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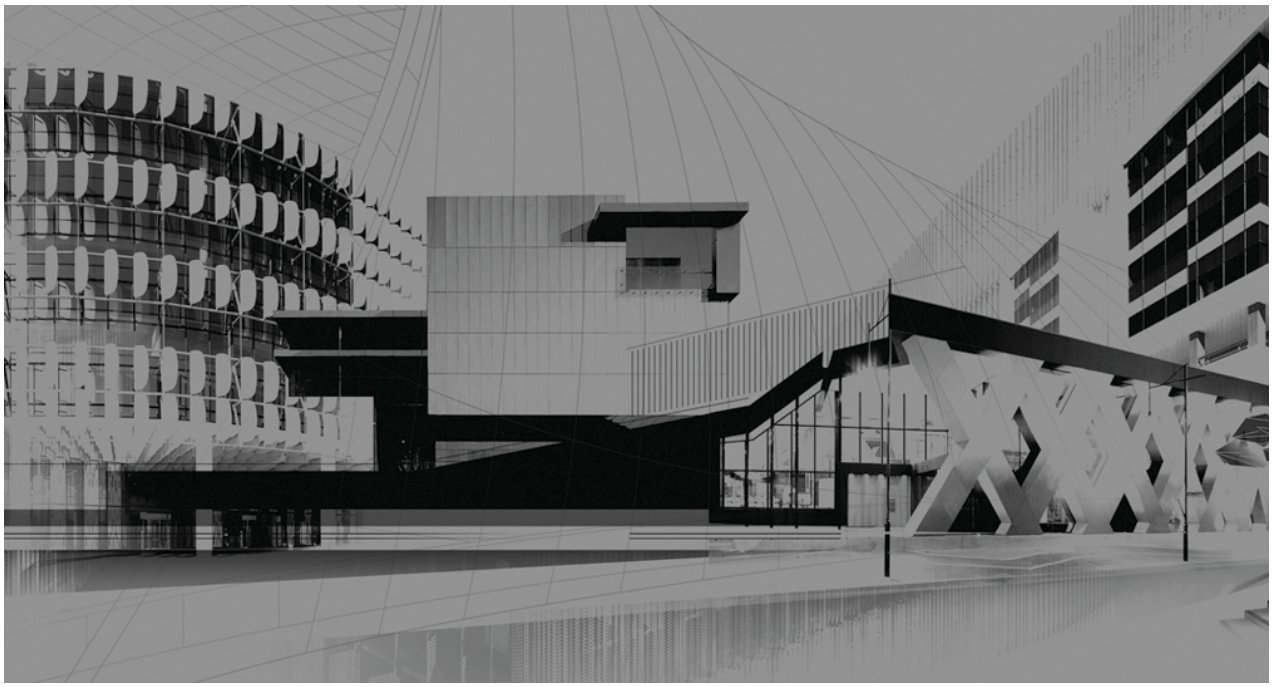

Apollo Bay Resort
Stormwater Drainage and Waterway Management Report

9th May 2018
Revision H
Update of original Town Planning issue, 22nd June 2017
Job no: 15ME0212

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Document Control

Project Title: Stormwater Drainage and Waterway Management Report

Project No: 15ME0212

Revision	Date				
A	24/05/2017	File name 15ME0212-20170524-AP3-CV-Apollo Bay Development Report – P1.docx			
		Description 40% Schematic Design			
			Prepared	Checked	Approved
		Initial	AP3		
		Date	24/05/2017		
B	14/06/2017	File name 15ME0212-20170607-TJ1-CV-Apollo Bay Development Report - B			
		Description			
			Prepared	Checked	Approved
		Initial	TJ1	AP3	RD2
		Date	14/06/2017	14/06/2017	14/06/2017
C	22/06/2017	File name 15ME0212-20170622-TJ1-CV-Apollo Bay Development Report - C			
		Description			
			Prepared	Checked	Approved
		Initial	TJ1	AP3	RD2
		Date	22/06/2017	22/06/2017	22/06/2017
D	30/06/2017	File name 15ME0212-20170630-TJ1-CV-Apollo Bay Development Report - D			
		Description			
			Prepared	Checked	Approved
		Initial	TJ1	AP3	RD2
		Date	30/06/2017	30/06/2017	30/06/2017
E	27/04/2018	File name 15ME0212-20180417-TJ1-CV-Apollo Bay Development Report - E			
		Description			
			Prepared	Checked	Approved
		Initial	TJ1	RD2	RD2
		Date	27/04/2018	27/04/2018	27/04/2018
F	03/05/2018	File name 15ME0212-20180417-TJ1-CV-Apollo Bay Development Report - F			
		Description			
			Prepared	Checked	Approved
		Initial	TJ1	RD2	RD2
		Date	03/05/2018	03/05/2018	03/05/2018
G	09/05/2018	File name 15ME0212-20180508-TJ1-CV-Apollo Bay Development Report - G			
		Description			
			Prepared	Checked	Approved
		Initial	TJ1	RD2	RD2
		Date	09/05/2018	09/05/2018	09/05/2018
H	09/05/2018	File name 15ME0212-20180509-TJ1-CV-Apollo Bay Development Report - H			
		Description			
			Prepared	Checked	Approved
		Initial	TJ1	RD2	RD2
		Date	09/05/2018	09/05/2018	09/05/2018

