APRIL 2025

Planning for drainage in Bannockburn South East Precinct Structure Plan

The VPA has commissioned Alluvium to prepare two documents for drainage in Bannockburn South East:

- Stormwater Drainage Concept Design Report (March 2025); and
- Memo on railway outfall optioneering (April 2025).

The **Stormwater Drainage Concept Design Report (March 2025)** has informed the current draft Place Based Plan for exhibition. The Concept maintains no additional post-development flows into existing railway culverts, maintaining current railway culvert downstream capacity. It avoids significant works to the railway easement and southern properties outside the precinct. Subsequently, it requires large areas for drainage assets within the precinct.

The railway culverts are under the Gheringhap-Maroona railway line which is used for freight. The easement is owned by VicTrack and managed by Australian Rail Track Corporation (ARTC).

VPA are aware that VicTrack does not currently support the Stormwater Drainage Concept Design Report (December 2024). VicTrack has requested that VPA consider an alternative arrangement that does not direct any runoff to the existing railway culverts regardless of whether post-development flows remain unchanged.

As a result, the VPA has requested that Alluvium prepare an additional document, **Memo on railway outfall optioneering (April 2025)** or 'the Memo'. The Memo provides an overview of three drainage concepts designs:

- Concept #1 has been superseded.
- Concept #2 is reflected in the Stormwater Drainage Concept Design Report (December 2024). This concept is currently reflected in the draft Precinct Structure Plan for exhibition.
- Concept #3 includes two drainage sub-options assessed at a high-level in the memo.

The intent of the Memo is to provide the VPA, Council, VicTrack and ARTC with further information regarding options to address rail authorities' concerns regarding railway outfall. There is no agreed decision from stakeholders and the VPA are working with Council, VicTrack and ARTC to resolve this matter.

While the PSP is being exhibited with drainage Concept #2, the options for Concept #3 will continue to be explored.

If Concept #3 is confirmed as preferred, works outside the precinct will be required. For works outside the Precinct the VPA and Council have agreed to apply the Public Acquisition Overlay (PAO). In lieu of a whole agency-preferred arrangement for the railway outfall, the VPA has identified the likely extent for where the PAO may be applied south of the railway. The extent will be refined prior to approval of the Bannockburn South East amendment should Concept #3 be the preferred outcome.

Memo

Subject	Railway outfall optioneering
Project	Bannockburn South East Precinct Structure Plan Stormwater Drainage Design
Distribution	Patricia Ocampo (VPA)
Date	16 April 2025
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1 Introduction

The Victorian Planning Authority (VPA), in collaboration with Golden Plains Shire, is developing the Precinct Structure Plan for Bannockburn South East. Alluvium has been engaged by the VPA to prepare concept and functional drainage designs and associated cost estimates.

This memo documents the high-level assessment of a third option, relevant to retarding basins outfalling through the railway line, to subsequently be progressed into a concept design and ultimately a functional design. The intent of the memo is to provide the VPA, Council and stakeholders with sufficient information to guide them on which option to progress into a third concept design.

2 Background

Concept #1

Alluvium delivered a draft proof of concept design report for the drainage design in October 2023. One of the key challenges for the drainage design in this precinct is the outfall constraints. The southern boundary of the precinct is bound by the railway line. Currently, the precinct drains in a southerly direction through several small and shallow culverts under the railway line, with limited capacity.

This poses challenges in terms of limiting outflows from the developed precinct, as well as the ability to outfall from any deeper retarding basins and associated outfall pipes. The limited existing culvert capacity is demonstrated in the CCMA supplied flood mapping, where water can be seen to pool behind the railway. VicTrack has advised that the culverts are not licensed, either to the local Council or to a Catchment Management Authority and it therefore considers their use is solely for transport purposes.

For the strategy (concept #1) presented within the proof of concept report (October 2023), it was agreed with the VPA to retard back to existing peak flows at the boundary of the development (immediately upstream of the railway line reserve), and not to existing culvert capacity flows (which is smaller). Required downstream channel works were identified to meet lower outfall levels and capacities and were documented at a high level (Figure 1). The downstream channel works would need to ensure the increased flows are contained within a channel, and the channel invert ties into an appropriate level downstream. The feasibility of these downstream works would need to be explored with the relevant landholders. No detailed concept was produced for the outfall works.

Following the delivery of the proof of concept report, the proposed retardation, outfall arrangement and downstream channel works were identified as a key concern from the various stakeholders. A series of meetings and phone calls were held between the VPA and Alluvium to discuss these concerns and explore potential alternative drainage arrangements.

