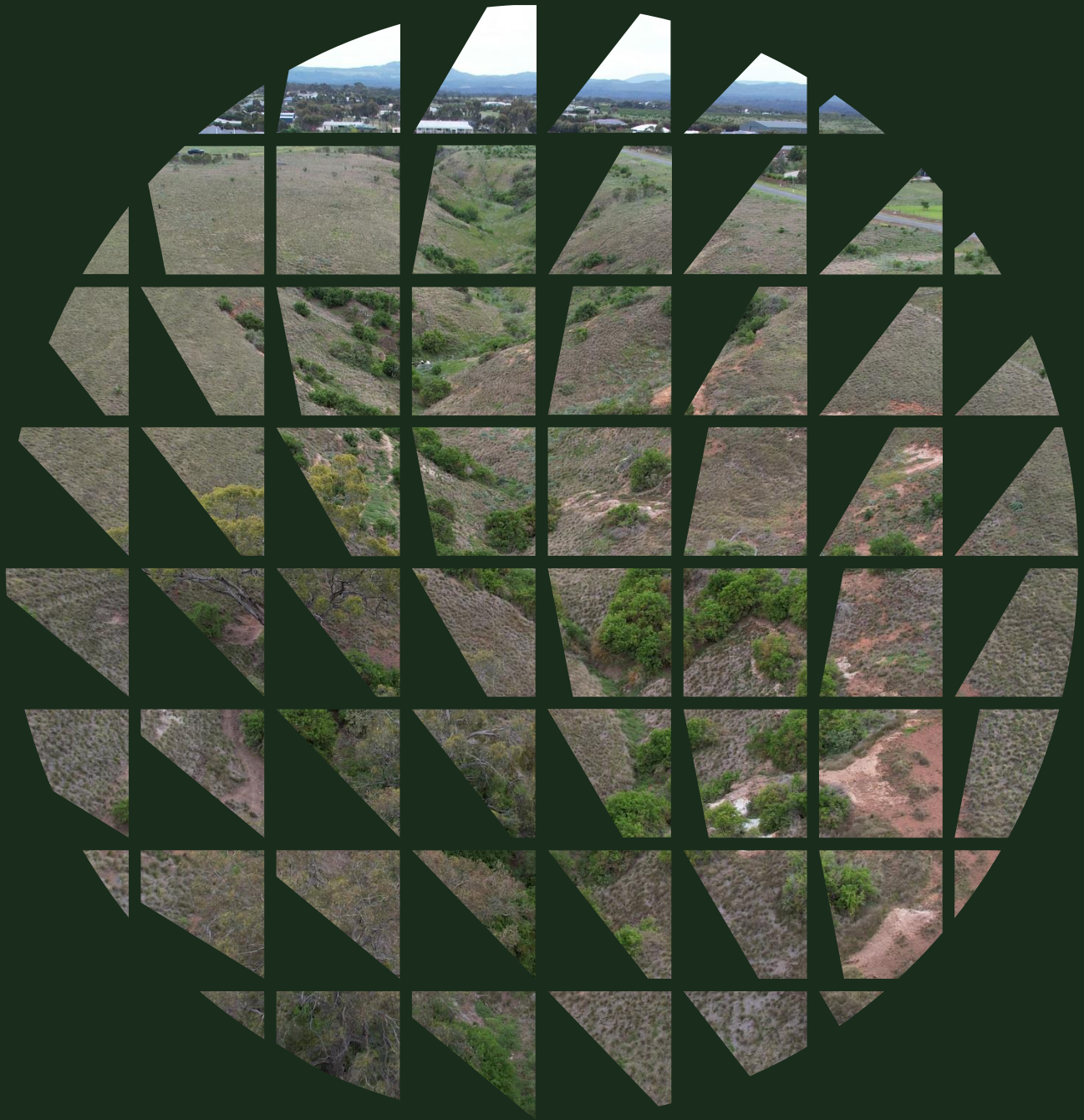




## INTERIM REPORT

# Environmental and Geomorphology assessments for selected stormwater outfalls in the Merrimu PSP area

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Prepared for  
**Melbourne Water**  
May 2026





Alluvium Consulting recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

Artwork by Melissa Barton. This piece was commissioned by the Alluvium Group, and tells our story of caring for Country, through different forms of waterbodies, from creeklines to coastlines. The artwork depicts people linked by journey lines, sharing stories, understanding and learning to care for country and the waterways within.

This report has been prepared by Alluvium Consulting Australia Pty Ltd for Melbourne Water under the contract titled Environmental and Geomorphology assessments for selected stormwater outfalls in the Merrimu PSP area.

|                     |                                                                                                                                                                                                       |
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| <b>Cover image:</b> | Creek adjacent to Flanagans Drive, K. Thompson                                                                                                                                                        |

**Developed for:**

**In partnership with:**



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## INTERIM REPORT

Environmental and Geomorphology assessments for selected stormwater outfalls in the Merrimu PSP area

# Executive Summary

Alluvium and EcoFutures assessed selected stormwater outfall areas in the Merrimu PSP for Melbourne Water, including Buckleys Road, O'Connell Road, Flanagans Run, and Sothern Outfall. The work combined ecology, geomorphology and concept drainage assessments to test whether proposed DSS outfalls can be serviced without creating avoidable waterway, erosion or vegetation impacts. The main finding is that stormwater servicing is feasible in principle, but several currently assumed outfall pathways are not suitable without further design work.

Flanagans Run is the main constraint. The upper tributary and nearby gullies contain exposed sodic, highly erodible soils, with existing rilling, tunnelling and bank erosion. Concentrating post-development flows into these headwater and escarpment areas would likely accelerate gully erosion and increase sediment delivery downstream. The wetland/outfall location proposed in the upper Flanagans Run tributary should not discharge there. Flows should instead be conveyed by pipe to a more suitable lower outfall location, with controlled discharge and stabilisation works.

The downstream drainage path from Flanagans Run remains unresolved. After crossing Flanagans Drive, Bacchus Marsh Road and the Western Freeway, the flow path toward Pyrites Creek and the Werribee River is poorly defined. There is no clear receiving channel across parts of the modified floodplain south of the freeway. The scheme should not assume that existing culverts and floodplain drains can safely convey ultimate development flows until their alignment, capacity and erosion risk are confirmed.

The O'Connell Road area has fewer direct geomorphic impacts, but the drainage strategy has changed because O'Connell Road is no longer proposed as part of the PSP infrastructure. Northern gravity discharge is not feasible because the land rises in that direction. Redirecting flows southeast is hydraulically possible, but it creates or exposes trapped low-lying areas that may not drain by gravity. These areas will need local stormwater management, potentially including detention, bioretention, reuse, infiltration or pumping, subject to further investigation.

The ecological assessment found moderate-quality native vegetation at Flanagans Run, including Rocky Chenopod Woodland, Grassy Woodland and Escarpment Shrubland. Rocky Chenopod Woodland is the highest ecological constraint because it corresponds with a threatened ecological community under the FFG Act. The site also contains large hollow-bearing trees and habitat features that may support threatened woodland birds, mammals and reptiles. Native vegetation impacts should be avoided where possible, and targeted flora and fauna surveys will be needed where impacts cannot be avoided.

The concept pipe network has been sized for 1% AEP flows, with indicative trunk pipe sizes up to 1500 mm. Because the PSP sits on a plateau above steep escarpments, the outfall pipes require controlled grades and drop pits to manage levels and energy.

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# Introduction

## Scope and study area

Alluvium Consulting and EcoFutures were commissioned by Melbourne Water to conduct additional ecological and geomorphic assessments to inform infrastructure planning associated with the Merrimu Precinct Structure Plan (PSP). This project builds on work by Alluvium from 2019<sup>1</sup> to assess the environmental and waterway values within the PSP and to identify potential impacts to those values as a result of post-development hydrologic regime changes.

