DESIGN REPORT

ESR

Westlink Stage 2, Kemps Creek – Naturalised Trunk Drainage Channel Design

3 April 2025

Prepared by

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Version control

Issue	Author	Reviewer	Approver	Date Approved
A	TM/PJM	PJM	PJM	14/08/2024
B	CR	PJM	PJM	24/01/2025
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D	CR	PJM	PJM	21/03/2025
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1. INTRODUCTION

This Design Report includes information on the design rationale and supporting key information used in developing the detailed engineering design for the Westlink Stage 2 naturalised trunk drainage channel, located at Kemps Creek. The design of the drainage channel has been developed in close consultation with Sydney Water, with several options being considered to address the site constraints.

The Stage 2 trunk drainage channel is located within Westlink at Abbotts Road Kemps Creek within the Mamre Road Precinct and is being developed by ESR. Engineering design of the site adjacent to Stage 2 trunk drainage channel is being undertaken by others (primarily AT&L Engineers), which includes bulk earthworks, roadworks, stormwater drainage, and utility services.

As required by the Planning Secretary’s Environmental Assessment Requirements (SEARs) for Lot 4 and 5, a Flood Impact Risk Assessment (FIRA) has also separately been prepared by J.Wyndham Prince. This FIRA Report has considered any potential flood impacts and risks in accordance with the NSW Flood Risk Management Manual (2023) and Section 2.5 of the MRP DCP along with the emergency management and response strategy for local catchment (and / or overland) and mainstream flooding.

The Stage 2 channel is a key trunk element within the overall Westlink Estate. The detailed design has carefully considered all interfaces with surrounding development areas to ensure that flood impacts are minimised as part of the FIRA.

Hydrology modelling has been undertaken by AT&L and Sydney Water for the broader Mamre Road Precinct. Peak flows entering the Stage 2 channel have been provided from these models and adopted in this study.

Hydraulic modelling has been undertaken by J.Wyndham Prince using TUFLOW to assess the channel performance for key design parameters, such as flow depths, velocities and shear stresses. These Stage 2 Channel results should be read in conjunction with both the engineering design plans and the FIRA Report (JWP, 2024).

The detailed engineering design for the Stage 2 design is represented in the J. Wyndham Prince engineering design plans **110965-04-DD001 - DD080** and the supporting hydrologic and hydraulic modelling presented in this report, demonstrates that the overall design is functional, constructible and achieves the relevant design criteria established by Sydney Water.

2. THE SITE

2.1. Existing Site

The overall ESR development site is located at Kemps Creek and forms part of the Mamre Road Precinct. The site falls within the Penrith City Council local government area. The site is accessed via Abbotts Road from the West and Aldington Road from the North.

The existing site consists of rural land, including residential dwellings, agricultural land, sheds and farm dams. The western portion of the consists of relatively flat terrain, with slopes generally between 2-5%. The eastern part of the site and land further to the east consists of steeper terrain, with slopes generally between 10-15%.

The overall ESR site and Stage 2 Trunk Drainage Channel location are shown below in Plate 2-1. The Stage 2 trunk drainage site is bordered by the 1016-1028 Mamre Road to the north (owned by others) and 1030-1048 Mamre Road to the south (owned by ESR).

Plate 2-1 – Existing Site Location (Aerial Image from MetroMap – May 2024)

2.2. Proposed Site

The proposed Stage 2 development consists of bulk earthworks, roadworks, stormwater drainage, utility services and the construction of one (1) warehouse building (Lot 2). The Stage 2 development layout is shown in Plate 2-2.

The proposed Stage 2 trunk drainage channel is highlighted in **red**. This includes approximately 323m of proposed trunk drainage channel (1% AEP capacity channel, meandering low flow invert and maintenance track) which connects to a proposed culvert crossing (3m x 0.75m RCBC) under the proposed upgrade of Mamre Road, before ultimately tailing out to the West.

The neighbouring site to the north of the Stage 2 channel (1016-1028 Mamre Road, owned by others) is not intended to be developed in the foreseeable future and so design consideration has been given to the interface at this boundary.

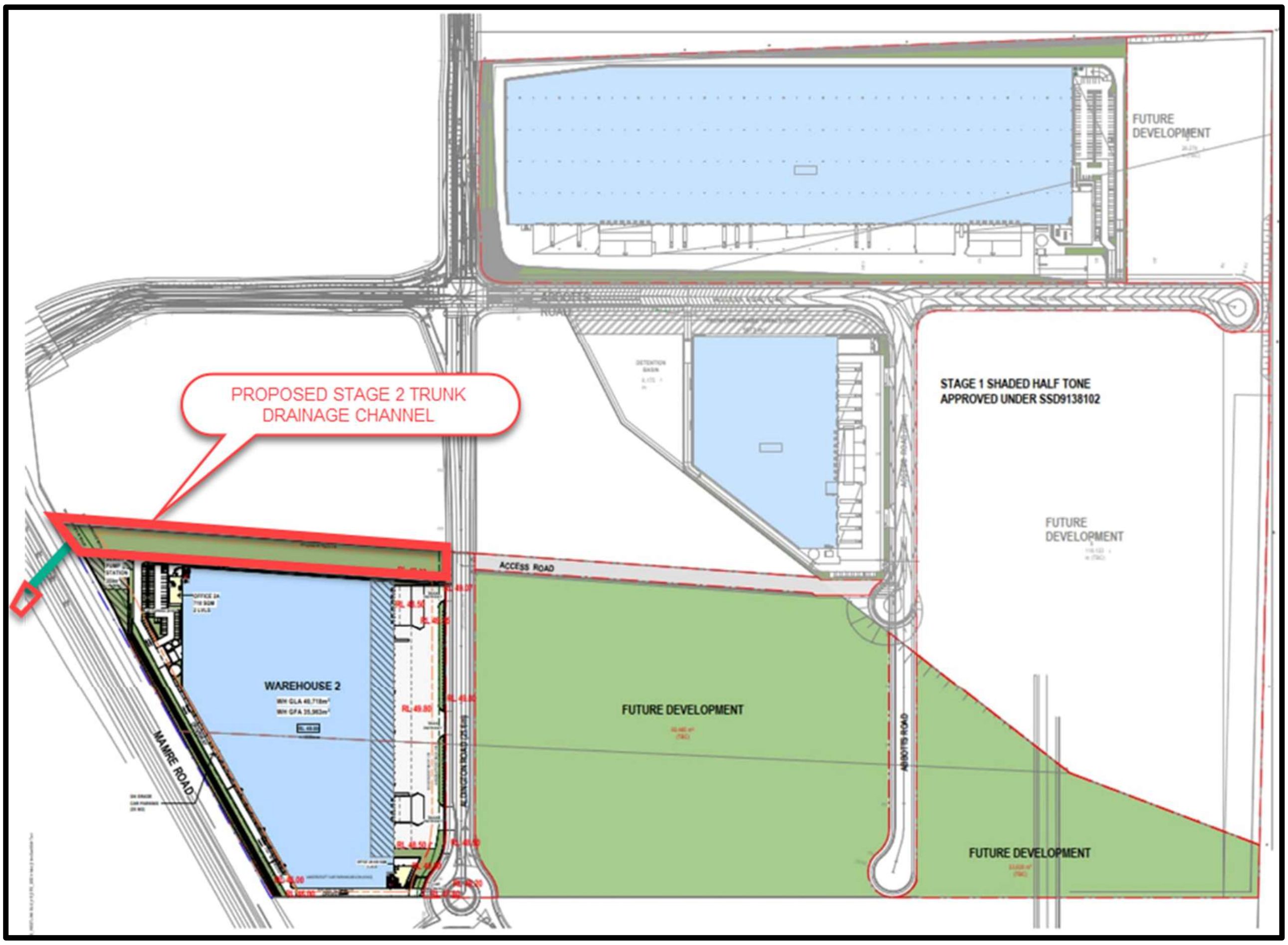

Plate 2-2 – Westlink Stage 2 Proposed Development (Source: AT&L Civil Plans)

2.3. Site Geotechnical Background

A Geotechnical investigation[1] was undertaken by Douglas Partners over the Westlink Stage 2 development site in late 2021 and this investigation included the portion of the site where the trunk drainage channel is to be constructed. The investigation identified that the proposed channel falls within the Blacktown soil landscape which comprises of multiple soil horizons consisting mostly of clayey soils.

SESL Australia were engaged by ESR in April 2024 to undertake a soil suitability assessment[2] including consideration of the necessary soil amelioration practices that may be needed to deal with the dispersive clays beneath the drainage channel. SESL proposed the application of gypsum at 1kg/m^2 ripped into the top 150 mm of exposed subgrade to ameliorate the dispersive soils in the channel subgrade. This will be incorporated into the Landscape specification for the Westlink drainage channel. This requirement has bene incorporated into the engineering plans.

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2.4. Design Controls and Standards

The design controls and standards that are relevant for the design of the Westlink Stage 2 Naturalised Drainage channel are:

- Stormwater Scheme Infrastructure Design Guideline - Draft (Sydney Water – v2024-1.0)
- Response to Submission – RTS Matrix from SW to ESR dated 29 April 2024. – (Refer to **Appendix A** for JWP's responses)
- Design Checklist – (Project Specific as part of Stage 1) Issued by Sydney Water 23 July 2024. (Refer to **Appendix C** for JWP's design response)
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2.4.1 Liaison with Sydney Water

Liaison has been undertaken with Sydney Water throughout the Stage 2 detailed design phase. On 18 October 2024, both J.Wyndham Prince and ESR attended a teams meeting with Sydney Water to discuss the key items which were raised by Sydney Water within the Stage 2 RFI Comments.

Several key items were discussed, with a particular focus on the updated requirements for the low flow channel sizing and sinuosity requirements under the latest *Stormwater Scheme Infrastructure Design Guidelines* (SWC, 2024).

Following the meeting, preliminary sketches and calculations were then subsequently provided to Sydney Water for discussion across the various 2D layout and sizing options. The following key items were agreed:

- **Low flow Calculations**
  - Confirmation that 4EY to be adopted for the low flow channel (superseding the previous target of 0.5 * 12EY)
  - Sydney Water's preferred outcome is **Scenario 2 Option 1** with a manning's of 0.08. This includes **5.5m wide, 2.5m base, 0.5m deep with 1 in 3 side slopes**.

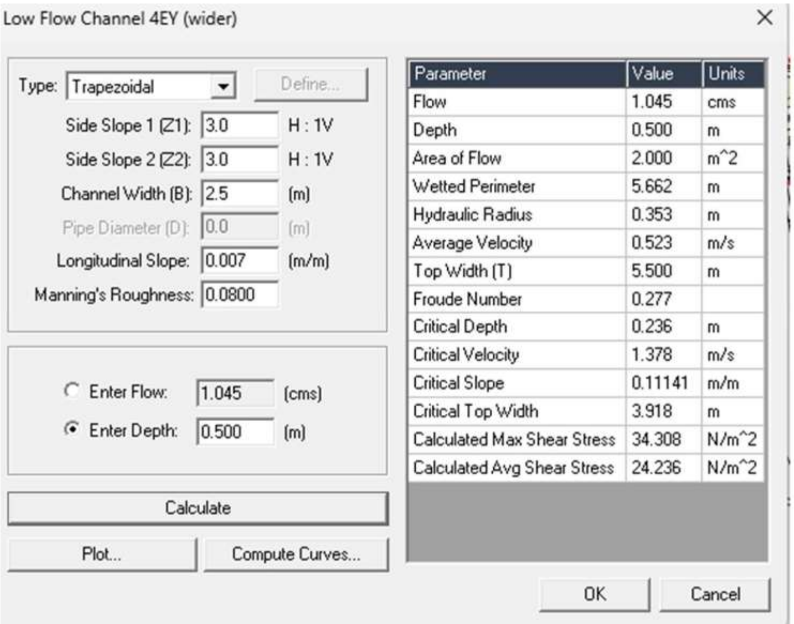

Plate 2-3 – Low Flow Calculations within Hydraulic Toolbox (Email dated 25 Oct 2024)

- **Sinuosity**
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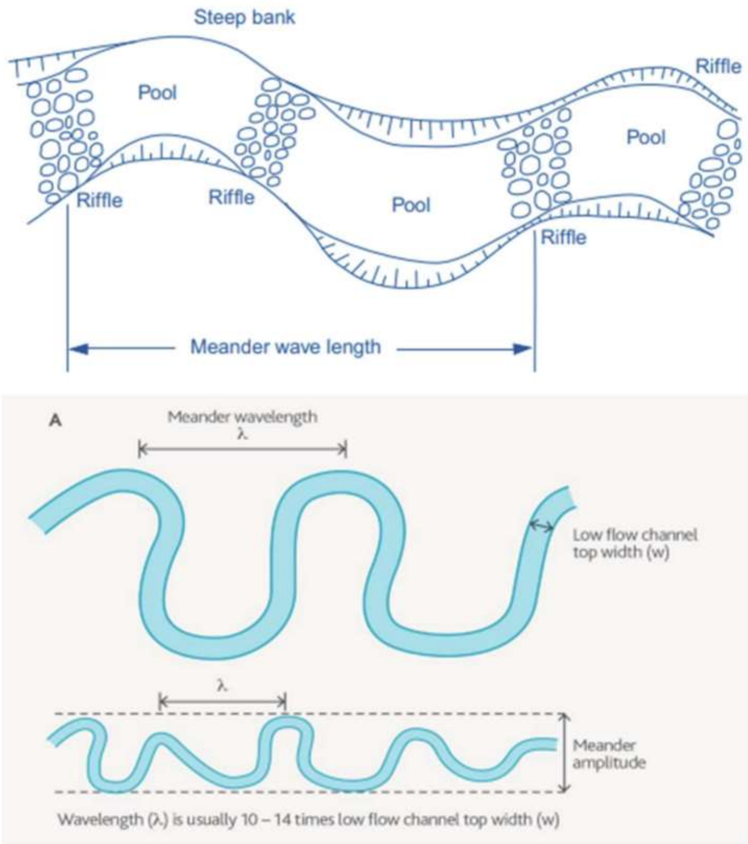

Plate 2-4 – Sinuosity Diagrams (Source: Brisbane City Council and Melbourne Water)

  - Sinuosity of 1.05 must be achieved for the 5.5m low channel width. This equates to a wavelength of 10x the top of the low flow width (i.e 10 x 5.5m = 55m) and a subsequent stream length of 1.05 * 55 = 57.75m.

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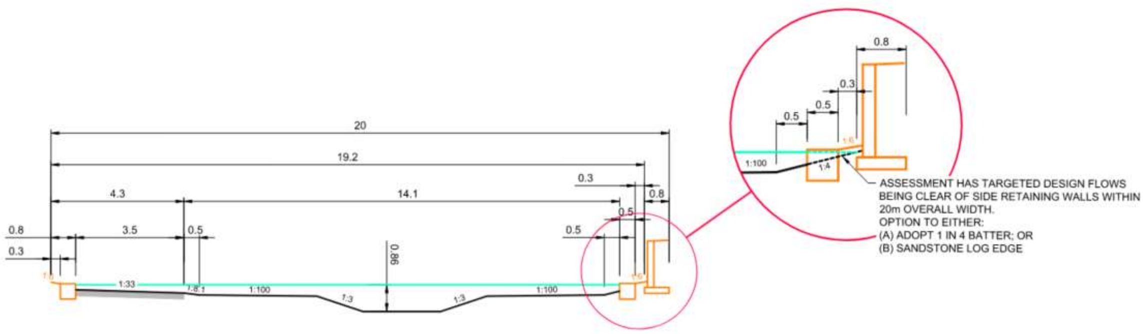
  - After some development, several channel profiles were presented to demonstrate how the detailed design intends to deliver the sinuosity, wavelength and low flow requirements within the 20m width. These included:



CHANNEL TYPE A - SANDSTONE EDGE
(TYPICAL SECTION
UPSTREAM OF OSD OUTLET)

Plate 2-5 – Preliminary Channel Type A (Email dated 27 November 2024)

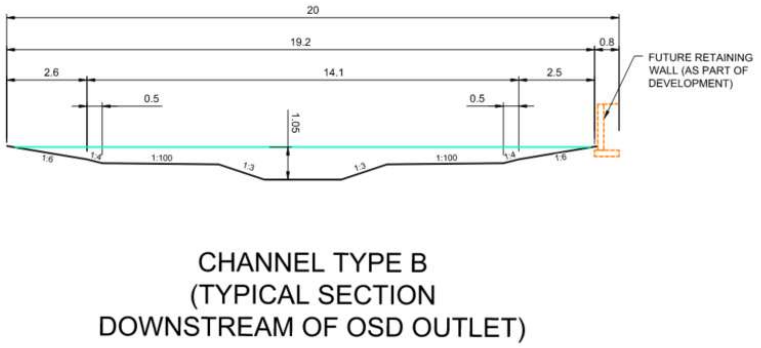


Plate 2-6 – Preliminary Channel Type B (Email dated 27 November 2024)

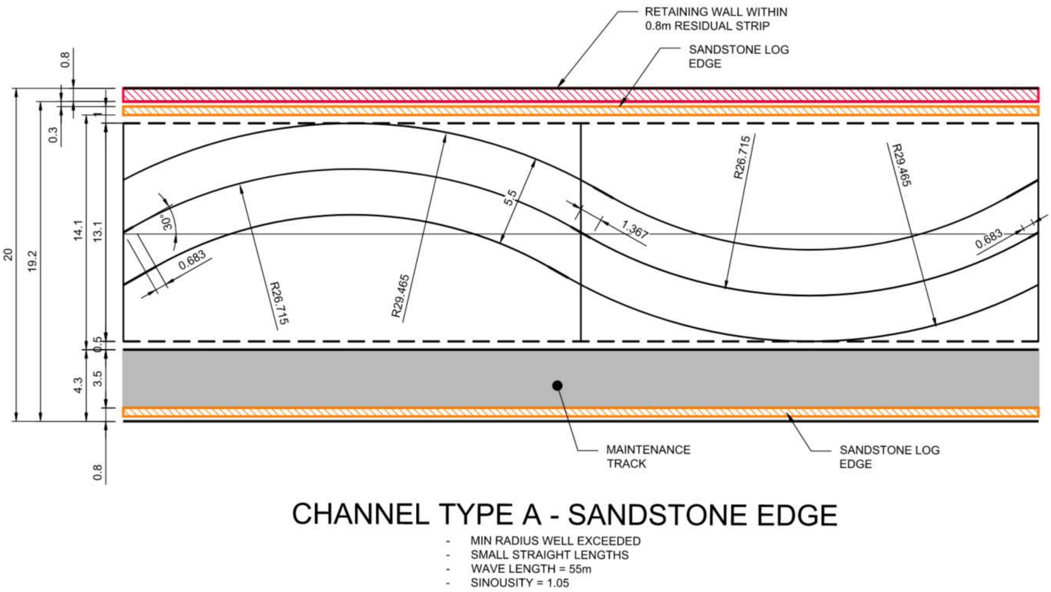


Plate 2-7 – Preliminary Channel Type A Plan (Email dated 27 November 2024)

- **Edge treatment** → Sydney Water confirmed that the preference is to adopt a 1:4 batter for the edge treatment (rather than placement of a sandstone long in front of the retaining walls).
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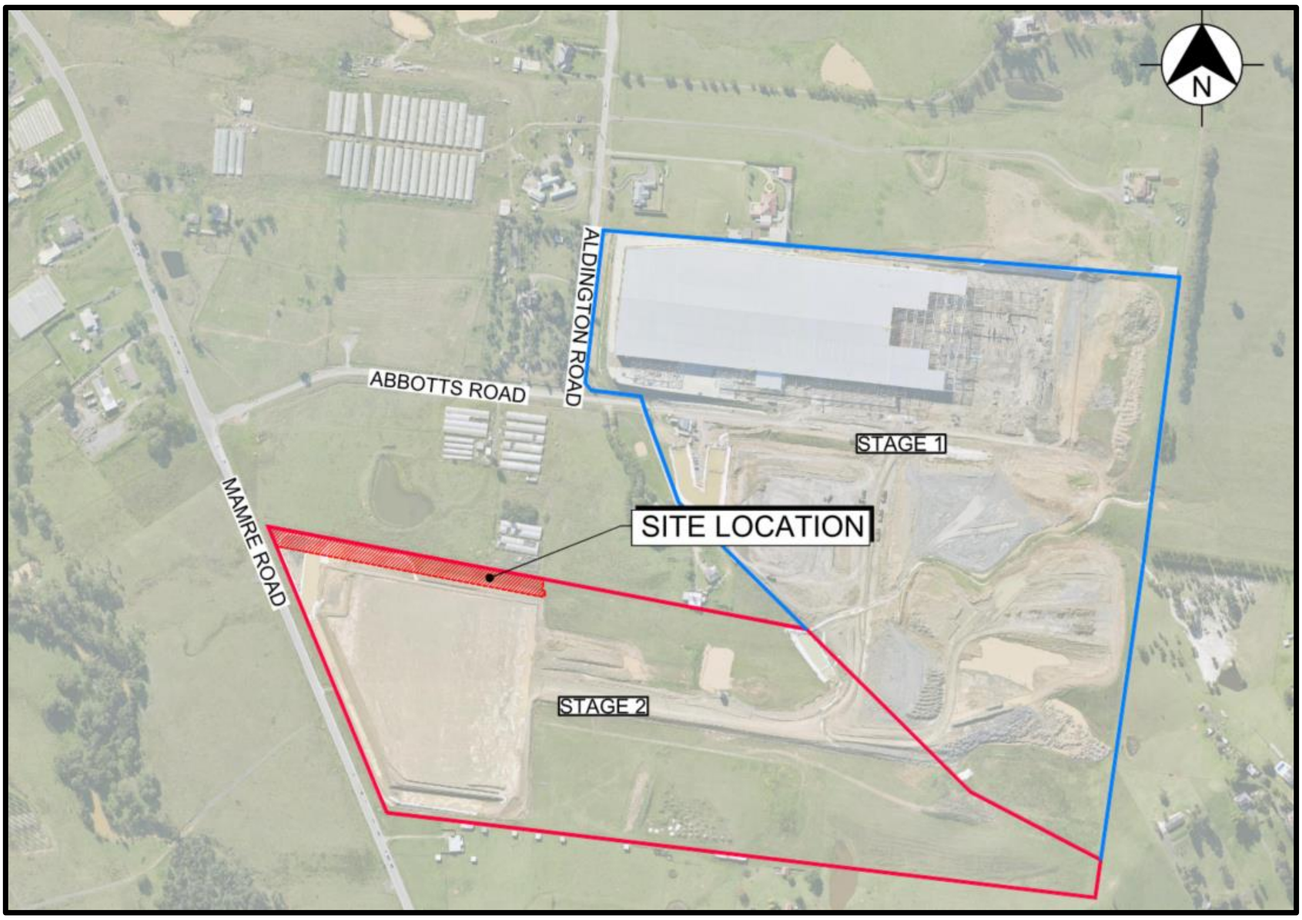

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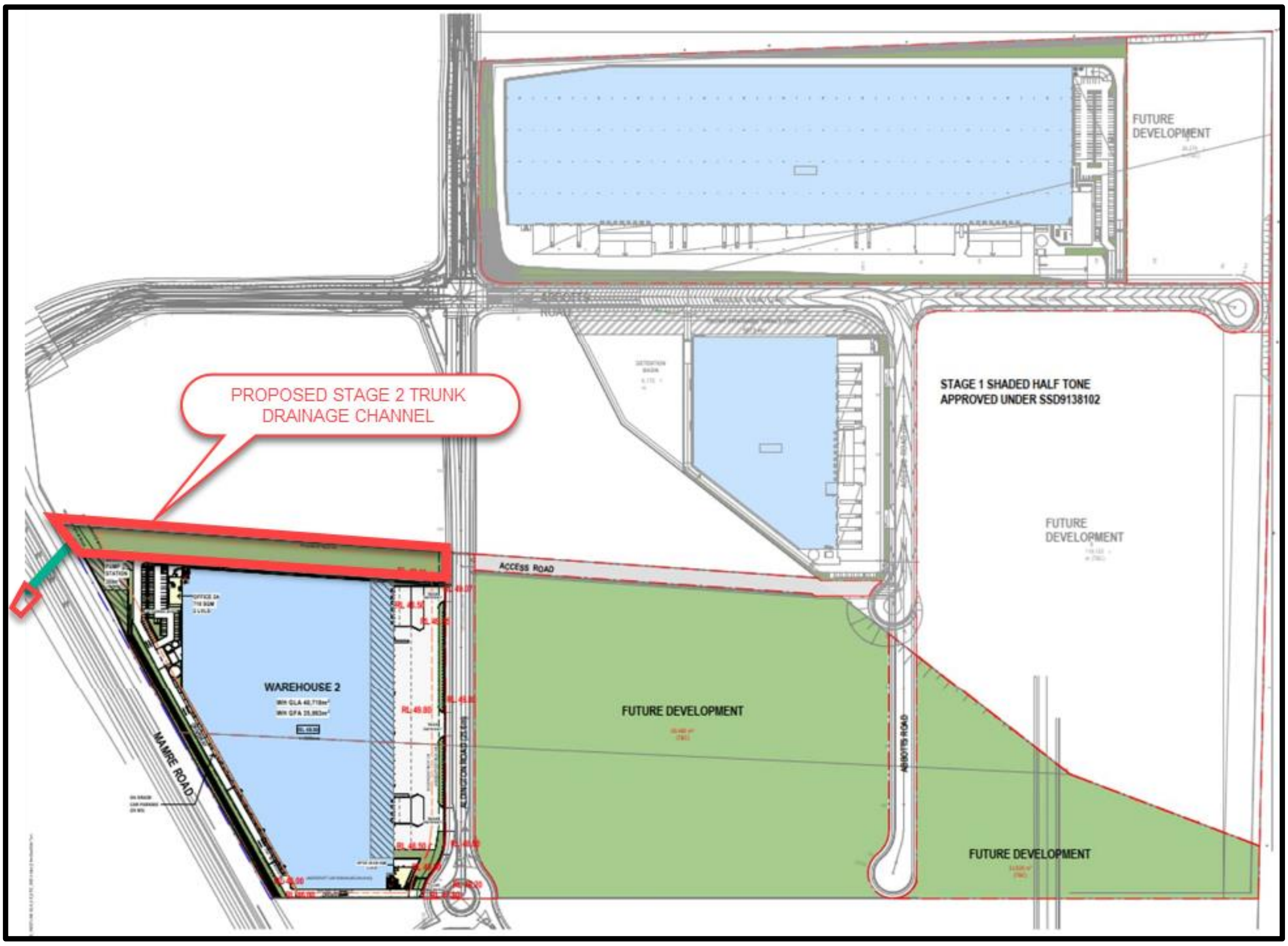

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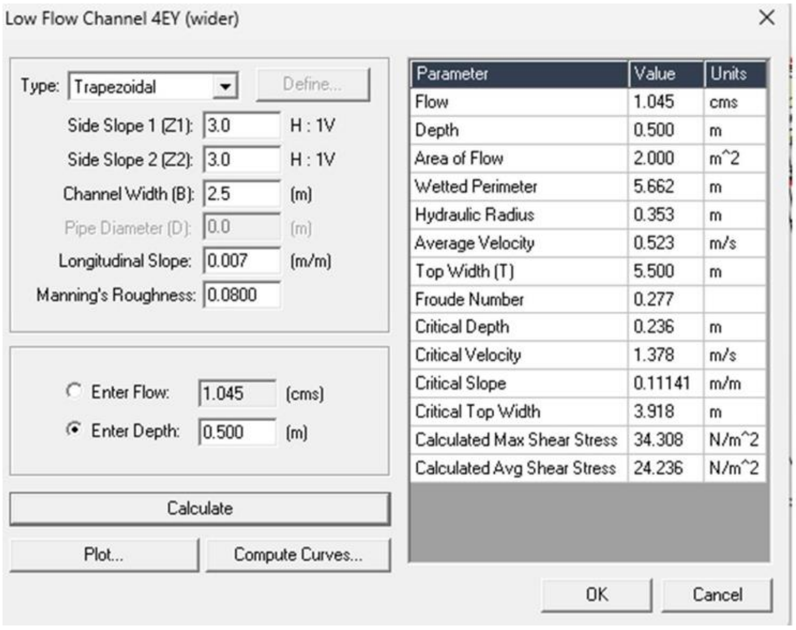

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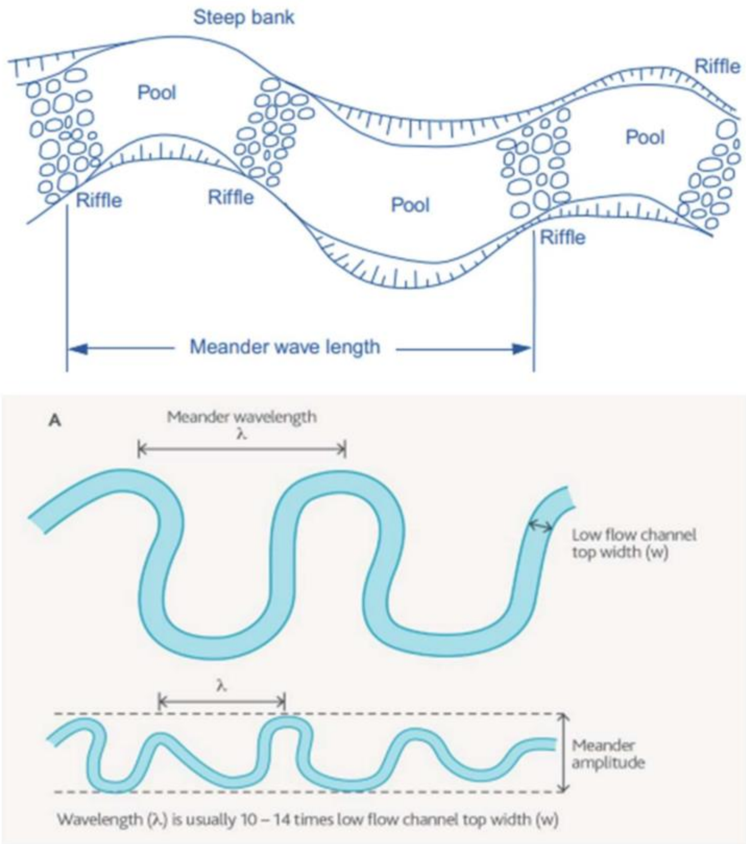

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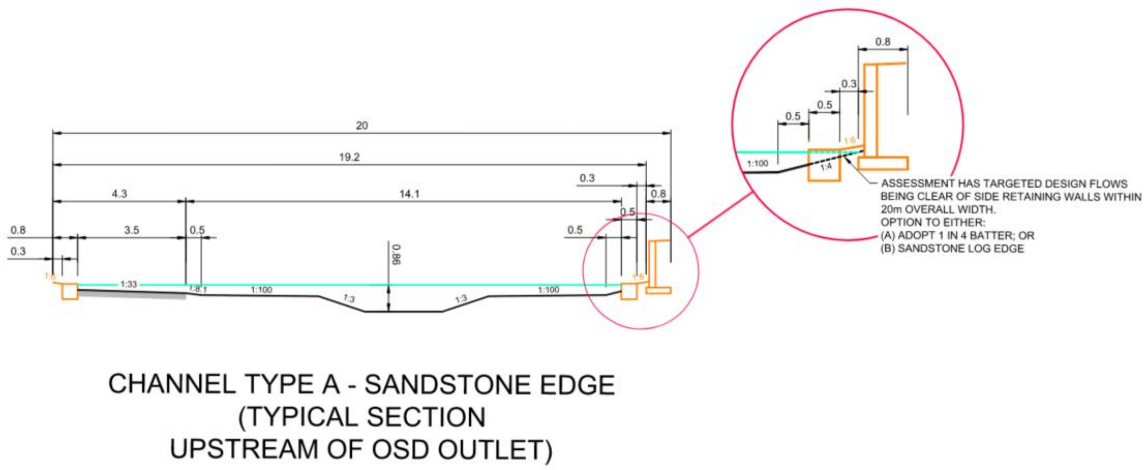


Plate 2-5 – Preliminary Channel Type A (Email dated 27 November 2024)

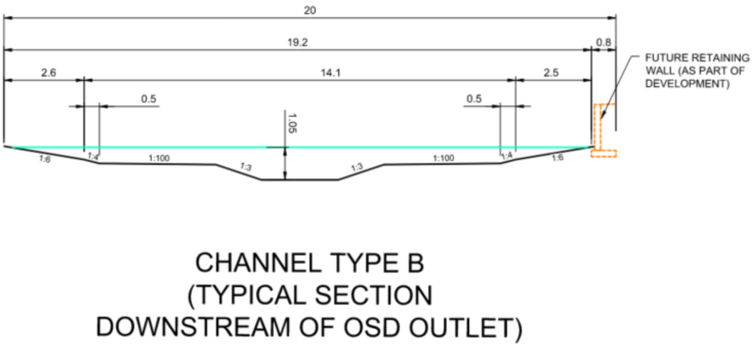
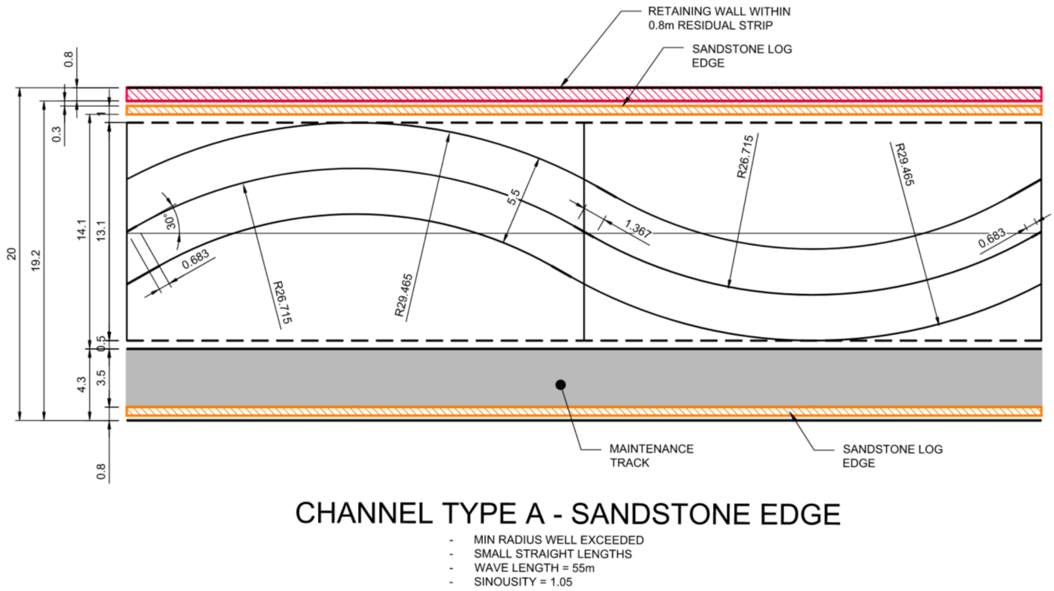


Plate 2-6 – Preliminary Channel Type B (Email dated 27 November 2024)



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  At this stage, the landscape design has included consideration of shade for those areas which may be impacted by shade from the higher sections of wall along the northern side. Shadow diagrams will be provided at detailed design stage.

2.5. Catchments

2.5.1 Existing and Developed Catchments

- Figures 3-1 and 3-2 are included in **Appendix G** to show catchment boundaries for both the pre-developed and post – developed conditions. Those catchment areas shown in magenta relate to the Stage 2 Trunk Drainage Channel.
- In summary, the existing catchment area to the downstream end of the Stage 2 trunk drainage channel is approximately 34.2 hectares. For the developed case, the 22.3 Ha portion of the catchment upstream and including the Stage 2 development will be captured and discharged to the head of the trunk drainage channel. This includes 2.3 ha of external catchment located to the east of Westlink. A further 6.9 ha of additional external catchment located to the north of Stage 2 (EX H1 and EX H2) are likely to be redirected in the future to the Abbotts Road channel once that residual site is developed. Flows from these external catchments have been conservatively included in the Stage 2 channel design.
- The developed portions associated with Lot 6 will be captured and piped to the proposed Stage 2 OSD tank. The outlet of the detention tank discharges towards the downstream extent of the Stage 1 channel. Similarly, there have been allowances in the modelling for OSD storages servicing the future Westlink development stages (Lots 4 and 5).

Table 2-1 – Catchment Summary

Existing		Developed	
Catchment ID	**Area (Ha)**	**Catchment ID**	**Area (Ha)**
EX H1	3.2	EX H1	3.2
EX H2	3.7	EX H2	3.7
EX D1	2.3	EX D1	2.3
EX D2	25.0	INTERNAL BUFFER	0.9
		L5-S	7.0
		D-10	0.7
		L6-1	4.0
		L6-2	5.2
		E-8	1.4
		L2	6.4
		ST2 CHANNEL	0.8
Total	**34.2 Ha**	**Total**	**35.6 Ha (+4.1%)**

3. STAGE 2 TRUNK DRAINAGE CHANNEL DESIGN DEVELOPMENT

The Stage 2 Trunk Drainage Channel is located immediately to the northern side of Westlink Lot 6. The design of the channel is compliant with the *Stormwater Scheme Infrastructure Guideline (Draft) (April 2024)*, prepared by Sydney Water.

3.1. Channel Design Constraints, Opportunities and Options Assessment

The design for the Stage 2 channel has been developed in conjunction with Sydney Water, ESR and the other engineering consultants involved in various components of the project (AT&L).

As discussed in Section 2.4.1, the detailed design for the Stage 2 channel has been developed in conjunction with Sydney Water, with iterations and options considered prior to the design presented herein. This included a teams meeting on 18 October 2024 along with associated correspondence with Sydney Waters Mamre Road Precinct stormwater team between October to January 2025. The key outcomes are presented in Section 2.4.1, whilst a copy of the correspondence is included in **Appendix B**.

There is a level difference between the upstream and downstream ends of the channel of 2.74m over the channel length of approximately 322.5m. This level difference is set by the proposed Aldington Road pipe drainage system (1350mm pipe), which discharges to the head of the channel and the future Mamre Road culvert crossing at the tail end of the channel. This has resulted in a longitudinal design for the channel invert of 0.85% grade for the length of the channel to the Mamre Road culverts. This configuration keeps adjacent retaining wall heights to a minimum. No drop structures are proposed.

The northern boundary of the drainage channel is constrained by the neighbouring site, which is not under the control of ESR and which we understand is not due to be developed in the foreseeable future. Consideration has been given to the interface of the channel with the northern boundary which will require retaining walls for the majority of the channel length. This is proposed to be a combination of:

- Sandstone Log Walls (up to 1.5m high)
- Concrete Sleeper Walls with sandstone face (greater than 1.5m high)

The design of both of these retaining wall types has targeted minimising the horizontal width (0.8m) whilst delivering a wall of a maximum height of 2.9m. This maximises the hydraulic capacity of the channel profile without the need to impinge on the northern property. The wall on the northern side of the channel will be located outside of the designated drainage easement, so the wall will be maintained in perpetuity by the landowner (ESR).

Under "Interim" conditions, the interface with the northern property at the downstream end (i.e ~Ch234 to end) has been designed to include a batter within the easement up to the point where it intersects with the existing surface. The level at the boundary is then maintained to ensure that there will be no overland flows blocked from entering from the adjacent property.

As shown on the FIRA Report (JWP, 2024), this adjacent lot includes flood inundation, as it does under existing conditions. This lot will then become flood free in "Ultimate" conditions, once the adjacent lot is developed and the retaining wall is constructed (by others) to form the full channel profile. Refer to the channel cross sections on **110965-04-DD020 and DD021**. Refer to Plate 3-1 below.

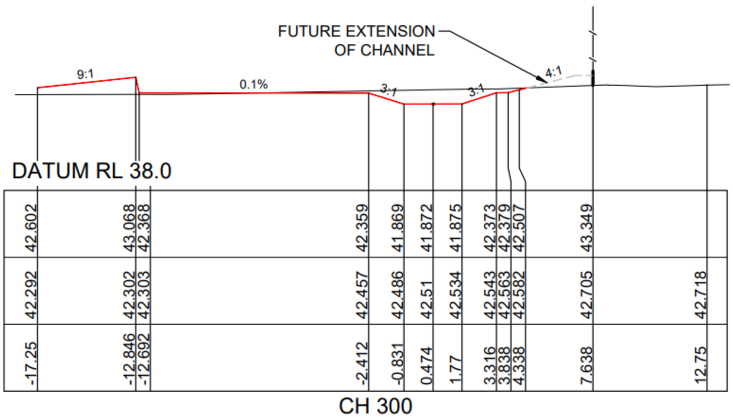


Plate 3-1 – Interface with Adjacent Property to North

The southern boundary of the channel interfaces with the proposed Westlink Lot 6 development being designed by AT&L. This interface will also consist of a retaining wall for the majority of the channel length which will be delivered within the Westlink Lot 6 development to the south. Refer to AT&L civil engineering plans for further details.

3.2. Channel Configuration

With consideration of all the above constraints, the proposed channel has been designed with a 0.85% longitudinal grade through to Mamre Road.

At the upstream end, flows are received from the Stage 2 development via a 1350mm pipe extending from the nearby GPT with scour protection being provided.

At the downstream end, the channel has been designed to neatly match to the proposed culvert crossing (3m wide x 0.75m high RCBC) under Mamre Road (refer to AT&L plans for details). A relatively short temporary tailout channel is assumed just downstream of Mamre Road to match to existing ground levels. These works will be undertaken (by others) as part of the Mamre Road Intersection Works.

Ultimately, a full width trunk drainage channel will be provided downstream of Mamre Road to Kemps Creek. Refer to Section 3.3 for discussion.

As agreed with Sydney Water, the low flow channel has been designed to include total width of 5.5m (i.e 2.5m base, 0.5 metres with 1:3 batter slopes). The low flow channel has been sized to convey 4EY flows (1.02m³/s) with a Manning's of 0.08 and is to be vegetated in accordance with the landscape architect plans.

The channel overbanks generally grade at 1% from the edge of the low-flow channel to maximise the hydraulic capacity and minimise overall flow depth. A 3.5 m wide maintenance track runs adjacent to the channel for the full length. A turning area is provided at the western extents, partially extending into the IOP area. The maintenance track generally runs at the same grade as the channel, except where it connects to Aldington Road.

The overall width of the channel between the southern Westlink Lot 6 boundary and the northern neighbouring property (1016-1028 Mamre Road) is 19.2 metres (being 20 m less the 0.8 m width of the sandstone block / concrete sleeper walling required to support the northern property).

The typical channel sections upstream and downstream of the detention basin outlet from Lot 6 are shown below on Plates 3-2 and 3-3, respectively. These include:

- **Channel Type A**
  - In the upper section of the Stage 2 Channel
  - Capacity of 6 m³/s in the 1% AEP
- **Channel Type B**
  - In the downstream section of the Stage 2 Channel i.e after the OSD outlet
  - Capacity increased to 7.4m³/s in the 1% AEP

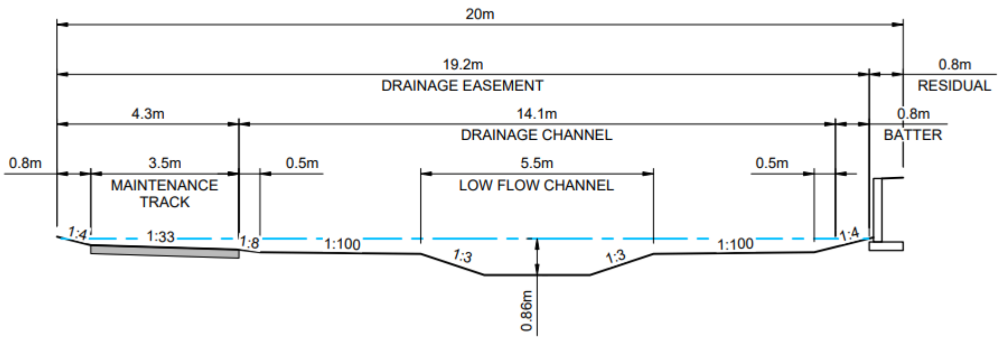


Plate 3-2 – Typical Channel Cross Sections (Upstream of OSD Outlet)

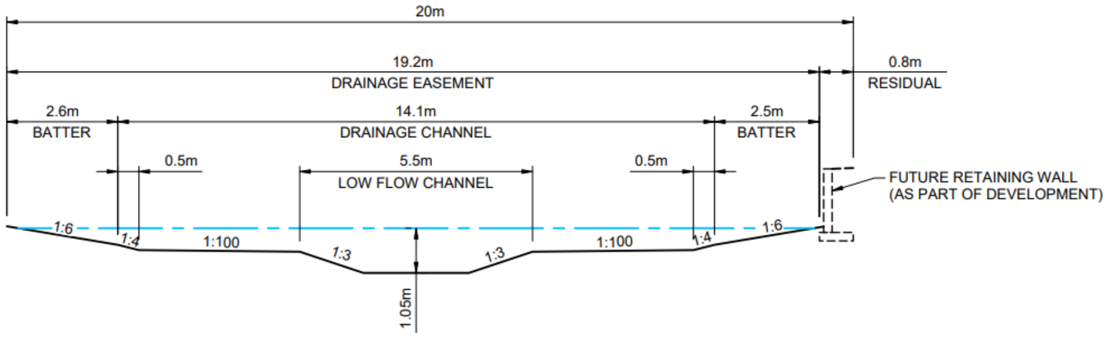


Plate 3-3 – Typical Channel Cross Sections (Downstream of OSD Outlet)

3.2.1 Sinuosity

The low-flow channel has been designed with sinuosity in accordance with the Sydney Water design guidelines. A wavelength of 55m has been adopted along the length of the Stage 2 channel along with a centreline radius of 26.7m for the bends. Transitions to the proposed pipe inlet and culvert outlet at either end are then locally modified to provide as smooth a hydraulic transition as possible.

The sinuosity has been configured to be as irregular as possible within the overall channel width, inlet / outlet, the OSD outlet and other channel constraints. The Sinuosity parameters attained are outlined in Table 3-1.

Table 3-1 – Channel Sinuosity Calculations

Sinuosity Parameter	SW Target	Value	Compliance
Low Flow Channel Top Width (W)	-	5.5 m	
Average Wavelength	10 W or greater	55 m	10 W
Minimum Centreline Radius Curvature	3 W or greater	26.72 m	4.8 W
Minimum Outer Radius Curvature	3.5 W or greater	23.97 m	4.4 W
Sinuosity Factor	1.05 or greater		1.05

3.2.2 Sydney Water Sewer

One key constraint relates to the sewer which has already been constructed along the entire length of the Stage 2 Channel. Refer to Plate 3-4 below.

This pipeline provides sewer flows to the IOP with a “future” sewer extension nominated to extend to the north west. This future extension has not been built yet since the location is subject to Sydney Water Approval for the connection to the pumping station. Staging of works will therefore need to be discussed and coordinated between ESR and Sydney Water.

Importantly, the sewer has been constructed within the proposed location of the maintenance track. This provided some challenges with competing SWC requirements. That is,

- The sewer manhole is required to be above the 1% AEP flood level; vs
- Flow conveyance for the 1% AEP flows to flow over the access track.

Given the manhole lids sit within the location of the track, they cannot be elevated above the surface level - since this would impede vehicle movements. A localised transition of levels is therefore proposed in the vicinity of these manholes to ensure that they are clear of the 1% AEP.

Importantly from a capacity perspective, the remainder of the track has been designed to remain at lower level to minimise capacity issues. This surface was tested in TUFLOW, which confirmed that the 1% AEP does not touch the base of the retaining wall along the northern side.

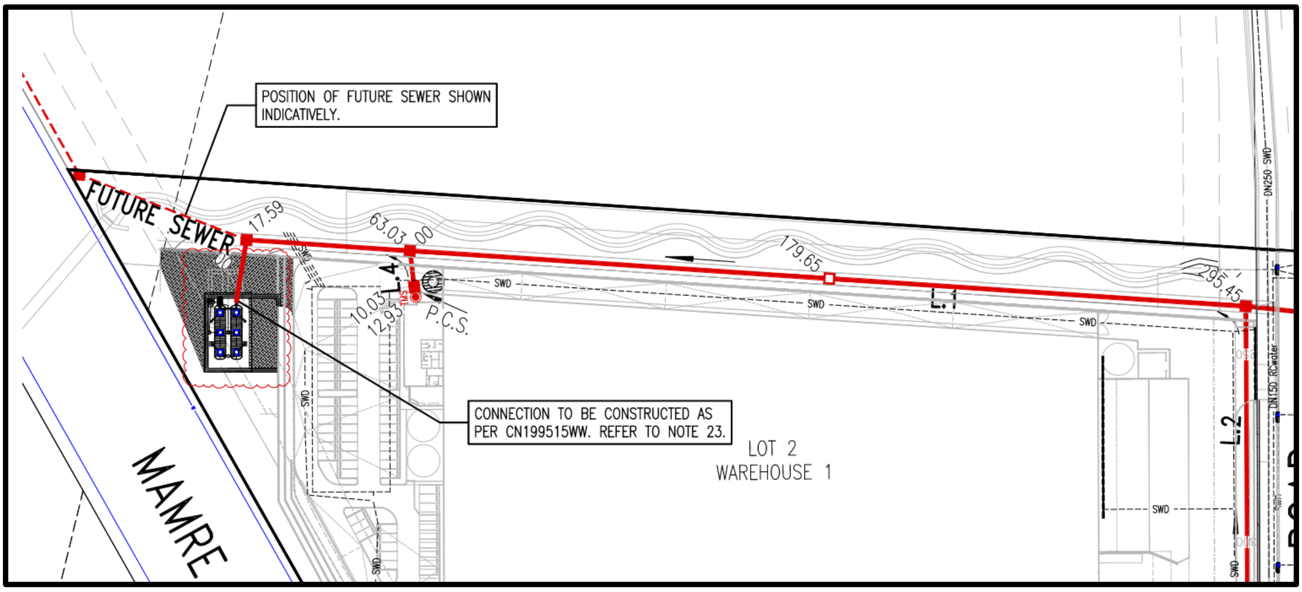


Plate 3-4 – Sewer in Stage 2 Channel

3.3. Downstream Areas

As part of the overall *Sydney Water Scheme Strategy* for the Mamre Precinct, a number of regional devices are proposed to be constructed (by others) to the West of Mamre Road.

As part of the Stage 2 Channel design, a review has been undertaken for these downstream areas to ensure that the proposed culvert crossing / Stage 2 Trunk Drainage Channel positioning / levels will work, with the future channel alignment running between these future SWC regional devices.

Importantly, the findings of the review confirmed that the Stage 2 works <u>are suitable and will work together with these future regional infrastructure devices</u>.

Refer to the Figure in **Appendix E** and the following summary of findings:

- The latest information from AT&L allows for a 3m x 0.75m RCBC under Mamre Road
- Based on Sydney Water's GIS database, the regional water quality system will comprise of a wetland, bioretention and pond in series
  - The devices alongside the Pump Station Site (i.e north of the Channel) will receive flows from the Stage 1 Channel.
  - The devices to the south will receive flows from the Stage 2 channel.
- The horizontal position of the proposed future Stage 2 channel generally aligns between these future SWC devices.
- Based on SWC concept plans, flows will be directed from the channel into the wetland via an offtake system. Flows then continue to the bioretention device and into the pond before ultimately draining into the natural waterway to the West (see sketch).

