Expert Witness Statement of Robert Campbell Swan - Drainage

Amendment C395 Geelong Planning Scheme

AWE200050

Prepared for
Minter Ellison on Behalf of Ramsey Property Group

6 November 2019

Cardno

Contact Information

Cardno Victoria Pty Ltd
ABN 47 106 610 913

Level 4
501 Swanston Street
Melbourne VIC 3000
Australia

www.cardno.com
Phone +61 3 8415 7777
Fax +61 3 8415 7788

Document Information

Prepared for	Minter Ellison on Behalf of Ramsey Property Group
Project Name	Amendment C395 Geelong Planning Scheme
File Reference	Document2
Job Reference	AWE200050
Date	6 November 2019
Version Number	Insert Version Number

Table of Contents

1	Name and address		1
2	Position		1
3	Area of expertise		1
4	Glossary of Terms		2
5	Services		4
6	Ramsey Land		4
7	Documents Reviewed		4
8	Drainage Infrastructure		4
	8.1	Framework Plan	4
	8.2	Stormwater Management Plan	6
9	Findings		1
10	Declaration		1

Appendices

Appendix A CV of Robert Campbell Swan

Figures

Figure 8-1 Indicative Creek Cross Section (taken from the Cowies Creek Corridor) 5

Figure 8-2 Example Alternate Drainage Layout, Cowies Creek catchment 7

1 Name and address

Mr Robert Campbell Swan

Cardno Victoria Pty Ltd

Level 4, 501 Swanston Street

Melbourne, VIC 3000

2 Position

National Technical Lead, Water

Principal Engineer, Hydrology and Stormwater

Manager, Water Engineering

Cardno

3 Area of expertise

a. My area of expertise is hydrology and hydraulics, particularly the areas relating to the flow and characteristics of surface water and flood dynamics.

b. I have over 18 years experience in the assessment, design and development of drainage strategies and water quality treatments in urban areas.

c. My qualifications are detailed in Appendix A.

4 Glossary of Terms

Average Exceedance Probability (AEP)

The chance of a given discharge or level value being exceeded in a given year. A 1% AEP flood event has a 1% chance of occurring in any year (and is equivalent to the 1 in 100 year ARI event).

The conversion from ARI to AEP is shown in the table below

ARI (years)	AEP (%)
1	63%
2	39%
5	18% (usually approximated as the 20% AEP)
10	10%
20	5%
50	2%
100	1%

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 period between exceedances of a given discharge or event. A 100-year ARI event would occur, on average, once every 100-years.

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.

City of Greater Geelong

The City of Geelong is the local government authority for Amendment C395

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 be overtopped in the 1 in 1 year or 100%AEP flood event.

DELWP

The Department of Environment, Land, Water and Planning of the Victorian Government

Difference Plot

A map showing the difference in flood depth between two flood events.

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.

Floodplain

Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.

Hydraulics

The term given to the study of water flow in a river, floodplain, 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.

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 and water quality.
Melbourne Water Corporation (MWC)	Melbourne Water is the regional floodplain management authority for the Melbourne Metropolitan area. Melbourne Water generally controls flooding once catchment area reaches greater than 60 hectares.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this document, 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.
Topography	A surface which defines the ground level of a chosen area.

5 Services

My services were engaged to provide expert opinion on issues relating to the drainage and stormwater quality elements of the North and West Geelong Growth Areas Framework.

My instructions were to prepare an expert report describing my views in relation to the drainage infrastructure matters associated with the Amendment. These views are to be made with specific regard to the Ramsey controlled land at Bell Post Hill.

6 Ramsey Land

The Ramsey Land is within the Creamery Road Precinct of the Western Geelong Growth Area. From a drainage perspective, the land is in the Cowies Creek catchment, eventually discharging into Corio Bay

7 Documents Reviewed

I have reviewed the following documents with regard to the drainage of the Creamery Road Precinct:

- Northern and Western Geelong Growth Areas Framework Plan, City of Greater Geelong, 2019
- Western Geelong Growth Area - Conceptual Layout for Stormwater Management Strategy, Draft v7, Neil M Craigie for City of Greater Geelong, 2017
- Western Geelong Growth Area, Flood Impact Assessment and Stormwater Management Strategy, Volume 1: Existing Conditions Report, Water Technology, January 2019
- Western Geelong Growth Area, Flood Impact Assessment and Stormwater Management Strategy, Volume 2: Developed Conditions Report, Water Technology, May 2019
- Waterway Corridors, Guidelines for greenfield development areas within the Port Phillip and Westernport Region, Melbourne Water Corporation, 2013
- Ramsey Property Group Submission to Amendment C395
- Aerial Photography, sourced from NearMap.

