City of Greater Geelong

WADAWURRUNG COUNTRY

PO BOX 104 GEELONG VIC 3220 AUSTRALIA

Date: Friday 29 September 2023

Report By:

Christopher Mitchell Beardshaw

Principal Engineer

Afflux Consulting Pty Ltd

Emerald, VIC 3178

Qualifications:

BEnvEng (Hons), Monash University, 2002

MEngSci, UNSW, 2006

Graduate Certificate River Health Management, University of Melbourne, 2009

Affiliations:

Member, Institution of Engineers Australia

Immediate Past President, Stormwater Victoria Industry Association

Area of Expertise:

Key areas of expertise relevant to this report are summarised below.

Assessment of flooding, water quality and waterway protection

Urban and rural river design and management

Data collection, processing and analysis

Application of GIS

1- and 2-Dimensional Flood modelling

Scope of this Statement and associated Report

This report forms a review of the Jetty Road Urban Growth Plan (JRUGP) and associated drainage matters. Specifically:

- The drainage improvements associated with the Curlewis Drainage Improvement Works (known in this report as the Scarborough Outfall Drain
- Drainage Contributions Plans associated with Stage 1 and Stage 2 works.
- Stormwater management for the JRUGP including a review of the associated Stormwater Management Plans (SWMP) and drainage objectives.
- Comparison of the drainage objectives and contemporary drainage standards
- Form an opinion on a number of drainages matters.

Key Report Conclusions

In relation to the apportionment of outfall works costs, in my opinion I offer the following points:

- The outfall works required for the JRUGP should have been considered in any Stage 1 DCP
- Further outfall works considerations are required for Stage 2 of the JRUGP
- The Stage 1 outfall works are required for Stage 2 if current EPA best practice volume management is considered.
- There are other volume management options available, but these are less cost effective than scheme contribution.
- The cost of the works should be allocated on a 'per development hectare' basis or other as negotiated format. Separate charges will be required for each catchment given the diversity of the works.

Introduction and Background

This letter sets out a review of the Jetty Road Stage 2 Development Contributions Plan (DCP) and the underlying stormwater assumptions. Accordingly, this letter will:

- Review the catchments and underlying hydrological assumptions associated with the works.
- Form an opinion on the suitability of stormwater works and requirements. In doing so the following questions are considered:
  - 1. Should the external drainage projects have properly been planned as part of Jetty Road Stage 1?
  - 2. If the external drainage projects were included in the Jetty Road Stage 1 DCP, is it likely that they would have been apportioned as between Jetty Road Stage 1 and Stage 2 given that Jetty Road Stage 2 was always a future proposition?
  - 3. Does Jetty Road Stage 2 require the external drainage projects to properly provide for stormwater management?
  - 4. What level of cost apportionment to areas external to the Jetty Road Growth Area is fair and reasonable?

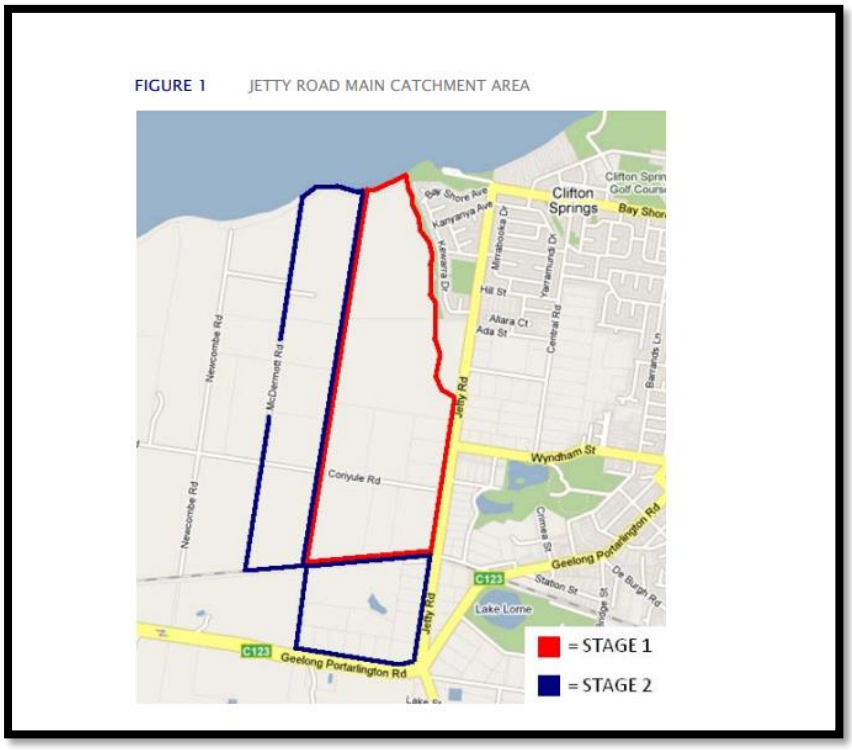


Figure 1. Jetty Road Stg1 DCP (2011)

Reviewed Documents

The following documents were supplied for review:

- Jetty Road Urban Growth Plan, City of Greater Geelong, Adopted 26 June 2007, Amended 23 September 2008.
- ii CPG Jetty Road Infrastructure Plan, February 2010.

- iii TGM Site Stormwater Management Strategy, 9 March 2011 (forming part of approved Stage 1 Jetty Road approved development plan).
- iv Jetty Road Urban Growth Area Stage 1 Development Contributions Plan, Version 4.2, Urban Enterprise, 2011.
- v Jetty Road Rezoning Stage 2 Flood Study v6, TGM, June 2020. v Jetty Road Rezoning Stage 2 SWMS Final Report, Water Technology, 15 February 2023.
- vi Jetty Road DCP Advice, Maddocks, 5 December 2022.
- vii Memorandum, subject: Coriyule Road Drain – Cost Recoupment via DCP or Agreement, City of Greater Geelong, July 2022
- Proposed Drainage Improvements, Coriyule Road, Curlewis, City of Greater, 2015
- 162-1921 Coriyule Road, Curlewis Drainage Improvement Works, City of Greater, 2018
- Scarborough Road Outfall Drain, Spiire, 2020
- Jetty Road South of Rail Trail, SWMS, Water Technology, December 2022
- Jetty Road Rezoning – Stage 2 SWMS, Water Technology, June 2022

Figure 2. DCP property numbering

Stormwater Objectives for the Area

The stormwater objectives for the area are set out in the Jetty Road Urban Growth Plan (2007) (Document I (JRUGP)). With respect to the Stage 2 DCP the following points are highlighted:

- That changes to stormwater hydrology impacts will be minimised for the 100y, 5y and 1.5y ARI's.

> Changes to the volume and timing of runoff following urbanisation may also impact the ecology and geomorphology of downstream waterways. Retarding basins will be used to ensure the post-development 100 year, 5 year and 1.5 year ARI flows are equivalent to pre-development flows where necessary.

- The water quality impacts will be managed through wetlands and meet BPEM (as defined at the time)

> The stormwater quality treatment and flow management facilities are expected to ensure the development will satisfy all flow and water treatment requirements of the City of Greater Geelong. Exact configurations of the facilities will be confirmed during detailed design. The final location of the basins and wetlands will need to comply with the State *Native Vegetation Framework*. Pollutant removal targets will need to be determined based on best practice standards.

- These objectives are codified in Principles 25, 26 and 27
- Objective 25.3 'achieve best practice' does state that peak discharge rate, volume and pollutant load should be considered in the stormwater management system and should be no greater than pre-development. This objective is typical of statements of that time (~2011) and is in practice unachievable. As such 'best practice' was taken to mean meet the EPA BPEM requirements of the time including volume management for the 1.5y ARI and 100y ARI, and pollutant targets for nutrient reduction.