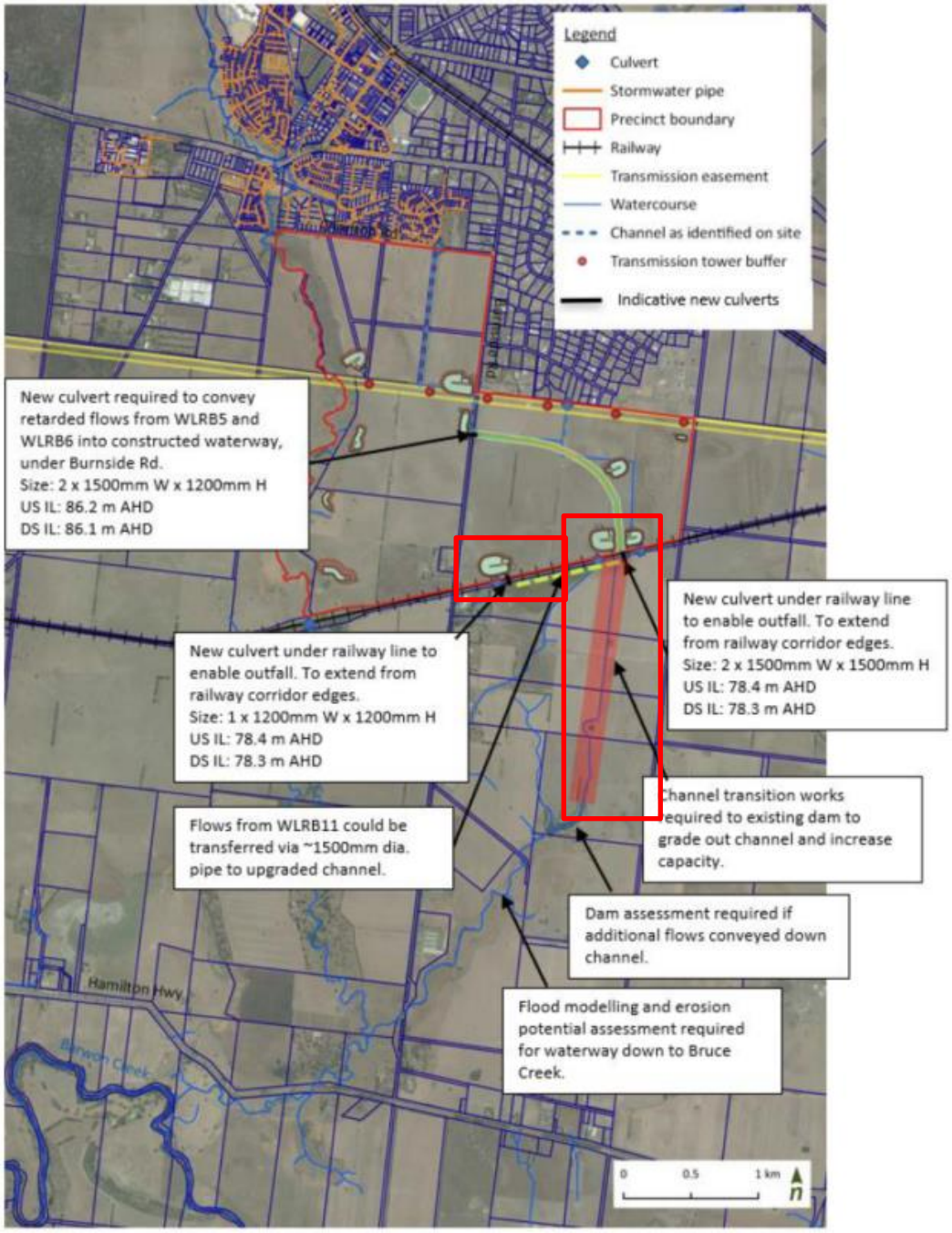

Figure 1. *Concept design #1 showing relevant RBs and downstream channel works in red (October 2023)*

Concept design #2

A second concept design was drafted in September 2024 and completed by December 2024, which explored an alternative retardation arrangement, as agreed with the VPA. That is, one that ensures no adverse impact on flood conditions downstream of the precinct and to limit capacity of outflows to the obvert of the existing culverts. This meant that the retarding basins which outfall south beyond the railway line need to retard post-development flows beyond the existing peak 1% AEP flows for their contributing catchment (at the railway boundary).

The target RB outflow (and therefore precinct outflow) used to size the required storage basins was determined by calculating the capacity of the railway culverts whereby the culvert obvert was not exceeded. This assumed that overtopping of the railway tracks does not occur, as it currently does. This target flow rate is therefore less than the pre development flow downstream of the railway. This resulted in upsizing of the

required storages for WLRB5, WLRB6, WLRB7, SBRB8, WLRB9, WLRB10 and WLRB11, when compared to the original concept arrangement.

This option looked at no lowering of the existing railway culverts, and therefore requires no works or Public Acquisition Overlays (PAOs) outside of the PSP.

In this design iteration all assets were updated to reflect the latest PSP land use catchment assumptions. Additionally, no assets were placed in culturally sensitive areas. Therefore, all proposed concept designs throughout the precinct were updated.

In addition to the above design and reporting updates, the original stakeholder comments (provided in February 2024) were considered and addressed in the reporting, where appropriate and covered within the project scope. Feedback such as major asset design changes or changes to the outfall approach were not addressed – this was considered further optioneering. The report was finalised in December 2024 (Figure 2).