Contents

Glossary of Terms

Annual Exceedance Probability (AEP)	*Refers to the probability or risk of a flood of a given size occurring or being exceeded in a given year.*
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 rainfall total accumulated over a given duration. e.g. 100 year ARI flood is expected to be exceeded once every 100 years on average (taken to be equivalent to 1% AEP). It is implicit in this definition that the periods between exceedances are generally random.*
Best Practice Environmental Management Guidelines (BPEMG)	*The BPEMG establishes stormwater quality objectives to help determine the level of stormwater management necessary to meet the State Environment Protection Policy (Waters of Victoria) objectives.*
Catchment	*Area draining to a site. It always relates to a particular location and may include the catchment of tributaries as well as main stream.*
Design flood	*The design is the probabilistic or statistical estimate, being generally based on some form of probability analysis of flood or rainfall data.*
Discharge	*The rate of flow of water measured in terms of volume over time.*
Flood	*A relatively high stream flow which overtops that natural or constructed watercourse or drainage system such as a stream, river, estuary, lake, canal or pipe drainage network.*
Flood damage	*The tangible or intangible detrimental impacts of flooding.*
Flood hazard	*Potential risk to life or property caused by flooding. Flood hazard is often evaluated in terms of flood depth, flood velocity and the product of these two parameters.*
Flood mitigation	*Works to prevent or reduce the impact of flooding.*
Flood storage	*Refers to the volume of a flood plain that flood water occupies. May be natural storage of the floodplain or constructed storages like detention or retardation basins.*
Floodplain	*Area of land which is subject to inundation by floods up to the probable maximum flood event. i.e. flood prone land.*

Freeboard	*A factor of safety above design flood levels typically used to define floor levels of buildings or bridge decks. Freeboard is usually expressed in terms of a height above the design flood level.*
Hydraulics	*Is the topic in civil engineering dealing with the mechanical properties water flow through such things as pipe drainage networks, dams rivers, stream and across land.*
Hydraulic Grade Line (HGL)	*The surface level of water flowing in an open channel or pipe flowing partially full. In a pipe under pressure, the HGL represents the level water would rise to in vertical tube connected to the pipe.*
Hydrograph	*A graph that shows the discharge to time relationship of a hydraulic flow at a particular location.*
Hydrology	*The term given to the study of the rainfall and runoff processes as it relates to the derivation of hydrographs for given floods.*
Intensity-Frequency-Duration (IFD) Chart/Table	*Statistical analysis, describing the rainfall intensity (mm/hr), frequency (probability measured by the AEP), duration (hrs). This analysis is used to generate design rainfall estimates.*
Legal Point of Discharge (LPD)	*The point on the site which is specified by Council as the stormwater outlet point for a property.*
Model for Urban Stormwater Improvement Conceptualisation (MUSIC)	*Computer program that predicts the performance of stormwater quality management systems.*
Peak Flow	*The maximum discharge occurring during a flood event.*
Permissible Site Discharge (PSD)	*Permissible Site Discharge. Maximum allowable rate of discharge for the total site that the existing downstream stormwater system can handle, generally calculated to Council's parameters and requirements.*
Runoff	*The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.*
Topography	*A surface that describes the ground profiles of a chosen land area.*
Water Sensitive Urban Design (WSUD)	*The integration of management of the urban water cycle with urban planning and design. WSUD aims to improves urban landscapes by reducing pollutant export, retarding storm flows and reducing irrigation requirements.*

Executive Summary

This report details the stormwater drainage strategy and waterway management for the Apollo Bay Resort development at 275-305 Barham River Road, Apollo Bay, Victoria, 3233. This report intends to present an overview of the stormwater strategy for the development and to demonstrate that the development can meet Colac Otway Shire's (COS) stormwater requirements and Corangamite Catchment Management Authority's (CCMA) waterways management requirements. This report summarises the existing site conditions and the proposed development's design intent.

This report is an update of the original report provided for the Town Planning Submission and has been prepared in response to the Planning Panels Victoria Directions letter of March 28, 2018.

The stormwater drainage design criteria is provided and the strategies for the site's stormwater conveyance, detention and water quality treatment are summarised. This report also proposes civil/stormwater strategies for the development to meet the tolerable risk criteria or lower, as specified by the Colac Otway Shire's Erosion Management Overlay.

Responses to Panel Directions (PPV Directions Letter 28/03/2018)

1) ***C) ii. details all proposed cut and fill associated with the proposal, including the internal access roads, buildings and associated infrastructure***
1) ***N) iii. The extent of cut and fill required (through sections) for buildings and associated infrastructure, with plans clearly marked to show where the sections are taken from. This needs to details the areas of cut and fill required for driveways to service the hotel and villas to the north of the site, and the driveway to service the villas to the south of the site.***

The vertical geometry of the internal access and circulation roads are designed to limit the maximum cut or fill to 1m depth. Car parking is located on-grade in areas that mitigate slope stability risk with maximum grades of 5% as per Australian Standards. Where any minor earthworks are required, these shall be limited to within 1m of natural surface. This is in direct response to Golder Associates Geotechnical Report submitted separately with this revised Application.

Refer to section 7 for more information on the proposed access roads and Appendix B for the indicative earthworks profiles of the private internal site access roads. During detailed design, the horizontal and vertical alignment of these roads shall be adjusted if required to achieve the slope stability objectives and eliminate inappropriate cut or fill areas. All roads shall have adequate surface and subsurface drainage to reduce the risk of erosion or slope destabilisation.

1) ***g. An updated Stormwater Drainage and Waterway Management Report that clearly details how stormwater management on site responds to the geotechnical issues raised in the Landslip Risk Assessment Report, and vegetation removal***

This revision of the Stormwater Drainage and Waterway Management (SDWM) report details the strategies the development will implement to fully achieve the tolerable risk criteria or lower, as specified by the COS EMO1. The development will implement the following strategies in response to the geotechnical risks raised in Golder Associates' Landslide Risk Assessment (LRA):

- No villas located within the northern flank of the north ridge;
- All new buildings are located outside of the *Very High Risk* areas;
- The masterplan does not include a hotel expansion or any villas on the uppermost terrace below the south ridge;
- Swale catch drains and subsoil trenches shall be provided to the west of the site and as required internally to intercept external overland and subsurface flows, which will enhance slope stability;
- Provision of surface water interception drainage on high side of all buildings and roads to enhance slope and structural stability;
- Provision of lateral subsoil cut-off drains at key locations to intercept and reduce subsoil moisture and enhance slope stability;
- Underground stormwater drainage provided at key locations to convey surface and subsurface flows to the existing drainage channels;
- Earthworks for drainage infrastructure will either be limited to a maximum depth of 1m or will avoid areas of slope instability;

- All roof water will be collected in a controlled manner via piped infrastructure and discharge downstream to drainage elements (underground pipe network, swale, detention basin);
- The main dam will be improved (e.g. formalise spillway into existing channel and formalise inlet drainage and erosion protection);
- Road-related earthworks to be limited to a maximum cut and fill depth of 1m;
- New access roads shall be provided with:
    - surface water interception drainage;
    - lateral subsoil cut-off drains or culverts to mitigate erosive flow concentrations;
    - underground stormwater drainage and discharge points to adjacent gullies at key locations;
    - waterway crossings in accordance with industry guidelines and recommendations from a suitably qualified geotechnical engineer and complying with CCMA requirements.