> • a stormwater management system which ensures that the peak discharge rate, volume and pollutant load of stormwater leaving a site after a development is no greater than pre-development;

Stage 1 Review of Hydrological Assumptions

The underlying hydrological assumptions with respect to the proposed (and completed) DCP items are important in defining if the infrastructure is appropriately sized and fit for purpose. The endorsed development plan (Document iii) would seem the most appropriate document to review the catchment assumptions as this forms the basis of the stormwater management strategy. I have not been given the background council reports referred to (Griggs Creek Rehabilitation Concept Design,(URS, 2005) and Water Sensitive Urban Design and Stream Rehabilitation Strategy (AECOM, 2005), but it is expected that the recommendations of these reports, and the underlying principles and objectives of

the JRUGP were considered in the SWMP. The catchment plan contained in this document can be seen in Figure 3, with the catchments of interest highlighted.

The TGM SWMP does not provide any calculations as to the expected flows from the catchments (pre or post development) but does quote that the following was used in the formulation of basin requirements:

- Noted they used an Adam's method formulation for pre-development flows Time of Concentration calculation.
- Noted that they used a Runoff Coefficient of 0.33 for the pre-development Q_{100} flows.
- Have not stated what other timing assumptions are used for post-development flows (TC method, slope assumptions, Runoff Coefficients)
- Have only stated the 100y ARI calculations, it is unclear if the 5y and1.5y ARIs were considered as per the JRUGP objective.
- The report does state that the 3 month, 5y and 100y flows should be matched for discharges to Griggs Creek but does not show how the is achieved or if this is applied to other outfalls.
- There is a suggestion that the wetlands will attenuation the 3 months storm, and that if the 100y storm volume is calculated the more frequent storms can also be attenuated in this volume. No calculations have been provided to show this, though this is logically possible.
- The report suggests that the basin locations as shown are conceptual in nature only and may be subject to future consolidation by negotiation between landholders.
- Wetland sizing has been completed in MUSIC, though the assumptions for each of these treatment systems is unclear. It is suggested that EDD is between 350 and 400mm.
- McDermotts road draining catchments have been assumed to have a shallower possible outfall depth of 1m.

To check the basic sizing within the SWMP against industry ratio's the stated areas have been reverse engineered from the reported assumptions, and the listed volumes in the report and are shown in 0. Generally, across Victora an expected volume to hectares ratio for residential development should be anywhere between 300-600 m^3/ha dependent on rainfall band and development intensity. The nominated density in the JRUGP is 14 lots/ha minimum. These rates without any further information or detail would seem on the low side of contemporary understandings.

Contemporary water quality sizing for a wetland system is around 3-4% depending on rainfall banding, EDD selection and catchment density. Again, the shown rates would seem on the low side, but given the calculation age (2011) these rates may have been possible (newer standards are more prescriptive and as such require more land).

It is unknown if more detailed calculations are provided in staging plans or functional design reports for each asset.

Table 1: Catchment areas and Volume Ratios

Catchment	Catchment Area (Ha)	Detention Basin Area (m²)	Basin Volume in repot	Detention Calc Volume (m³)	M³/ Ha rate	Wetland % catchment
Catch 8	8.9	1,972	1,156	1,865	130/ 210	2.0%
Catch 9	13.34	4,283	1,880*	3,389	141/ 254	1.9%
Catch 11	23.61	4,345	3,595	4,509	152/ 191	2.0%
Catch 14	14.802	4,690	2,073*	3,827	140/ 259	2.0%
Catch 15	17.793	5,557	2,543*	4,466	143/ 251	1.9%

* Noted as based on a Triangle shape. No detail on this calculation method shown.

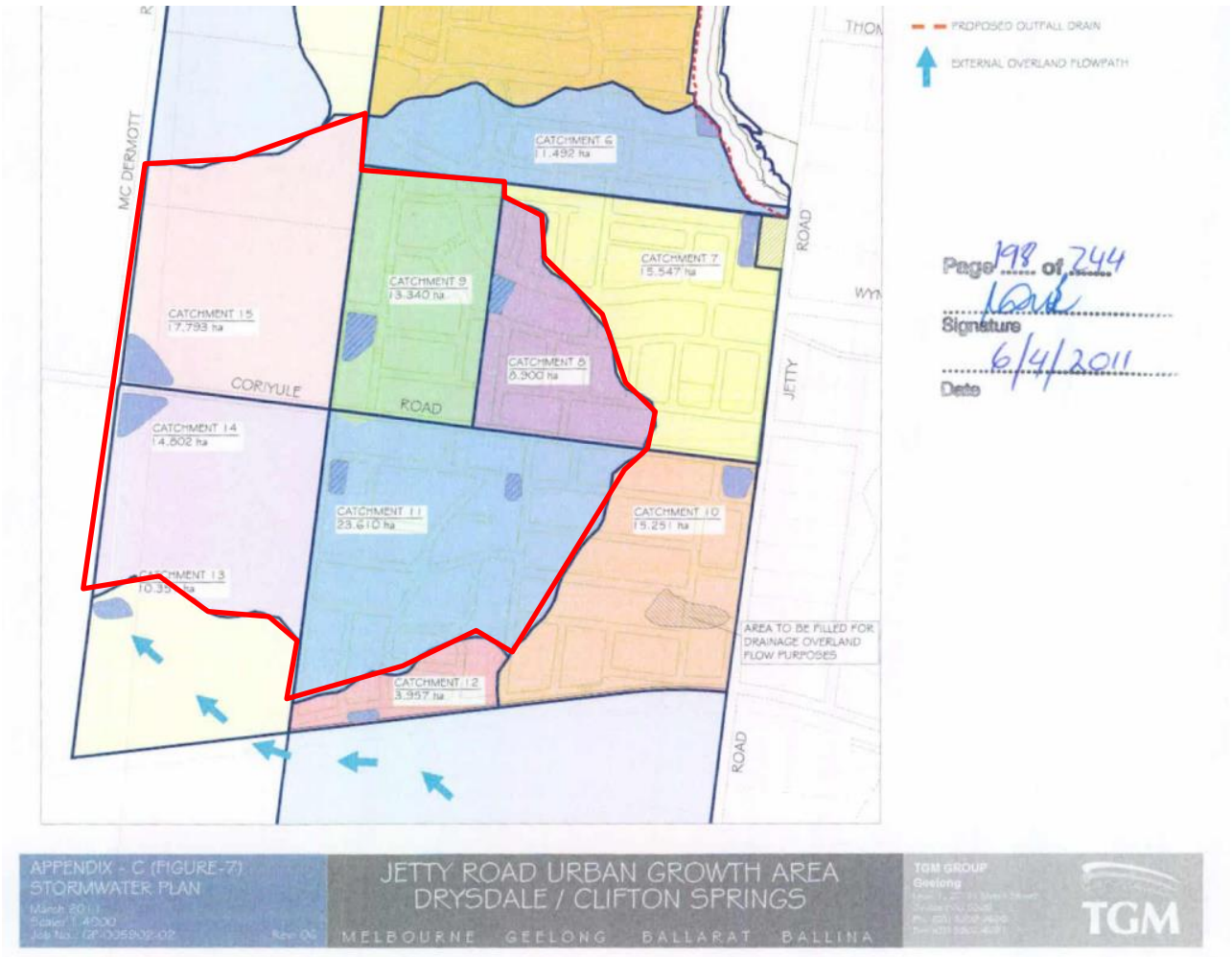
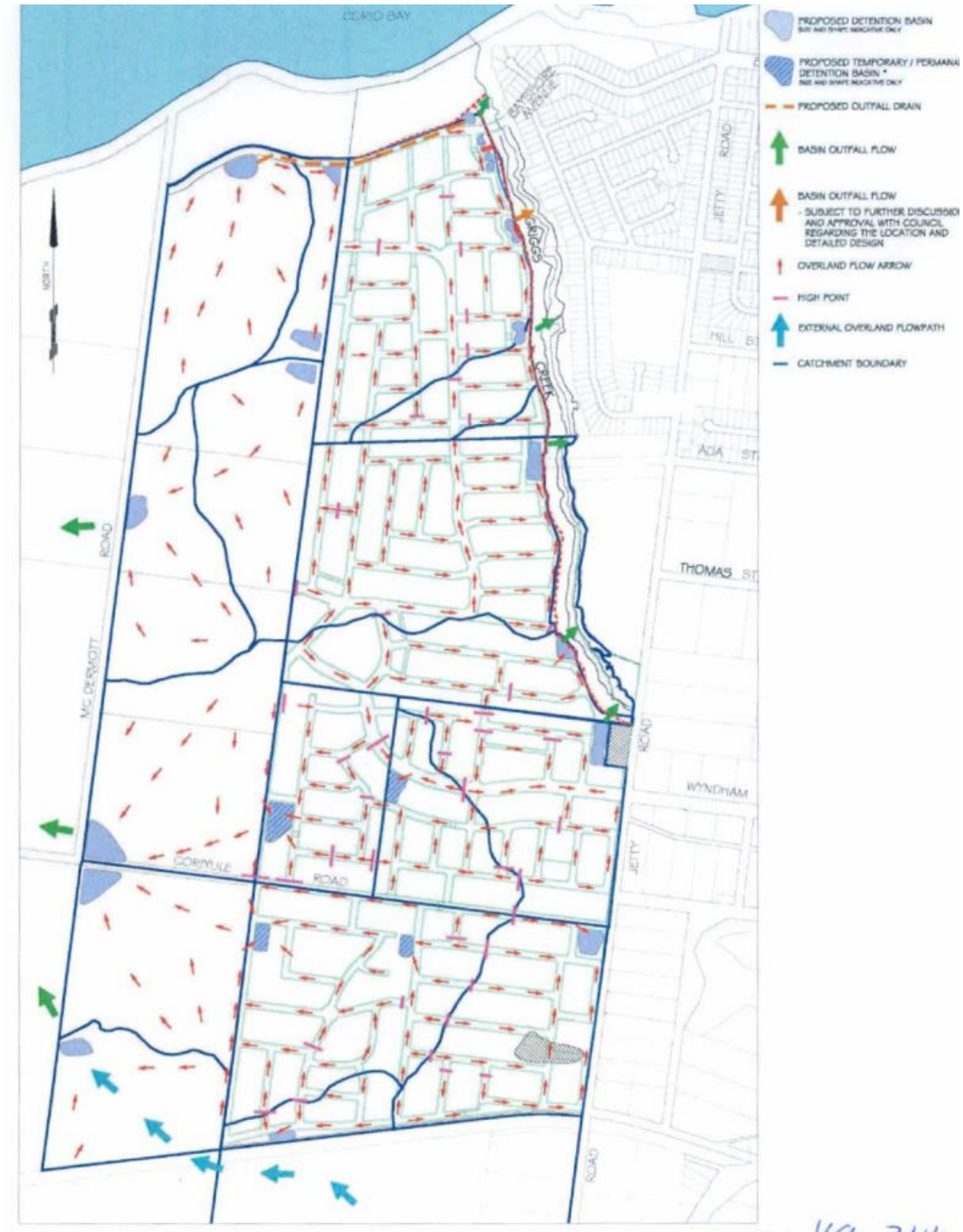


