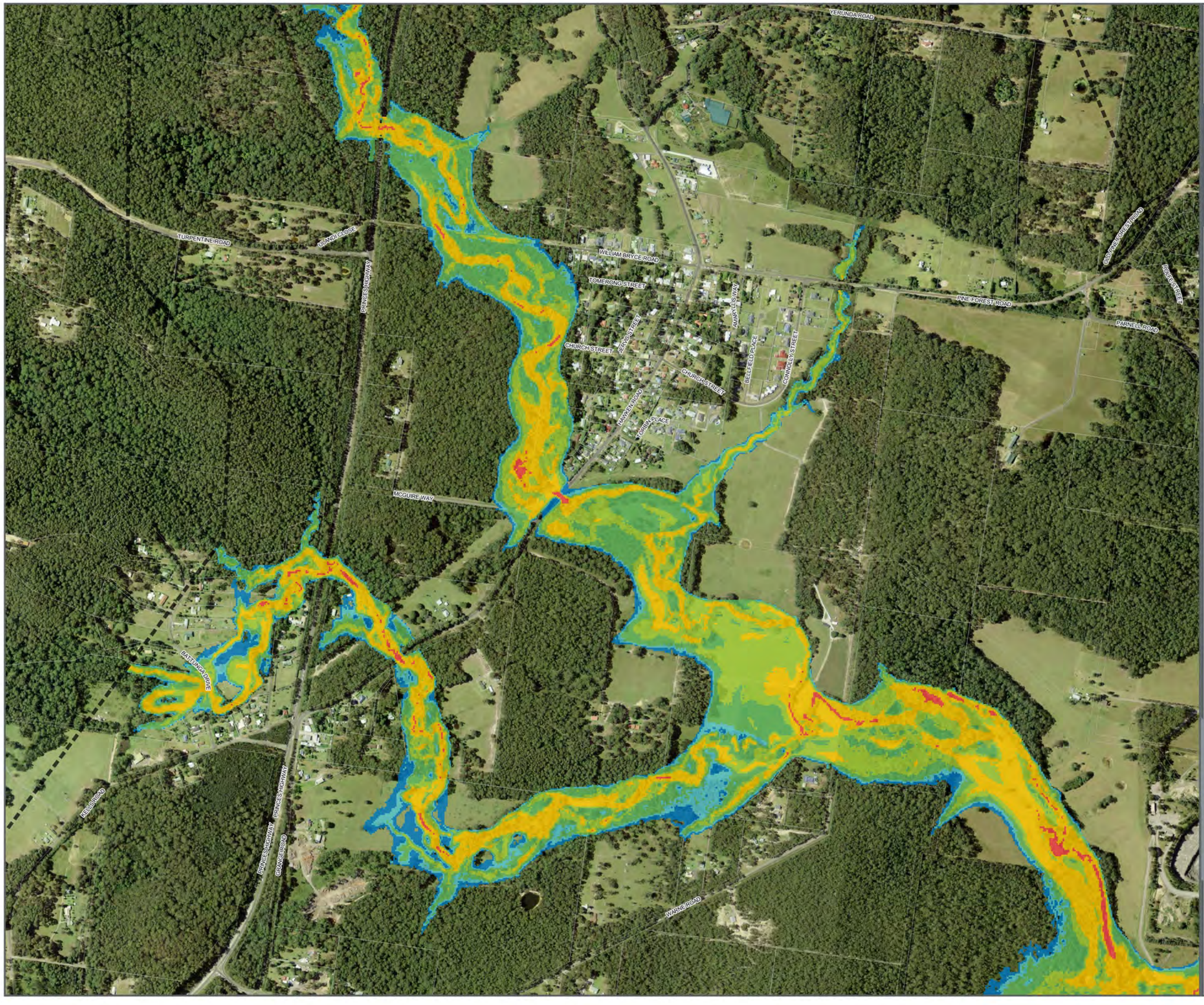
FIGURE G46.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Hazard Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G46.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G47

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Provisional Hazard Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G48

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Provisional Hazard Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G48.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Provisional Hazard Basin View

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G48.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Provisional Hazard Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G48.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Provisional Hazard Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G48.4

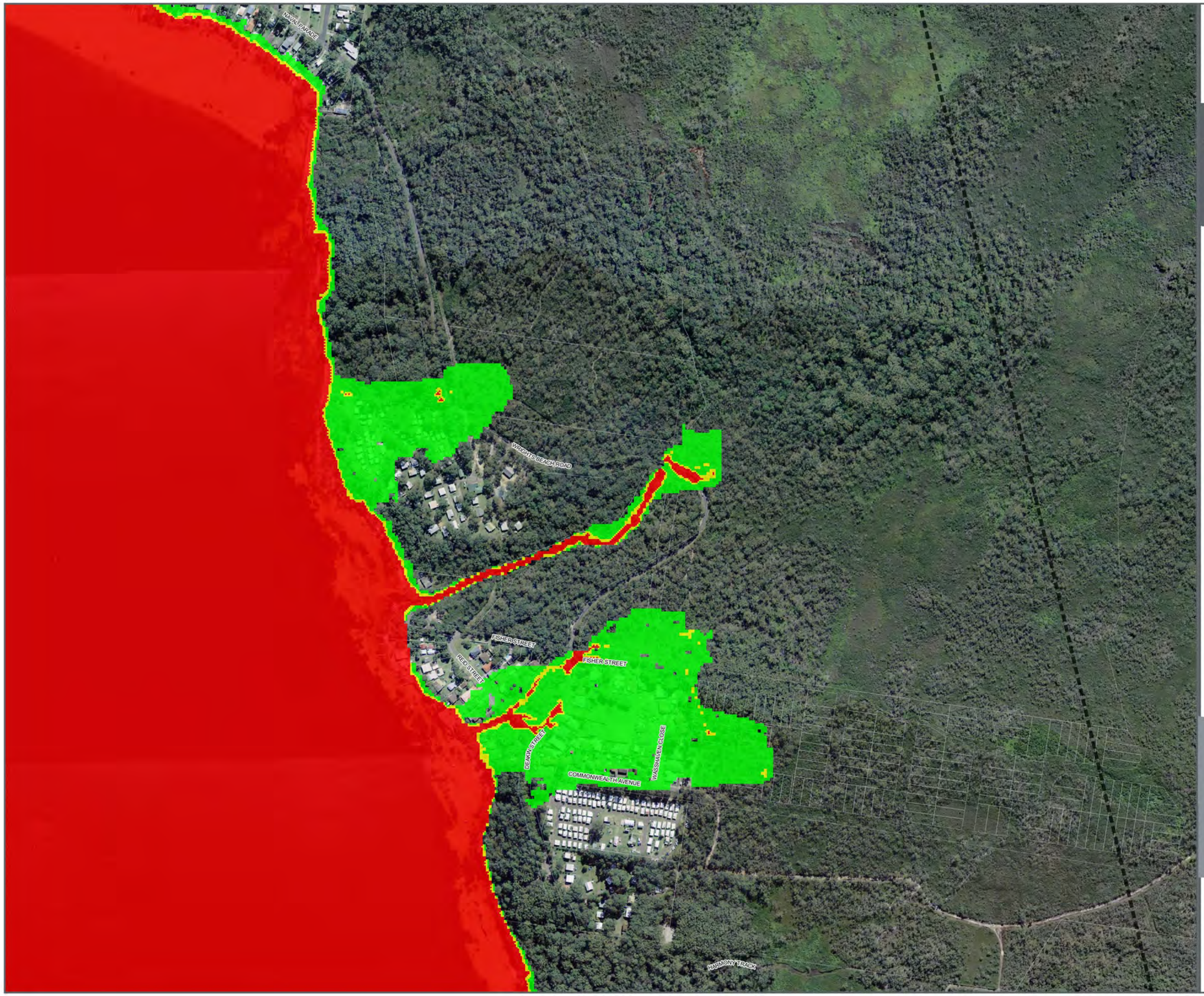
1:11,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Provisional Hazard Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

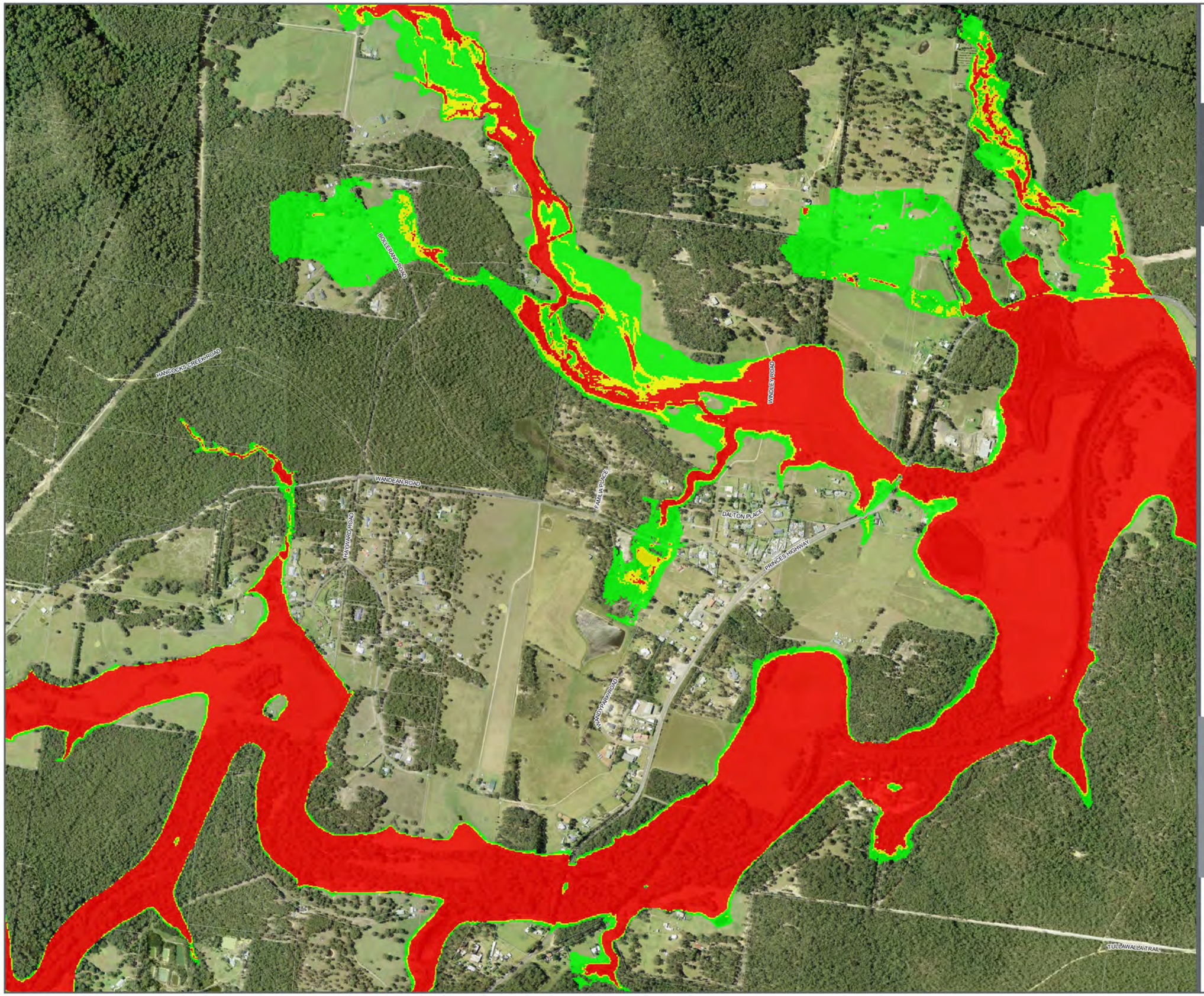
FIGURE G48.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Provisional Hazard Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G48.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

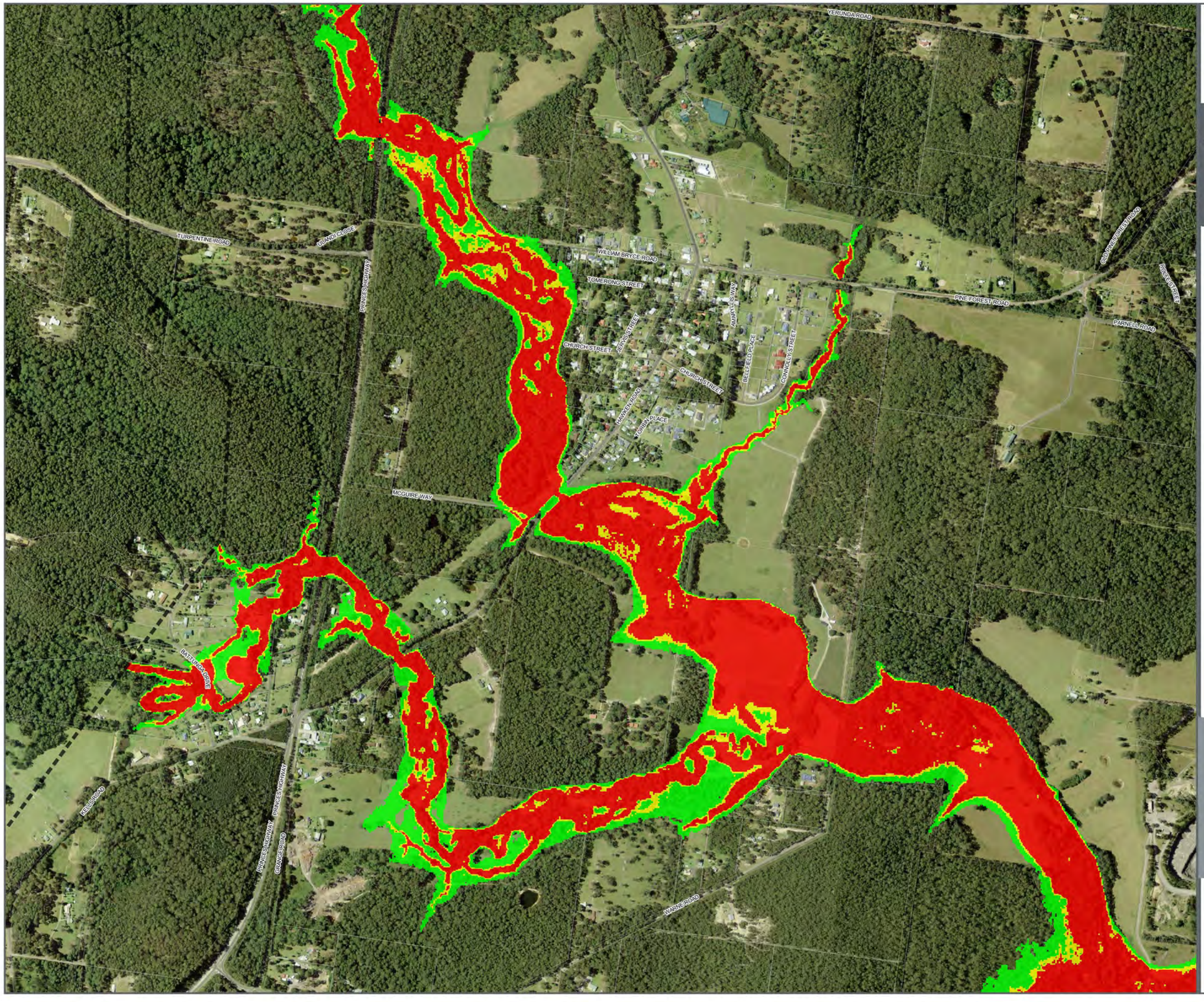
N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Provisional Hazard Tomerong

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G48.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Provisional Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G49

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hydraulic Categories Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Erowal Bay

Basin View

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hydraulic Categories Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Hydraulic Categories Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hydraulic Categories Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hydraulic Categories Erowal Bav

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hydraulic Categories Wrights Beach

St Georges Basin Flood Study

NAVAL PARADE
WRIGHTS BEACH ROAD
FISHER STREET
RED STREET
FISHER STREET
DENNY STREET
WASSHAVEN CLOSE
COMMONWEALTH AVENUE
HARMONY TRACK