Refer to sketch CSK003 in Appendix A and Section 4.2 for further information.

1 Introduction

Irwinconsult was engaged by Oceans United Investments (the Developer) to review and prepare a Stormwater Drainage and Waterway Management (SDWM) strategy report for the proposed Apollo Bay Resort development. This report updates the previously issued report of June 2017.

The purpose of the Stormwater Drainage and Waterway Management (SDWM) strategy is to define the stormwater drainage and waterways management requirements to be met during the detailed design. The SDWM has been prepared in support of the Town Planning application being made by Oceans United Redevelopment Group Pty. Ltd.

More specifically the key aims of the SDWM are to define:

- design criteria for the on-site drainage in accordance with requirements of AS3500;
- site stormwater retention and discharge strategies;
- design objectives and Water Sensitive Urban Design (WSUD) features;
- landslide risk mitigation;
  and:
- waterway vehicular crossing design requirements.

2 Existing Site Conditions

2.1 Location

The proposed Apollo Bay Resort is located approximately 200km South-West of the Melbourne CBD and situated on the south-west side of the Apollo Bay township with current road access from Barham River Road. The site address is 275-305 Barham River Road, Apollo Bay, Victoria 3233, Lot 2 PS515118.

The total site is approximately 100 ha and is bound by Old Hordern Vale Access and Barham River Road to the north and adjacent neighbouring lots to the east, south and west (refer to Figure 2.1 below).

Figure 2.1 Site Plan (land.vic.gov.au planning maps)

2.2 Planning Zones and Overlays

A desktop investigation of the planning property report for the site has identified that the site is subject to the following Planning Zones:

- Rural Activity Zone (RAZ)
- Schedule to the Rural Activity Zone

The following planning overlays affect the Apollo Bay Resort development site:

- Bushfire Management Overlay (BMO)
- Environmental Significance Overlay (ESO)
- Environmental Significance Overlay – Schedule 3 (ESO3)
- Erosion Management Overlay (EMO)
- Erosion Management Overlay – Schedule 1 (EMO1)
- Land Subject to Inundation Overlay (LSIO)
- Land Subject to Inundation Overlay Schedule (LSIO)
- Significant Landscape Overlay (SLO)
- Significant Landscape Overlay – Schedule 3 (SLO3)

2.2.1 Land Subject to Inundation

The LSIO is a planning scheme control that applies to land affected by flooding associated with waterways and open drainage systems. The LSIO for the subject site affects the north-east corner of the site and is a result of flooding from the Barham River. Corangamite Catchment Management Authority (CCMA) has provided further information on the flood overlay affecting the site. Refer to Section 2.4 of this report for further information on site flooding.

Figure 2.2 Land Subject to Inundation Overlay (land.vic.gov.au planning maps)

2.2.2 Erosion Management Overlay

The EMO is a planning scheme control that applies to land that has been identified as being susceptible to erosion, landslip or other land degradation processes. For further information on the proposed development's erosion management strategies refer to Section 4.2.

Figure 2.3 Erosion Management Overlay (land.vic.gov.au planning maps)

2.3 Site Topography and Overview

The existing land is largely cleared grassland, with small thickets of trees scattered across the site. Vegetation is concentrated along waterways. Corangamite Catchment Authority (CCMA) has advised that there are two designated waterways located within the site. For more information on the site's waterways refer to Section 2.4.

There are several existing buildings in the northeast corner of the site and existing site access is from Barham River Road. The first access from Barham River Road runs approximately south along the eastern boundary to existing buildings in the south-east corner (Homestead Driveway); another access road services the existing buildings in the north-eastern corner of the site (Function Centre Driveway), and Old Hordern Vale Access Road runs along the site's northern boundary. Barham River Road and Old Hordern Vale Access are classified as Council roads and are currently managed by COS.

The low point of the site is in the north-east corner at a level of 12.5m AHD. The high point of the site is in the south-west corner at a level of 140m AHD. There are two major ridgelines across the site. One runs along the northern boundary and the second along the southern boundary. The site's levels fall steeply from these ridgelines down to the central section of the site. The north ridge slopes steeply down to the Old Hordern Vale Access Road. The high point of the central section is on the western boundary at a level of approximately 100m AHD. From the western boundary, the site falls at an approximate slope of 5-10% towards the eastern boundary. An existing dam sits at a level of approximately 90m AHD near the western boundary of the site. Refer to Figure 2.4 for a plan view of the existing site conditions.