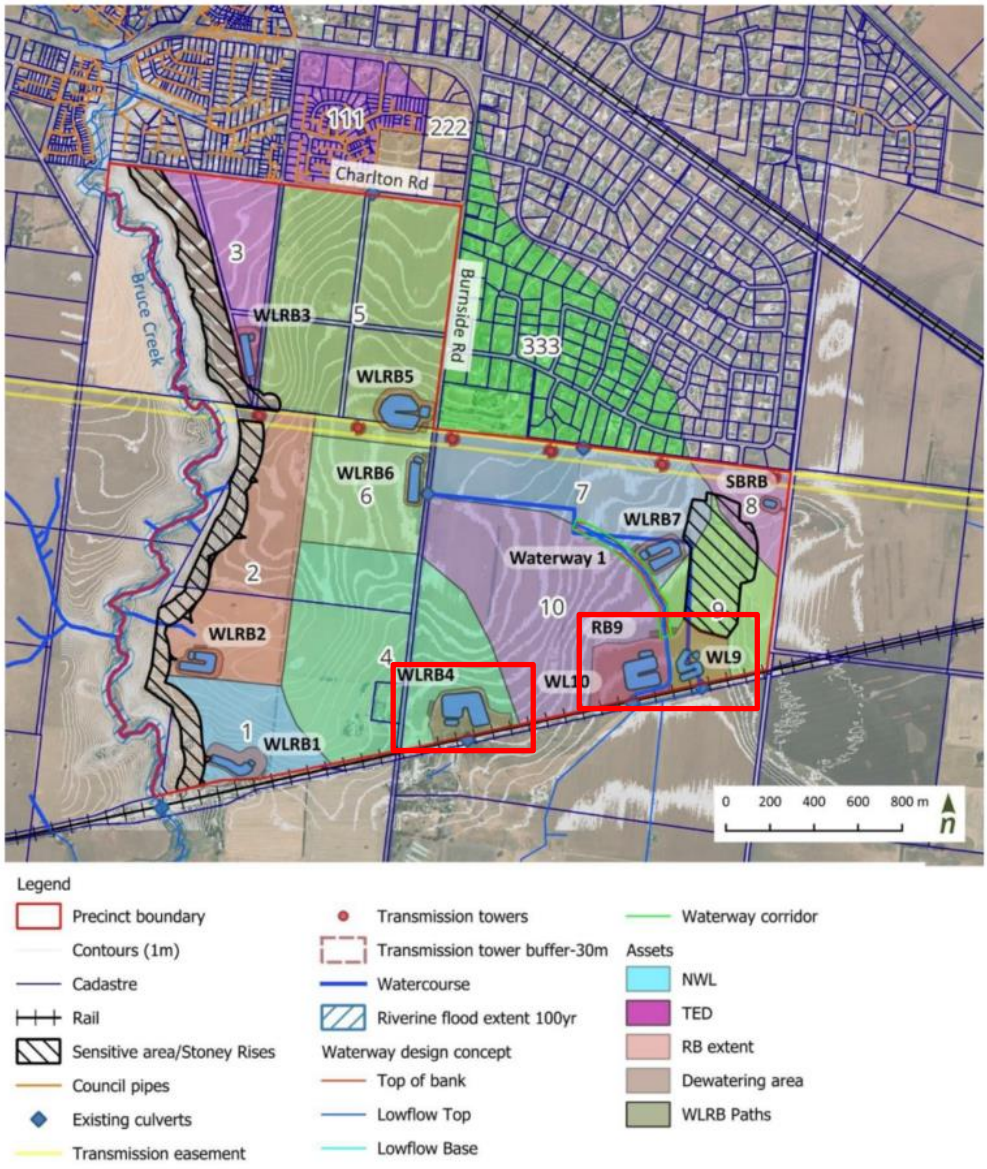

Figure 2. *Concept design #2 showing relevant RBs in red (December 2024)*

Concept design #3

Through consultation with VicTrack it has been confirmed that VicTrack oppose use of their culverts in any way, even if current flows are maintained/improved, considering a change in land use is going to occur.

Therefore, the VPA has instructed Alluvium to consider an alternative option which outfalls into the downstream area via upgraded outfall under the railway. This is a third concept option to be developed.

Alternative options relevant for WLRB4 and RB9 include:

- Option A: Installing new culverts under the railway that are the same size and depths as the current ones. This option would require minor works outside of the precinct to ensure the culverts connect to existing drainage swales.

- Option B: Installing syphons under the railway line. The main consideration for this option is that it would require a small pond outside of the precinct (connected to the syphon).

The VPA have indicated that the option should satisfy the following requirements:

- New culvert /syphon
- Retention of existing rail culverts as is.
- No draining into the rail corridor
- If new culverts they are to be approximately the same invert level as the existing culverts
- Flow rate/capacity of new culverts to be confirmed.
- Minimum cover to top of new culverts to be 1.20m in accordance with current Vic Track design guidelines.
- Suitable drainage treatment within the PSP on the north side of the rail.
- Suitable drainage treatment on the south side of the rail
- Minimise land take and works on the south side of the rail as far as is practicable.
- RBs along Bruce Creek to remain as per previous, discharging to the creek.
- VicTrack requirements, as provided.

The intent of this memo is to assess, at a high-level, the possible options to develop into a third concept (e.g. new culverts vs syphon). This memo will include a rough mud map of the possible options, pros and cons, considerations, and a recommendation on which to progress into a concept design, and subsequently functional design. Ultimately, the preferred option will be up to the VPA and Council to confirm, in consultation with stakeholders.