  From a level perspective, **this will work given the current channel design will allow for the offtake (around RL41.10) to direct flows to the wetland via gravity (at RL40.38)**
- The proposed channel levels currently show on plan:
  - Allows for 1.67% longitudinal grade.
  - Tails out to the existing surface at the downstream end.
- Importantly, this is considered to be a conservative position for flood modelling, since the tailwater levels for the Stage 2 ESR Channel and at Mamre Road Culverts will be higher.
- It is noted that:

- The channel profile currently sits higher than ground levels, since the invert matches to the existing surface. This creates an embankment on either side of the channel.
- This interface between the channel / future devices (i.e where our batters are shown) will need to be looked at as part of those future designs. Importantly, there will be opportunity to drop the channel lower to avoid the need for walls.
- Refer to sketch for suggested location of future drop structures.

Following this review, the tailout channel from Stage 2 was adjusted to minimise works through the area. The tailout channel as presented on **110965-04-DD010** has been set at RL41.05 which will enable a future offtake system to the regional devices.

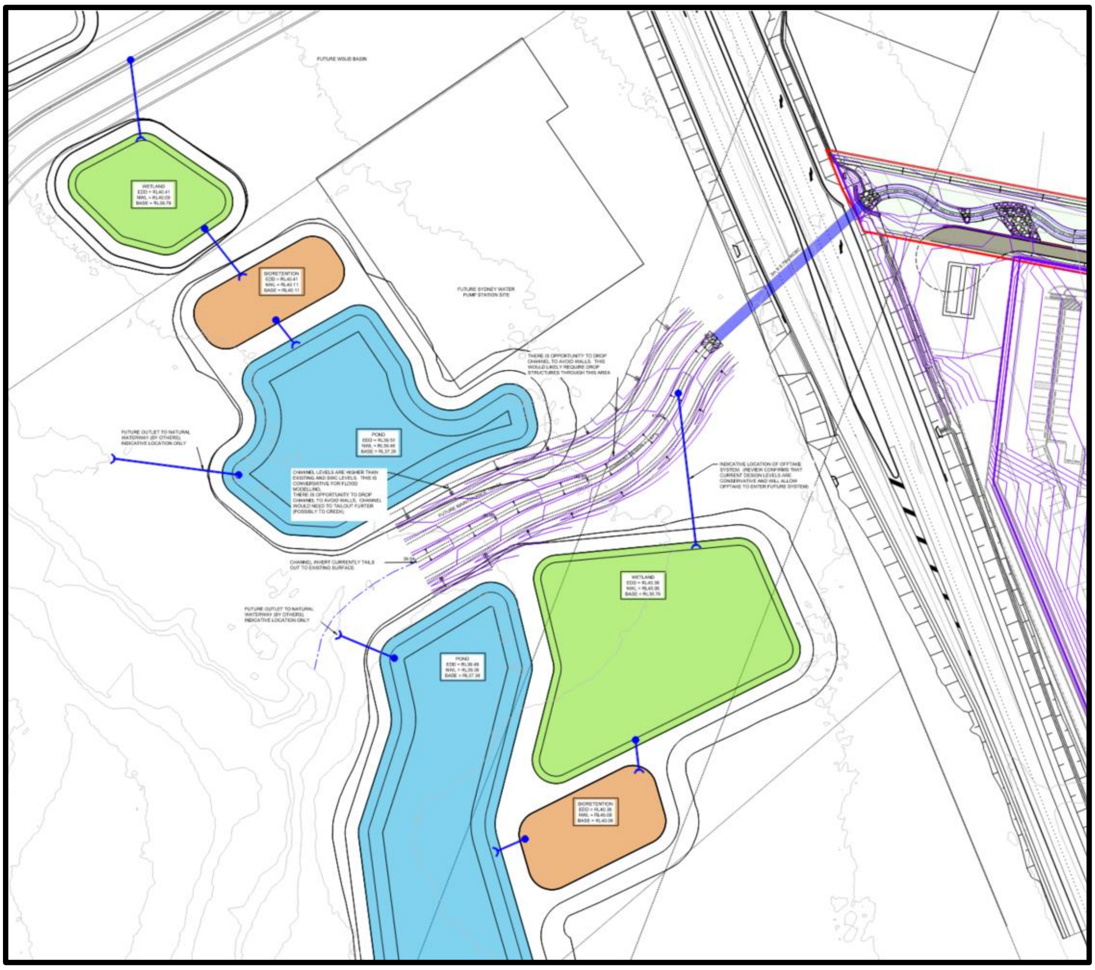


Plate 3-5 – Interface with Downstream Areas (Future Devices)

4. HYDROLOGY

Hydrology modelling for Westlink Stage 2 was developed by AT&L. Sydney Water has also advised on peak 1% AEP channel flow rates relevant for the design of the Stage 2 Channel.

The relevant 12EY, 20% AEP, 5% AEP, and 1% AEP design flow rates for the Stage 2 channel were obtained from the Westlink Industrial Estate – Civil Infrastructure & Water Management Strategy Stage 2 report (AT&L, August 2024). The adopted peak flows are summarised in Table 4-1 below.

Table 4-1 – Peak Design Flow Rates

FLOW LOCATION	**AT&L Derived Peak Flows**					**SYDNEY WATER VALUE**
Storm Event	4EY (m^3/s)	20% AEP (m^3/s)	5% AEP (m^3/s)	1% AEP (m^3/s)	PMF (GSDM) (m^3/s)	1% AEP (m^3/s)
Channel - Upstream end		1.787	3.07	6.01		4.3
Lot 6 OSD Basin Outlet		0.303	0.832	1.38		
Channel - Downstream of Lot 6 OSD outlet	1.04	2.09	3.90	7.42	11.2 (Top of Channel) 26.7 (End of Channel)	5.1

5. HYDRAULICS

5.1. Channel Modelling

5.1.1 Concept Phase

As mentioned in Section 2.4.1, liaison was initially undertaken with Sydney Water throughout the Stage 2 detailed design phase, with the following preliminary calculations provided to Sydney Water for discussion.

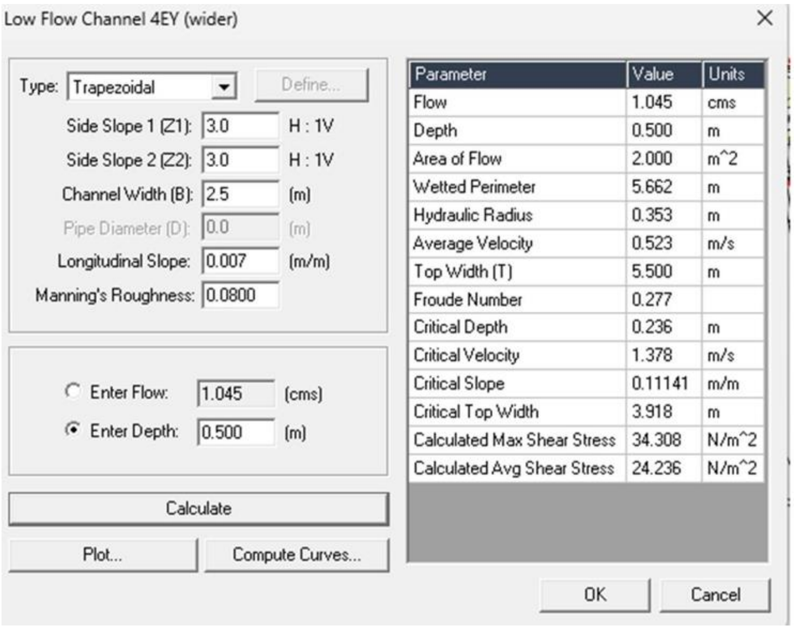
The assessment considered both the establishment and ultimate phases of the channel delivery and assesses these conditions in the key storm events which dictate the design of the channel profile. The events that have been assessed in the channel include:

- Low Flow (4EY) = 1.04 m^3/s
- Overall Channel (1% AEP)
  - 6.0m^3/s (Channel Type A - upstream of OSD); and
  - 7.4 m^3/s (Channel Type B - downstream of OSD)

The results of the preliminary hydraulic modelling for the channel are summarised below in Tables 5-1 to 5-3 below.

5.1.2 Low Flow Channel

Table 5-1 – Summary of Concept Stage Hydraulic Modelling Results (Low Flow Channel)



Parameter	Value	Units
Flow	1.045	cms
Depth	0.500	m
Area of Flow	2.000	m^2
Wetted Perimeter	5.662	m
Hydraulic Radius	0.353	m
Average Velocity	0.523	m/s
Top Width (T)	5.500	m
Froude Number	0.277	
Critical Depth	0.236	m
Critical Velocity	1.378	m/s
Critical Slope	0.11141	m/m
Critical Top Width	3.918	m
Calculated Max Shear Stress	34.308	N/m^2
Calculated Avg Shear Stress	24.236	N/m^2

Results show that the proposed low flow channel (5.5m wide, 2.5m base, 0.5m deep with 1 in 3 side slopes) and a Manning's of 0.08 will convey the 4EY event.

5.1.3 Channel Type A (Upstream of OSD)

Table 5-2 – Summary of Hydraulic Modelling Results for Channel Type A (Upstream of OSD Outlet)

Channel Hydraulics (Calculated using Hydraulic Toolbox)

TYPE A CHANNEL	
Max Channel Slope = 0.84%	
1% AEP Flow Rate = 6.0 m^3/s	4EY Flow Rate = 1.02 m^3/s
Design Conditions	
Mannings n Low Flow Channel = 0.08	
Mannings n Overbanks = 0.08	
Mannings n Track = 0.018	

Full Profile (Type A - Sandstone), 0.84% Grade, 5.5m low flow, 6 m3/s

Type	Cross Section	
Side Slope 1 (Z1)	0.0	H : 1V
Side Slope 2 (Z2)	0.0	H : 1V
Channel Width (B)	0.0	(m)
Pipe Diameter (D)	0.0	(m)
Longitudinal Slope	0.0084	(m/m)
Manning's Roughness	0.0644	
Enter Flow	6.000	(cms)
Enter Depth	0.860	(m)

Parameter	Value	Units
Flow	6.000	cms
Depth	0.860	m
Area of Flow	7.557	m^2
Wetted Perimeter	18.115	m
Hydraulic Radius	0.417	m
Average Velocity	0.794	m/s
Top Width (T)	17.602	m
Froude Number	0.387	
Critical Depth	0.645	m
Critical Velocity	1.563	m/s
Critical Slope	0.09015	m/m
Critical Top Width	15.427	m
Calculated Max Shear Stress	70.772	N/m^2
Calculated Avg Shear Stress	34.348	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0644	

Results show that the proposed Channel Type A (as shown on Plate 3-2) will convey the 1% AEP event.

5.1.4 Channel Type B (Downstream of OSD)

Table 5-3 – Summary of Hydraulic Modelling Results for Channel Type B (Downstream of OSD Outlet)

Channel Hydraulics (Calculated using Hydraulic Toolbox)

TYPE B CHANNEL	
Max Channel Slope = 0.7%	
1% AEP Flow Rate = 7.4 m^3/s	4EY Flow Rate = 1.02 m^3/s
Design Conditions	
Mannings n Low Flow Channel = 0.08	
Mannings n Overbanks = 0.08	
Mannings n Track = 0.018	

Full Profile (Type B DS), 0.7% Grade, 5.5m low flow, 7.42 m3/s

Type	Cross Section	
Side Slope 1 (Z1)	0.0	H : 1V
Side Slope 2 (Z2)	0.0	H : 1V
Channel Width (B)	0.0	(m)
Pipe Diameter (D)	0.0	(m)
Longitudinal Slope	0.007	(m/m)
Manning's Roughness	0.0800	
Enter Flow	7.420	(cms)
Enter Depth	1.055	(m)

Parameter	Value	Units
Flow	7.420	cms
Depth	1.055	m
Area of Flow	10.536	m^2
Wetted Perimeter	19.067	m
Hydraulic Radius	0.553	m
Average Velocity	0.704	m/s
Top Width (T)	18.800	m
Froude Number	0.300	
Critical Depth	0.678	m
Critical Velocity	1.721	m/s
Critical Slope	0.09543	m/m
Critical Top Width	14.284	m
Calculated Max Shear Stress	72.365	N/m^2
Calculated Avg Shear Stress	37.914	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0800	

Results show that the proposed Channel Type B (as shown on Plate 3-3) will convey the 1% AEP event.

It is noted that these preliminary calculations were initially undertaken for grades of 0.7 – 0.84%. Throughout the design development, the longitudinal grade of the channel was then adjusted to 0.85% - which achieves a slightly higher capacity. The revised sizing was then tested in the detailed TUFLOW Model. Refer to Section 5.2.

5.2. Flood Modelling

5.2.1 TUFLOW Parameters and Modelling

Following in-principle agreement of the preliminary sizing and configuration from Sydney Water, detailed surface modelling was then undertaken in 12d software.

Detailed 1D / 2D Flood Modelling was then undertaken within TUFLOW software in conjunction with the *Flood Impact Risk Assessment* (FIRA) which supports the overall Westlink Estate. This Report considered any potential flood impacts and risks in accordance with the NSW Flood Risk Management Manual (2023) and Section 2.5 of the MRP DCP along with the emergency management and response strategy for local catchment (and / or overland) and mainstream flooding.

Refer to J.Wyndham Prince FIRA Report (JWP, 2024) for all modelling details and parameters.

Importantly, the 1D / 2D TUFLOW Flood Modelling was undertaken to assess the performance of the proposed Stage 2 Channel sizing across a range of events. This included the following:

- Size and test the capacity of the low flow channel (4EY)
- Size and test the capacity of the high flow channel (1% AEP, 0.2% AEP and PMF)
- Assess shear stresses for the developed scenario (4EY, 5% AEP, 1% AEP, 0.5% AEP and 0.2% AEP)
- Assess velocities for the developed scenario (1% AEP, 0.2% AEP and PMF)
- Determine flood hazards for the developed scenario (5% AEP, 1% AEP, 0.5% AEP and 0.2% AEP)
- Prepare flood maps to demonstrate flood depth, velocity and shear stresses.

5.2.2 Results and Discussion

Figures 5-1 to 5-16 in **Appendix F** are included to demonstrate the Stage 2 Trunk Drainage Channel results across the 4EY, 1EY, 5% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and PMF Events. Maps are also provided for the shear stresses and velocities.

Results demonstrate:

- The low flow channel suitably conveys the 4EY event
- The overall channel width appropriately conveys the 1% AEP flows safely within the corridor, with appropriate freeboard to adjacent properties.
- 1% AEP flows are observed to still extend into the adjacent property (to the north) just upstream of the proposed culvert crossing under Mamre Road. It is noted that this also occurs under existing conditions and that flows will ultimately be fully conveyed within the Stage 2 trunk drainage channel once the lot is developed (by others) in future.
- Shear stresses and velocities are shown across the range of rainfall events. These velocities are generally in the range of 0.5 – 1 m/s for the 1% AEP – which is below the threshold of 1.4 m/s, with shear stresses only having isolated areas in the range of 45 to 80 N/m^2 in the 1% AEP, which is therefore under the required threshold for long native grass of 80 N/m^2.
- 1% AEP flood levels are clear from the bottom of Retaining Wall RW2 along the northern side. This confirms 1% AEP capacity of the channel compliant with Sydney Water objectives.
- Flood Hazards within the channel range from H1 to H3 – which is expected for a trunk drainage channel.

6. CONCLUSION

A naturalistic trunk drainage channel design has been developed and documented for the 323 m long naturalised trunk drainage channel to be constructed within Westlink Stage 2 at Kemps Creek. The channel is designated as a component of the Stormwater Infrastructure scheme within the Mamre Road Precinct which is managed by Sydney Water as the Regional Stormwater Authority. The design for the drainage channel was developed in close collaboration with Sydney Water's Wianamatta Stormwater team and responds to Sydney Waters evolving /draft design guidelines being established for this urban release area.

The preliminary assessment and modelling of the hydraulic performance of the system was initially undertaken using Hydraulic Toolbox software to inform the detailed design and engineering design documentation of the channel.

1D / 2D Flood Modelling within TUFLOW software was then also undertaken in conjunction with the *Flood Impact Risk Assessment* (FIRA) which supports the overall Westlink Estate.

Importantly, the 1D / 2D TUFLOW Flood Modelling assessed the channel performance for key design parameters, such as flow depths, velocities and shear stresses. Results demonstrate that the channel complies with the design requirements established by Sydney Water for this infrastructure. These Stage 2 Channel results should be read in conjunction with both the engineering design plans and the FIRA Report (JWP, 2024).

The detailed engineering design for the Stage 2 design is represented in the J. Wyndham Prince engineering design plans **110965-04-DD001 - DD080** and the supporting hydrologic and hydraulic modelling presented in this report, demonstrates that the overall design is functional, constructible and achieves the relevant design criteria established by Sydney Water.

APPENDIX A

Agency Response to Submission
For ESR Stage 2 Trunk Drainage Channel

REF	COMMENT	TOPIC	RtS RESPONSE
A	The proponent should alter the riparian corridor to be in accordance with the Guidelines for Controlled Activities on Waterfront Land - Riparian Corridors.	Trunk Drainage	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been field verified by CTEnvironmental in 2020 (refer Appendix F of the *Mamre Rd Flood Riparian Corridor and Integrated Water Cycle Management Strategy* (Sydney Water 2021)). The watercouse was identified as "Unamed Trib Kenps Creek 1" and was confirmed as not having defined bed and banks. The inspection also validated that the mapped lower section within Lot 2 in DP 250002 was not present. This assessment informed the Precinct planning process for MRP.
A	The proponent should incorporate a flow path into the design of the riparian corridor if the connection between the watercourse and the online dam to the north of the site is to be retained.	Trunk Drainage	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been extinguished during the Precinct planning process for MRP (refer Biosis report). There is no clear defined overflow path from the dam and flows can be received by the channel along the length of the common boundary
A	A Vegetation Management Plan should be developed for both sections (within the project site and the section of re-alignment to the west between Kemps Creek and Mamre Road) of the watercourse re-alignment.	Trunk Drainage	This is not waterfront land and so a riparian type VMP is not required. Sydney Water is the caretaker of the future Drainage Channel. A suitable landscape design will be proposed consistent with Sydney Waters documented landscape design objectives.
A	Works within waterfront land including outlet structures, crossings and vegetation management plans should be in accordance with the Guidelines for Controlled Activities on Waterfront Land	Trunk Drainage	This is not waterfront land. However the Sydney Water drainage channel design objectives will be achieved which will ensure the works are consistent with naturalistic drainage channel design best practice.
A	The proponent has committed to preparing a Soil and Water Management Plan. This is supported and it is recommended to be developed in accordance with industry standards including the guideline, Managing Urban Stormwater: Soils and Construction (Landcom 2004).	Trunk Drainage	A soil and water management plan was developed for the trunk drainage channel and is included on JWP Engineering Drawings CD070 -072. Similarly, an updated Soil and water management Plan has been developed for the proposed Stage 2 Civil works and this is presented in XXX plans YYYYY
Penrith City Council			
A	The site has a mapped waterway at the north-western corner near Mamre Road. Any works to the waterway will need to be undertaken in accordance with Water Management Act and the requirements of the Department of Climate Change, Energy, the Environment and Water.	Trunk Drainage	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been extinguished during the Precinct planning process for MRP (refer Biosis report). However the Sydney Water drainage channel design objectives will be achieved which will ensure the works are consistent with naturalistic drainage channel design best practice.
A	In relation to the trunk drainage, it will be important that Sydney Water approve the design and that it is designed in accordance with any of their requirements and technical guidelines	Trunk Drainage	The trunk drainage detailed engineering concept design has been developed based on the extensive consultation with Sydney Water that occurred for the recent similar Stage 1 Channel works, The naturalistic channel design documented on JWP engineering concept design plans 110695-04-CD001-080 are compliant with Sydney Waters documented design objectives. Suitable consent conditions are anticipated
A	The development includes the provision of temporary stormwater management basins, temporary irrigation of undeveloped areas, proprietary treatment devices and rainwater tanks. It is indicated that ultimately the site will connect to Sydney Water's drainage network. Interim arrangements are proposed although it is noted that additional information is required to demonstrate compliance with the requirements outlined in the MRP DCP. It is noted that no MUSIC modelling was made available, but the Department should review this.	Stormwater	Music model provided
A	No primary objections are raised regarding waterways health, as the proposed development includes commitments to connect to the regional stormwater scheme once available. However, it is recommended that DPHI ensure that the controls are met in terms of compliance with the stormwater and waterway health targets (for both the construction and operational stages). MUSIC modelling and design of stormwater temporary infrastructure should be prepared in accordance with the Technical guidance for achieving Wianamatta South Creek Penrith City Council PO Box 60, Penrith NSW 2751 Australia T 4732 7777 F 4732 7958 penrith.city stormwater management targets. This is likely to require additional information prior to determination of the application.	Stormwater	Noted Music model now provided

REF	COMMENT	TOPIC	RtS RESPONSE
A	Regarding the GPTs, while the plans indicate locations, additional details (such as access arrangements and type) is required on the engineering plans. Further, the GPTs need to be prepared as per the specifications outlined in Sydney Water Technical Design Guidelines. It is noted that the GPT's will be the responsibility of the developer / property owners to maintain. Conditions will need to be included in any consent requiring this.	Stormwater	SQUIDEP compliant Pit Inserts are proposed across the industrial lots on Westlink Stage 2 development in lieu of wet sump GPT's. A SQUIDEP compliant wet sump GPT is proposed at the Eastern end of the drainage channel and has suitable maintenance access.
A	It is suggested that additional details of the stormwater infrastructure are required. Functional design drawings of the temporary ponds, Hume filter, temporary irrigation systems and associated infrastructure should be provided. The plans should include additional details to demonstrate they can function and include details of levels, cross sections, access arranagements and the like. This should include details of a functional design and an operation and maintenance manual/s for the infrastructure. The maintenance manual should be provided prior to determination and conditions should be applied to ensure interim (and permanent) measures are maintained to the required standards.	Stormwater	No temporary ponds are proposed for Stage 2. Functional design drawings are not necessary for development consent but will be developed at the detailed design stage. A section showing the interconnection between the Stage 2 OSD system and the drainage channel is included oin JWP engineering drawing CD051
A	Should the application be approved, adequate conditions will need to be in place to ensure that all temporary infrastructure is maintained until the regional ifnrastructure is available. The conditions should ensure that future development on the site achieves compliance with the Integrated Water Cycle Management (IWCM) controls in the MRP DCP in accordance with the Technical Guidance for achieving Winamatta South Creek Stormwater Management Targets (NSW Government 2022).	Stormwater	Appropriate development conditions pertaining to the operation and maintenance of all stormwater infrastructure, including the removal of all interim measures are anticipated.
A	Conditions should be applied to ensure that adequate land is reserved for initial stages of the development's treatment and management of stormwater (such as irrigation of undeveloped land).	Stormwater	Appropriate development conditions pertaining to the implementation of interim irrigation disposal area are anticipated.
A	Conditions should also be used to ensure that all stormwater infrastructure, including GPTs, rainwater tanks, irrigation systems, temporary ponds (and the like) remain under the ownership, control and care of the registered proprietor of the lots. It is suggested that positive covenants and restrictions of use should be placed to ensure that all privately owned systems will be maintained in perpetuity. It is acknowledged some infrastructure will not be required once the regional scheme is available. Conditions may need to be included to manage the transition and decommissioning of the infrastructure once connection to the regional infrastructure is available.	Stormwater	Appropriate development conditions pertaining to the operation and maintenance of all stormwater infrastructure , including the removal of all interim measures is anticipated.
A	With respect to waterways, it is noted that a mapped waterway is located on the site. Any works will need to be undertaken in accordance with Water Management Act and the Department of Climate Change, Energy, the Environment and Water requirements.	Stormwater	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been extinguished during the Precinct planning process for MRP (refer Biosis report). However the Sydney Water drainage channel design objectives will be achieved which will ensure the works are consistent with naturalistic drainage channel design best practice. Suitable consent conditions are anticipated
A	In relation to the trunk draiange, it is noted that a naturalised channel will be provided. It is relevant that Sydney Water approve the designa nd that it is designed in accordane with any of their requirements and technical guidelines.	Trunk Drainage	The trunk drainage detailed engineering concept design has been developed based on the extensive consultation with Sydney Water that occurred for the recent similar Stage 1 Channel works, The naturalistic channel design is compliant with Sydney Water's documented design objectives. Suitable consent conditions are anticipated
Biodiversity, Conservation and Science Group			
A	Provide an updated MUSIC model and flow spreadsheet which accounts for the influence of any external catchments which will flow through the treatment devices.	Stormwater	Music model now provided. LB to confirm
A	Drawing 20-748-C6144 (Lot 2 OSD Tank) - why has the OSD tank and HumeFilter been set so far below pavement level? This creates several issues, including backwater from the trunk drainage channel of the pipe as it is only 30mm above the channel invert. The 1% AEP level in the trunk drainage channel is alo different (lower) than shown on the JWP plan. Conservative design of flood levels for the trunk drainage channel should be adopted, given the uncertainty over the final design of Mamre Road culverts. Additional details are required in relation to wildlife hazard.	Stormwater	The level of the OSD tank is dicatated by the overall pipe lengths needed to drain the site and the need to drain undercroft parking areas. Surface levels above the tank have now been reduced. Darins modelling of the OSD tank confirms the system performance with an appropriate tailwater level. No open water systems are propsed so Wildlife hazrads are not anticipated.

REF	COMMENT	TOPIC	RtS RESPONSE
A	Recommendation - Revise levels of on-lot system (OSD, HumeFilter) to ensure system is not affected by backwater from trunk drainage channel and final outlet pipe will not be at elevated risk due to blockage - ensure consistent flood levels with JWP plans and that conservative flood levels have been adopted, reflective of the uncertainty of the Mamre Road culvert design - provide an overall drainage plan for the estatw which shows finished contours and all drainage infrastructure - as the site is within proximity of the airport, provide a wildlife hazard assessment and wildlife maangement plan and make any required changes to the design of the sediment basins and retention ponds to mitigate the hazard - extend the landscape drawing set to encompass the on-lot pond and incorporate recommendations from the wildlife hazard assessment and management plan - why does the LandPartners plan of subdivision use different lot numbering to the civil engineering plans?	Stormwater	See response above
A	Provide updated bulk earthworks drawings which include interim drainage measures which will manage runoff both generated within the lots and for external catchments, such that flows are directed to the underground drainage system in a controlled manner and without causing erosion.	Stormwater	Updated civil drawings have been providied indictaing how developed Lot 2 drains via underground network into the OSD tank in the north west corner of the lot. Refer to AT&L drawings 20-748 -C6000 series for details. All future lots drain via open swales into ERSED basins and discharge into the open trunk drainage channel. Refer to AT&L drawings 20-748 C5000 series for details
Sydney Water			
A	For Sydney Water to accept connection to the regional stormwater scheme, the development must demonstrate that the following will be implemented: - the documentation must clearly demonstrate that the mandatory 15% pervious area has been provided for the ultimate state of development - adequately sized and SQIDEP approved GPT must be installed across the development - passively irrigated street trees are to be installed on all roads within the development. The street trees act as a stormwater retention device and will assist the regional stormwater infrastructure strategy but also help achieve government canopy targets and urban cooling. Street trees are to be delivered under Council's guidance and nominally spaced at 8m centres.	Trunk Drainage	- the hydrologic modelling has adopted 15% pervious for all development sites consistent with the MRP DCP - SQUIDEP compliant Pit Inserts are proposed for all industrial lots within the Westlink Stage 2 development. - Passively irrigated street trees compliant with Penrith Councils approved details will be provided in all public and private roads
A	The channel as shown in the sketch below will have flows impacting the base of the retaining walls. This is considered a potential point of failure and should be designed to align with the Design Guidelines.	Trunk Drainage	The proposed Drainage Stage 2 channel typical cross section has been modified to ensure 1% AEP flows are contained within the channel batters consistent with Sydney Waters standard channel section details. Refer to JWP Plan no CD016 for details of the supporting hydraulic calculations.
A	"The peak 1% AEP are at a maximum of 7.4m3/s at the Mamre Road end. According to the design guideline, the channel should therefore be 25m wide a. 20m - 4.5m3/s b. 25m - 11m3/s c. 30m - 20m3/s	Trunk Drainage	An 18.9 m wide channel is proposed and this is supported by detailed hydraulic assessment that demonstrate its capacity and compliance with key design objectives, consistent with Sydney Waters Channel Design checklist (page 6). At the detailed design stage this will be further supported by TUFLOW 2D hydraulic modelling and mapping that assesses velocity and shear stresses at a suitable level of detail to support construction stage
A	Catchment boundaries are to be provided overlaying existing natural catchments with design catchments in shape or CAD files to understand the gap with SW evaluation.	Trunk Drainage	Need to reference AT&L and/or Stantec reported catchment plans
A	Modelling parameters to be aligned with the design guidelines	Trunk Drainage	Need to reference AT&L and/or Stantec reported modelling parameters
A	Retaining wall at the border of the property (north) should be replaced with a batter 1:4 to avoid impacting the neighbouring lot	Trunk Drainage	The small parapet wall at the Mamre Road end of the channel has been removed. Flows for the South west corner of Lot 2 DP250002 can freely drain to the channel. Future development of Lot 2 may result in the formalising of the drainage corridor batters to a future fill level on Lot 2 if required. The Stantec updated Flood impact assessment demonstrates that flood impacts are within acceptable thresholds.
A	Demonstrate that low flow invert channel coveys 12EY	Trunk Drainage	The Hydraulic assessment presented on JWP engineering plan CD016 demonstrates that 0.5 x 12EY flows are contained within the low flow channel. This approach is consistent with Sydney Waters standard Channel section

REF	COMMENT	TOPIC	RtS RESPONSE
A	Demonstrate water level at PMF, 5%AEP and 20%AEP	Trunk Drainage	The Hydraulic assessment presented on JWP engineering plan CD016 demonstrates that 1% AEP flows are contained within the channel. Further 2D hydraulic assessment will be undertaken at the detailed design stage for the full range of additional storm events including 12 EY, 20%, 5%, 1% and PMF events
A	Provide retaining wall longsection on channel longsection to show wall to invert and maintenance track relationship	Trunk Drainage	The maintenance access track no longer has a role in providing interim site access for effluent removal for Westlink and as a consequence will now be consistent with Sydney Waters standard channel details.
A	Please provide the dimensioning of the different elements of the trunk draiange: access road, riparian edge, upper bank and lower bank	Trunk Drainage	Additional details and dimensions have been included on the channel typical section included on JWP Engineering plan CD016. Upper and lower bank profiles are included on the Channel longitudinal profile (refer CD015)
A	As per design guidelines: "all corridors will require a 3.5m wide maintenance/ access track suitable for light vehicles. A 1m planted buffer is required adjacent to the access track"	Trunk Drainage	The required 1m buffer has been included on the channel typical section and is indicated on JWP Engineering plan CD016
A	Drop structure should be installed where a grade is at 2%. Please provide shear force modelling to inform if drop structure are required. Erosion protection to be provided as an alternative to drop structure	Trunk Drainage	The hydraulic assessment provided on JWP engineering Plan CD016 demonstrates that the short rock lined section meets performance requirements. The extent of rockwork of approx 120 m2 is a relatively small footprint and allows for an uninterrupted habitat along the channel length (unlike a drop structure and aprons)
A	Velocities and shear force at bank/retaining wall interface to be provided as this location is vulnerable to erosion	Trunk Drainage	The channel section has been modified to avoid flows impacting upon adjoining walls. Additional detailed shear stress modelling will be undertaken at the next design stage
A	Plot PMF level against the retaining wall	Trunk Drainage	The Channel performance during a PMF flood event has been assesed and is reported in the Concept Design Stage Design report at Section 5.3. Average channel velocities for this extreme event are 1.65 m/s and therefore doesn't exceed the capbility of the wall to withstand the applied loads (subject to structural design)
A	Retaining walls need to be certified by structural engineer: stability and reslience to flooding up to the PMG need to be engineered	Trunk Drainage	Consistent with the Stage 1 Channel design process. Structural engineering of all walls and drop structures greater than 0.9 m in height will be provided at the detailed design stage for the channel
A	Sydney Water will not own and maintain the retaining wall along the trunk drainage channel that is adjacent and supporting the development site and the neighbouring lot. As such should be clear of the 1% AEP trunk flows	Trunk Drainage	Consistent with the approach agreed with Sydney Water for the Westlink Stage 1 channel, the northern retaining wall will remain outside of the proposed drainage easement which has been narrowed slightly for this purpose. Refer to the typical channel section on JWP engineering plan CD016
A	At the downstream end of the channel the retaining wall is also blocking flows from undeveloped property to the north. This shall be designed to ensure there is no adverse stormwater flow impact to this property	Trunk Drainage	The small parapet wall at the Mamre road end of the channel has been removed. Flows for the South west corner of Lot 2 DP 250002 can freely drain to the channel. Future development of Lot 2 may result in the formalising of the drainage corridor batters to a future fill level on Lot 2 if required. The Stantec updated Flood impact assessment demonstrates that flood impacts are within acceptable thresholds.
A	The undeveloped case 50% AEP flood model shall be mapped to confirm upstream and downstream inflow and outflow points. These points shall be used to assess if the proposed development is maintaining status quo for developed flows. Peak flows shall be extracted at these points for comparison to developed flows.	Flood	The agreed Stage 2 channel position does not align with the low point on the landform so peak flows cannot be readily compared. Nevertheless, all post development landforms can be directed to the new channel which delivers flows to Sydney Water future water management basins west of Mamre Road in an agreed manner. The channel design does not impede runoff from the residual (undeveloped) land on the northern side of the channel - noting that this land does not have any clearly defined flow paths.

Item	Agency	RFI Item	Tag	Consultan	Status	Response	Notes
3	Sydney Water	**Detailed Design Comment** Please provide a map showing the pre-development and post-development catchment areas as per section 2.5.1 of the Trunk Drainage report. A table showing the difference in catchment areas between the pre and post development scenarios must be included in the trunk drainage report. We understand that the DRAINS model has been used for the design of trunk drainage. However, the stormwater management report prepared by AT&L doesn't clearly indicate the post-development areas draining to the trunk drainage and change in catchment areas specifically for Stage 2 development.	Catchment	AT&L	Open	Figures 3-1 and 3-2 have been included in Appendix G to show the pre-developed and post-developed catchments. Section 2.5.1 has also been updated to include a pre and post developed summary of catchment areas.	
4	Sydney Water	**Detailed Design Comment** Table 4-1 indicates that the PMF have been extrapolated from 1% AEP peak flows. The determination of the PMF by extrapolation is not acceptable. The PMF is to be determined using the GSDM for trunk drainage design. Please update the report.	PMF	JWP	Open	The Trunk Drainage Design Report has been updated to reflect accurate PMF flows which have been generated using GSDM in DRAINS.	
5	Sydney Water	**Detailed Design Comment** It is understood that the overflow from IOP is discharing to the trunk drainage as an interim solution to cater for very rare instances. However, the proponent is to provide details about the timing and construction of the channel and IOP overflow as well as ownership and maintenance responsibility during the interim period and for the decommissioning of the overflow pipe to ensure appropriate risk mitigation measrues are placed for the downstream harvesting.	IOP	JWP/AT&L	Open	The IOP has been constructed, and final approval from SW is expected by 1 April 2025. It is a private IOP that will be managed and maintained by ESR. The decommissioning of the IOP system can happen immediately upon SW commissioning of the stormwater harvesting systems that include the infrastructure downstream of the IOP. The careful coordination of these events by SW provides a suitable risk mitigation mechanism.	
6	Sydney Water	**Detailed Design Comment** The maximum height of sandstone sleeper retaining wall RW2 on the northern side of the trunk drainge is 2.9m. Shadow diagram must be provided to ensure a minimum 1 hour solar access in mid-winter over the trunk drainage area.	Solar	JWP/AT&L	Open	Refer to the shadow diagram plans prepared by Nettleton. A suitable rock rip-rap treatment will be applied to any areas without 1hr solar access in mid-winter	
7	Sydney Water	**Detailed Design Comment** Drawing DD007: Sydney Water easement is shown to include the area housing the private GPT and maintenance track connection to the IOP area. The drawing must be updated to include only the Sydney Water easement area to be consistent with Appendix A of Stormwater Developer Works Policy.	Easement	JWP	Open	The easement needs to include the maintenance track connection to Aldington Road. The conditions relating to the easement will be updated to confirm that SW has no responsibility to manage, maintain or remove the interim GPT.	
8	Sydney Water	**Detailed Design Comment** Drawing DD011: The location of HW3 has been modified from the previous version. Please recitfy the annotation of HW3. It appears the labels of headwall and overflow pipes points to the previous location.	Drawing	JWP	Open	DD011 amended to rectify HW3 annotation	
9	Sydney Water	**Detailed Design Comment** Drawing DD016: The channel slope is shown as 0.85% in the longitudinal section whereas documented as 0.84% for the first 244m and then at 0.7% grade through to Mamre Road in the report. This discrepancy must be addressed.	Drawing	JWP	Open	DD016 is correct. The design report has been amended for consistency.	
10	Sydney Water	Drawing DD020 and DD021: Cross sections must extend beyond the channel boundary to show the proposed interface with development adjacent to the trunk drainage corridor and clearly show retaining walls including Lot 6 RW.	Drawing	JWP	Open	Cross Sections have been updated to include the boundary positions to demonstrate that the indicated walls are outside of the propsoed easement.	

Item	Agency	RFI Item	Tag	Consultan	Status	Response	Notes
11	Sydney Water	**Detailed Design Comment** Drawing DD060: The IL (42.64) of the outlet pipes from underground OSD tank to trunk drainage at the headwall is not consistent with the IL (42.3) shown in the On- Lot Civil drawings by AT&L. Please rectify the discrepancy.	Drawing	JWP/AT&L	Open	DD060 amended for consistency with AT&L OSD design	
12	Sydney Water	**Detailed Design Comment** The material specification of retaining walls within the channel, headwalls, maintenance access tracks must be agreed with Sydney Water at the detailed design stage.	Drawing	JWP	Open	This is an advanced concept design. Materials have previously been discussed with SWC as part of the Stage 1 channel and have been kept consistent.	

APPENDIX B

Sydney Water Detailed Design Advice For ESR Stage 2 Trunk Drainage Channel

Chris Randall

From: Darren Galia <Darren.Galia@sydneywater.com.au>
Sent: Wednesday, 27 November 2024 3:46 PM
To: Chris Randall; Craig Bush
Cc: Peter Mehl; Grace Macdonald; Daniel Gardiner
Subject: RE: [110965.04] [External] Westlink - Stage 2 Channel Clarifications

Follow Up Flag: Follow up
Flag Status: Flagged

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Hi Chris,

Thank you for sharing the sketches. The preliminary results for the modified channel cross-section look promising.

Regarding the edge treatment, Sydney Water does not permit the placement of sandstone logs or walls in front of retaining walls. Therefore, we encourage adopting Option A, which features a 1:4 batter for the edge treatment.

We are happy for JWP to proceed with this channel cross-section design, provided it meets the requirements outlined in the *Stormwater Scheme Infrastructure Design Guideline (DRAFT)*.

Please let us know if you need further clarification.

Regards,

Darren Galia
Senior Stormwater Engineer
Western Sydney Development
Sydney Water, Level 10, 1 Smith Street, Parramatta NSW 2150

Darren.Galia@sydneywater.com.au

Mobile: 0455 344 819

From: Chris Randall <CRandall@jwprince.com.au>
Sent: Tuesday, November 26, 2024 4:13 PM
To: Darren Galia <Darren.Galia@sydneywater.com.au>; Craig Bush <Craig.Bush@sydneywater.com.au>
Cc: Peter Mehl <pmehl@jwprince.com.au>; Grace Macdonald <Grace.Macdonald@esr.com>; Daniel Gardiner <dgardiner@jwprince.com.au>
Subject: [110965.04] [External] Westlink - Stage 2 Channel Clarifications

Hi Darren and Craig,

Further to my email below, we've done some further option development to confirm how the below requirements can fit within the overall 20m width.
Overall, we believe that the SWC objectives can each be achieved by adjusting to the alignment and allowing some treatment along the edges.

Please refer to the attached sketches and discussion.
Can you please review and confirm SWC concurrence and then we will get detailed design underway.

Discussion
To achieve SWC objectives, we propose the following two (2) channel profiles:

- **Channel Type A**
  - In the upper section of the Stage 2 Channel
  - Capacity of 6m^3/s in the 1% AEP
- **Channel Type B**
  - In the downstream section of the Stage 2 Channel i.e after the OSD outlet
  - Capacity increased to 7.4m^3/s in the 1% AEP

Key design considerations
Alignment
On SK101, the plan view and sections show the differences in the alignment compared to what was previously proposed.
This includes:

- The residual strip has been decreased to 0.8m
  This widens the easement to 19.2m, whilst still allowing for a retaining wall to be constructed (0.8m)
- The channel has been widened to provide a central section of 14.1m
- A wavelength of 55m is adopted along with sinuosity of 1.05.
- As shown on the plan view, this allows for much larger sinuosity and wavelength results to suit the 5.5m wide low flow.
  See table.

	SW Target	Value	Compliance
Low Flow Channel Width (W)	-	5.5m	
Average Wavelength	10W or greater	55m	10W
Minimum Centreline Radius Curvature	3W or greater	26.715m	4.9W
Minimum Outer Radius Curvature	3.5W or greater	19.25m	5.6W
Sinuosity Factor	1.05 or greater		1.05

Capacity
Preliminary hydraulic calculations have been undertaken within Hydraulic Toolbox and are presented on SK100.
These show that both the Type A and Type B will convey the 1% AEP
(Note: These are preliminary only and are for discussion. We will prove up in TUFLOW in due course).
The assessment has included:

- Manning's at n = 0.08 (low flow and overbanks)
- Targeting design flows in the 1% AEP to be clear of side retaining walls (which we understand is desired by SWC).
  Within Type A, the options for edge treatment is proposed to include either:
  (a) 1 in 4 on the side slopes; or
  (b) A small sandstone log edge just in front of the retaining wall.
  Either option will allow for the 1% AEP capacity to be achieved clear of the adjacent wall.
- Within Type B, there is opportunity to widen the channel section beyond the track area and include the 1 in 4 and 1 in 6 batters on the edge.

Rock Protection / Steep Section
Previously we discussed the need to replace the steeper section of channel (i.e 2%) which was requiring scour protection with a drop structure or rock chute.
Upon review however, we think the better option would be slightly increase the longitudinal grade from 0.7% to 0.84% and grade this out.
Please refer to the attached long section. This appears to be a better solution, do you agree?

Conclusion
The results show that each of the SWC objectives can be achieved.
Can you please review and confirm concurrence along with the desired preference for the edge treatment within Type A.

We look forward to hearing your feedback so that we can proceed with formal submission.

Regards,
Chris Randall – Technical Lead - Design

Chris Randall
Technical Lead - Design

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From: Chris Randall
Sent: Wednesday, 30 October 2024 11:03 AM
To: Darren Galia <Darren.Galia@sydneywater.com.au>
Cc: Craig Bush <Craig.Bush@sydneywater.com.au>; Grace Macdonald <Grace.Macdonald@esr.com>; Peter Mehl <pmehl@jwprince.com.au>
Subject: RE: [110965.04] [External] Westlink - Stage 2 Channel Clarifications

Hi Darren,

Thankyou for the quick response.
We'll work out a 2D geometry based on the below and circulate back to SWC for concurrence to make sure we are on the same page.

Regards,

Chris Randall – Technical Lead - Design

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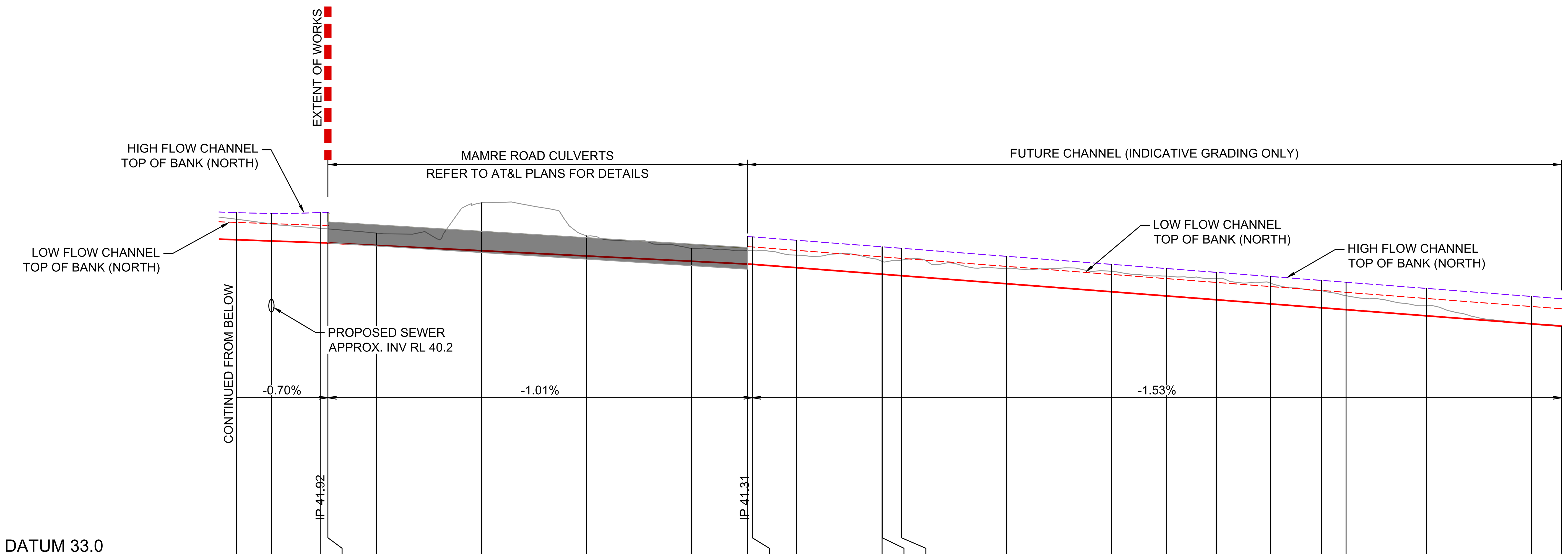
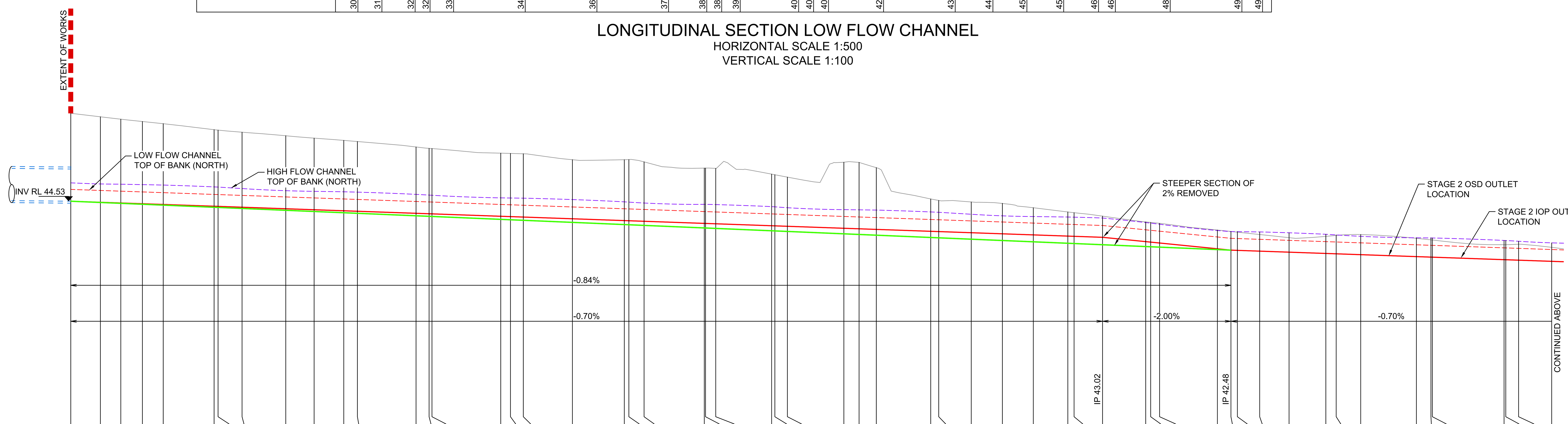


DATUM 33.0

DESIGN CHANNEL INVERT	42.01	41.98	41.93	41.92	41.85	41.70	41.55	41.40	41.32	41.31	41.21	41.03
HIGH FLOW CHANNEL TOP OF BANK	42.79	42.77	42.79	42.79					42.10	42.09	42.00	41.81
LOW FLOW CHANNEL TOP OF BANK	42.51	42.47	42.42	42.42					41.81	41.81	41.71	41.52
EXISTING SURFACE	42.60	42.46	42.34	42.32	42.20	43.07	42.12	41.76	41.71	41.70	41.57	41.39
CHAINAGE	309.97	315.00	321.95	323.05	330.00	345.00	360.00	375.00	382.99	383.69	390.00	402.23

DESIGN CHANNEL INVERT	41.03	40.98	40.76	40.53	40.41	40.30	40.18	40.07	40.01	39.84	39.61	39.54
HIGH FLOW CHANNEL TOP OF BANK	41.81	41.77	41.54	41.31	41.19	41.08	40.96	40.85	40.80	40.62	40.39	
LOW FLOW CHANNEL TOP OF BANK	41.52	41.48	41.25	41.02	40.90	40.79	40.67	40.56	40.51	40.33	40.10	
EXISTING SURFACE	41.39	41.43	41.20	41.11	40.98	40.91	40.77	40.56	40.41	40.14	39.61	39.54
CHAINAGE	402.25	405.00	420.00	435.00	442.89	450.00	457.70	465.00	468.52	480.00	495.00	499.33

LONGITUDINAL SECTION LOW FLOW CHANNEL
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



DATUM 35.0

DESIGN CHANNEL INVERT	44.53	44.49	44.46	44.42	44.39	44.32	44.31	44.28	44.21	44.17	44.13	44.11	44.02	44.00
HIGH FLOW CHANNEL TOP OF BANK	45.30	45.25	45.24	45.23	45.21	45.13	45.12	45.06	44.97	44.94	44.93	44.91	44.82	44.79
LOW FLOW CHANNEL TOP OF BANK	45.02	44.98	44.95	44.92	44.89	44.81	44.81	44.77	44.71	44.67	44.62	44.60	44.52	44.50
EXISTING SURFACE	48.22	48.07	47.97	47.87	47.78	47.53	47.51	47.42	47.27	47.17	47.08	47.03	46.80	46.75
CHAINAGE	0.00	6.21	10.47	15.00	19.35	30.00	30.83	35.85	45.00	50.93	57.14	60.00	72.27	75.00

DESIGN CHANNEL INVERT	44.00	43.90	43.89	43.87	43.79	43.72	43.71	43.69	43.60	43.60	43.58	43.50	43.50	43.48
HIGH FLOW CHANNEL TOP OF BANK	44.78	44.67	44.67	44.66	44.60	44.50	44.49	44.46	44.40	44.40	44.39	44.30	44.30	44.26
LOW FLOW CHANNEL TOP OF BANK	44.50	44.39	44.38	44.36	44.29	44.21	44.21	44.18	44.10	44.09	44.08	44.00	43.99	43.97
EXISTING SURFACE	46.74	46.54	46.53	46.52	46.27	46.27	46.27	46.18	45.92	45.92	45.91	45.67	45.64	45.54
CHAINAGE	75.61	90.00	92.04	94.72	105.00	115.86	116.81	120.00	132.60	132.86	135.00	146.70	147.37	150.00