8 Drainage Infrastructure

Under the existing conditions, the properties contained within the Creamery Road Precinct area drain towards Cowies Creek, through natural drainage lines and farm drainage networks. The catchment contains no formal water quality treatments and does not appear to have any watercourses with constant base flow (flows that occur continuously).

8.1 Framework Plan

Plan 47 of the Growth Areas Framework Plan identifies a number of proposed waterway corridors through the Creamery Road Precinct. Based on the scale, this plan suggests that waterway corridors in the area are up to 200m wide. Along Cowies Creek, there is a lateral buffer, south of the creek of between 150 and 200m wide. Although the framework plan states that the waterway setbacks will be exceed or meet the requirements specified in Melbourne Water's Waterway Corridor guidelines, the reserve widths show in the plans are significantly greater than indicated by these guidelines:

- Cowies Creek, an existing waterway with a Strahler stream order greater than 4, that under the guidelines would normally require a 50m setback from the top of bank. This is significantly less than the indicated buffer shown in on Plan 47.

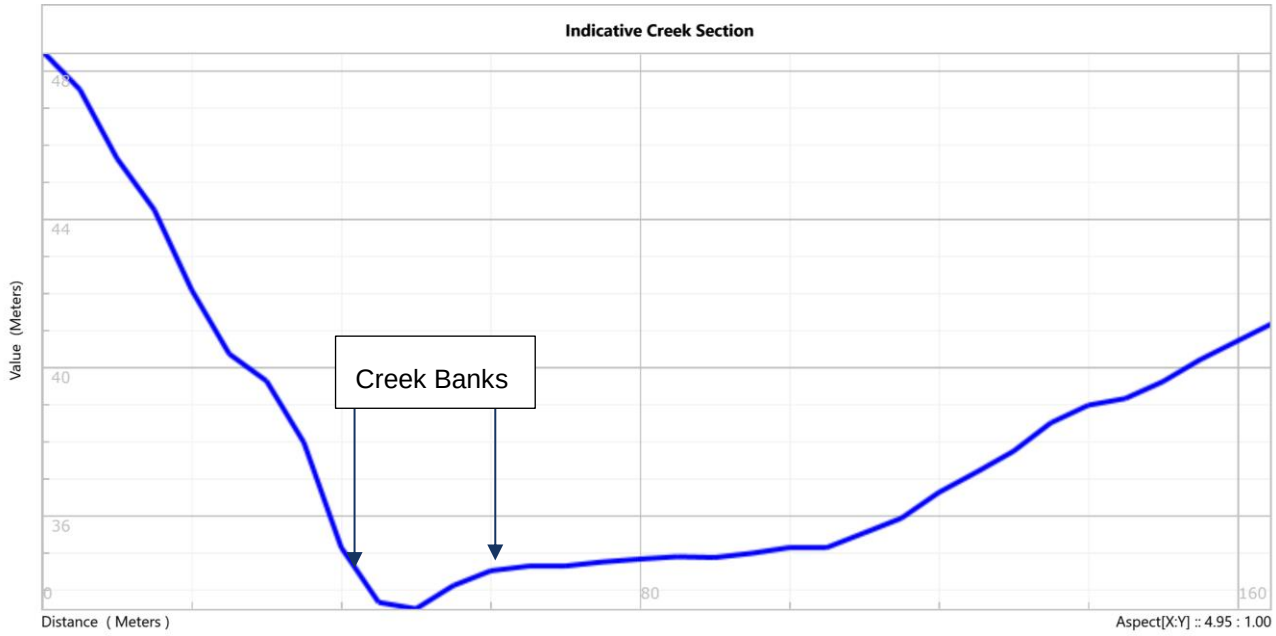
- The waterway corridors through the Creamery Road Precinct will be constructed as part of the overall development of the area. The waterway corridor widths are indicated in the Stormwater Management Strategy (Volume 2) as being between 30 and 40m wide.
- Plan 47 includes some areas designated as waterways that are proposed wetlands and retarding basins under the SWMS. These locations should be considered preliminary as the location of these features may change as a result of investigations during the PSP process

In my view, Plan 47 is misleading in that the area shown as 'Waterways" is significantly larger than required under the guidelines. It is noted that the Framework plan does indicate that the Precinct Structure plans to be developed for each Precinct will further define the extent of drainage infrastructure. A suggested amendment to the plan is not to show specific areas, but use dotted lines indicating the proposed waterway corridors. This provides certainty in the drainage corridor locations without an expectation of waterway sizing that will be defined as part of the Precinct Structure Plans. Additionally, the legend could be changed to state that the waterway corridors are indicative only.