A limitation of this memo is that revised modelling (e.g. hydrologic modelling) for retarding basins has not yet been undertaken – this will occur when the preferred option is developed into concept #3.

3 Concept #3 optioneering

The retardation for concept #3 is different to concept #1 and #2 for the basins outfalling south. This approach will seek to confirm pre-development flow rates exiting the precinct (i.e. immediately downstream of the tracks). That is, calculating the existing 'storage' immediately upstream of the railway tracks and including this in the existing conditions hydrologic model, along with the current culverts outfalls through the railway track. This will enable an accurate capture of total flows (i.e. culvert plus flows overtopping the railway track) at the precinct outfalls, and therefore this becomes the target flow rate to retard post-development flows back to. These flows are likely to be less than the targets for concept #1 (which didn't include 'storage' behind the railway tracks nor did it assume any outfall restrictions), but more than concept #2 (which didn't include 'storage' behind the tracks and assumed no overtopping of the tracks). This would result in a larger basin requirement when compared to concept #1, but smaller than concept #2.

The outfall approaches are summarised in Table 1.

Table 1. Summary of concept design outfall approaches for retarding basins outfalling south through railway track

Concept	Outfall infrastructure through railway track	Outflow targets through railway track
Concept #1	New culverts, larger and deeper than existing. Channel works to enable outfall from new culverts required.	Pre-development peak 1% AEP flows from the contributing catchment upstream of the railway reserve boundary (i.e. does not account for 'storage' behind the railway and further reduction in flows). Flow targets higher than existing downstream conditions.
Concept #2	Utilise existing railway culverts (small and shallow)	Existing culvert capacity (assuming flow does not exceed culvert obvert; no overtopping of railway). Flow targets less than existing downstream conditions.
Concept #3	New culverts OR syphon. Both will need to ensure 1.2m clearance to track from obvert.	Pre-development peak 1% AEP flow rates exiting the precinct including impact of railway (i.e. immediately downstream of the tracks). Includes existing culvert capacity and overtopping of track, as well as 'storage' behind tracks. Flow targets in line with existing downstream conditions

3.1 Option A: New culverts

Overview

- Option A would be to install new culverts under the railway line, so the development can drain through these as opposed to the existing culverts.
- The bank of culverts would be sized to enable a peak outflow that matched the target outflow. The sizing has not yet been undertaken.
- The intent was originally that these culverts would have the same invert levels of the existing culverts, so to minimise works outside of the precinct. However, **the current culverts do not meet the minimum 1.2m clearance from the top of the culverts to the railway. Therefore, any new culverts will have to be lowered to meet this requirement.**

- The new culverts would need to extend across the full length of the railway easement.
- The installation of new culverts would result in **minor works being required outside of the precinct given they need to be lowered**, and to ensure free-draining outfall. The existing drainage channels would need to be deepened for a short stretch.
- RB4
    - At RB4 the new culverts are proposed at a location near the wetland outlet. There is no existing defined drainage channel outside of the precinct for the outfall to connect into.
    - It should be noted that track levels drop from west to east, so shifting the new culverts further east results in a need to lower them further and thereby increasing works needed outside of the precinct.
    - The culverts would need to be at an upstream invert level of at least approximately 80.3 m AHD (assuming a minimum culvert height of 600mm) at the proposed culvert location, and a downstream level of approximately 80.2 m AHD.
    - Outfall channel works would be required for a length of approximately 85m to match into existing surface levels. A minimum of 5m width has been allowed for at the culvert upstream end. The channel works would taper as they tie into existing surface levels.
    - The proposed location of the channel works does indicate tree/vegetation removal from the aerial – the alignment may need to change if these cannot be removed. There is some flexibility in the outfall channel alignment, so long as it follows the natural fall of the land.
    - Other considerations: The outfall from the existing railway culverts may be feeding the nearby dam (it is challenging to ascertain from contours). Formalising a channel as proposed may cut off flows into the dam.
- RB9
    - The new culverts are proposed to align with the existing drainage channel downstream of the precinct. There is a defined channel to connect into.
    - The culverts would need to be at an upstream invert level of at least approximately 76.15 m AHD (assuming a minimum culvert height of 600mm) at the proposed culvert location, and a downstream level of approximately 76.05 m AHD. This is approximately 1m deeper than existing channel levels (according to LiDAR). The LiDAR may be picking up water levels in which case the excavation requirements might not be as great in reality.
    - Outfall channel works would be required for a length of approximately 368m to match into existing surface levels (76 m AHD). A minimum of 8m width has been allowed for at the culvert upstream end. The channel works would taper as they tie into existing surface levels.
- Treatment sizing (wetlands and sediment basins) is as per concept design #2.

Indicative mud maps showing the required outfall infrastructure are provided in Figure 3 and Figure 4. The retarding basins have not yet been resized – this will occur once the preferred option is provided to Alluvium.