DESIGN CHANNEL INVERT	43.40	43.37	43.35	43.27	43.26	43.21	43.16	43.12	43.07	43.06	43.02	42.84	42.82	42.78
HIGH FLOW CHANNEL TOP OF BANK	44.18	44.17	44.16	44.08	44.07	43.98	43.92	43.89	43.87	43.86	43.83	43.64	43.61	43.57
LOW FLOW CHANNEL TOP OF BANK	43.89	43.87	43.84	43.76	43.75	43.71	43.66	43.61	43.56	43.55	43.51	43.33	43.31	43.27
EXISTING SURFACE	46.16	46.16	45.94	44.62	44.56	44.50	44.44	44.26	44.08	44.05	43.91	43.66	43.64	43.60
CHAINAGE	161.82	165.00	168.61	180.00	181.67	188.48	195.00	201.47	208.70	210.00	215.96	225.00	226.03	227.90

DESIGN CHANNEL INVERT	42.54	42.48	42.47	42.44	42.40	42.34	42.33	42.29	42.21	42.19	42.19	42.08	42.08	42.06	42.01	
HIGH FLOW CHANNEL TOP OF BANK	43.30	43.26	43.25	43.24	43.21	43.15	43.12	43.06	43.00	42.99	42.99	42.89	42.88	42.85	42.79	
LOW FLOW CHANNEL TOP OF BANK	43.03	42.98	42.97	42.93	42.89	42.84	42.82	42.79	42.70	42.68	42.68	42.58	42.57	42.55	42.51	
EXISTING SURFACE	43.32	43.26	43.23	43.14	43.00	43.06	43.10	43.13	42.98	42.91	42.90	42.71	42.71	42.73	42.60	
CHAINAGE	240.00	242.84	244.19	248.85	255.00	262.70	264.87	270.00	281.66	284.70	285.00	300.00	300.36	303.04	309.97	

VERTICAL SCALE 1:100

LONGITUDINAL SECTION LOW FLOW CHANNEL
HORIZONTAL SCALE 1:500

V 1:100 (AT A1)
V 1:200 (AT A3)
2 1 0 1 2 3 4 5
METRES
H 1:500 (AT A1)
H 1:1000 (AT A3)
10 0 10 20 30
METRES

DRAFT ISSUE ONLY
PRELIMINARY DESIGNS SUBJECT TO CHANGE

1	ISSUE FOR AGENCY REVIEW	DG	GA	PM	PM	14/08/24
	AMENDMENT	DES	DRN	CKD	APR	DATE

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
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CLIENT: ESR

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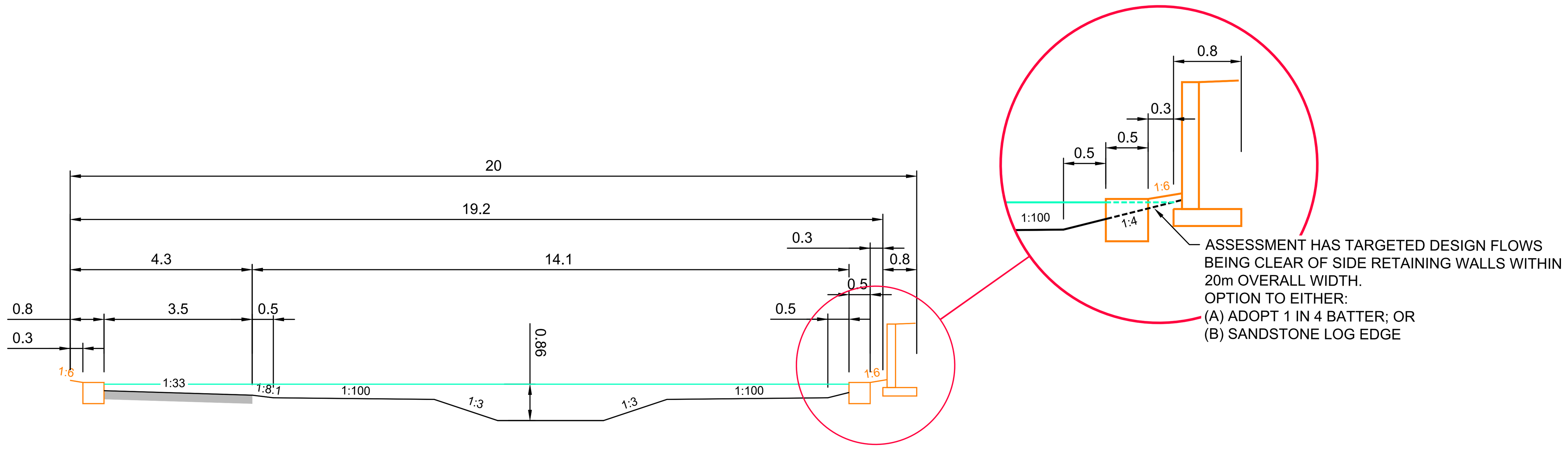
WESTLINK - ALDINGTON ROAD, KEMPS CREEK
STAGE 2 DRAINAGE CHANNEL WORKS
CHANNEL LONGITUDINAL SECTIONS

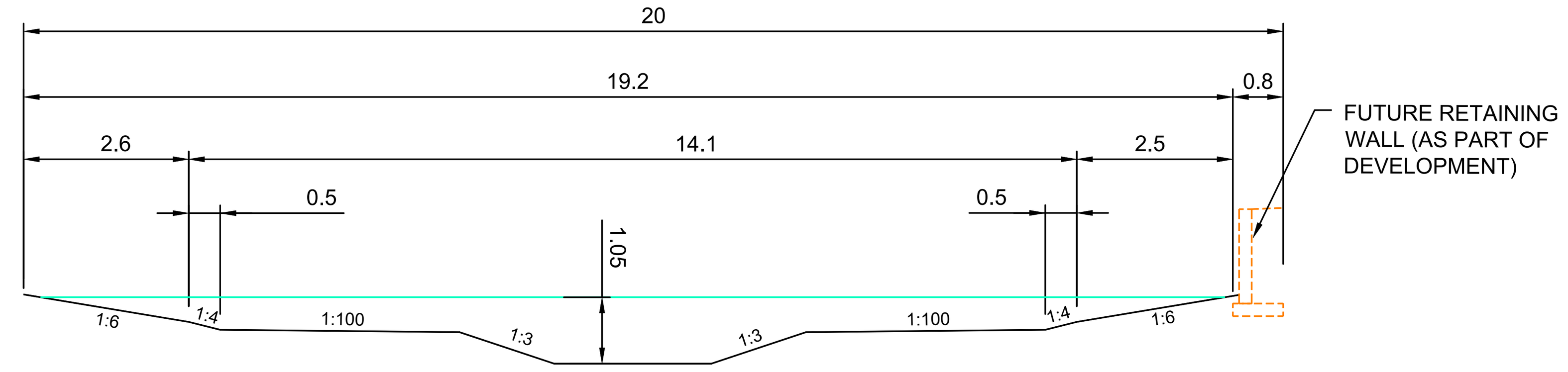
PROJECT No: 110965-04
SHEET No: CD015

AZIMUTH: M.G.A. | DATUM: A.H.D. | ORIGIN: SSM 1112 | PLAN No: 110965-04-CD015 | 1

Plotted: 19 November , 2024 3:40:34 PM File Name: C:\Synergy\WS\data\ASJWP04\110965.004 - Stage 2 Lot 2 Trunk Drainage Channel Design_13920\Design\DD\110965-04-DD015.dwg



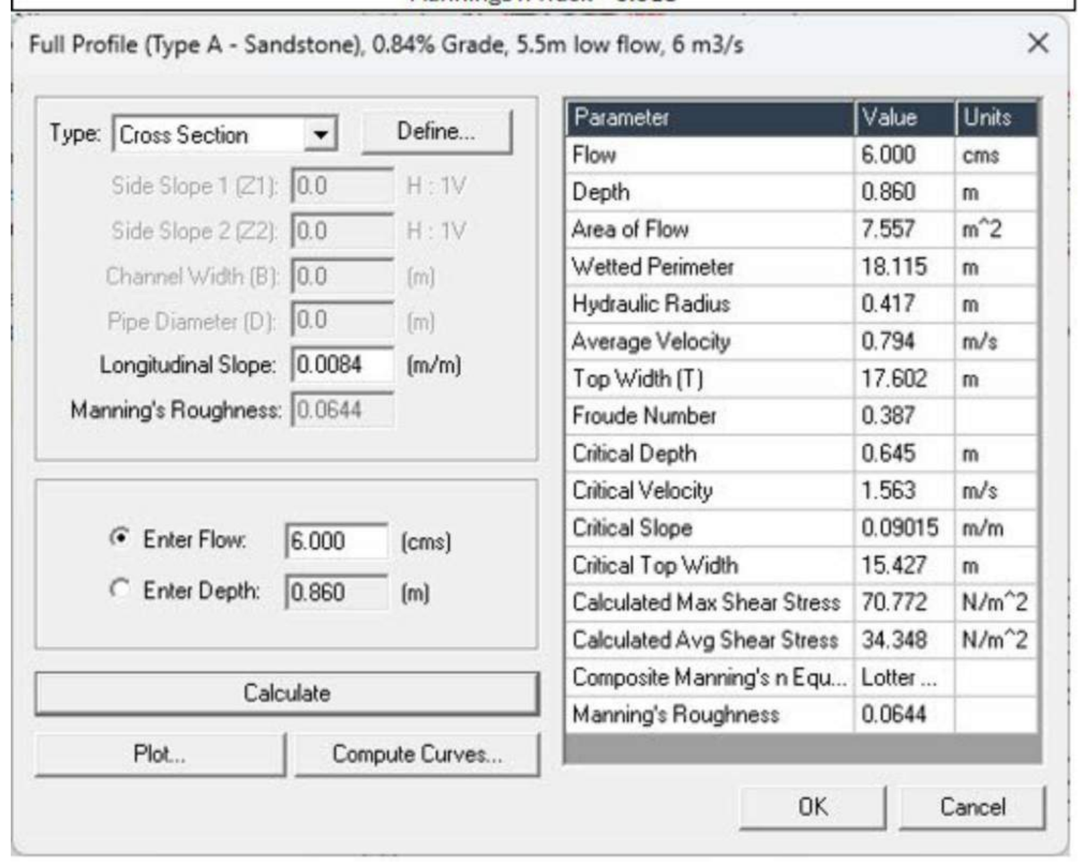
CHANNEL TYPE A - SANDSTONE EDGE
(TYPICAL SECTION
UPSTREAM OF OSD OUTLET)



CHANNEL TYPE B
(TYPICAL SECTION
DOWNSTREAM OF OSD OUTLET)

Channel Hydraulics (Calculated using Hydraulic Toolbox)

TYPE A CHANNEL	
Max Channel Slope = 0.84%	
1% AEP Flow Rate = 6.0 m^3/s	4EY Flow Rate = 1.02 m^3/s
Design Conditions	
Mannings n Low Flow Channel = 0.08	
Mannings n Overbanks = 0.08	
Mannings n Track = 0.018	



Full Profile (Type A - Sandstone), 0.84% Grade, 5.5m low flow, 6 m3/s

Type: Cross Section — Define...
Side Slope 1 (Z1): 0.0 H : 1V
Side Slope 2 (Z2): 0.0 H : 1V
Channel Width (B): 0.0 (m)
Pipe Diameter (D): 0.0 (m)
Longitudinal Slope: 0.0084 (m/m)
Manning's Roughness: 0.0644

Enter Flow: 6.000 (cms)
Enter Depth: 0.860 (m)

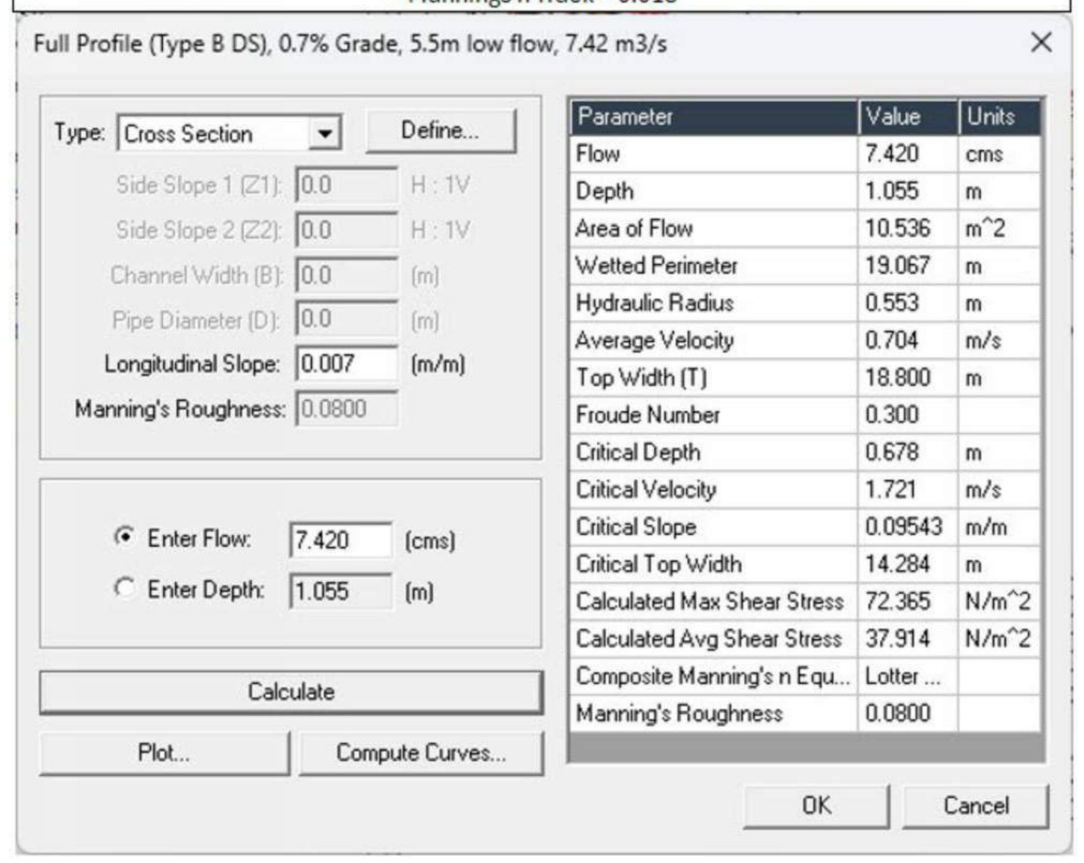
Calculate — Plot... — Compute Curves...

Parameter	Value	Units
Flow	6.000	cms
Depth	0.860	m
Area of Flow	7.557	m^2
Wetted Perimeter	18.115	m
Hydraulic Radius	0.417	m
Average Velocity	0.794	m/s
Top Width (T)	17.602	m
Froude Number	0.387	
Critical Depth	0.645	m
Critical Velocity	1.563	m/s
Critical Slope	0.09015	m/m
Critical Top Width	15.427	m
Calculated Max Shear Stress	70.772	N/m^2
Calculated Avg Shear Stress	34.348	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0644	

OK — Cancel

Channel Hydraulics (Calculated using Hydraulic Toolbox)

TYPE B CHANNEL	
Max Channel Slope = 0.7%	
1% AEP Flow Rate = 7.4 m^3/s	4EY Flow Rate = 1.02 m^3/s
Design Conditions	
Mannings n Low Flow Channel = 0.08	
Mannings n Overbanks = 0.08	
Mannings n Track = 0.018	



Full Profile (Type B DS), 0.7% Grade, 5.5m low flow, 7.42 m3/s

Type: Cross Section — Define...
Side Slope 1 (Z1): 0.0 H : 1V
Side Slope 2 (Z2): 0.0 H : 1V
Channel Width (B): 0.0 (m)
Pipe Diameter (D): 0.0 (m)
Longitudinal Slope: 0.007 (m/m)
Manning's Roughness: 0.0800

Enter Flow: 7.420 (cms)
Enter Depth: 1.055 (m)

Calculate — Plot... — Compute Curves...

Parameter	Value	Units
Flow	7.420	cms
Depth	1.055	m
Area of Flow	10.536	m^2
Wetted Perimeter	19.067	m
Hydraulic Radius	0.553	m
Average Velocity	0.704	m/s
Top Width (T)	18.800	m
Froude Number	0.300	
Critical Depth	0.678	m
Critical Velocity	1.721	m/s
Critical Slope	0.09543	m/m
Critical Top Width	14.284	m
Calculated Max Shear Stress	72.365	N/m^2
Calculated Avg Shear Stress	37.914	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0800	

OK — Cancel

FOR DISCUSSION

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
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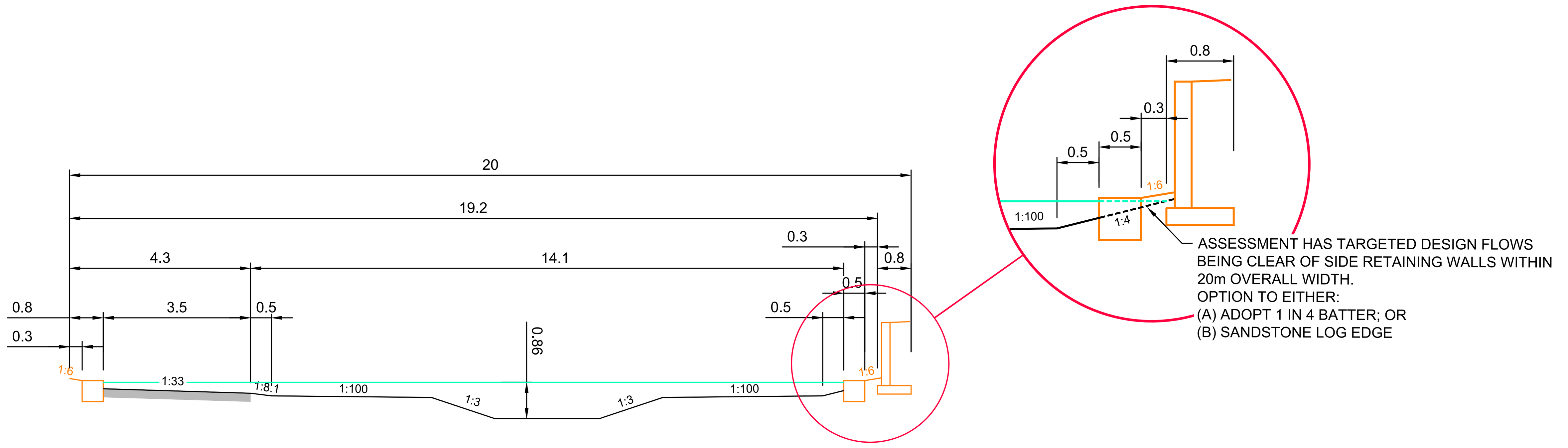
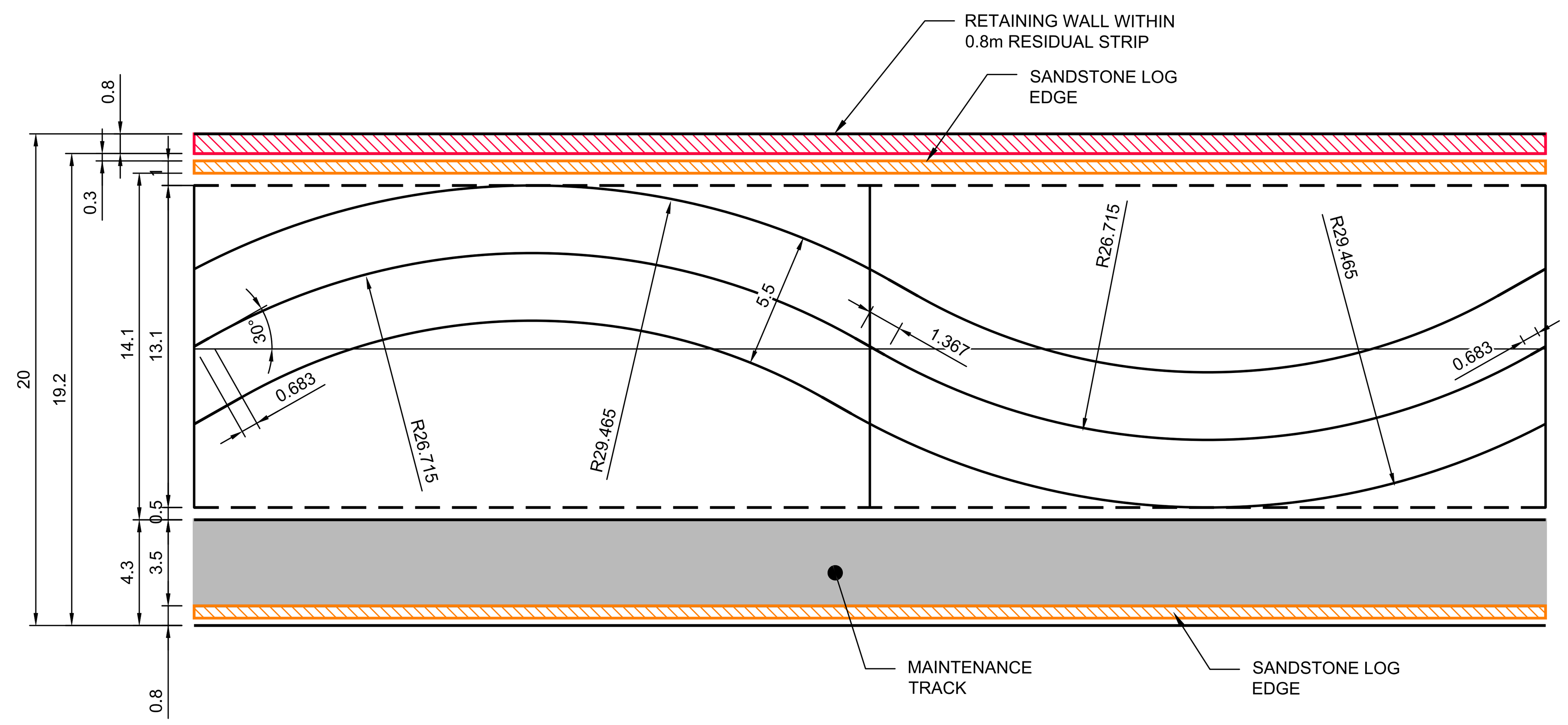
WESTLINK - ABBOTTS ROAD, KEMPS CREEK

STAGE 2 CHANNEL TYPES - CAPACITY CALCS

110965-04-SK100
20/11/2024
A

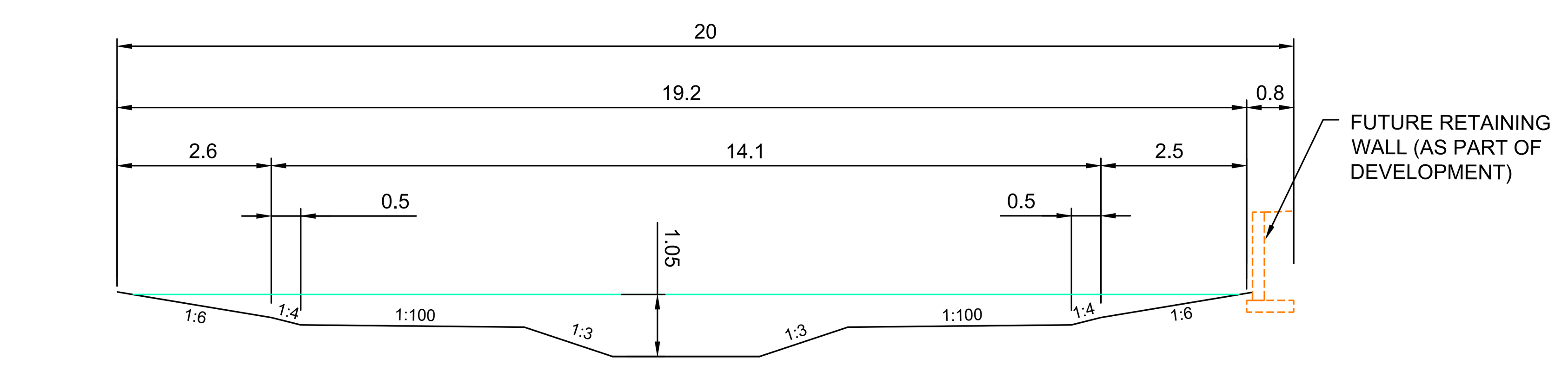


CHANNEL TYPE A - SANDSTONE EDGE
(TYPICAL SECTION
UPSTREAM OF OSD OUTLET)

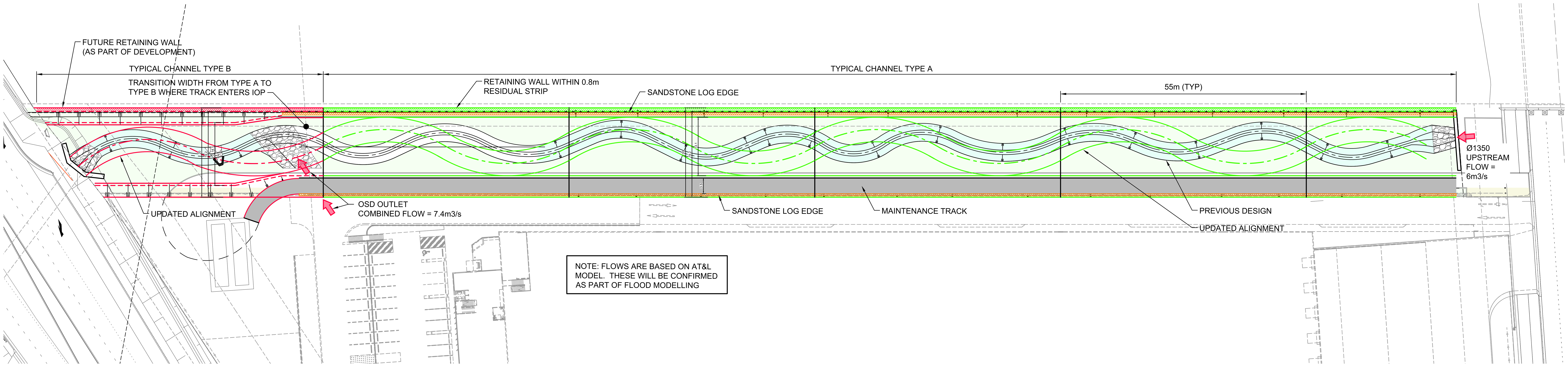


CHANNEL TYPE A - SANDSTONE EDGE

- MIN RADIUS WELL EXCEEDED
- SMALL STRAIGHT LENGTHS
- WAVE LENGTH = 55m
- SINOUSITY = 1.05



CHANNEL TYPE B
(TYPICAL SECTION
DOWNSTREAM OF OSD OUTLET)



FOR DISCUSSION

J. WYNDHAM PRINCE
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WESTLINK - ABBOTTS ROAD, KEMPS CREEK

STAGE 2 CHANNEL TYPES

110965-04-SK101
20/11/2024
A

From: Darren Galia <Darren.Galia@sydneywater.com.au>
Sent: Monday, 28 October 2024 4:11 PM
To: Chris Randall <CRandall@jwprince.com.au>
Cc: Craig Bush <Craig.Bush@sydneywater.com.au>; Grace Macdonald <Grace.Macdonald@esr.com>; Peter Mehl <pmehl@jwprince.com.au>
Subject: RE: [External] [110965.04] Westlink - Stage 2 Channel Clarifications

Hi Chris,

Thanks for the summary and queries. I appreciate the organized format, which made it easy to review. Please see my formal response below:

Sinuosity

- I can confirm that the wavelength is based on the full sine wave rather than what we've shown on the diagram. We will revise and update our guidelines accordingly.
- The wavelength of 30m (wavelength) / 4m (top of low flow channel width) = 7.5 will not be deemed acceptable, particularly due to the narrowing of the channel from 25m to 18.9m.

Low Flow Calculations

- I can confirm that the correct design parameter for the low flow channel is the 4EY, the drawings will be updated as soon as possible.
- The preferred design outcome is **Scenario 2 Option 1** with a manning's of 0.08 with the capacity for 1.043.

I've attached a drawing above with sinuosity 1.05, wavelength 10x the top of the low flow channel and width for your reference, by widening the channel from 13.3m to 15.3m the trunk drainage will comply with both sinuosity and wavelength requirements.

Regards,

Darren Galia
Senior Stormwater Engineer
Western Sydney Development
Sydney Water, Level 10, 1 Smith Street, Parramatta NSW 2150

Darren.Galia@sydneywater.com.au

Mobile: 0455 344 819

From: Chris Randall <CRandall@jwprince.com.au>
Sent: Friday, October 25, 2024 3:03 PM
To: Darren Galia <Darren.Galia@sydneywater.com.au>

Cc: Craig Bush <Craig.Bush@sydneywater.com.au>; Grace Macdonald <Grace.Macdonald@esr.com>; Peter Mehl <pmehl@jwprince.com.au>
Subject: [External] [110965.04] Westlink - Stage 2 Channel Clarifications

CAUTION: This email originated from outside the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi Darren,

Thankyou for your time last week to discuss Sydney Water's latest requirements for the Westlink Stage 2 Channel. As discussed, there are a few items we would like Sydney Water to confirm / clarify to inform the design.

Can you please review the attached summary and confirm your position.
Once you've had a chance to review, perhaps you and I can have another teams session to resolve.

The attached two (2) items relate to:

- **Sinuosity**
  - Confirmation on whether the standards should actually be referring to the full sine curve for Sinuosity?
  - Confirmation on whether SWC will accept being slightly under the wavelength criteria given the design complies with all the other criteria?
- **Low Flow Calculations**
  - We note that plans in current standards still refer to 0.5 x 12EY. Please confirm which is correct.
  - A series of calculations provided to test the capacity of the current channel. Along with testing of either increasing width or depth.

	Flowrate (m^3/s)		Depth (m)
4EY	1.02		-
0.5 * 12EY (0.5 * 0.59)	0.30		-
Current Design - 4m wide (1m base, 1 in 3 side slopes, 0.5m deep)	n = 0.05	0.94	0.5
Scenario 1 - 4m wide (1m base, 1 in 3 side slopes, 0.5m deep)	n = 0.05	1.02	0.52
	n = 0.08	1.02	0.64
Scenario 2, Option 1 - 5.5m wide (2.5m base, 1 in 3 side slopes, 0.5m deep)	n = 0.08	1.02	0.5
			0.5
Scenario 2, Option 2 - 4.9m wide (1m base, 1 in 3 side slopes, 0.65m deep)	n = 0.08	1.02	0.65
			0.65

  - The results show that the increase in both target flows (from 0.5 * 12EY to 4EY) and Manning's increase (from 0.05 to 0.08) will impact on the sizing of the low flow.
    This would require either:
    - Increasing by 1.5m width; or
    - Increased depth by 0.15m + increasing width by 0.9m.

    Importantly, both of these would likely in turn impact upon the Sinuosity calculations.
    Before proceeding, we'd like to discuss further with SWC.

Next week, I will also provide the sketches we discussed however thought it would be best to send these first.

Regards,

Chris Randall – Technical Lead - Design

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W www.jwprince.com.au
Level 2, 50 Belmore Street, Penrith NSW

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS

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SINUOUSITY

Sydney Water Comment

The current design does not achieve the target for sinuosity.

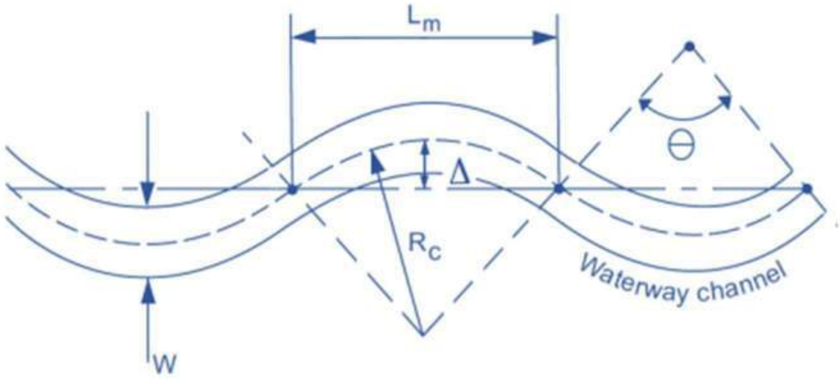
- *Sydney Water recommended increasing the average wavelength.*
- *After retaining a minimum 1m buffer, the proponent could potentially transfer the remaining portion of the 2m buffer next to the maintenance track to the upper bank to allow for an appropriate channel wavelength.*

JWP Response:

The failing parameter in our current design is the average wavelength. Which we understand the requirement for the average wavelength is to be ≥ 10 x Low Flow Channel Top Width (ie ≥ 40 m).

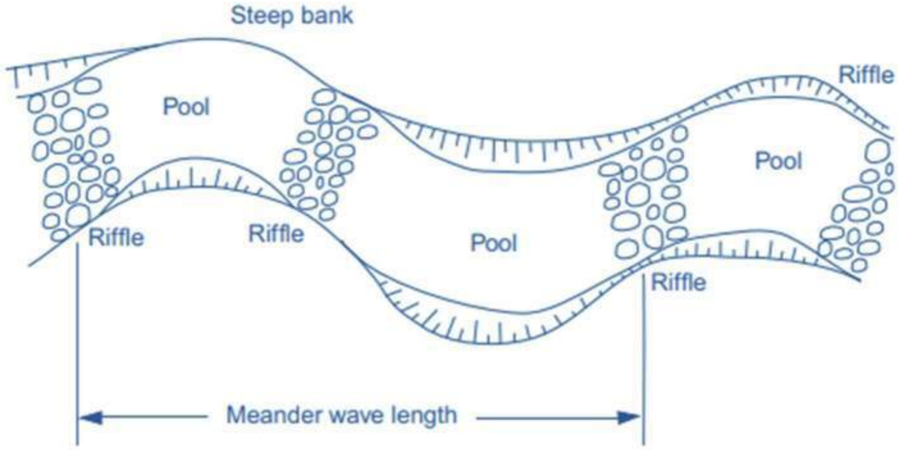
Based on the Sydney Water sinuosity diagram (Figure 6 below) the average wavelength achieved in our current design is 15m.

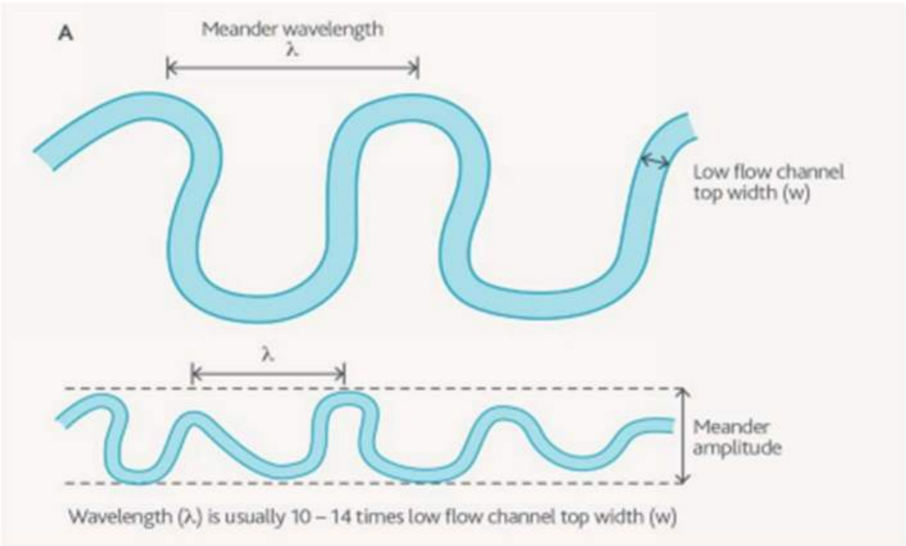
Figure 6: Sinuosity diagram (Brisbane City Council, 2000)



However, we believe the full cycle of the sine curve meander should actually be adopted as the wavelength i.e **DOUBLED** (see other diagram from Brisbane City Council and Melbourne Water below).

This would equate to an average wavelength of **30 m** (still failing but much closer to compliance with the required target of **40 m**).





Further to the discussion in our meeting, I understand that Figure 6 may be in error and that Sydney Water intend for the guidelines to consider the full sine curve (which will be updated in future revisions).

Can you please confirm that this is correct?

Also with this in mind, would Sydney Water accept being slightly under this criteria given we comply with all the other criteria?

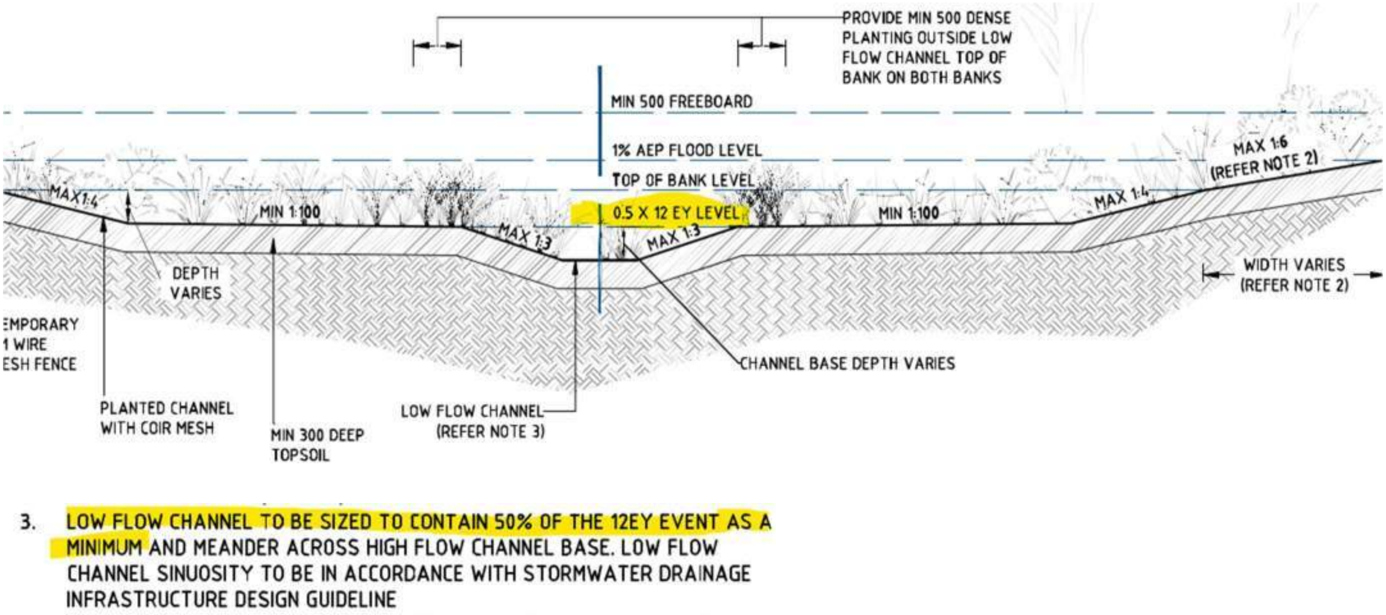
LOW FLOW CALCULATIONS

Sydney Water Comment

The proponent is to use 4EY flowrate for designing the low flow channel as outlined in the Draft Stormwater Scheme Infrastructure Design Guideline (Sydney Water, 2024) rather than 0.5X12EY.

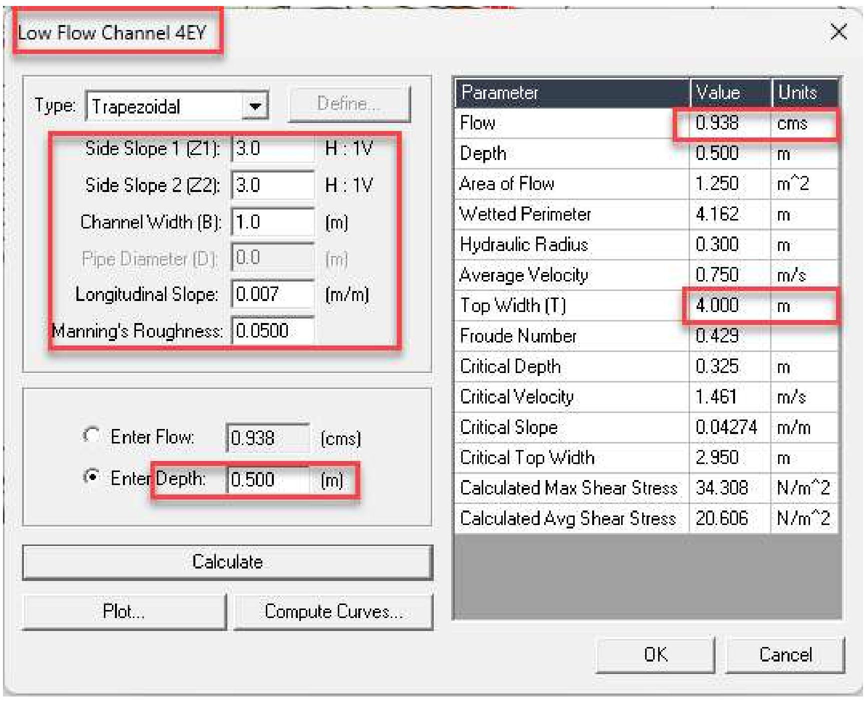
JWP Response:

We recognise that SWC have updated Section 6.2.3.1 of the guidelines from the previous lower target of the 0.5 x 12EY to now be 4EY. It is noted however that the draft channel typical section from the latest guidelines still shows the 0.5 * 12EY. Please confirm.



Based on a Manning's of 0.05 (i.e rock lined), our current design (i.e 1m base, 0.5m depth and 1 in 3 side slopes) easily covers the previous 0.5 x 12EY requirement and is very close to the 4EY capacity (4EY is 1.02m^3/s vs 0.94m^3/s capacity).

Given this is very close to the 4EY capacity, would this be acceptable to Sydney Water?



Further to the meeting request for a Manning's of n = 0.08, we've also undertaken the following calculations.,

Scenario 1 – Testing of Current Low Flow Profile

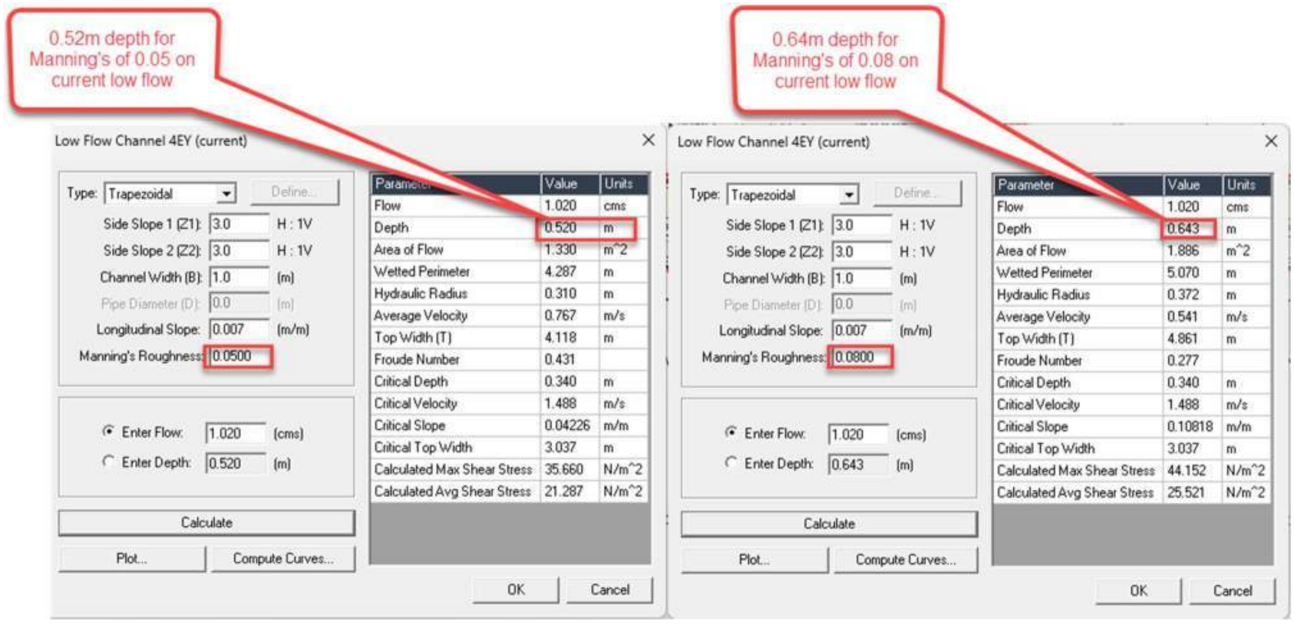
(1m base, 1 in 3 slopes, 0.5m depth, 4m total width)

- Mannings of 0.05 → 4EY flows would be just over the top of the current profile

  (i.e 20mm over the 0.5m depth)

- Mannings of 0.08 → 4EY flows would be over the top of the current profile

  (i.e 140mm over the 0.5m depth)



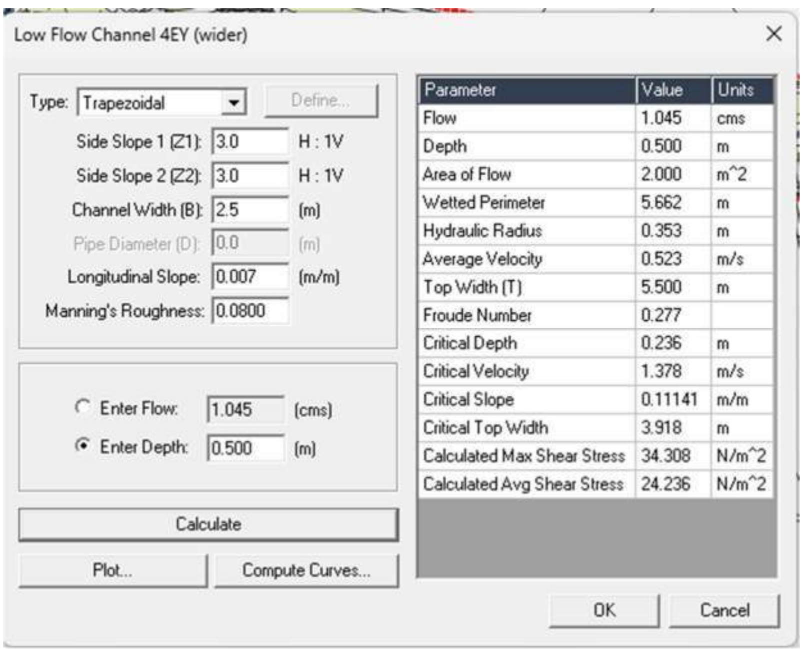
Scenario 2 – Widening or Deepening the Channel

In order to achieve the 4EY capacity ($1.02m^3/s$) for a Manning's of 0.08, the low flow channel will need to be either widened or deepened.

I've looked at both options, summarised below:

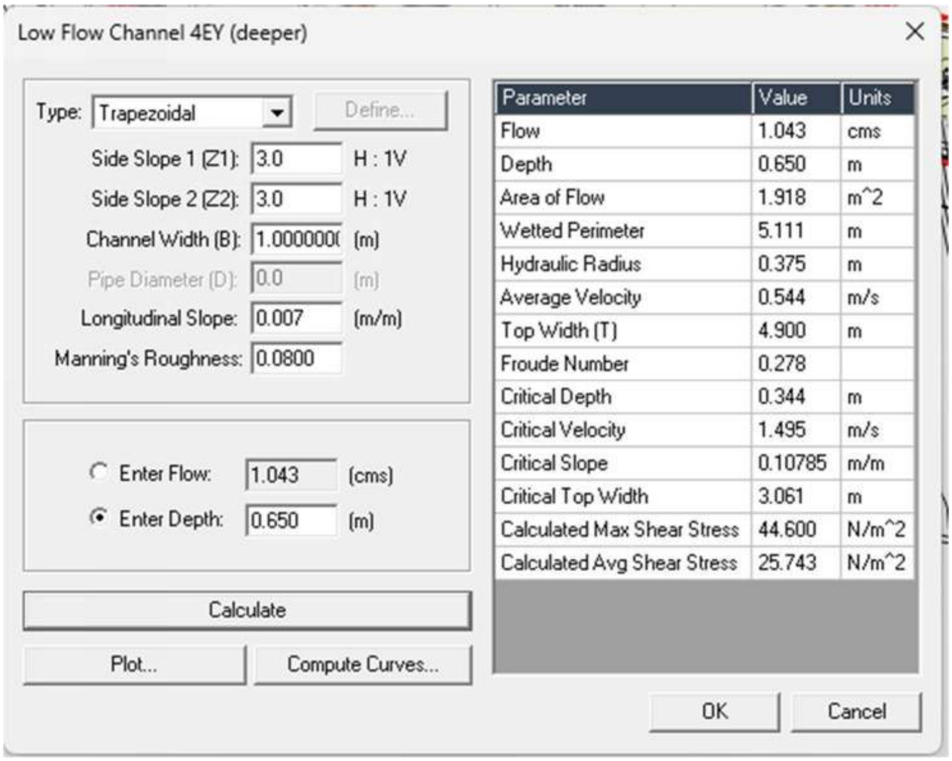
- **Channel width increased to 5.5m total**

  (2.5m wide base, 0.5m deep, 1:3 batters = 5.5m top width)



- **Channel depth increased to 0.65m**

(1m wide base, 0.65m deep, 1:3 batters = **4.9m top width**)



Discussion of Results

	Flowrate (m^3/s)		Depth (m)
4EY	1.02		-
0.5 * 12EY (0.5 * 0.59)	0.30		-
Current Design - 4m wide (1m base, 1 in 3 side slopes, 0.5m deep)	n = 0.05	0.94	0.5
Scenario 1 - 4m wide (1m base, 1 in 3 side slopes, 0.5m deep)	n = 0.05	1.02	0.52
	n = 0.08	1.02	0.64
Scenario 2, Option 1 - 5.5m wide (2.5m base, 1 in 3 side slopes, 0.5m deep)	n = 0.08	1.02	0.5
			0.5
Scenario 2, Option 2 - 4.9m wide (1m base, 1 in 3 side slopes, 0.65m deep)	n = 0.08	1.02	0.65
			0.65

The results show that the increase in both target flows (from 0.5 * 12EY to 4EY) and Manning's increase (from 0.05 to 0.08) will impact on the sizing of the low flow.

This would require either:

- Increasing by 1.5m width; or
- Increased depth by 0.15m + increasing width by 0.9m.

Importantly, both of these would likely in turn impact upon the Sinuosity calculations. Before proceeding, we'd like to discuss further with SWC.

Chris Randall

From: Craig Bush <Craig.Bush@sydneywater.com.au>
Sent: Thursday, 23 January 2025 11:47 AM
To: Chris Randall; Darren Galia
Cc: Grace Macdonald; Daniel Gardiner; Peter Mehl; Andrew Tweedie; lucas.b; Troy McLeod; Niranjana Vetrivelu
Subject: RE: [External] [110965.04] Stage 2 Westlink - Maintenance Access to Culvert

Hi Chris,

Thanks for the email. In principle, we agree that the proposed design for the maintenance access to the culvert/turn around point is acceptable. Just need to ensure the grades to the culvert are acceptable for maintenance vehicles and no scraping, which can occur in detailed design.

We can also discuss during the detail the material to be used in the access ramp, ideally it shouldn't require reinforced concrete but use of sandstone logs or similar, which has been used in Blacktown for some recent channel works that look to be functional (as seen in image below).

If you have any questions, please let me know.

Regards,

Craig Bush
Acting Wianamatta Stormwater Lead
Western Sydney Development

Mobile 0475 063 488
craig.bush@sydneywater.com.au
I'm in the office Monday and Thursday

1 Smith Street
Parramatta NSW 2150

Sydney
WATER

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Read more about our commitment to reconciliation.