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50.5

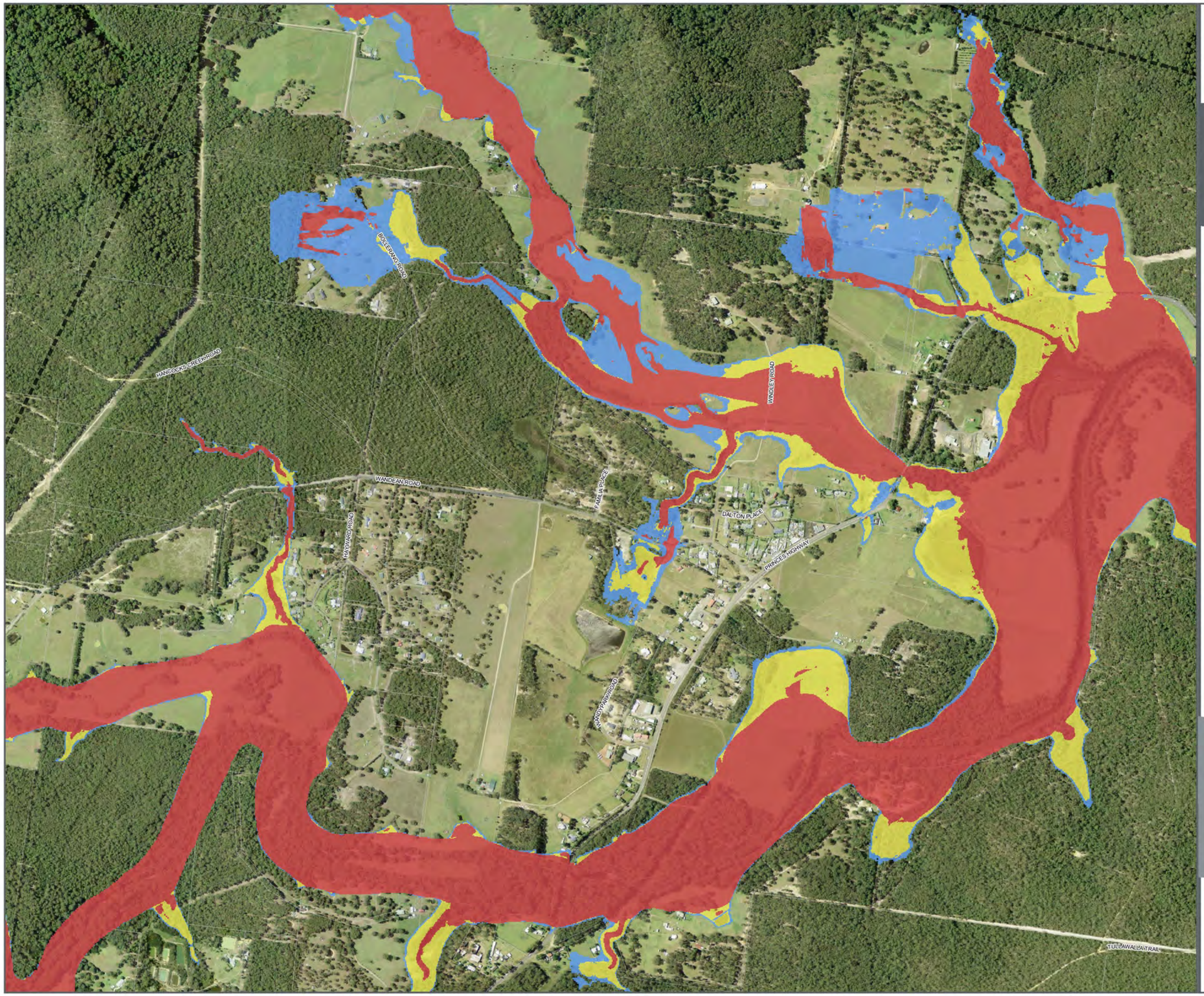
1:6,000 Scale at A3

0 70 140 210 280 350 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Hydraulic Categories Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Hydraulic Categories Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G50.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Hydraulic Categories

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G51

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Combined Hazard and Hydraulic Category Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G52

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Combined Hazard and Hydraulic Category Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G52.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Combined Hazard and Hydraulic Category Basin View

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G52.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Combined Hazard and Hydraulic Category Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G52.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Combined Hazard and Hydraulic Category Erowal Bav

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

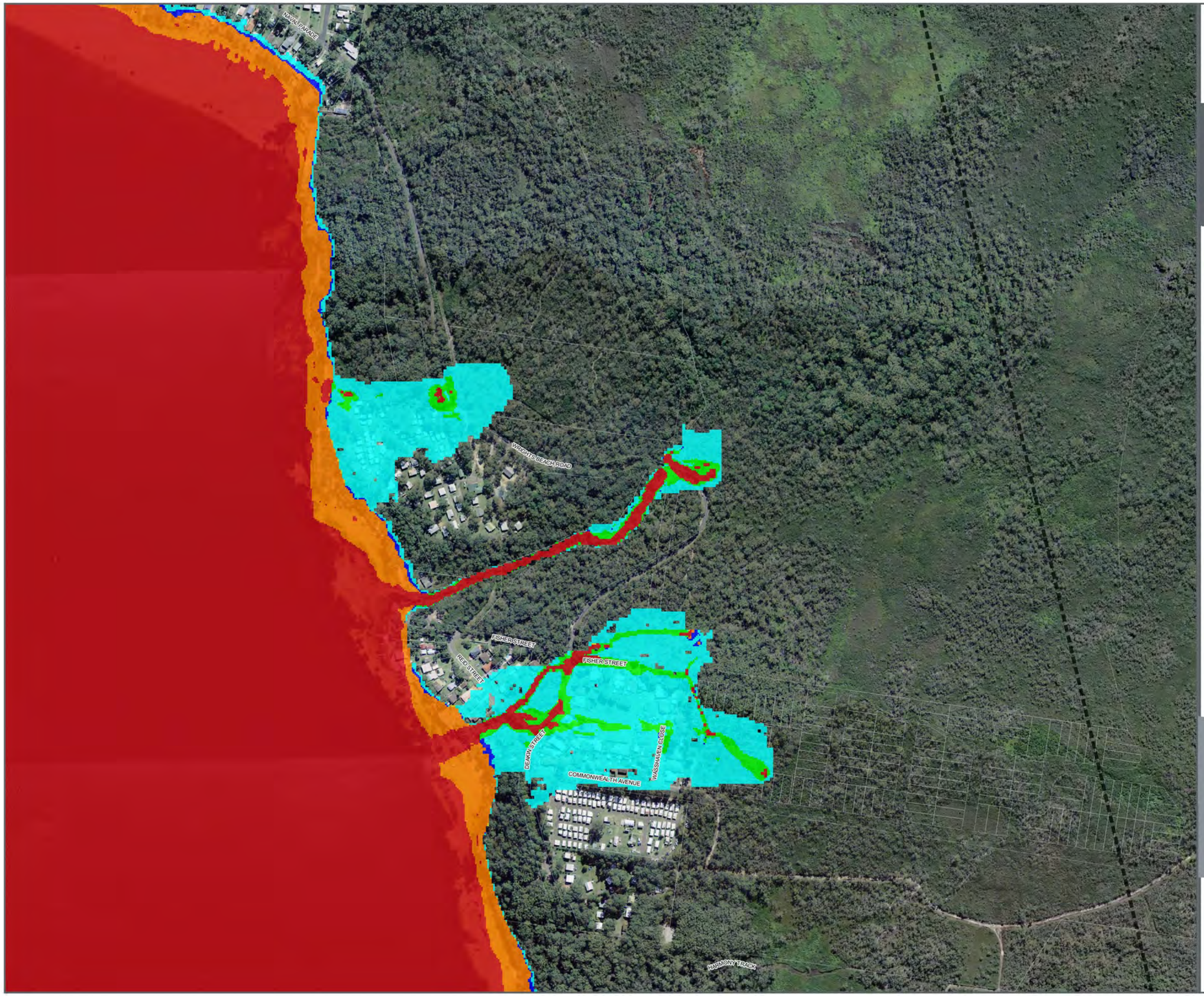
FIGURE G52.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 1% AEP Combined Hazard and Hydraulic Category Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G52.5

1:6,000 Scale at A3

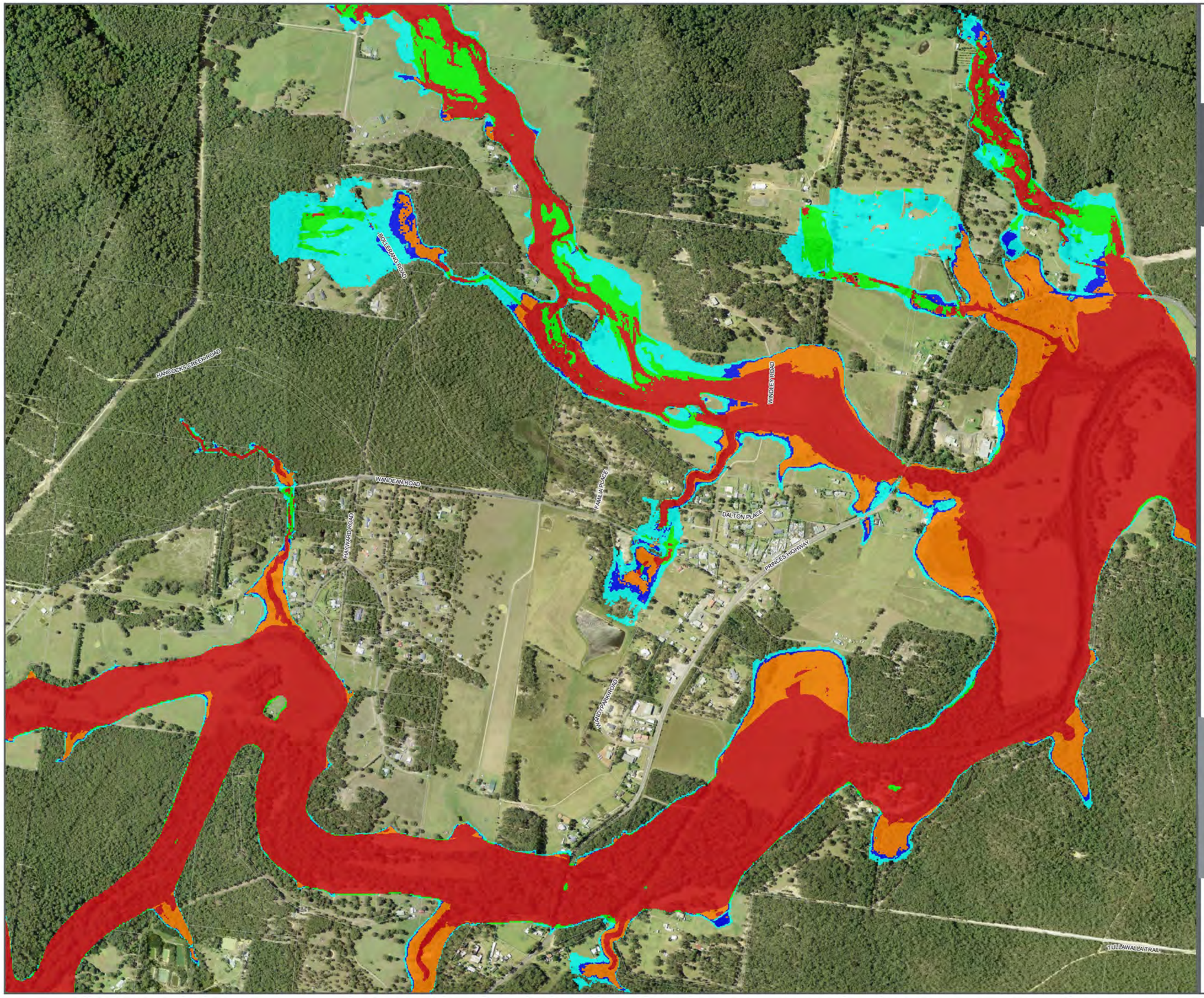
0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Combined Hazard and Hydraulic Category Wandandian

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G52.6

1:12,000 Scale at A3

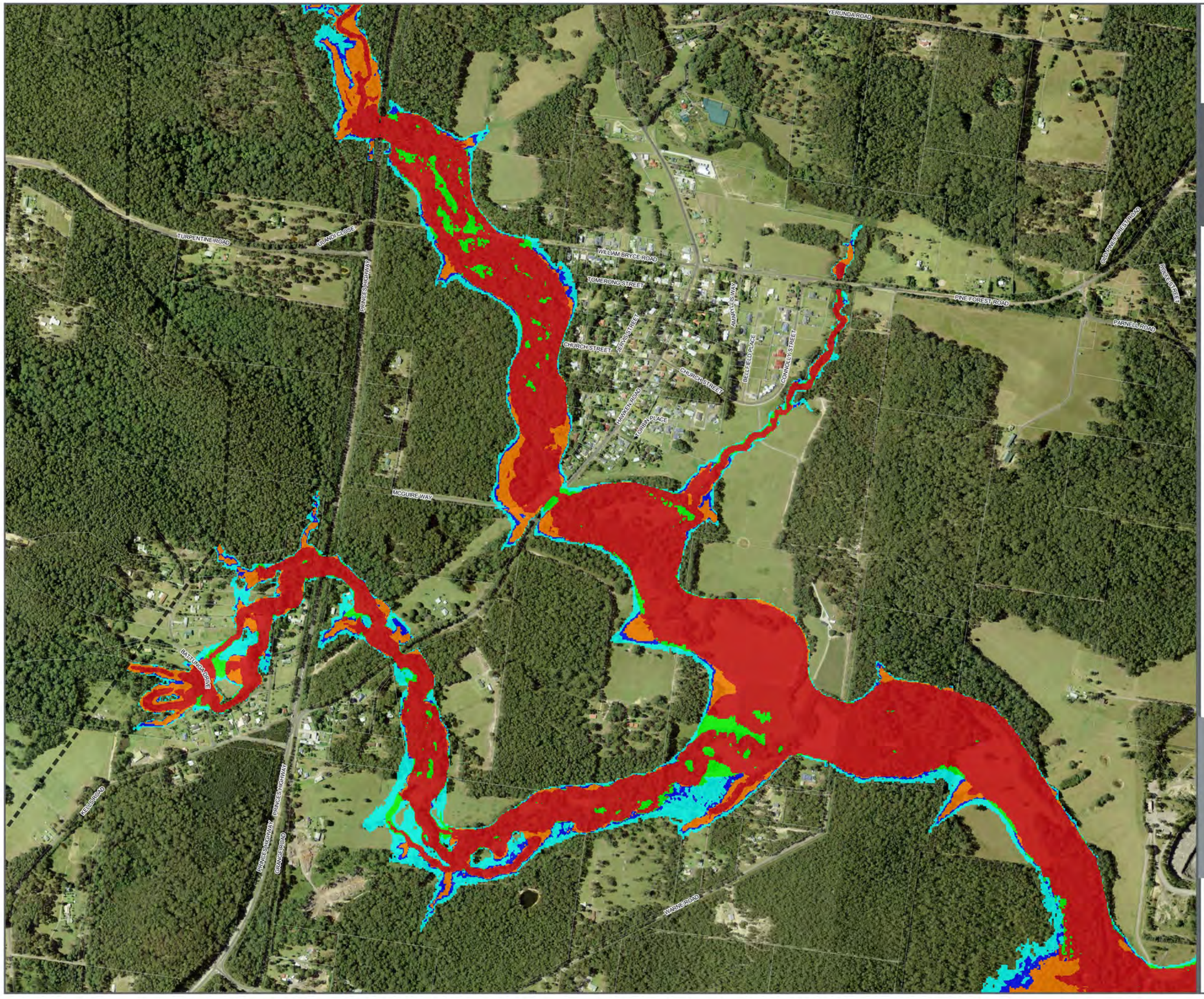
0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Combined Hazard and Hydraulic Category Tomerong

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G52.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Combined Hazard and Hydraulic Category

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G53

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 10% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G54

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 5% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G55

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 2% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G56

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G57

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 PMF Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G58

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 10% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G59

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 5% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G60

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 2% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G61

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G62

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Flood Depth

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G63

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 10% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G64

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 5% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G65

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 2% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G66

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Water Level Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Basin View

Erowal Bay

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

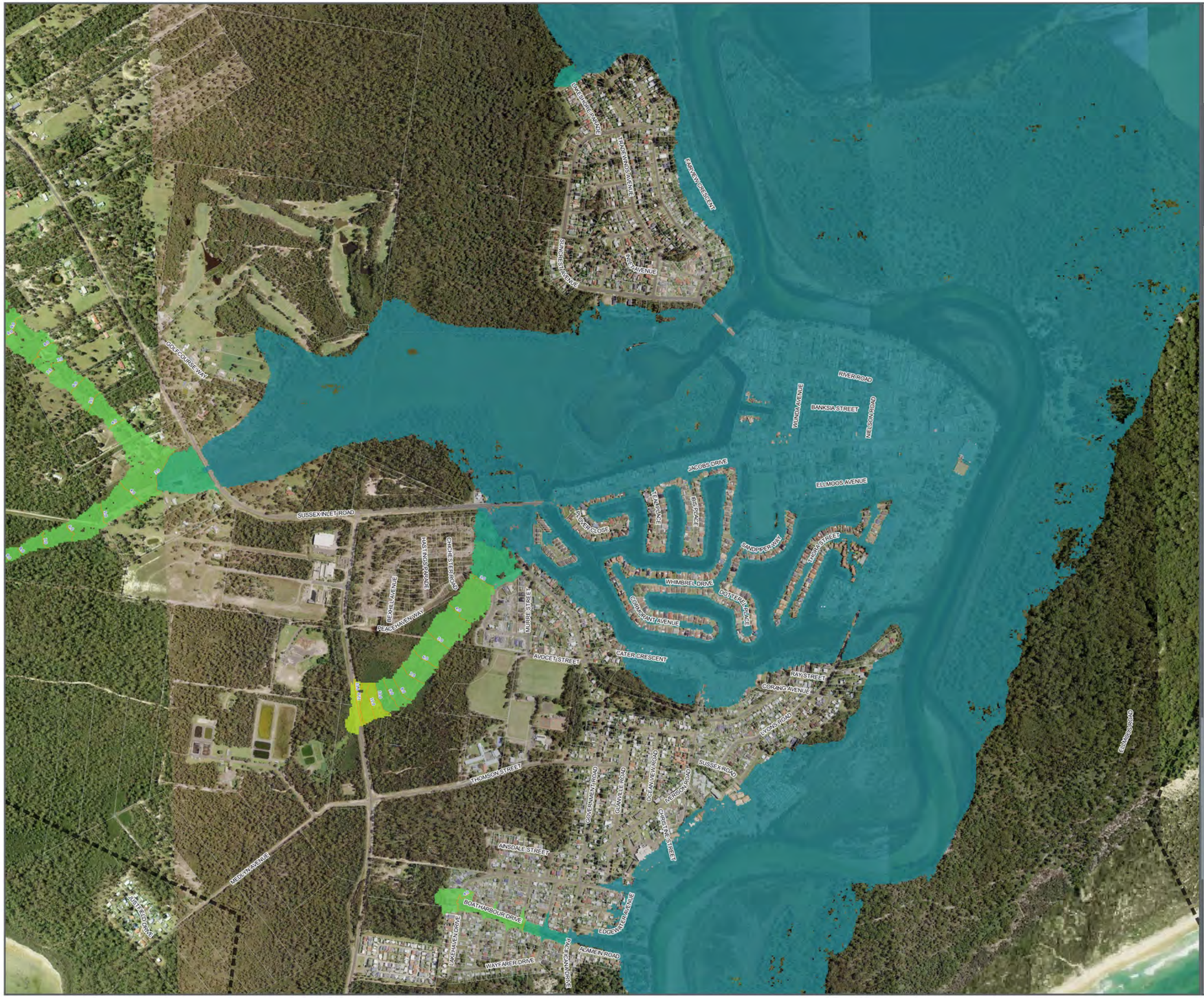
FIGURE G67

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Water Level Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G67.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Water Level Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G67.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Water Level Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G67.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Water Level Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