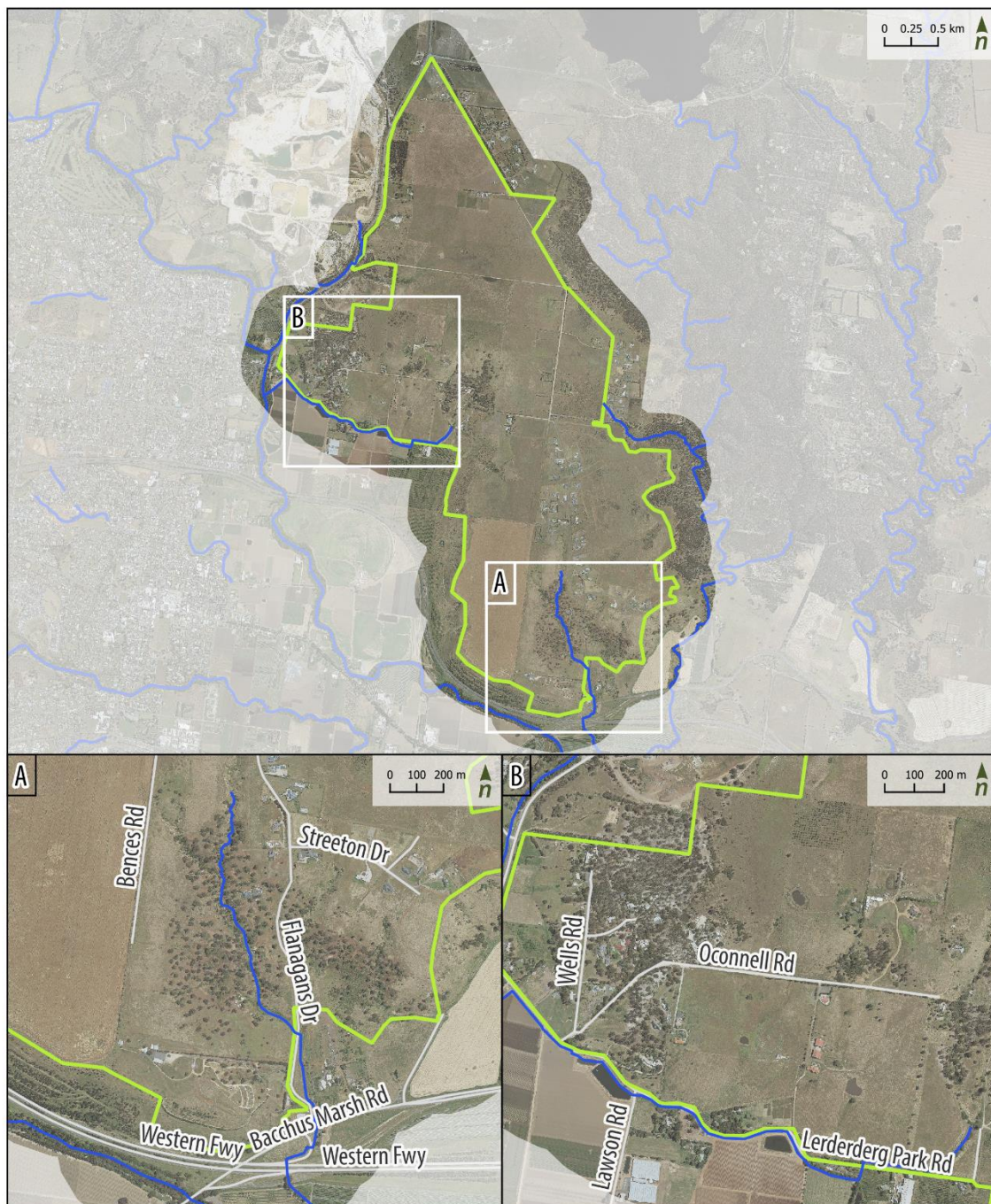
This project focuses on two areas within the Merrimu PSP (Figure 1): the Flanagans Run assessment area and the O'Connell Road assessment area.

The Flanagans Run assessment area (Figure 1A) includes a tributary of the Werribee River and several contributing gullies that flow over the plateau and the southern side of the escarpment. This area was not accessible during the previous work by Alluvium in 2019 but was surveyed during a site walkover by an EcoFutures ecologist and an Alluvium geomorphologist for this project. The assessment area also includes the area south of the Western Freeway, which was inspected visually by the roadside and via a drone to gain an understanding of the tributary's flow direction after it passes under the freeway to its confluence with the Werribee River. The final portion of the Flanagans Run assessment area was the area along the eastern side of the escarpment adjacent to Pyrites Creek, which was inspected via a site survey.

The O'Connell Road assessment area is located on the western side of the escarpment. This assessment area was inspected visually from the roadside given the limited access to private lands throughout this area.

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<sup>1</sup> Alluvium (2019). Merrimu PSP: Final geomorphology and vegetation assessment, report prepared by Alluvium for Melbourne Water.



# MERRIMU PSP SITE OVERVIEW

## Legend

- Waterways
- Merrimu PSP



Figure 1. Merrimu PSP and overview of sites at (A) Flanagans Drive and (B) O'Connell Road.

# Ecology assessments

## Methods

Ecological assessments were undertaken using a combination of on-ground field survey and visual inspection as per site access constraints across the two sites (Figure 1). The site inspection was conducted by an EcoFutures ecologist, in concurrence with the Alluvium Consulting geomorphology assessment, on 4 - 5 December 2025.

The O'Connell Road study area was assessed via visual inspections from publicly accessible roadsides only. This assessment focused on confirming the presence of native vegetation, and where possible, identifying potential environmental constraints to future works.

A detailed on-ground assessment was conducted at the Flanagan's Run study area. Activities included a site walkover survey to map native vegetation extent, identify potential ecological values, and record incidental flora and fauna observations within and adjacent to the waterway corridor. Vegetation mapping was broadscale in approach, and more detailed future assessments may separate some vegetation polygons into smaller constituent parts to better reflect the spaces between individual patches.

Where future works could potentially impact ecological values, recommendations for more detailed flora and fauna surveys were made.

## Results

### O'Connell Road

Vegetation observed at the O'Connell Road site included a mix of remnant native vegetation, introduced pasture, and historically planted vegetation. As the surveys were completed from a vehicle on the roadsides, a detailed assessment of vegetation composition and quality was not conducted. The results of the four photo-points are presented below in Figure 2, and their locations shown on the map in Figure 3.

#### Photo-point 1

Photo-point 1 is at the northern end of McKenzie Court and shows native and planted exotic vegetation within the private properties. It was unclear if the native vegetation was planted by the property owner or remnant.

#### Photo-point 2

Photo-point 2 shows planted roadside vegetation on the western side of O'Connell Road. There was evidence of planting and weed control, indicating that this area is currently being actively managed.

#### Photo-point 3

Photo-point 3 shows some sparse native vegetation within one of the private properties north of O'Connell Road, approximately near the centre of the study site.

### Photo-point 4

Photo-point 4 shows the patches of native vegetation on the private properties at the eastern end of O'Connell Road, looking towards Bences Road. This appears to be remnant native vegetation, as some of the trees are relatively large, especially in the background of the image. There is a 2009 record of the FFG Act-listed Speckled Warbler (*Pyrrholaemus sagittatus*) within the patch.



Photo-point 1



Photo-point 2



Photo-point 3



Photo-point 4

Figure 2 Photo-points at O'Connell Road

## Flanagan's Run

Vegetation in the Flanagan's Run study site was generally of moderate quality. There were numerous large old trees, but the midstory and ground layer were heavily modified with significant weed invasion and reduced understory diversity.

A total of 96 flora species were observed within the Flanagan's Run study site. Of these 41 were indigenous, 54 were exotic, and one (1) was native but non-indigenous to the area. This also included one species *Rhagodia parabolica* (Fragrant Saltbush) which is listed as Vulnerable under the *Flora and Fauna Guarantee Act 1988* (FFG Act).

Three (3) Ecological Vegetation Classes (EVCs) were observed within the two parts of the Flanagan's Run Site (Figure 3), which are discussed further below.