From: Chris Randall <CRandall@jwprince.com.au>
Sent: Monday, 20 January 2025 4:12 PM
To: Craig Bush <Craig.Bush@sydneywater.com.au>; Darren Galia <Darren.Galia@sydneywater.com.au>
Cc: Grace Macdonald <Grace.Macdonald@esr.com>; Daniel Gardiner <dgardiner@jwprince.com.au>; Peter Mehl <pmehl@jwprince.com.au>; Andrew Tweedie <andrew.t@atl.net.au>; lucas.b <lucas.b@atl.net.au>; Troy McLeod <tmcleod@jwprince.com.au>; Niranjana Vetrivelu <NIRANJANA.VETRIVELU2@sydneywater.com.au>
Subject: [External] [110965.04] Stage 2 Westlink - Maintenance Access to Culvert

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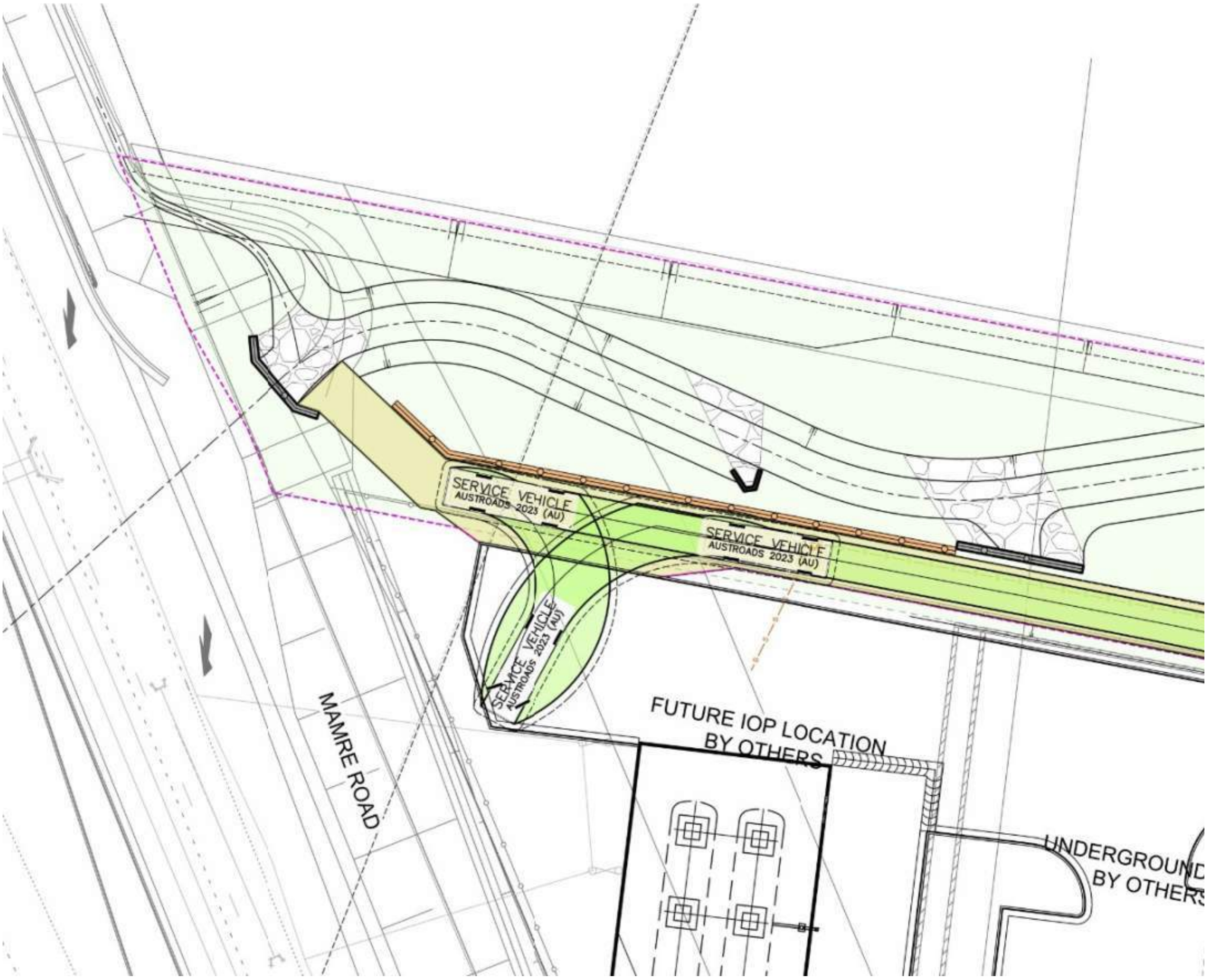
Hi Craig and Darren,

Thanks for your time in our meeting last Monday (13/1/2025).
As mentioned, we are progressing well with the Stage 2 documentation and are in the final stages this week.

You may recall that one of the items was about the positioning of the maintenance track and whether SWC have any requirements to have maintenance access to the headwall under Mamre Road. (i.e to clear debris / blockages, etc).

After consideration of a few options (including access from above via Mamre Road), we've landed on the below.
This option allows for a service vehicle to turn around within the sealed area in front of the IOP. With provision being made for a section of ramp to provide access down to the headwall.
We've tested this in the flood modelling to confirm and believe this will provide SWC with the most practical outcome.

We are proceeding on this basis, so hope that it will be in line with your expectations.
Please let me know if you have any feedback or comments.



Regards,
Chris Randall – Technical Lead – Design

jwp

Chris Randall
Technical Lead - Design

A Level 2, 50 Belmore Street
Penrith NSW 2750
P 02 4720 3330 **M** 0404 073 431
E crandall@jwprince.com.au

jwprince.com.au

APPENDIX C

Sydney Water Design Checklist

DRAWING REQUIREMENTS	REVIEWER COMMENTS	CLOSED/OPEN	DESIGNER COMMENTS	REVIEWER COMMENTS
Pre-development Catchment	To be provided	Open	JWP adopted the AT&L's Westlink Stage 2 DRAINS model for the source of channel design flows. A copy of AT&L's Stormwater report is included in Appendix D. Refer to Section 2.4 for discussion on the post-developed catchments.	
Post development Catchment	To be provided	Open	JWP adopted the AT&L's Westlink Stage 2 DRAINS model for the source of channel design flows. A copy of AT&L's Stormwater report is included in Appendix D. Refer to Section 2.4 for discussion on the post-developed catchments.	
Pre and post catchment overlaid	To be provided	Open	JWP adopted the AT&L's Westlink Stage 2 DRAINS model for the source of channel design flows. A copy of AT&L's Stormwater report is included in Appendix D. Refer to Figure 2 and Figure 7 of the AT&L report and Table 1 for the catchment details. All design flows were extracted from the supplied DRAINS models and liaison with AT&L	
Overland Flow Arrows	To be provided	Open	A copy of AT&L's Stormwater report is included in Appendix D. Refer to Section 2.4 and Figure 7 of the AT&L report for overland flow arrows	
General Arrangement				
Channel Corridor Width	To be provided	Open	A Sydney Water Easement Plan is also included on DD007 showing the 19.2m drainage easement width (including the overall area of the system) along with the 0.8m residual plan. Also refer to the Plan of Subdivision by Land Partners (Ref: SY074698.000.01) for Setout Details	
Cross Section Drawings				
Typical Cross Section	To be provided	Open	Refer to JWP Engineering Design Plans Sheet No's DD009 for typical cross sections for the channel both upstream and downstream of the OSD outlet. These were agreed in principle by SWC	
Cross Sections At 20m Intervals	To be provided	Open	Refer to JWP Engineering Design Plans Sheet No's DD020 to DD021 for cross sections at 15m intervals. 15m intervals was selected to provide a reasonable interval along the sinuousity of the low flow channel	
Water Levels of Minor Storm Event, 1% AEP And 0.5m Freeboard	To be provided	Open	Figure 5-1 in Appendix F demonstrates the water levels across the channel in the 1% AEP, with flows being contained in the channel with freeboard. The 1% AEP flood levels have also been included on each of the channel sections provided on sheets DD020-DD021 of the JWP Engineering Drawings	
Private Retaining Walls and Easement shown on Plan	To be provided	Open	A Sydney Water Easement Plan is also included on DD007 showing the 19.2m drainage easement width (including the overall area of the system) along with the 0.8m residual plan. Also refer to the Plan of Subdivision by Land Partners (Ref: SY074698.000.01) for Setout Details. Details and long sections of the proposed retaining walls are included on drawings DD030 to DD036.	
Long Section Drawings				
Inverts Levels and Slopes	To be provided	Open	Long sections for the proposed channel is shown on JWP Engineering Drawing DD016. This includes the connection to the downstream culvert under Mamre Road (by others)	
Tie-Ins With Surrounding Area	To be provided	Open		
Major Infrastructure Crossings (Road Grades, Retaining Walls, Maintenance Access Track	To be provided	Open	There are no major crossings across the Stage 2 Channel.	
Incoming Pipe Long Sections	To be provided	Open	HGL's are indicated on JWP Engineering Design Plans Sheet No's DD060 (Plan) and were obtained from AT&L's adjacent Stage 2 civil design plans.	
Drop Structures				

DRAWING REQUIREMENTS	REVIEWER COMMENTS	CLOSED/OPEN	DESIGNER COMMENTS	REVIEWER COMMENTS
Materials Specification	Designer to confirm the proposed material is sandstone block	Open	Retaining wall / headwall types across Stage 2 include a combination of: Northern Edge - Sandstone Log Retaining Walls (up to 1.5m high) - Concrete Sleeper Walls with Sandstone face (greater than 1.5m high) Other Locations - Sandstone Log Retaining Walls - Headwalls to be Sandstone Log	
Scour Protection	To be provided	Open	Detailed Flood Mapping has been undertaken in TUFLOW, including shear stress mapping for a wide range of design flood events. This mapping showed shear mapping within acceptable limits. Rock armouring is therefore proposed at all headwall locations. The flood mapping is included in Appendix F	
Frequency of Drops	Not required as item is not proposed by designer	Closed	No drop structures are proposed	
Drop Structure Physical Dimensions	Not required as item is not proposed by designer	Closed	No drop structures are proposed	
Rock Chutes	Not required as item is not proposed by designer	Closed	No rock chutes are proposed	
Rock Chutes Calculations	Not required as item is not proposed by designer	Closed	No rock chutes are proposed	
Geotechnical Assessment of Drop Structure Treatment	Not required as item is not proposed by designer	Closed	No drop structures are proposed	
Sinuosity				
Average Wavelength	To be provided in design report	Open	Refer to section 3.2.1 of the design report for details of sinuosity achieved for the Westlink Stage 2 Trunk Drainage channel	
Sinuosity Calculations	To be provided in design report	Open	Refer to section 3.2.1 of the design report for details of sinuosity achieved for the Westlink Stage 2 Trunk Drainage channel	
Centreline Radius Curvature	To be shown on plan	Open	Refer to section 3.2.1 of the design report for details of radius curvatures being achieved for the Westlink Stage 2 Trunk Drainage channel. Radius details have been incorporated into the JWP Engineering design plan sheets DD005	
Minimum Outer Radius Curvature	To be shown on plan	Open	Refer to section 3.2.1 of the design report for details of radius curvatures being achieved for the Westlink Stage 2 Trunk Drainage channel. Radius details have been incorporated into the JWP Engineering design plan sheets DD005	
Maintenance Access				

DRAWING REQUIREMENTS	REVIEWER COMMENTS	CLOSED/OPEN	DESIGNER COMMENTS	REVIEWER COMMENTS
Access Track Width and Length	Width is to be denoted on plan, access track cross section, advice is being prepared on material	Open	Details of the maintenance track width are incorporated into the plan sheets. Dimensions are shown on Plans DD011 to DD015. A "Concrete edge strip and maintenance access pavement detail" is included on DD009 showing the overall width of 3.5m and material specifications. The Blacktown WSUD guideline standard access pavement detail was adopted as a guide but concrete edge strips have bene added to improve longevity.	
Turning Circles	To be provided	Open	Maintenance access turning paths have been added at Sheet DD080 of the engineering plans for each of the entry / exit points. The corresponding edge strip and driveway positioning has been widened to consider service vehicle movements. The movements in the vicinity of the IOP has been coordinated with AT&L along with provision for an access ramp to the Mamre Road headwall	
Access Ramp Grades	To be provided	Open	Provision for an access ramp to the Mamre Road headwall. Refer to DD011 and DD080.	
Access Ramp Fencing	To be provided	Open	Fencing is provided at all retaining wall locations	
Access track scrap testing	To be provided	Open	Vehicle vertical clearance at the key locations were reviewed and some of the vertical curve radii's adjusted on the Access track longitudinal sections as presented on Sheet DD017 of the JWP Engineering drawings.	
Bollard Location and Type	To be provided	Open	Removable bollards are included at Access Road Entry Points.	
Irrigation				
Location and arrangement shown on plan	To be provided in consultation with Sydney Water	Open	The Sydney Water supplied Irrgiation Plans have been undertaken by Waterwise Consulting (Ref: SW-MR-2409) and have been used to inform landscape plans. These have not been shown on the civil plans for clarity (since they are drawn NTS) but are listed as reference plans on Sheet DD002.	
Irrigation Line Diameter, Isolation Valves, Sprinkler Heads	To be provided in consultation with Sydney Water	Open	The Sydney Water supplied Irrgiation Plans have been undertaken by Waterwise Consulting (Ref: SW-MR-2409) and have been used to inform landscape plans. These have not been shown on the civil plans for clarity (since they are drawn NTS) but are listed as reference plans on Sheet DD002.	
Landscape plan				
landscape zones	To be provided	Open	Landscape plans will be provided by ESR	
appropriate species and densities	To be provided	Open	Landscape plans will be provided by ESR	
Fencing				
Falls risk fencing (type and location)	To be provided	Open	Falls Risk Fencing has been included for all wall/drop heights greater than 0.9 m as detailed on JWP Engineering design plans Sheets No. DD010 - DD015 with details of the fencing provided on Sheets DD009	
Vehicle exclusion fencing (type and location)	To be provided	Open	No vehicle exclusion fences are included along the side of the channel, given each side will be proposed lots. This will be dealt with as part of the individual works on those lots (by others)	

DRAWING REQUIREMENTS	REVIEWER COMMENTS	CLOSED/OPEN	DESIGNER COMMENTS	REVIEWER COMMENTS
HYDROLOGY				
IFD Data	To be provided	Open	JWP adopted the AT&L's Westlink Stage 2 DRAINS model for the source of channel design flows. A copy of AT&L's Stormwater report is included in Appendix D. Refer to Section 2.4 for discussion on the post-developed catchments.	
ARR Probability Neutral Pre-burst	To be provided	Open		
4EY Storm Flow Rate	To be provided	Open	The peak flow rates for the adopted Design hydrographs are reported at Table 4-1 of the JWP design report	
Minor Storm Flow Rate	To be provided	Open	The peak flow rates for the adopted Design hydrographs are reported at Table 4-1 of the JWP design report	
Major Storm Flow Rate	To be provided	Open	The peak flow rates for the adopted Design hydrographs are reported at Table 4-1 of the JWP design report	
PMF Flow Rate	To be provided	Open	The peak flow rates for the adopted Design hydrographs are reported at Table 4-1 of the JWP design report	
Potential Erosion Assessment				
Climate Change Assessment	To be provided	Open	The peak flow rates for the adopted Design hydrographs are reported in Table 4-1 of the JWP design report. The 0.2% AEP storm (shown on Figure 5-2) was adopted as a proxy for the post CC 1% AEP design event, given the intended design life of the channel. This shows design flows being contained within the trunk drainage channel. Noting that the flooding within the lot to the north, will be removed once that lot is constructed in future.	
HYDRAULICS				
Mapping	To be provided	Open	The 2D mapping for these events are provided in Appendix F Figures 5-1 to 5-16 of the JWP Design report	
Shear Stress Modelling				
4EY Event	To be provided	Open	The 2D mapping for this event is provided in Appendix F Figure 5-7 of the JWP Design report	
5% AEP Event	To be provided	Open	The 2D mapping for this event is provided in Appendix F Figure 5-8 of the JWP Design report	
1% AEP Event	To be provided	Open	The 2D mapping for this event is provided in Appendix F Figure 5-9 of the JWP Design report.	
Drop Structure Modelling	To be provided.	Open	No drop structures are proposed in Stage 2 channel	
Slopes and Alignment	To be provided	Open	The 2D mapping for presented in provided in Appendix F Figures 5-1 to 5-16 of the JWP Design report incorporates modelling of all proposed slopes and alignments. Refer to Long Sections on Engineering Drawing DD016 for longitudinal slope	
Manning's (n) Values	To be provided	Open	As requested by Sydney Water, a Manning's of 0.08 has been adopted in the Trunk Drainage Channel for the Low Flow and Overbank Areas. Refer to Figures 4-3 and 4-4 in Appendix F for developed conditions Manning's values. Refer to JWP's FIRA Report for full discussion on the TUFLOW model setup.	
Channel Velocities				
4EY Event		Open	As per SWC guidelines, flood mapping is provided in accordance with Section 6.2.4.2. This includes flood velocities for the 1% AEP, 0.2% AEP and PMF. Refer to Figures 5-4 to 5-6 in Appendix F.	

5% AEP Event		Open	As per SWC guidelines, flood mapping is provided in accordance with Section 6.2.4.2. This includes flood velocities for the 1% AEP, 0.2% AEP and PMF. Refer to Figures 5-4 to 5-6 in Appendix F.	
1% AEP Event	To be provided	Open	The 2D mapping for this event is provided in Appendix F Figure 5-4 of the JWP Design report.	
Hydraulic Flow Type		Open	As per SWC guidelines, this can be provided during detailed design if required	
Hydraulic Flow Regime		Closed		

APPENDIX D

Westlink Industrial Estate, Kemps Creek – Stage 2 Water And Stormwater Management Plan (AT&L January 2025)

Westlink Industrial Estate, Kemps Creek

Water and Stormwater Management Plan Stage 2

ESR Development (Australia) Pty Ltd

JANUARY 2025

20-748

Commercial in Confidence

Document Registration

Document Title	Westlink Industrial Estate – Civil Infrastructure & Water Management Strategy Stage 2
Document File Name	R009-06-20-748-Stage 2 Water and Stormwater Management Plan
Section	Civil
Document Author	Andrew Tweedie

Issue	Description	Date	Author	Checked	Approved
01	Issued for Review	12/09/23	Andrew Tweedie	☒	☒
02	Final Issue	28/09/23	Andrew Tweedie	☒	☒
03	Final Issue	05/10/23	Andrew Tweedie	☒	☒
04	Final Issue	13/10/23	Andrew Tweedie	☒	☒
05	Final Issue	16/08/24	Andrew Tweedie	☒	☒
06	Final Issue	29/01/25	Andrew Tweedie	☒	☒

Contents

Figures

Tables

1. Introduction

This Water and Stormwater Management Plan (WSMP) has been prepared by AT&L on behalf of ESR Australia in support of a State Significant Development Application (SSD-46983729) for the proposed development of the site located at 1030-1064 Mamre Road Aldington Road and 59-63 Abbotts Road, Kemps Creek (the Site. This SSD builds on the Stage 1 approval SSD-9138102. Combined both these SSD's form the entire Westlink Industry Park.

1.1. Site Description

The extent of the site is presented in Figure 1.

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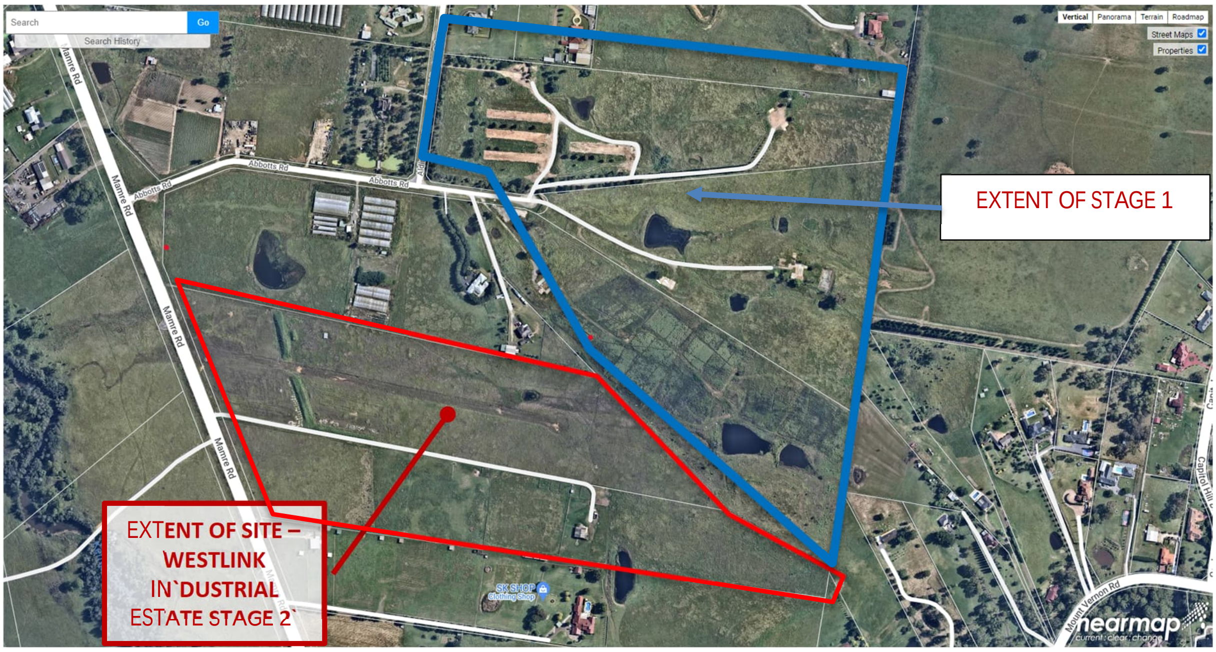


Figure 1: Site Extent (imagery from nearmap, dated 17 February 2022)

The site is located in the suburb of Kemps Creek, within the Penrith Local Government Area (LGA), and approximately 15 km south-east of the Penrith CBD and 5 km north-east of the under-construction Western Sydney Airport. The site is made up of the following allotments:

- Lots 3 and 4 DP250002 (1030-1064 Mamre Road, Kemps Creek)
- Lots 11 and 13 DP253503 (59-63 Abbotts Road, Kemps Creek)

The total area of the site is approximately 53.6 hectares.

Stage 1 SSD approval contains bulk earthworks, servicing and construction of Warehouse 1 and 3. Total work area is approximately 11.72Ha.

The proposed works associated for this Stage 2 SSD application is as follows and referenced in Figure 2:

- Construction of extension of Abbotts Road from Stage 1 extents to southern boundary
- Construction of Aldington Road extension to southern boundary
- Construction of private road north of Lot 6 linking Aldington Road with Abbotts Road extension
- Development of Lot 6 (Bulk earthworks of Lot approved under a different application CDC AT&L Drawings 20-748 C30000 series)
- Bulk earthworks and associated retaining walls within Lots 6, 4 and Lot 5

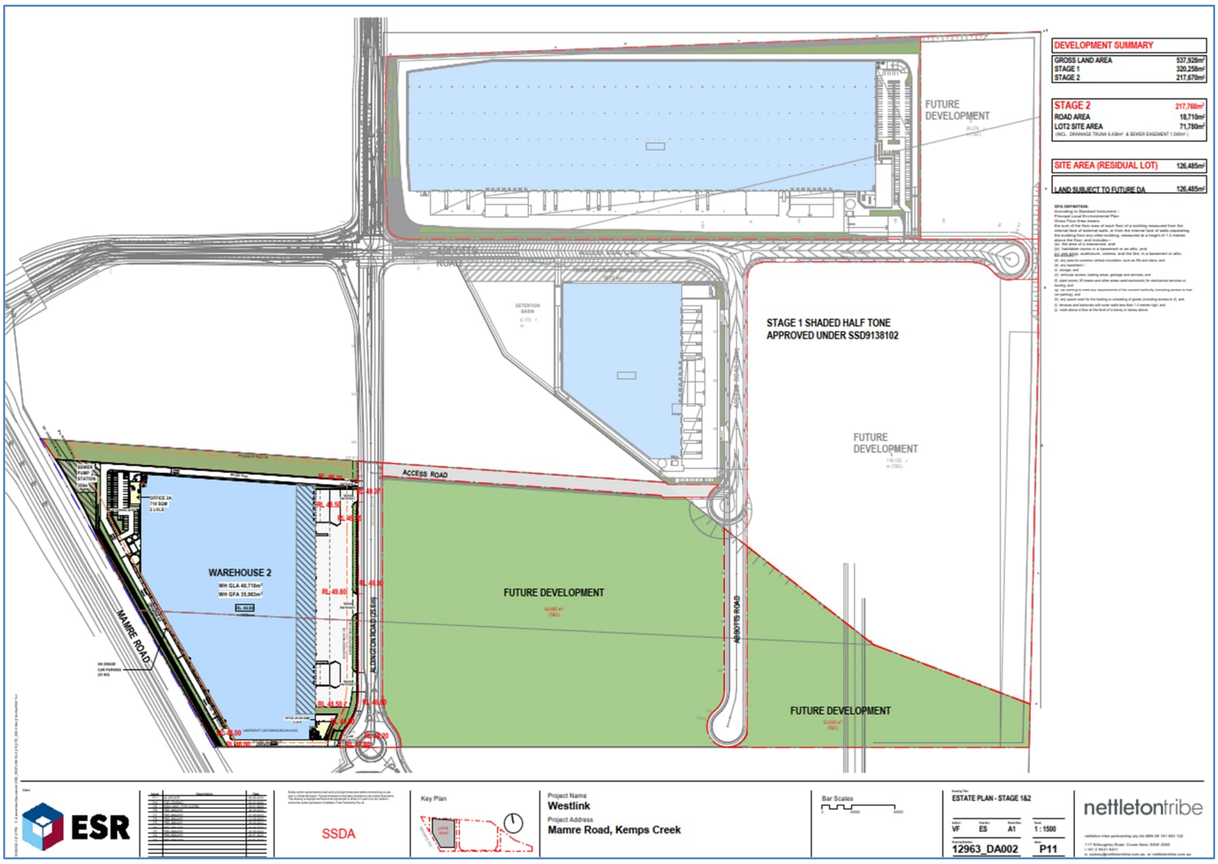


Figure 2 - Estate Plan Stage 2

The site is currently characterised as rural land and comprises residential dwellings, agricultural areas, sheds, greenhouses and some farm dams.

In June 2020, the site was rezoned *IN1 – General Industrial* under the *State Environmental Planning Policy (Western Sydney Employment Area) 2009*. The site is also located in the Mamre Road Precinct and is therefore subject to controls outlined in the *Mamre Road Precinct Development Control Plan 2021*.

1.2. Supporting Documentation

The following documentation is referred to throughout and should be read in conjunction with this report:

- Civil Drawings (AT&L), 20-748-C5000 (Infrastructure) and C6000 (on-lot) series – refer to Appendix 1.
- Stormwater Management Layout Plan 20-748-C11075 in Appendix 1
- Pre-Development hydrology parameters and assumptions letter (LTR007-02)- refer to Appendix 2
- Life Cycle Costings, and O&M Manuals from Landcom & Atlan - refer to Appendix 3
- Trunk Drainage Drawings and associated report by J.Wyndham Prince
- Westlink Industrial Estate Kemps Creek- Stage 2 flood Impact & Risk Assessment Report- Jan 2025 prepared by J Wyndham Prince

2. Site Characteristics

2.1. Existing Topography and Catchments

The Site in its existing condition is characterised by undulating topography. The ground slope across most of the site has a general fall from the east to west towards Mamre Road with existing levels ranging from RL98 in the south-east, RL 93 in the north-east, RL 42.5 in the south and west adjacent Mamre Road.

The eastern portion of the site consists of four ridgelines that are generally aligned in an east-west direction. Ground slopes off these ridgelines towards local gullies within the site are typically between 10% and 15%. The western portion of the site adjacent to Aldington Road and Abbotts Road is generally flatter than the eastern portion, with ground slopes typically in the range of between 2% and 8%.

Most of the site in its existing condition is pervious, other than some residential dwellings, sheds and access driveways.

Delineation of the existing internal drainage catchments and external catchment that drain through the site is presented as Figure 3. Note that this includes the existing conditions before the commencement of Stage 1 works.

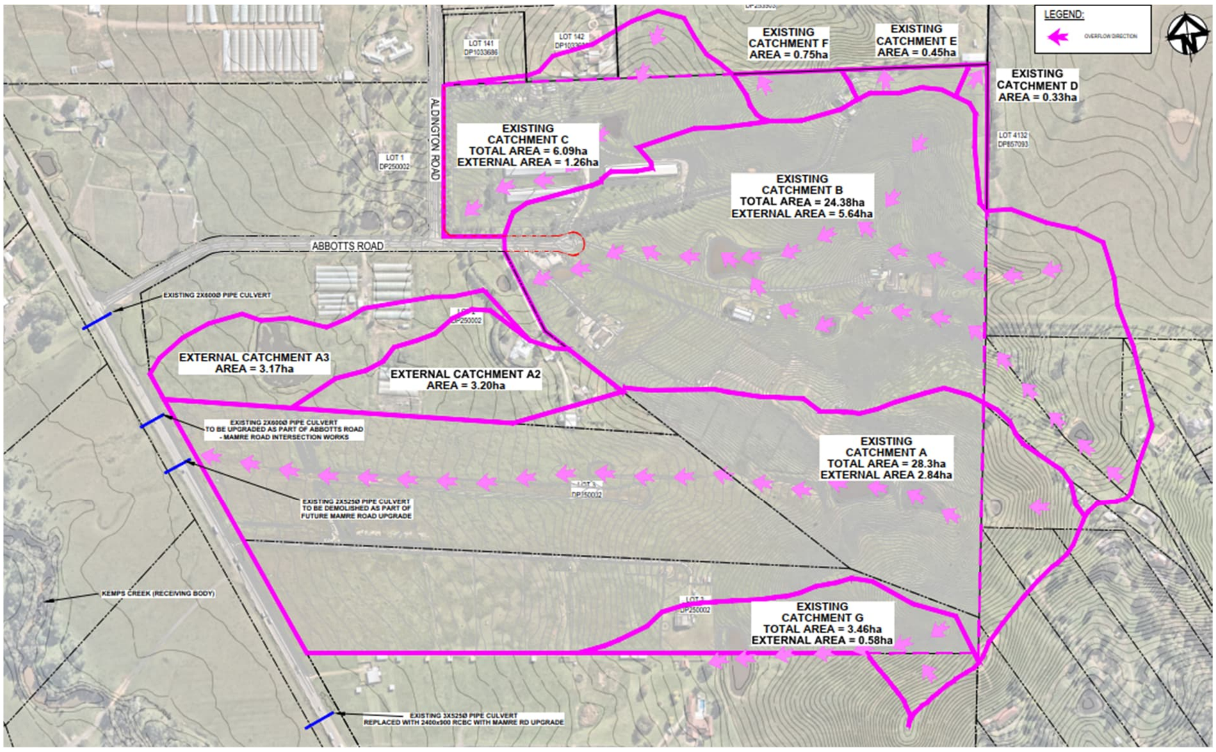


Figure 3: Catchment extents under existing conditions

A summary of the internal catchments under existing conditions is presented in Table 1.

Table 1: Description of internal and external catchments under existing conditions

Catchment ID	Area (ha)	Description
A	28.82	Discharges towards Mamre Road via residual land 1030-1064 Mamre Rd.
A2	3.20	Sheet flow into the ESR site, then joining catchment A.
A3	3.17	Sheet flow into the ESR site, and discharge from the existing farm dam, then joining catchment A.
B	24.38	Discharges towards the eastern boundary of 1016-1028 Mamre Road (Lot 2 DP250002) and ultimately into a catch drain that runs along the southern edge of Abbotts Road.
C	6.09	Discharges towards the intersection of Abbotts Road and Aldington Road.
D	0.33	Discharges in a north-easterly direction towards 19-105 Capitol Hill Drive Mount Vernon (Lot 4132 DP857093)
E	0.45	Discharges in a northerly direction towards 272 Aldington Road (Lot 15 DP253053)
F	0.75	
G	3.46	Discharges into a shared existing farm dam, which overflows into the 1066-1074 Mamre Rd property to the south.

There is currently no formal trunk stormwater infrastructure within the site.

2.2. Existing Drainage Lines

Based on large-scale topographic mapping (1:25,000 from NSW Six Maps), there is one mapped overland drainage lines within the site, refer to Figure 4.

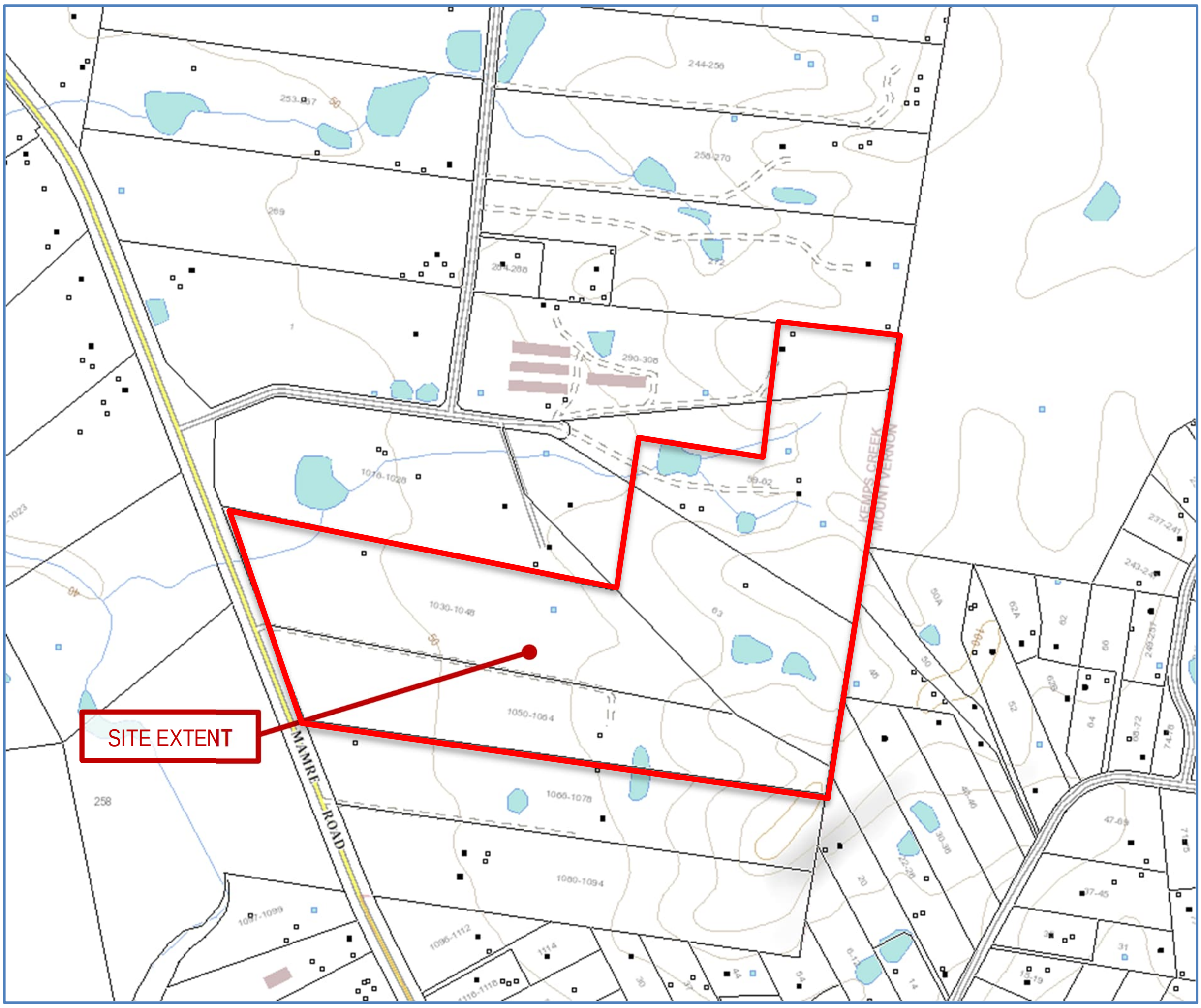


Figure 4: Topographic mapping showing drainage lines in the vicinity of the site (Source: NSW SIX Maps)

The *Mamre Road Precinct Waterway Assessment* (CT Environmental, April 2020), contained in the *Mamre Road Flood, Riparian Corridor, and Integrated Water Cycle Management Strategy* (Sydney Water, October 2020) presents the extents of waterways in the Mamre Road Precinct that have been the subject of a desktop review and field assessment to confirm the presence of mapped and unmapped waterways. An extract of mapping showing the extents of waterways in the Mamre Road Precinct is presented as Figure 5. This shows an unnamed tributary of Kemps Creek passing through the site.

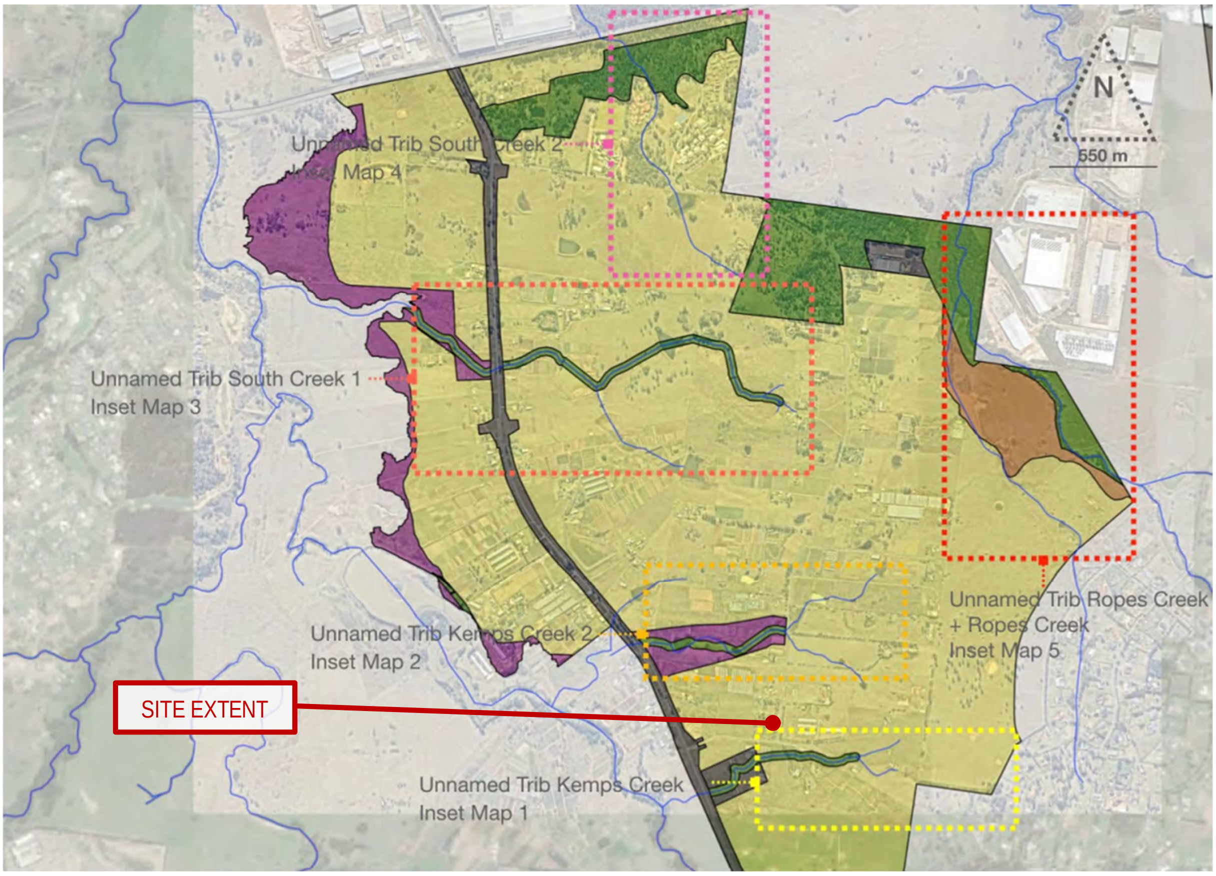


Figure 5: Extract of waterway mapping (CT Environmental, April 2020)

Results of the inspection of the unnamed tributary of Kemps Creek are described in the *Mamre Road Precinct Waterway Assessment* (CT Environmental, April 2020), and are summarised below:

- Two first order watercourses were evident in the headwaters which run to the north and south of the recently demolished house on 59-62 Abbotts Road.
- A clear flow path was evident below the confluence of the two first order watercourses, which validated the presence of a second order watercourse.
- The flow path did not have defined bed and banks, likely due to the presence of three upstream farm dams.
- From a point approximately 200 metres downstream (west) of the confluence of the first order watercourses, the flow path was observed to be heavily modified and formed into a drainage channel that runs parallel to and on the southern side of Abbotts Road. The flow path continues to Mamre Road.
- The section of mapped watercourse downstream of the Westlink Industrial Estate Stage 1, and passing through Stage 2, was not present, refer to Figure 6.
- Due to the lack of vegetation along the upper section of the headwater and significant modification to the drainage channel in the lower section, the watercourse had minimal ecological value.

Figure 6: Field validated flow paths and watercourses within and downstream of the site

2.3. Existing Geology

Based on the Preliminary Geotechnical Investigation undertaken by Douglas Partners (reference: 92352.00, dated August 2019) for 59-63 Abbotts Road and the Geotechnical Investigation Report prepared by Alliance Geotechnical (reference: 9687-GR-1-1, dated October 2019) for 290-308 Aldington Road, the following inferred sub surface soils were encountered across the site:

- TOPSOIL / topsoil filling to depths of 0.1 - 0.6m
- FILL to depths of 2.3m over parts of the site
- Residual Soil – variably stiff to hard silty clay, to depths in the range 2.5-3.5m
- BEDROCK - initially extremely low to very low strength shale or sandstone at first contact at depths of 0.7

2.4. Post-Development Catchment Extents

A post-development catchment plan based on the proposed site grading is presented as Figure 7.

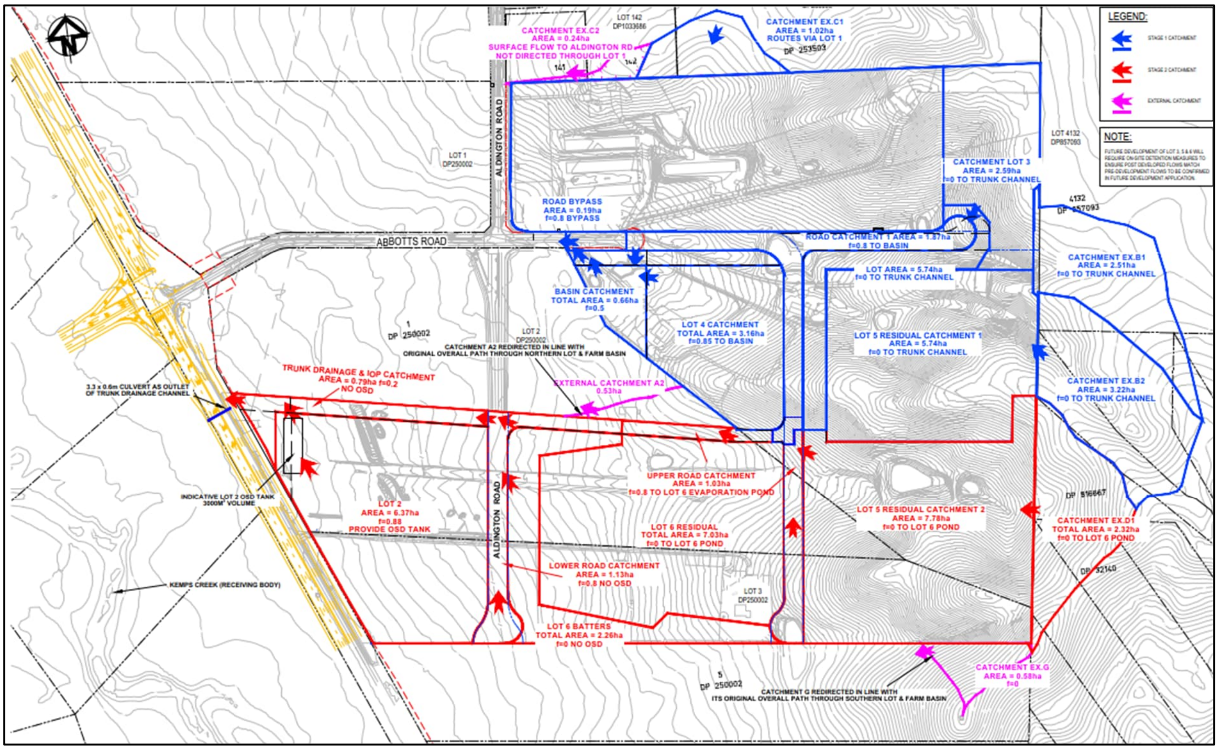


Figure 7: Catchment extents under proposed conditions

The post developed catchment extents are proposed to drain to the existing culvert beneath Mamre Road in the northwest corner of Stage 2 site as per Figure 7. It is noted the existing culverts beneath Mamre Road are scheduled to be completed in advance of the Westlink stage 2 development.

Prior to draining through the culvert beneath Mamre Road, the Stage 2 catchment is proposed as such:

- The Trunk Drainage & Sewer IOP easements bypass all OSD and treatment, draining directly into the downstream culvert
- Developed Lot 6 (western Lot) – drains via a proposed underground OSD tank with orifice outlet and proprietary treatment within the western portion of the lot to drain into the 19.2m open trunk drainage channel along the north of Lot 6
- Lots 5 and southern half of Lot 4 (both bulk surface only), and the southern portion of Abbotts Road to drain into an evaporation pond on Lot 5, then discharging into the open trunk drainage channel via GPT unit.
- The lower road catchment including Aldington Rd and a number of batters from lot 5 drain into the trunk drainage channel via a GPT unit.
- Lot 2 and northern portion of Lot 4 (both bulk surface only) to drain into the stage 1 trunk drainage channel (as per the Stage 1 stormwater management plan)
- Undeveloped External catchment to east to drain via lot 5 as surface flows.

Once Lot 4 and Lot 5 and the eastern external catchments are developed, detention and gross pollutant treatment measures within each site will be required to be implemented to ensure peak post flows into the open channel do not exceed the pre-developed flows and quality requirements. This will need to be determined as part of the Development Applications on each of these lots. As such the open trunk drainage channel is designed for pre-developed flow rates.

3. Stormwater Drainage

3.1. Stormwater Drainage Design Criteria

Design criteria and requirements for the proposed site stormwater management and stormwater drainage are outlined in the following documents:

- AS 3500.3 – Plumbing and drainage – Stormwater drainage
- Commonwealth of Australia (Geoscience Australia), *Australian Rainfall and Runoff: A guide to flood estimation*, 2019.
- NSW Department of Planning, Industry and Environment (DPIE), *Mamre Road Precinct Development Control Plan 2021*.
- NSW Department of Planning, Industry and Environment (DPIE), *MUSIC Modelling Toolkit – Wianamatta*, 2 August 2021.
- Penrith City Council, *Design Guidelines for Engineering Works for Subdivisions and Developments*, as amended 20 November 2013.
- Penrith City Council, *Water Sensitive Urban Design (WSUD) Policy*, December 2013.
- Penrith City Council, *WSUD Technical Guidelines*, Version 4 – October 2020.

3.2. Proposed Site Stormwater Drainage

The proposed drainage network within the estate has been designed to safely convey major and minor flows prior to discharging to neighbouring properties to the south and west. The following criteria have been adopted for the proposed drainage system:

- Major system (pit and pipe network, overland flow paths and channels): 1% AEP
- Minor system (pit and pipe network): minimum 5% AEP and increased where required to address major system design requirements.
- Flood Impacts from external catchments are to be minimised to an acceptable level for all floods up to the PMF.

The minor system stormwater drainage has been designed to drain towards the culvert crossing beneath Mamre Road in the northwest corner of the site. Limited road overland flow paths discharge into the southern property or Mamre Rd verge when exceeding the minor drainage system capacity.

3.3. Trunk Drainage Infrastructure

The *Mamre Road Precinct DCP* includes indicative locations of trunk drainage infrastructure across the precinct, refer to Figure 8. A 25m trunk drainage line is situated within the ESR Westlink Stage 2 site, which would drain in a westerly direction to Mamre Road. J. Wyndham Prince (JWP) has investigated the hydraulics and spatial design of the open trunk drainage channel in stage 2.

Confirmation has been received in discussions with Sydney Water in August 2023 that the naturalized trunk drainage channel within the development can be reduced in width from 25m (as per the Precinct DCP) to 19.2m and length to solely be located along the northern boundary between the Aldington Road extension at the east and Mamre Road to the west.

As such all documentation refers to the naturalized trunk drainage channel being 19.2m wide. This open channel is to form the naturalized trunk drainage network as per the DCP and the Mamre Road Precinct Stormwater Scheme Plan (Figure 8). Refer to JWP Channel Drawings for location and extents of open trunk drainage channel.

At the time of writing this report there is no detailed design of this stormwater naturalized trunk drainage channel provided by SWC to the west of Mamre Road and into the proposed Regional Wetland 17 as indicated in Figure 9 – Mamre Road Precinct Stormwater Scheme Plan.

It is assumed construction of the open trunk drainage channel within the Westlink Estate will occur prior to construction of the Regional Wetland and associated channel west of Mamre Road. As such outlet flows into the culvert beneath Mamre Road will be modelled to ensure pre-developed peak flows are not exceeded and existing flow paths west of Mamre Road are maintained.

The future downstream culvert as part of the Mamre Road upgrade is understood to be capable of conveying the entire Westlink Estate stage 2 catchment at pre-developed flows (but excludes the external catchments). The culvert requires re-alignment to the updated trunk drainage alignment. This has been formally accepted by Sydney Water. Design of the culvert as part of the Aldington/Abbotts Rd Intersection upgrade is still underway and may be updated prior to construction of Stage 2, however, they will maintain the Sydney Water culvert design including flow rates.