Figure 3. Endorsed Development Plan (iii) Catchment and SWMP

Drainage Flow Paths

The SWMP outlines a number of drainage flow paths from the development area and notes the outfalls as shown in Figure 4. The catchments that this report reviews are clearly shown to discharge to the intersection of McDermott and Coriyule Roads.



Page 169 of 244

Signature

6/4/2011

Figure 8 - Overland Flow Paths

Figure 4. Proposed drainage outfalls

The discharge of these catchments was highlighted in the report:

> The catchments generating the highest degree of difficulty to drain are Catchments 7 to 10. This is due mainly to the undulating topography of the area causing flows to drain in one direction before abruptly changing and heading in a new direction. Careful manipulation of the road layout in this area to follow these changes will reduce this problem substantially, along with localized filling / cut and sections of 100 yr drainage to remove the isolated low points. Road through-connections through open spaces and / or drainage reserves will be required in a number of locations, especially where the natural flow path of a catchment is impeded by residential allotments. Alternatives to this may be to pipe these sections around the impediment. It should be noted that some of these locations do not form isolated low points; just the flows if allowed to continue down the roadway will be transferred to another catchment. This may be desirable; however it will need to be considered in the final design of the downstream detention basin.

Figure 5. Overland Flows recommendations

The terrain for the area is well described by the above paragraph as can be seen below (Figure 6, Figure 7).

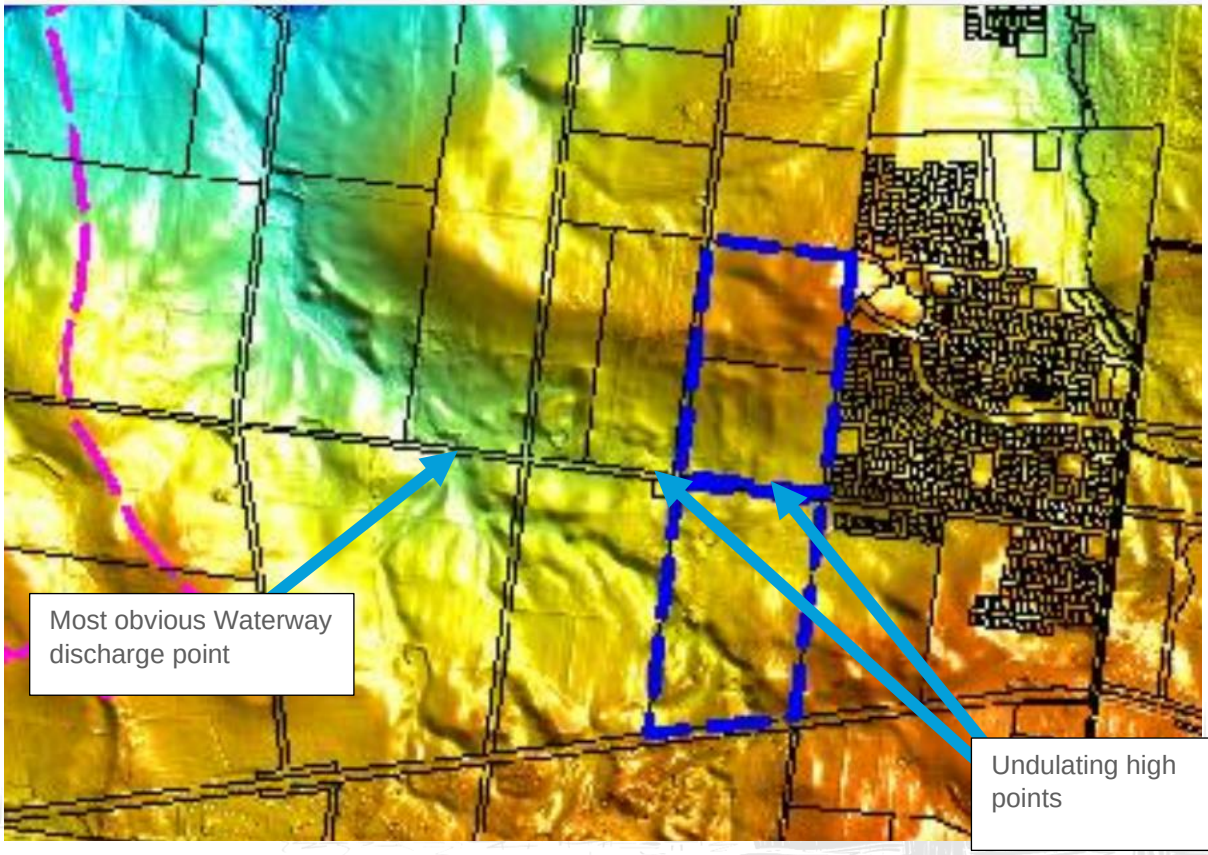


Figure 6. Terrain (TGM, 2020 (Document v))