I note that in the Waterway Corridor Guidelines, the extent of offsets and setbacks can be varied to account for site specific conditions. This can involve a narrowing of the corridor widths, particularly if the natural landform does not require such wide buffers. There are a number of cases where a smaller buffer may be appropriate, including:

- a heavily incised creek, where the 1% AEP flood extent is contained within the incised valley.
- A waterway where the floodplain is not generally symmetrical as shown in Figure 8-1. In this example section, taken from the Cowies Creek corridor, a 50m buffer either side of the creek bank would not cover the main floodplain features on the right hand side of the creek, and would include areas on the left of the creek that do not significantly contribute to waterway health. In this case, a smaller buffer on the left and a wider buffer on the right would be justified.

Figure 8-1 Indicative Creek Cross Section (taken from the Cowies Creek Corridor)



Section 4 of the Waterway Corridor Guidelines, 'Scope of the Guidelines' provides the following information:

> *These guidelines focus on regional drainage assets, which can be perennial (always flowing) and ephemeral (flowing sometimes) rivers and/or creeks with catchments greater than 60 hectares.*

The catchment area for some of the proposed waterway corridors shown in the Plan 47 is less than 60 hectares. Section 7.2 of the guidelines allows that protection of natural streams with smaller catchment areas is desirable. Based on the aerial photography of the Creamery Road Precinct, the drainage lines in this area have been highly modified due to farming and are not considered natural streams.

The need to set aside large waterway corridors for drainage purposes in these smaller catchment areas may not be required. Drainage from these areas could be provided through other means, as discussed further in Section 8.2. The PSP process should assess what setbacks and waterway corridor widths are appropriate.

8.2 Stormwater Management Plan

The Water Technology report "Flood Impact Assessment and Stormwater Management Strategy, Volume 2: Developed Conditions" (SWMS), is a primary source for the framework plan. I have undertaken a review of the proposed strategy. The aim of the strategy is to provide an indication of the drainage infrastructure required to meet Actions W1.2.1 to 1.2.5 of the Framework Plan. In my view these actions are well defined and in line with best practice stormwater management.

The SWMS provides an indicative waterway and water quality layout for the Creamery Road Precinct, as part of the Cowies Creek catchment SWMS, including indicative sizes and features. However, there are some potential issues with the infrastructure proposed under the SWMS and there appears to have been a lack of consideration of alternate drainage options in the development of the SWMS.

My review has found that, with reference to the Cowies Creek area:

- The methods adopted to estimate peak flows were completed under the guidelines of ARR1987. These have been superseded in recent years by the release of ARR2016 (now 2019). The impact on the indicative infrastructure is likely to be small and would not affect the proposed location of waterway channels.
- The SWMS does not appear to have considered alternative layouts to that originally proposed in the Craigie Report.
- The large retarding basin (WLRB G) creates a significant embankment across the drainage line with height of approximately 12 metres and significant fill. This design creates a very large waterbody ad embankment and does not promote a continuous waterway corridor. There are alternate stormwater layouts that can reduce the footprint of this basin and the cost of the infrastructure.
- Some of the proposed stormwater infrastructure, particularly basin WLRB G, appears to impact areas of native vegetation shown on Plan 47 (Framework Plan). The proposed design in the stormwater strategy would impact these areas due to the engineering works including wetlands, embankments and drainage channels.
- Some waterway channels provide drainage to areas with catchments of less than 60 hectares. These areas may be able to be serviced through a combination of underground pipes and overland flow paths. Specifically, this includes the southern waterway (between nodes 'SBRB B' and 'B30B') and the waterway draining into WLRB C, as shown in Appendix B of Volume 2 of the SWMS