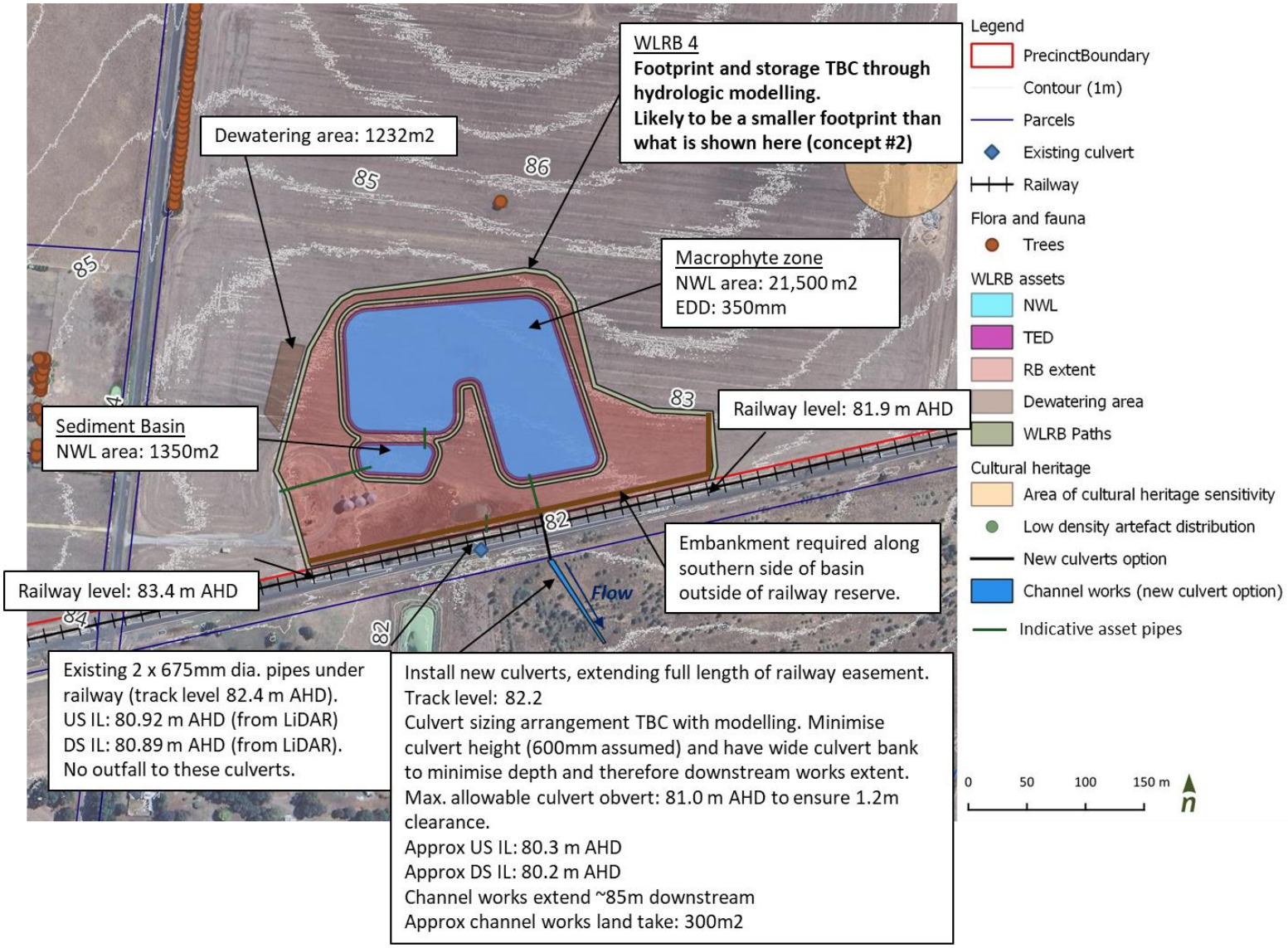

Figure 3. *Indicative RB4 new culvert option (noting retarding basin has not yet been resized)*