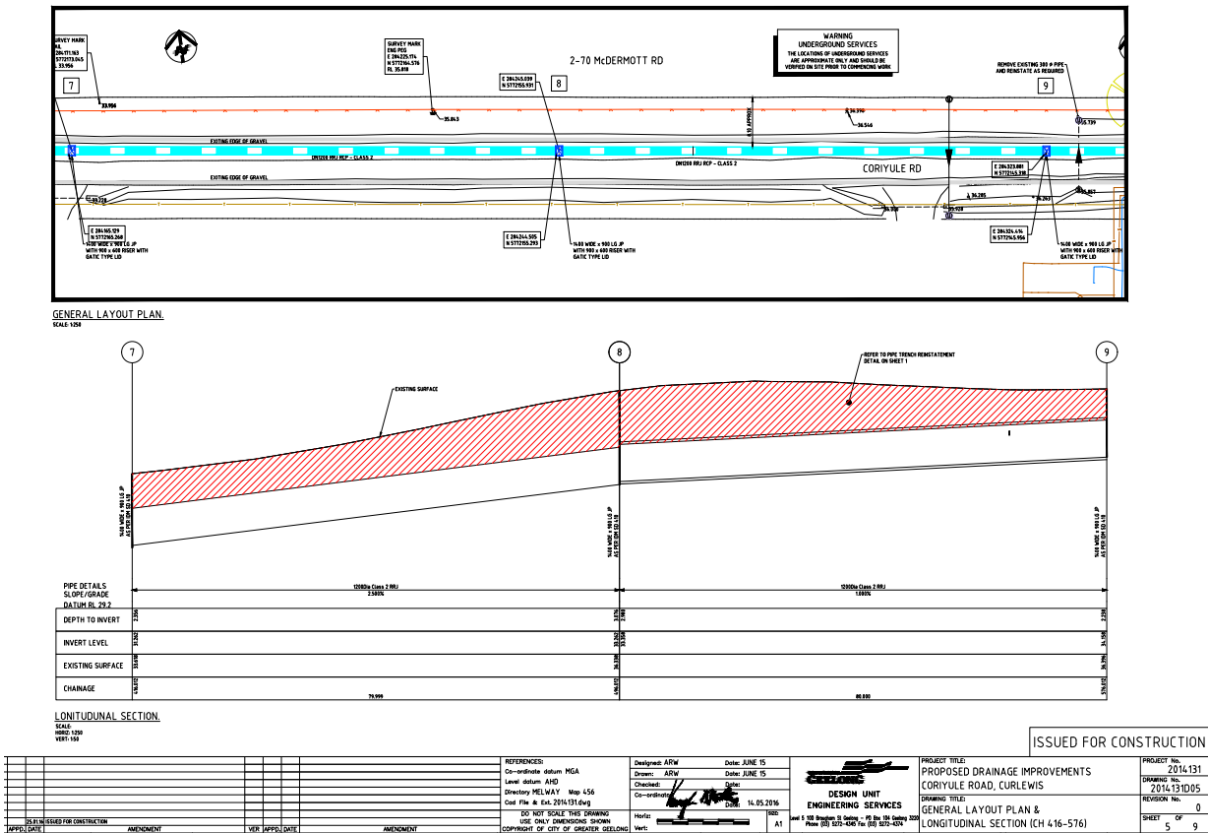


Figure 7. Undulations in Coriyule Road pipe alignment (COGG, 2015)

Based on these descriptions, the stated JRUGP objectives, terrain analysis, and resulting pipe alignments it would be hard to argue that a piped solution to the outfall would not be required for Stage 1 works from these catchments.

Stage 2 Assumptions

The stage 2 areas do not currently have a unifying SWMP for the area, and as such the preliminary assumptions as contained in the Stage 1 SWMP (TGM, 2011) along with an "under review" SWMP (WT, 2022) for the areas south of the rail trail have been reviewed for this area.

Stage 2 Western Areas

As highlighted in the TGM (2011) report at least 4 outfalls are required for the Western Areas. These are highlighted in Figure 8, but can be cross referenced somewhat with Figure 6 above. Consideration of these outfall requirements should be made in conjunction with the Stage 2 DCP works. Specifically:

- Northern outfall - an extension of the outfall drain provided for property 1 as shown in the SWMP is required to drain properties 11 and 12 and parts of property 13. Given that this piece of infrastructure benefits multiple properties it would generally be considered a DCP item unless developer agreement can be sought. Similarly, the outfall wetlands for these properties could be combined for better efficiency.
- Midpoint outfall - The currently proposed midpoint outfall is to a local low point on McDermott Rd. There is not however a discernible flow path past the existing dam on McDermott Rd, and as such any change in volume or frequency will be experienced acutely. As such, without further outfall works (pipe or easement to waterway) there is likely to be concerns with this approach. An alternative is to pipe (as a minimum low flows) to the northern outfall with storages to limit the flow

rate to the defined pipe capacity. This approach would further the argument for the northern outfall extension (properties 11,12,13 connection) to become a DCP item. This issue is highlighted in Figure 8 and Figure 9. These points are also considered in the WT, June 2022 document.