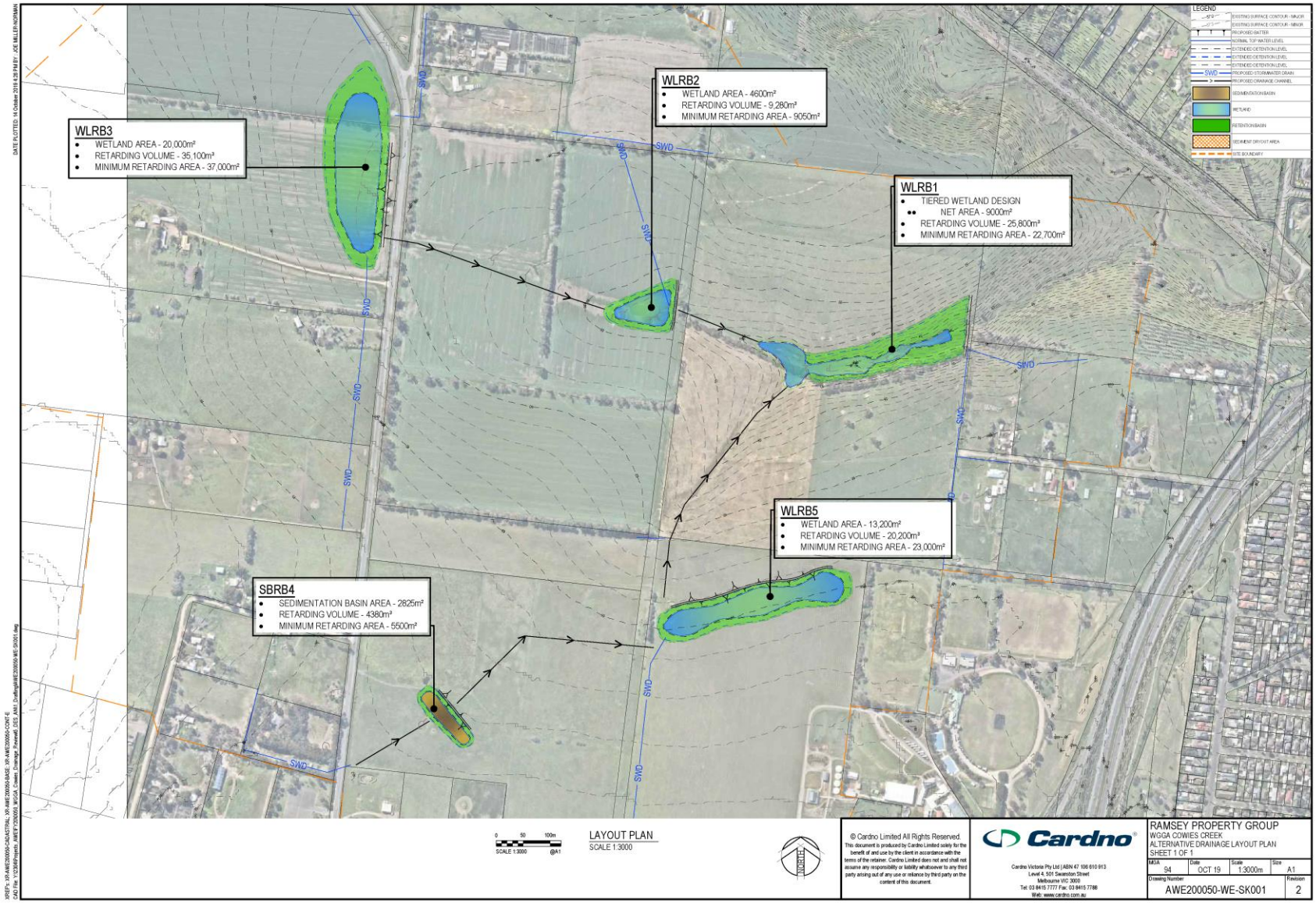
In the Ramsey Property Group Submission at Attachment 1, Leigh Prossor and Mark Colgate of CardnoTGM provided specific comments on the technical analysis methods adopted in the SWMS. The findings in that attachment are technically correct, although I note that RORB is widely used in Victoria for these types of studies. Some overestimation of drainage at this stage of the design process may be prudent, as long as appropriate refinement occurs as part of the PSP.

As an example, I have developed a potential alternative layout for the stormwater infrastructure for the Cowies Creek catchment that achieves the objectives of the framework plan. The general location of drainage corridors is the same, however alternate design strategies, such as adopting a stepped wetland and redirecting some catchments, changes the required retarding basin, channel and water quality infrastructure sizing. This is shown in Figure 8-2.

In my view, adopting the all the proposed drainage infrastructure in the SWMS, and using the findings of the SWMS with regard to setting waterway corridors, particularly around retarding basins and wetlands, is premature at this stage. This is more appropriately done, as is recommended in the Framework Plan, as part of the PSP process.