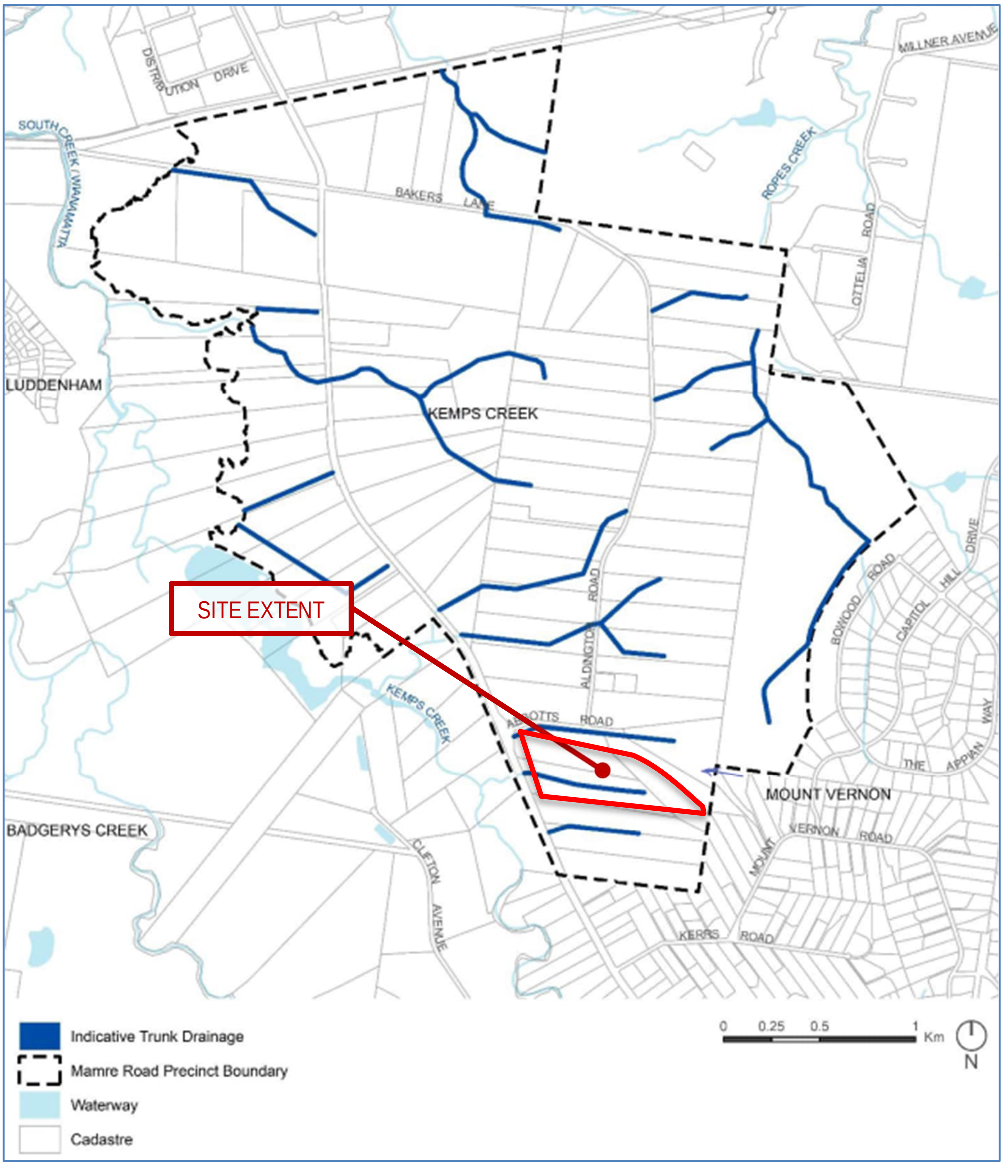


Figure 8: Trunk drainage infrastructure identified in the Mamre Road Precinct DCP

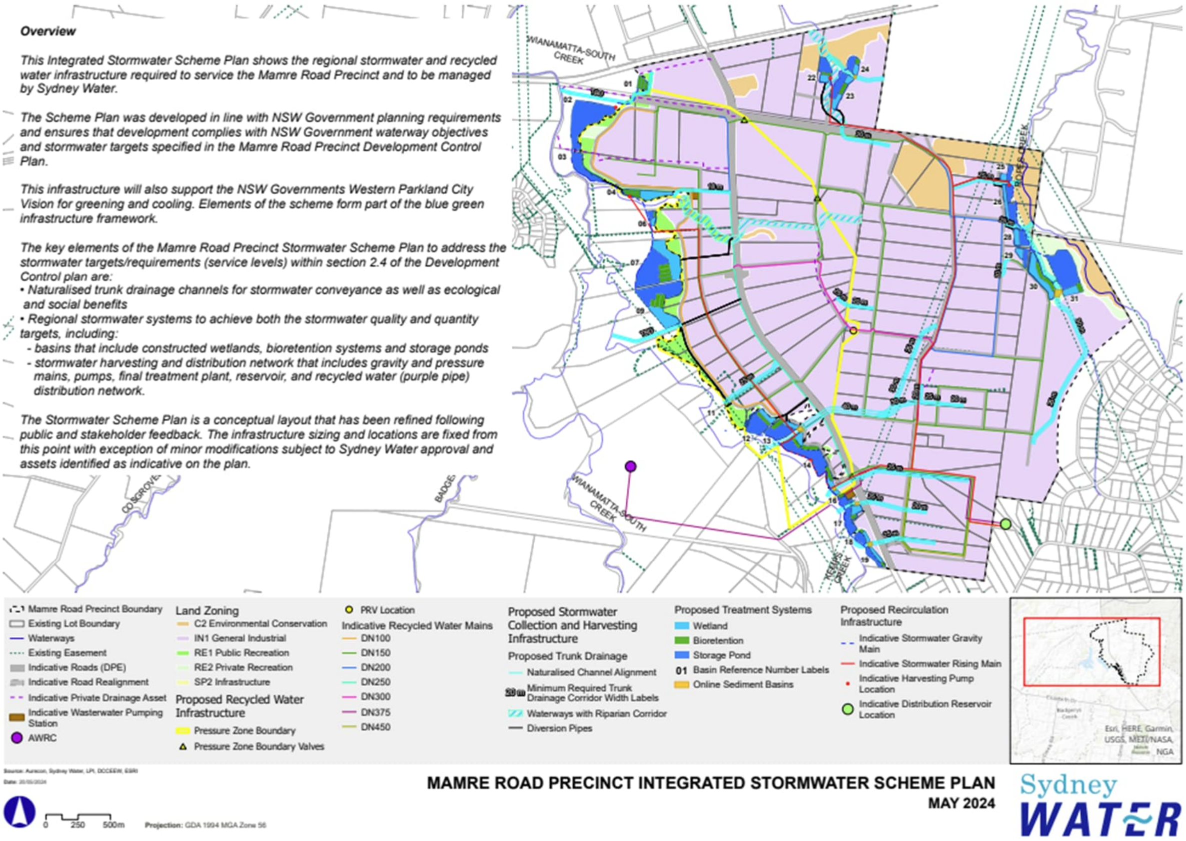


Figure 9 - Mamre Road Precinct Stormwater Scheme Plan (2024)

3.4. Downstream Culvert Hydraulics

As of January 2025, the downstream culvert from the stage 2 open channel (at Mamre Road) is still in the detailed design process with TfNSW. It is understood that the culvert sizing is a 0.75m x 3.3m culvert at IL41.788 has been assumed. This provides a 1% AEP tailwater level for design of RL 43.13 at the Lot 6 outlet (as per JWP flood modelling).

4. Water Management Strategy

This section summarises the proposed water management strategy for the site, including details of the proposed stormwater management measures and characterisation of water quality, quantity and flow volume at the points of discharge at the site boundary against the controls outlined in the Mamre Road Precinct DCP.

4.1. Water Management Strategy Objectives and Controls

The main objectives pertaining to the management of stormwater within the proposed development site are outlined in Section 2.4 of the Mamre Road Precinct DCP. Controls relating to stormwater quantity management and the requirement to attenuate peak flow rates are outlined in Section 2.5 of the DCP.

Specific controls relating to water management, as well as a response to these controls, is summarised below in Table 2.

Table 2: Response to DCP controls relating to water management

DCP Controls	Response
Waterway health and Water Sensitive Urban Design	
1) Development applications must demonstrate compliance with the stormwater quality targets in Table 4 (DCP) and the stormwater flow targets during construction and operation phases in Table 5 (DCP) and Table 6 (DCP) at the lot or estate scale to ensure the NSW Government's waterway objectives (flow and water quality) for the Wianamatta-South Creek catchment are achieved (see Appendix D). Where the strategy for waterway management is assessed at an estate level, the approval should include for individual buildings within the estate, which may be the subject of future applications.	Performance of the proposed water management strategy against the stormwater quality targets is presented in Section 4.2. Performance against the construction phase stormwater flow & quality targets is shown indicatively in plan 20-748-C5201 noting that contractors are to create their own plan detail for construction. A CPESC has revised the plan and confirms the detail in the documentation is sufficient for the SSD. Performance of the proposed water management strategy against the operational stormwater flow targets is presented in Table 13, which includes measures for Lot 6 Warehouse under the interim arrangement. The strategy is also demonstrated on plan 20-748-C5220.
2) The stormwater flow targets during operation phase (Table 5) include criteria for a mean annual runoff volume (MARV) flow-related option and a flow duration-related option. Applicants must demonstrate compliance with either option.	Performance of the proposed water management strategy against the operational stormwater flow targets is presented in Table 13. Option 1 has been satisfied.
3) Development applications must include a Water Management Strategy (WMS) detailing the proposed Water Sensitive Urban Design (WSUD) approach, how the WMS complies with stormwater targets (i.e., MUSIC modelling), and how these measures will be implemented, including ongoing management and maintenance responsibilities. Conceptual designs of the stormwater drainage and WSUD system must be provided to illustrate the functional layout and levels of the WSUD systems to ensure the operation has been considered in site levels and layout.	The Water Management Strategy for the site is outlined in Section 4, and includes the approach to WSUD for the site, performance of the proposed stormwater management measures against the DCP targets, and description of delivery, ongoing management and maintenance of each proposed measure. Design drawings showing the layout and levels of the proposed stormwater management elements are included in the AT&L civil package.
4) The design and mix of WSUD infrastructure shall consider ongoing operation and maintenance. Development applications must include a detailed	Ongoing management and maintenance considerations are addressed in Section 4.10.

DCP Controls	Response
lifecycle cost assessment (including capital, operation/maintenance, and renewal costs over 30 years) and Maintenance Plan for WSUD measures.	All costs associated with the delivery, operation and maintenance of the estate-based water management measures will be borne by the proponent.
5) WSUD infrastructure may be adopted at a range of scales (i.e., allotment, street, estate, or sub-precinct scale) to treat stormwater, integrate with the landscape and maximise evaporative losses to reduce development flow runoff. Vegetated WSUD measures, naturalised trunk drainage and rainwater/stormwater reuse are preferred. Acceptable WSUD measures to retain stormwater within the development footprint and subdivision are shown in Table 7 (DCP).	A summary of the proposed WSUD infrastructure adopted in the water management strategy is presented in Table 3.
6) Development must not adversely impact soil salinity or sodic soils and shall balance the needs of groundwater dependent ecosystems.	Refer to Geotechnical Investigation Reports prepared by Douglas Partners (for 59-63 Abbotts Road) and Alliance Geotechnical (for 290-308 Aldington Road) for details of soil salinity, sodicity and groundwater.
7) Infiltration of collected stormwater is generally not supported due to anticipated soil conditions in the catchment. All WSUD systems must incorporate an impervious liner unless a detailed Salinity and Sodicity Assessment demonstrates infiltration of stormwater will not adversely impact the water table and soil salinity (or other soil conditions).	The proposed water management strategy does not incorporate infiltration of collected stormwater.
8) Where development is not serviced by a recycled water scheme, at least 80% of its non-potable demand is to be supplied through allotment rainwater tanks.	Refer to Section 4.5.5 for details of proposed rainwater tanks and demand statistics.
9) Where a recycled water scheme (supplied by stormwater harvesting and/or recycled wastewater) is in place, development shall: ▪ *Be designed in a manner that does not compromise waterway objectives, with stormwater harvesting prioritised over reticulated recycled water;* ▪ *Bring a purple pipe for recycled water to the boundary of the site, as required under Clause 33G of the WSEA SEPP. Not top up rainwater tanks with recycled water unless approved by Sydney Water; and* ▪ *Design recycled water reticulation to standards required by the operator of the recycled water scheme.*	Stormwater harvesting in the form of rainwater tanks on proposed Lot 6 will not be incorporated. Refer to Section 4.5.5
Trunk Drainage Infrastructure	

DCP Controls	Response
10) Indicative naturalised trunk drainage paths are shown in Figure 4 (DCP)	Reproduced in this report for context as Figure 8.
11) Naturalised trunk drainage paths are to be provided when the: ▪ *Contributing catchment exceeds 15ha; or* ▪ *1% AEP overland flows cannot be safely conveyed overland as described in Australian Rainfall and Runoff – 2019;* *unless otherwise agreed by the consent authority.*	Details of the proposed trunk drainage infrastructure are included in Section 3.3.
12) The design and rehabilitation of naturalised trunk drainage paths is to be generally in accordance with NRAR requirements (refer to Section 2.3) that replicates natural Western Sydney streams. An example of a naturalised trunk drainage path is shown in Figure 3.	Based on discussions with Sydney Water there is no detailed design on the naturalised trunk channel downstream of the Estate. It is proposed at detailed design to coordinate with Sydney Water on the design and rehabilitation of the naturalised trunk drainage channel to match into any downstream open channels. This must also be co-ordinated with TfNSW for the culvert connection across Mamre Road.
13) Naturalised trunk drainage paths shall be designed to: ▪ *Contain the 50% AEP flows from the critical duration event in a low flow natural invert;* ▪ *Convey 1% AEP flows from the critical duration event with a minimum 0.5m freeboard to applicable finished floor levels and road/driveway crossings; and* ▪ *Provide safe conveyance of flows up to the 1% AEP flood event.*	The alignment of the naturalised trunk drainage has been altered with the approval of Sydney Water. The naturalised trunk drainage path is now along the northern boundary of Lot 6 which was deemed to not compromise the objectives of the trunk drainage, while assisting in preferred layouts of the industrial development. As described above, trunk drainage infrastructure in the form of a 19.2m wide open channel along the northern boundary between Aldington Road extension and Mamre Road is proposed as the naturalised trunk drainage path. This system will have sufficient capacity to capture and convey flows up to or exceeding the 1% AEP design event. Refer to JWP drawings for further detail.
14) Where naturalised trunk drainage paths traverse development sites, they may be realigned to suit the development footprint, provided that they: ▪ *Comply with the performance requirements for flow conveyance and freeboard;* ▪ *Are designed to integrate with the formed landscape and permit safe and effective access for maintenance;* ▪ *Do not have adverse flood impacts on neighbouring properties; and* ▪ *Enter and leave the development site at the existing points of flow entry and exit.*	The proposed trunk drainage lines within the site will (as per the J. Wyndham Prince Design): ▪ Comply with requirements for flow conveyance and freeboard. ▪ Incorporate sufficient access points for maintenance – maximum spacing of pits will not exceed 75 metres, which is consistent with Penrith City Council's *Design Guidelines for Engineering Works for Subdivisions and Developments* (considered an appropriate reference in the absence of any specific Sydney Water guideline or standard). ▪ Have sufficient capacity to capture and convey flow from the external catchments to the east of the Westlink Industrial Estate, and

DCP Controls	Response
	will therefore not result in adverse flood impacts on neighbouring properties
15) Trunk drainage paths shall remain in private ownership with maintenance covenants placed over them to the satisfaction of Council (standard wording for positive covenants is available from Council). Easements will also be required to benefit upstream land.	The proposed trunk drainage channel will be located in private lands considered part of Lot 6 gross land area. Maintenance covenants over the trunk drainage channel and easements over public stormwater infrastructure located within private lands will be incorporated in the deposited plans prepared by a Registered Surveyor.
16) Where pipes/ culverts are implemented in lieu of naturalised trunk drainage paths, they must remain on private land and not burden public roads, unless otherwise accepted by Council.	Not applicable as pipe/culverts are not proposed as part of the trunk drainage. Open channel drainage is proposed which will be situated within private lands and not within public road reserve. The downstream culvert design is as part of Mamre Rd works.
17) High vertical walls and steep batters shall be avoided. Batters shall be vegetated with a maximum batter slope 1V:4H. Where unavoidable, retaining walls shall not exceed 2.0m in cumulative height.	Batters at maximum 1:4 slope are incorporated across the Estate however given the existing sloping topography of the site along with proposed "flat" pads for industrial warehouses (as the estate is zoned for) retaining walls are unavoidable. Tiered walls as per the Mamre Rd DCP are proposed when adjacent to public roads. Refer Civil Drawings.
18) Raingardens and other temporary water storage facilities may be installed online in naturalised trunk drainage paths to promote runoff volume reductions.	Not applicable to the Westlink Industrial Estate as proposed.
19) Subdivision and development are to consider the coordinated staging and delivery of naturalised trunk drainage infrastructure. Development consent will only be granted to land serviced by trunk drainage infrastructure where suitable arrangements are in place for the delivery of trunk infrastructure (to the satisfaction of the relevant Water Management Authority).	The proposed trunk drainage infrastructure will be staged and delivered commensurate with the staging of earthworks and infrastructure across the estate. The trunk drainage infrastructure will form a critical component of the site water management strategy throughout construction and will be incorporated into the Erosion and Sediment Control Plan and Construction Environmental Management Plan. The final form of the trunk drainage lines, including connections to infrastructure downstream of the Westlink Industrial Estate, will be undertaken at a suitable stage of development and will be subject to further consultation with the Sydney Water (the nominated Waterway Manager).

DCP Controls	Response
20) Stormwater drainage infrastructure, upstream of the trunk drainage, is to be constructed by the developer of the land considered for approval.	All stormwater drainage upstream of the proposed trunk drainage lines will be designed and delivered by the proponent.
21) All land identified by the Water Management Authority as performing a significant drainage function and where not specifically identified in the Contributions Plan, is to be covered by an appropriate "restriction to user" and created free of cost to the Water Management Authority.	Noted – subject to further consultation with Sydney Water (the nominated Waterway Manager).
22) All proposed development submissions must clearly demonstrate via 2-dimensional flood modelling that: *1) Overland flow paths are preserved and accommodated through the site;* *2) Runoff from upstream properties (post development flows) are accommodated in the trunk drainage system design;* *3) Any proposed change in site levels or drainage works are not to adversely impact and upstream or downstream, or cause a restriction to flows from upstream properties;* *4) There is no concentration of flows onto an adjoining property; and* *5) No flows have been diverted from their natural catchment to another.*	Refer to Flood Impact & Risk Assessment Report prepared by J Wyndham Prince
Overland Flow Flooding	
10) Development should not obstruct overland flow paths. Development is required to demonstrate that any overland flow is maintained for the 1% AEP overland flow with consideration for failsafe of flows up to the PMF.	The proposed major and minor system drainage has been designed such that development within the estate will not obstruct any overland flow paths. Suitable allowance for overland flow has been made within the design of the major and minor system. Any future development in the external catchments must be attenuated to this flow regime. The flood impact assessment will address storms above the 1% AEP.
11) Where existing natural streams do not exist, naturalised drainage channels are encouraged to ensure overland flows are safely conveyed via vegetated trunk drainage channels with 1% AEP capacity plus 0.5m freeboard. Any increase in peak flow must be offset using on-site stormwater detention (OSD) basins.	Refer to Section 3.3 for details of the proposed trunk drainage infrastructure. While the existing conditions show overland flows primarily as sheet flows, the developed case concentrates into the naturalised trunk drainage system. For stage 2 development, the OSD on Lot 6

DCP Controls	Response
	is overcompensating for bypassing roads such that peak flows are below pre-development levels.
12) OSD is to be accommodated on-lot, within the development site, or at the subdivision or estate level, unless otherwise provided at the catchment level to the satisfaction of the relevant consent authority.	The location of the proposed detention tank within Lot 6 is presented on drawing 20-748-C5071. On site detention is provided on an estate level, not an allotment level, however future lot 4 and lot 5 will require OSD to be provided on-lot.
13) Stormwater basins are to be located above the 1% AEP.	No stormwater basins are proposed as part of this SSD.
14) Post-development flow rates from development sites are to be the same or less than pre-development flow rates for the 50% to 1% AEP events.	The performance of the proposed site post developed flows against the stormwater quantity targets in the Mamre Road Precinct DCP is summarised in Table 12
15) OSD must be sized to ensure no increase in 50% and 1% AEP peak storm flows at the Precinct boundary or at Mamre Road culverts. OSD design shall compensate for any local roads and/or areas within the development site that does not drain to OSD.	As demonstrated in Table 12, the proposed detention tank and outlet from the open channel has been sized to ensure no increase in peak flows at the discharge point from the estate. J Wyndham Prince flood modelling. The Lot 6 OSD tank overcompensates for bypassing road catchments.

4.2. Water Management Strategy Overview

Since the release of the Draft Mamre Road Precinct DCP in November 2020, AT&L has been working with several landowners in the Mamre Road Precinct, Government, other Industry Bodies, and experts in water management to resolve practical solutions that will address the stormwater flow targets that have been adopted in the final DCP.

The *Mamre Road Flood, Riparian Corridor and Integrated Water Cycle Management Report* (FRCIWCM) (Sydney Water, 2023) addresses links between waterway health, hydrology and water quality targets. The stormwater management objectives outlined in the FRCIWCM Report, which have ultimately been adopted in the Mamre Road Precinct DCP, were developed by applying the *Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions* (NSW OEH, 2017). The effects-based assessment outlined in the FRCIWCM Report addressed three metrics relating to waterway health and stormwater management:

1. Flow volume – mean annual runoff volume (MARV), measured in ML/ha/year. The target adopted in the Mamre Road Precinct DCP is 2 ML/ha/year (revised from 1.9 ML/ha/year in the Draft DCP). The outcomes for the Westlink Industrial Estate are summarised in Section 4.9.

2. Seasonal pulses – as shown by flow duration curves. The targets and outcomes demonstrated by a flow duration curve under post-development conditions is presented in Section 4.9.

3. Water quality – as indicated by stormwater pollution reduction. The targets and outcomes demonstrated as reduction in average annual pollutant load are summarised in Section 4.7. Note that as this design contains significant natural catchment, we have adopted the concentration targets as provided in the 21/09/2022 “Technical guidance for achieving Wianamatta South Creek stormwater management targets” produced by DPE.

In the FRCIWCM, Sydney Water also discussed the potential for regional facilities to be implemented to satisfy the stormwater flow objectives for the Mamre Road Precinct. The FRCIWCM report states:

> *“It is noted that the most cost-effective way to achieve stormwater volume load reductions is via open water bodies and these have a maintenance implication for developers and a wildlife risk.*
>
> *Through master planning of the Wianamatta South Creek precinct, it will be possible to integrate regional wetlands and water bodies and offset the need for wetlands and open water to be distributed through the Precinct on private lands.*
>
> *This centralised management of water is preferable as it provides a more appropriate scale of WSUD assets for more cost-effective maintenance and management outcomes.”*

The Water Management Strategy for Stage 2 has been developed to satisfy the flow targets fully without the regional solution being in place, by taking advantage of residual undeveloped land as part of the catchment area. It is important to note that for the full site (i.e. further lots becoming developed) to satisfy the flow duration and MARV requirements, the stage 2 measures may need to be altered. By the time that the future development is under assessment, it may also be the case that the regional scheme is further progressed, and these measures may be reduced or decommissioned instead. This report focuses on the “Estate” level flow duration and MARV strategies.

A summary of the proposed stormwater management measures that would be required to satisfy stormwater quality, quantity and flow controls under both the “Estate” and “Regional” Arrangem*ents is presented in Table 3.*

Table 3: Proposed water management measures under the Estate and Regional Arrangements

	Estate Arrangement (Stage 2) (prior to implementation of regional stormwater management scheme)		Regional Arrangement (with regional stormwater scheme to be operated by Sydney Water)	
Gross pollutant traps (GPTs) (refer to Section 4.5.1 for further details)	✓	GPTs with capacity for hydrocarbon and sediment removal to be installed upstream of the proposed OSD tank and open drainage channel as a pre-treatment measure for the regional stormwater management scheme. SQIDEP approved Atlan Vortceptor units have been chosen.	✓	GPTs with capacity for hydrocarbon and sediment removal to be installed upstream of the proposed detention basin and open drainage channel as a pre-treatment measure for the regional stormwater management scheme. SQIDEP approved Atlan Vortceptor units have been chosen.
Detention Tank (refer to Section 4.5.2 for further details)	✓	Required to satisfy stormwater quantity controls.	✓	Required to satisfy stormwater quantity controls.
Evaporation / Storage ponds and residual irrigation (refer to Section Error! Reference source not found. for further details)	✓	Required to satisfy interim stormwater flow controls and stormwater quality treatment.	×	Will not be required on the basis that stormwater flow controls and stormwater quality treatment will be incorporated into the regional stormwater management scheme.

4.2.1. Technical Guidance for achieving Wianamatta-South Creek stormwater management targets

In September 2022 The Department of Planning and Environment released a *Technical guidance for achieving Wianamatta-South Creek stormwater management targets.* This guideline was prepared to give advice on modelling to undertake, assumptions to make and which data is to be used to demonstrate that the water targets are being achieved. It also provided a range of example WSUD strategies that could be utilised to meet the water quantity targets.

Refer to Figure 10 below for extract from the Technical Guidelines (page 14) which indicates typical WSUD measures which could be implemented to meet the required water quantity targets.

Technical guidance for achieving stormwater management targets

On lot or allotment measures

Typical on lot or allotment WSUD measures include, but are not limited to:

- rainwater tanks
- on-site stormwater detention
- gross pollutant traps (GPTs)
- bioretention basins
- swales
- wetlands, subject to relevant wildlife risk mitigation measures to manage bird strikes (note that wetlands are likely to be interim or temporary under a regional-scale WSUD strategy, see Chapter 4 of this guide)
- stormwater harvesting systems (likely to be interim or temporary under a regional-scale WSUD strategy, see Chapter 4 of this guide).

The design of on lot or allotment measures should consider the existing documents relevant to the Wianamatta–South Creek catchment (see section 'Relationship to other documents'). Important considerations include:

- accessibility for inspections and maintenance
- protection from damage during construction and building phase and then finalised once the site is finished and landscaped
- careful integration with the landscape but avoiding large level drops and walls, and vegetated with trees.

Figure 10 - Extract from Technical Guidance

For this SSD all the dot points as noted within Figure 10 aside from wetlands and bioretention basins are being incorporated into the civil design to ensure the water quantity targets are met. Refer to Section 4.5 for additional details.

4.3. Hydrological and Hydraulic Modelling

DRAINS modelling software has been used to calculate the Hydraulic Grade Line (HGL) of the proposed estate-wide stormwater network, including pits, pipes, overland flow paths and detention basins. DRAINS is a software package used for designing and analysing urban stormwater drainage systems and catchments. It is widely accepted by Council's across NSW as the basis for stormwater design and has been confirmed by Penrith City Council as the preferred stormwater software analysis package.

A summary of the key hydrological and hydraulic design parameters adopted in DRAINS to develop a major and minor system drainage design for the proposed development are as follows:

- Minor system (pit and pipe) drainage has been designed to accommodate the 5% AEP storm event.
- The combined pit and pipe drainage and overland flow paths have been designed to accommodate the 1% AEP storm event.
- Where trapped low points are unavoidable and potential for flooding private property is a concern, an overland flow path capable of carrying the total 1% AEP storm event has been provided. Alternatively, the pipe and inlet system has been upgraded to accommodate the 1% AEP storm event.
- Rainfall intensities have been adopted using the Bureau of Meteorology Design Rainfall Data System (2016).
- Times of concentration for each sub catchment have been determined using the kinematic wave equation.
- The width of flow in the gutter does not exceed 2.5 metres and pits are spaced no further than 75 metres apart.
- Velocity x depth product shall not exceed 0.4 m^2/s for all storms up to and including the 1% AEP event.
- Bypass from any pit on grade shall not exceed 15% of the total flow at the pit.
- Blockage factors of 20% and 50% shall be adopted for on-grade and sag pits respectively.
- A hydraulic grade line HGL design method shall be adopted for all road pipe drainage design.
- Pipelines in roadways shall have a minimum diameter of 375mm.
- A desirable minimum grade of 1% for all pipelines is preferred for self-cleansing under low flow velocities. An absolute minimum grade of 0.5% has been adopted.
- The minimum cover over pipes shall be 450mm in grassed areas and 600mm within carriageways.
- Where minimum cover cannot be achieved due to physical constraints the pipe class shall be suitably increased.
- All pipes in trafficable areas will be Reinforced Concrete Pipes (RCP) or Fibre Reinforced Cement (FRC) equivalent.
- Pipes discharging to an overland flow path shall adopt a minimum tailwater level equivalent to respective overland flow level.
- Pit Loss coefficients have been calculated in accordance with the Hare Charts as documented in the Queensland Urban Drainage Manual.
- A minimum 150mm freeboard has been maintained between pit HGL and pit surface levels for the minor design storm event (5% AEP).
- Overland flow paths maintain a minimum of 300mm freeboard to all habitable floor levels.

4.4. Stormwater Quality Modelling

The proposed stormwater treatment train has been modelled using the MUSICX software package (Version 1.1.0). Modelling has been undertaken in accordance with the *MUSIC Modelling Toolkit – Wianamatta* (NSW DPIE, 2021).

Rainfall and evaporation data

Penrith City Council's MUSIC-link climate data (rainfall and evapotranspiration) was adopted in the MUSIC model, as well as some evapotranspiration data from the MUSIC Modelling toolkit. The meteorological data includes:

- Pluviometer data (six-minute rainfall intensity and evapotranspiration) for Penrith Lakes AWS (Station 67113) for the period between 1999 and 2008 inclusive (average annual rainfall over this period = 691mm).
- Monthly potential evapotranspiration (PET) as per the *MUSIC Modelling Toolkit - Wianamatta*.

Rainfall-runoff parameters

The rainfall-runoff parameters adopted in the MUSIC model are consistent with the parameters adopted in *MUSIC Modelling Toolkit – Wianamatta*, refer to Table 4.

Table 4: Rainfall-runoff parameters adopted in MUSIC

Parameter	Unit	Value
Impervious area parameters		
Rainfall Threshold	mm/day	1.0
Pervious area parameter		
Soil Storage Capacity	mm	150
Initial Storage	% of Capacity	30
Field Capacity	mm	130
Infiltration Capacity Coefficient α	-	175
Infiltration Capacity Coefficient β	-	2.5
Groundwater properties		
Initial Depth (groundwater)	mm	10
Daily Recharge Rate	%	25
Daily Baseflow Rate	%	1.4
Daily Seepage Rate	%	0.0

Source nodes and pollutant generation

Pollutant events mean concentrations (EMCs) for base flow and storm flow scenarios have been adopted from Table 6 of Blacktown City Council's WSUD developer handbook (consistent with the *MUSIC Modelling Toolkit - Wianamatta*). The EMC values are applied to source nodes in the MUSIC model to estimate annual pollutant loads exported from the site under the proposed ultimate development scenario. The adopted pollutant EMCs for various catchment types are summarised in Table 5.

Table 5: Stormwater quality parameters for MUSIC source nodes

Landuse category		log10 TSS (mg/l)		log10 TP (mg/l)		log10 TN (mg/l)	
		Base flow	Storm flow	Base flow	Storm flow	Base flow	Storm flow
Roof areas	Mean	1.20	1.30	-0.85	-0.89	0.11	0.30
	Std dev	0.17	0.32	0.19	0.25	0.12	0.19
Road areas	Mean	1.20	2.43	-0.85	-0.30	0.11	0.34
	Std dev	0.17	0.32	0.19	0.25	0.12	0.19
Pervious areas	Mean	1.20	2.15	-0.85	-0.60	0.11	0.30
	Std dev	0.17	0.32	0.19	0.25	0.12	0.19

4.5. Proposed Stormwater Management Measures

A series of stormwater quantity and quality control measures are proposed to be adopted within the site to satisfy the stormwater management strategy objectives listed in Section 4.1. A general description of the proposed stormwater treatment train components is presented in the following sections.

4.5.1. Gross Pollutant Traps

The proposed stormwater treatment train under the Interim Arrangement would consist of gross pollutant traps (GPT) upstream of the proposed OSD tank on Lot 6 and connection into open trunk drainage channel as a means of primary stormwater treatment. GPTs are designed to capture litter, debris, coarse sediment, as well as some oils and greases. All GPT's are proposed to be located within private lands with two located within Lot 6 and the other upstream (east) of the open trunk drainage channel.

A high-flow bypass for the GPTs would nominally be equivalent to the 4 EY (3-month ARI) peak flow rate discharging to the GPT. Design flows for the GPTs and their final configuration would be confirmed at the detailed design phase. Atland Vortceptor units have been uniformly chosen, as they are SQIDEP approved and providing sufficient treatment for the interim phase. Potential alternative products must be SQIDEP approved, and requires re-running of the estate wide MUSIC modelling to ensure estate level compliance.

4.5.2. Detention Tanks

Stormwater runoff from the developed Lot 6 is proposed to be collected via pits and pipes and discharge into the proposed detention tank within the north west corner of the lot. This underground tank will provide storage and with a controlled outlet structure detain all storm events up to and including the 1% AEP event. Proprietary treatment devices will be installed within the tank to ensure the stormwater nutrient targets as met to comply with the Mamre Road DCP. Part of the tank volume (excluded from OSD volume) is to be used as stormwater storage for reuse purposes. This is discussed further in section 4.5.4.

A summary of the key detention tank parameters and DRAINS model results for the major and minor system flow is presented in Table 6.

Table 6 : Key Lot 6 Detention Tank & Reuse tank parameters and Drains model results

Parameter	Unit	Lot 6 Tank
Base level	mAHD	42.44
Reuse Tank max Still Water Level	mAHD	42.94
Low Flow orifice level	mAHD	42.94
Low Flow orifice diameter	mm	310
Mid Flow orifice level	mAHD	44.30
Mid flow orifice diameter	mm	700
High flow weir crest level	mAHD	44.75
High flow weir length	mm	500
Outlet pipe diameter	mm	900dia
Outlet pipe upstream IL	mAHD	42.94
Outlet pipe downstream IL (at channel)	mAHD	42.30
Outlet pipe length	m	46m
Tank Roof Level	mAHD	45.05
Total Tank Volume	m^3	2530
Total Tank Reuse Volume	m^3	150
Total Tank OSD Volume	m^3	2380
5% AEP		
Peak Inflow	m^3/s	2.11
Peak Outflow total	m^3/s	0.737
Peak tank water level	mAHD	44.78
Peak tank storage	m^3	2050
1% AEP		
Peak Inflow	m^3/s	2.87
Peak Outflow total	m^3/s	1.31
Peak OSD water level	mAHD	45.05
Peak tank storage (excluding long term storage)	m^3	2380

4.5.3. Erosion and Sediment Basins (acting as evaporation ponds)

Ponds provide an effective means of reducing runoff volume from the site as water would be lost via evaporation over a large area. A pond can capture large quantities of stormwater runoff, while also being relatively easy to maintain.

Large-scale MUSIC modelling undertaken by AT&L indicates that, in combination with other measures, ponds can achieve a relatively high reduction of stormwater runoff volume and are generally more efficient than irrigation.

This Water Management Strategy under the Estate Arrangement (in the absence of the regional stormwater management scheme), which addresses the stormwater flow targets adopted in the Mamre Road Precinct DCP, incorporates an erosion and sediment pond within the residual pads of Lot 5, Lot 2 and the northern part of lot 4.

Table 7: Adopted estate-wide pond parameters

Parameter	Lot 5 Pad	Lot 4 Northern Pad	Lot 2 Pad
Contributing Catchment (ha)	15.86	5.75	2.72
Surface Area (m^2)	3093	1250	1258
Permanent pool volume (m^3)	5082	1881	1090
Exfiltration rate (mm/hr)	0	0	0
Evaporative loss (% of PET)	100	100	100

4.5.4. Stormwater Harvesting for Irrigation

As per the Technical guidance for achieving Wianamatta-South Creek stormwater management targets stormwater harvesting and reuse is another effective way to reduce stormwater flow volumes from frequent flows events to achieve the water quantity targets.

Water runoff from the developed Lot 6 is proposed to be stored in tank volume underneath the OSD tank volume (refer Section 4.5.2) within Lot 6 carpark. Refer to Drawing 20-748 C6121 for early layout. Water from this reuse tank will be stored and used as irrigation in the residual lot 6 pads. Refer to Table 8 for re-use details.

Refer to Drawing 20-748 C5220 for extent of residual lands to be irrigated via this basin. It is noted this basin arrangement is interim only, to be used only before the regional basins are constructed (and decommissioned when instructed by DPIE).

Table 8: Summary of reuse tank parameters under the Stage 2 Arrangement

Lot	Total Lot Area (ha)	Catchment Area of Tank (ha)	Estimated annual irrigation demand (kL/yr)	Total re-use volume required (within OSD tank) m3
6 (Storage tank)	7.16	6.42	4000 (On Lot 6)	200

4.5.5. Rainwater Tanks

Recent discourse from Sydney Water and DPIE indicate that rainwater tanks under interim conditions, where the estate is to be connected to the future recycled mains scheme, are not desired. As such no rainwater tanks collecting runoff from the roof areas are proposed for Lot 6. It is proposed this lot with be connected to the recycled water network within Adlington Road when constructed.

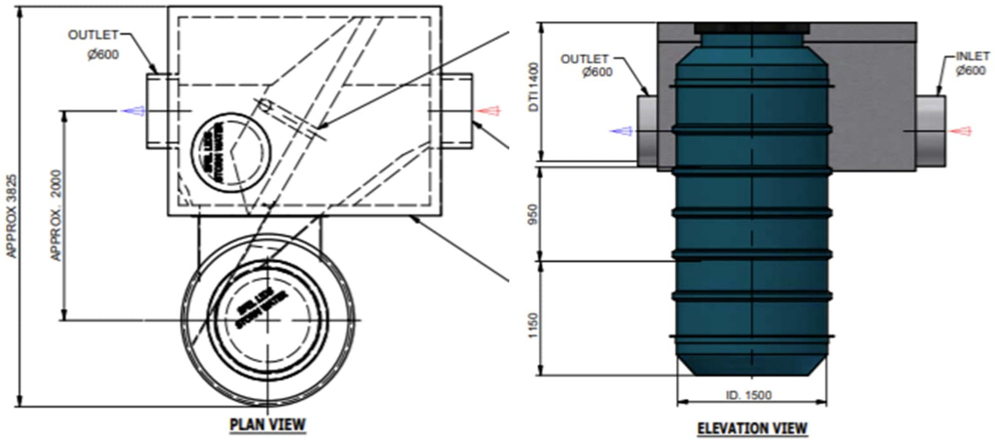
4.5.6. Passively Irrigated Street Trees

Advice received from Sydney Water are that passively irrigated street trees are an important component of their Regional stormwater drainage scheme. These street trees need to be designed to the Sydney Water Stormwater Scheme Infrastructure and Council's approval.

As the time of writing this report (August 2024) it is our understanding SWC and Penrith City Council have prepared a draft design for the passively irrigated street tree (PIST) which is on exhibition for comments. Whilst no design of the PIST are including within street infrastructure of Westlink Estate as yet these trees will be incorporated into the street infrastructure design once finalised. These trees will be included within all public road reserves as per Sydney Water's requirements. The street trees are excluded from the MUSIC modelling.

4.5.7. Atlan Vortceptor Gross Pollutant Traps

Atlan Vorceptor units are specified within Lot 6 at both inlets to the OSD tank, as well as upstream of the trunk drain to treat road drainage. The Atlan Vortceptor is a SQIDEP approved GPT, so it is permitted to provide treatment in the MUSIC modelling for TN, TP, and TSS, as well as for Gross pollutants. This is sufficient to provide treatment within stage 2 without any tertiary treatment to the concentration based targets for the estate.



Each GPT provides a weir pit to divert low flows into the Vortceptor, with excessive flows overtopping the internal weir. The low flows are then filtered with a sump and a screen to remove the pollutants, before returning to the weir pit downstream of the weir.

The treatable flow is treated at SQIDEP approved removal rates: 100% for Gross Pollutants (GP), 93% for Total Suspended Solids (TSS), 86% for Total Phosphorous (TP) and 49% of Total Nitrogen. Each of the 3 Vortceptor units specified are the SVO.096 unit, with 96L/s of treatable flow rate.

4.6. Scenario Modelling

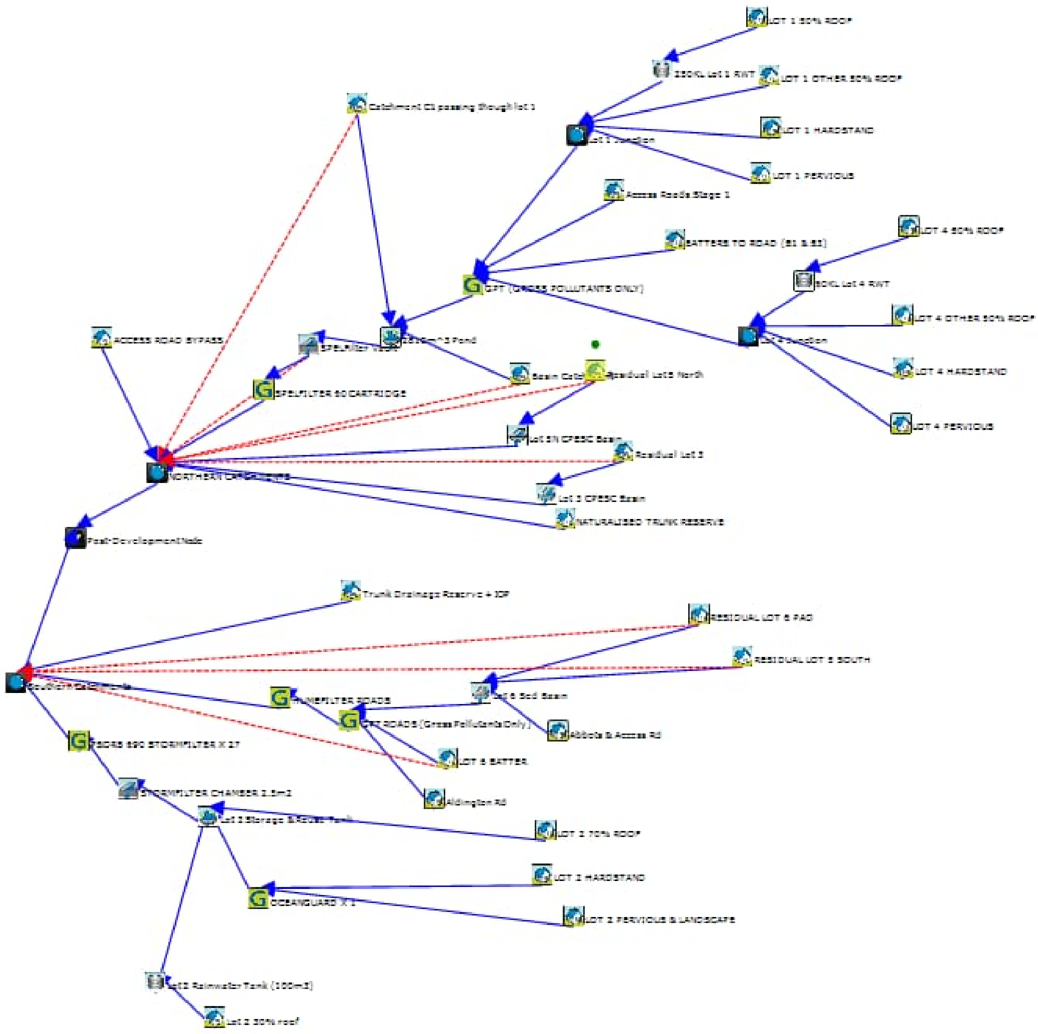


Figure 11: Post-development MUSIC model layout (Stage 2 Arrangement)

A MUSIC model was created to simulate post-development mean annual loads under the Stage 2 scenario. The post-development model has been created based upon the proposed post-development catchment extents presented in Figure 7 and includes the approved Stage 1 scenario. Source nodes for each of the proposed lots have been adopted based on typical large-scale industrial land uses, including those depicted in the Estate Plan prepared by Nettleton Tribe. The layout of the post-development scenario is presented in Figure 11. Note that the natural catchments draining externally are not included in the MUSIC modelling, or in per hectare targets.

The post-development model has been created based upon the proposed post-development catchment extents presented in Table 9. This table only presents catchments associated with Stage 2.

Table 9: Music Modelling Catchments

Catchment	Total Area (ha)	Impervious Area (ha)	Pervious Area (ha)
LOT 6 70% ROOF	3.14	3.14	-
LOT 6 HARDSTAND	1.13	1.13	-
LOT 6 PERVIOUS & LANDSCAPE	0.75	-	0.75
LOT 6 30% ROOF	1.35	1.35	-
ALDINGTON RD	1.13	0.90	0.23
LOT 5 BATTER	2.28	-	2.28
RESIDUAL LOT 5 PAD	7.03	-	7.03
RESIDUAL LOT 4 SOUTH	7.83	-	7.83
ABBOTS & ACCESS RD	1.03	0.82	0.21
TRUNK DRAINAGE RESERVE + IOP	0.79	0.16	0.64
STAGE 1 AREA (APPROVED UNDER PREVIOUS SSD)	27.2		
TOTAL INTERNAL	53.66	22.11	31.55

Table 10: Post-development scenario land use breakdown under the Interim Arrangement

Catchment	Total Area (ha)	Roof area to rainwater tanks (ha)	Other impervious area (ha)	Pervious area (ha)	% Pervious area
Lot 6 (including drainage reserve)	7.16	1.35	4.43	1.39	19.4
Access Roads to Southern Trunk	2.16	-	1.73	0.43	20
Stage 2 Developed Areas	9.32	1.35	6.16	1.82	19.5
Residual catchments draining through stage 2	19.39	-	-	19.39	100

Pond area is considered impervious area.

Note: Residual and External catchments are assumed to represent existing greenfield flows and not included within the Music modelling for flow duration or stormwater quality management, as agreed with EH&G in the consultation period.

The post-development scenario model under the Interim Arrangement incorporates the following stormwater management measures:

- Pervious landscape target of 15% as per Clause 4.2.3 (4) of the Mamre Road DCP s achieved as the total % pervious area for the developed portion of Stage 2 equates to 19.5% (refer Table 10).
- Rainwater tanks, as per the parameters presented in Section 4.5.5.
- GPTs, as per the parameters described in Section 4.5.1.
- Detention tank, as per the parameters described in Section 4.5.2.
- Stormwater reuse tank for irrigation, as per the parameters presented in Section 4.5.4
- Erosion and Sediment Basin for CPESC compliance, but improving flow reduction targets,

- Landscape irrigation, at 3.0ML/ha of pervious space (600mm/year with 50% of area irrigated).
- Residual land irrigation at 6.0ML/ha (600mm/year with 100% of area irrigated)
- Baseflow from pervious residual land surfaces is assumed to drain directly to the receiving node over time (red dashed arrows in Figure 11).

The attributes for each of the proposed stormwater management measures have been determined such that they will satisfy the stormwater quality, quantity and flow targets outlined in Section 4.1.

4.7. Performance against stormwater quality targets

The "MUSIC MODELLING TOOKIT – WIANAMATTA" Published on 20/04/2022 by DPE, supplied to "support assessments and development of proposals for State Significant Development", provides two options for operational phase stormwater quality targets. The first option is the traditional "reduction in mean annual load from unmitigated development", while the new Option 2 provides an allowable mean annual load. For this development, due to the high amount of residual land, the allowable mean annual load target has been selected.

MUSIC model results presented as mean annual loads per hectare per year at the receiving node indicate that the adopted stormwater quality target reductions are achieved, as shown in Table 11.

Table 11: Summary of MUSIC modelling results against stormwater quality targets (kg/ha/year)

Parameter	Proposed Layout Source Load (kg/ha/yr)	Proposed Layout Residual Load for Stage 2 (kg/ha/yr)	Target allowable Mean Annual Load (kg/ha/yr)
TSS (kg/ha/yr)	422.5	71.9	80.00
TP (kg/ha/yr)	0.88	0.204	0.30
TN (kg/ha/yr)	6.13	2.44	3.50
Gross Pollutants (kg/ha/yr)	74.10	2.44	16

The MUSIC model results presenting treatment train effectiveness shows that while the adequately satisfies the allowable mean annual loads (Option 2). Due to the large proportion of un-developed land contributing to the treatment train, the reduction targets are less feasible than in a fully developed estate assessment.

Under the Sydney Water Regional strategy, stormwater quality management measures would be incorporated into the regional stormwater management scheme to be designed, delivered and operated by Sydney Water. In this case, the Stage 1 filter cartridges, Stage 2 GPTs, residual irrigation, rainwater tanks, and storage ponds or tank volumes are expected to become redundant, with treatment targets met by Sydney Water centralised assets.

Additionally, as per the RTS comment, the MUSIC model has been run inclusive of external catchments for treatment rates only, to confirm that the treatable flow rates and water balance are not negatively affected by the additional volumes of water. Note that the "per hectare" target has not been adjusted to increase with the additional external areas. As the GPT used in stage 1 has recently been SQIDEP approved, the treatment parameters for the asset have been added to the model for this purpose of checking external catchment treatment only. The results are still within the limits required – this is a "check only" and added as an additional MUSIC model for submission. Note that these catchments have not been used in assessing the flow duration curve as per previous stage 1 advice.

4.8. Performance against stormwater quantity targets

Table 12 presents the pre-development and post development flow rates, generated by hydrologic and hydraulic modelling in DRAINS, for a range of events between and including the 50% AEP and 1% AEP design storm events at the discharge points from the site. Note that the DRAINS model incorporates the future lot 4 and lot 5 developments as 85% impervious catchments, such that the OSD is designed appropriately for the ultimate design of the development.

Table 12: Pre-development and post-development peak flow rates (Interim and Ultimate Arrangements)

Design Storm Event	Pre-Development Peak Flow Rate (m^3/s)	Post-Development Peak Flow Rate (m^3/s)
50% AEP	1.37	1.20
20% AEP	2.09	2.09
10% AEP	3.00	2.80
5% AEP	4.01	4.01
2% AEP	6.13	5.80
1% AEP	7.42	7.42

The DRAINS model results demonstrate that the post-development peak flow rates would be less than or equal to pre-development peak flow rates for a range of storm events between (and including) the 50% AEP and 1% AEP design events. Therefore, the stormwater drainage system and detention basins as proposed would satisfy the development controls relating to stormwater quantity management.

The Westlink Estate design flows have been derived using IL-CL methods and post development flows use ILSAX modelling to these limits. It is understood that the higher level modelling undertaken by Sydney Water uses RAFTS modelling, resulting in significantly lower pre-development peak flow rates (5.1m^3/s for the 1% AEP). RAFTS is not practical or accurate for finely modelling urban catchments to the level of detail the civil design must reach. Our understanding is that while using ILSAX and IL-CL results in higher flow rates, as long as we are consistent with our internal modelling of pre-development and post-development this will be acceptable to Sydney Water. The flood modelling by J Wyndham Prince provides a like for like analysis against Sydney Water modelling showing that the development does not negatively impact the downstream catchments, regardless of the modelling method used for the urban catchments.

4.9. Performance against stormwater runoff volume targets

MUSIC model results demonstrating performance of the proposed stormwater management measures in the Interim Arrangement against the stormwater flow targets are presented below in Table 13. The resultant flow duration curve is presented as Figure 12.