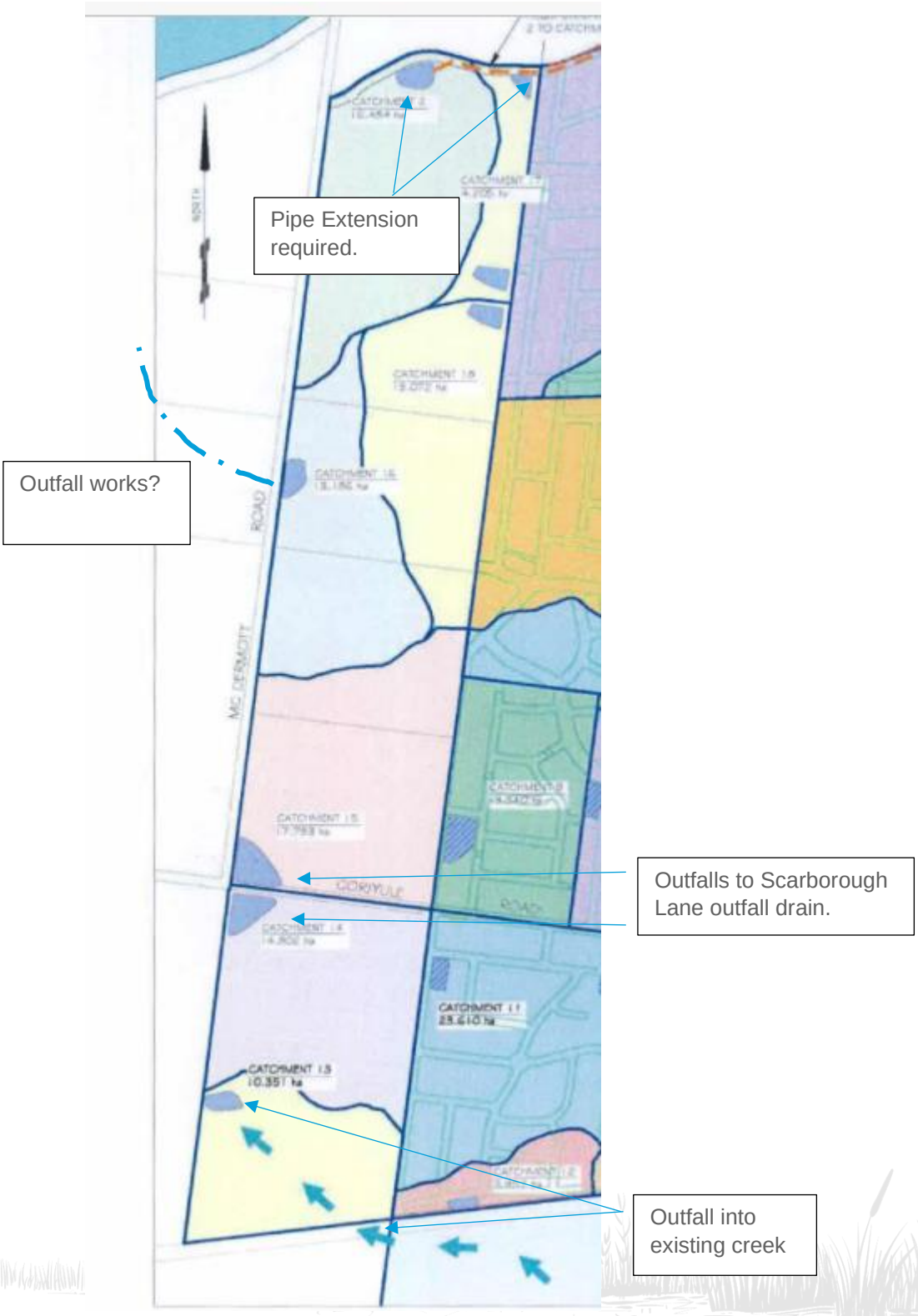


Figure 8. Stage 2 Western Outfalls

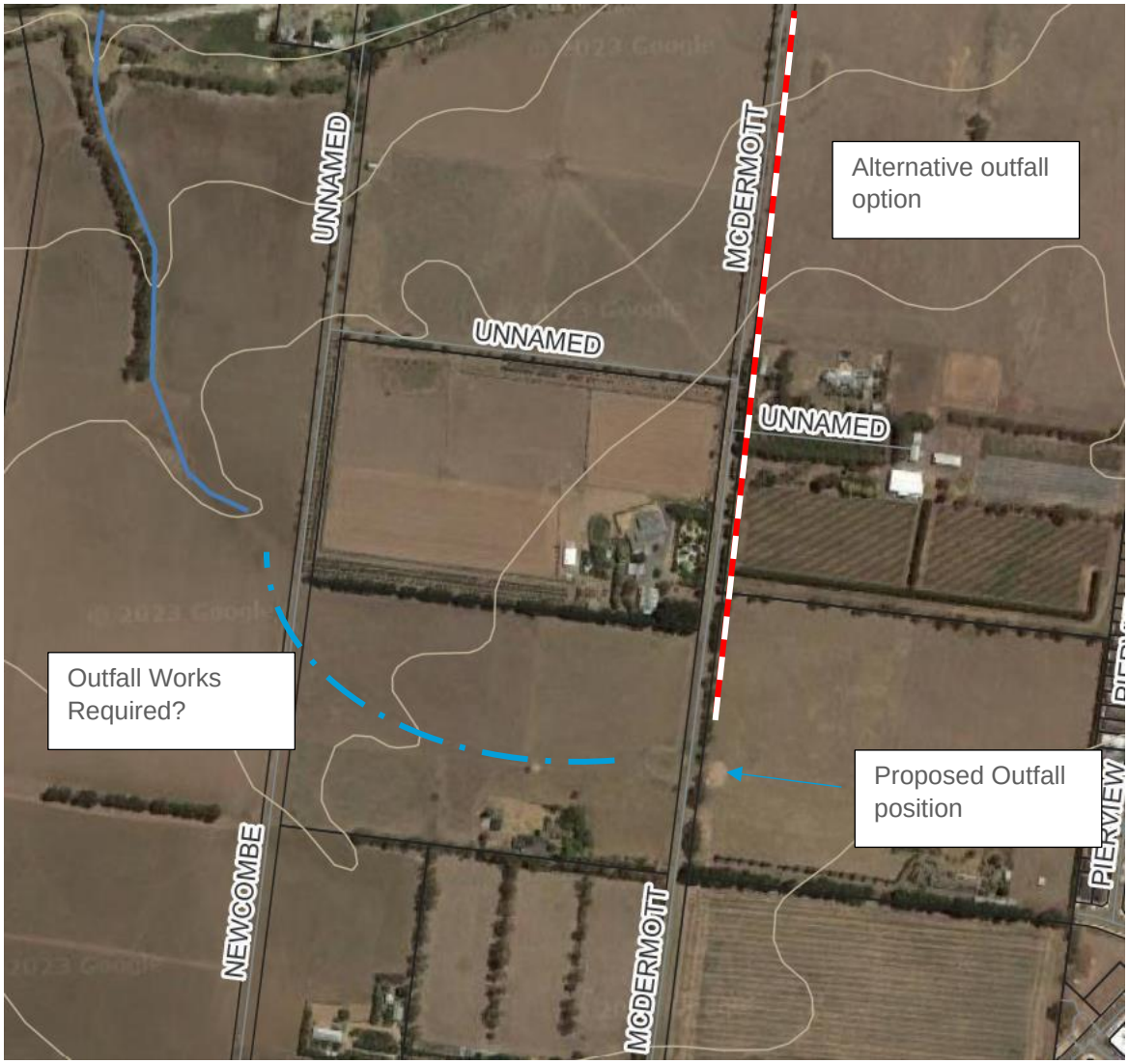


Figure 9. Midpoint Outfall

Stage 2 - Southern Areas

The southern areas of Stage 2 differ significantly from the western areas in terms of stormwater management primarily because they discharge directly to defined watercourses (Figure 10. Primarily this is because the development area is further downstream in the local catchment (i.e., there is a greater area of catchment upstream of the development parcel) than the western areas. This is highlighted in Figure 11 with the comparative catchment areas shown in pink and green for the western and southern development areas respectively.

The southern areas have proposed a constructed waterway and basin system to meet the objectives of the JRUGP. The basin system has been calibrated to meet the 100y, 10y and 1.5y ARI's (missing the 5y JRUGP objective) however this is not considered a consequential change (Figure 13). Given that this waterway and basin serves a number of properties (16-30) this area would also be a possible DCP area if landholder agreement cannot be reached.