The general layout of the waterway corridors is sound although the location of retarding basins and wetlands should not be locked in at this stage.

Figure 8-2 Example Alternate Drainage Layout, Cowies Creek catchment



9 Findings

With regard to the proposed drainage and stormwater infrastructure proposed for the Creamery Road area in the Framework Plan. it is my opinion that:

- The waterway corridors shown on the plan are generally in the appropriate location, with regard to the topography of the area. However, the need for waterway corridors in all locations indicated in the framework plan is premature, prior to a detailed assessment as part of the PSP.
- The waterway corridors shown on Plan 47 are significantly greater than will be created as part of the PSP. The framework plan should be amended to show a narrower waterway corridor or show the waterway corridors as indicative dotted lines.
- The SWMS prepared for the Cowies Creek area does not necessarily provide the best stormwater solution for the area. Alternate options should be assessed as part of the PSP.
- The adoption of the SWMS at this stage, prior to detailed assessment under the PSP, is premature.

10 Declaration

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Robert Campbell Swan

6 November 2019

APPENDIX

A

CV OF ROBERT CAMPBELL SWAN

Robert Swan

Current Position
National Technical Lead, Water

Principal, Hydrology and Hydraulics

Manager – Water Engineering

Profession
Engineer

Years' Experience
18

Joined Cardno
January 2003

Education
Bachelor of Engineering

Diploma of Project Management

Summary of Experience

Robert is Cardno's National Technical Lead for Water, a Principal Engineer and leads the Victorian Water Engineering team. He has over eighteen years' experience in the areas of hydrology and hydraulics, flood analysis, water quality and environmental assessment. He has significant project management experience and has worked on a number of large multi-disciplinary projects.

Rob is an expert in floodplain management and the simulation and modelling of large flood events. He is a member of the Victorian State Emergency Service Expert Hydrologist Panel and has performed in an operational capacity in emergency flood response. Rob has significant experience in the intersection of the planning system and flood analysis and their interaction to provide community benefit and appropriate management of natural assets.

Rob has authored papers and presented at multiple national and international conferences. Key areas of experience include:

> One and two-dimensional numerical model development and application for the study of flooding and water quality
> Flood Emergency Response and Planning
> Drainage Scheme Development and Application
> Planning Scheme Amendments
> Hydraulic and hydrologic investigations of urban and rural floodplains
> Water quality investigations of shallow lakes and Water Sensitive Urban Design
> Floodplain management and planning
> Environmental and geomorphological assessment
> Project Management
> Expert Witness Services and Planning Panels

Significant Projects

> Moorabool Flood Studies Peer Review - Rob was the expert independent reviewer for the Moorabool Shire Council in the development of planning scheme amendments for the Shire. Rob reviewed models developed by Melbourne Water and other Consultants and provided advice and opinion on their adequacy for use.
> Flood Lead, Western Distributor Tender Design - Rob was the design lead for flooding for the Western Distributor Tender Design. The project is a 5.5 Billion tunnel and freeway upgrade and included crossings of 4 major waterways. The analysis of a new bridge crossing of the Maribyrnong River included consideration of PMP and climate change flooding and the navigational requirements of commercial and recreational craft on the river.
> City of Manningham Flood Modelling and Planning Scheme Amendments - Rob represented the City of Manningham and Melbourne Water at the planning panel to implement the changes to the Manningham Special Building Overlay. This followed the successful delivery of 5 major flood models in the municipality