Table 13: Summary of MUSIC model results against stormwater flow targets (Interim Arrangement)

Parameter	Result	DCP Target	Complies with DCP target	
			DCP Option 1 (MARV approach)	DCP Option 2 (Flow Duration Curve approach)
Mean annual runoff volume (ML/ha/yr)	2.0	2.0	Yes	n/a
95%ile flow (L/ha/day)	25,089	3000 to 15000	n/a	No
90%ile flow (L/ha/day)	4,855	1000 to 5000	Yes	Yes
75%ile flow (L/ha/day)	351	100 to 1000	n/a	Yes
50%ile flow (L/ha/day)	50	5 to 100	Yes	Yes
10%ile flow (L/ha/day)	0	0	Yes	n/a
Cease to flow	12%	10% to 30%	n/a	Yes

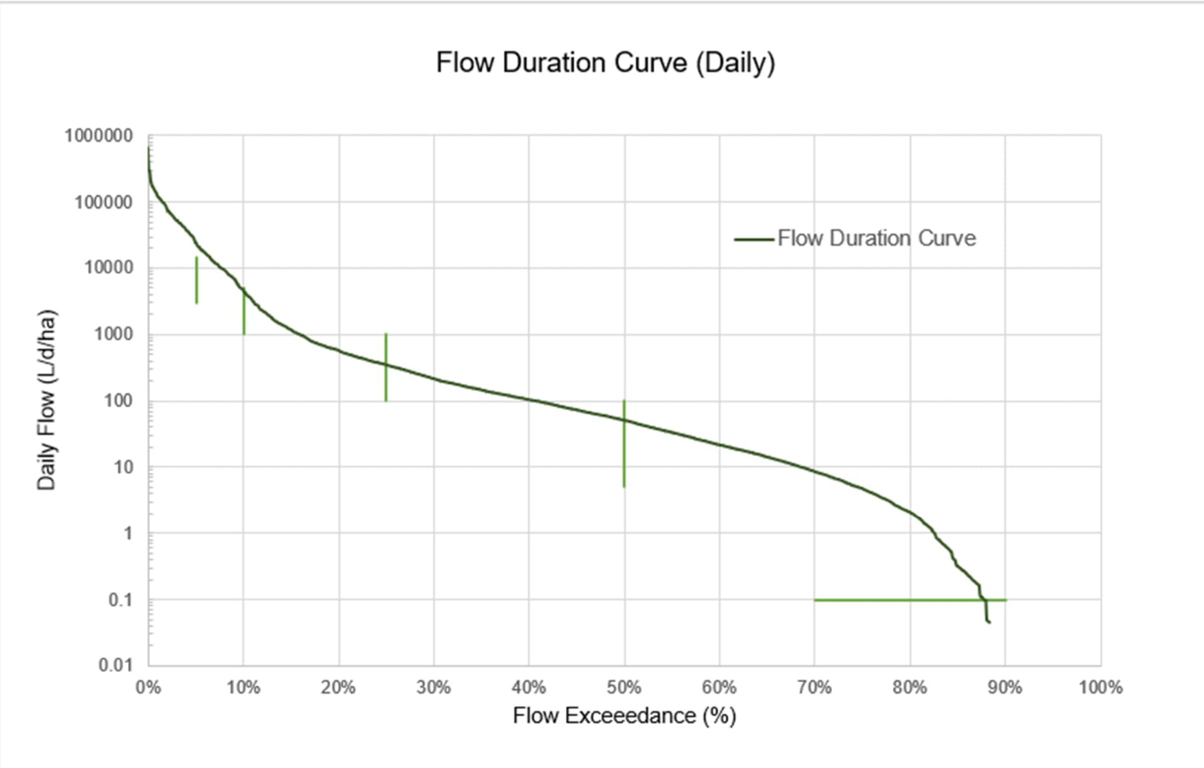


Figure 12: Flow duration curve for the proposed stormwater management measures

The results presented in Table 13 demonstrate the proposed stormwater management measures that will be implemented under the Interim Arrangement satisfy the Option 1 DCP stormwater flow targets for the site.

4.10. Ongoing Management and Maintenance

All proposed water management measures that make up the Interim Arrangement of the water management strategy would be managed and maintained by the proponent. An Inspection and Maintenance Plan will be prepared and lodged with the construction certificate for the subdivision works once final design details and the extent and layout of all proposed water management measures is confirmed. It is anticipated that the Inspection and Maintenance Plan would be prepared using current best practice guidance such as *Water sensitive urban design inspection and maintenance guidelines* (Blacktown City Council, 2019) and would describe:

- Each of the functional components of each water management measure.
- Expertise required to inspect, maintain and (where necessary) repair or replace components.
- Minimum required frequency of inspection, repair or replacement activities.
- Inspection and maintenance forms that list all necessary activities and contain a record of activities completed.

The Estate Arrangement would incorporate some estate-based measures such as on-lot rainwater tanks, GPTs and an estate-wide detention basin. These measures would be managed and maintained by the proponent, with inspection and maintenance requirements consistent with those described above. The planned regional stormwater management scheme, which would incorporate measures to manage stormwater quality and volume across the Mamre Road Precinct, would be managed and maintained by Sydney Water.

5. Site Water Balance

5.1. Water Balance Overview

Potable water supplies in the Sydney area are in recognised short supply with projected population increases, potential climate change and periods of extended drought. It is acknowledged that any development in the Sydney region places greater demand on an already limited water supply. As a result, government bodies, together with Sydney Water have encouraged sustainable development by the implementation of an integrated approach to water cycle management (potable water, sewerage, stormwater and rainwater) to minimise potable water demand and maximise the potential for non-potable water sources to replace potable water demand where possible.

With the appointment of Sydney Water as the regional Waterway Manager and the announcement of a regional stormwater management scheme, opportunities for water reuse within the Mamre Road Precinct will include regional stormwater harvesting and reticulated recycled water.

5.2. Water Requirements

Water requirements within the Westlink Industrial Estate will be typical of large format warehouses and distribution centres. Sources of demand for water within the proposed allotments and public domain will include:

- Office amenities (kitchen, bathrooms)
- Landscape irrigation
- Dust suppression (depending on end user requirements)

5.3. Water Sources

The primary source of water to the Westlink Industrial Estate will be Sydney Water's potable water reticulation network.

A "third-pipe" reticulated recycled water network will supply non-potable water throughout the Mamre Road Precinct. Non-potable water will be supplied from two sources:

- Stormwater harvested within precinct-wide wetlands / ponds, to be delivered and operated by Sydney Water as part of a regional stormwater management scheme.
- Recycled water from the planned Upper South Creek Advanced Recycled Water Centre.
- Recycled roof runoff water treated and pumped on site.

5.4. Water Use Minimisation

Sydney Water provides a wide range of advice and guidance relating to water use minimisation and water efficiency. Whilst warehouses and distribution centres are relatively low water users in comparison to other industrial users, the following water use minimisation principles will apply to development within the Westlink Industrial Estate:

- Avoid using water where possible, such as sweeping hard surfaces instead of washing them.
- Reduce water use by installing water-efficient appliances and equipment (e.g., toilets, urinals, shower heads).
- Reuse water from manufacturing or cooling processes to toilet flushing, landscape irrigation and dust suppression.

6. Overland Flow Flooding

The site is located outside the extent of the Flood Planning Area identified in the *Penrith Local Environment Plan 2010*, refer to Figure 13.

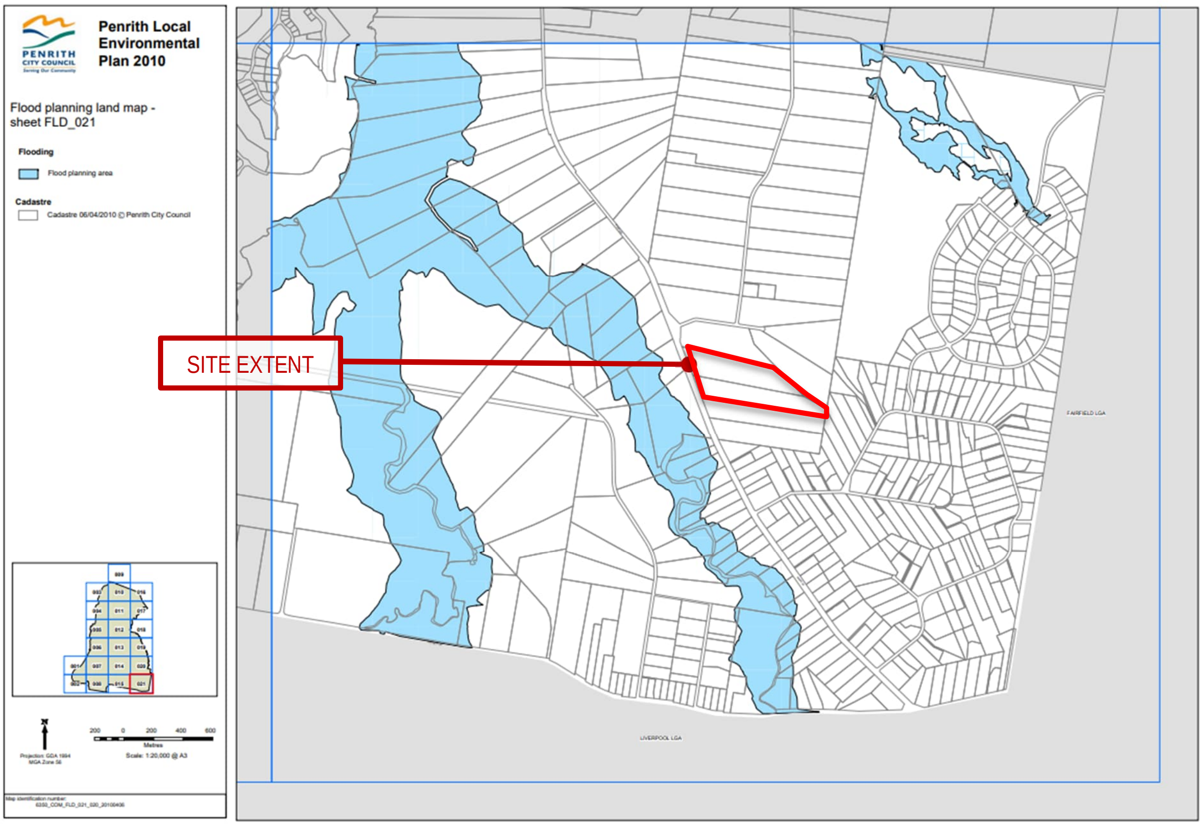


Figure 13 : Extract of flood planning land map (Penrith LEP 2010)

Mapping of the 1% AEP flood extent from local catchments within the Mamre Road Precinct is presented in the *Mamre Road Flood, Riparian Corridor and Integrated Water Cycle Management Strategy* (Sydney Water, October 2020), and is reproduced as Error! Reference source not found. This mapping shows the extent and depth of overland flow from local catchments within the site.

The proposed development of the site, including bulk earthworks, construction of a major and minor drainage system and construction of the proposed detention basin, will satisfy the development controls related to flood prone land outlined in Section 2.5 of the Mamre Road Precinct DCP.

The design of major system drainage elements is consistent with the principles of the NSW Government *Floodplain Development Manual* and Penrith City Council's *Stormwater Drainage Specification for Building Developments*. Under the post-development scenario, overland flow will be safely contained within the proposed road reserve and within trunk drainage infrastructure that has been incorporated into the design of the subdivision works.

As presented in Table 12, the post-development peak flow rates will be less than the pre-development peak flow rates at each of the discharge points for all design storm events between (and including) the 50% AEP and the 1% AEP event. Therefore, there will be no flood impact on adjacent properties associated with the proposed development of the site.

Refer to "Westlink Industrial Estate, Kemps Creek – Stage 2 Flood Impact & Risk Assessment Report" January 2025 by J Wyndham Prince for further details including 2D flood modelling of downstream impacts.

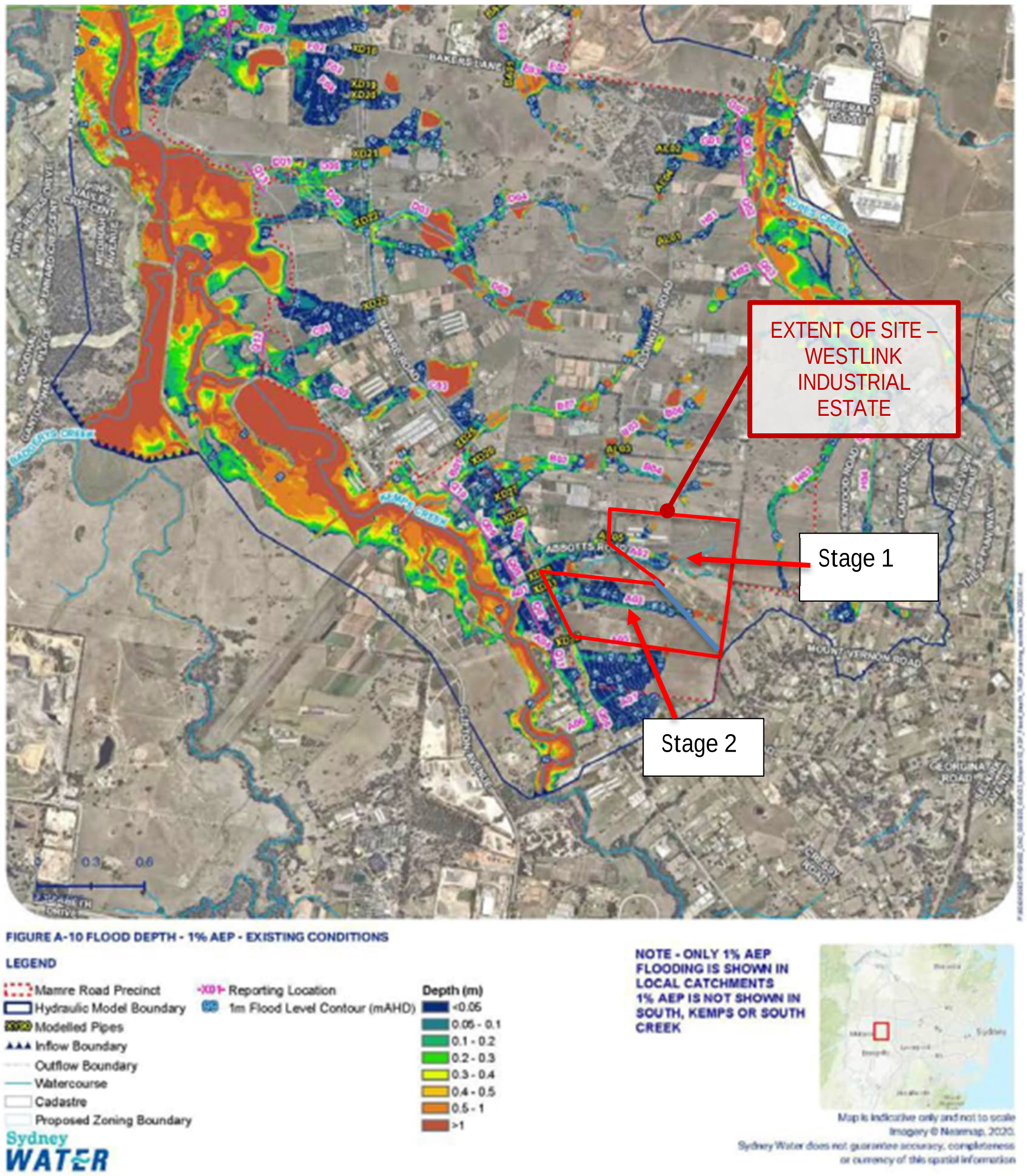


Figure 14: 1% AEP flood depth from local catchments under existing conditions (Sydney Water, 2020)

Figure 14 above shows that there are some flood impacts under the existing conditions within the stage 2 site.

The J Wyndham Prince modelling indicates the development of Westlink Stage 2 and Lot 4 and 5 will not result in adverse flood impacts on surrounding properties and does not adversely increase the flood hazard categories in the site. While the site is impacted by overland flows flood hazards for local floods have been assessed and are managed within acceptable levels.

7. Inspection and Maintenance Plan

7.1. Maintenance and Operations

Inspection and maintenance of the stormwater management measures that will be implemented under Stage 2 Phase 1 conditions shall be undertaken at the minimum frequency as outlined in Error! Reference source not found. The majority of these requirements have been derived from the Penrith City Council guideline titled *Water sensitive urban design (WSUD) inspection and maintenance guidelines* (Version 1.0, 2022).

Refer to Appendix 3 for Inspection and Maintenance Sheets for each of the stormwater management elements that will be owned, operated and maintained by the Property Owner (or representatives), including:

- Rainwater tanks
- On-lot stormwater drainage
- Gross pollutant traps
- OSD Tank

Table 14 - Inspection and monitoring requirements

Inspection / Monitoring Requirement	Responsibility	Timing / Frequency	References / Notes
1. On-lot stormwater drainage (including rainwater tanks)			
Eaves / box guttering system and downpipes	ESR as current property manager	At least once every six months	Refer to Inspection and Maintenance Sheets for rainwater tanks in Appendix 3.
On-lot stormwater drainage – grates and pits	ESR as current property manager	At least once every year	Refer to Inspection and Maintenance Sheets for on-lot stormwater drainage in Appendix 3.
On-lot stormwater pits and pipes (by CCTV)	ESR as current property manager	At least once every three years	
Rainwater tank (first flush device, external inspection of tank and fittings)	ESR as current property manager	At least once every six months	Refer to Inspection and Maintenance Sheets for rainwater tanks and Maintenance Manual (Appendix 3).
Rainwater tank – internal inspection and cleaning of tank, pumps, pipework and fittings	ESR as current property manager	At least once every year	
2. Gross pollutant traps			
GPT components (lids and surrounds, inlet, outlet, sump, screens, oil baffles)	ESR as current property manager	At least once every six months	Refer to Atlan Vortceptor Operation and Maintenance Manual
3. Estate-wide stormwater drainage (within road reserve)			
Stormwater drainage elements visible at ground level (grates, lintels, headwalls)	Penrith City Council	To be determined by Penrith City Council	Assets to be incorporated into Council's asset management system
Stormwater pits and pipes (by CCTV)	Penrith City Council	To be determined by Penrith City Council	

Inspection / Monitoring Requirement	Responsibility	Timing / Frequency	References / Notes
4. OSD Tank			
Tank inlet and outlet	ESR as current property manager	At least once every six months	Refer to Inspection and Maintenance Sheets for OSD Tank in Appendix 3.
Tank discharge control pit (grates, orifices, screens)	ESR as current property manager	At least once every six months	
5. Stormwater Pump Station and Irrigation Rising Main			
Pre-packaged pump station	ESR as current property manager	At least once every six months	To be confirmed with Pump Manufacturers
Rising Main	ESR as current property manager	At least once every six months	
Irrigation sprinkler system	ESR as current property manager	At least once every six months	
6. Open Trunk Drainage Channel			
Irrigation of landscaped elements	Sydney Water and ESR as current property manager	Monthly during establishment. TBC with Sydney Water	Assumed SWC will maintain open trunk drainage channel. To be confirmed with ESR as current property manager how hand over process works
Visual inspections after more than 5mm of rainfall	Sydney Water and ESR as current property manager	Monthly and/or after 5mm of rainfall during establishment	
Debris/Blockage removal	Sydney Water and ESR as current property manager	Monthly during establishment. TBC with Sydney Water	
Weed Management and Plant replacement	Sydney Water and ESR as current property manager	Monthly during establishment. TBC with Sydney Water	
Soil / Rock Protection inspections	Sydney Water and ESR as current property manager	Monthly during establishment. TBC with Sydney Water	

7.2. Monitoring

Elements of the stormwater management measures that will be monitored will be limited to general condition of each of the measures, which will be recorded on the Inspection and Maintenance Sheets for each measure (refer to Appendix 3).

7.3. Reporting and Auditing

Reporting and auditing of the stormwater management measures that will be incorporated under Stage 1 Phase 1 conditions will require completion of Inspection Sheets and Maintenance Sheets at the minimum interval recommended in Error! Reference source not found.. Inspection and Maintenance Sheets for each of the measures are included in Appendix 3 and have been either:

- Reproduced from the Penrith City Council WSUD inspection and maintenance guideline; or
- Produced using a similar format to the sheets incorporated in Council's guideline.

Completed Inspection Sheets and Maintenance Sheets for all stormwater management measures that will be owned, monitored and implemented by the Property Owner will be incorporated in an asset register and retained for the purpose of monitoring and environmental audit reporting that is required under Division 9.4 of Part 9 of the *Environmental Planning and Assessment Act 1979*.

8. Contingency Management

In the event that this SMP is not effective in managing potential environmental impacts, specific contingency actions will be implemented. Table 15 lists actions to be implemented if inspections, monitoring or auditing indicate that the stormwater management measures listed in Section 5 and any specialist management plans are not effective in managing environmental impacts.

The Contingency Plan categorises conditions as follows:

- Condition Green – considered to be normal operating condition.
- Condition Amber – minor non-compliance that should be rectified as soon as practical.
- Condition Red – non-compliance that should be rectified as a matter of urgency.

Table 15 - Contingency measures relating to operational stormwater management

Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Water quality monitoring	Trigger	No visible indicators within the Westlink Estate (oil / grease, turbidity). No complaints from property owners downstream of the Westlink Estate	Visible indicators within the Westlink Estate. Complaints from property owners downstream of the Westlink Estate	Prolonged poor water quality within ponds and downstream of the Westlink Estate.
	Response by ESR as current property manager	Continue SMP / OEMP implementation	Water quality sampling and testing to be undertaken to ensure results are just an anomaly and not a trend.	Appropriate rectification measures are implemented (e.g., aeration, additional filtration). Follow up water quality monitoring is undertaken to ensure parameters meet the ambient water quality objectives for the Wianamatta-South Creek catchment.
Flooding (inundation of lots, surcharge of stormwater drainage)	Trigger	Stormwater drainage system and riparian corridor functioning as per design intent (no exceedance of capacity, no surcharge in road network or inundation of lots)	N/A	Inundation of lots. Surcharge of stormwater drainage within road reserve.
	Response by ESR as current	Continue SMP / OEMP implementation	N/A	Check for blockages within stormwater drainage network

Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
	property manager			(sediment, debris, OSD Basin inlet and outlet structures). Rectify when required.
OSD Tank-Safety	Trigger	OSD tank functioning as intended – no visible damage to tank structure	Minor defects within OSD tank (e.g., blockage at discharge control pit).	Major defects within OSD Tank (e.g., failure of the discharge control pit)
	Response by ESR as current property manager	Continue SMP / OEMP implementation	Undertake short-term rectification works to address defects.	Undertake urgent works to address defects.
Pumped Irrigation System	Trigger	Pumped Irrigation system functions as intended- no visible damage to pumps or pressure mains.	Minor defects to Pump and pressure main but pump still operating	Major defects with pump and pressure main. Pump broken and not operating
	Response by ESR as current property manager	Continue SMP/OEMP implementation	Undertake minor repairs	Undertake urgent works to address defects

9. Lifecycle Costs

9.1. OSD Basin

Lifecycle costs associated with the OSD basin will be in accordance with Landcom Water Sensitive Urban Design Book 4 – Maintenance as indicated in Figure 15.

The costs within Figure 15 are based off 2003-2004 rates so would need to be indexed off 2023 prices (According to Rawlinsons 2022, 2003 to 2021 indexation is + 93% is a conservative estimate) and based off current rates provided by Civil and Landscape contractors for all associated WSUD works. These prices would be confirmed during Detailed Design and civil/landscaping tendering periods.

LIFE CYCLE COST ELEMENT	BIORETENTION	WETLANDS	PONDS & SEDIMENTATION BASINS
Life cycle	25 to 50 years	15 to 80 years (with 50 years used as the default in MUSIC) Wetlands are designed to have an infinite life span. However, to determine a life cycle cost, a finite number needs to be set	5 year (sedimentation basins) 50 years (ponds)
Total acquisition cost (TAC) (per m^2)	$387.4 \times (A)^{0.7673}$ \$1000/m^2 for first 20 m^2 (\$200/m^2 for remaining area)	$1911 \times (A)^{0.6435}$ The treatment area used in defining the total acquisition cost is the combined inlet and macrophyte zone area	$685.1 \times (A)^{0.7893}$
Total annual maintenance (TAM) (%TAC)	$48.87 \times (TAC)^{0.4410}$	$6.831 \times (A)^{0.8634}$	$185.4 \times (A)^{0.4780}$ The annual maintenance cost considers the volume of material likely to be removed from the basin per year (referred in MUSIC as the size attribute, V). The size attribute is the sum of gross pollutants, coarse sediment and total suspended solids (TSS) that are trapped in the basin / pond per year
Renewal period (years)	25	20 Renewal considerations include replanting and recontouring of the macrophyte zone	1 year (default in MUSIC due to lack of evidence). 10 years based on available data
Renewal costs (%TAC p.a.)	2.0%	0.52%	1.4% Costs associated with access ramps and contouring Limited data available
Decommisioning costs (% TAC)			38% - only applicable to sedimentation basins

Figure 15 - Lifecycle Costs from Landcom

9.2. Proprietary Stormwater Treatment Devices

Proprietary stormwater treatment device specifications and life cycle costs will be confirmed by the Manufacturer. Ocean Protect & Atlan as manufacturers will provide these specifications at the detailed design stage.

9.3. Pumping and Landscape Irrigation System

Pumping spec and life cycle cost will be confirmed by the Hydraulic Engineer.

APPENDIX 1 – CIVIL DRAWINGS

- 20-748-C5000 SERIES (INFRASTRUCTURE)
- 20-748-C6000 SERIES (ON-LOT)

APPENDIX 2 – STORMWATER HYDROLOGY SUMMARY

Level 7
153 Walker Street
North Sydney
NSW 2060
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F 02 9923 1055
E info@atl.net.au
ABN 96 130 882 405
www.atl.net.au

04 July 2023

Sydney Water
PO Box 399
Parramatta NSW 2124

Your Ref: TBC
Our Ref: LTR007-02 -20-748 Westlink Industrial Estate Hydrology

Attention: John Molteno

Email: TBC

Dear John,

Westlink Industrial Estate Hydrology

1. General

This letter summarises the hydrological assumptions being utilised by AT&L across the Mamre Road Precinct to establish predevelopment and post development flow rates.

2. Existing Available Information

The following list of documents provide historical hydrological estimation methods within the Wianamatta South Creek Catchment:

- Flood Study Report, South Creek' (Department of Water Resources, 1990).
- South Creek Floodplain Management Study' (Willing and Partners Pty Ltd, 1991).
- ADI St Mary's Watercycle & Soil Management Study - Final Study Report' (Sinclair Knight Merz, 1998).
- Austral Floodplain Risk Management Study and Plan' (Perrens Consultants, 2003).
- South Creek Floodplain Risk Management Study and Plan' (Bewsher Consulting, 2004).
- Upper South Creek Flood Study' (WMA Water, 2012).
- Upper South Creek Floodplain Risk Management Study and Plan' (Cardno, 2014).
- Updated South Creek Flood Study' (WorleyParsons, 2015).
- South Creek Floodplain Risk Management Study and Plan' (Advisian, 2020).
- Wianamatta-South Creek Catchment Flood Study Existing Conditions (Advisian, 2022).
- Stormwater Scheme Infrastructure Design Guidelines Draft (Sydney Water, 2022).

We note that the hydrological methods for establishing existing conditions across the Wianamatta South Catchment in the reports above vary greatly and range from RAFTS, RORB, WBNM and ILSAX.

3. Predevelopment Hydrology Assumptions

AT&L have been consistent with the Stormwater Scheme Infrastructure Design Guidelines Draft (Sydney Water,

2022) and utilised the ARR2019 IL-CL methodology to establish existing conditions across the development. We note that the *Wianamatta-South Creek Catchment Flood Study Existing Conditions* by Advisian utilised ARR1987 rainfall values in combination with RAFTS to calibrate flows to an existing Flood Frequency Analysis (FFA) for the area.

3.1. Rainfall Data

Rainfall Data was derived from ARR Datahub for the area.

- Coordinates: Longitude: 150.792 Latitude: -33.845
- Rainfall IFD (2019) data
- NSW median pre-burst rainfalls were derived from ARR Datahub.

3.2. IL - CL values

The IL-CL values were derived from the Stormwater Scheme Infrastructure Design Guidelines Draft (2022)

- Pervious Areas – IL: 37.1mm CL: 0.94mm
- Impervious Areas – IL: 1.00mm CL: 0.00mm

No Bx value was nominated as the RAFTS (Laurenson) method for calculating flows was not used.

3.3. Catchment Perviousness

The following Assumptions have been made for catchment perviousness.

- Effective Impervious Area: 5% of total catchment area to account for waterbodies and directly connected roads.
- Remaining Impervious Area: Not utilised
- Pervious Area: 95% remainder of site. We note a sensitivity test was run on perviousness of 100% and 90% and found changes in the order of +- 5%.

3.4. Time of Concentration

Time of concentration estimation was determined through a combination of the following methods:

- Friend's equation: at the most upstream ends of the catchment to estimate sheet flow (*dependent on Horton's roughness and slope*). A comparative assessment of kinematic wave vs friends equation was undertaken with JWP and AT&L, results indicated time of concentration is similar in both instances for catchment lengths less than 30m . For catchment lengths greater than 30m the a typical manning's open channel equation was utilised with an assumed velocity ranging between 1.5m/s-3m/s dependant on flow rate.
- Manning's Open Channel Flow: where sheet flow ends and becomes concentrated.
- Manning's Pipe Flow: Where open channel flow ends and enters a culvert.

Time of concentration typically ranged between 15 minutes – 28 minutes.

4. Post Development Hydrology

AT&L have been consistent with the industry standards for estimating flows in urban catchments and utilised the ILSAX methodology to establish post development conditions across the local site.

4.1. Rainfall Data

Rainfall Data was derived from ARR Datahub for the area.

- Coordinates: Longitude: 150.792 Latitude: -33.845
- Rainfall IFD (2019) data
- NSW median pre-burst rainfalls were derived from ARR Datahub.

4.2. Soil Depression Storage

The ILSAX values were derived from the Stormwater Scheme Infrastructure Design Guidelines Draft (2022)

- Paved (impervious) area depression storage: 1 mm
- Grassed (pervious) area depression storage: 5 mm
- Soil type: 3

4.3. Catchment Perviousness

Catchment perviousness was established based on land use as follows:

- IN2 Land – 85% imperviousness and 15% perviousness (to be measured at detailed design).
- Roads – 85% imperviousness and 15% perviousness (to be measured at detailed design)
- Water Courses 5% imperviousness and 95% perviousness.

4.4. Time of Concentration

Time of concentration estimation was determined through a combination of the following methods:

- Friend's equation: at the most upstream ends of the catchment to estimate sheet flow (*dependent on Horton's roughness and slope*).
- Manning's Pipe Flow: Where open channel flow ends and enters a culvert.

Time of concentration typically ranged between 6 minutes – 15 minutes. Generally, lots scales along with pit and pipe data results in a fast-reacting catchment.

Yours sincerely,

Darren Galia
Senior Civil Engineer
0433 759 556

APPENDIX 3 – INSPECTION, MAINTANCE AND OPERATIONS GUIDELINES

OPERATION & MAINTENANCE MANUAL

Vortceptor

Atlan STORMWATER

atlan.com.au

INTRODUCTION

This operation and maintenance manual has been written to assist asset owners and maintenance staff understand how the Vortceptor GPT works, and how to maintain their asset to ensure it performs optimally throughout its life cycle.

The Vortceptor is a vortex type Gross Pollutant Trap that provides robust, high performing, and reliable primary stormwater treatment. It is able to remove litter, sediment, oil, and particulate bound nutrient pollutants out of stormwater. The Vortceptor has no moving parts, which reduces the risk of moving part malfunctions.

It is constructed out of a FRP (fibreglass) body, and 316 stainless steel screens that has been specifically engineered to withstand the tough demands of stormwater and wastewater applications. FRP is resistant to the most demanding of conditions and can exceed the durability of conventional precast concrete and cast in-situ concrete construction.

25 YEAR WARRANTY

100 YEAR FIBREGLASS - DESIGN LIFE

Manufacture

The Vortceptor is manufactured in Penrith NSW Australia.

Why FRP?

Glass fibre reinforced polymer (FRP) or fibreglass is a composite material of high strength glass fibre reinforcement in a polymer resin matrix. The glass fibres provide the main load bearing function of the material, and can be woven and aligned specifically for strength. Glass fibre reinforcing provides ideal engineering properties of linear elastic behaviour until failure, and extremely high strength that can exceed that of steel in tension. The matrix has 4 important functions: 1. It holds the glass fibre reinforcing in place 2. It transfers forces to and between the fibres, 3. Prevents buckling of the fibres 4. it provides the beneficial protection from the environment. The resin is specifically formulated to ensure resistance to harsh stormwater environments, that can exceed the durability that of concrete.

This material stands up to the harshest environments, commonly found in stormwater, wastewater, acid sulfate soils, and saltwater.

Fibreglass is becoming a material that is enjoying increased adoption in civil structural engineering applications worldwide due to its light weight, high strength, and its ability to resist degradation. The ability of fibreglass to achieve high strength with low weight means that the Vortceptor can be fabricated and delivered to site in a substantially assembled state. The treatment chamber is mostly one-piece, with the other sections being any risers, covers, and a precast concrete diversion chamber. One-piece construction means there are no joints to be made on site for the treatment chamber, which eliminates the potential for leaking joints, and risk of backfill and subgrade degradation from water egress through leaking joints. This means that the Vortceptor will provide a more reliable and watertight body, than one made from precast concrete components that are joined and sealed onsite. This is especially important as joints must be able to withstand tremendous hydrostatic pressures. The Vortceptor takes away this risk by eliminating joints, using a single piece FRP body.

MAINTENANCE

Structural strength of FRP

The Vortceptor has been engineered to withstand the forces associated with structures that are buried and carry vehicular loads. The Vortceptor has been engineered to withstand vehicular loadings to Class D rating per AS3996. A cast in situ concrete cover slab that is 600mm larger than the diameter of the FRP Vortceptor separation chamber, and 200mm thick is required to support a dynamic T44 traffic load. The precast concrete diversion chamber is rated to carry Class D traffic loads without the need for the additional concrete cover slab. Refer to Atlan Stormwater Vertical Tank installation guide for further details.

Safety Precautions

The Vortceptor is an underground structure that retains water. Ensure that adequate safety equipment and procedures are in place to avoid personnel falling into the Vortceptor, as there is a severe risk of drowning.

The Vortceptor is deemed a confined space. It is not necessary to enter the Vortceptor during maintenance, however in the rare event that entry is required, it should only be done so by suitably qualified and equipped personnel, working in accordance with strict OH&S laws, regulations and procedures.

Pollution captured by the Vortceptor can be hazardous to health. Do not make contact with the pollutant material. Ensure personnel are fully equipped with PPE to avoid contact and have procedures in place for first aid.

OPERATION

The Vortceptor is comprised of two chambers: The separation treatment chamber stormwater enters this chamber by being directed by a weir into a chute and is then circulated into the screening area. A vortex flow pattern forms as a result of flow velocity and head. Pollutants are removed via screening, and via centrifugal and gravitational forces acting to separate sediment and other particles.

Pollutants are captured and are stored in a sump area separate to the screening area. The shear cone separates the screening area and the sump, and acts to create quiescent conditions in the sump. This is what allows the Vortceptor to avoid resuspension of captured pollutants. The sump resides directly below the screening area and is conveniently accessible from the manhole for vacuum cleaning.

Storage of pollutants away from the screening area ensures that the Vortceptor can provide a consistent treatment flow rate, that does not diminish according to the level of pollutants stored. This is a key advantage over other GPTs that store pollutants in the screening area.

Floating pollutants are kept at the top of the screening area, but do not impede flow rate. An oil baffle acts to contain oil and hydrocarbons within the treatment chamber. The captured floatable pollution remains inside the Vortceptor until the time it is cleaned.

The vortex action of flow acts to create a shear force across the face of the 316 stainless steel vortex separation screen. The flow is tangential to the screen, which acts to create a self-cleaning effect and prevents the screen from blinding.

Treated flows are then discharged into the diversion chamber via the outlet chute and then discharged from the diversion chamber outlet into the drainage network.

The Diversion Chamber Pit

This chamber allows interface of the Vortceptor with the pipe or culvert drainage network. A weir goes across the width of the Diversion Chamber and is angled so that it is aligned with the entry chute to the separation treatment chamber. The Diversion Chamber is sized to allow bypass of flows exceeding the treatment flow rate over the weir.

Inline Vortceptor models have a small diversion chamber integrated over the separation treatment chamber, to provide a unit that is packaged into a compact footprint.

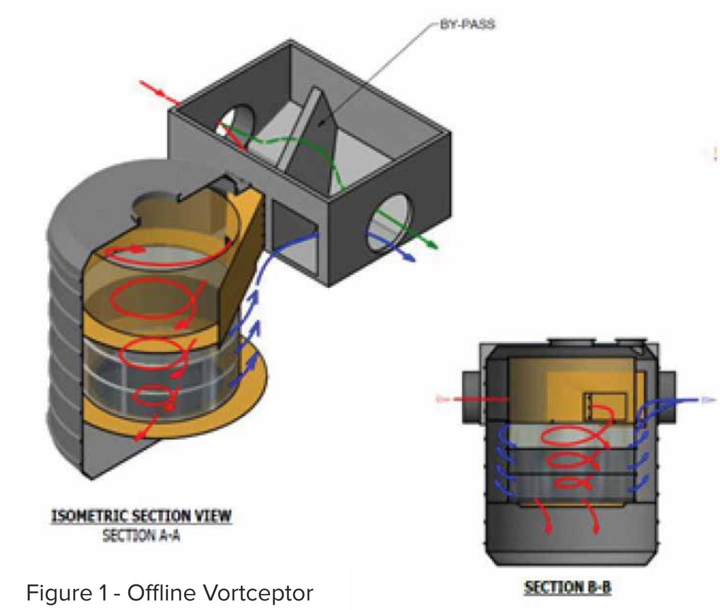


Figure 1 - Offline Vortceptor

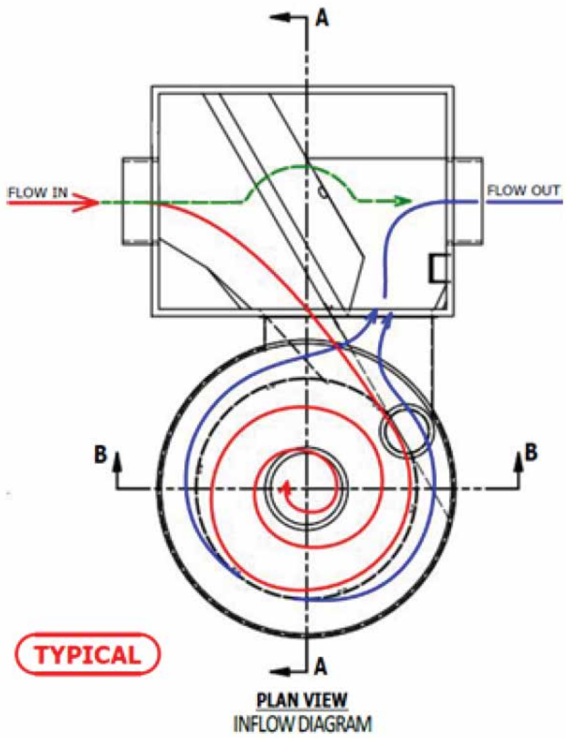


Figure 2 - Offline Vortceptor Plan view showing Separation treatment chamber (Circle) and diversion chamber (rectangle)

Offline and Online

The Vortceptor GPT comes in an offline and online configuration. Offline – the treatment separation chamber is adjacent to the diversion chamber. Online – The diversion chamber and the separation treatment chamber are integrated together.

Cleaning options

The following cleaning options allow asset owners to choose the best option available for ongoing maintenance and the required cleaning frequency with the right cleaning services and resources available.

Depending on the size, access, and depth of the system, the three following methods can be used to clean the Atlan Vortceptor.

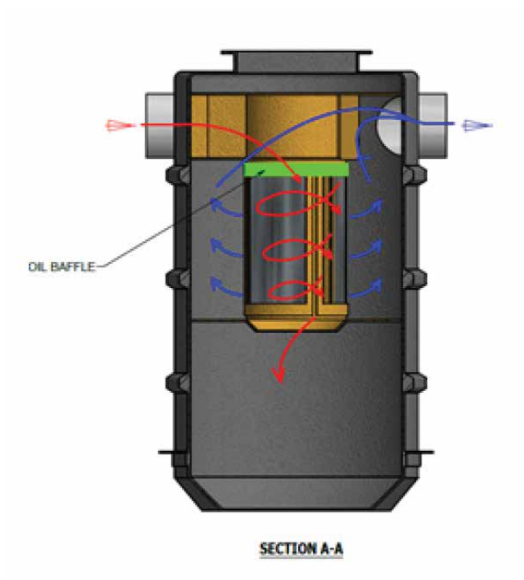


Figure 3 - Online Vortceptor in Elevation view

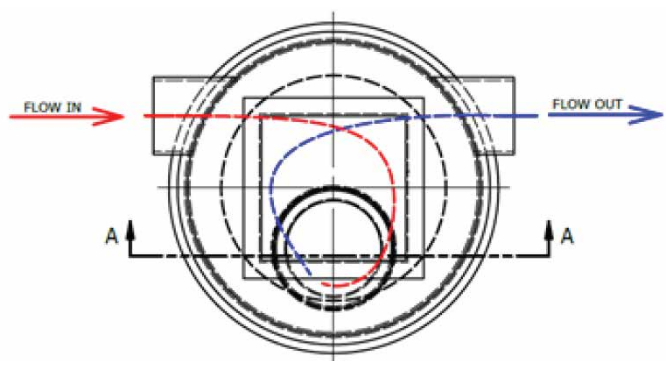


Figure 4 - Online Vortceptor in Plan view showing the diversion chamber and separation chamber in line

Vacuum Suction Cleaning

Equipment needed – eductor truck
Personnel needed – 2

Suction cleaning is used for most proprietary GPT's. This is by far the most convenient and safest method but does require specialist machinery to achieve. There are several specialist companies that offer vacuum suction cleaning of GPTs. Costs are usually based on the total volume of pollutants disposed, as well as water removed. Asset owners should enquire with cleaning contractors if the option to decant captured water back into the Vortceptor is possible, to reduce disposal fees.

Grab Cleaner

Equipment needed – truck with mounted crane and grab attachment
Personnel needed – 1 to 2

The Grab Cleaner can be carried out without dewatering the system. However, this operation is limited to the larger Vortceptor models with larger screen internal diameters. This option is practically only available for the SVO.530 and above as they have screen internal diameters of 2m. Care must be taken by the operator to ensure that the grab does not make contact with the stainless steel screen, and the shear cone underneath the screen area.

The grab truck cleaning option offers the removal of 80 – 90% of the pollution stored in a sump. It can be a cheaper option than vacuum suction cleaning. However, the asset owner must still allow for an annual vacuum clean, to remove accumulated sediment in the sump and behind the screens.

Removable Basket

Truck with mounted crane
Personnel – 1 to 2

If a removal waste basket is fitted, it can be lifted at any time, without the need for dewatering. This is the fastest and the most cost-effective option but comes at the sacrifice of sump capacity. The basket will not impede flow rate.

The smaller sump capacity that results from using a basket may lead to the need for more frequent maintenance activities. But this is offset by the ease and ability to carry out the cleaning activity in house.

An annual vacuum clean to thoroughly dewater and remove accumulated sediment will be recommended for this approach.

Tidal and backwater affected Vortceptors

Gross pollutant traps, including the Vortceptor, may from time to time, be required in tidal and backwater affected locations. The designer should consider specifying a penstock or stop valve on the outlet side of the Vortceptor, so that the Vortceptor can be isolated from tidal and backwater, and effectively dewatered and cleaned. It will be critical for the maintenance crew to re-open the penstock or stop valve after they have finished maintaining the Vortceptor. Failure to re-open the penstock or valve can lead to catastrophic flooding.

Increasing the Vortceptor sump capacity to spread out the cleaning intervals

Vortceptor sump capacities can be increased over and above the standard capacities listed in Table 1 below. It is recommended that the designer carefully estimate the expected pollution load volumes from their catchment and target a sump capacity to match a desired cleaning frequency. Extending the sump is only possible during the desktop design stage, before the Vortceptor is manufactured, so good early planning and design is essential.

Atlan Vortceptor Maintenance Capacities & Dimensions Inline

Models	Dimensions (mm)					Capacities			
	Internal Diameter	Overall Width	Depth Below Invert	Manhole Size (mm)	Max Pipe Size (mm)	Sump Capacity (m^3)	Floatables Volume (m^3)	Treatable Flow Rate (L/s)	Max Flow Rate (L/s)
INLINE SERIES									
SVI.025 (L/R)	1200	1370	1400	600x 600	450	1.2	0.06	26	280
SVI.055 (L/R)	1800	1970	1650	900x 900	525	2.7	0.22	55	380
SVI.055.M (L/R)	2200	2370	1585		525	3.2	0.22	55	750
SVI.100/15 (L/R)	1500	1670	1900	1000 DIA Internal 600x 600	600	3.1	0.20	100	700
SVI.160/22 (L/R)	2200	2370	2400		750	3.4	0.39	160	940
SVI.200/22 (L/R)	2200	2370	2900		750	3.1	0.39	200	990
SVI.300/22 (L/R)	2200	2370	3100		750	4.5	0.83	300	1050
SVI.400/22 (L/R)	2200	2370	3000		750	3.4	0.83	400	1180
SVI.400/25 (L/R)	2500	2670	2900		900	5.5	0.83	400	1650
SVI.400/30 (L/R)	3000	3170	3500		900	10	1.5	400	2500
SVI.500/30 (L/R)	3000	3170	3500		1050	10	1.5	500	1650
SVI.500/35 (L/R)	3500	3670	4000		1050	10	1.5	500	1900

Atlan Vortceptor Maintenance Capacities & Dimensions Offline

Models	Dimensions (mm)				Capacities			
	Internal Diameter	Overall Width	Depth below invert	Manhole Size (mm)	Sump Capacity (m^3)	Floatables Volume (m^3)	Treatable Flow Rate (L/s)	Bypass Flow Rate (L/s)
OFFLINE SERIES								
SVO.096 (L/R)	1500	1670	1725	1000 DIA Internal 600x600	2.0	0.35	96	PROJECT SPECIFIC DESIGN
SVO.140 (L/R)	1500	1670	2025		2.3	0.35	140	
SVO.180 (L/R)	1500	1670	2325		3.0	0.35	180	
SVO.220 (L/R)	2200	2350	2800		4.5	1.1	220	
SVO.360 (L/R)	2200	2350	3080		6.0	1.1	360	
SVO.530 (L/R)	3000	3150	3200		8.5	2.8	530	
SVO.800 (L/R)	3000	3150	4200		8.5	2.8	800	
SVO.810 (L/R)	4000	4150	3400		19.3	5.65	800	
SVO.1200 (L/R)	4000	4150	4000		19.3	5.65	1200	
SVO.1600 (L/R)	4000	4150	4600		19.3	5.65	1600	

Maintenance

The Atlan Vortceptor requires regular inspections and cleaning. There are no consumable parts on the Atlan Vortceptor throughout its operating life. The regularity of inspections and cleaning of the Vortceptor is contingent on the features and properties of the catchment area. Good monitoring and record keeping systems by the asset owner will allow them to optimally schedule cleaning activities for each individual Vortceptor. The section below provides asset owners some guidance to the frequencies for maintaining the Vortceptor.

Inspection

Routine inspection is the key to effective maintenance. Pollutant transportation and deposition may vary from catchment to catchment. Regular routine inspections will help the asset owner assess the rate of pollutant capture for that specific location.

At a minimum, routine inspections should be performed twice per year. The suggested inspection frequency in the first year of operation is 3 months.

This interval can be extended to 6 months at the discretion of the asset owner. The routine visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet, outlet, and separation screen. The routine inspection should also quantify the accumulation of floating trash, and sediment in the sump. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. All inspections should be recorded. A sample inspection report is attached to this manual. Furthermore, it is recommended that the Vortceptor be inspected after every major rain event, with a focus on ensuring there are no blockages to the inlet and outlets of the Vortceptor and the diversion chamber.

Access for maintenance

Separation Treatment chamber

The separation treatment chamber has adequate access for maintenance. Vortceptor models up to SVO.360 have single manhole access, whereas the larger Vortceptor models SVO.530 and above have 2 manholes, consisting of Class D cast iron lids. The lid in the centre of the separation chamber provides access into the screen and sump area.

The single round lid as pictured below provides access behind the screen, so that sediment can be extracted using a vacuum.

The lids are locked with bolts. The lids can be lifted using standard manhole cover lifters.

As described above, an additional Class D manhole cover allows access to the clean water side of the screen, or otherwise called the area ‘behind the screen’. This area can have some level of sediment deposition over time. This manhole allows convenient access, by allowing the vacuum hose to be dropped down vertically to the area behind the screen. It is recommended that the area behind the vortex separation screen be cleaned annually, to avoid build-up of sediment. Alternatively, access behind the screen can be gained by inserting the vacuum hose from the outlet side of the diversion chamber, and into the outlet of the separation treatment chamber.

Diversion chamber

There are access manholes above the diversion chamber, with a lid situated either above the inlet side and/or the outlet side of the chamber.

These manholes allow for visual inspection to the treatment chamber inlet and outlet chutes, and if required, access for cleaning.

Access for Maintenance

Pollution removal performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to reaching maximum sump capacity for easier removal of sediment. The level of sediment is easily determined by measuring from the finished surface level down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile.

Method to calculate the % sump capacity filled with pollutants

1. Determine the water depth that is above the sediment layer. This is done by taking two measurements with a measuring staff: one measurement from the finished surface level (ie manhole opening level) to the top of the sediment pile and the other from the manhole opening to the water surface.

2. If the difference between these measurements is less than the Depth from water level to top of sump in table 2, the system should be cleaned out. If the water depth to the sediment is less than the water depth to the top of sump, this means the sediment level is above the sump.

3. If the water depth to sediment is greater than the depth from water level to top of sump, calculate the % of sump that contains sediment by the following method:

Height of sediment = Depth of Water level to top of sump + Sump depth - water depth to sediment
Sump % full = height of sediment / height of sump x 100

A work sheet is attached to the end of this manual to assist with calculating and recording the sump levels.

Models	Sump depth (mm)	Depth from Water level to top of sump	Sump Capacity (m^3)	Light Liquid Volume (L)	Floatables Volume (m^3)
INLINE SERIES					
SVI.025	25	1400	500	600	770
SVI.055	55	1650	700	800	770
SVI.055.M	55	1585	700	800	770
OFFLINE SERIES					
SVO.096	1150	1010	2.0	239	0.39
SVO.096	1320	1260	2.3	239	0.39
SVO.096	1380	1560	2.5	239	0.39
SVO.096	1430	1560	4.3	515	1.1
SVO.096	1570	1860	6.0	515	1.1
SVO.096	1270	1860	8.5	1263	2.8
SVO.096	1270	2860	8.5	1263	2.8
SVO.096	1540	1860	19.3	2155	5.65
SVO.096	1540	2490	19.3	2155	5.65
SVO.096	1560	3150	19.3	2155	5.65

Table 2 - Sump depth dimensions

Cleaning

Cleaning of the Vortceptor system should be done during dry weather conditions when little or no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump.

The system should be completely drained down and the sump fully evacuated of sediment, and a final hose down of the screen and sump.

Disposal of material

The material captured by the Vortceptor could include hazardous material, such as syringes, chemicals, and sharp objects. Care must be taken by cleaning crews and they must work in accordance with a specific job safety plan. PPE such as gloves, protective wear, boots should be mandatory. Disposal of material must be done in accordance with all environmental regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins.

Inspection and cleaning frequencies

The frequency of cleaning will depend on the pollutant loads of the catchment, so inspections are recommended to confirm the maintenance intervals, which could be either three, six or twelve months.

Visual inspection and cleaning frequencies

	After every major storm	3 months	6 months	12 months
Visual inspection of treatment chamber	-	visually inspect every 3 months. Measure the amount of pollutants in the sump	-	-
Visual inspection of diversion chamber	Check inlet and outlet pipe or culvert for blockages	-	Visually inspect the diversion chamber for any signs of blockage and sediment build up	Visually inspect the diversion chamber for any signs of blockage and sediment build up
Regular Clean – Removal of captured pollutant material from the Vortceptor separation chamber	-	-	-	-
-	-	-	Primarily to remove floatables and sump contents contents. Note Cleaning interval is every 6 months on average but may need to be adjusted according to site specific conditions. Interval frequency can be reduced if extended sump has been installed	-
Full dewater and clean	-	-	-	Full sump pump out, jet screen and sump
Clean behind screen	-	-	-	In conjunction with full dewater and clean
Visual inspection of Vortex separation screen	-	-	-	Note the condition of the screen – note down signs of damage if any
Clean diversion chamber	-	-	Visual inspection	Remove sediment buildup if required.