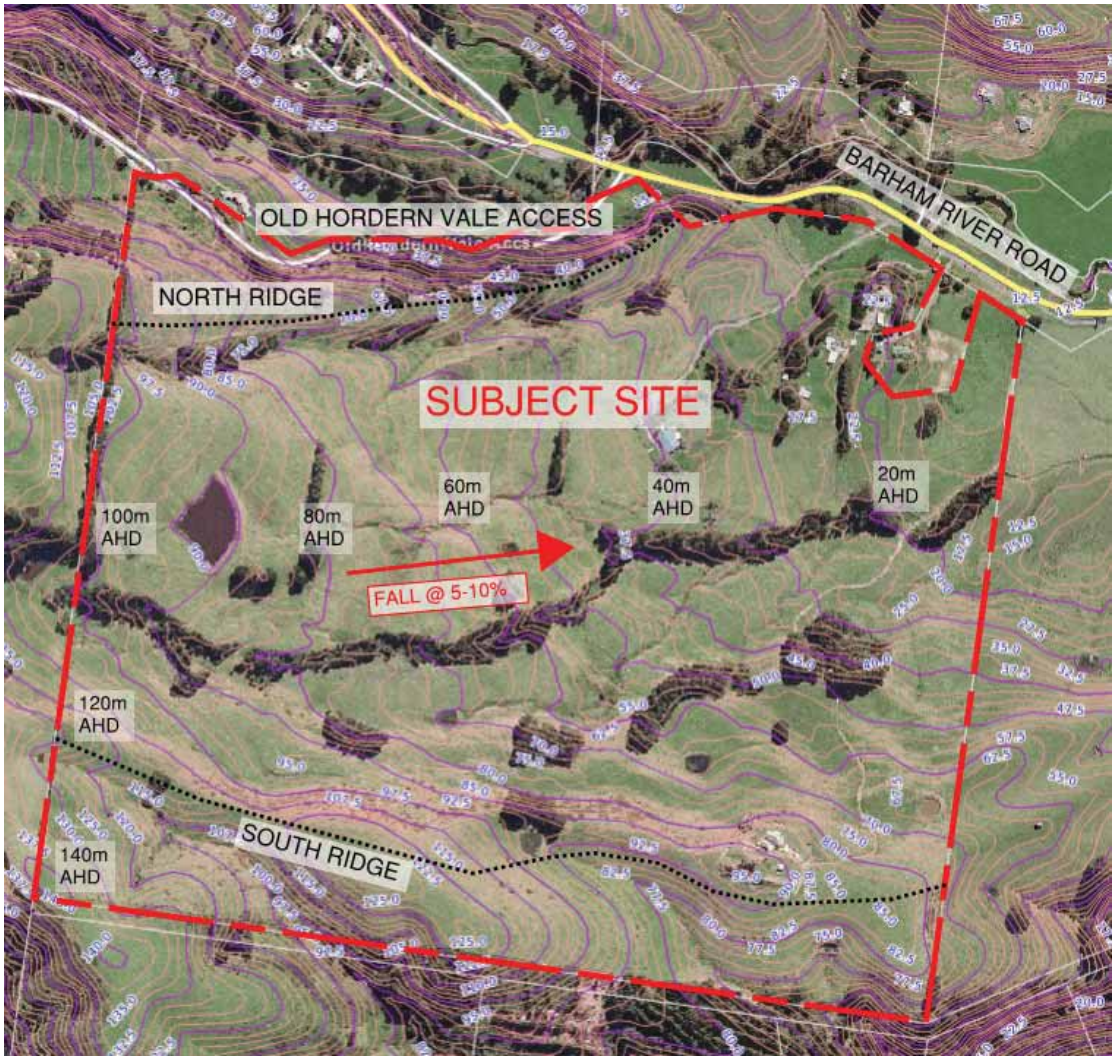

Figure 2.4 Existing Site Plan

2.4 Site Flood, Waterway and Water Quality Advice

The Corangamite Catchment Management Authority (CCMA) issued a flood advice form to Colac Otway Shire (COS) on the 23rd of March, 2017 (CCMA Reference Number: F-2017-0152). The flood advice details known flood issues and information on the existing waterways running through the site.

2.4.1 Existing Waterways

There are a number of waterways traversing the site (or nearby) which have been designated under the Water Act (1989). CCMA have identified these Designated Waterways as No. 35-47-6, 35-47-4, 35-47 and 34-47-3-1. Refer to Figure 2.5 below. A Works on Waterway Permit is required from the CCMA for any works or crossings in, on or over these waterways. This permit process is independent of the planning permit process.

In addition to the Designated Waterways, there are several undesignated drainage channels running across the site. These undesignated waterways are ephemeral open channels and their contributing catchments fall mainly within the subject site with no external catchment.

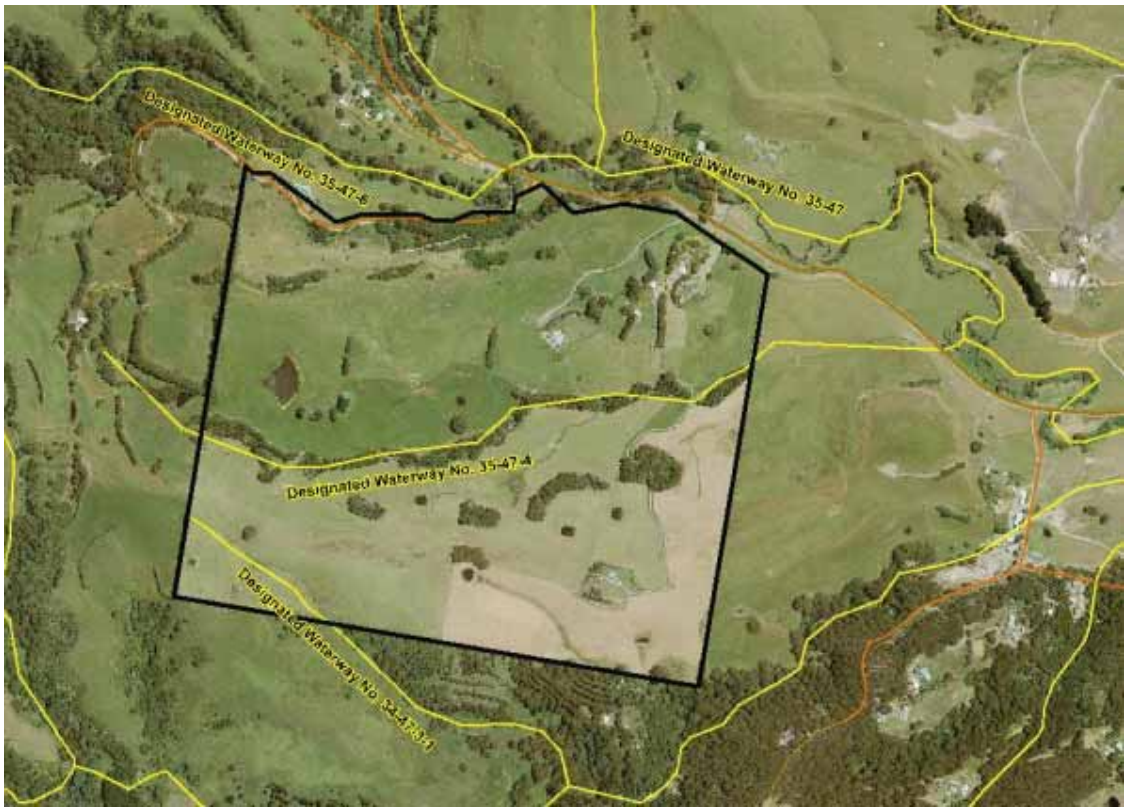

Figure 2.5 Designated Waterways on or nearby subject site (reproduced from CCMA Flood Advice F-2017-0152)