- SES Expert Hydrologist 2012 Broken Creek Flood Event - Rob was one of two external experts brought in to provide hydrological and hydraulic analysis as part of the incident response to flooding on the Broken Creek. His work included public meetings and liaison, flood impact prediction, hydrological assessment and flood impact assessment.
- Echuca Bridge Crossing - Rob has provided design and technical advice to VicRoads on the required bridge and culvert requirements for the proposed second crossing of the Murray and Campaspe Rivers at Echuca. This advice included flood impact assessment, mitigation sizing, preliminary costing, water quality and quantity assessment and community consultation.
- Swan Hill Bridge Crossing - Rob was the project manager and technical expert for the Swan Hill Bridge Planning Study. This project included analysis of the hydrology and hydraulics of the Murray River at Swan Hill to inform and plan the replacement road and bridge crossing of the Murray River. Rob prepared the technical reports and provided expert advice to the Planning Panel considering the application.
- Warrnambool Drainage Analysis - Provided advice and assistance to the City of Warrnambool in the development of a number of drainage strategies for developing areas in Warrnambool, including Dennington, the Warrnambool North-East activity precinct and the Warrnambool Eastern Activity Precinct. The strategies included the specification of drainage works, their type and location, cost estimates and the specification of water quality treatments to protect downstream waterways. These strategies have been adopted by the City and now form part of the overall drainage plan for these areas.
- Glenelg Flood Investigations - Flood modelling and assessment of flood extents for three towns in the Glenelg Shire: Portland, Casterton and Heywood. The study provided council with updated inundation and risk mapping to inform planning decision making and included the assessment of floodway areas. The projects outputs were an order of magnitude more accurate than the previous extents used by Council and the information provided could be used for emergency response purposes in the future.
- Benalla Rural City Flood Information - Rob was the lead for the Rural City of Benalla for a number of projects, including the detailed investigation of large scale flood mitigation options. This included presenting to three community forums with over 300 total attendees and providing summary documents to Council for distribution to residents. The outcome of this work was the Benalla Flood Information Portal, which provides advice on flood risk to all residents of Benalla. Rob led this follow up project and launched the portal alongside Council and VicSES in late 2017.
- Melbourne Water Flood Mapping and Analysis - Rob has variously been the lead technical engineer, project manager and project director for approximately 20 Melbourne Water Flood Mapping projects, including those in the developing areas of Pakenham, Hallam and Koo Wee Rup. This work provides a detailed understanding of floodplain modelling and how it can be used to support flood mitigation works and development advice.
- Tooleybuc Bridge Analysis, Roads and Maritime Services, NSW - Rob was the project director and technical adviser for the Tooleybuc Bridge Crossing project. This project included analysis of the hydrology of the Murray River at Tooleybuc and the dynamics of flows through the proposed road and bridge upgrades.

Publications

May 2018

ARR 2016 – Adopting a Practical Methodology for Catchment Scale Urban Flood Mapping Projects

Swan, R, Guest, R, Sommerville, H, and Haywood, J

Proceedings of the 2018 Floodplain Management Australia National Conference, May 29 to June 1, 2018

September 2016

Adaptive Floodplain Planning - from modelling to implementation

Veldema, A, and Swan, R.

Proceedings of the 4th National Conference of Stormwater Australia, August-September 2016

December 2015

Transforming Flood Mapping Outputs to Decision Making Inputs

Veldema, A, and Swan, R.

Proceedings of the 36th National Hydrology and Water Resources Symposium

December 2015

Ocean Inundation, climate change and policy planning – is the Flood approach suitable?

Swan, R, Provis, D and Bicknell, P.

Proceedings of the 36th National Hydrology Water Resources Symposium

Feb 2013

Representing flood mechanisms in the Koo Wee Rup Flood Protection District

Swan, R and Thompson A

Presented at the 8th Victorian Flood Conference, February 2013

Feb 2013

Flood Mapping without Drainage Asset Data

Thompson A and Swan, R

Presented at the 8th Victorian Flood Conference, February 2013

Jun 2011

Direct Rainfall - Verifying the technique across two States

Swan, R and Thomson R

Proceedings of the 34th IAHR World Congress and the 33rd National Hydrology and Water Resources Symposium and the 10th National Conference on Hydraulics in Water Engineering

Oct 2010

Direct Rainfall - Loss Modelling Approaches

Swan, R.

Presented at the 7th Victorian Floodplain Management Conference

Oct 2010

Ocean versus River - Coastal Interfaces, Climate Change and Flood Analysis

Swan, R. and Provis, D.

Presented at the 7th Victorian Floodplain Management Conference

Oct 2007

Dealing with Hydrological Uncertainty: A New Modelling Approach

Swan, R.

Presented at the 5th Victorian Floodplain Management Conference

Oct 2005

Flood Studies and Extreme Events - Modelling, Mitigation and Assessment at Fairfield, Victoria

Swan, R.

Presented at the 5th Victorian Floodplain Management Conference.

Dec 2004

Application of Australian Runoff Quality Draft Chapter 6 - A 'model' approach?

Swan, R.

6th International Conference on WSUD - Cities as Catchments (WSUD 2004)

Jul 2004

Integrated High Order Water Quality and Hydrodynamic Analysis - An Essential Tool for Lake Management

Swan, R.

8th National Conference on Hydraulics in Water Engineering (2004).