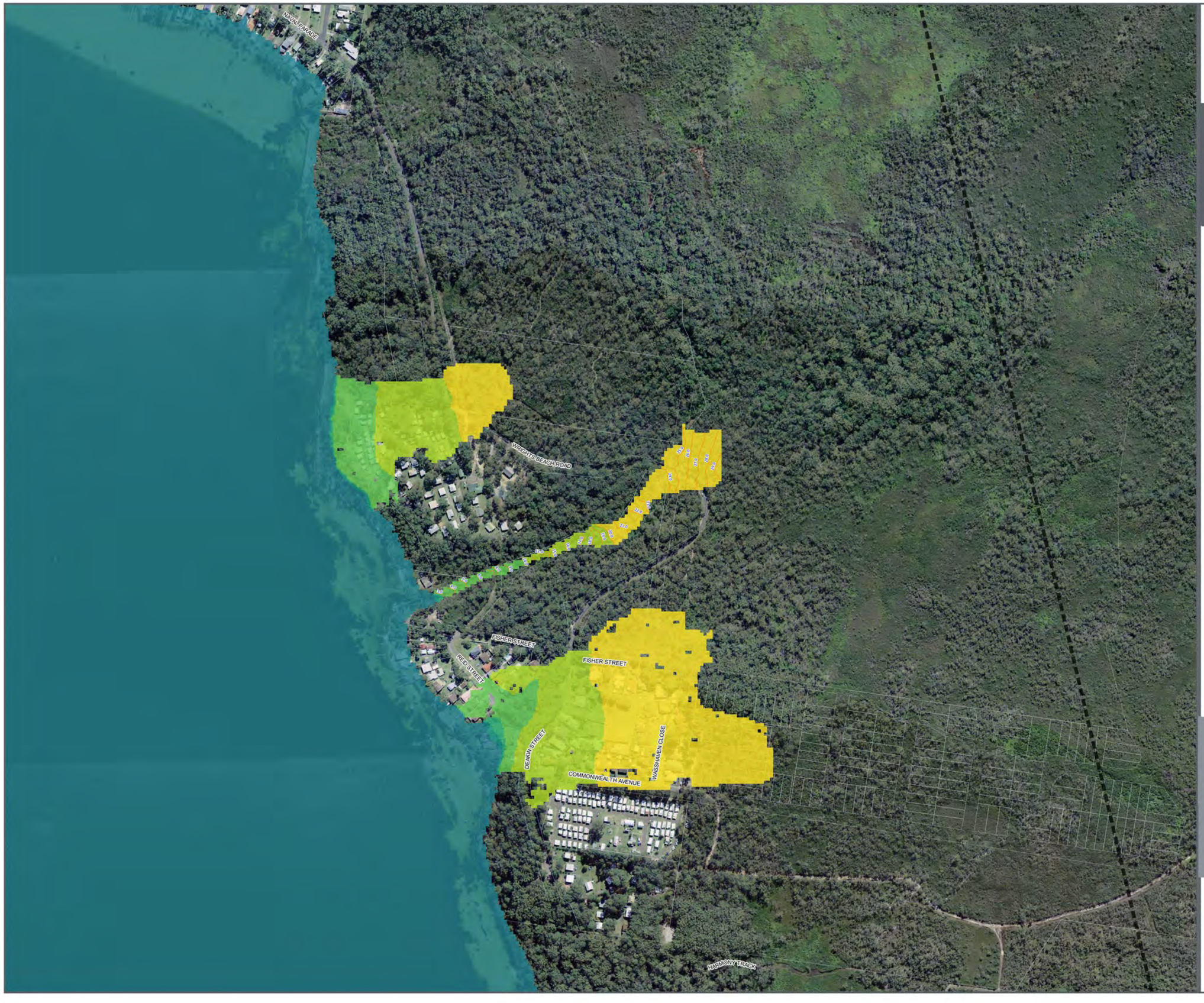
FIGURE G67.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Water Level Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G67.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Water Level Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G67.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Water Level Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G67.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Water Level Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

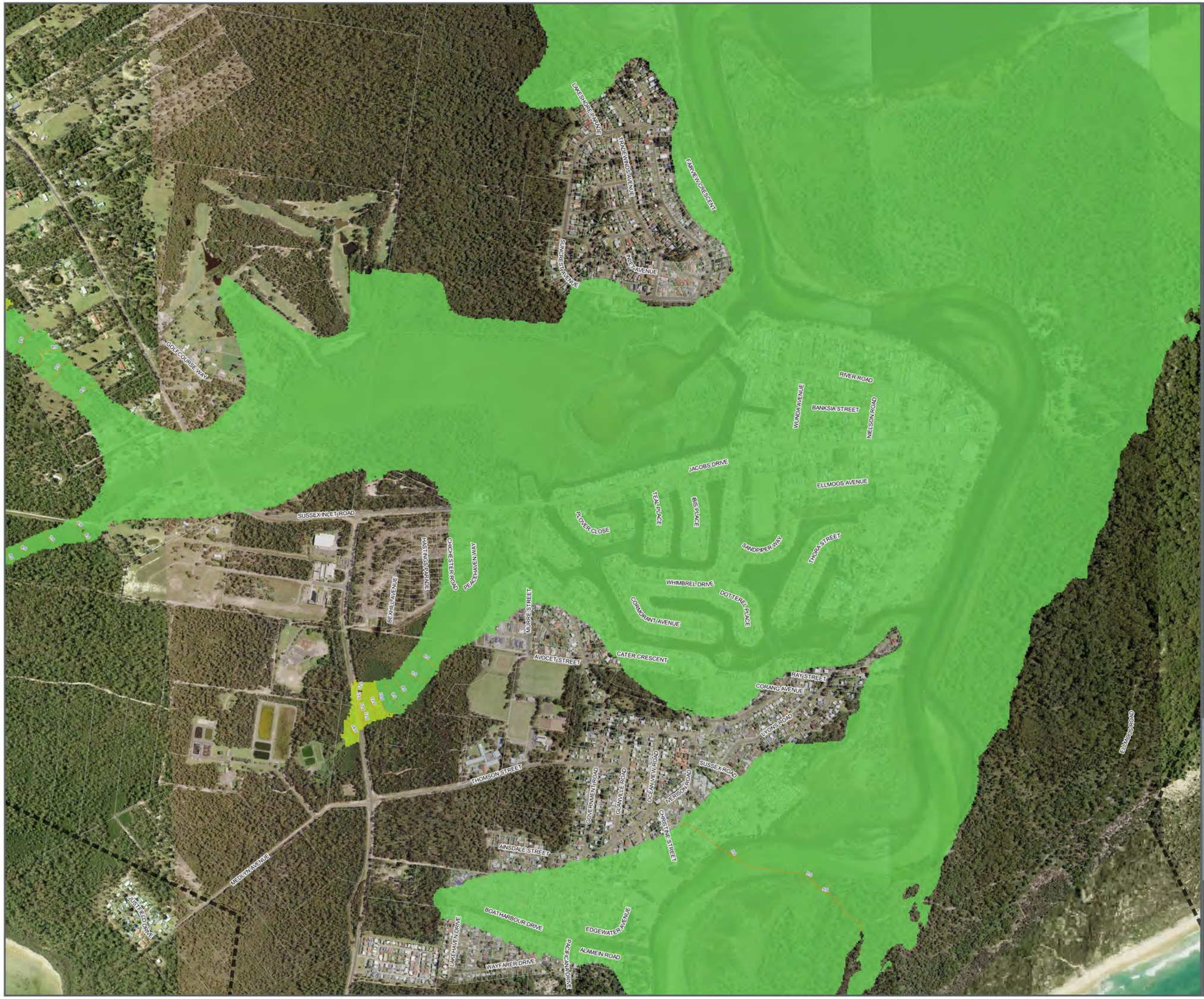
FIGURE G68

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 PMF Water Level Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G68.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 PMF Water Level Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G68.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Water Level Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G68.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Water Level Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G68.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 PMF Water Level Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

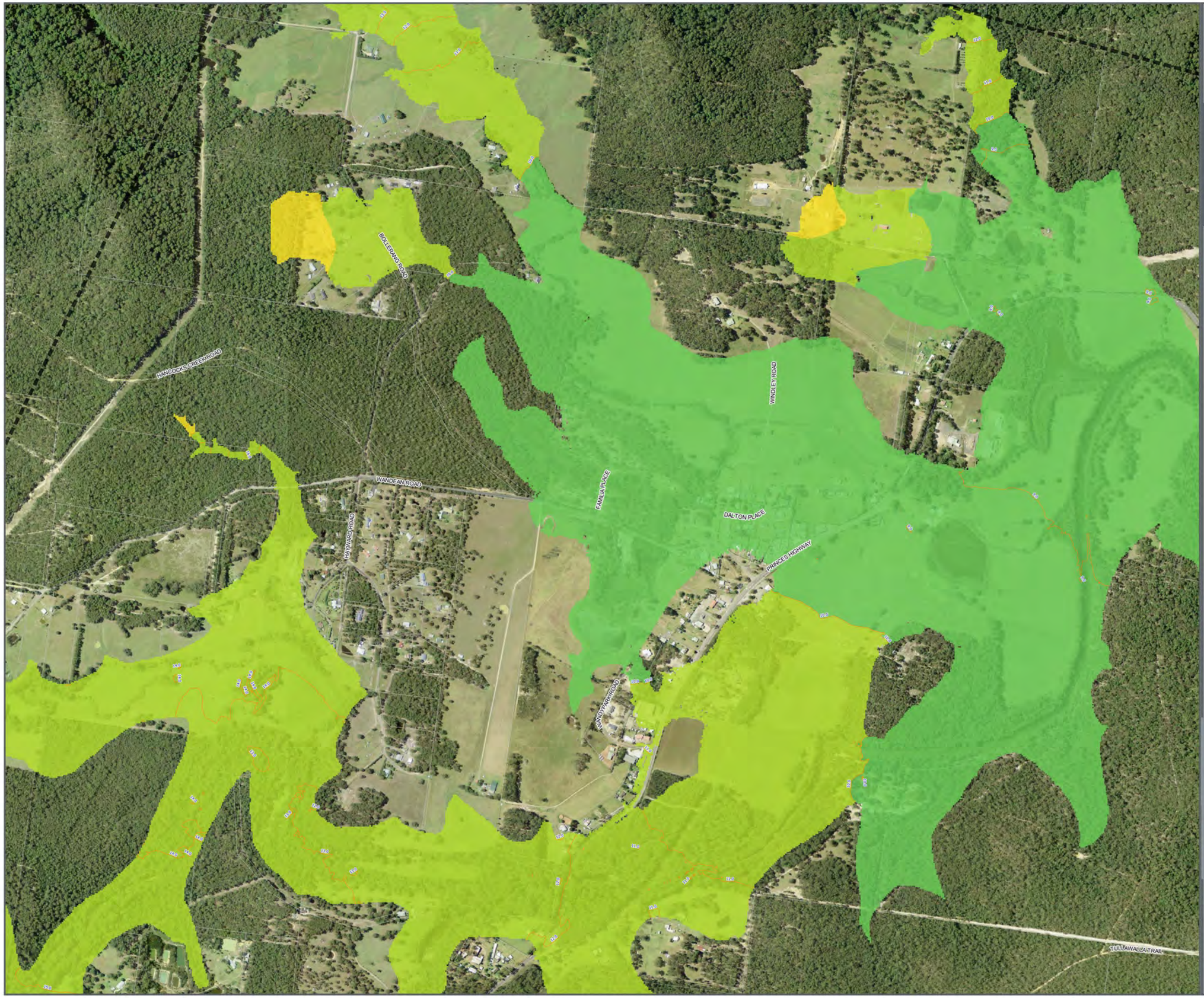
FIGURE G68.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 PMF Water Level Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 4
- 4 - 5
- 5 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6
- 6 - 8
- 8 - 10
- 10 - 20
- > 20

FIGURE G68.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Water Level Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Water Level (m AHD)

- <= 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3 - 10
- 10 - 20
- > 20

FIGURE G68.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Velocity Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G69

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Velocity Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G69.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Velocity Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G69.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Velocity Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G69.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Velocity Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G69.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Velocity Wrights Beach

St Georges Basin Flood Study

NAVAL PARADE
WRIGHTS BEACH ROAD
FISHER STREET
RED STREET
FISHER STREET
BEKKY STREET
WASSHAVEN CLOSE
COMMONWEALTH AVENUE
HARMONY TRACKS

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

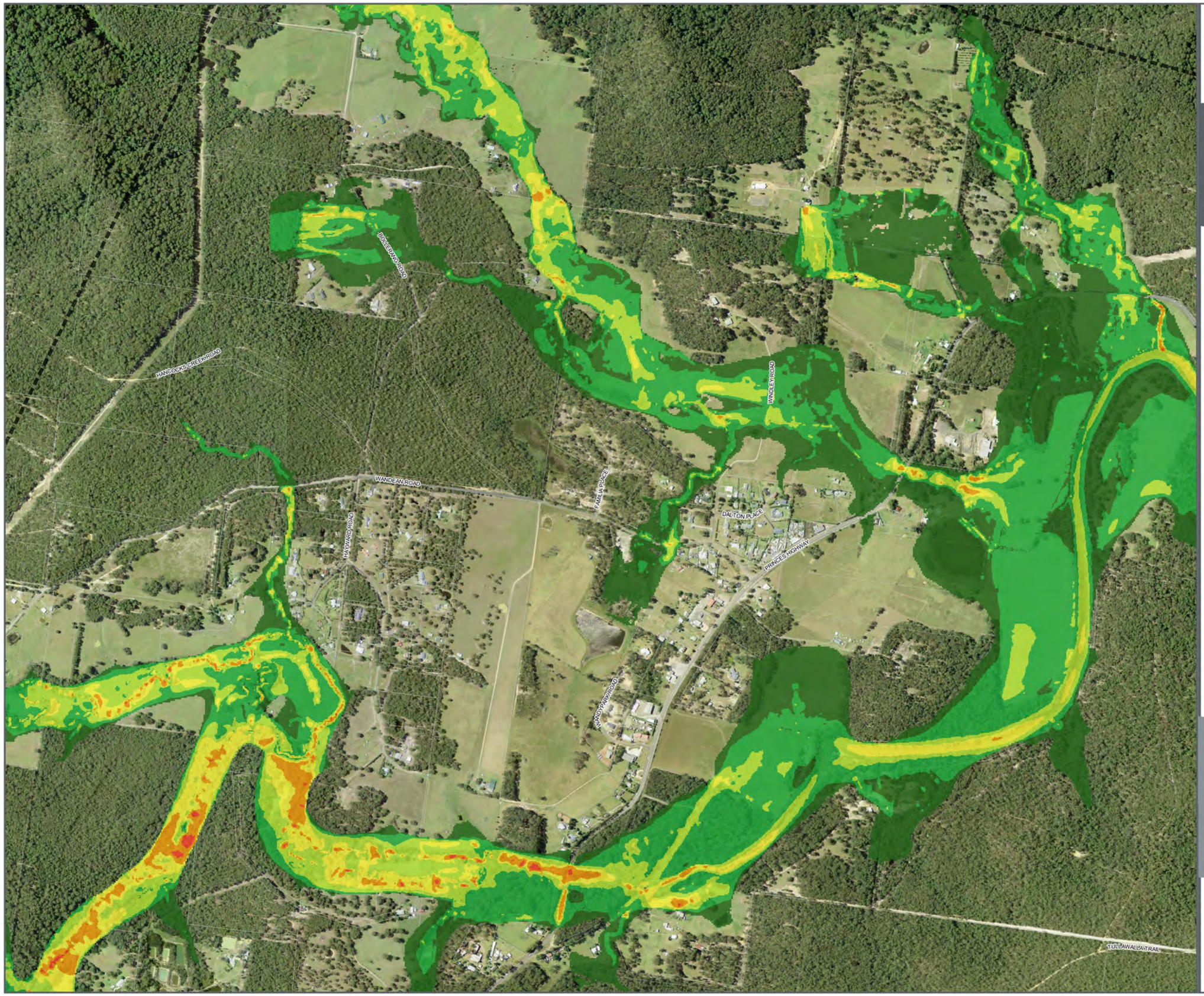
FIGURE G69.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Velocity Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G69.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Velocity Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G69.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Velocity

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE G70

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 10% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G71

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 5% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G72

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 2% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G73

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hazard Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G74

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hazard Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G74.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hazard Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G74.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hazard Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G74.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hazard Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