2.4.2 Waterway Buffers

Clause 14.02-1 of the Victorian Planning Provisions requires vegetated buffer zones at least 30m wide to be retained along each side of a waterway. The Barham River requires a 50m buffer zone. Where a property is covered by both the 30m buffer zone and the 1% AEP flood extent the greater of the two extents will be required for the setback.

2.4.3 Flood Advice Information

CCMA flood advice (F-2017-0152) indicates that there is a known flood risk from flooding of the Barham River and its tributaries. There is currently an absence of high-resolution flood mapping available for the site; therefore the CCMA has requested a detailed flood impact assessment to direct future development across the site. Refer to the separate Access Management Plan for the planned approach with respect to access and egress to the site during periods of flooding.

The known flood extent for the 1% AEP flood occurs in the north-east of the site (Figure 2.6). The main access to the site from Barham River Road is likely to be inundated by floodwaters of significant depth. Current flood mapping is insufficient to determine if the existing site access meets the applicable flood hazard criteria as outlined in the advice. CCMA requires safe vehicular access to be demonstrated for the property under the 1% AEP flood conditions. Refer to the Access Management Plan for further information on emergency egress from the site.

Figure 2.6 Subject property showing 1% AEP flood extent (blue shaded area) and waterways/tributaries (blue lines) (CCMA flood advice F-2017-0152)

2.4.4 Water Quality and Quantity

The CCMA has advised Council that the development must meet EPA Victoria's best practice stormwater management objectives. These guidelines require the treatment and retardation of stormwater from new developments. Refer to Sections 4.5 and 4.6 for the water quality and quantity management strategies of the development.

3 The Proposed Development

The development plan prepared by Spowers proposes the construction of a hotel resort with retail and dining areas, resort villas, new roads, parking, bike and pedestrian paths, and new landscape features. Refer to Figure 3.1 for the current proposed site master plan.

The property will undergo some change in site surface conditions with the construction of roofs, roads and paths across the site. When complete, all buildings, roads and infrastructure occupy a footprint of less than 5% of the site's total area of 1,046,000m^2. The development includes two vehicular crossings of Designated Waterways and several crossings of non-designated local depressions/gullies/waterways.

Figure 3.1 Site Masterplan as of 03/05/2018 – Refer to architectural documentation for further information

4 Stormwater Drainage Management

4.1 Drainage Design Criteria

All roof drainage, downpipe hydraulics, stormwater harvesting and treatment infrastructure internal to the buildings shall be designed by the services consultant. The civil consultant shall design the in-ground stormwater drainage network. Rainwater-harvesting tanks are included in the proposal and therefore the in-ground stormwater network shall be designed to accommodate design overflows and mitigate erosion or flooding due to overflow from the tanks. The civil works design shall be coordinated with all proposed services and existing site constraints.

There are currently a number of existing waterways and water bodies located and traversing within the site including designated and non-designated waterways and a dam. These existing waterways and dam will be incorporated into the overall drainage design strategy.

The stormwater drainage network for the development shall be composed of a system of grassed swales, kerb and channels, subsoil agricultural drains, and in-ground stormwater drains. Where possible roads and paths shall fall to grassed channels, and roof areas shall be conveyed from downpipes to in-ground stormwater drains. All flows from green-roofs will also be drained via downpipe collection systems and be directed to the treatment and detention systems. The proposal is for the in-ground network to discharge downstream to grassed open-channels. The treatment performance of all biological and reuse elements will be modelled during detailed design to ensure best practise treatment objectives are achieved.

Stormwater is conveyed through the grassed channels into biofiltration swales/cells prior to discharging into a stormwater detention element. Stormwater detention shall be provided by either grassed basins or shallow underground structures that subsequently discharge to the site's existing waterways with appropriate outfalls to mitigate erosion.

Refer to the Civil and Drainage scheme in Appendix A for a schematic plan of the proposed drainage strategy.

4.1.1 Site Stormwater Discharge

It is proposed that stormwater runoff from the development is to discharge into the existing waterways/drainage features with suitable flow attenuation and erosion protection measures. The site stormwater runoff will require treatment and retardation from a stormwater treatment train prior to discharging into the waterways in order to achieve water sensitive urban design objectives.

Verbal discussions between the CCMA and Irwinconsult have highlighted that stormwater discharge to the existing waterways must be designed in accordance with the CCMA's stormwater outlet permit conditions. A Works on Waterway Permit is required from the CCMA for any works or crossings in, on or over these waterways.

4.1.2 Australian Standards

The following reference documents shall inform the civil design for the proposed development:

- AS3500.3 Stormwater Drainage
- Australian Rainfall and Runoff (ARR) – Engineers Australia
- Austroads Design Guidelines (where applicable)
- Colac Otway Shire Standard drawings and specifications (where applicable)
- CCMA design guidelines

Surface drainage systems shall be designed to ensure overflows, in storm events with a 1% Annual Exceedance Probability (AEP), do not present hazards to people or cause significant damage to property. New minor below ground stormwater drainage systems and surface swales shall convey flows up to the 5% AEP so that they do not cause nuisance.