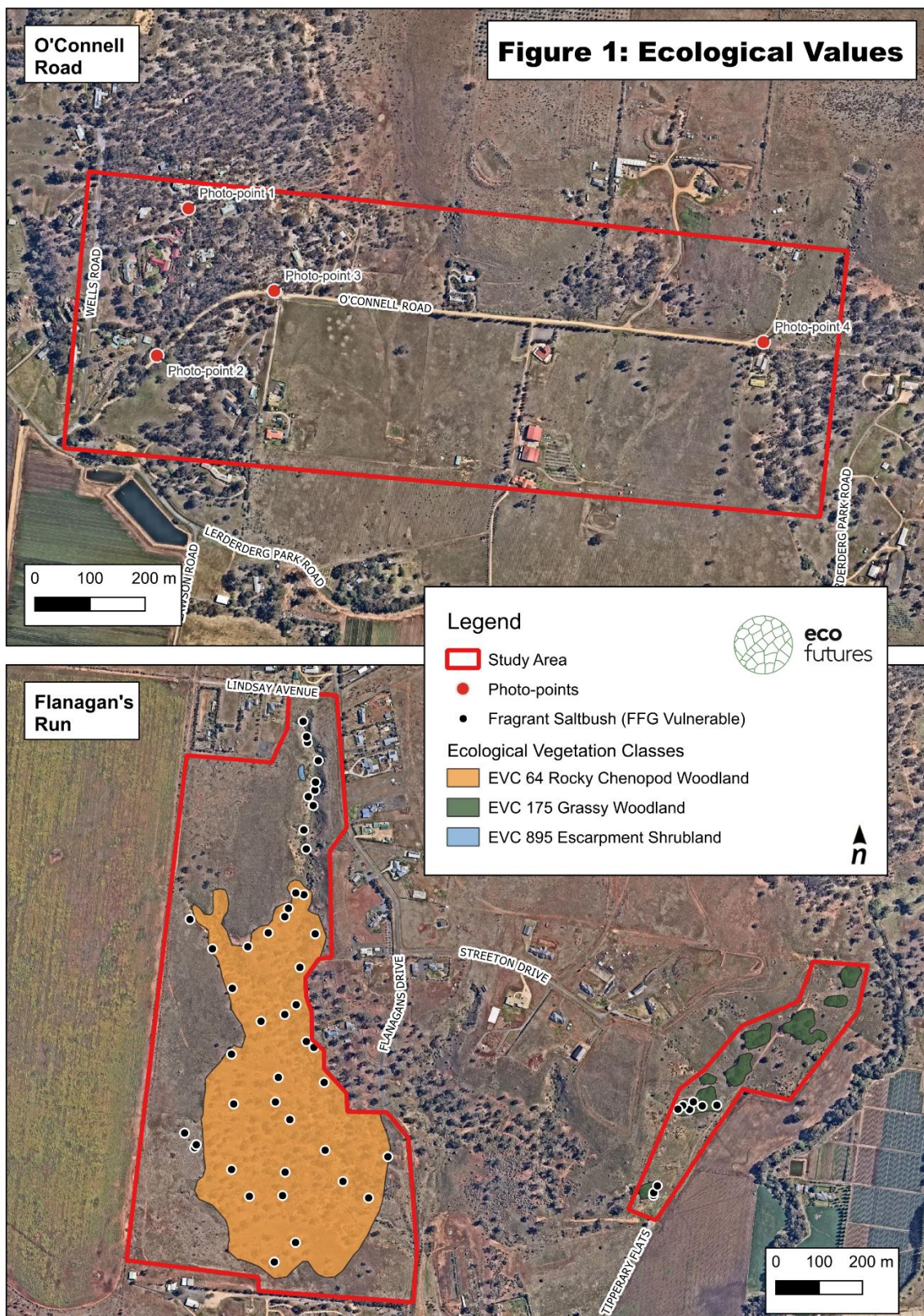


Figure 3 Ecological values within the study site

## EVC 64 Rocky Chenopod Woodland

Rocky Chenopod Woodlands (Figure 4) are typically low open woodlands with trees reaching up to approximately 8 m in height. The understorey is dominated by chenopod species, with occasional grasses and seasonal herbaceous species. This EVC typically occurs on weathered clays and duplex soils with elevated salinity and low permeability, which strongly influence vegetation structure and limit water infiltration.



**Figure 4 EVC 64 Rocky Chenopod Woodland**

Examples of this EVC within the study site were characterised as a *Eucalyptus microcarpa* (Grey Box) Open Woodland (ESCAVI 2003), with a projective foliage cover of approximately 10%, and a maximum height of 12 m. The understory was dominated by the FFG Act-listed *Rhagodia parabolica* (Fragrant Saltbush, Figure 5). Other scattered chenopod shrubs observed in EVC 64 at Flanagan's Run included *Carpobrotus modestus* (Inland Pigface), *Einadia hastata* (Saloop), *Enchylaena tomentosa* var. *tomentosa* (Ruby Saltbush), *Maireana brevifolia* (Short-leaf Bluebush), *Maireana decalvans* s.s. (Black Cotton-bush), (*Sclerolaena diacantha*) Grey Copperburr, and *Sclerolaena muricata* var. *villosa* (Grey Roly-poly).

Weed cover in the ground layer was very high, and in some patches completely displaced indigenous understory plants. The dominant weeds included *Aizoon pubescens* (Galenia), *Gazania linearis* (Gazania),

*Lycium ferocissimum* (African Box-thorn), *Olea europaea* (Olive), *Mesembryanthemum cordifolium* (Heart-leaf Ice-plant), and *Physalis hederifolia* (Sticky Ground-cherry).

The vegetation observed in this EVC corresponds with the *Rocky Chenopod Open-scrub Community*, a threatened ecological community listed under the FFG Act. This community has a highly restricted distribution in Victoria, with less than approximately 200 ha estimated to remain, largely confined to sites west of Melbourne. Despite the weedy conditions within the study site, there is potential for future ecological rehabilitation and any further impacts on the vegetation should be avoided.

The very high numbers of hollow bearing trees (Figure 5) observed within this vegetation community could provide important habitat for fauna species, including several threatened taxa such as the Brush-tailed Phascogale (*Phascogale tapoatafa tapoatafa*) and Powerful Owl (*Ninox strenua*). The vegetation could also provide important habitat for woodland birds, including the threatened Speckled Warbler (*Pyrholaemus sagittatus*) and Diamond Firetail (*Stagonopleura guttata*), which have been previously recorded at the nearby Long Forest Flora and Fauna Reserve. The prevalence of fallen logs and dense shrubs could also provide habitat for ground-dwelling reptiles and mammals, such as the incidentally observed Water Skink (*Lampropholis guichenoti*) (Figure 5).



Figure 5 Clockwise from the upper left: Hollow-bearing tree, Water Skinks (*Lampropholis guichenoti*), FFG Act-listed *Rhagodia parabolica* (Fragrant Saltbush).

## EVC 175 Grassy Woodland

EVC 175 Grassy Woodland (Figure 6) typically refers to variable open woodlands, dominated by eucalypt species reaching up to approximately 15 m in height, or occasionally by *Allocasuarina* (Sheoak) and *Acacia* species forming a lower woodland to around 10 m. The understorey is characterised by a diverse and often species-rich ground layer of native grasses and forbs, while the shrub layer is generally sparse or absent. This EVC occurs on sites of moderate soil fertility, typically on gentle slopes or undulating hills, and is associated with a range of underlying geological substrates.



**Figure 6 EVC 175 Grassy Woodland within the study site**

Within the Flanagan's Run site EVC 175 Grassy Woodland was an Open Woodland (ESCAVI 2003) occupying the escarpments and lower slopes in the eastern portion of the study site. The observed patches of EVC 175 were characterised by a canopy layer of large *Eucalyptus melliodora* (Yellow Box) up to 14 m tall, with a projective foliage cover of approximately 15%. The ground layer has suffered from significant weed invasion and the only commonly occurring remnant native species was *Rhagodia parabolica* (Fragrant Saltbush). The dominant noxious weeds included *Lycium ferocissimum* (African Box-thorn) and *Nassella trichotoma* (Serrated Tussock).

Faunal habitat values are similar to those described for EVC 64 Rocky Chenopod Woodland due to the generally similar habitat structure and the presence of large hollow-bearing trees.