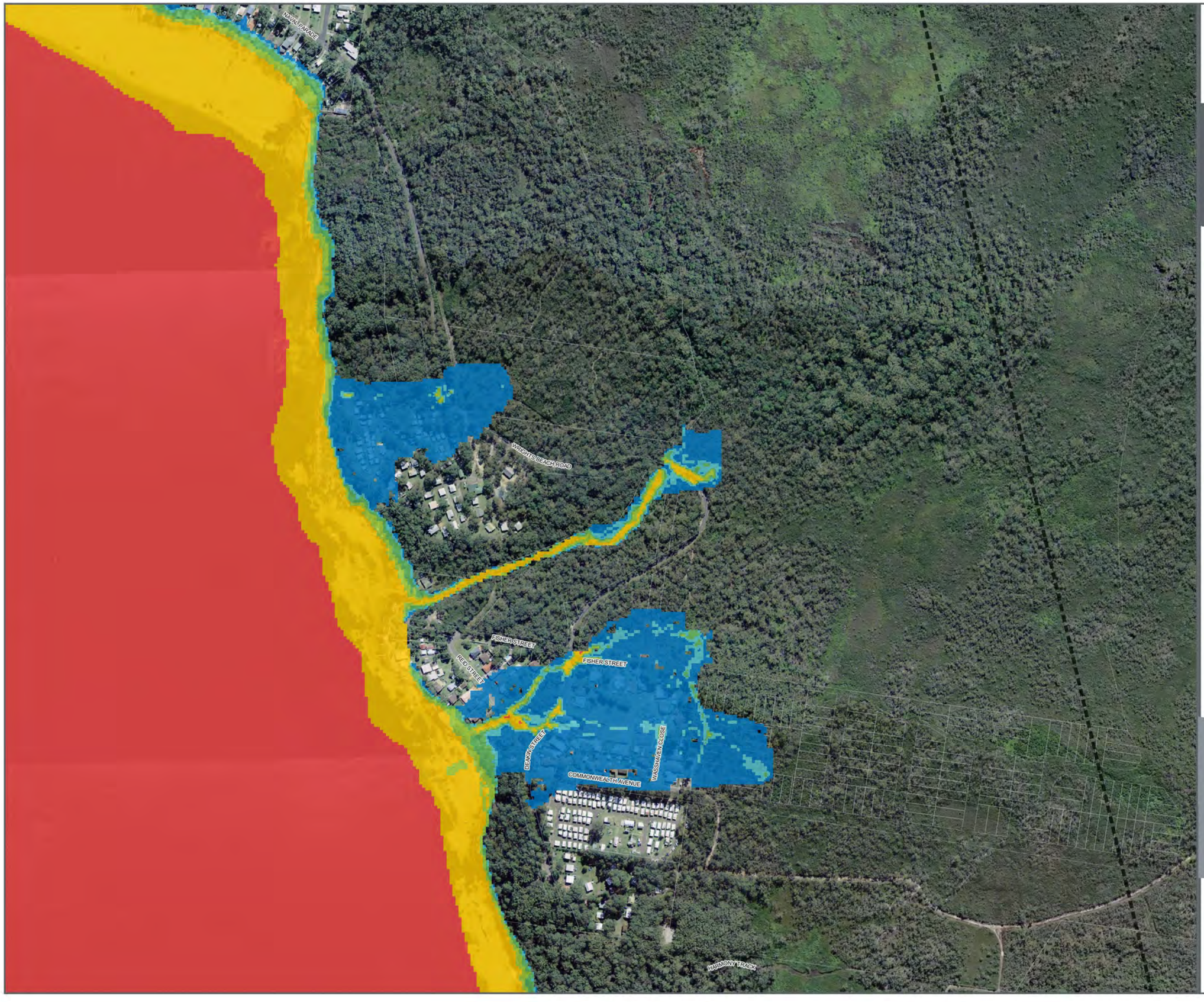
FIGURE G74.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Hazard Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

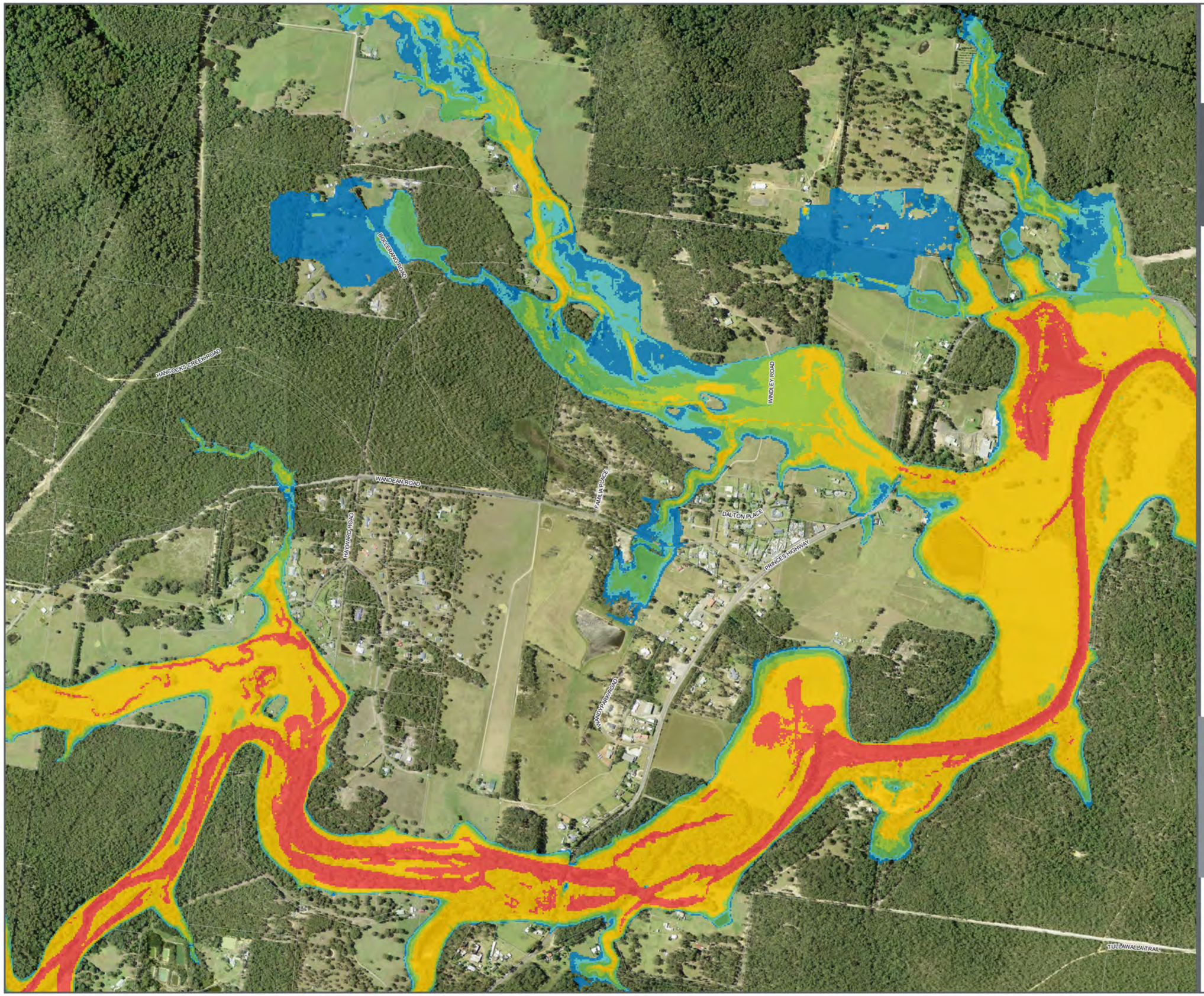
FIGURE G74.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Hazard Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G74.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hazard Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G74.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE G75

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Provisional Hazard Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G76

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Provisional Hazard Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G76.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Provisional Hazard Basin View

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G76.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Provisional Hazard Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G76.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Provisional Hazard Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

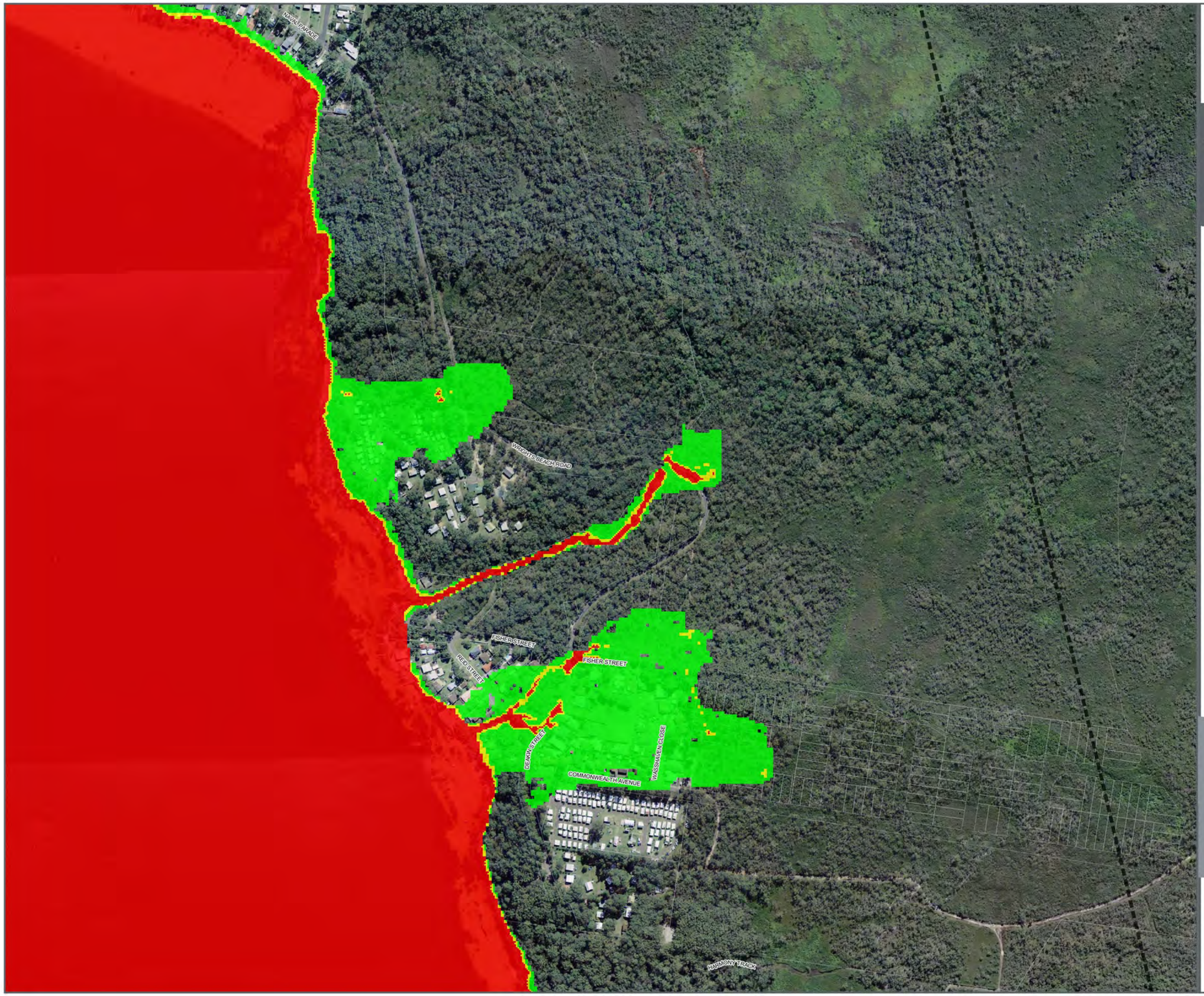
FIGURE G76.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Provisional Hazard Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G76.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Provisional Hazard Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G76.6

1:12,000 Scale at A3

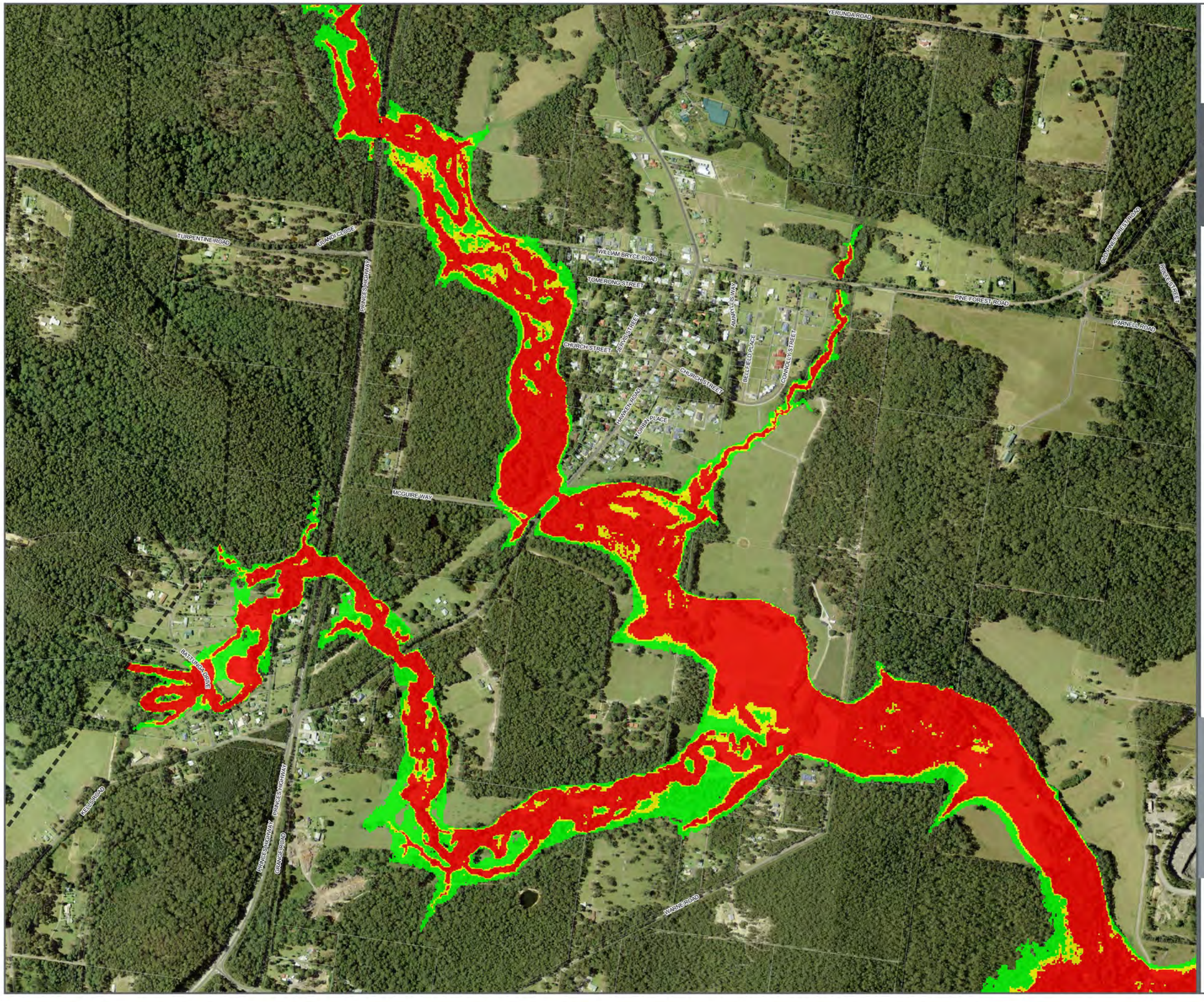
0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Provisional Hazard Tomerong

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G76.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Provisional Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (FDM)

- Low
- Transitional
- High

FIGURE G77

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hydraulic Categories Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Erowal Bay

Basin View

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G78

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hydraulic Categories Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G78.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hydraulic Categories Basin View

St Georges Basin Flood Study

PRINCES HIGHWAY
GROVE ROAD
NEBRASKA ROAD
ISLAND POINT ROAD
PELICAN ROAD
CLARENDON CRESCENT
WATERPARK ROAD
LOSMANIA AVENUE
AMHERST STREET
FISHERMAN ROAD
PARK ROAD
PANORAMA ROAD
BROMPTON ROAD
TASMAN ROAD
DEANE STREET
ST GEORGES ROAD
TERRY STREET
WIN AVENUE
JUNE AVENUE
JOHN STREET
DOROTHY AVENUE
EUNORA PARADE
AUDREY AVENUE
WATERSEDGE AVENUE
RESERVE ROAD
TALIYAN POINT ROAD
KATIE STREET
CLARENDON CRESCENT
RIVERSIDE ESPLANADE
EASTVIEW PARADE
WATERPARK ROAD
HARRIS AVENUE
BOATHAVEN AVENUE
ISLAND POINT ROAD

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G78.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hydraulic Categories Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G78.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hydraulic Categories Erowal Bav