Figure 10. Southern Stage 2 Area outfall location

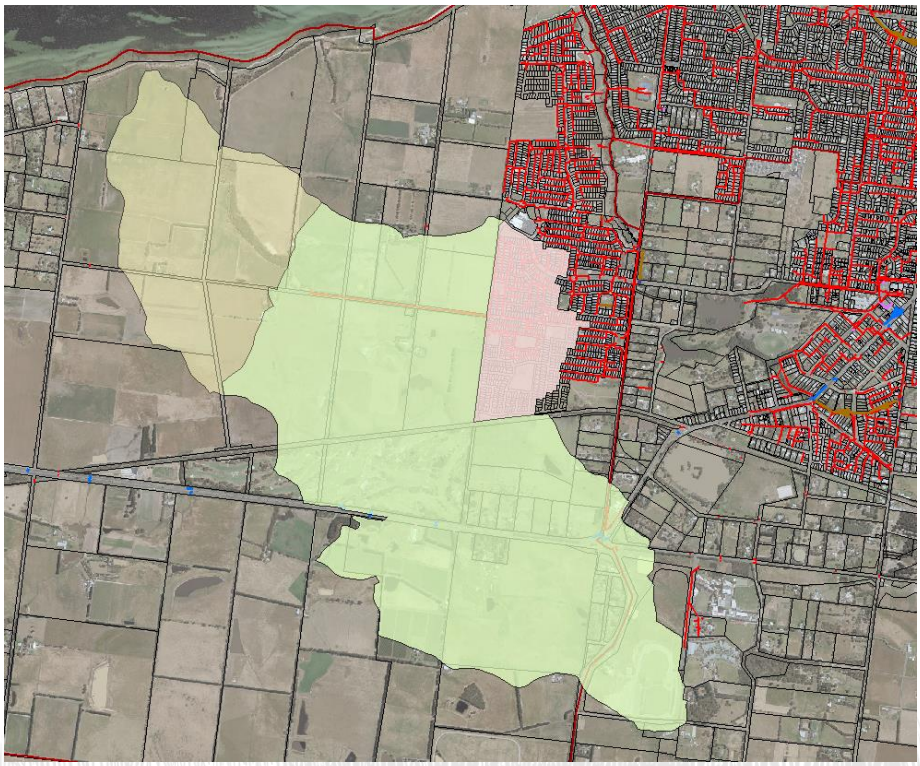


Figure 11. Southern Catchments

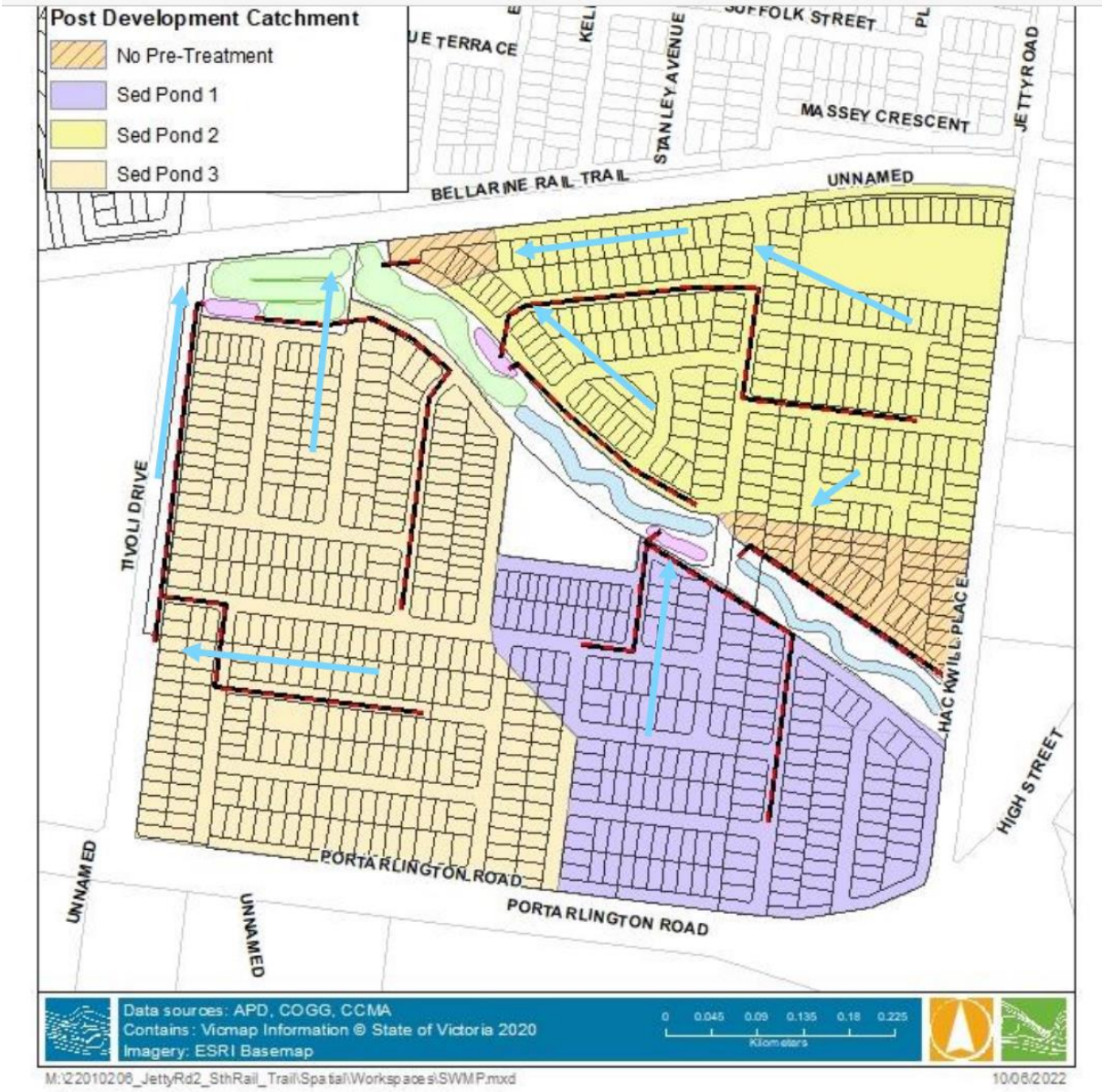


FIGURE 6-1 WSUD ASSET LOCATION AND INDICATIVE DRAINAGE ALIGNMENT

Figure 12. Proposed Southern Catchment SWMP

Item	Details
Upstream Area (ha)	**134***
Storage Volume (m^3)	12,800
Pre-development 1% rate at RB (m^3/s)	1.88
Peak 1% AEP RB Inflow (m^3/s)	8.67
Peak 1% AEP Outflow (m^3/s)	1.70
Peak 1% AEP Water Depth (m)	1.99
Pre-development 10% rate at RB (m^3/s)	0.83
Peak 10% AEP RB Inflow (m^3/s)	4.14
Peak 10% AEP Outflow (m^3/s)	0.83
Peak 10% AEP Water Depth (m)	1.56

Figure 13. Southern Development Areas Proposed Outflows (WT,2022)

Opinions On Stormwater Strategy and Stage 2 DCP

- *1. Should the external drainage projects have properly been planned as part of Jetty Road Stage 1?*

In my opinion the external drainage projects should have been considered in the Stage 1 SWMP. The catchments were identified, the terrain was described as undulating and requiring a piping solution, and the volume and frequency change potential was outlined in the JRGUP. There is no defined waterway to discharge too, and the development would be highly likely to cause a detrimental effect to downstream landholders despite the proposed basin systems.

- *2. If the external drainage projects were included in the Jetty Road Stage 1 DCP, is it likely that they would have been apportioned as between Jetty Road Stage 1 and Stage 2 given that Jetty Road Stage 2 was always a future proposition*?

In all likelihood if the outfall strategy was identified earlier, then it would have been added to the DCP, with apportionment including part of the Stage 2 works. The apportionment of these pipe works **at the time** would have been closer to the dark green area as shown in Figure 15 and contained in the Jetty Road Infrastructure Plan. This is an area of approximately 71ha, of which approximately 40ha is contained within the Stage 1 area (in subsequent works approximately 8-10ha of the orange areas has been added to this catchment to align with the TGM SWMP). The works also provide drainage improvements for Coriyule Road itself and as such a proportion of the works could be Council funded.

The reason that the timing of the infrastructure plan is important is related to the changes in contemporary drainage assessment. Whilst the JRUGP outlines downstream volume change minimisation as an objective, the only specific reduction requirements are flow related. Since that time the Victorian EPA released the "Urban stormwater management guidelines" (June 2021) with a 2-year transition period for implementation. These guidelines introduce quantitative water volume objectives as can be seen in Figure 14. For this area the Drysdale (closest BOM rain gauge) gives a Mean Annual Rainfall (MAR) of 669mm. This requires a 29% Volumetric reduction to meet the performance objective.

The WT (2022) SWMP for the areas south of the rail trail provides a useful summary of the options to meet volumetric reductions. These are:

- Compulsory rainwater tanks - for this catchment the SWMP concludes a ~9% reduction could be achieved using this approach only.
- Rainwater Tanks and Precinct Harvesting - This option was excluded due to the presence of recycled water on the most probable demand models (golf course irrigation)
- Ocean Outfall - this option is to connect to the Scarborough Road outfall system and pass excess volumes west of Tivoli Drive. It would seem that there is capacity in the system for this low flow connection.
- Evaporation ponds - requires an additional ~8ha of land to meet requirement.

Whist these options and values have not been cross checked; they are in the general order of magnitude of options I have tested in similar projects. As such it would seem that the Ocean Outfall connection is the most viable of these options. To meet the performance objective a low flow pipe for the area would be required, with the most efficient location on property 15 as shown in Figure 15. Given the number of properties addressed by this pipe it is suggested that this would be a Stage 2 DCP item. This in turn would require all of the properties 15 through 30 to contribute to the Scarborough Road outfall drain as constructed in Stage 1 (Orange and Magenta areas as shown).