4.2 Measures to mitigate landslide risk

Golder Associates (Report no. 1787175-002-R-Rev1, 01/11/2017) has prepared a Landslide Risk Assessment (LRA) report for the subject site. This has been augmented by Golder Associates (Ref No. 1787175-007-L-Rev2) issued with the amended Permit information. Golder's report outlines the landslide risks of the site and proposes strategies for the development to meet the tolerable risk criteria or lower, as specified by the COS EMO1. The below summary outlines how the civil design will mitigate the landslide risks outlined by Golder.

Refer to Appendix A for the civil site plan that illustrates the proposed stormwater management measures of the development.

Table 1 – Landslide Risk and Mitigation

Identified Landslide Risk Item	Mitigation Measures
1. Villas north of north ridge	• No Villas are to be located within the northern flank of the north ridge.
2. Villas on north ridge	• Swale catch drain and subsurface drainage trench to the west of the villas to intercept external overland flows; • Provision of surface water interception drainage on high side of villas; • Provision of lateral subsoil cut-off drains at key locations to intercept and reduce subsoil moisture and enhance slope stability; • Earthworks (for example depth of swale drains, pits and pipes) will be limited to a maximum depth of 1m to mitigate risk in areas susceptible to landslide; • Roof water formally collected, piped and discharged to drainage element (underground pipe network, swale, detention basin).
4. Villas west of Main Dam	• Villas relocated away from the *Very High Risk* area (west of the main dam). Mitigation measures for villas remaining outside of VH risk zone: • Swale catch drain to the west of the villas to intercept external overland flows; • Formalise the existing channel entering the main dam from the west; • Provide a formalised spillway for the main dam into the existing drainage channel; • Provision of lateral subsoil cut-off drains at key locations to intercept and reduce subsoil moisture and enhance slope stability; • Provision of surface water interception drainage on high side of villas; • Earthworks (for example depth of swale drains, pits and pipes) will be limited to a maximum depth of 1m; • Roof water piped off and discharged to drainage element (underground pipe network, swale, detention basin).
5. Hotel	• Formalised drainage provided for the road and carparks west of the main hotel building (interception of surface water); • Provision of lateral subsoil cut-off drains at key locations to intercept and reduce subsoil moisture and enhance slope stability; • Drainage related earthworks (for example depth of swale drains, pits and pipes) will be limited to a maximum depth of 1m; • Roof water collected, piped and detained prior to discharge.
7. Proposed hotel expansion	• These buildings have been deleted
8. New access road	• Provision of surface water interception drainage; • Provision of lateral subsoil cut-off drains at key locations to intercept and reduce subsoil moisture and enhance slope stability; • Underground stormwater drainage provided at key locations to convey surface and subsurface flows to the existing drainage channels; • Earthworks will generally be limited to a maximum cut and fill depth of 1m; • Localised excavations or fill deeper than 1m will undergo detailed design based on the recommendations of a suitably qualified geotechnical engineer; • Waterway crossings will be designed in accordance with industry guidelines and recommendations from a suitably qualified geotechnical engineer.

9. Old access road	• Provision of surface water interception drainage; • Provision of lateral subsoil cut-off drains at key locations to intercept and reduce subsoil moisture and enhance slope stability; • Underground stormwater drainage provided at key locations to convey surface and subsurface flows to the existing drainage channels; • Earthworks will generally be limited to a maximum cut and fill depth of 1m; • Localised excavations or fill deeper than 1m will undergo detailed design based on the recommendations of a suitably qualified geotechnical engineer; • Waterway crossings will be designed in accordance with industry guidelines and recommendations from a suitably qualified geotechnical engineer; • Slope stabilisation at targeted locations as identified by a suitably qualified geotechnical engineer.
11. Villas on the uppermost terrace below the south ridge	• These buildings have been removed from this zone.

4.3 Hydrology

Guidance from the Australian Rainfall & Runoff (ARR2016) is to be used and observed along with any additional guidance supplied by the CCMA or COS.

4.3.1 Rainfall Intensity-Frequency-Duration

Rainfall Intensity Frequency Duration (IFD) data has been generated from the Bureau of Meteorology's website (Figure 4.1).

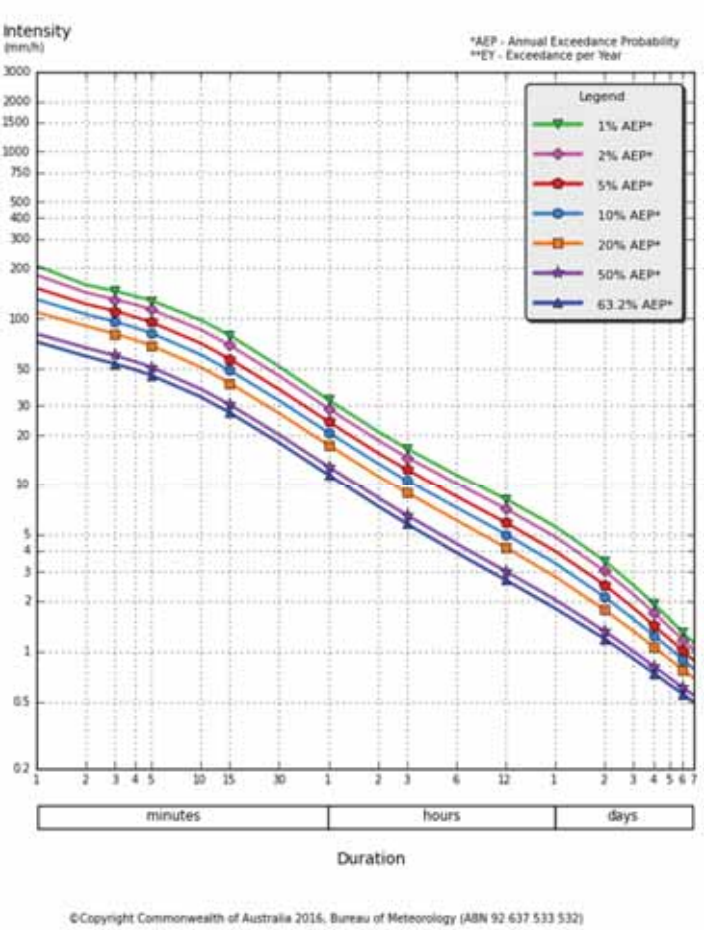

Figure 4.1 Intensity Frequency Duration Chart from the Bureau of Meteorology for the site

4.4 Flood and Overland Flow Management

The development must not result in a loss of floodplain storage, increase in flood level, velocity, duration or extent for a range of events up to and including 1% AEP flood event. Any alterations to overland flow paths as a result of the development must therefore utilise effective drainage to prevent any of the above negative consequences from occurring. A flood impact assessment is required for the development.