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

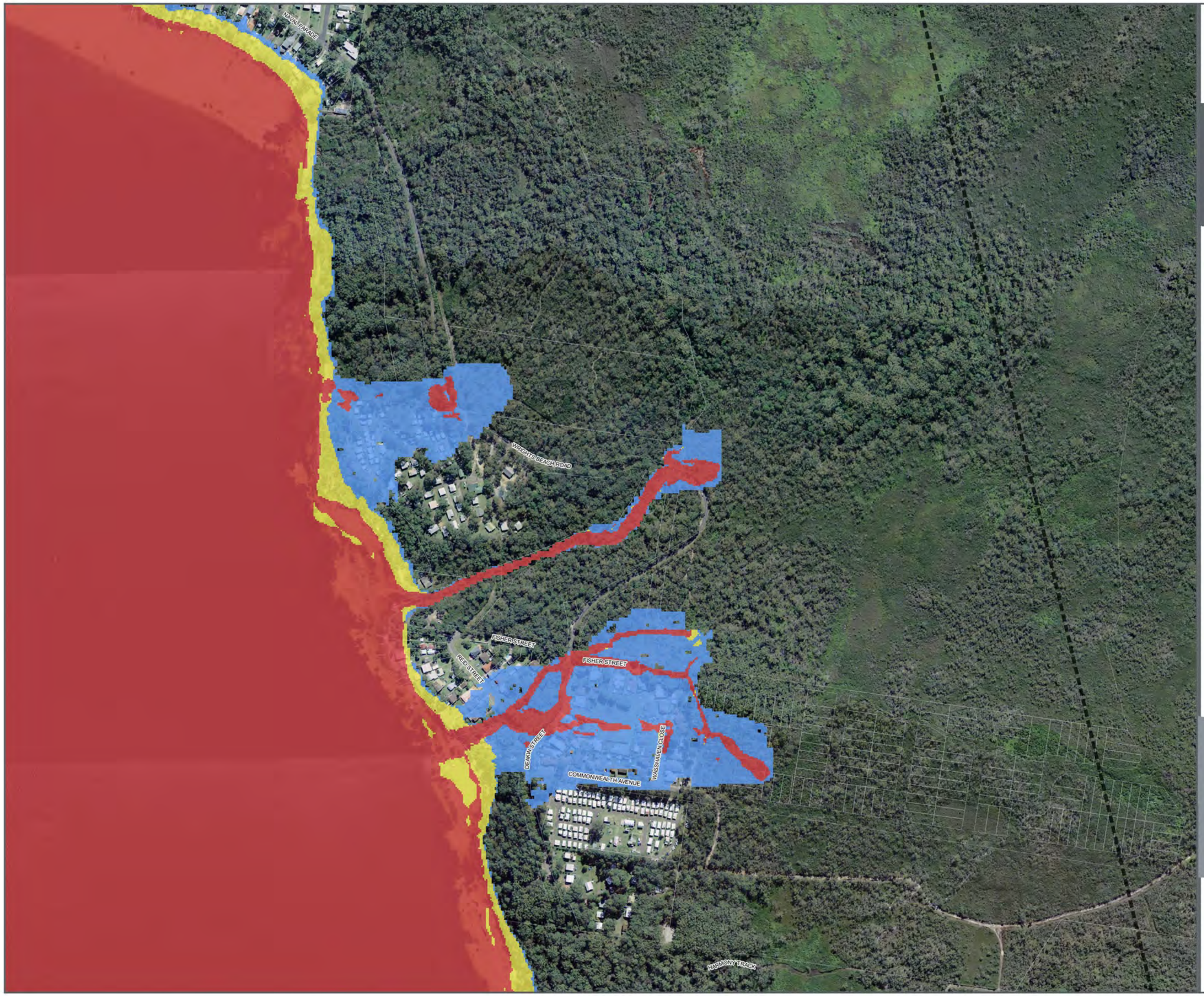
FIGURE G78.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Hydraulic Categories Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

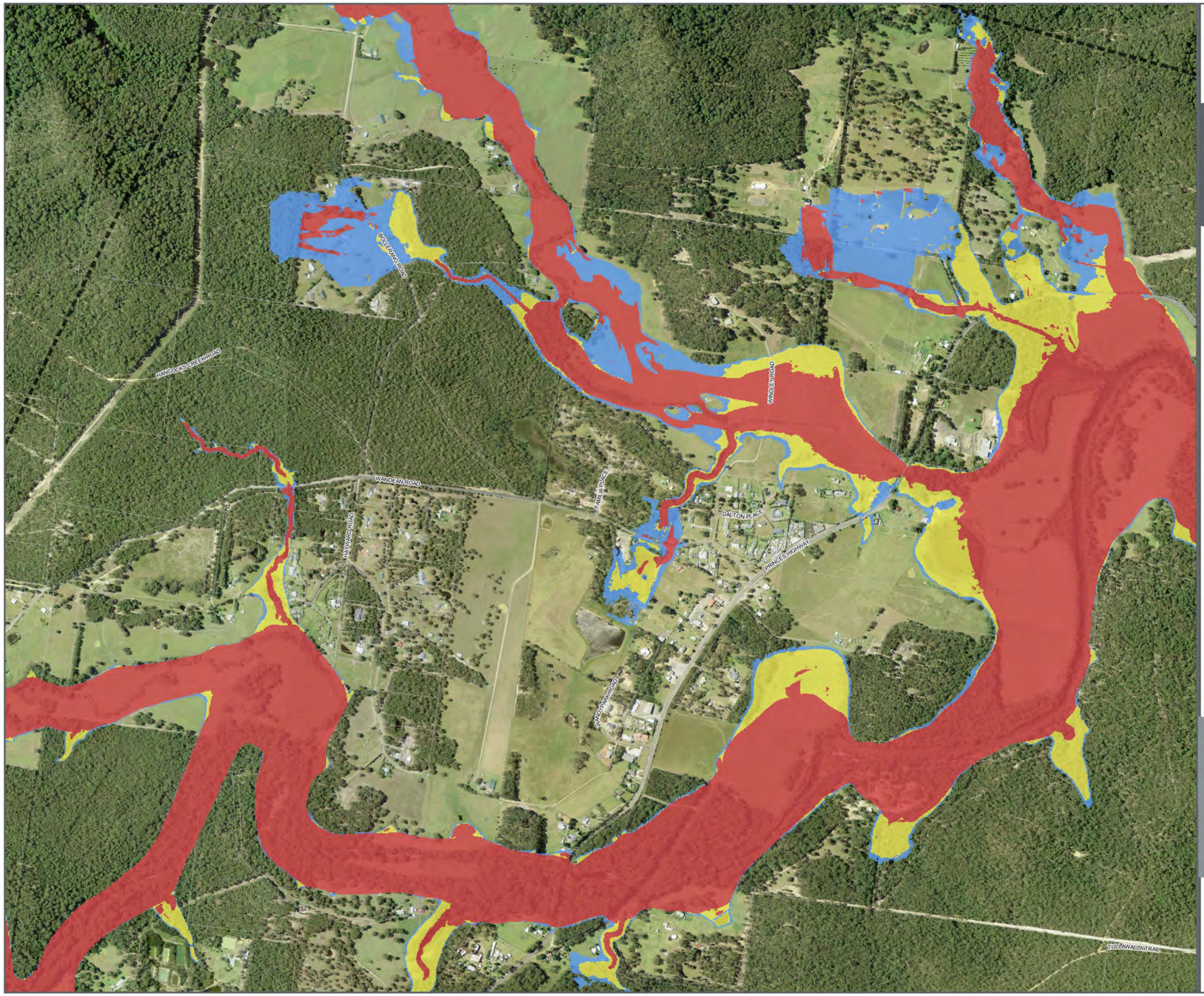
FIGURE G78.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Hydraulic Categories Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G78.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Hydraulic Categories Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G78.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Hydraulic Categories

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE G79

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Combined Hazard and Hydraulic Category Overview

St Georges Basin Flood Study

Tomerong

Wandandian

Erowal Bay

Basin View

Sanctuary Point

Wrights Beach

Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G80

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Combined Hazard and Hydraulic Category Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G80.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Combined Hazard and Hydraulic Category Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G80.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Combined Hazard and Hydraulic Category Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G80.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Combined Hazard and Hydraulic Category Erowal Bav

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

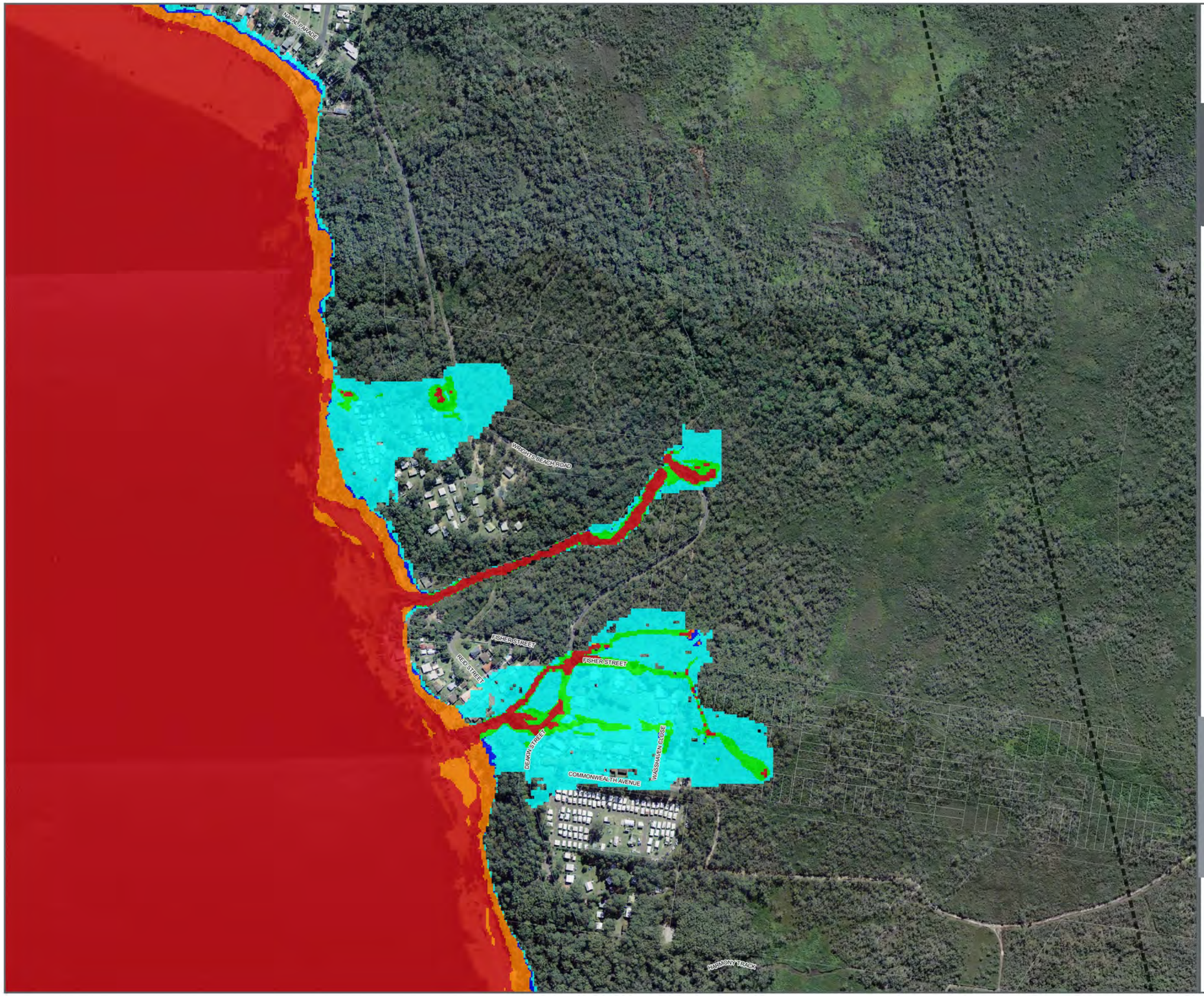
FIGURE G80.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 1% AEP Combined Hazard and Hydraulic Category Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G80.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Combined Hazard and Hydraulic Category Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G80.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Combined Hazard and Hydraulic Category Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G80.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Combined Hazard and Hydraulic Category

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Combined Hazard and Hydraulic Category

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe

FIGURE G81

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-30| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 10% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G82

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 5% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G83

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 2% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G84

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G85

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 PMF Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G86

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

NSW Projected 2100 Sea Level Rise (+0.90m) 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE G87

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Flood Depth and Water Level Contours Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Erowal Bay
Basin View
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G88

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Flood Depth and Water Level Contours Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G88.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Flood Depth and Water Level Contours Basin View

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G88.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Flood Depth and Water Level Contours Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G88.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Flood Depth and Water Level Contours Erowal Bav

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G88.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Tidal Inundation Flood Depth and Water Level Contours Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G88.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Tidal Inundation Flood Depth and Water Level Contours Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G88.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Tidal Inundation Flood Depth and Water Level Contours Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

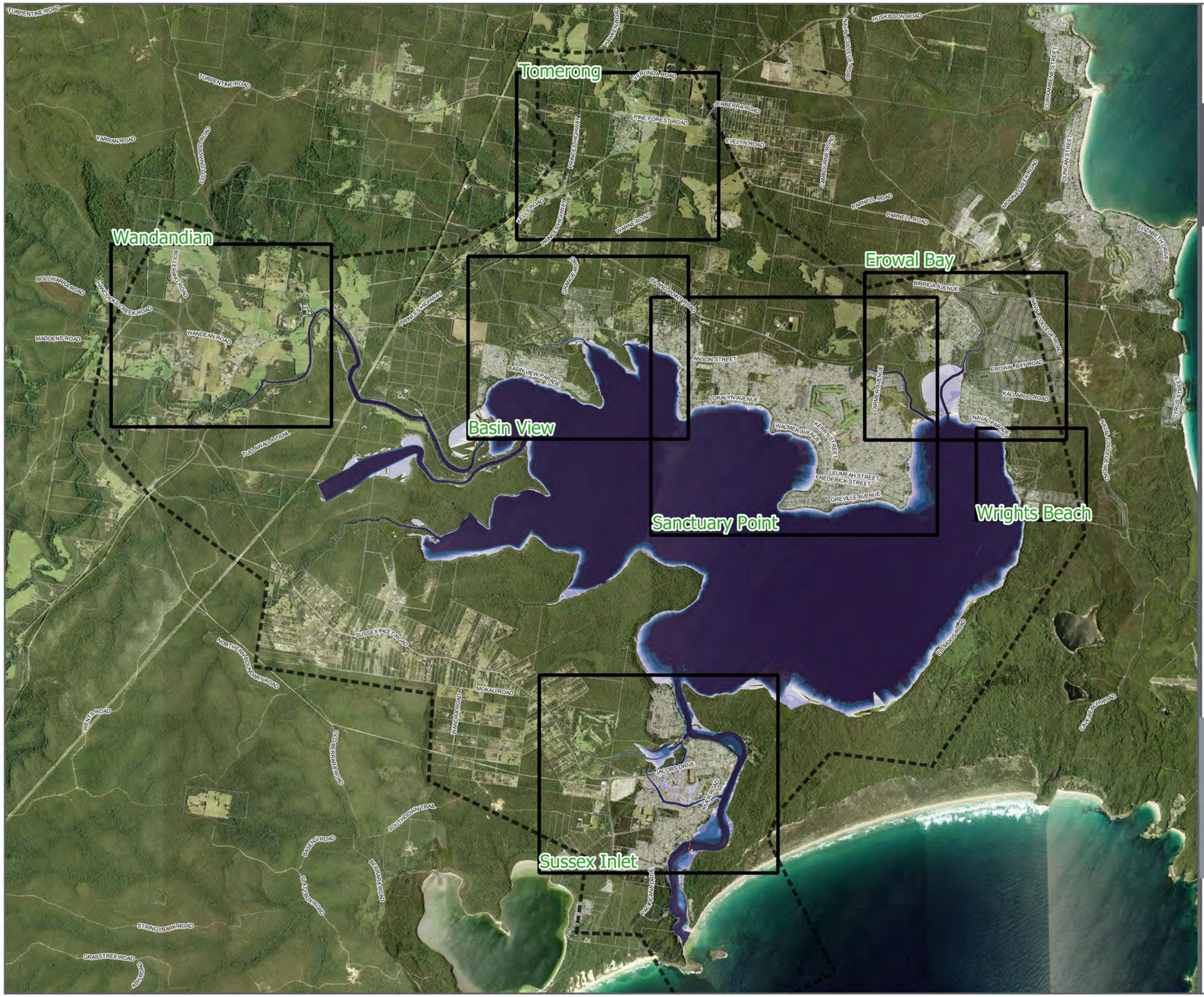
FIGURE G88.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Tidal Inundation Projected 2050 Flood Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2050
Flood Depth and Water Level Contours
St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2050
Flood Depth and Water Level Contours
St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2050 Flood Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2050 Flood Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Tidal Inundation Projected 2050 Flood Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89.5

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2050
Flood Depth and Water Level Contours
St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2050
Flood Depth and Water Level Contours
St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G89.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2100
Flood Depth and Water Level Contours
St Georges Basin Flood Study

Tomerong
Wandandian
Erowal Bay
Basin View
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2100
Flood Depth and Water Level Contours
St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2100
Flood Depth and Water Level Contours
St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2100
Flood Depth and Water Level Contours
St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2100 Flood Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2100
Flood Depth and Water Level Contours
St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90.5

1:6,000 Scale at A3

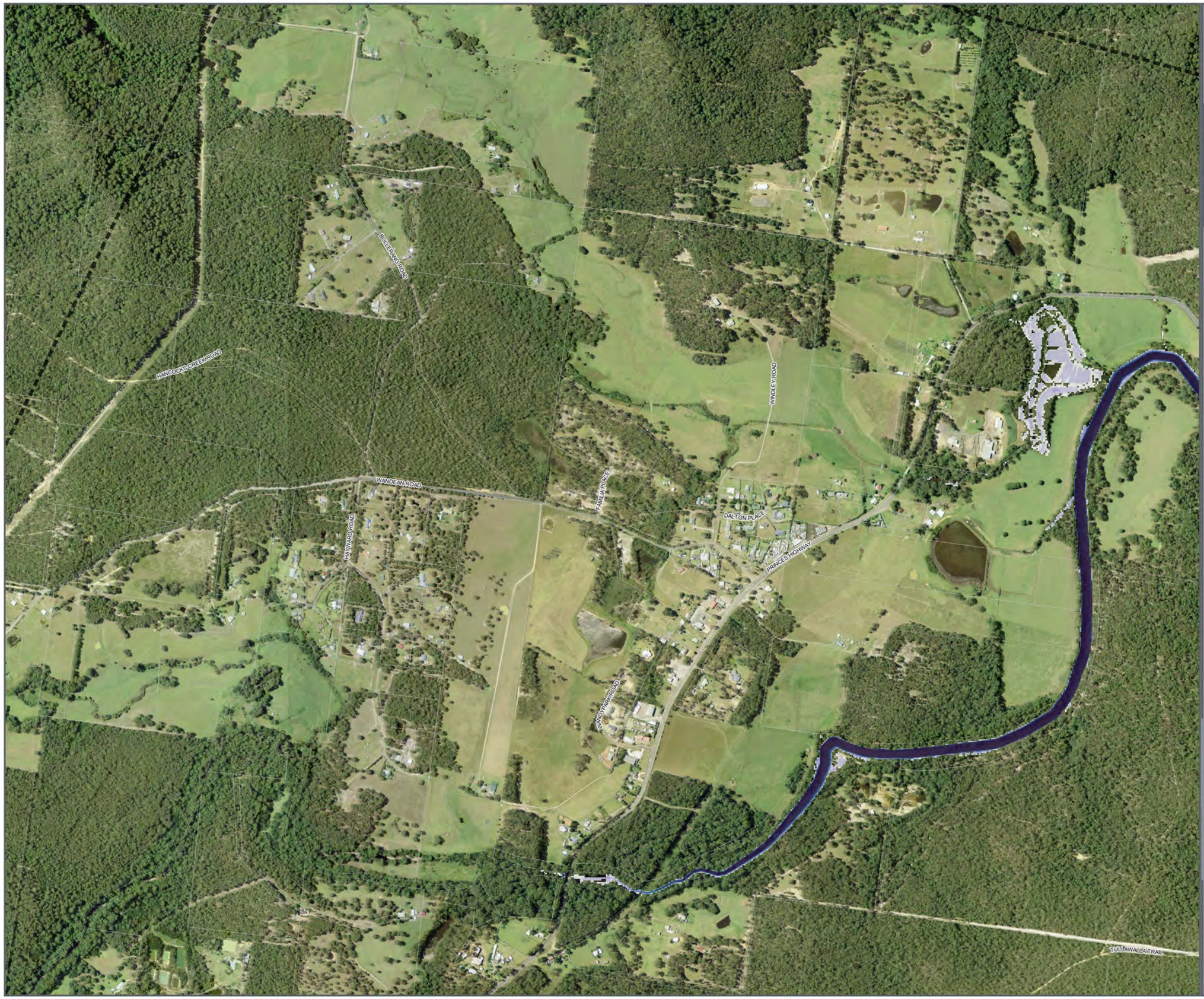
0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Tidal Inundation Projected 2100 Flood Depth and Water Level Contours