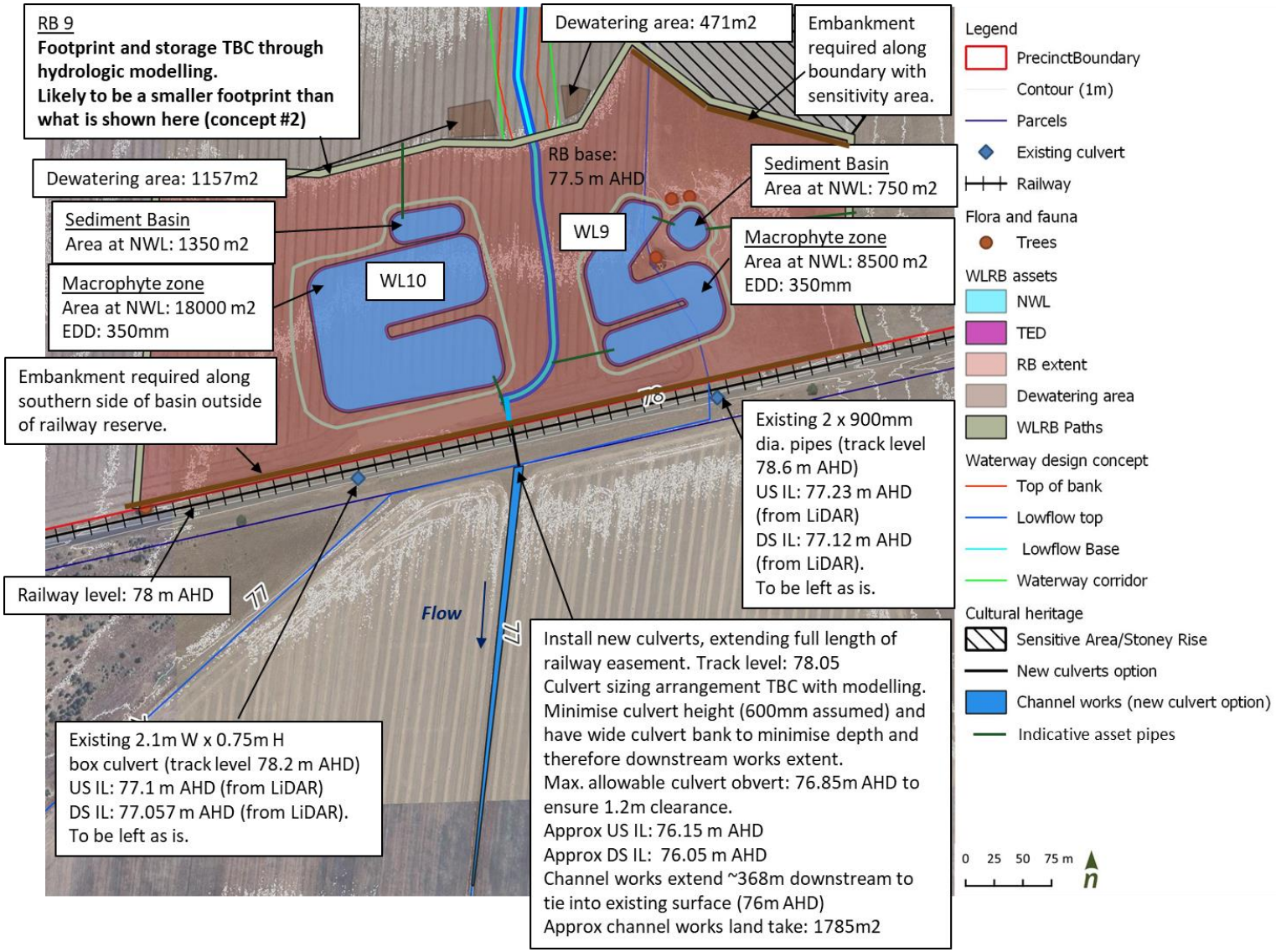

Figure 4. *Indicative RB9 new culvert option (noting retarding basin has not yet been resized)*

3.2 Option B: Inverted syphon

Overview

- Option B would be to install inverted syphons under the railway line, so the development can drain through these as opposed to the existing culverts.
- The syphon would need to be sized to enable a peak outflow that matched the target outflow.
- The syphon would need to be at a sufficient depth to ensure 1.2m clearance from the top of the syphon to the railway tracks.
- The syphons would need to extend across the full length of the railway easement.
- The installation of syphons would result in **minor work required outside the precinct – a small pond would be required for each of the syphons that service RB4 and RB9.** These essentially would be like sediment basins, and will need to be a minimum of approximately 210m^2 to allow for a 1.5m depth below Normal Water Level and appropriate grades, including a safety bench. 300mm freeboard from the NWL to existing surface has nominally been allowed for, at a 1 in 5 grade.
- A 4m buffer has been allowed for around the ponds for access.
- **The total land take, outside of the precinct, for each pond is 710m^2 (required for RB4 and RB9).**
- The location of the syphon and connected balancing pond for RB9 aligns with the existing drainage channel. Water will spill from the pond south down the existing drainage channel.
- The location of the syphon and balancing pond for RB4 is more flexible. It has been placed near the end of the wetland so to limit wetland outlet pipe length and subsequently costs. It has also been placed so to align with the low point of the landscape outside of the precinct. There is no defined drainage channel here, so the water will spill from the pond and flow across the landscape as it currently does.
- Treatment sizing (wetlands and sediment basins) is as per concept design #2.

Indicative mud maps showing the required outfall infrastructure are provided in Figure 5 and Figure 6. The retarding basins have not yet been resized – this will occur once the preferred option is provided to Alluvium.