The CCMA flood advice stipulates the following safety criteria for roads that are subject to flooding:

1. Depth of water must be no greater than or equal to 0.3 metres
2. Velocity of flow must be no greater than or equal to 3.0m/s
3. The product of depth multiplied by velocity must be no greater than or equal to $0.3m^2/s$

The site is also affected by an external overland flow path from the west. Whilst we anticipate that the external catchment and associated discharge is relatively small, the proposed development's roads and buildings shall be protected from the external flows through the use of catch drains and swales to divert these overland flows before they reach the development (Figure 4.2).

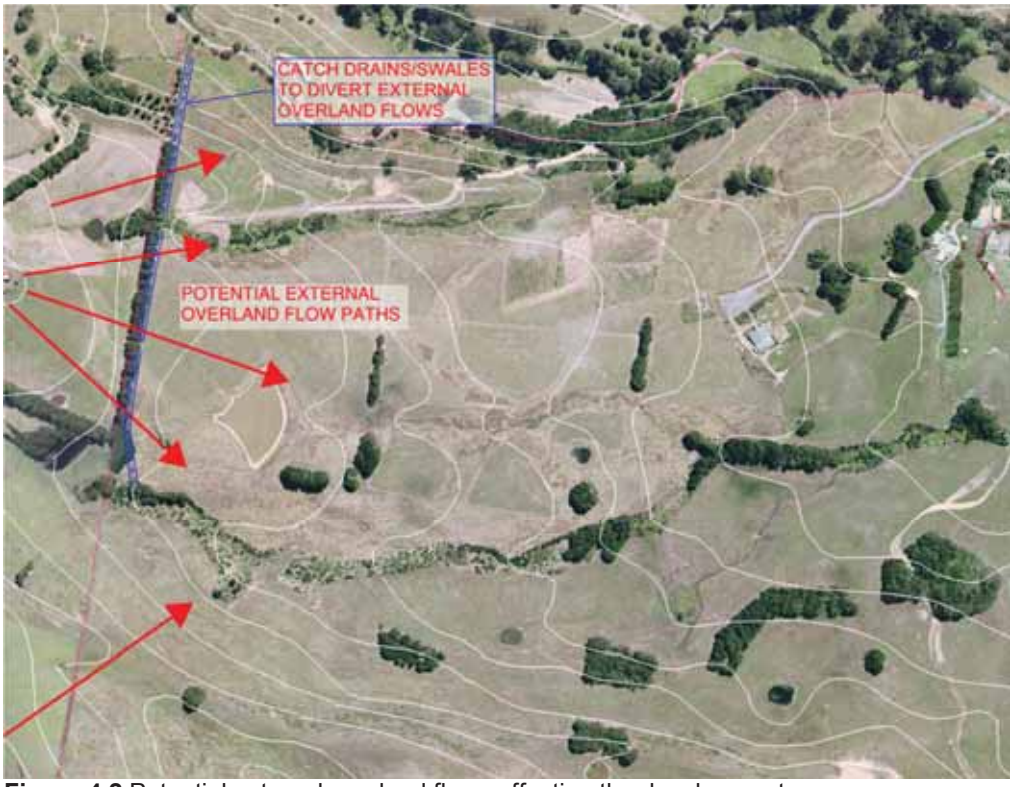

Figure 4.2 Potential external overland flows affecting the development

4.5 Stormwater Detention Strategy

4.5.1 On-site Detention

The proposed development will result in a marginal increase of hard surfaces across the site. This results in an increase in peak stormwater runoff discharging to the existing waterways network. Peak flow rates can be reduced by a variety of methods. Irwinconsult proposes that a combination of various Water Sensitive Urban Design (WSUD) methods be utilised to not only reduce peak flow rates, but also treat post-development water quality prior to discharging back into the existing waterways. As part of the overall drainage strategy, grassed swales and detention basins have been considered as key drainage elements to be incorporated into the overall drainage scheme and site landscaping proposals. However, underground detention elements may also be utilised in key locations. The sizing of the swales and detention elements will be further developed in the detailed design phase.

4.6 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) aims to utilise design features in the stormwater drainage system to reduce pollutants, retard storm flows and reduce irrigation requirements. WSUD elements can be combined to create a treatment train that will effectively retard and treat stormwater runoff from the urban elements of the development, i.e. roads, paths and roofs.

A brief description of various WSUD elements that shall be utilised across the site is given below.

4.6.1 Rainwater Harvesting Tanks

It has been proposed that rainwater harvesting tanks can be used for the harvesting and reuse of stormwater runoff from the roof of the main hotel building. Stormwater shall be collected and used for toilet flushing in the buildings. Overflow from the rainwater tanks shall discharge into the stormwater drainage network.

Preliminary MUSIC modelling has identified that the works can incorporate a 150kL rainwater-harvesting tank to provide recycled water for toilet flushing (Refer to Hydraulics section of services report for further details). The water reuse parameters obtained by utilising a 150kL tank are shown below in Table 2. These results are indicative only and need to be refined as the design progresses.

Table 2 Rainwater Harvesting Tank Reuse Results

Tank size (kL)	% Flushing demand met	% Rainwater Utilised	% Rainwater overflow
150	88.6	52	48

4.6.2 Swales and biofiltration

It is proposed that the safe conveyance of stormwater runoff across the site is to be achieved with grassed swales. A grassed swale utilises mild slopes and vegetation to convey water downstream to the discharge point. Grassed swales will be incorporated around the buildings' perimeters and adjacent to roads and paths as required. Biofiltration swales/cells can be utilised to enhance the effectiveness of the stormwater treatment train. It is anticipated that biofiltration swales/cells will be incorporated as end-of-line treatment measures prior to stormwater discharging into existing waterways/drainage features.