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Tidal Inundation Projected 2100 Flood Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE G90.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

APPENDIX H

SENSITIVITY FLOOD MAPS

Figure List:

Figure H1	Climate Change 2050 RCP 4.5 5% AEP Water Level Difference
Figure H2	Climate Change 2050 RCP 4.5 1% AEP Water Level Difference
Figure H3	Climate Change 2050 RCP 8.5 5% AEP Water Level Difference
Figure H4	Climate Change 2050 RCP 8.5 1% AEP Water Level Difference
Figure H5	Climate Change 2090 RCP 4.5 5% AEP Water Level Difference
Figure H6	Climate Change 2090 RCP 4.5 1% AEP Water Level Difference
Figure H7	Climate Change 2090 RCP 8.5 5% AEP Water Level Difference
Figure H8	Climate Change 2090 RCP 8.5 1% AEP Water Level Difference
Figure H9	Climate Change 2050 RCP 4.5 + 0.23m SLR (SCC - 2050) 5% AEP Water Level Difference
Figure H10	Climate Change 2050 RCP 4.5 + 0.23m SLR (SCC - 2050) 1% AEP Water Level Difference
Figure H11	Climate Change 2050 RCP 8.5 + 0.23m SLR (SCC - 2050) 5% AEP Water Level Difference
Figure H12	Climate Change 2050 RCP 8.5 + 0.23m SLR (SCC - 2050) 1% AEP Water Level Difference
Figure H13	Climate Change 2090 RCP 4.5 + 0.36m SLR (SCC - 2100) 5% AEP Water Level Difference
Figure H14	Climate Change 2090 RCP 4.5 + 0.36m SLR (SCC - 2100) 1% AEP Water Level Difference
Figure H15	Climate Change 2090 RCP 8.5 + 0.36m SLR (SCC - 2100) 5% AEP Water Level Difference
Figure H16	Climate Change 2090 RCP 8.5 + 0.36m SLR (SCC - 2100) 1% AEP Water Level Difference
Figure H17	Flow Sensitivity - Continuing Loss = 1.0 mm/hr 1% AEP Water Level Difference
Figure H18	Flow Sensitivity - Continuing Loss = 2.5 mm/hr 1% AEP Water Level Difference
Figure H19	Flow Sensitivity - Minimum Temporal Pattern 1% AEP Water Level Difference
Figure H20	Flow Sensitivity - Maximum Temporal Pattern 1% AEP Water Level Difference
Figure H21	Manning's +20% Sensitivity 1% AEP Water Level Difference
Figure H22	Manning's -20% Sensitivity 1% AEP Water Level Difference
Figure H23	Constricted Sussex Inlet Entrance 1% AEP Water Level Difference
Figure H24	Downstream Boundary - HHWSS 1% AEP Water Level Difference
Figure H25	Blockage Case 1 of Hydraulic Structures 1% AEP Water Level Difference
Figure H26	Blockage Case 2 of Hydraulic Structures 1% AEP Water Level Difference
Figure H27	ARR1987 5% AEP Depth and Water Level Contours
Figure H28	ARR1987 5% AEP Velocity
Figure H29	ARR1987 5% AEP Hazard
Figure H30	ARR1987 5% AEP Water Level Difference
Figure H31	ARR1987 1% AEP Depth and Water Level Contours
Figure H32	ARR1987 1% AEP Velocity
Figure H33	ARR1987 1% AEP Hazard
Figure H34	ARR1987 1% AEP Water Level Difference

Climate Change 2050 RCP 4.5 5% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H1

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2050 RCP 4.5 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H2

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2050 RCP 8.5 5% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H3

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2050 RCP 8.5
1% AEP Water Level Difference
St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H4

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 4.5 5% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H5

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 4.5 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H6

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 8.5
5% AEP Water Level Difference
St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H7

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 8.5 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H8

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2050 RCP 4.5 + 0.23m SLR (SCC - 2050) 5% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H9

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2050 RCP 4.5 + 0.23m SLR (SCC - 2050) 1% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H10

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2050 RCP 8.5 + 0.23m SLR (SCC - 2050) 5% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H11

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2050 RCP 8.5 + 0.23m SLR (SCC - 2050) 1% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H12

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 4.5 + 0.36m SLR (SCC - 2100) 5% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H13

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 4.5 + 0.36m SLR (SCC - 2100) 1% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H14

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 8.5 + 0.36m SLR (SCC - 2100) 5% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H15

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Climate Change 2090 RCP 8.5 + 0.36m SLR (SCC - 2100) 1% AEP Water Level

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H16

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flow Sensitivity - Continuing Loss = 1.0 mm/ hr
1% AEP Water Level
St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H17

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flow Sensitivity - Continuing Loss = 2.5 mm/ hr
1% AEP Water Level
St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H18

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flow Sensitivity - Minimum Temporal Pattern 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H19

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flow Sensitivity - Maximum Temporal Pattern 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H20

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Manning's +20% Sensitivity 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H21

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Manning's -20% Sensitivity 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H22

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Constricted Sussex Inlet Entrance 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H23

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Downstream Boundary - HHWSS 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H24

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Blockage Case 1 of Hydraulic Structures 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H25

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Blockage Case 2 of Hydraulic Structures 1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H26

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
5% AEP Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE H27

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
5% AEP Velocity

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE H28

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
5% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE H29

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
5% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H30

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
1% AEP Depth and Water Level Contours

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Water Level Contours (1.0m)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE H31

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
1% AEP Velocity

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

FIGURE H32

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
1% AEP Hazard

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Hazard (AEMI H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE H33

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

ARR1987
1% AEP Water Level Difference

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary

Change in Flood Levels (m)

- Was Wet, Now Dry
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50
- Was Dry, Now Wet

FIGURE H34

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2021-11-29| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

APPENDIX

I

FLOOD PLANNING AREA

Figure List:

Figure I01	Existing Flood Planning Area Overview
Figure I01.1	Existing Flood Planning Area Sussex Inlet
Figure I01.2	Existing Flood Planning Area Basin View
Figure I01.3	Existing Flood Planning Area Sanctuary Point
Figure I01.4	Existing Flood Planning Area Erowal Bay
Figure I01.5	Existing Flood Planning Area Wrights Beach
Figure I01.6	Existing Flood Planning Area Wandandian
Figure I01.7	Existing Flood Planning Area Tomerong
Figure I02	Projected 2050 Flood Planning Area Overview
Figure I02.1	Projected 2050 Flood Planning Area Sussex Inlet
Figure I02.2	Projected 2050 Flood Planning Area Basin View
Figure I02.3	Projected 2050 Flood Planning Area Sanctuary Point
Figure I02.4	Projected 2050 Flood Planning Area Erowal Bay
Figure I02.5	Projected 2050 Flood Planning Area Wrights Beach
Figure I02.6	Projected 2050 Flood Planning Area Wandandian
Figure I02.7	Projected 2050 Flood Planning Area Tomerong
Figure I03	Projected 2100 Flood Planning Area Overview
Figure I03.1	Projected 2100 Flood Planning Area Sussex Inlet
Figure I03.2	Projected 2100 Flood Planning Area Basin View
Figure I03.3	Projected 2100 Flood Planning Area Sanctuary Point
Figure I03.4	Projected 2100 Flood Planning Area Erowal Bay
Figure I03.5	Projected 2100 Flood Planning Area Wrights Beach
Figure I03.6	Projected 2100 Flood Planning Area Wandandian
Figure I03.7	Projected 2100 Flood Planning Area Tomerong

Existing Flood Planning Area Overview

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I01

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing Flood Planning Area Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I01.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing Flood Planning Area Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I01.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing Flood Planning Area Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I01.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing Flood Planning Area Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

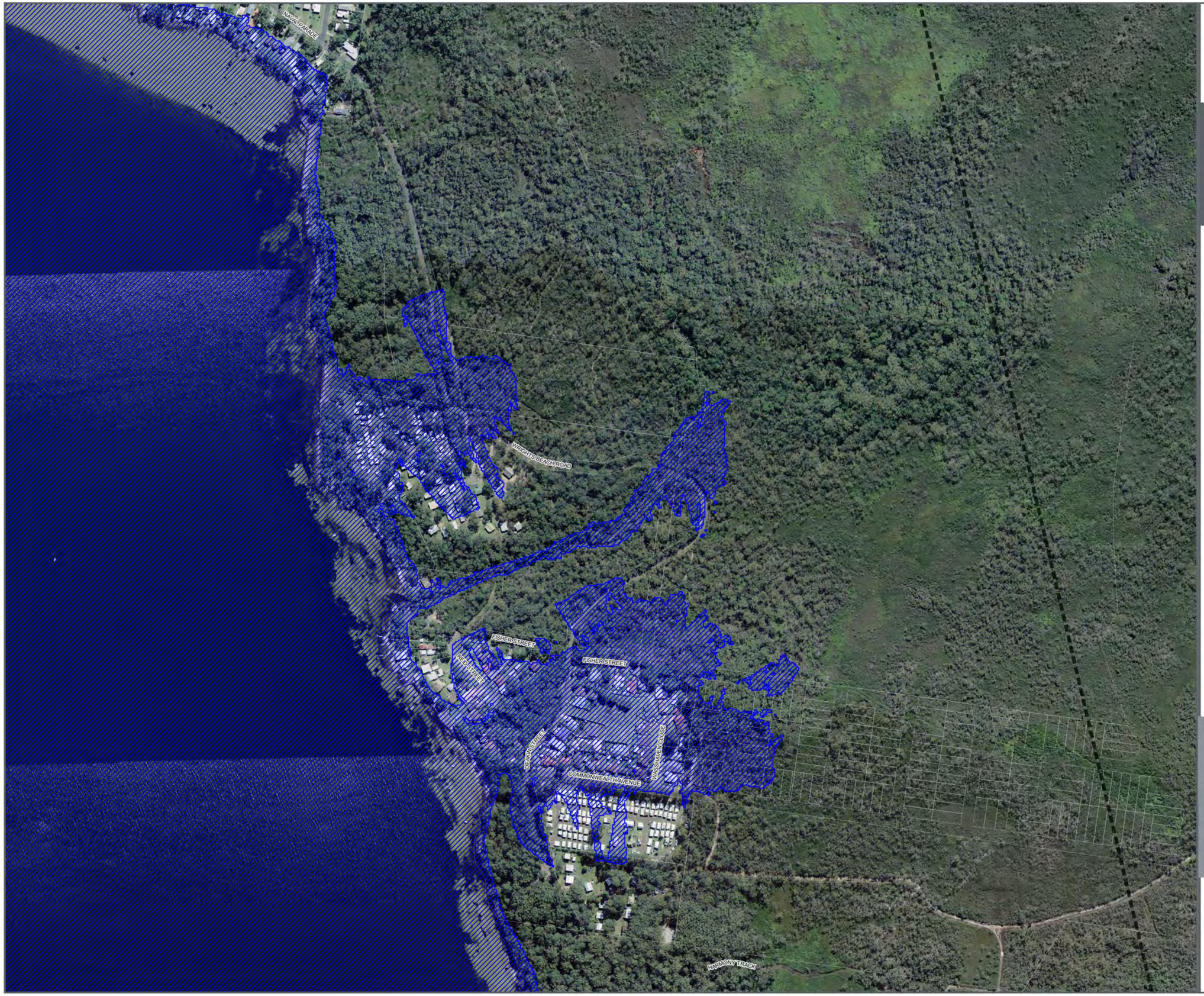
FIGURE I01.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing Flood Planning Area Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I01.5

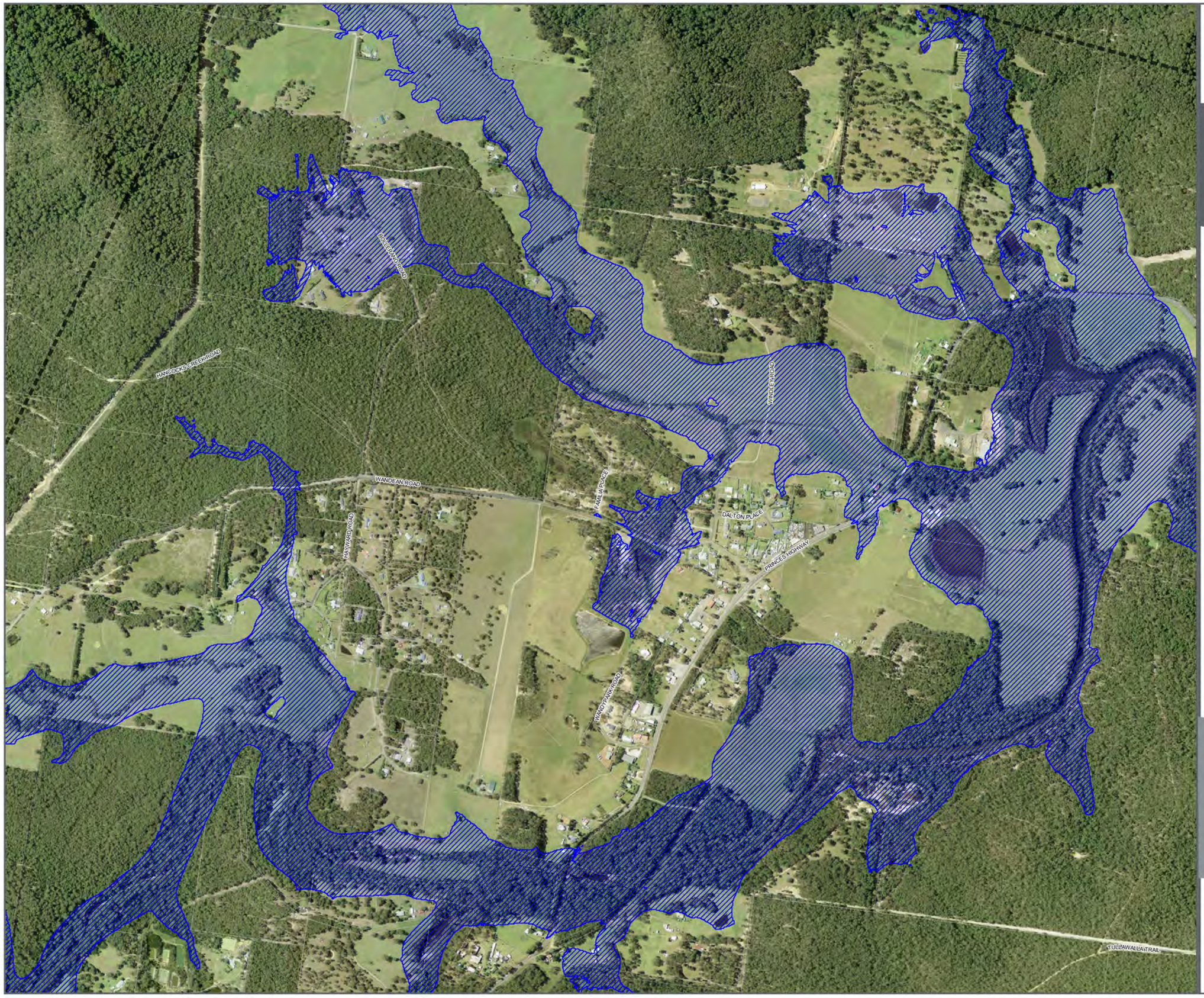
1:6,000 Scale at A3

0 70 140 210 280 350 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Existing Flood Planning Area Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I01.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Existing Flood Planning Area Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I01.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 Flood Planning Area Overview

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I02

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 Flood Planning Area Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I02.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 Flood Planning Area Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I02.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 Flood Planning Area Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I02.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 Flood Planning Area Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