Repairs and replacement

The Vortceptor does not have any consumable parts that require replacement throughout its design life of the unit. However, in the unlikely event that the Vortceptor requires repair due to damage, the following provides guidance on repairing the Vortceptor.

All repairs should be conducted by suitably qualified personnel, following OH&S requirements for working in confined spaces. All repairs should be conducted in dry weather and should be conducted after the Vortceptor has been dewatered and emptied.

Vortex Separation Screen

The vortex separation screen is comprised of 316 stainless steel. The Screen is not a consumable item. In the unlikely event that the screen is damaged, specific sections of the screen can be removed by cutting them out. Replacement screens can be riveted into the fibreglass body, and tack welded to the neighbouring screens. The installer must ensure that the screen is installed such that the screen aperture is facing the correct direction.

The way to check this is to run a hand over the surface of the screen. Ensure you are wearing gloves. The screen is smooth when stroking in one direction, and rough when stroking in the opposite direction. The smooth direction indicates the direction that the vortex will flow. Ensure that the replaced screen is in the same direction as of the screens next to them. Replacement screens are available from Atlan Stormwater, as well as specialist on site support from Atlan Stormwater's maintenance team.

Shear cone

The shear cone is not a consumable item. The only practical way it will be damaged is if a grab makes contact. Vortceptors up to SVO.360 have FRP shear cones, and the units from SVO.530 and above have 316 stainless steel shear cones. Replacement of the shear cone has been designed for easy replacement.

First completely dewater the unit, then gain access, noting that it is a confined space. Undo bolts and replace the damaged shear cone section. The shear cone is divided into 4 separate sections, so that only the damaged section needs to be replaced. Replacement shear cone sections are available from Atlan Stormwater as well as specialist on site support from Atlan Stormwater's maintenance team.

Cast iron Manhole covers

Cast iron manhole covers are not consumable items. However in the event they are damaged, they are readily available on the market as standard covers are used for the Vortceptor.

Precast concrete Diversion chamber

The diversion chamber is made of min 40Mpa concrete. Damage or cracks can be repaired with a concrete mortar such as Rapidset, Xypex, Parchem. 2-part epoxy and flexible fillers such as Sikaflex are also widely available. Refer to the manufacturers for specialist details on repairing precast concrete for water retaining structures.

Fibreglass components

One of the many benefits of using FRP/fibreglass over conventional materials such as concrete is its ease and durability of repairs. The material to repair fibreglass is readily and widely available.

Safety

Ensure the work area is well ventilated as the resin fumes can be harmful, especially in a confined space area. Resins, acetone, and FRP dust are flammable. Peroxides (catalyst) are strong oxidizing agents and can ignite fuels. Follow MSDS instructions, including PPE prior to commencement of repair work.

Repairs to Fibreglass

A key principle of repairs to fibreglass is that the repair will differ from the original fibreglass primary structure. The original resin and glass reinforcing fabric in the primary structure has cured and bonded chemically and physically with each other, forming the primary bond. Repairs to a damaged fibreglass part is referred to as secondary bonds, that are attached to the primary structure. The repair relies on the physical bond to the primary structure, and the resin must have strong adhesive properties. Increasing the surface area of the bond to the primary structure will increase the strength and durability of the repair.

Parts for repair

1. Resin – Polyester resin or Vinyl ester resin
2. Catalyst / Hardener – MEKP (Butanox M50 or equivalent)
3. Fibreglass matt – 450g/m2 chopped strand mat
4. Acetone – for cleaning the bond surface
5. Hot Coat – finishing layer (resin mixed with 1% solution of 8% wax in styrene can be used for this purpose)
6. Paint brush and or roller – for applying resin to fibreglass mat

Commercial fibreglass repair kits are widely available and can be used to repair the Vortceptor.

Identify the Damaged Area

Identify the damage and draw the boundary of the damage. An easy inspection method is to tap a solid material, like a coin, and listen for any differences in the sound of the tap. Mark out suspect areas. Damage could be cracks, holes, puncture, and delamination.

Trimming and cutting

Cut out the damaged area if you cannot patch over the area. Otherwise grind the surface as described below. Most concrete or masonry cutting tools are compatible to cut FRP. Note that high speed cutting tools for metals are not suitable for FRP.

Surface cleaning and grinding

Grind approximately 20mm or more of surface area from the damaged area to promote adhesion of the repair. Grind surface using abrasive methods.

Recommended equipment are 4 inch grinder with 34 grit sanding disc, or an orbital sander with a low grit number such as 60 grit. Do not use chemical primers. Grind the surface until the glossy finish of the resin is no longer visible, surface is even and uniform with no high or low spots. A slight taper in the surface will assist with locking in the repair.

Clean the surface of dust, water, oil. Brush or vacuum to remove dust, then wipe the surface with clean acetone. The surface should not be wet and must be dried.

The surface must be prepared again if the repair has not been performed within 24 hours of the surface preparation, or if the surface is contaminated with oil or water.

Resin preparation

Mix resin and catalyst in small batches. Catalyst should be between 1.25% to 2.5% of the resin weight. The reaction of the resin and catalyst will cause high amount of heat when curing. Refer to the resin and catalyst manufacturer's instructions.

Applying Fibreglass layers

Wet the bonding surface with catalysed resin. Apply fibreglass mat in layers, and completely cover with resin. Minimise the layer thickness to no more than 7mm, to avoid generating excess heat. Build up the layers until it matches or exceeds the thickness of the primary structure. Press the layers together to avoid the formation of air pockets between the layers, by using a roller.

Finishing the Fibreglass repair

After all layers are applied, a final coat of 'Hot Coat' is to be applied. The Hot coat can be applied while the top layer is still wet.

Further Assistance

Thank you for choosing the Atlan Vortceptor GPT. We are confident that it will faithfully carry out the essential task of keeping our waterways clean of pollution and do so in a robust and hassle-free manner for years to come. Our confidence in the product is backed by our 25 year warranty. Engineering and maintenance support are at hand for all asset owners. Contact Atlan Stormwater on 1300 773 500 or email maintenance@atlan.com.au.





Inspection & Maintenance Log

Model ______________________________ Location ____

Date	Depth from manhole to top of sediment (1)	Depth from manhole to top of water level (2)	Water depth to sediment (1) – (2) (3)	Water Depth top of sump (from table 2) (4)	Is the water Depth (3) less than water depth to sump (4) Yes/No If yes, organize clean	% sump capacity full	Describe Maintenance Performed	Comments

a. The water depth to sediment is determined by taking two measurements with a measuring staff: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface.

b. Obtain the Water depth to top of sump for the specific Vortceptor model from table 2 of this manual

c. Compare the Water Depth to Sediment (3) to the Water Depth to top of sump (4). If the water depth to the sediment is less than the water depth to the top of sump, this means the sediment level is above the sump.

d. If the water depth to sediment is greater than the depth from water level to top of sump, calculate the % of sump that contains sediment by the following method:

Height of sediment = Depth of Water level to top of sump + Sump depth - water depth to sediment
Sump % full = height of sediment / height of sump x 100

e. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable

Ecoceptor
6000 SERIES

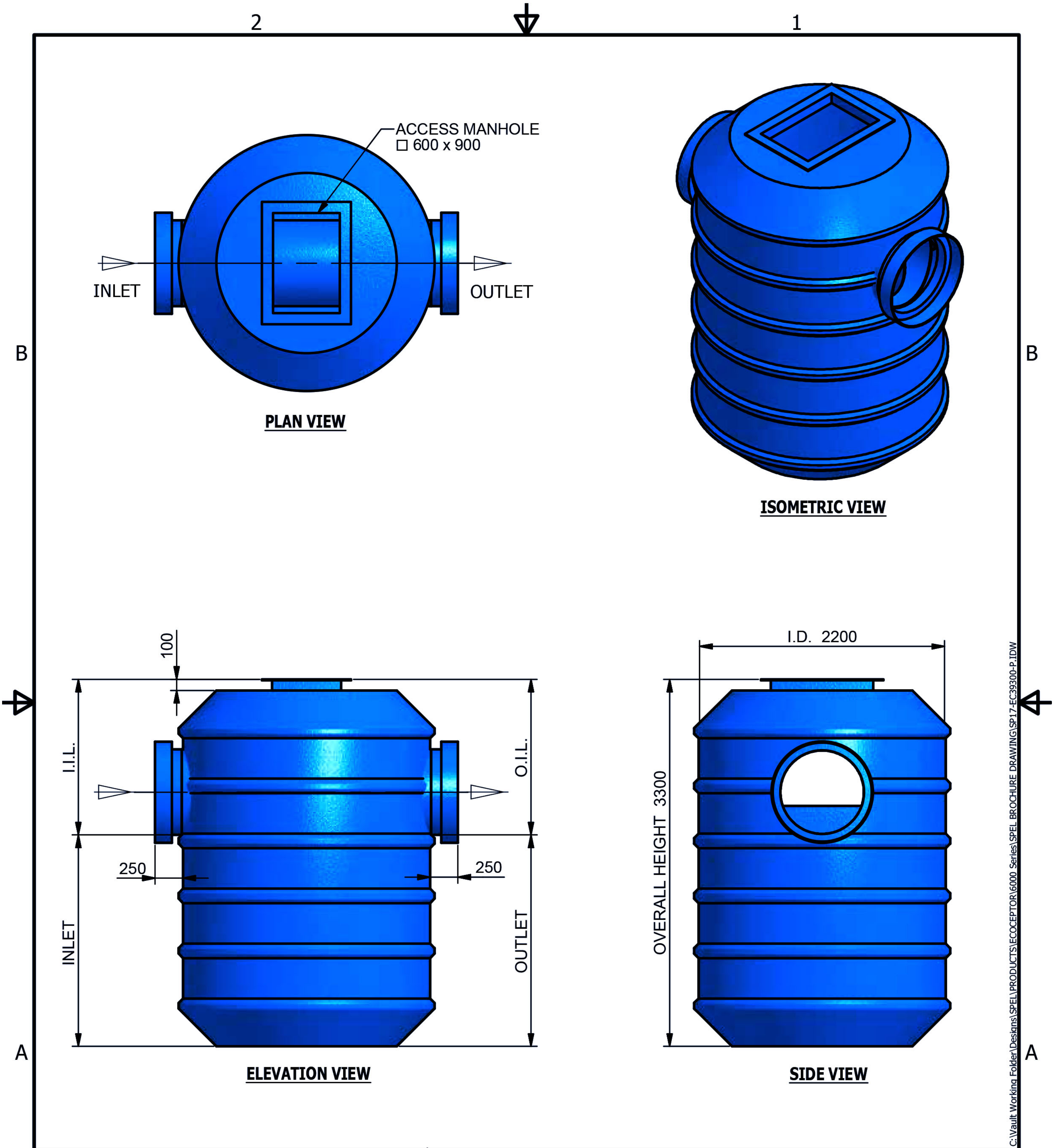
SELECTION CHART

Weight approximately 700kg each

MODEL	E/606767	E/607575	E/609090
Inlet (mm)	675	750	900
Outlet (mm)	675	750	900
Invert Level* (mm)	1400	1400	1400
Overall Height* (mm)	3300	3300	3300
Internal Diameter (mm)	2200	2200	2200
Manhole Opening (mm)	900 x 600	900 x 600	900 x 600
Manhole Quantity	1	1	1
Max Silt Capacity (Litre)	6000	6000	6000
Max Hydrocarbon Capacity (Litre)	2200	2200	2200
Max Capacity (Litre)	11500	11500	11500

Atlan Stormwater accepts no responsibility for any loss or damage resulting from any person acting on this information. The details and dimensions contained in this document may change, please check with Atlan Stormwater for confirmation of current specifications.

*Height does not include lid.



TOLERANCE: ALL DIMENSIONS 10mm UNLESS OTHERWISE STATED.

ALL INTERCONNECTING PIPEWORK, PITS AND ASSOCIATED DRAINAGE BY OTHERS

Drawn P.Z.	Date 10-10-17
Check	Date
Verified	Date
Approved	Date
Request No. RN4656	

Atlan STORMWATER

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100 Silverwater Rd,
Silverwater NSW 2128
atlan.com.au

PRODUCT : 6000 SERIES

TITLE

SCALE	SIZE	SHEET	REV
N.T.S	1	1	1

CUSTOMER CODE :

DWG No. SP17-EC39300-P

Ecoceptor
8000 SERIES

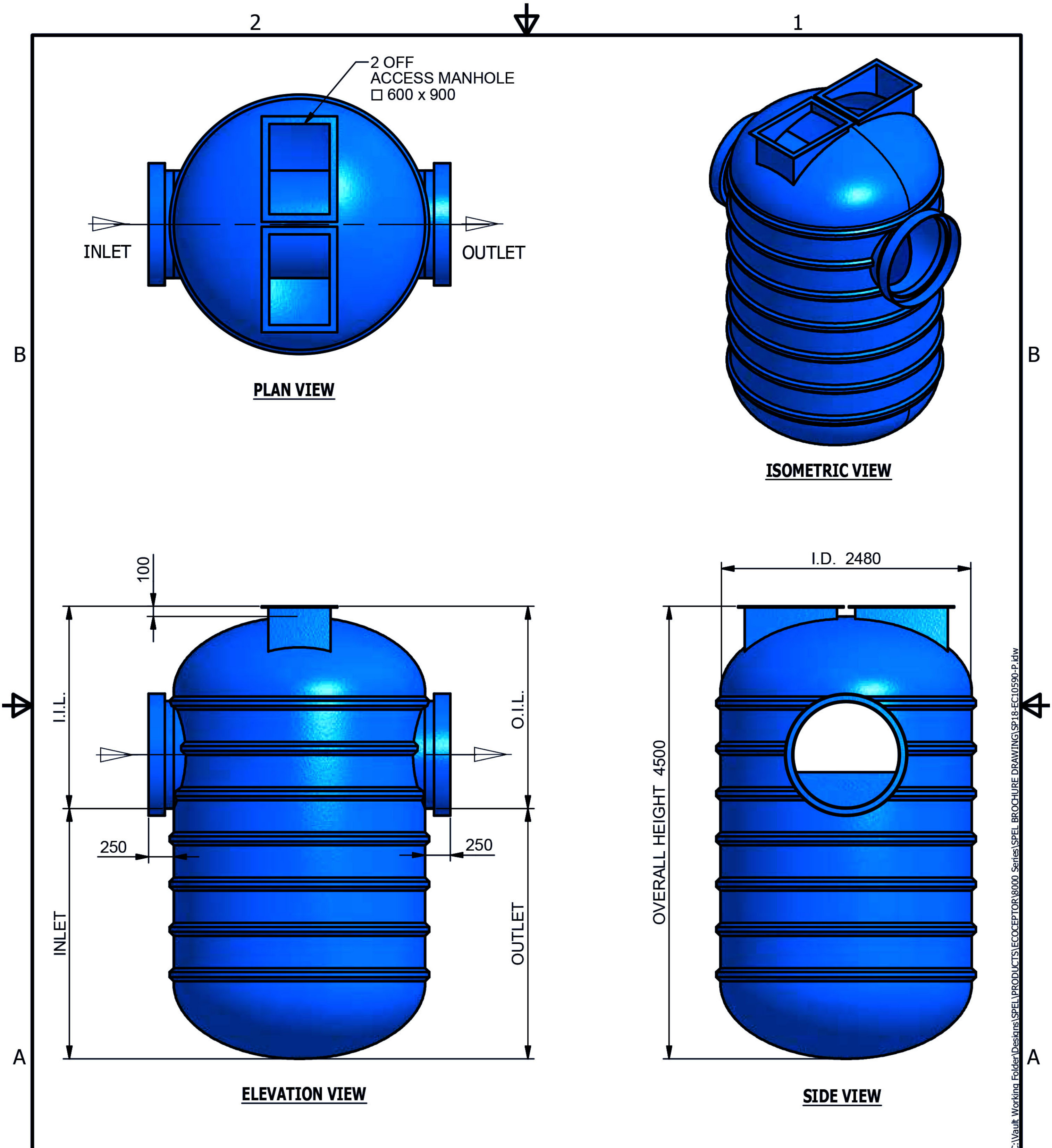
SELECTION CHART

Weight approximately 1350kg each

MODEL	E.175.105105	E.185.135135	E.200.150150	E.8018090.BC
Inlet (mm)	1050	1350	1500	1800x800 BC
Maximum Treatment Flow (lps)	1750	1850	2000	-
Outlet (mm)	1050	1350	1500	1800x800 BC
Invert Level* (mm)	2400	2400	2400	1800
Overall Height* (mm)	4500	4500	4500	4500
Diameter (mm)	2480	2480	2480	2480
Manhole Opening (mm)	900 x 600	900 x 600	900 x 600	900 x 600
Manhole Quantity	2	2	2	2
Max Silt Capacity (Litre)	10,000	10,000	10,000	10,000
Max Hydrocarbon Capacity (Litre)	4200	4200	4200	4200
Max Capacity (Litre)	19,000	19,000	19,000	19,000

Atlan Stormwater accepts no responsibility for any loss or damage resulting from any person acting on this information. The details and dimensions contained in this document may change, please check with Atlan Stormwater for confirmation of current specifications.

*Height does not include lid.



TOLERANCE: ALL DIMENSIONS 10mm UNLESS OTHERWISE STATED.

ALL INTERCONNECTING PIPEWORK, PITS AND ASSOCIATED DRAINAGE BY OTHERS

Drawn P.Z.	Date 22-03-18
Check	Date
Verified	Date
Approved	Date
Request No. RN1801	

Atlan STORMWATER

P 02 8705 0255 sales@atlan.com.au
100 Silverwater Rd,
Silverwater NSW 2128
atlan.com.au

PRODUCT : 8000 SERIES

TITLE

SCALE N.T.S	SIZE 1	SHEET 1	REV 1
CUSTOMER CODE :	DWG No. SP18-EC10590-P		

Joy in water

'We believe clean waterways are a right not a privilege and we work to ensure a joy in water experience for you and future generations.'

Andy Hornbuckle

Atlan
STORMWATER

P 02 8705 0255
sales@atlan.com.au
100 Silverwater Rd,
Silverwater NSW 2128
atlan.com.au

REFERENCE SHEET - On-lot stormwater drainage

Functional component		Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
1	**Downpipes**				
1a	Connection to subsurface drainage	36	Secure downpipes. No holes or leaks.	Downpipes showing signs of wear and/or damage (holes, cracks, leaking joints).	Downpipes are unstable and/or not discharging flow to subsurface drainage.
2	**Stormwater pits**				
2a	Grates / covers	12	Grates / covers are in place not blocked and do not pose a safety hazard.	Grates / covers require adjustment or clearing of blockage.	Grates / covers require repair or replacement due to damage.
2b	Internal	36	No damage or blockage evident.	Minor blockage or evidence of damage (cracking, spalling).	Significant blockage causing loss of conveyance capacity. Damage to pit that poses a risk to structural integrity, safety or function of stormwater system.
3	**Stormwater pipes / culverts**				
3a	Structural condition	36	No defects or blockage evident	Minor defects evident (e.g., hairline cracks)	Major defects requiring repair (e.g., cracks, concrete spalling, displacement at joints, pipe collapse).
3b	Debris / blockage	36	No blockage evident.	Minor blockage (<15% of pipe / culvert cross-sectional area)	Significant blockage affecting pipe conveyance capacity (>15% of cross-sectional area).

INSPECTION SHEET - On-lot stormwater drainage

Date: ______________________

Location: ______________________

Asset Name: ______________________

Asset ID: ______________________

Inspected by: ______________________
(name / company)

Purpose of visit

- ☐ Inspection
- ☐ Response to complaint
- ☐ Other (specify) ______________________

Rainfall conditions

- ☐ Rainfall today (___mm)
- ☐ Rainfall in last 3 days (___mm)
- ☐ No recent rainfall

Functional component		Condition score and evidence Circle the score 1, 2, 3 or N/A (not applicable) for each functional component based on good (1), moderate (2) or poor (3) conditions as noted in the reference sheet. Write why the score was given in the Notes section.
1	**Downpipes**	
1a	Connection to subsurface drainage	1 2 3 NA Notes:
2	**Stormwater pits**	
2a	Grates / covers	1 2 3 NA Notes:
2b	Internal	1 2 3 NA Notes:
3	**Stormwater pipes / culverts**	
3a	Structural condition	1 2 3 NA Notes:
3b	Debris / blockage	1 2 3 NA Notes:

MAINTENANCE SHEET - On-lot stormwater drainage

Date: ____________________

Location: ____________________

Asset Name: ____________________

Asset ID: ____________________

Inspected by: (name / company) ____________________

Purpose of visit

- ☐ Inspection
- ☐ Response to complaint
- ☐ Other (specify) ____________________

Rainfall conditions

- ☐ Rainfall today (___mm)
- ☐ Rainfall in last 3 days (___mm)
- ☐ No recent rainfall

Functional component		Maintenance response and information	Maintenance completed
1	**Downpipes**		
1a	Connection to subsurface drainage	Response: Information:	Y / N / NA Notes:
2	**Stormwater pits**		
2a	Grates / covers	Response: Information:	Y / N / NA Notes:
2b	Internal	Response: Information:	Y / N / NA Notes:
3	**Stormwater pipes / culverts**		
3a	Structural condition	Response: Information:	Y / N / NA Notes:
3b	Debris / blockage	Response: Information:	Y / N / NA Notes:

REFERENCE SHEET – Gross pollutant trap (GPT)

PENRITH CITY COUNCIL

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
	Surrounds and other infrastructure					
	Damage or removal of structures	6	6	Stable structures. No damage to structure or surrounding infrastructure. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**					
1a	Blockage	3	6	No accumulated solids or minimal solids with no obvious impacts.	Partial blockage of inlet causing some obstruction of flows or requiring removal.	Blockage of inlet preventing or significantly obstructing flows.
2	**GPT sump**					
2a	Debris, sediment and oil accumulation	7	6	None, or minimal accumulated solids/oil (<10% capacity).	Some accumulated solids/oil (>50% capacity).	Accumulated sediment/oil is reaching capacity (>75% capacity).
3	**Screens**					
3a	Damage	5	6	No holes or damage to the screen.	Some small holes/light damage. Can still function to filter most gross pollutants.	Large holes/heavy damage to the screen. Gross pollutants can pass through. Screen not securely attached to wall.
3b	Blockage	3	6	No accumulated solids or minimal solids with no obvious impacts.	Partial blockage of screen causing some obstruction of flows or requiring removal.	Blockage of screen preventing or significantly obstructing flows.
4	**Outlet**					
4a	Blockage	3	6	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.

Sheet 1 of 1

INSPECTION SHEET – Gross pollutant trap (GPT)

PENRITH CITY COUNCIL

Date ______________________

Location ______________________

Asset name ______________________

Asset ID ______________________

Inspected by (name/company) ______________________

Purpose of visit

- ☐ Inspection
- ☐ Response to complaint
- ☐ Other (specify) ______________________

Rainfall conditions

- ☐ Rainfall today (__ mm)
- ☐ Rainfall in last 3 days (__ mm)
- ☐ No recent rainfall

Functional component		Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
2	**GPT sump**	
2a	Debris, sediment and oil accumulation	1 2 3 NA Notes:
3	**Screens**	
3a	Damage	1 2 3 NA Notes:
3b	Blockage	1 2 3 NA Notes:
4	**Outlet**	
4a	Blockage	1 2 3 NA Notes:

Other:

Sheet 1 of 1

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
	Surrounds and other infrastructure					
	Damage or removal of structures	6	6	Stable structures. No damage to structure or surrounding infrastructure. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	**Inlet**					
1a	Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2	**Storage area**					
2a	Storage volume	30	6	No significant sediment accumulation or other volume reduction.	Some sediment accumulated, but no more than 5% of volume has been lost.	Sediment or debris accumulation resulting in 5% or more of volume being lost.
2b	Sediment accumulation	27	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering <50% of surface), causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Significantly impeding flows.
2c	Standing water or boggy conditions	29	6	No standing water.	Standing water visible at time of inspection.	Standing water >5% of depth remains more than 12 hours since last rainfall.
3	**Outlet (discharge control pit)**					
3a	Blockage	3	6	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.
3b	Screen	26	6	No holes or damage to the screen. No clogging evident.	Some small holes/light damage. Can still function to remove most gross pollutants. Screen not securely attached to the wall of the pit.	Large holes/heavy damage to the screen. Gross pollutants can enter the tank. Screen completely detached from the wall of the pit.
3c	Sediment accumulation	27	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering <50% of surface), causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Significantly impeding flows.
4	**Overflow**					
4a	Blockage	3	6	No blockage.	Partial blockage of overflow causing some obstruction of outflows or requiring removal.	Blockage of overflow preventing or significantly obstructing outflows.
4b	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

Sheet 1 of 1

INSPECTION SHEET – On-site stormwater detention (OSD)

PENRITH CITY COUNCIL

Date ______________________

Location ______________________

Asset name ______________________

Asset ID ______________________

Inspected by (name/company) ______________________

Purpose of visit

- ☐ Inspection
- ☐ Response to complaint
- ☐ Other (specify) ______________________

Rainfall conditions

- ☐ Rainfall today (__ mm)
- ☐ Rainfall in last 3 days (__mm)
- ☐ No recent rainfall

Functional component		Condition score and evidence *Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.*
	Surrounds and other infrastructure	
	Damage or removal of structures	1 2 3 NA Notes:
1	**Inlet**	
1a	Blockage	1 2 3 NA Notes:
1b	Erosion	1 2 3 NA Notes:
2	**Storage area**	
2a	Storage volume	1 2 3 NA Notes:
2b	Sediment accumulation	1 2 3 NA Notes:
2c	Standing water or boggy conditions	1 2 3 NA Notes:
3	**Outlet (discharge control pit)**	
3a	Blockage	1 2 3 NA Notes:
3b	Screen	1 2 3 NA Notes:
3c	Sediment accumulation	1 2 3 NA Notes:
4	**Overflow**	
4a	Blockage	1 2 3 NA Notes:
4b	Erosion	1 2 3 NA Notes:

Other:

Sheet 1 of 1

MAINTENANCE SHEET – On-site stormwater detention (OSD)

PENRITH CITY COUNCIL

Date	____________	**Purpose of visit**	**Rainfall conditions**
Location	____________	☐ Maintenance	☐ Rainfall today (__ mm)
Asset name	____________	☐ Response to complaint	☐ Rainfall in last 3 days (__ mm)
Asset ID	____________	☐ Other (specify)	☐ No recent rainfall
Maintained by (name/company)	____________	____________	

	Functional component	Maintenance response and information	Maintenance completed *Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.*
	Surrounds and other infrastructure		
	Damage or removal of structures	**Response:** Rectification works for structural issues to be undertaken immediately. **Information:** Refer to Works as Executed plans for specifications for structural repairs.	Y N NA Notes:
1	**Inlet**		
1a	Blockage	**Response:** Inspect via manhole, pit or inlet. Remove litter, debris and sediment by hand, shovel or machinery. **Information:** Ensure that water can enter the system freely. Forks and tongs may be used for litter pick ups. Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
1b	Erosion	**Response:** Re-profiling using hand tools or light machinery. Replant if required. **Information:** Typically required after heavy rainfall.	Y N NA Notes:
2	**Storage area**		
2a	Storage volume	**Response:** Remove any litter, debris and sediment by hand, shovel or machinery. **Information:** Ensure that the detention volume is maintained as per design. May require personnel with confined space clearance to carry out maintenance tasks. If detention volume is occupied by something else, reconstruct and replace the volume lost. Notify council of proposal.	Y N NA Notes:
2b	Sediment accumulation	**Response:** If accumulated sediment is present on the surface, remove using a flat shovel and dispose. **Information:** Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
2c	Standing water or boggy conditions	**Response:** System should be desilted and screens cleaned. **Information:** Water should drain away within hours after rain events.	Y N NA Notes:
3	**Outlet (discharge control pit)**		
3a	Blockage	**Response:** Inspect via manhole, pit or inlet. Remove litter, debris and sediment by hand, or shovel. **Information:** Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y N NA Notes:
3b	Screen	**Response:** Use a broom, hose or high pressure hose to clean screen of debris. Replace screen if required. **Information:** Remove grate and screen and examine for rust or corrosion, especially at corners or welds.	Y N NA Notes:

Sheet 1 of 2

APPENDIX E

Downstream Interface with Future Stormwater Regional Infrastructure

Review Comments

- The latest information we have from AT&L allows for a 3m x 0.75m RCBC under Mamre Road
- Based on Sydney Water's GIS database, the regional water quality system will comprise of a wetland, bioretention and pond in series.
  - -The devices alongside the Pump Station Site (i.e north of the Channel) will receive flows from the Stage 1 Channel.
  - -The devices to the south will receive flows from the Stage 2 channel.
- The horizontal position of the proposed future Stage 2 channel generally aligns between these future SWC devices.
- Based on SWC concept plans, flows will be directed from the channel into the wetland via an offtake system. Flows then continue to the bioretention device and into the pond before ultimately draining into the natural waterway to the West.

From a level perspective, this will work given the current channel design will allow for the offtake (around RL41.10) to direct flows to the wetland via gravity (at RL40.38)

- The proposed channel levels we currently show on plan:
  - -Allows for 1.67% longitudinal grade.
  - -Tails out to the existing surface at the downstream end.

Importantly, this is considered to be a conservative position for flood modelling, since the tailwater levels for the Stage 2 ESR Channel and at Mamre Road Culverts will be higher.

- It is noted that:
  - -The channel profile currently sits higher than ground levels, since the invert matches to the existing surface. This creates an embankment on either side of the channel.
  - -This interface between the channel / future devices (i.e where our batters are shown) will need to be looked at as part of those future designs. Importantly, there will be opportunity to drop the channel lower to avoid the need for walls.
  - -Refer to sketch for suggested location of future drop structures.

JWP COMMENTS

110965.04
STAGE 2 CHANNEL - WESTLINK

REVIEW OF DOWNSTREAM AREAS
17/10/2024

APPENDIX F

Flood Maps (Figures 4-1 to 4-4 and 5-1 to 5-16)

j.wyndham prince

LEGEND

TUFLOW MODEL ELEMENTS

- TUFLOW Model Boundary
- SA Catchment Inflow Boundary
- IWL Initial Water Level Area
- HQ Slope Boundary
- 2D LOC (Line)
- Connection Line (CN)
- 1d NWK Culvert
- 1d NWK Pit
- 2D SX Connection (Line)
- 2D ZSH Terrain Modification
- 1d QT Inflow Point

N

0 160

metres

Scale 1:4,000 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 4-1

Westlink Stage 2, Lot 4 & Lot 5 Flood Impact and Risk

Developed Conditions
TUFLOW Setup Plan

Date: 23/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 FIRA\110965-04_Fig4-3_DES04_TFS_A.wor

j.wyndham prince

LEGEND

MANNINGS VALUE

- 0.020 Road Reserve
- 0.100 Farm Sheds
- 0.050 Light Vegetation
- 0.080 Medium Vegetation
- 0.100 Dense Vegetation
- 0.020 Waterbody
- 0.100 Riparian Replanting (Dense Vegetation)
- 0.013 Concrete Surface
- 2.000 Building
- Site Boundary
- TUFLOW Model Boundary

N

0 160 metres

Scale 1:4,000 @ A3

Projection: GDA 2020 MGA Zone 56

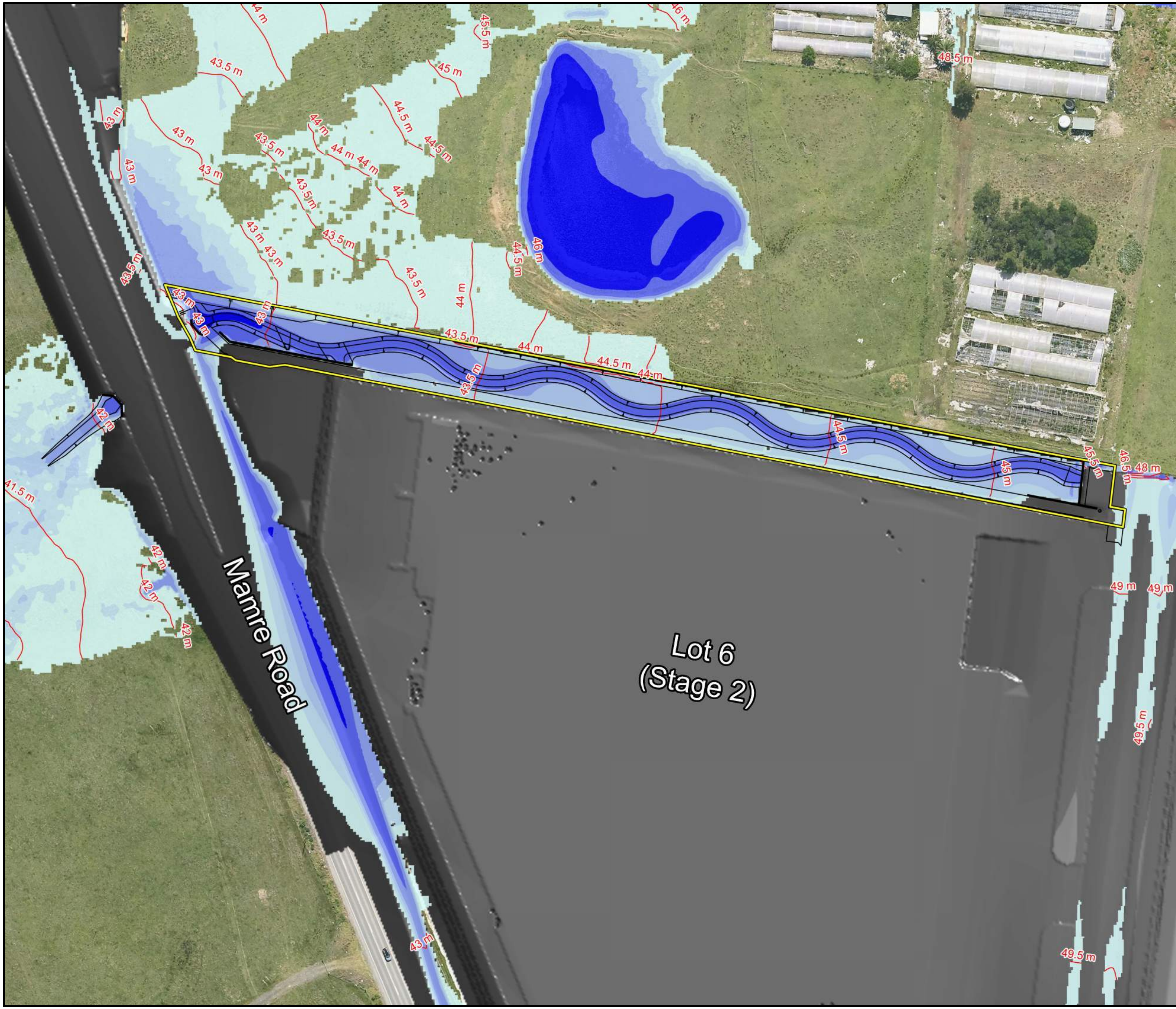
Figure 4-4

Westlink Stage 2, Lot 4 & Lot 5 Flood Impact and Risk

Developed Conditions TUFLOW Materials Plan

Date: 23/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 FIRA\110965-04_Fig4-4_DES04_TFM_A.wor



j.wyndham prince

LEGEND

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +
- 35.0 — 0.5 m Flood Contours
- Site Boundary

N

0 30 metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

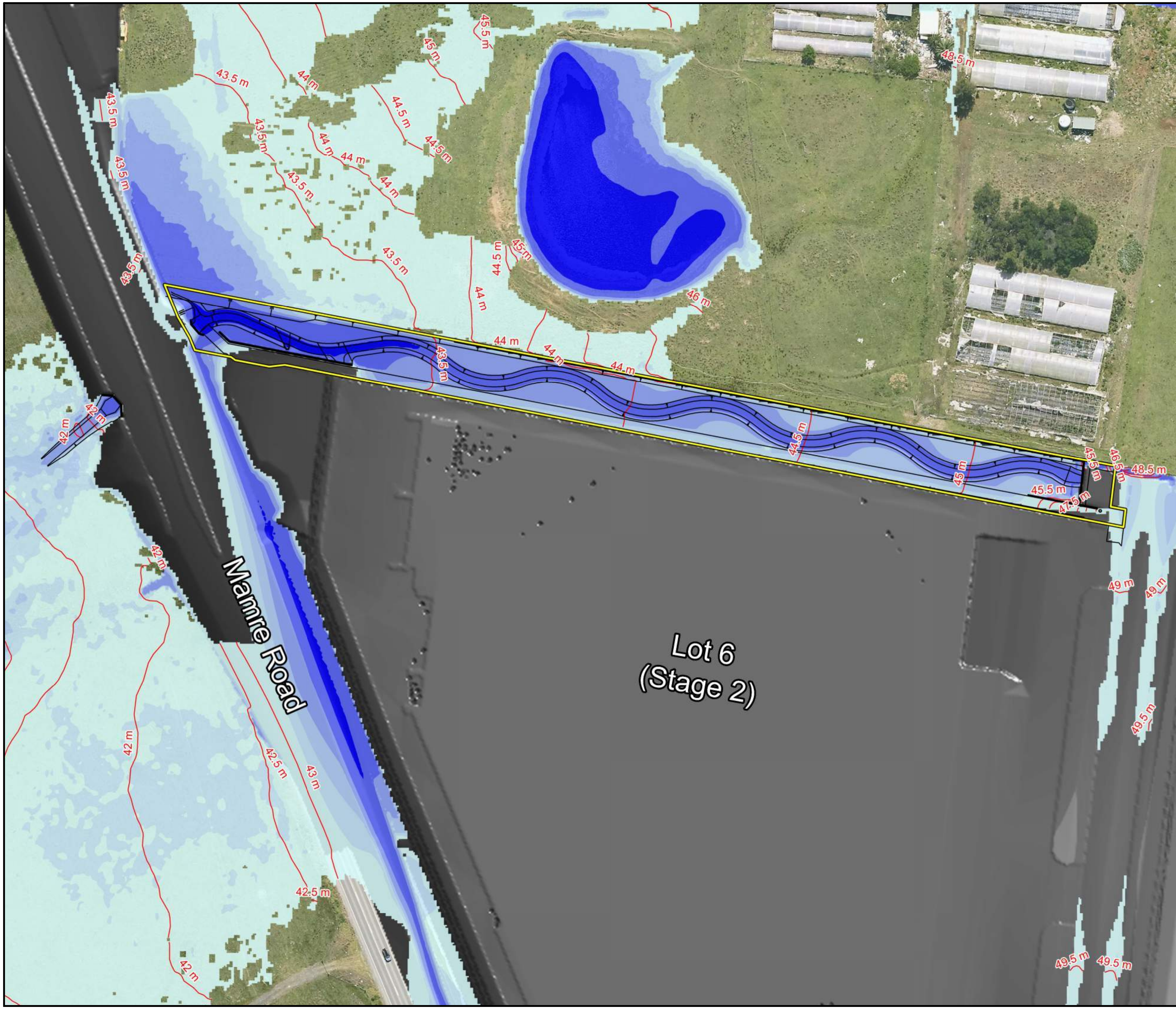
Figure 5-1

Westlink Stage 2 Naturalised Trunk Drainage Channel

1% AEP
Developed Conditions NoTW
Flood Depths and Levels

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-1_DES04_1pc_DEP_A.wor



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LEGEND

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +
- 35.0 — 0.5 m Flood Contours
- Site Boundary

N

0 — 30 metres

Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 5-2

Westlink Stage 2 Naturalised Trunk Drainage Channel

0.2% AEP
Developed Conditions NoTW
Flood Depths and Levels

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-2_DES04_0p2pc_DEP_A.wor

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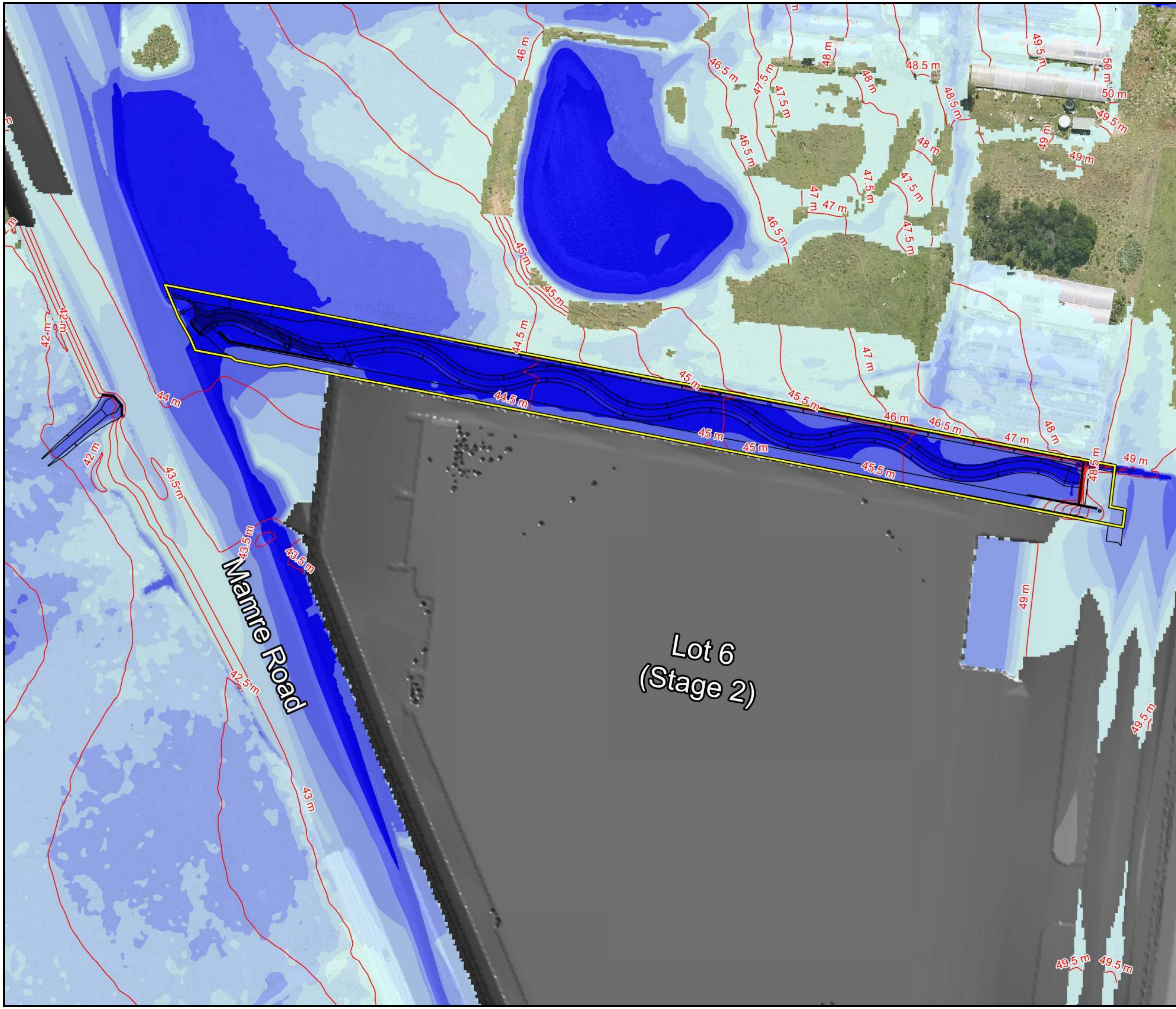

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LEGEND

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +
- 35.0 — 0.5 m Flood Contours
- Site Boundary

N

0 — 30 metres
Scale 1:1200 @ A3

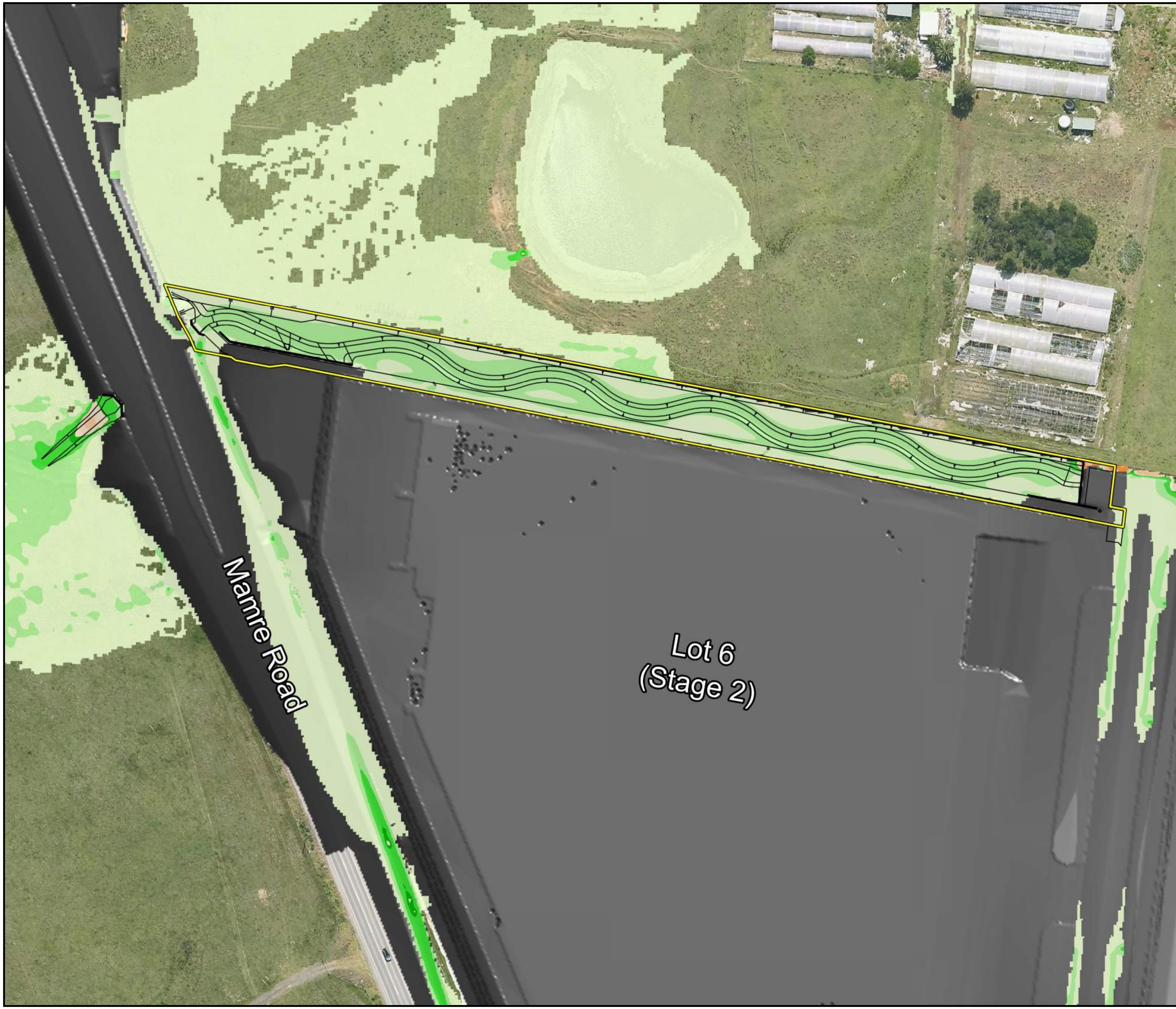
Projection: GDA 2020 MGA Zone 56

Figure 5-3

Westlink Stage 2 Naturalised Trunk Drainage Channel

PMF
Developed Conditions NoTW
Flood Depths and Levels

Date: 22/01/2025 Issue: A



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LEGEND

VELOCITY (m/s)

- < 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 1.6
- 1.6 to 2.0
- 2.0 to 2.5
- 2.5 +
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 5-4

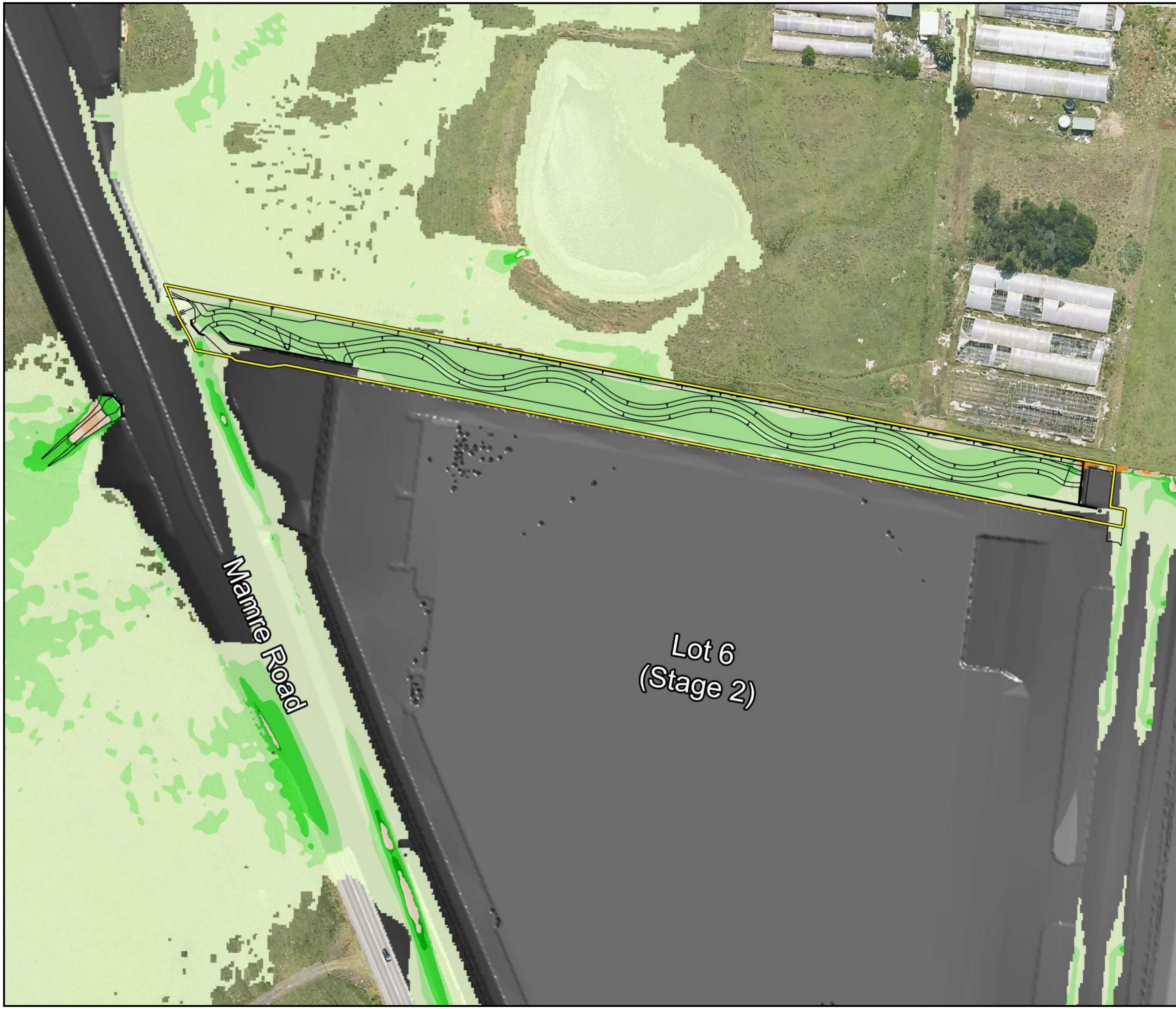
Westlink Stage 2 Naturalised Trunk Drainage Channel

1% AEP
Developed Conditions NoTW
Flood Velocity

Date: 22/01/2025

Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-4_DES04_1pc_VEL_A.wor



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LEGEND

VELOCITY (m/s)