## EVC 895 Escarpment Shrubland

EVC 895 Escarpment Shrubland (Figure 7) occurs on rocky escarpments within steep valleys and gorges, typically associated with limestone or basalt substrates. Sites are generally well-drained and of moderate to high fertility but are subject to regular summer moisture stress due to shallow soil profiles. Vegetation structure can be variable, comprising either open eucalypt woodland up to approximately 15 m tall or non-eucalypt shrubland to around 8 m tall with occasional emergent eucalypts. Exposed, lichen-covered rock outcrops are a common and characteristic feature of this EVC.



**Figure 7 EVC 895 Escarpment Shrubland within the study site**

Within the study site, this EVC occurred in a few small sections of the waterway where the suitable geomorphic conditions were present. The vegetation in these patches was an *Acacia implexa* (Lightwood) and *Melicytus dentatus* (Tree Violet) Open Shrubland (ESCAVI 2003), with a maximum height of 4 m and a projective foliage cover of 15%. The patches of this EVC were unique in the context of the study site for having a more intact ground layer with several grass and forb species still present. These included species such as *Chloris truncata* (Windmill Grass), *Convolvulus angustissimus* subsp. *omnigracilis* (Slender Bindweed), *Dichanthium sericeum* subsp. *sericeum* (Silky Blue-grass), *Erodium crinitum* (Blue Heron's Bill), *Hackelia suaveolens* (Sweet Hound's-tongue), *Geranium gardneri* (Rough Crane's-bill), *Wahlenbergia capillaris* s.s. (Tufted Bluebell), *Rytidosperma setaceum* var. *setaceum* (Bristly Wallaby-grass), and *Themeda triandra* (Kangaroo Grass). The floristic composition observed in these locations indicates that

the plains surrounding the study site (now occupied by housing and farmland) may have historically supported a C4 grass-dominated ecosystem.

Weed cover within patches of EVC 895 was moderate, and included *Aizoon pubescens* (Galenia), *Lycium ferocissimum* (African Box-thorn) and *Nassella trichotoma* (Serrated Tussock).

As the patches of EVC 895 are relatively small they are unlikely to have their own distinct faunal assemblages. It is more likely that fauna more strongly associated with more extensive nearby patches Rocky Chenopod Woodland opportunistically forage or pass through the vegetation as they move across the landscape.

## Ecological Recommendations

Based on the ecological values identified within the Flanagan's Run and O'Connell Road study areas, the following recommendations should be considered in the future planning of the drainage scheme. As this was a preliminary assessment the recommendations provided are broad and non-specific. Detailed recommendations for further avoidance and mitigation measures can be provided upon the completion of conceptual designs.

- Impacts on native vegetation should be avoided wherever practicable. Particular emphasis should be placed on avoiding disturbance to the patches of EVC 64 Rocky Chenopod Woodland, which correspond with the Rocky Chenopod Open-scrub Community, listed as a Threatened Ecological Community under the FFG Act.
- Where impacts on native vegetation cannot be avoided, targeted threatened flora and fauna surveys should be undertaken to determine the presence of significant species and inform appropriate mitigation measures.
- If works proceed within the O'Connell Road study area, a detailed flora and fauna assessment should be undertaken to confirm the extent, condition, and significance of remnant native vegetation and fauna habitat identified during the roadside surveys.
- Where disturbance is unavoidable, opportunities for targeted weed control and ecological rehabilitation should be considered, particularly in the highly weedy areas. Any rehabilitation or planting should use locally indigenous species consistent with the relevant EVCs.

# Geomorphic assessment

## Methods

Geomorphic assessments were conducted via on-ground surveys and visual inspections from roadsides and via a drone by an Alluvium geomorphologist on 4-5 December 2025. The purpose of these assessments was to record any geomorphic values within the study areas, identify potential geomorphic risks associated with developed flows and support engineering assessments on proposed DSS pipe alignments.

The following sections outline the observations made during the geomorphic assessments and their implications for DSS pipe alignments and the Merrimu PSP.

## Results

### O'Connell Road assessment area

A desktop review, complemented by a visual inspection from the roadside along O'Connell Road, was undertaken to assess the suitability of local stormwater outfall options.

Since Alluvium's geomorphic assessment of the region in 2019, the irrigation channel that was a tributary of Lerderderg River that previously flowed adjacent to Lerderderg Park Road has been redirected underground and is no longer a surface waterway. Therefore, the closest surface waterway for local stormwater outfall from O'Connell Road is the Lerderberg River to the west of O'Connell Road. The desktop and visual assessment found no particular pathways between O'Connell Road and the Lerderderg River that should be avoided for geomorphic reasons.



**Figure 8. Configuration of O'Connell Road with respect to the River Lerderberg and irrigation channel that has been redirected underground.**

## Flanagans Run assessment area

The main waterway within the Flanagans Run assessment area is an ephemeral creek that flows in a southerly direction, roughly parallel to Flanagans Drive (Figure 1). The creek's headwaters originate approximately 1200 m from the southern edge of the escarpment.

The main creek and several contributing gullies are carving a valley with steep banks into the escarpment plateau (Figure 9). The headwaters of the creek have carved through a bedrock of Newer Volcanic Group basalts, while the downstream portion of the tributary and the gullies overlay fluvial deposits of the Werribee Formation. Materials comprising the Werribee Formation (which are sodic and highly dispersive) are poorly cemented and are known to be easily erodible<sup>2</sup>.

Sodic soils were observed throughout the banks of the creek and gullies within the Flanagans Run assessment area (Figure 9). Sodic soils are highly erodible given their high concentrations of sodium cations, which have weak bonding abilities relative to other cations. Several geomorphic structures diagnostic of sodic soils, including tunnelling, were also observed throughout the assessment area.

<sup>2</sup> Earth Tech (2006). Geomorphic overview of waterways in the Werribee River catchment, report prepared by Earth Tech for Melbourne Water.

Without management intervention, increased flows from development would likely exacerbate erosion rates of the sodic soils, leading to degradation of the waterways and increased turbidity downstream.

Preliminary DSS plans show a small water treatment wetland and outfall in the upper part of the Flanagan's Run tributary, marked by the white arrow and dashed line at Point A in Figure 9. This is not a suitable outfall location. The proposed discharge point is close to the transition from the basalt cap to the underlying Werribee Formation, where sensitive dispersive soils are exposed slightly downstream. Flows discharged at this location are likely to pass directly over these sensitive soils and across the gully before entering the channel. This risks exacerbating erosion, even if some proportion of the additional post-development flows are diverted elsewhere.

After flowing off the escarpment, the creek continues south, passing through culverts beneath Flanagan's Drive. Here, the creek's flow is interrupted by a series of small farm dams before continuing through culverts under Bacchus Marsh Road, and subsequently, the Western Freeway (Figure 10). Once the waterway flows under the freeway, the path it takes to reach Pyrites Creek and, ultimately, the Werribee River is unclear and was not observable from the roadside or via drone imagery (Figure 11).

The area has been heavily modified by both freeway construction and associated earthworks. Although the exact waterway alignment is unclear at this point, the waterway is mapped (and does appear) to pass under the Western Freeway, where it meets then flows across an intensively cropped section of the Pyrites Creek floodplain. No defined channel is evident in this section of the cropped floodplain, with the exception of what appears to be a linear drain that may convey flows towards a road within the floodplain. This channel is not distinguishable in LiDAR datasets and it is unclear whether it does convey any flows from the plateau towards Pyrites Creek. Any such flows may be lost to infiltration between the plateau escarpment and the freeway, or soon afterwards within the cropped section south of the freeway.

The southeastern edge of the escarpment that runs parallel to Pyrites Creek has several gullies that have formed along the steep slopes of the plateau's edge (Figure 12). Sodic soils were observed within these gullies and exposed on the steep slopes of the escarpment (Figure 13).