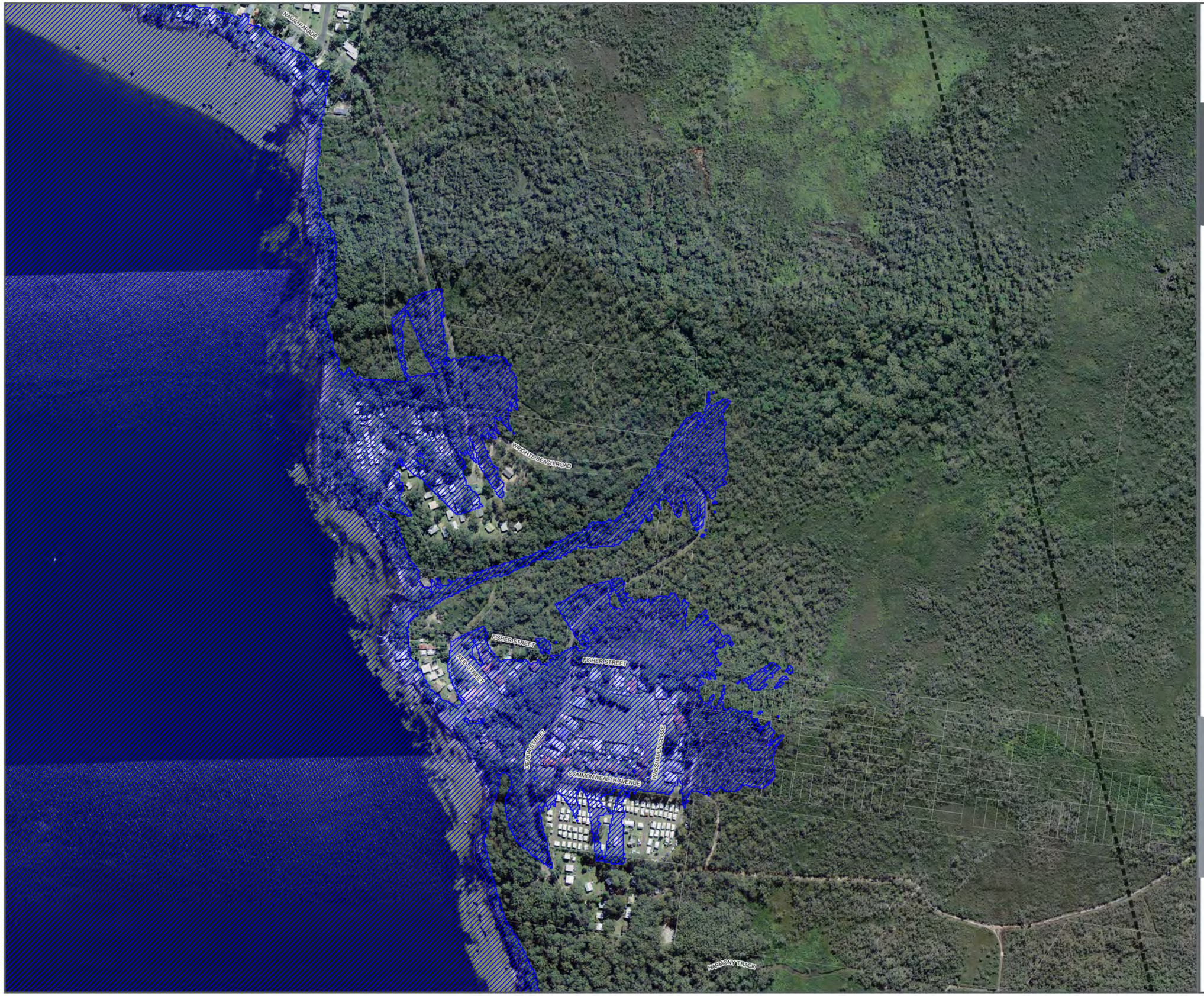
FIGURE I02.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 Flood Planning Area Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I02.5

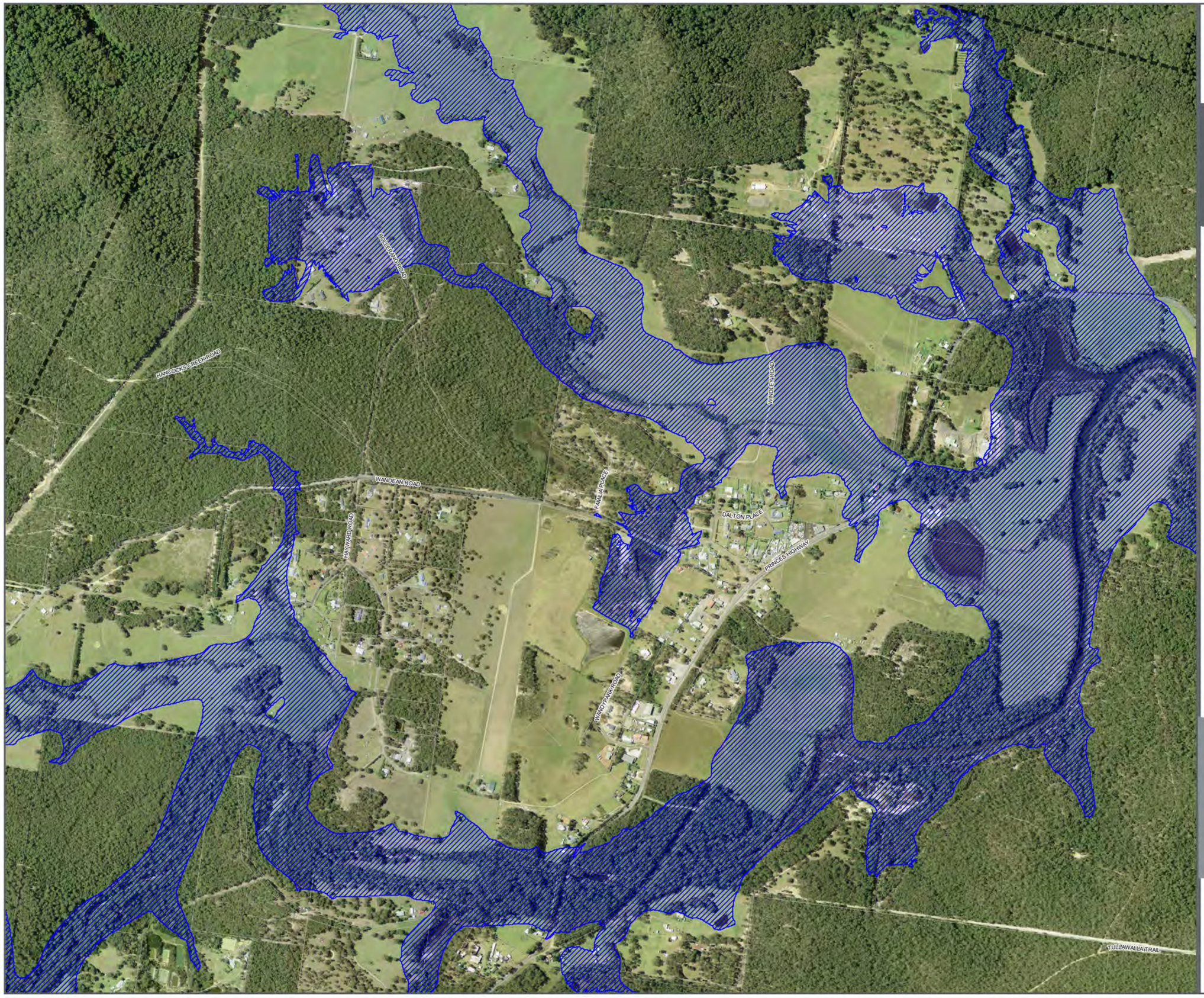
1:6,000 Scale at A3

0 70 140 210 280 350 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2050 Flood Planning Area Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I02.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2050 Flood Planning Area Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I02.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 Flood Planning Area Overview

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

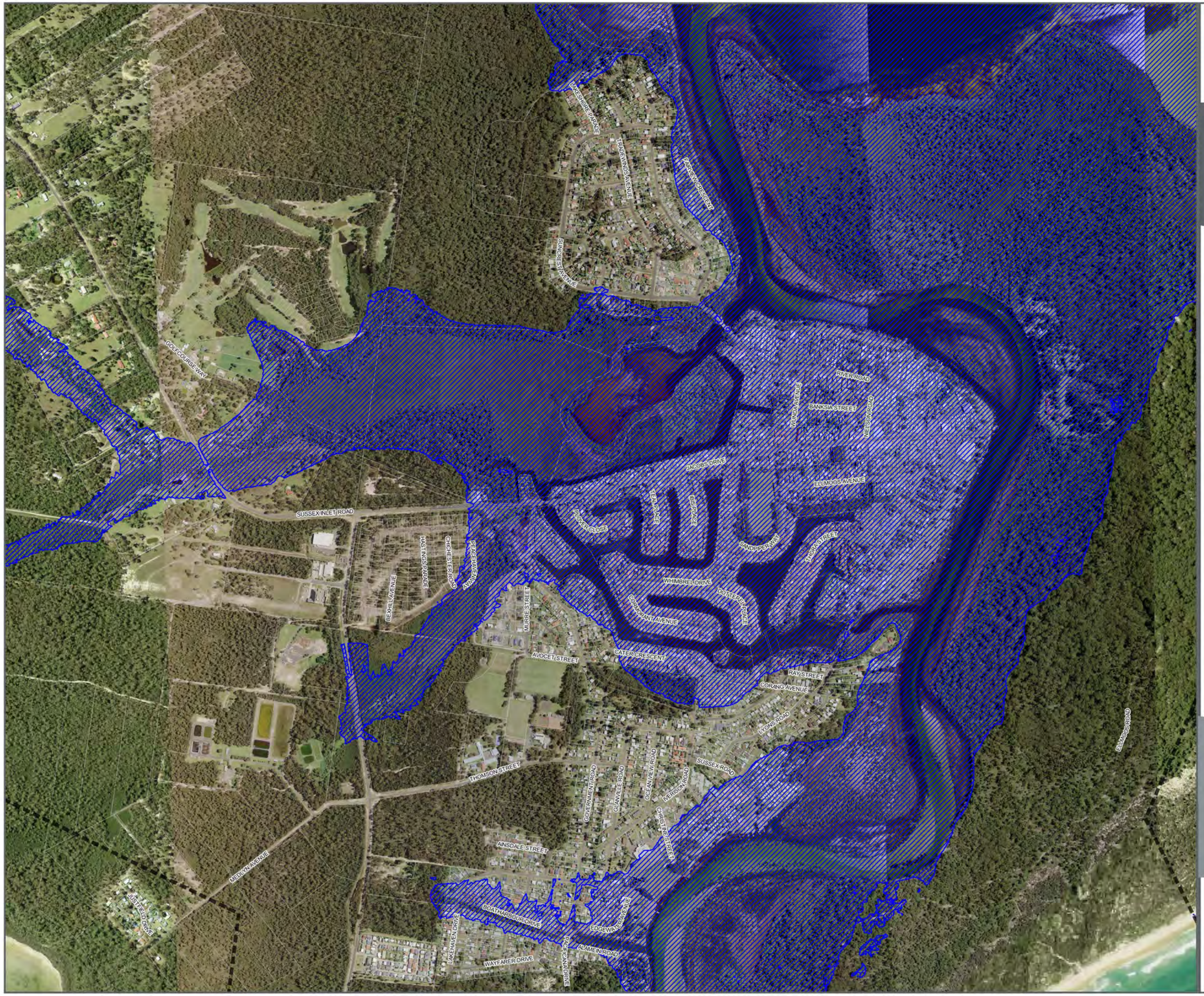
FIGURE I03

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 Flood Planning Area Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I03.1

1:13,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 Flood Planning Area Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I03.2

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 Flood Planning Area Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I03.3

1:15,600 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 Flood Planning Area Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

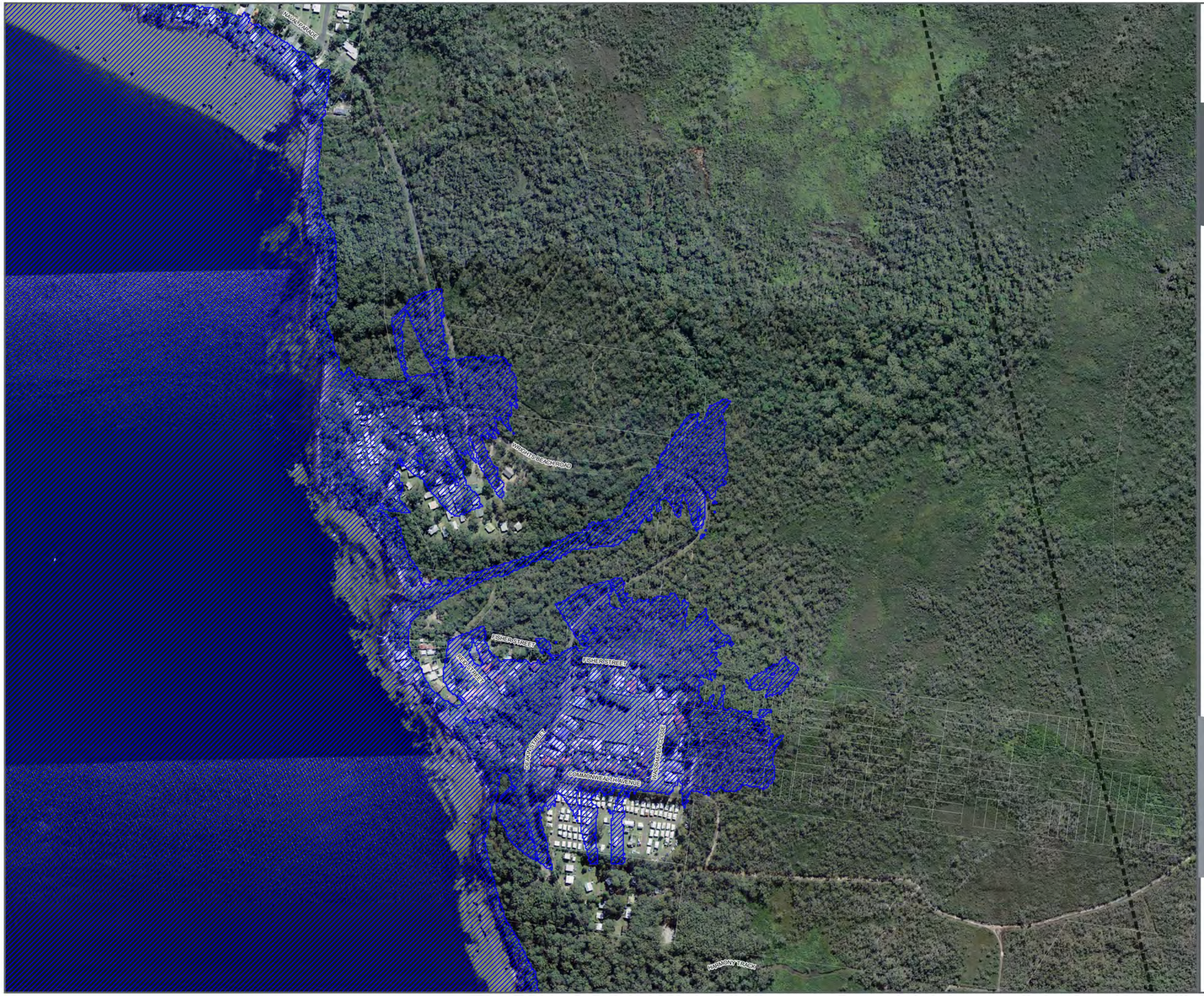
FIGURE I03.4

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 Flood Planning Area Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I03.5

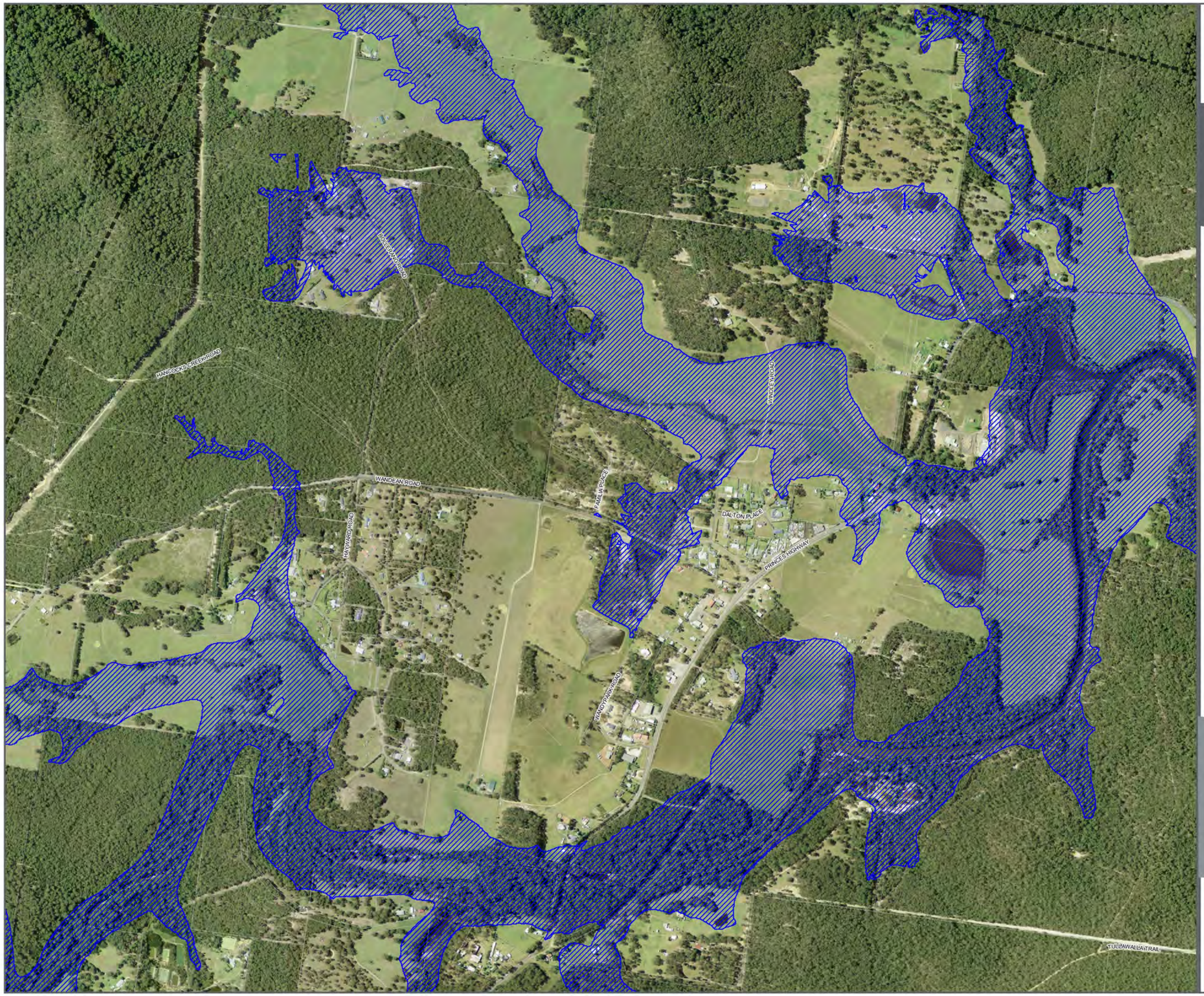
1:6,000 Scale at A3

0 70 140 210 280 350 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Projected 2100 Flood Planning Area Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I03.6