Table 1: Quantitative performance objectives for urban stormwater

Indicator	Performance objective
Suspended solids	80% reduction in mean annual load (Note:1)
Total phosphorus	45% reduction in mean annual load (Note:1)
Total nitrogen	45% reduction in mean annual load (Note:1)
Litter	70% reduction of mean annual load
Flow (water volume)	

	Priority areas (Notes 2, 4, 5, 6)		Other areas (Notes 3, 4, 5, 6)	
rainfall band (ml)	Harvest/evapotranspire (% mean annual impervious run-off)	Infiltrate/filter (% mean annual impervious run-off)	Harvest/evapotranspire (% mean annual impervious run-off)	Infiltrate/filter (% mean annual impervious run-off)
200	93	0	37	0
300	88	0	35	0
400	83	0	33	0
500	77	5	31	4
600	72	9	29	7
700	68	11	27	9
800	64	14	26	11
900	60	16	24	13
1000	56	18	22	14
1100	53	19	21	15
1200	50	21	20	17
1300	48	22	19	18
1400	46	23	18	18
1500	44	25	18	20
1600	42	26	17	21
1700	40	27	16	22
1800	38	28	15	22

Figure 14. EPA 2021 Stormwater Objectives

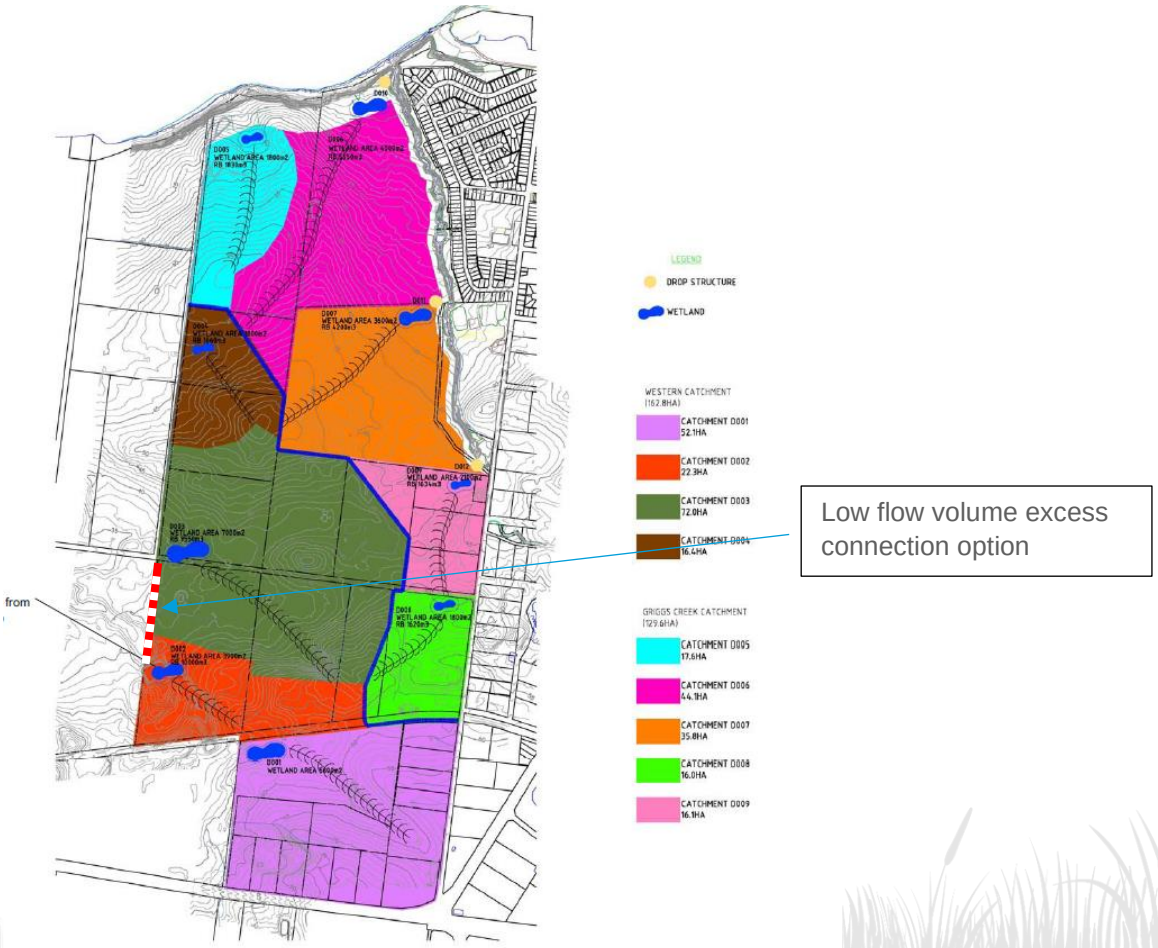


Figure 15. Jetty Road Infrastructure Plan

- *3. Does Jetty Road Stage 2 require the external drainage projects to properly provide for stormwater management?*

Stage 2 does require the external drainage projects if the EPA 2021 volumetric reductions are applied to this area. The nexus argument is less strong in a 2011 regulatory environment given the defined BPEM requirements of the time. In theory other options are available to meet the contemporary requirements (as listed in the WT, Dec 2022 report), but at this stage it would not seem that they are economically viable. Specifically:

- The low flow pipe connection is needed for the Stage 2 areas (Blue and Orange (Figure 16)
- The low flow pipe would also been needed for the Stage 1 areas if constructed today (green areas Figure 16)
- The Orange area should be extended as shown in Figure 16

- *4. What level of cost apportionment to areas external to the Jetty Road Growth Area is fair and reasonable?*

Generally, drainage solutions have been cost apportioned on a 'per hectare' of development basis. As highlighted early there is some direct benefit to the Council managed road systems through this scheme and as such around 5ha (length of road x 20m reserve) could be apportioned to Council. It has been suggested that a 1/3 split between the blue, orange and green (Council funded) catchments as shown below (Figure 16) could be applied. Given the similarity in areas this would seem a reasonable approach if it can be achieved through negotiation. As discussed above however, this approach is only viable if the EPA regulations are applied, and a low flow connection pipe is added to the DCP (this should be a relatively small pipe). Specifically, the following points should be noted:

Coriyule Road Outfall Pipe Charges

- The outfall pipe is required for both the Stage 1 and Stage 2 works.
- The cost apportionment should apply to all of the orange, bule and green areas as shown in Figure 16. An additional 5ha of Council apportionment should apply for Coriyule Road itself.
- The Orange area should be extended as shown in Figure 16. Charges should apply to properties 14 through 30.
- Property 13 could also be included in this depended on its final outfall. Dependent on timing it could drain either north or south though for the purposes of the scheme it may be easier to include it in the southern charge (inclusive of the outfall pipe). This will facilitate a faster development approval for this parcel.
- Apportionment should be on a per/hectare basis for the areas identified. No properties outside of this area should be applied the drainage charge for the outfall pipe given that the land development is the agent of change that requires the pipe (i.e., no external catchments to be applied).

Northern Catchments Charges

- Properties 11 and 12 should be subject to a separate charge to provide outfall and standard stormwater requirements (volume, quality and flow) for development.

- A low flow diversion as a minimum is required for property 12, though from an asset management perspective a larger pipe with a single treatment in property 11 would result in a more efficient drainage outcome.

Other Matters

- The treatment of waterways within a scheme generally does not attract a separate drainage scheme charge unless there are geomorphic implications of the development. In this case, given that a low flow pipe is intended to be implemented (and therefore limiting geomorphic change), I would not add additional waterway improvement charges.
- A waterway is listed in the Vic Hydro layer for property 15 and as such this would attract the requirements of Geelong Planning scheme ordinance 14.02. This land would be considered encumbered and not subject to scheme credits for land or works.
- The proposed constructed waterway and basin in the 'Orange' areas is not considered a waterway by the DEECA definitions, though it is clearly required to convey water from upstream catchments.
- The basin area within this waterway is required for water quality and quantity treatments for the entire orange area and would be considered a credited asset (the land should be purchased to benefit all). Given that this is effectively an online basin for storage, the definition of the basin area should be limited to the extent of the attenuated flows for the 1% storm.
- The area upstream of the basin would not generally be considered as a creditable area for land as the land has some current drainage functions. However, the construction costs of the waterway upgrade should be considered a DCP item as it adds to the benefit of all parties within this area. Given that it is not concluded as a defined waterway, the width of the corridor area could be reduced to a hydraulic width (width required to convey flow in 1% AEP) plus vegetation requirements (i.e., less than 60m).

Figure 16. Scheme Apportionment and Low flow pipe option

I trust the matters discussed meet your requirements for a scheme review. Please do not hesitate to contact me for further discussion if required.