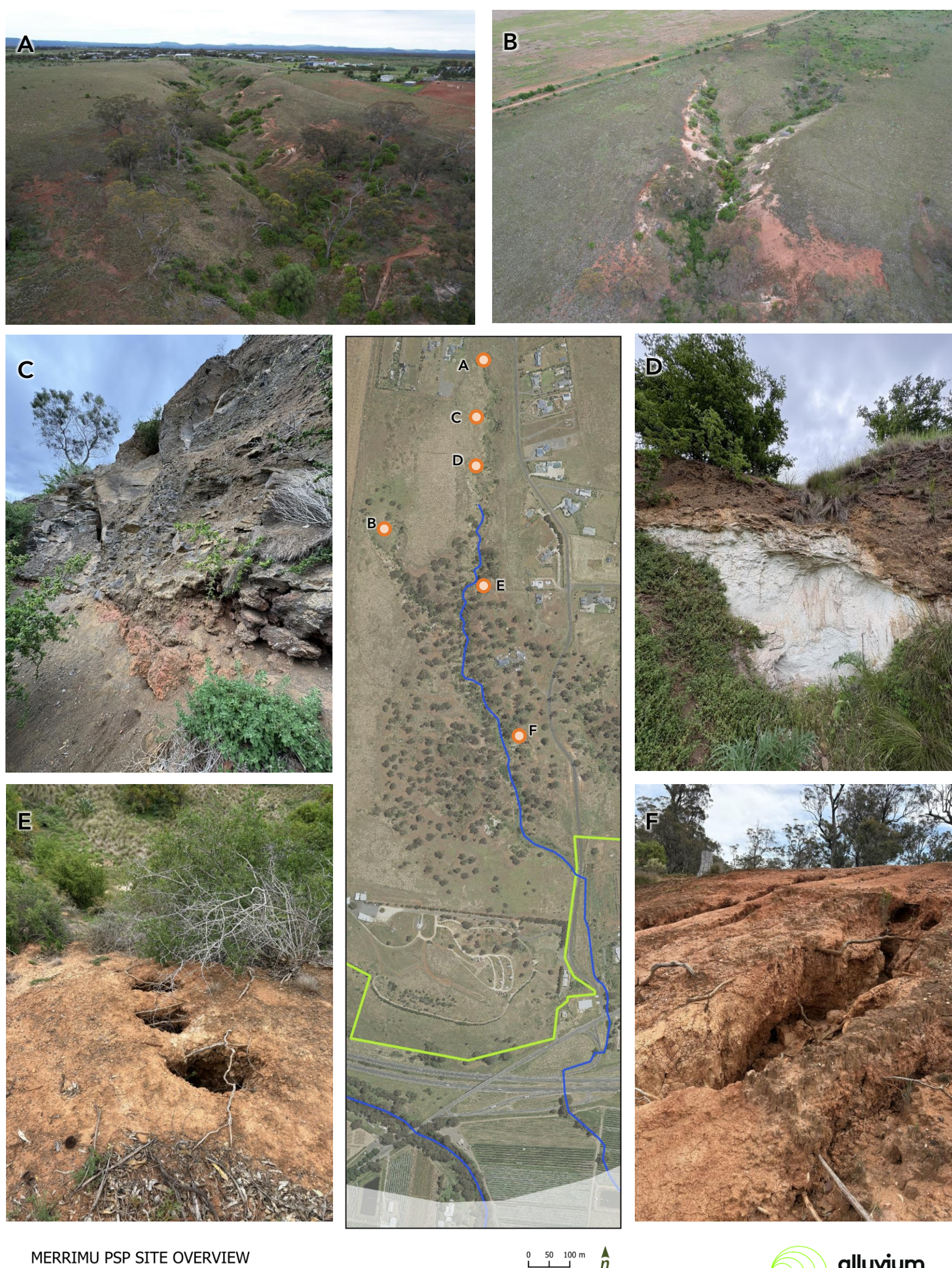


Figure 9. Geomorphic observations from the Flanagans Run assessment area, including (A) a steep headwater cutting a valley with steep banks into the escarpment plateau; (B) several gullies originating from the tributary with similarly steep slopes; (C) exposed bedrock of Newer Volcanic Group basalt flows overlying fluvial deposits from the Werribee Formation; (D) large volumes of sodic soils exposed along the banks of the tributary; (E) tunnelling features that are symptomatic of underlying sodic soil erosion; and (F) rill erosion on the banks of the main tributary.



Figure 10. Looking south-southwest, a view of the Flanagans run assessment area's main tributary crossing under Flanagans Drive, through farm dams and agricultural lands, towards the Western Freeway, where it's path to the Werribee River becomes unknown.



Figure 11. Looking south, a view of the Flanagans Run assessment area's main tributary crossing under the Western Freeway. The tributary's flow pathway to the Werribee River is currently unknown.



Figure 12. Looking north, a view of the eastern side of the escarpment plateau running parallel to Pyrites Creek to the east.



Figure 13. Looking west, a view of gullies on the eastern side of the escarpment.

## Geomorphology recommendations

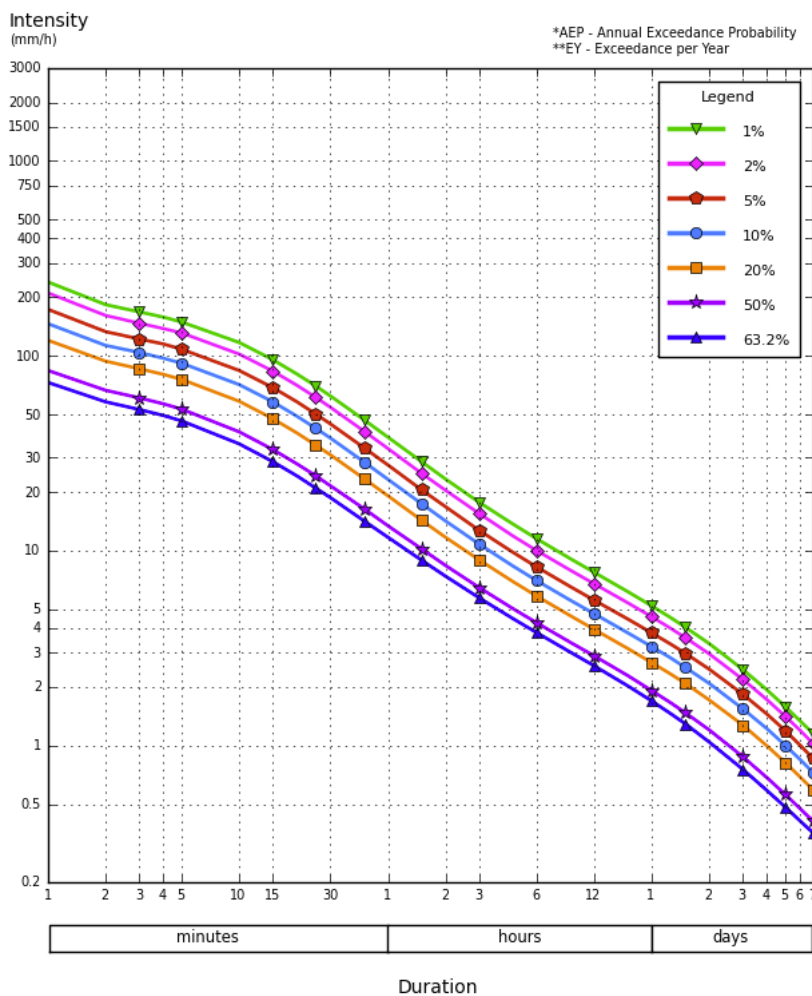
Sodic and highly dispersive soils are exposed along much of the Flanagan's Run valley walls, gully margins and parts of the escarpment face. These areas have a high inherent erosion risk where soil is exposed or runoff becomes concentrated. The basalt cap is providing a local control on incision and headward migration, with further gully progression constrained where channels have reached harder basalt or basalt-derived materials. The geomorphic recommendations therefore focus on avoiding additional concentrated flows to sensitive headwater and escarpment areas, identifying suitable outfall locations, and resolving the downstream flow path once Flanagan's Run exits the Merrimu PSP area. Our recommendations are:

- Restoration of the pre-European EVC vegetation along the upper escarpment is appropriate, but it should be considered a surface-stabilisation and erosion-prevention treatment that limits the potential for localised erosion at the escarpment crest, rather than a measure that would control further headward migration of the gullies. Re-establishing vegetation consistent with the pre-European EVCs would help protect the soil mantle over the basalt cap, reduce raindrop impact, increase surface roughness, reduce shallow overland flow velocities and limit the formation of new rills or small gullies on the escarpment face. A limitation is that vegetation would not prevent risks caused by any concentration of flow at one location via a stormwater outfall (or any other point source, such as runoff from road drains).
- No additional post-development outfalls or concentrated flows should be directed to the small gullies, headwater sections or confined upper tributary margins of Flanagan's Run. These areas already contain exposed sodic and highly dispersive soils, with existing rilling, tunnelling and bank erosion. Additional concentrated flow would increase the risk of gully enlargement, headward erosion and sediment delivery downstream. Any local runoff retained within the tributary's catchment should remain diffuse and is unlikely to trigger new gully formation.
- The wetland originally proposed to discharge to the upper headwater section of the Flanagan's Run tributary should not discharge at that location. Flows from this wetland should be piped into the broader controlled outfall system, rather than released across the escarpment face or into the upper tributary. Engineering solutions should prioritise piped conveyance to a more appropriate downstream discharge location. The preferred approach is to avoid the confined and actively eroding parts of Flanagan's Run and discharge closer to the lower, less confined section of the tributary, where flows can be managed through a controlled outfall arrangement and associated stabilisation works.
- The downstream flow path from Flanagan's Run, after it passes beneath Flanagan's Drive, Bacchus Marsh Road and the Western Freeway, remains poorly defined. South of the freeway, flows appear to move across a modified floodplain toward Pyrites Creek and the Werribee River, but there is no clearly defined receiving channel across parts of this floodplain. Existing culverts may provide some conveyance, but their capacity and suitability for post-development flows have not yet been assessed.
- Further hydraulic assessment is required south of Flanagan's Drive to define the preferred outfall alignment and receiving location. This should include basic hydraulic modelling to delineate flow paths, confirm culvert capacity, assess whether new or upgraded channels or pipes are required, define the dimensions of any required conveyance works, and assess erosive forces under peak flow events relative to existing conditions.

# Engineering assessments

## Hydrologic Analysis

The hydrological conditions of the subject site were established using the rational method to estimate the peak design flows from the subject site. The following design rainfall parameters were adopted for the Donnybrook area based upon the Bureau of Meteorology's (BOM) "Intensity Frequency Duration (IFD) Tool - AR&R 2019) (see Figure 14).



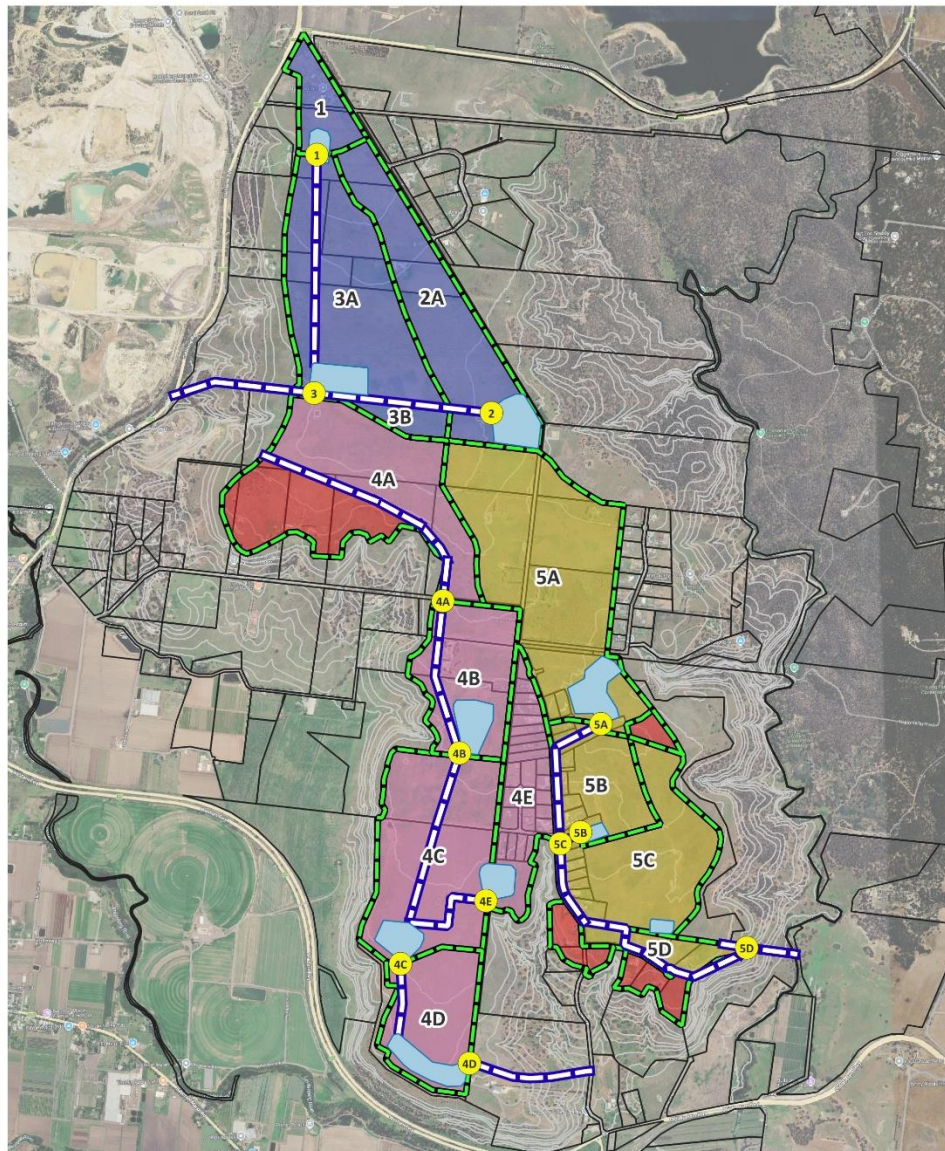
©Copyright Commonwealth of Australia 2016, Bureau of Meteorology (ABN 92 637 533 532)

Figure 14. Design rainfall intensities for Merrimu PSP Area

## Catchment Areas

Catchment delineation was conducted based on available contour data and the proposed road network (see Figure 15). The catchment plan for the subject site is consistent with the provisions provided in the

Plan 2 Place Based Plan Merrimu Precinct Structure Plan. The size and description of the catchments are provided in Table 1.



#### Legend

- |                                                                   |                                                                                              |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <span style="color: yellow;">●</span> DSS discharge points        | DSS pipe major contributing catchments                                                       |
| <span style="color: grey;">—</span> Contours (5m)                 | <span style="background-color: #e0f0ff; border: 1px solid black;"> </span> Buckleys Rd       |
| <span style="color: blue;">—</span> Proposed DSS pipes            | <span style="background-color: #ffe0e0; border: 1px solid black;"> </span> Flanagans Run     |
| <span style="border: 1px solid black;"> </span> Property boundary | <span style="background-color: #ffffe0; border: 1px solid black;"> </span> Southern          |
| <span style="border: 2px solid green;"> </span> DSS catchments    | <span style="background-color: #ffe0e0; border: 1px solid black;"> </span> Trapped Low lands |