- < 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 1.6
- 1.6 to 2.0
- 2.0 to 2.5
- 2.5 +
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

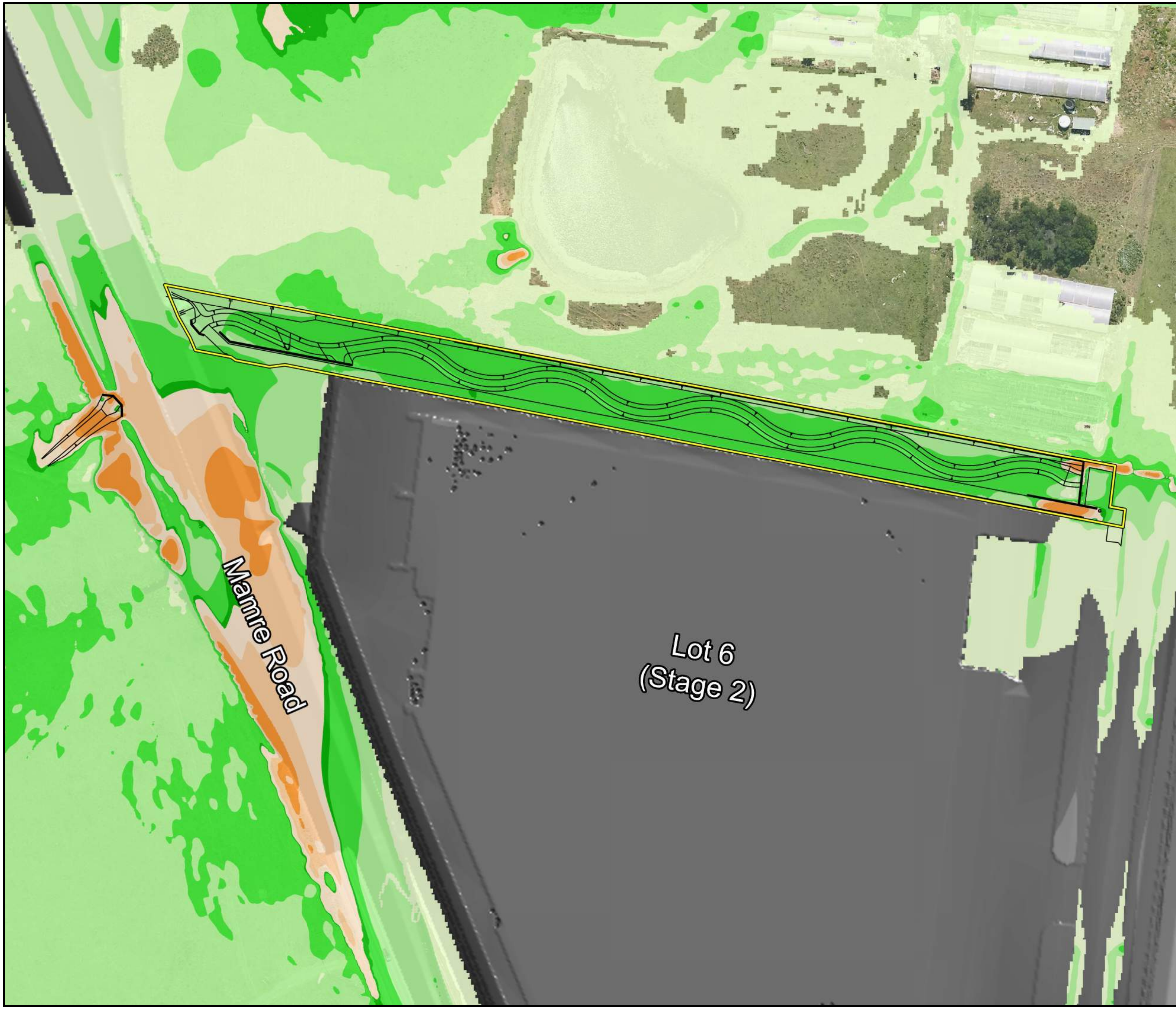
Figure 5-5

Westlink Stage 2 Naturalised Trunk Drainage Channel

0.2% AEP
Developed Conditions NoTW
Flood Velocity

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-5_DES04_0p2pc_VEL_A.wor



j.wyndham prince

LEGEND

VELOCITY (m/s)

- < 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 1.6
- 1.6 to 2.0
- 2.0 to 2.5
- 2.5 +
- Site Boundary

N

0 30

metres

Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 5-6

Westlink Stage 2 Naturalised Trunk Drainage Channel

PMF
Developed Conditions NoTW
Flood Velocity

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-6_DES04_PMF_VEL_A.wor

j.wyndham prince

LEGEND

BED SHEAR (N/m²)

- 0 to 45
- 45 to 80
- 80 to 177
- 177 to 192
- 192+
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

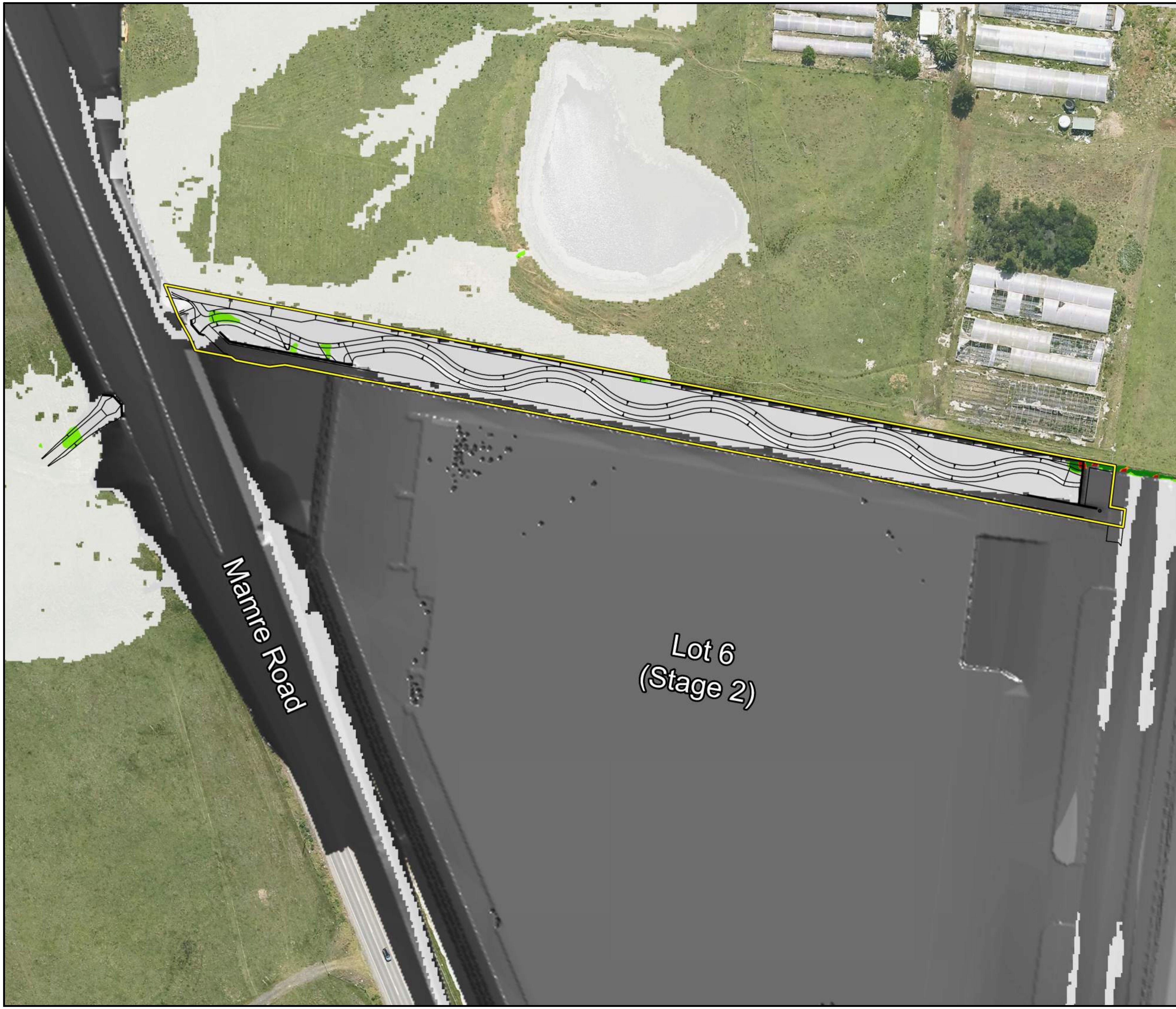
Figure 5-7

Westlink Stage 2 Naturalised Trunk Drainage Channel

4EY
Developed Conditions NoTW
Bed Shear Stress

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-7_DES04_4EY_BSS_A.wor



j.wyndham prince

LEGEND

BED SHEAR (N/m²)

- 0 to 45
- 45 to 80
- 80 to 177
- 177 to 192
- 192+
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 5-8

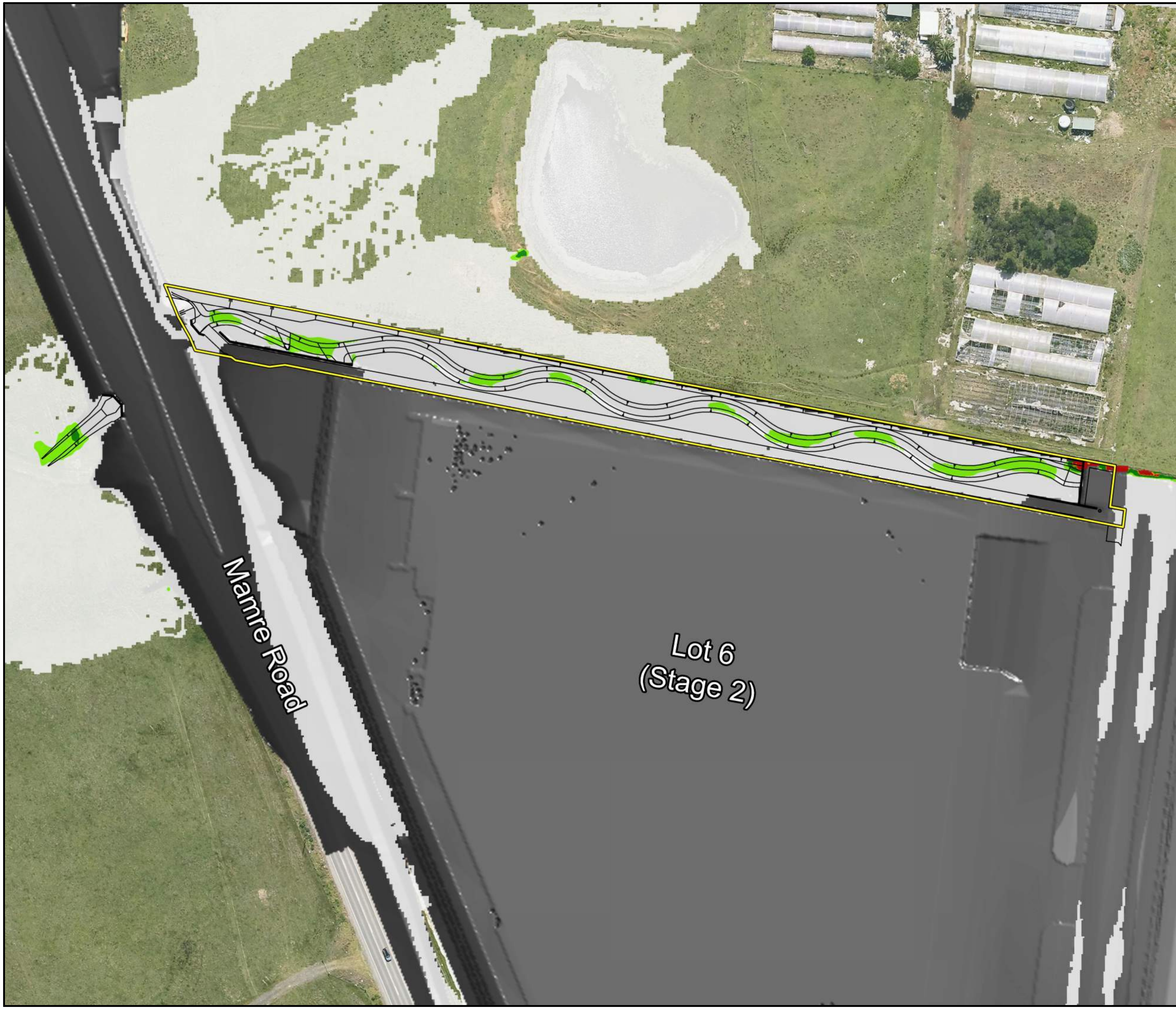
Westlink Stage 2 Naturalised Trunk Drainage Channel

5% AEP
Developed Conditions NoTW
Bed Shear Stress

Date: 22/01/2025

Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-8_DES04_5pc_BSS_A.wor



j.wyndham prince

LEGEND

BED SHEAR (N/m²)

- 0 to 45
- 45 to 80
- 80 to 177
- 177 to 192
- 192+
- Site Boundary

N

0 30

metres

Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 5-9

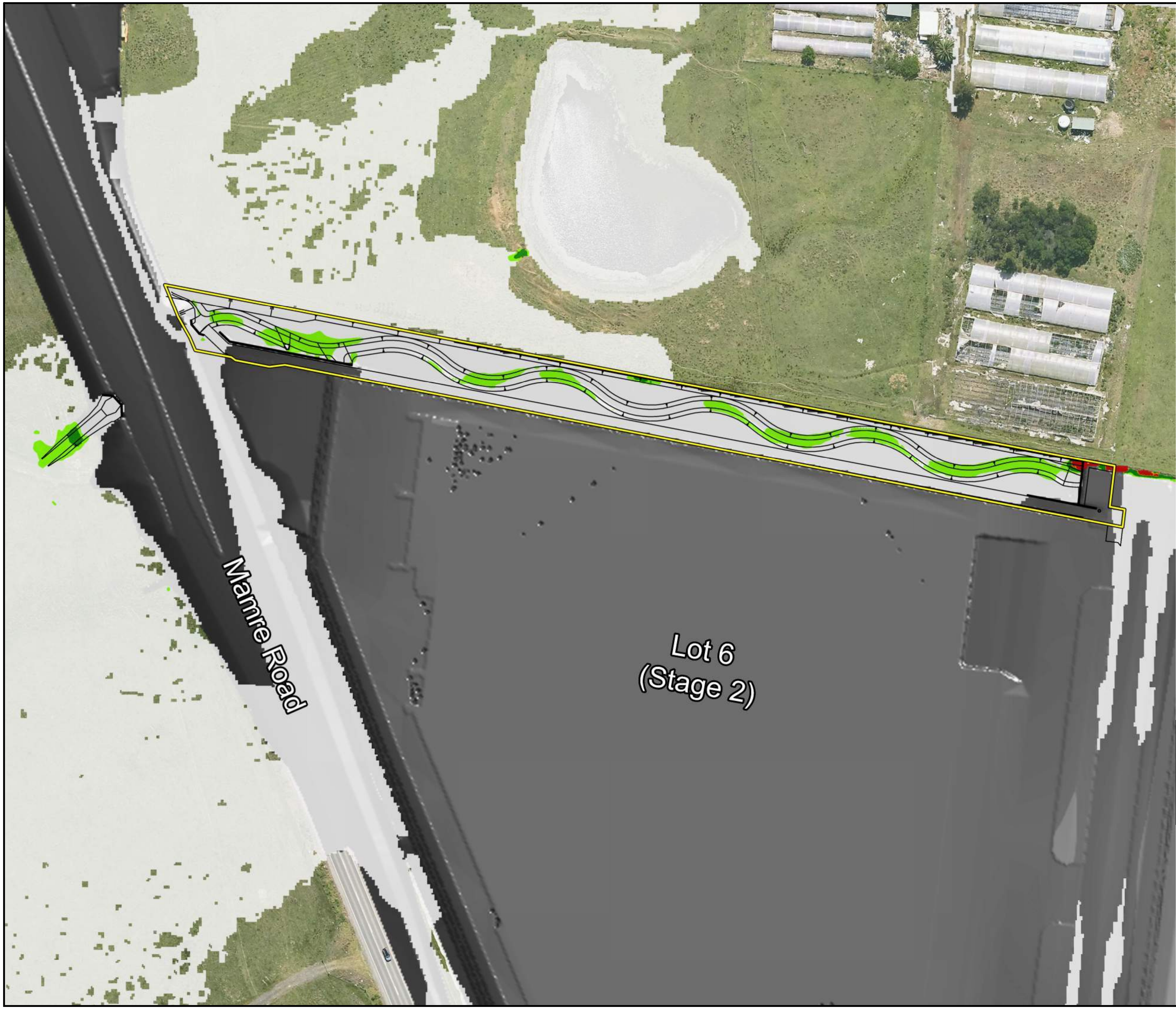
Westlink Stage 2 Naturalised Trunk Drainage Channel

1% AEP
Developed Conditions NoTW
Bed Shear Stress

Date: 22/01/2025

Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-9_DES04_1pc_BSS_A.wor



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LEGEND

BED SHEAR (N/m²)

- 0 to 45
- 45 to 80
- 80 to 177
- 177 to 192
- 192+
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

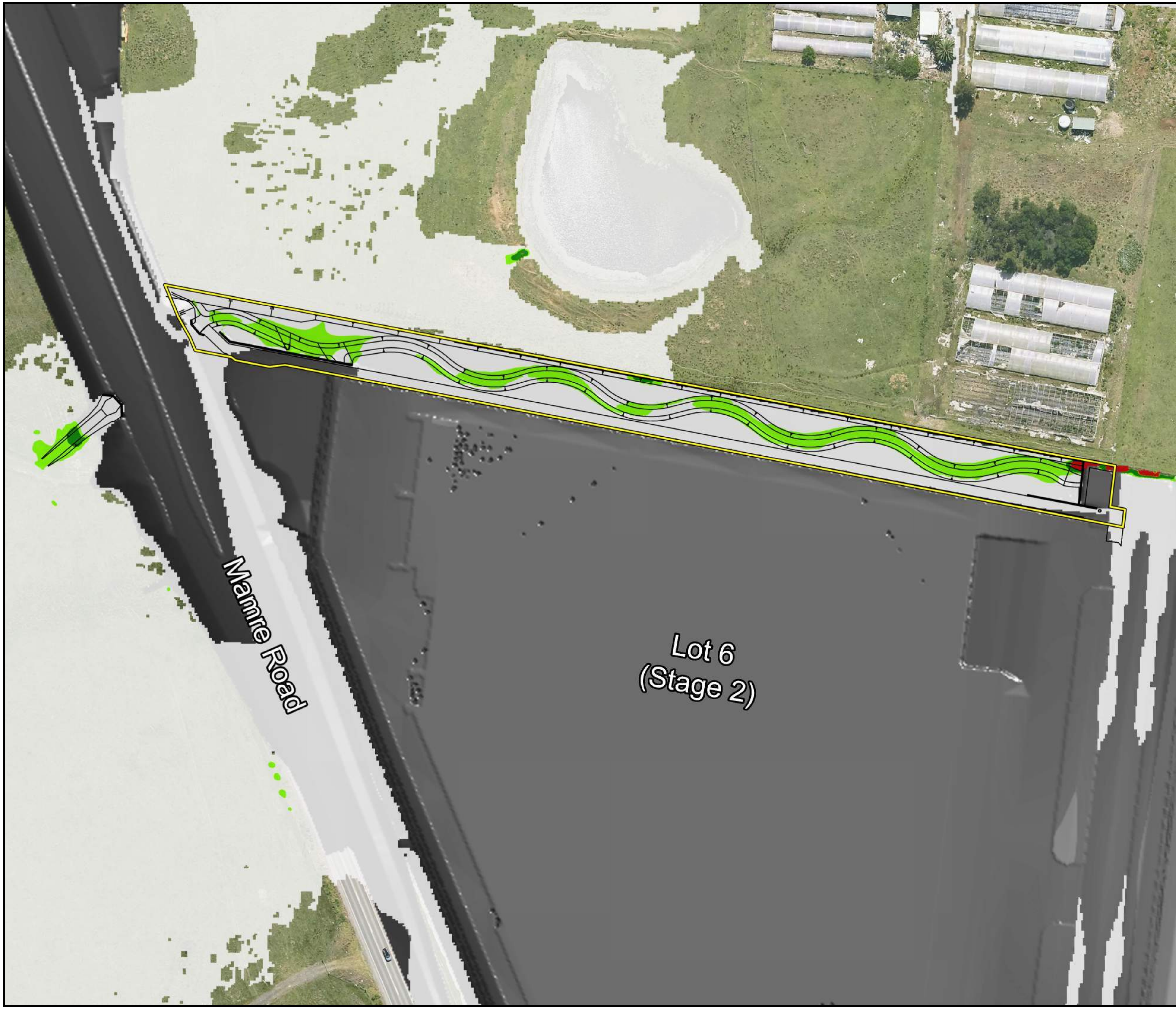
Figure 5-10

Westlink Stage 2 Naturalised Trunk Drainage Channel

0.5% AEP
Developed Conditions NoTW
Bed Shear Stress

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-10_DES04_0p5pc_BSS_A.wor



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LEGEND

BED SHEAR (N/m²)

- 0 to 45
- 45 to 80
- 80 to 177
- 177 to 192
- 192+
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

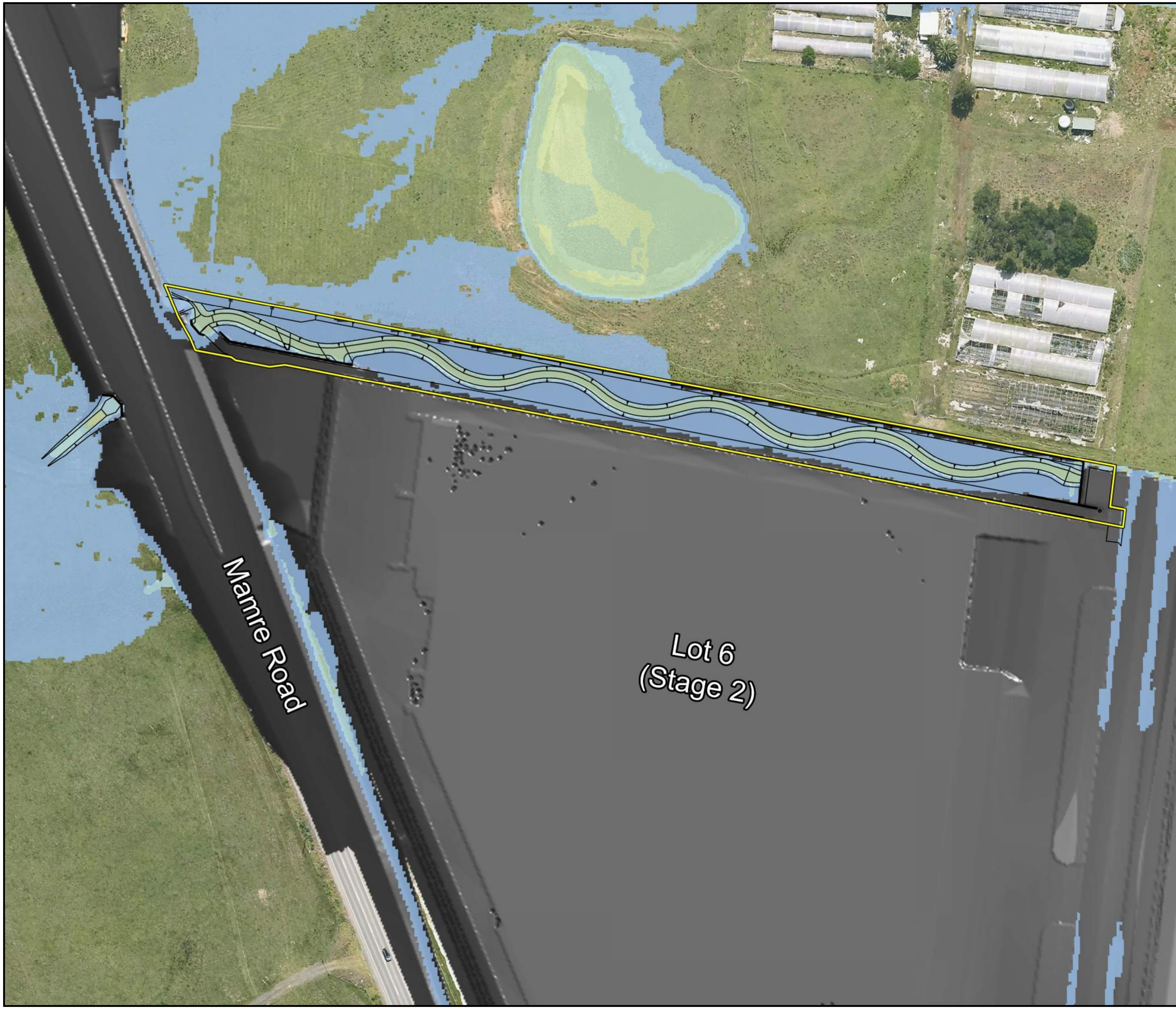
Figure 5-11

Westlink Stage 2 Naturalised Trunk Drainage Channel

0.2% AEP
Developed Conditions NoTW
Bed Shear Stress

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-11_DES04_0p2pc_BSS_A.wor



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LEGEND

FLOOD HAZARD

- H1 - Generally safe.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4- Unsafe for people and vehicles.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage.
- H6 - Unsafe for vehicles and people. All buildings vulnerable to failure.
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

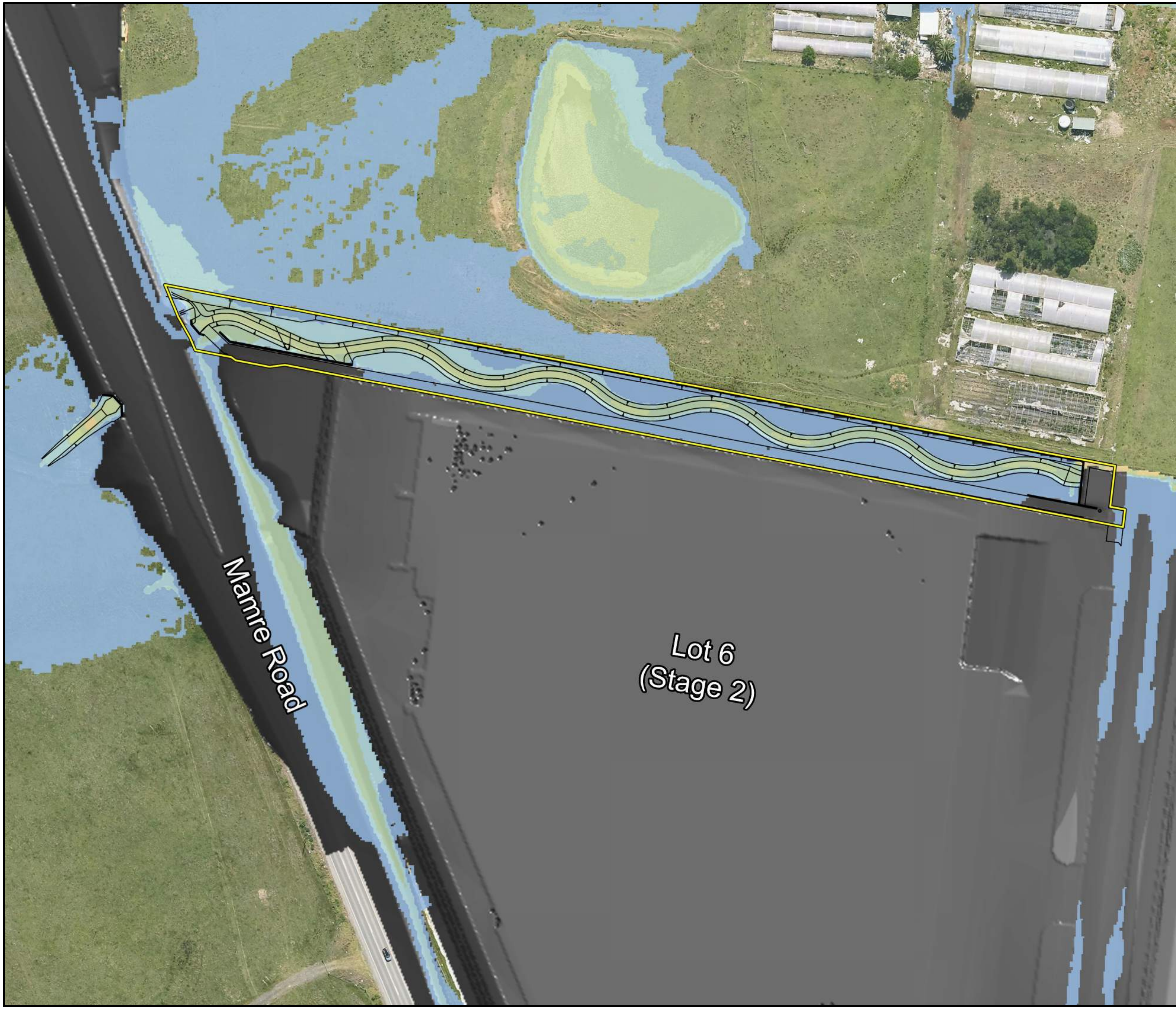
Figure 5-12

Westlink Stage 2 Naturalised Trunk Drainage Channel

5% AEP
Developed Conditions NoTW
Flood Hazard

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-12_DES04_5pc_HAZ_A.wor



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LEGEND

FLOOD HAZARD

- H1 - Generally safe.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4- Unsafe for people and vehicles.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage.
- H6 - Unsafe for vehicles and people. All buildings vulnerable to failure.
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

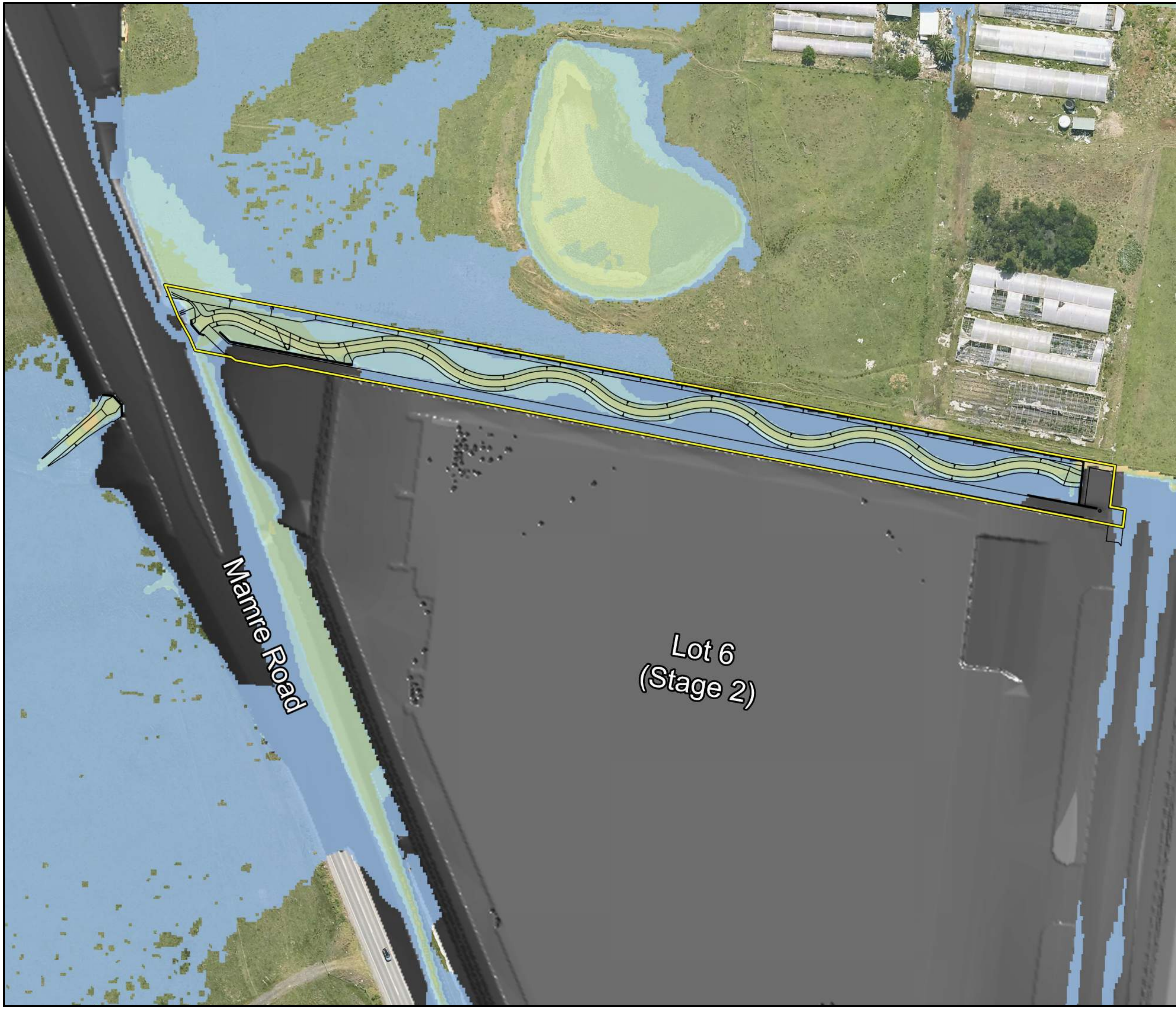
Figure 5-13

Westlink Stage 2 Naturalised Trunk Drainage Channel

1% AEP
Developed Conditions NoTW
Flood Hazard

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-13_DES04_1pc_HAZ_A.wor



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LEGEND

FLOOD HAZARD

- H1 - Generally safe.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4- Unsafe for people and vehicles.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage.
- H6 - Unsafe for vehicles and people. All buildings vulnerable to failure.
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

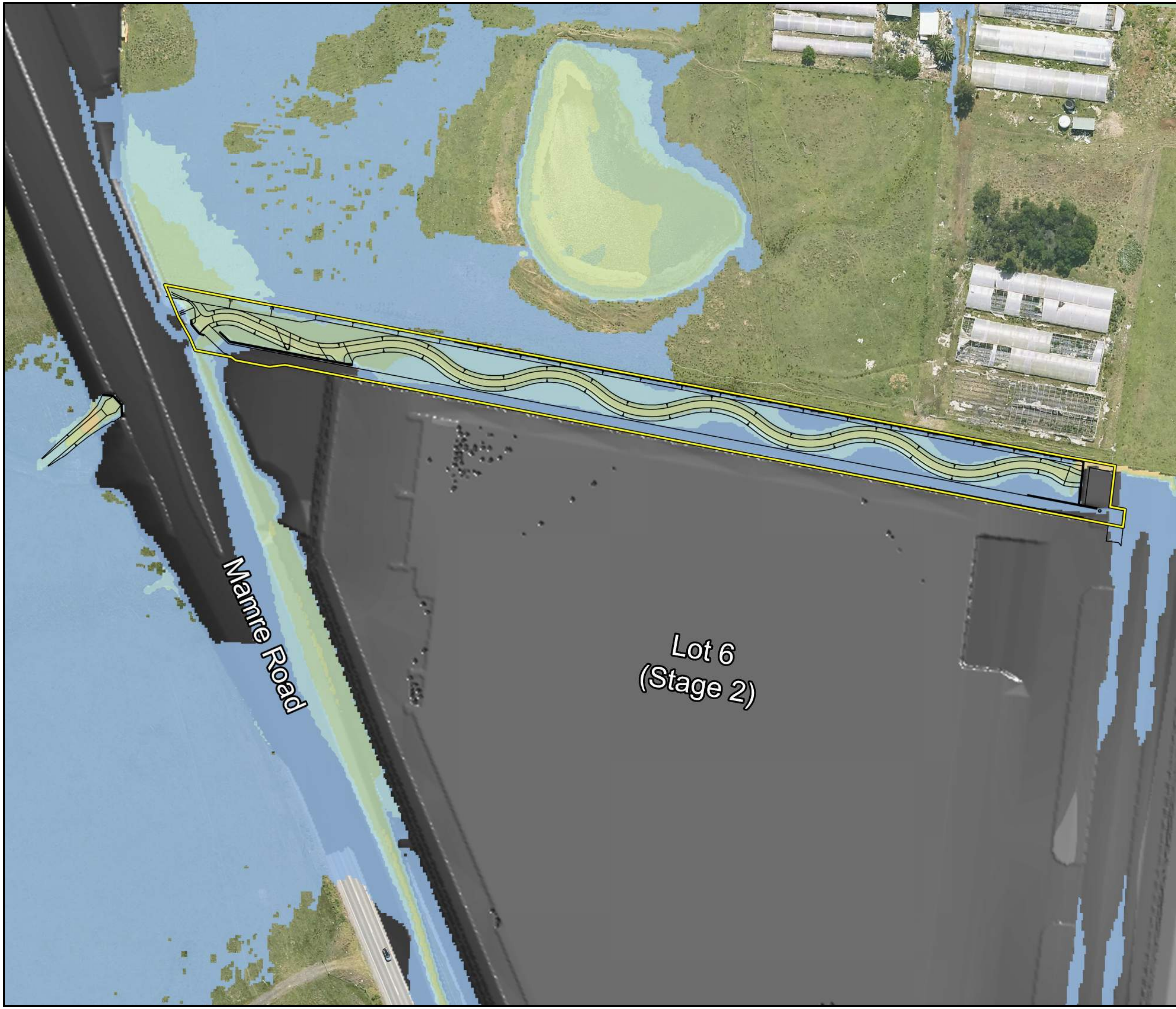
Figure 5-14

Westlink Stage 2 Naturalised Trunk Drainage Channel

0.5% AEP
Developed Conditions NoTW
Flood Hazard

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-14_DES04_0p5pc_HAZ_A.wor



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LEGEND

FLOOD HAZARD

- H1 - Generally safe.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4- Unsafe for people and vehicles.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage.
- H6 - Unsafe for vehicles and people. All buildings vulnerable to failure.
- Site Boundary

N

0 30 metres
Scale 1:1200 @ A3

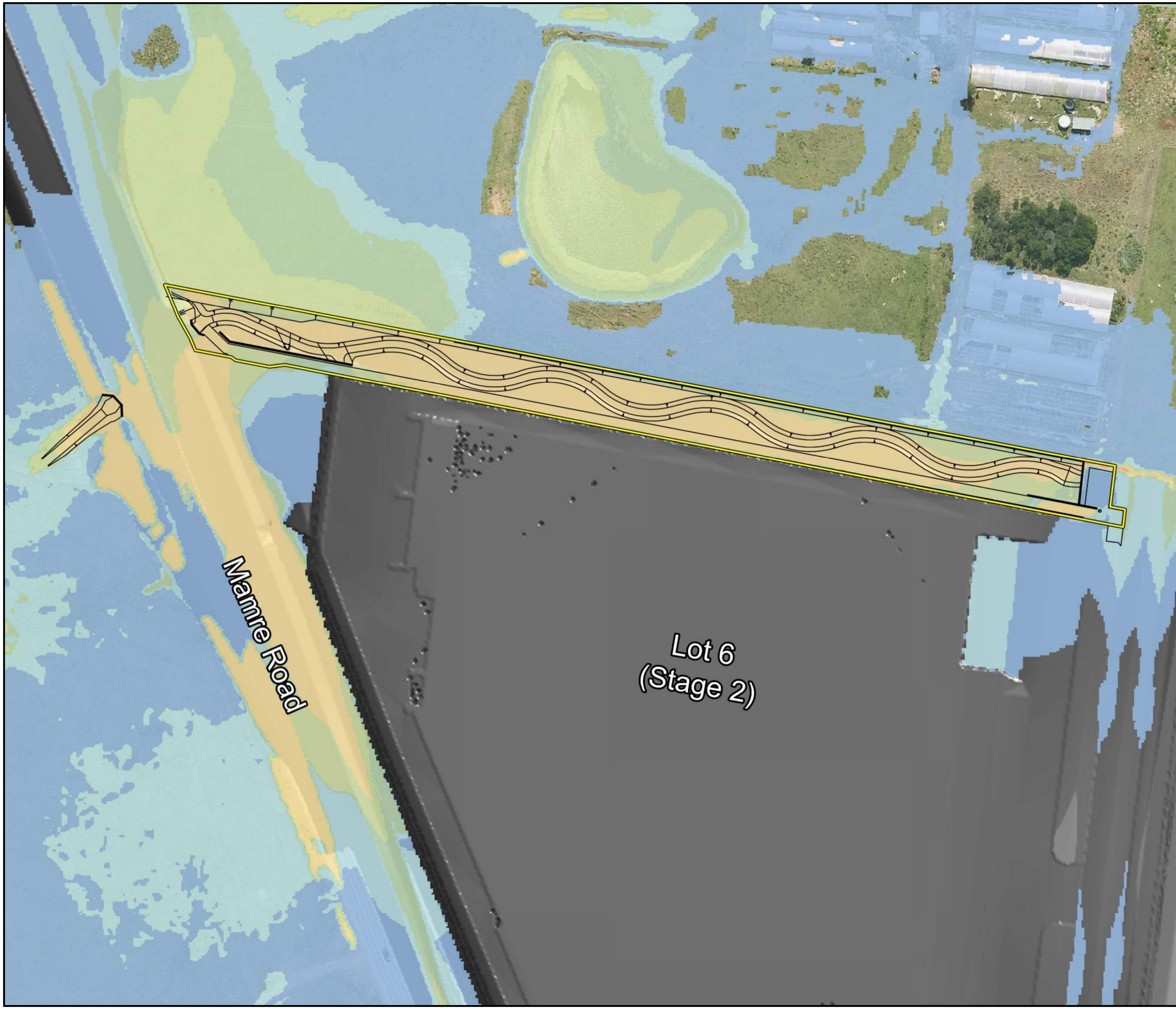
Projection: GDA 2020 MGA Zone 56

Figure 5-15

Westlink Stage 2 Naturalised Trunk Drainage Channel

0.2% AEP
Developed Conditions NoTW
Flood Hazard

Date: 22/01/2025 Issue: A



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LEGEND

FLOOD HAZARD

- H1 - Generally safe.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4- Unsafe for people and vehicles.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage.
- H6 - Unsafe for vehicles and people. All buildings vulnerable to failure.
- Site Boundary

N

0 30
metres
Scale 1:1200 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 5-16

Westlink Stage 2 Naturalised Trunk Drainage Channel

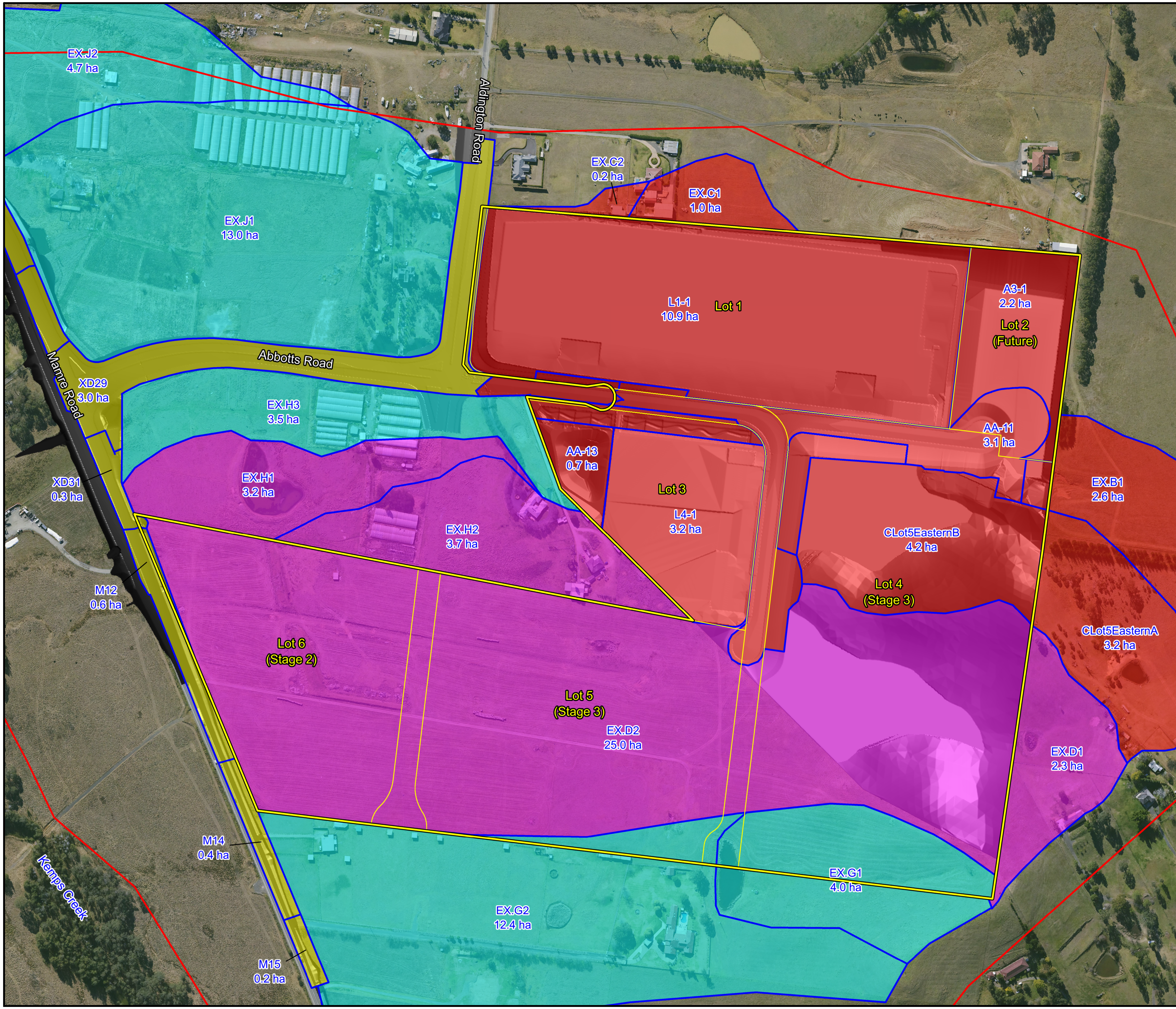
PMF
Developed Conditions NoTW
Flood Hazard

Date: 22/01/2025 Issue: A

Filename: J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 Channel\110965-04_Fig5-16_DES04_PMF_HAZ_A.wor

APPENDIX G
Catchment Plans

Filename: "J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 FIRA\110965-04_Fig3-1_Base_Catchments_A.wor"



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LEGEND

- Site Boundary
- Westlink Lot Boundaries
- Interim Stage 1 (Base Conditions) DEM
- TUFLOW Model Boundary
- Westlink Stage 2 Existing Catchments
- Westlink Stage 1 Interim Catchments
- Mamre/Abbotts/Aldington Catchments
- Residual Existing Catchments

N

0 160
metres
Scale 1:4,000 @ A3

Projection: GDA 2020 MGA Zone 56

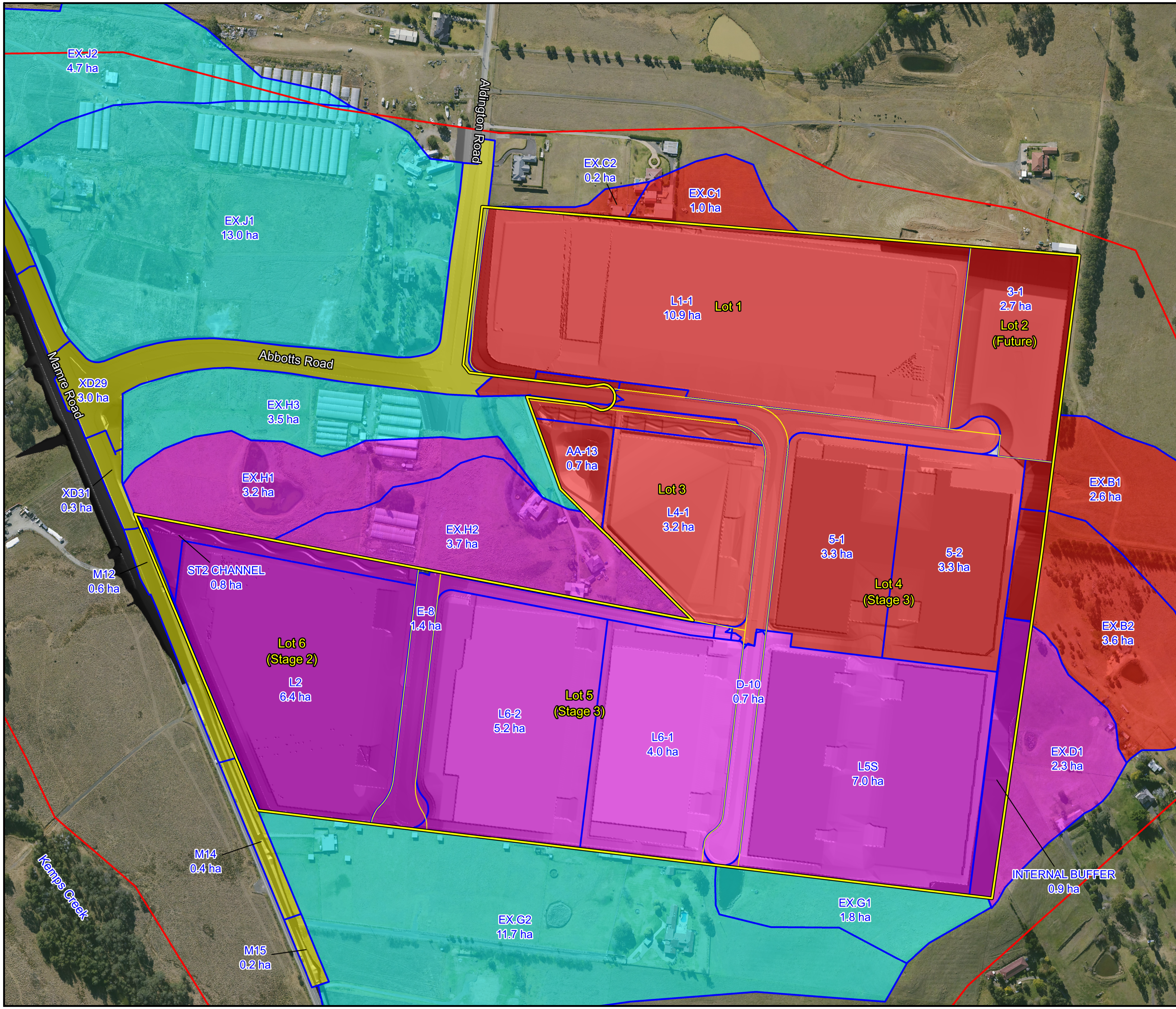
Figure 3-1

Westlink Stage 2, Lot 4 & Lot 5 Flood Impact and Risk

Base Conditions Catchment Plan

Date: 3/04/2025

Issue: A



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LEGEND

- Site Boundary
- Westlink Lot Boundaries
- Stage 2, Lot 4 & Lot 5 DEM
- TUFLOW Model Boundary
- Westlink Stage 2 Ultimate Catchments
- Westlink Stage 1 Ultimate Catchments
- Mamre/Abbotts/Aldington Catchments
- Residual Existing Catchments

N

0 160
metres
Scale 1:4,000 @ A3

Projection: GDA 2020 MGA Zone 56

Figure 3-2

Westlink Stage 2, Lot 4 & Lot 5 Flood Impact and Risk

Developed Conditions Catchment Plan

Date: 3/04/2025

Issue: A

Filename: "J:\110965 - Westlink\SWF\Mapinfo\Figures\ST2 FIRA\110965-04_Fig3-2_Dev_Catchments_A.wor"