1:12,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Projected 2100 Flood Planning Area Tomerong

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Flood Planning Area

FIGURE I03.7

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-15| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

APPENDIX

J

FLOOD EMERGENCY RESPONSE CLASSIFICATION

Figure List:

Figure J01	Flood Emergency Response Classification Overview
Figure J02	Flood Emergency Response Classification Sussex Inlet
Figure J03	Flood Emergency Response Classification Wandandian
Figure J04	Flood Emergency Response Classification Sanctuary Point
Figure J05	Flood Emergency Response Classification Basin View
Figure J06	Flood Emergency Response Classification Tomerong
Figure J07	Flood Emergency Response Classification Erowal Bay
Figure J08	Flood Emergency Response Classification Wrights Beach

Flood Emergency Response Classification Overview

St Georges Basin Flood Study

Tomerong
Wandandian
Basin View
Erowal Bay
Sanctuary Point
Wrights Beach
Sussex Inlet

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

FIGURE J01

1:65,000 Scale at A3

0 700 1,400 2,100 2,800 3,500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flood Emergency Response Classification Sussex Inlet

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

FIGURE J02

1:13,000 Scale at A3

0 100 200 300 400 500 m

N

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flood Emergency Response Classification Wandandian

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

FIGURE J03

1:12,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flood Emergency Response Classification Sanctuary Point

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

FIGURE J04

1:15,600 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flood Emergency Response Classification Basin View

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

FIGURE J05

1:12,000 Scale at A3

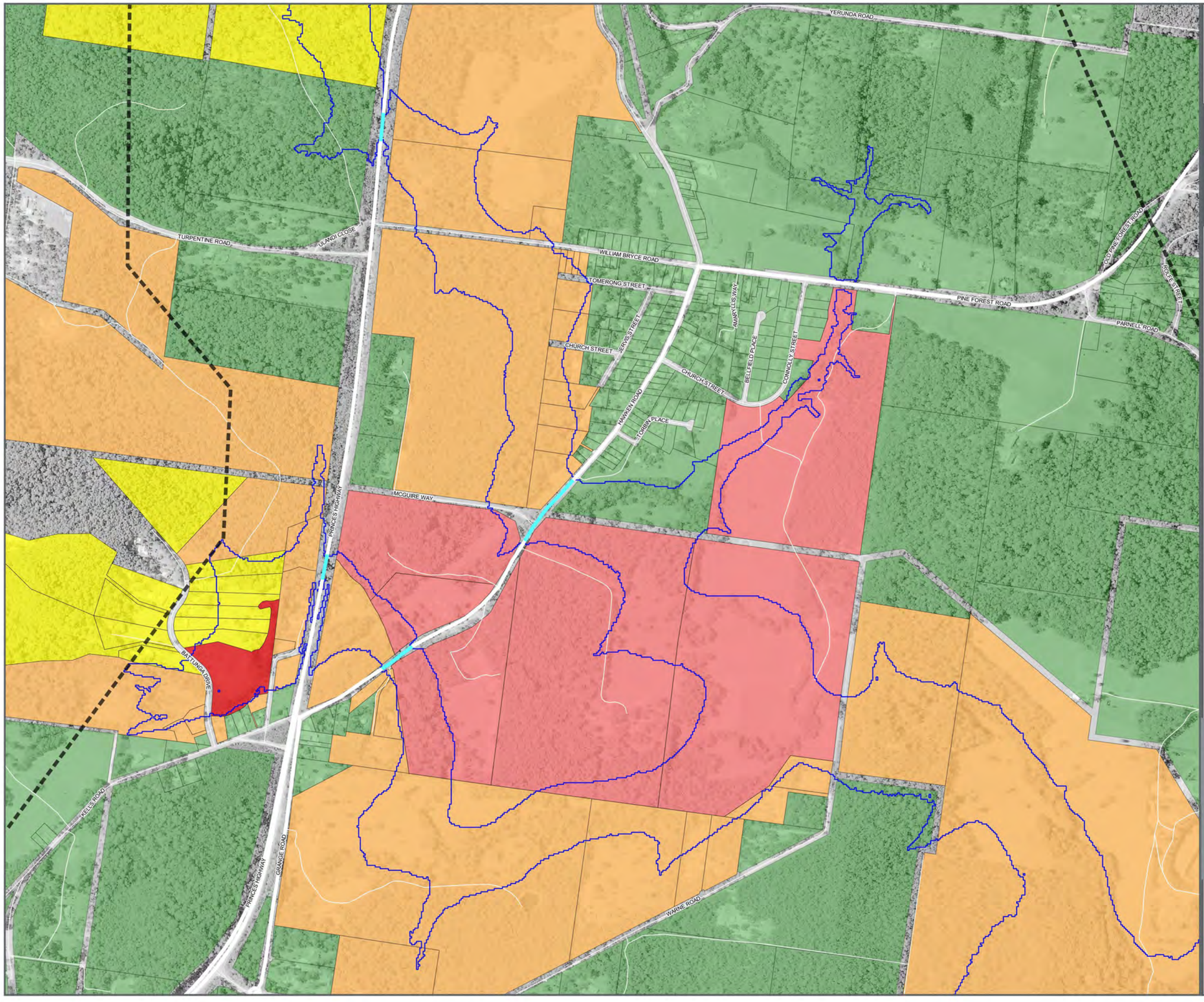
0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flood Emergency Response Classification Tomerong

St Georges Basin Flood Study



Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

FIGURE J06

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

Flood Emergency Response Classification Erowal Bay

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

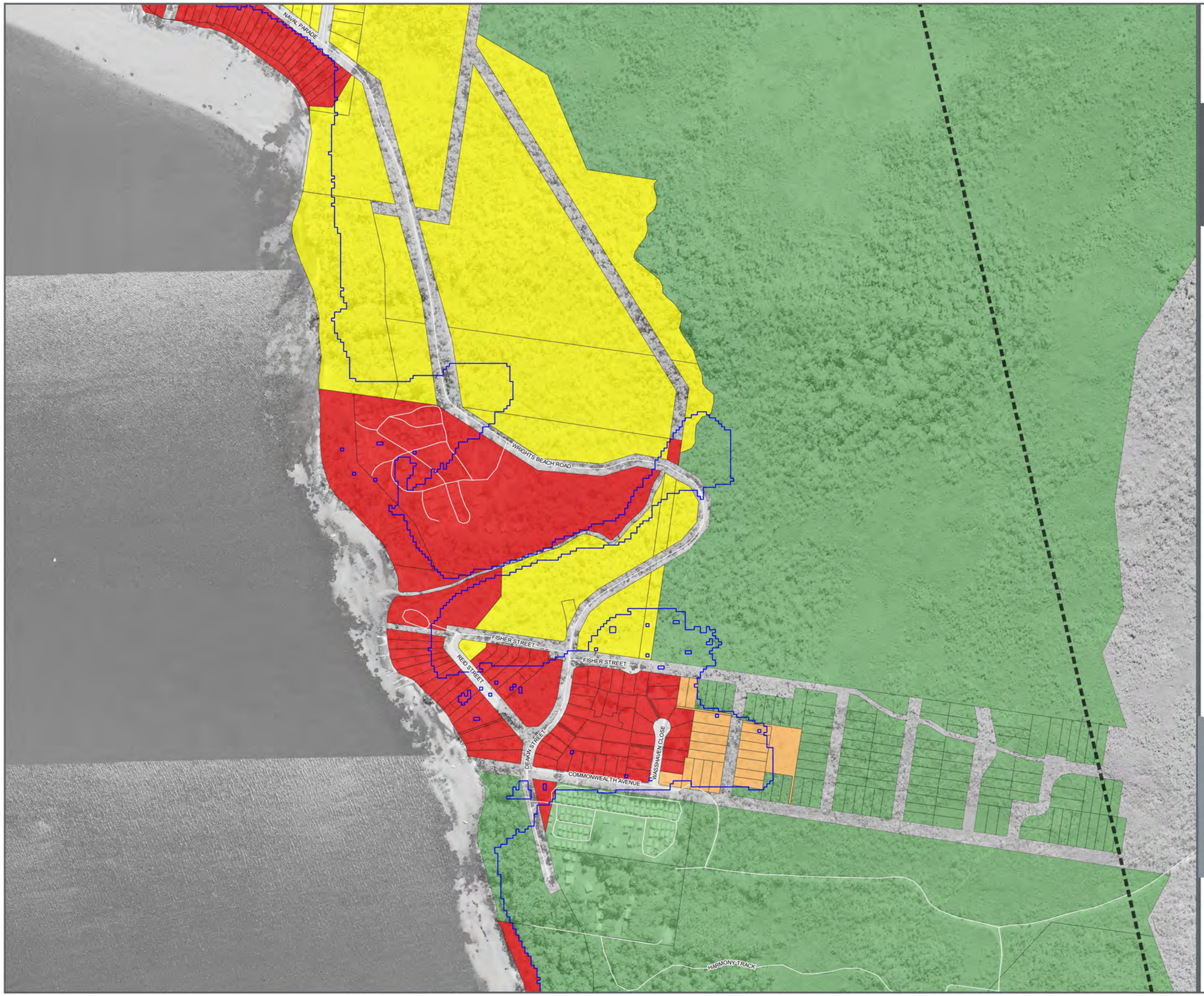
FIGURE J07

1:11,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz



Flood Emergency Response Classification Wrights Beach

St Georges Basin Flood Study

Legend

- Cadastre (NSW Spatial Services, 2019)
- Hydraulic Model Boundary
- Existing PMF Extents
- Local Road
- Not Flooded Evacuation Route
- Flooded Evacuation Route

Key Facility

- Police Station
- SES Facility
- Evacuation Centre or Assembly Area

Flood Emergency Response Classification

- Submerged
- Elevated
- Overland Escape Route
- Rising Road Egress
- Indirect Consequences
- No Flood Impacts

FIGURE J08

1:6,000 Scale at A3

0 70 140 210 280 350 m

Cardno

Map Produced by Cardno NSW/ACT Pty LTD (NatW&E)
Date: 2022-9-6| Project: 59918099
Coordinate System: MGA Zone 56
Map: 59918099_SGB_Flood_Maps_v2.qgz

APPENDIX

K

WIND WAVE CLIMATE ASSESSMENT

Calculations have been undertaken to estimate wave heights, wind set-up and indicative wave runup levels at the three nominated locations within St Georges Basin. These analyses have been based on recorded wind data provided by the BoM at the following stations:

- Jervis Bay (Point Perpendicular AWS, Station 068151). Data is available between 2001 and 2021 and is collected at an elevation of 85m AHD;
- Nowra Station (stations 068076 and 068072). Data is available between 1986 and 2021 and is collected at an elevation of 109m AHD; and
- Port Kembla wind data from Australian Baseline Sea Level Monitoring Project. Data is available between 1991 and 2020 with some gaps in 2013, 2015, 2017 and 2019.

This data was corrected to be 10m above ground level and extremal analyses were undertaken using directional sectors of 45° to determine the 10-minute average peak event wind speeds at 5, 10 and 20-years ARI. Wind speeds adopted in this assessment are the average of the extreme estimates from each site. These ARI are those that are likely to jointly occur with the selected flood event AEP's of 1 in 20, 1 in 50 and 1 in 100. Bathymetry and LiDAR data of St Georges Basin was used to provide depth and fetch data for wave and wind set-up calculations.

Wave heights were estimated using the SMB method described in the SPM (1984), which assumes the waves will be fetch limited (i.e. the storm duration is sufficient for the waves to become fully developed). Table 1 provides a summary of the SMB wave and wind set-up and wave run-up calculations.

For these calculations:

- The SMB method was used to calculated the wave parameters
- Wind set-up was calculated using the following equation from the CIRIA Rock Manual (assuming a constant water depth as per Table 1 and C_D of 3e-3):

$$\eta_w = \frac{1}{2}\frac{\rho_{air}}{\rho_w} C_D \frac{U_{10}^2}{g\,h} F$$

The wind set-up increments can be added to the catchment flooding design 'still' water levels. Additionally, indicative values of the wave run-up, implicitly including any wave set-up, calculated using Holman (1986), (see **Attachment A**) are included in Table 1. However, it is recommended that a site specific wave runup be calculated on a block-by-block basis, which is the common approach adopted in other studies such as those in Pittwater and the Leichhardt LGA (now Inner West) because wave run-up depends on edge treatment – seawalls, revetments, beaches, for example. **Attachment A** provides typical wave run-up formulae, but others can be adopted by development proponents and Councils.

Table 1 - Calculated wave parameters, wind setup wand wave runup

Site	Flood ARI (yrs)	Wind ARI (yrs)	WD (° TN)	WS (m/s)	Fetch (km)	Depth (m)	Hs (m)	Ts (s)	Wind Set-up (cm)	Shoreline Slope (H:V)	R_2 (m)
1	20	5	270	16.2	7.3	7.4	0.87	3.4	4.7	10	0.63
	50	10	270	16.9	7.3	7.4	0.91	3.5	5.1	10	0.66
	100	20	270	17.7	7.3	7.4	0.95	3.6	5.6	10	0.69
2	20	5	180	15.0	5.3	10.4	0.75	3.2	2.1	17	0.38
	50	10	180	15.8	5.3	10.4	0.79	3.2	2.3	17	0.40
	100	20	180	16.5	5.3	10.4	0.83	3.3	2.5	17	0.42
3	20	5	135	12.0	9	7.4	0.69	3.1	3.2	9	0.53
	50	10	135	12.9	9	7.4	0.74	3.2	3.7	9	0.58
	100	20	135	13.7	9	7.4	0.79	3.3	4.1	9	0.61



Historic Event Runup Values

Following the same methodology outlined above, wind and wave setup and wave runup has been estimated at each of the three sites under the peak wind speeds for three historic flood events (June 2013, August 2015 and June 2016).

For these events the peak wind speed from the critical directional sectors were extracted from the wind measurements and used to estimate the wave conditions during the events. The results are presented below in Table 2.

Table 2 - Calculated wave parameters, wind setup wand wave runup during historic flood events

Site	Flood Event	WD (° TN)	WS (m/s)	Fetch (km)	Depth (m)	Hs (m)	Ts (s)	Wind Set-up (cm)	Slope (H:V)	R_2 (m)
1	Jun-13	240	4	5	6.4	0.14	1.4	0.2	10	0.10
2		180	12	5.3	9.4	0.54	2.4	1.5	10	0.39
3		135	12	9	6.4	0.69	2.8	3.6	10	0.50
1	Aug-15	270	9	7.3	6.8	0.45	2.3	1.6	17	0.23
2		180	4	5.3	9.8	0.14	1.5	0.2	17	0.07
3		135	3	9	6.8	0.12	1.4	0.2	17	0.06
1	Jun-16	270	14.5	7.3	6.2	0.75	2.8	4.5	9	0.58
2		180	5	5.3	9.2	0.19	1.6	0.3	9	0.15
3		135	3	9	6.2	0.12	1.4	0.2	9	0.09

ATTACHMENT A

Wave Run-up Equations

Parameters:

H_s - significant wave height

T - wave period

H_o - deepwater wave height

L_o - deepwater wave length $\left(= gT^2/2\pi\right)$

s_{op} - deepwater wave steepness $\left(= H_o/L_o\right)$

α - slope angle

ξ_{op} - surf similarity parameter $\left(= \tan\alpha/\sqrt{s_{op}}\right)$

$R_{u2\%}$ - Run-up height exceeded by 2% of waves

R_c - freeboard

K_{TO} - Transmitted overtopping wave coefficient

H_{TO} - Transmitted overtopping wave height

SWL - Still water level

Wave run-up without overtopping

De Waal and van der Meer (1992)

$$\frac{R_{u2\%}}{H_s} = \begin{cases} 1.6\xi_{op} \ for & 0.5 < \xi_{op} \le 2 \\ 3.2 \ for & 2 < \xi_{op} \le 3-4 \end{cases}$$

$$Level = SWL + R_{u2\%}$$

Wave run-up without overtopping

Holman (1986)

$R_{u2\%}$ = (5.2 * Slope + 0.2) * Hs

$$Level = SWL + R_{u2\%}$$

Wave run-up with overtopping

Van der Meer and Janssen (1995)

$$K_{TO} = C\left(1.0 - R_c/R_{u2\%}\right)$$

where $C = 0.51$ for transmitted wave at the crest

$$H_{TO} = K_{TO} \times H_s$$

$$Level = SWL + H_{TO}$$

Wave overtopping when still water is above the crest

Public Works Department (1990)

$$Level = SWL + \frac{H_s}{2}$$

Wave overtopping of a vertical wall

$$Level = SWL + H_s$$