Figure 15. Sub-catchment delineation for Merrimu PSP area

Table 1. Sub-catchments for the Merrimu PSP area

| Sub-catchment | Major catchment | Area (ha) | Comment                                                                                                                                                                                                                         |
|---------------|-----------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1             | Buckleys Rd     | 14.6      | Catchment 1 outfalls southwest on proposed uncredited open space. Flows are carried through proposed DSS pipe to Catchment 3A.                                                                                                  |
| 2A            | Buckleys Rd     | 49.42     | Catchments 2A and 2B outfall west into Catchment 3A via proposed DSS pipe                                                                                                                                                       |
| 2B            | Buckleys Rd     | 8.86      |                                                                                                                                                                                                                                 |
| 3A            | Buckleys Rd     | 73.64     | Catchments 3A and 3B outfall at the proposed southwest uncredited open space, following to Buckleys Road through proposed DSS pipe to outfall west via proposed culverts and ultimately into the tributary of Lerderderg River. |
| 3B            | Buckleys Rd     | 8.39      |                                                                                                                                                                                                                                 |
| 4A            | Flanagans Run   | 50.14     | Catchment 4A outfalls southeast at proposed credited open space                                                                                                                                                                 |
| 4B            | Flanagans Run   | 39.35     | Catchment 4B outfalls south through Catchment 4C. Flows are carried through proposed DSS pipe to Catchment 4C's southern uncredited open space.                                                                                 |
| 4C            | Flanagans Run   | 69.74     | Catchment 4C outfalls west through Catchment 4D. Flows are carried through proposed DSS pipe to Catchment 4D's southern uncredited open space.                                                                                  |
| 4D            | Flanagans Run   | 34.12     | Flows up to 20% AEP: Catchment 4D outfalls east, along the ridge line into the tributary of Pyrites Creek<br>Flows above 20% AEP: Catchment 4D outfalls northeast via the gully into the tributary of Pyrites Creek             |
| 4E            | Flanagans Run   | 32.09     | Flows up to 20% AEP: Catchment 4E outfalls west through Catchment 4D<br>Flows above 20% AEP: Catchment 4D outfalls south via the gully into the tributary of Pyrites Creek                                                      |
| 5A            | Southern        | 99.27     | Catchment 5A outfalls south through catchment 5B, carried through proposed DSS pipe.                                                                                                                                            |
| 5B            | Southern        | 29.81     | Catchment 5B outfalls southwest and flows are carried through proposed DSS pipe across catchment 5C, outfalling at Pyrites Creek.                                                                                               |
| 5C            | Southern        | 50.83     | Catchment 5C outfalls east of its catchment boundary into Pyrites Creek.                                                                                                                                                        |
| 5D            | Southern        | 11.98     | Catchment 5D outfalls east of its catchment boundary into Pyrites Creek.                                                                                                                                                        |

## Stormwater Quantity

The stormwater pipe network was sized using the Rational Method to estimate peak design flows for the 1% AEP design event. A fraction impervious of 0.10 was adopted across the contributing catchments for runoff estimation. The sub-catchments, location of flows at key points of interest and summary of the pipe sizing are shown in Figure 16 and detailed in Table 2.

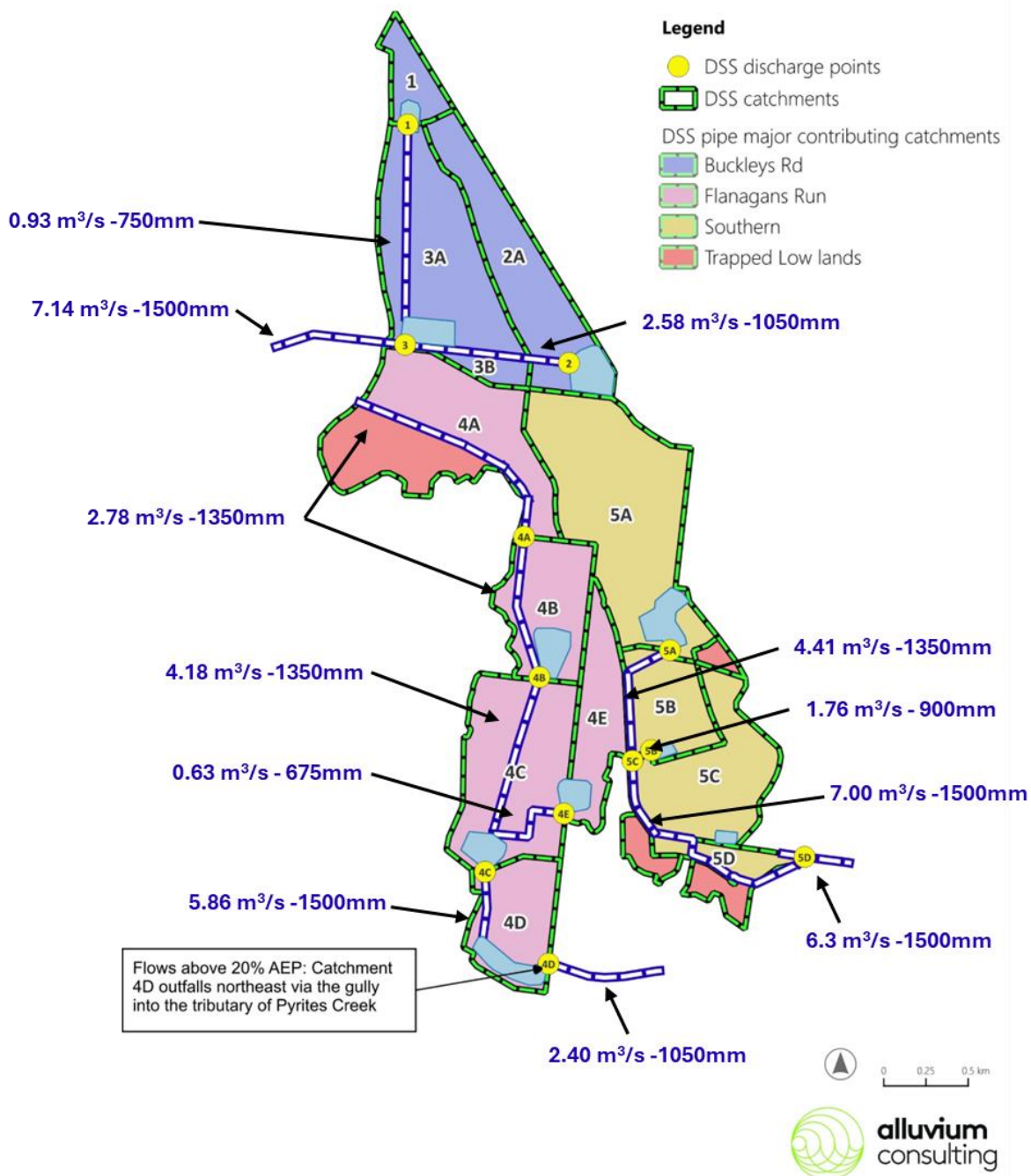


**Figure 16. Proposed DSS pipes**

The rainfall intensity was selected based on the calculated time of concentration ( $t_c$ ) for each pipe reach. The time of concentration incorporated upstream travel times and pipe flow times, accounting for pipe length, hydraulic grade, and flow velocity.

Pipe grades were determined from the longitudinal layout and ground levels, and full-flow hydraulic capacity was assessed based on pipe diameter, slope, and calculated velocities. Pipe diameters were

then selected to safely convey the 1% AEP peak discharge without exceeding acceptable hydraulic capacity limits.

**Table 2. Ultimate flows (refer to Figure 14 for flow locations)**

| Location | Contributing catchment | Area (ha) | tc (min) | I (1% AEP -mm/h) | Flows (1% AEP) (m <sup>3</sup> /s) | Indicative pipe size (mm) |
|----------|------------------------|-----------|----------|------------------|------------------------------------|---------------------------|
| 1        | 1                      | 14.59     | 9.48     | 120.14           | 0.93                               | 750                       |
| 2        | 2A + 2B                | 58.28     | 19.18    | 83.68            | 2.58                               | 1050                      |
| 3        | 1+2A+2B+3A+3B          | 154.88    | 18.19    | 87.27            | 7.14                               | 1500                      |
| 4A       | 4A                     | 50.14     | 13.26    | 105.16           | 2.78                               | 1350                      |
| 4B       | 4A + 4B                | 89.49     | 17.89    | 88.37            | 4.18                               | 1350                      |
| 4C       | 4A+4B+4C+4E*           | 159.23    | 25.93    | 69.73            | 5.86                               | 1500                      |
| 4D*      | 4A+4B+4C+4D*+4E*       | 193.35*   | 33.3*    | 59.6*            | 6.08*                              | 1050*                     |
| 4E*      | 4E*                    | 32.09*    | 16.36*   | 93.9*            | 1.59*                              | 675*                      |
| 5A       | 5A                     | 99.27     | 19.05    | 84.15            | 4.41                               | 1350                      |
| 5B       | 5B                     | 29.81     | 11.42    | 111.86           | 1.76                               | 900                       |
| 5C       | 5A+5B                  | 129.08    | 23.83    | 73.62            | 5.02                               | 1350                      |
| 5D       | 5A+5B+5C+5D            | 191.89    | 30.07    | 62.14            | 6.3                                | 1500                      |

\*The outfall pipe is proposed to convey up to the 20% AEP event flows and follow the existing ridgeline, providing a longer outfall alignment that reduces outfall slopes before outfalling southeast into the tributary of Pyrites Creek. Flows above the 20% AEP event will spill away into the local gully and ultimately into the tributary of Pyrites Creek.