Yours sincerely,

Chris Beardshaw

Principal Engineer

Afflux Consulting

Appendix A - Catchment Plans

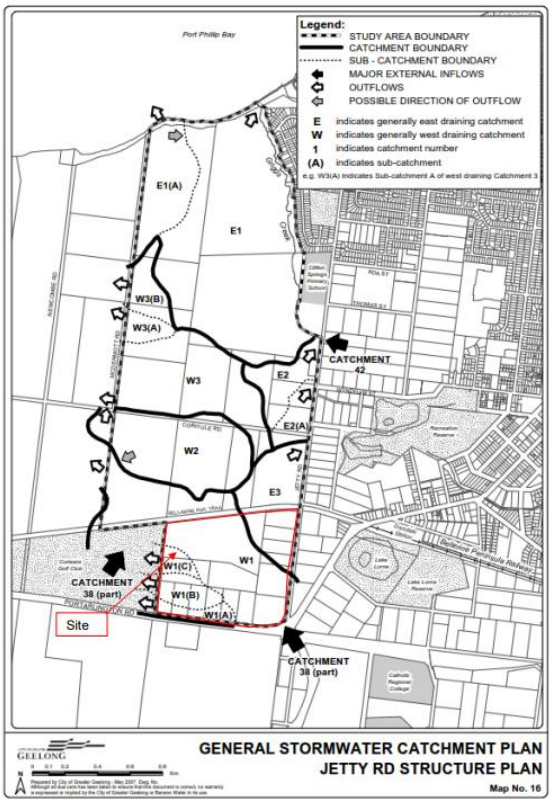
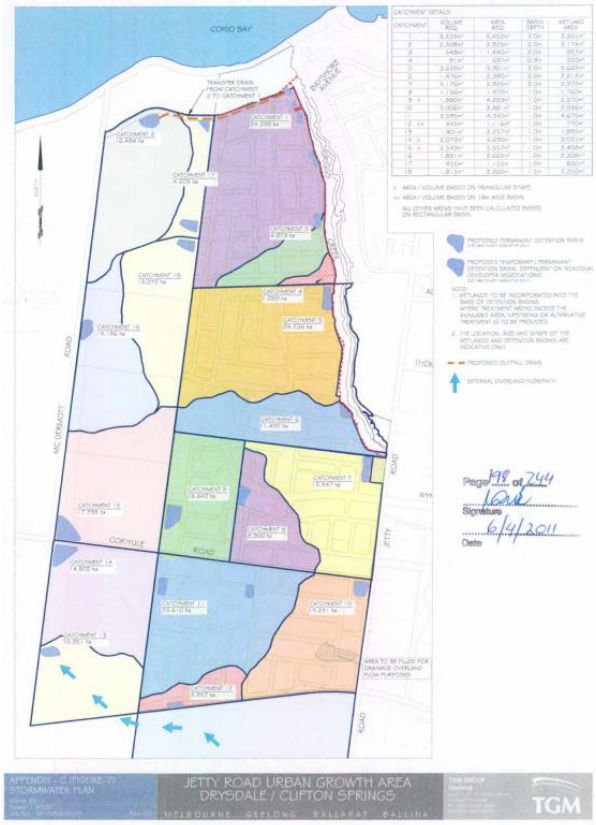


FIGURE 2-2 JETTY ROAD GROWTH AREA CATCHMENT PLAN



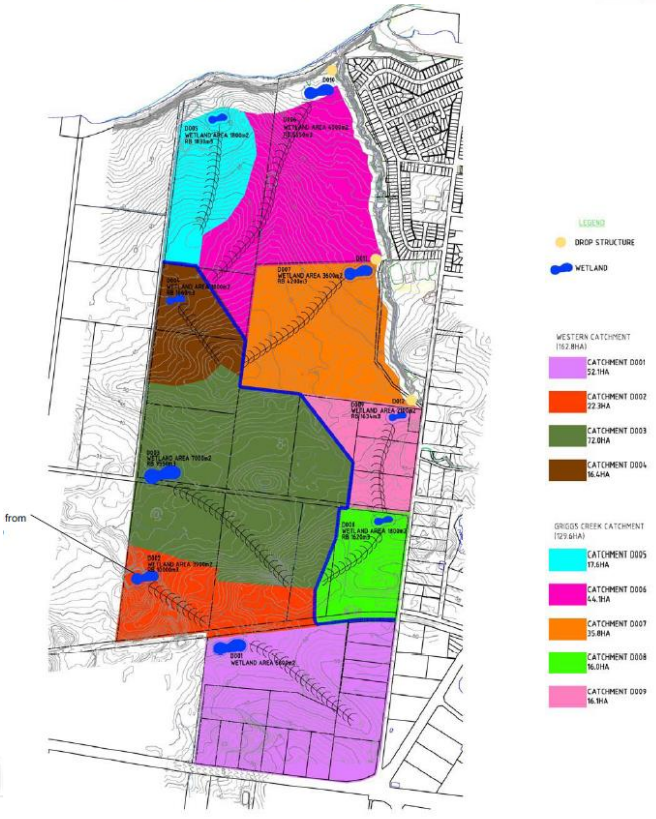


Figure 17. Catchment Plans circa 2011

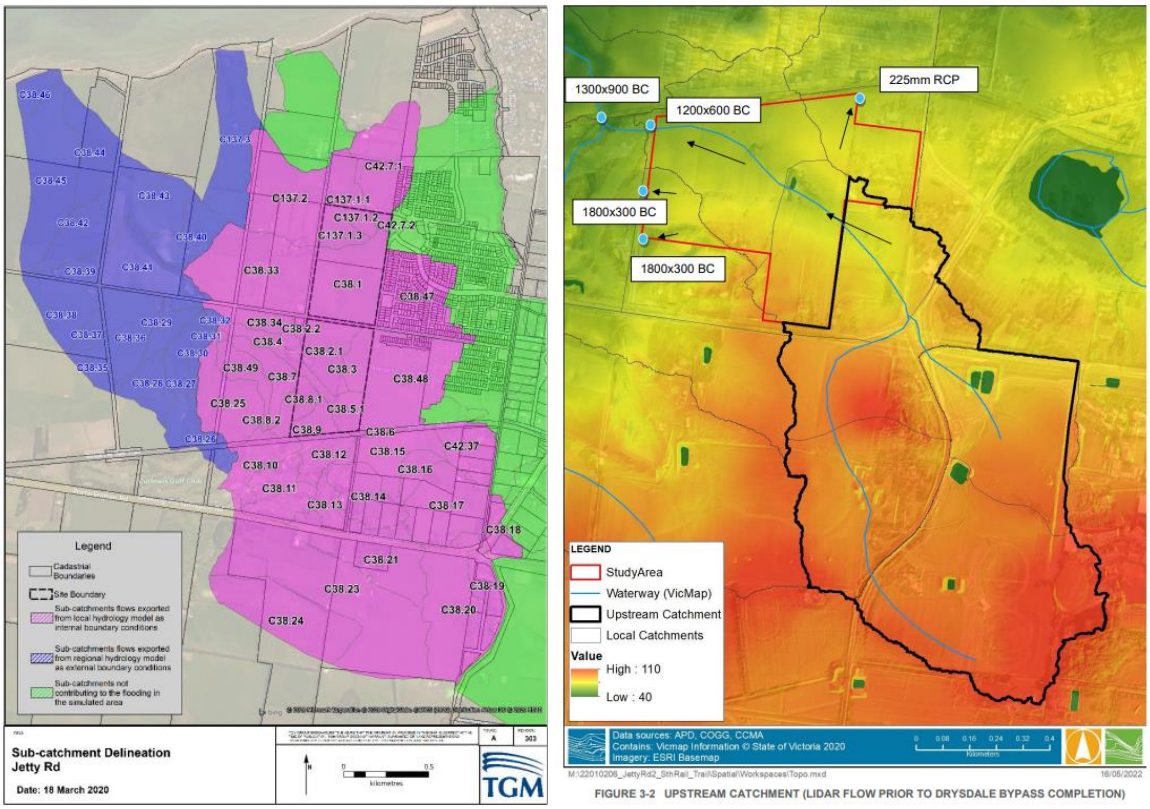


Figure 18. Catchment Plans circa 2020