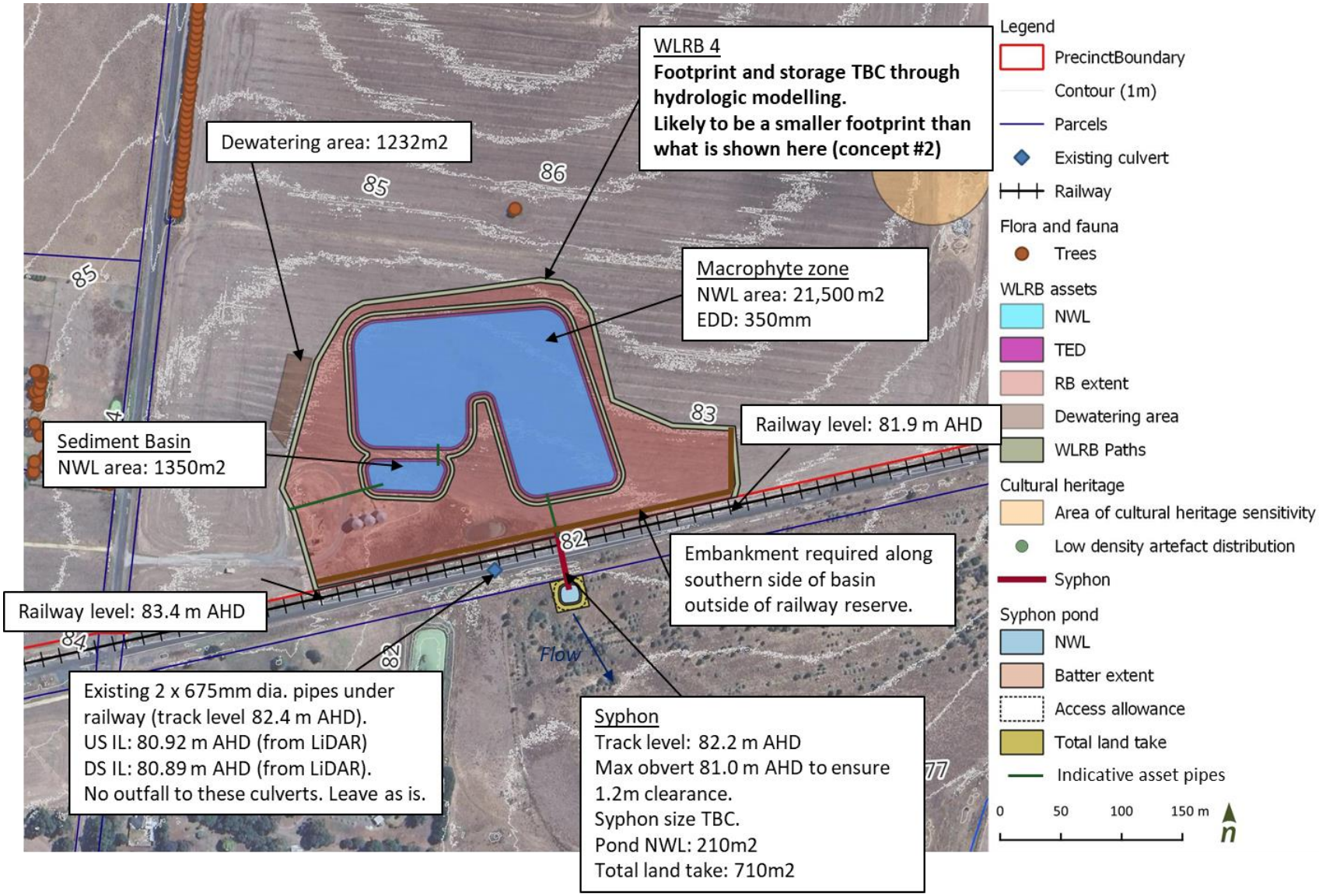

Figure 5. *Indicative RB4 syphon option (noting retarding basin has not yet been resized)*