4.6.3 Existing Dam

The existing dam currently collects stormwater runoff from the upstream catchment. It is anticipated that the development can utilise the existing dam for water quality treatment and irrigation/water reuse. The development could therefore derive some environmental benefits from maintaining and enhancing the existing dam. The dam requires upgrades prior to development works downstream. A formalised spillway for the dam will be required and Golder Associates recommends that a dam break analysis be undertaken to assess the impact of failure of the dam wall. This will be undertaken during detailed design.

Figure 4.3 Existing dam

5 Waterway Management

5.1 Designated Waterways

Under the Water Act (1989) there are two Designated Waterways (No. 35-47-4 and No. 34-47-3-1) traversing the site. The development proposes two vehicular crossings of Designated Waterway No. 35-47-4 which bisects the lot. Furthermore, it is anticipated there will be multiple points of discharge into Designated Waterway No. 35-47-4. Stormwater will be adequately treated, and flow rates reduced, prior to discharging into the Designated Waterway. Any discharge points into the designated waterway will adhere to CCMA guidelines for stormwater outlets.

5.2 Non-designated Waterways

There are also a number of non-designated ephemeral waterways meandering across the site. These correspond to natural depressions and valleys within the site. The development proposes four crossings of, and multiple discharges into, the site's non-designated waterways.

6 Waterway Crossings

Across the site, there are two crossings of Designated Waterways and four crossings of the non-designated waterways by the proposed exposed aggregate access road. The grade of the road will be considered in the design and will influence the use of either forded crossings or culvert crossings of these existing drainage paths. It is anticipated that stormwater flows through these crossings will not cause any interruption to site access as the upstream catchments are minor in nature. In later design stages, design flow rates will be calculated and the resultant crossing solution determined based on safely maintaining vehicular access and egress from the development in accordance with the relevant authority hazard criteria. Waterway crossings will be designed in accordance with industry guidelines (including CCMA's Waterway Crossing Design guidelines).

7 Roads

Road and pedestrian pavement build-ups will be documented during the design and development stage of the Apollo Bay resort project. At this stage of the project the proposed road pavements are to be flexible pavements consisting of compacted layers of crushed rock over an approved subgrade. Pavements will be designed to cater for the expected traffic and soil conditions of the site. The Corangamite "Buck Shot" exposed aggregate finish is proposed to harmonise with the site's natural rural character. Earthworks associated with the roads will generally be limited to a maximum cut and fill depth of 1m. Localised excavations or fill deeper than 1m will require detailed design based on the recommendations of a suitably qualified geotechnical engineer. During detailed design, the horizontal and vertical alignment of these roads shall be adjusted if required to achieve the slope stability objectives and eliminate inappropriate cut or fill areas. The LRA offers preliminary advice on providing unsupported batter slopes of max 3H:1V to reduce the risks of slope destabilisation. Refer to Appendix B for Internal Access Roads Earthworks drawings detailing the site's road earthworks. Roads shall be provided with adequate surface and sub-surface drainage (Refer to Section 4.2 and Appendix A).

8 Conclusion

This report has outlined an overall stormwater drainage and waterway management strategy to ensure that stormwater discharge from the Apollo Bay Resort development is appropriately managed and meets the requirements of the relevant authorities.

Stormwater drainage design criteria is identified and strategies for the efficient conveyance of stormwater runoff according to relevant design standards and guidelines are presented. Stormwater runoff quantity and quality issues are addressed and methods to ensure flow rates and environmental issues are appropriately managed have been summarised. In addition, flood and waterway management strategies and waterway crossing options have been discussed. This report also proposes civil/stormwater strategies for the development to meet the tolerable risk criteria or lower, as specified by the Colac Otway Shire's Erosion Management Overlay.

9 References

The stormwater/drainage and waterway management report for Apollo Bay Resort Development has been prepared in accordance with the following guidance and support documents.

Relevant Authority Standards:

- AustRoads Guidelines – Guide to Road Design
- AS3500 Part 3 Stormwater Drainage

Other guidance documents:

- Infrastructure Design Manual (IDM), adopted 12 September 2016
- Australian Rainfall and Runoff Volumes 1 & 2
- CSIRO, Urban Stormwater: Best Practice Environmental Management Guidelines
- CSIRO, Engineering Procedures – Stormwater
- MUSIC version 3 Manual – MUSIC Development Team April 2005
- Melbourne Water 2011, *Constructing Waterway Crossings*: *A guide on building road (Bridge/Culvert) crossings across Melbourne Water's waterways and drains*, Melbourne Water Corporation, Australia.
- Melbourne Water 2005, *WSUD Engineering Procedures: Stormwater,* CSIRO Publishing, Australia.
- Corangamite CMA Waterway Crossing Design
- Corangamite CMA Permit Conditions: Culvert Crossings
- Corangamite CMA Permit Conditions: Stormwater Outlet
- Golder Associates, Landslide Risk Assessment, Report No. 1787175-002-R-Rev0 (24/10/2017)
- Golder Associates, Landslide Risk Assessment, Report No. 1787175-002-R-Rev1 (01/11/2017)
- Golder Associates, Landslide Risk Assessment, Report No. 1787175-007-L-Rev2 (15/05/2018)
- Bruce Hollioake Consulting Civil and Structural Engineers Geotechnical Report 17310 (June 26, 2017)

APPENDIX A – PROPOSED CIVIL AND DRAINAGE SCHEME

Refer to the below drawing:
CSK003

APPENDIX B – INTERNAL ACCESS ROADS EARTHWORKS

Refer to the below drawings:
15ME0212-CSK004
15ME0212-CSK005
15ME0212-CSK006
15ME0212-CSK007
15ME0212-CSK008
15ME0212-CSK009
15ME0212-CSK010