## Proposed Pipe Outfall Design

The subject site is characterised by a significant escarpment separating the elevated plateau from the downstream creek corridor. The fall across the plateau (which slopes north to south and to a lesser extent, west to east) and the steep escarpment presents substantial grade challenges for conventional gravity drainage, particularly where trunk outfall pipes are required to transition from the upper development areas down to the lower receiving environment.

To manage this level difference in a controlled and serviceable manner, the proposed outfall strategy adopts a nominal pipe grade of 1 in 100 for all trunk outfall alignments along the steep escarpment. This consistent design grade has been selected to:

- Maintain hydraulic capacity and self-cleansing velocities
- Avoid excessive pipe depths at upstream locations
- Provide constructability consistency across all outfall alignments

Given the steep escarpment, a continuous 1 in 100 grade alone is insufficient to traverse the full vertical drop between the plateau and the creek. Accordingly, a series of drop pits are incorporated at defined intervals to step the pipeline down the escarpment in a controlled manner.

The proposed drop pits range from approximately 0.5 m to a maximum of 4.0 m per structure, depending on local topography and alignment constraints. This stepped arrangement allows the system to:

- Manage excessive longitudinal grades
- Control energy dissipation
- Minimise deep trenching and associated construction risk
- Maintain structural feasibility within the escarpment zone

The number of drop pits required varies for each outfall alignment and is dependent on total alignment length and overall level difference between upstream and downstream connection points.

| <b>Outfall Catchment</b>    | <b>Overall Length (m)</b> | <b>Upstream Invert Level (m AHD)</b> | <b>Downstream Invert Level (m AHD)</b> | <b>Overall Level Difference (m)</b> | <b>No. of Drop Pits Required</b> | <b>Max Drop Height (m)</b> |
|-----------------------------|---------------------------|--------------------------------------|----------------------------------------|-------------------------------------|----------------------------------|----------------------------|
| Buckelys Rd                 | 790m                      | 192.32                               | 130.43                                 | 62m                                 | 17                               | <=4.0m                     |
| Flanagans Run (Original)    | 171m                      | 145.50                               | 134.40                                 | 11.1m                               | 5                                | <=4.0m                     |
| Flanagans Run (Proposed)*   | 680m                      | 146.00                               | 100.64                                 | 45.36m                              | 11                               | <=4.0m                     |
| Southern Outfall (Original) | 220m                      | 150.60                               | 90.41                                  | 60.19m                              | 16                               | <=4.0m                     |
| Southern Outfall (Proposed) | 595m                      | 149.45                               | 89.67                                  | 59.78m                              | 16                               | <=4.0m                     |

For detailed information on the concept design of proposed outfall pipe, please refer to the AutoCAD drawing package.

## Limitations of Pipe Outfall Design

### O'Connell Road outfalls

As per the Place Based Plan for the Merrimu Precinct Structure Plan (PSP) area provided by Melbourne Water, Alluvium understands that the development of O'Connell Road is no longer proposed. The original drainage strategy for this catchment relied on this road corridor to convey flows south along a steep escarpment before ultimately discharging southwest to the receiving creek.

While the future major road infrastructure associated with O'Connell Road development is no longer proposed as part of the PSP, the existing road reserve remains available and may still provide a feasible corridor for the original outfall alignment. The original O'Connell Road outfall concept therefore remains a potential servicing option with the requirement of further investigation, design refinement and confirmation of an appropriate drainage corridor.

However, given the steep escarpment terrain and the associated constructability, servicing and drainage constraints along the original outfall alignment, alternative outfall arrangements were also explored as part of this assessment..

An alternative northern outfall option (via Buckleys Rd outfall catchment) was firstly investigated; however, this was deemed infeasible due to the rising topography, with ground levels increasing more than 5 metres in the northward direction. Achieving gravity drainage would require excessive excavation depths, which is not considered practical or economically viable. Accordingly, this option was not pursued further.

Our revised concept proposes redirecting flows to the southeast to connect into the adjacent downstream catchment (via Flanangans Run outfall catchment). While this approach is hydraulically achievable, it introduces constraints associated with a locally trapped low-lying sub-catchment (shown in red in Figure 15). The surrounding terrain creates a topographic bowl condition, with insufficient grade to enable gravity discharge to the north or east. As a result, the southeastern outfall arrangement may generate a locally isolated drainage area requiring additional stormwater management measures (for example via some combination of pumping, infiltration and/or evaporation)

Further detailed investigation will therefore be required to confirm servicing strategy and mitigate impacts within this trapped sub-catchment. Potential solutions may include localised treatment and detention systems such as bio-retention assets, on-site detention, or rainwater harvesting for reuse to manage runoff volumes and maintain compliance with drainage and water quality objectives.

## Southern outfalls

Similar to the O'connell Road catchment, the currently proposed strategy for the southern outfall catchment involves directing flows toward the southeast to connect into the downstream drainage system. While this alignment is hydraulically achievable for the broader catchment, the red-shaded areas shown on Figure 15 represents a locally trapped sub-catchment constrained by surrounding higher ground. The contour pattern indicates that gravity discharge to the north or west is not feasible due to rising terrain, and levels within these pockets sit lower than adjacent connection points. As a result, these areas do not have a natural gravity outlet and may become isolated under the revised outfall arrangement. Further investigation will be required to determine appropriate local stormwater management measures—such as on-site detention, bio-retention systems, or rainwater harvesting—to manage runoff within this trapped terrain condition.

# Conclusion and recommendations

This report has assessed the hydrological characteristics and drainage servicing strategy for the Merrimu PSP area, including catchment delineation, peak flow estimation and concept outfall design. The proposed pipe network has been developed at concept level to safely convey ultimate development flows while responding to significant topographic constraints, particularly the escarpment separating the plateau from the downstream creek systems. Revisions to broader infrastructure planning have required reconsideration of outfall pathways, resulting in identified constraints associated with locally trapped sub-catchments. The key conclusions and recommended next steps are summarised below.

- The 'waterway' that would convey flows from the Flanagans Run outfalls to Pyrites Creek is not well defined and the mapped feature does not align with any such waterway that would be able to convey flows post-development. The most substantial challenge is how flows will cross the Western Freeway, noting that directing surface water westwards adjacent to the freeway (along either the north or southern side of the freeway) and then discharging directly into the Lerderderg River may be the most feasible option – although this requires further investigation to confirm.
- The proposed DSS pipe network and concept outfall arrangements has been sized and developed to convey the 1% AEP design flows under ultimate development conditions, adopting appropriate times of concentration, rainfall intensities and hydraulic capacity checks.
- Due to the significant escarpment separating the plateau from downstream creek corridors, trunk outfall pipes require a controlled stepped arrangement. A nominal grade of 1 in 100 has been adopted with a series of drop pits (0.5 m to 4.0 m maximum drop) to safely transition levels while maintaining constructability.
- While the future major road infrastructure associated with O'Connell Road is no longer proposed as part of the PSP, the existing road reserve may still provide a feasible corridor for the original O'Connell Road outfall alignment. Due to the steep escarpment terrain and associated constructability and servicing constraints, alternative outfall arrangements were also explored as part of this assessment. An alternative northern outfall direction was assessed but is not considered feasible under a gravity drainage arrangement due to significant rising terrain.
- The Southern Outfall arrangement is considered hydraulically feasible at concept level; however, locally trapped sub-catchments have been identified where gravity discharge is constrained by surrounding topography. Further detailed design and investigation will therefore be required to confirm the preferred servicing approach and determine appropriate local stormwater management measures within these constrained low-lying areas.
- The proposed Flanagans Run outfall arrangement is also considered feasible at concept level, provided flows are conveyed via the proposed controlled piped outfall system to the lower downstream discharge location. Direct discharge to the upper headwater and escarpment sections of Flanagans Run is not considered appropriate due to the presence of highly dispersive sodic soils, active erosion processes and associated geomorphic risks.