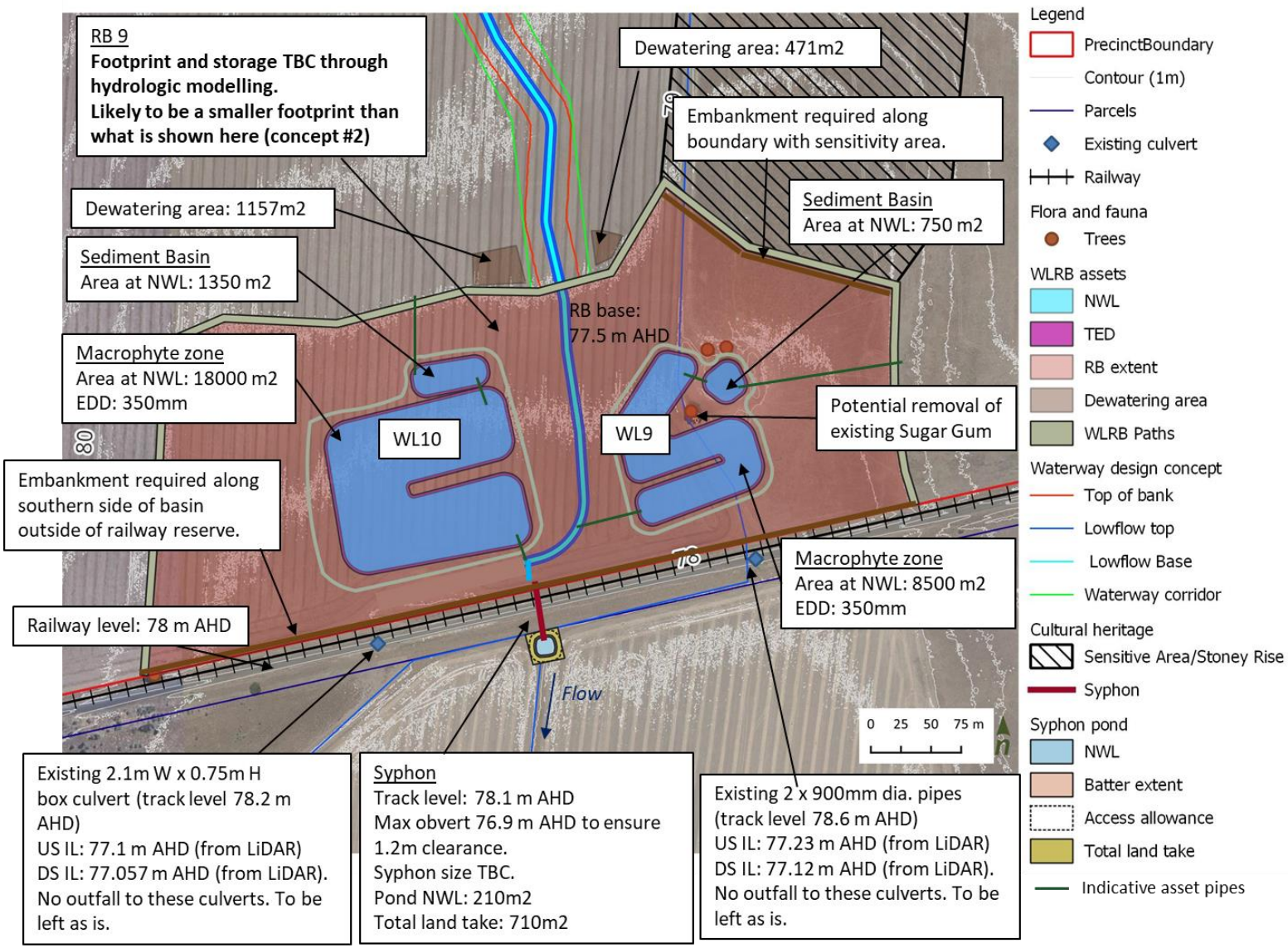

Figure 6. *Indicative RB9 syphon option (noting retarding basin has not yet been resized)*

Comparison of options
A brief comparison of the two options is provided in Table 2.

Table 2. Comparison of options

	Option A: new culverts	Option B: inverted syphons
Land take outside of precinct	RB4: 300m^2 RB9: 1785m^2	RB4: 710m^2 RB9: 710m^2
Pros	• Smaller land take outside of precinct for RB4 outfall. • Meets VicTrack 1.2m clearance requirements. • There is a defined drainage channel to connect into for the RB9 outfall. • Minimal maintenance requirements of outfall channel once established with vegetation.	• Smaller land take outside of precinct for RB9 outfall. • Meets VicTrack 1.2m clearance requirements. • There is a defined drainage channel to connect into for the RB9 outfall balancing pond. • Land take outside of precinct is more compact in nature. • Not as easily impacted by railway cover requirements.
Cons	• Land take outside of precinct for both outfalls cover long distances, not compact locations. No additional allowance has been made for access alongside the channel. • Culverts need to be deepened to meet the 1.2m clearance requirements. This results in needing to have extended channel works to enable free-draining outfall, and to tie into existing surface levels. • There is no defined drainage channel to connect into for the RB4 outfall channel works. • Tree removal potentially required for RB4 outfall channel works alignment (noting there is some flexibility in alignment given no defined drainage channel)	• Some maintenance of balancing pond may be required over time to dewater and remove any accumulated sediment. • Siphons can be difficult to maintain/clean and may not be acceptable to council

4 Stakeholder meeting

Following the delivery of a draft memo, a meeting was held on 28th February 2025 with representatives from VicTrack, ARTC, Council and the VPA to:

- discuss the railway outfall drainage options as a group;
- understand Council, VicTrack and ARTC preferred option for the railway outfall (if any).

General outcomes from the meeting were:

- VicTrack and ARTC required further information, modelling and detail to be able to provide a preferred option.

- VicTrack and ARTC reiterated the importance of the provision of lateral track drainage in any future design scenario. This refers to drainage parallel to the railway which prevents the track from being damaged.

- Council have not formalised their position on a preferred approach.

- Despite the above, the discussion indicated that a new culvert option appeared to be the more likely option due to access and maintenance challenges associated with a syphon. It was noted that a syphon would incur on going costs annually for the infrastructure to be in the rail corridor (infrastructure licence).

- Vic Track advised that in their role as rail property owner they avoid requiring the rail operator (in this case ARTC) to maintain rail culverts and this is typically included in a licence agreement with the local Council. Maintenance agreements need to be established. VicTrack and ARTC expectation is that Council maintains any new culverts.

- Top of drainage pipes under tracks shall not be less than 1.2m below top of rail level.

- Risk assessments such as ANCOLD assessments would be expected to be undertaken in later design stages by developers, prior to any development.

4.1 Post-stakeholder meeting

Following the stakeholder meeting, some additional information and requirements were provided.

- The VPA have indicated that a minimum buffer of 10m from the outer edge of the railway easement to any drainage works should be provided.
- Maintenance access will need to be provided for any downstream channel works associated with the new culverts option. A minimum of 4m either side of the channel has been provided. Any additional access requirements would need to be confirmed by Council.
- Key VPA concerns are:
    - Minimising any outfall works to reduce impacts on the land and any sensitive values.
    - Minimising costs for any outfall work which will be funded by the DCP.
    - Facilitating the drainage treatment within the PSP and under the railway line.