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DEVELOPMENT APPROVAL

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YARRABILBA

PRECINCT 6 ROL3

STORMWATER MANAGEMENT PLAN

VERSION 1

DesignFlow

Prepared for Stockland

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Inherent natural variability in soils and plants

Where particular types of soils are recommended, such recommendations are based on information provided by soils suppliers, laboratories and published industry guidelines. There can be inconsistencies in the behaviour of soils under field conditions compared to laboratory conditions, and, for both natural and blended soils, many soils are non-homogenous and properties and behaviour can be variable. Where particular plant species have been recommended, such recommendations are based on botanical knowledge and observations of similar species growing in similar, but not identical conditions. Plants can be sensitive to subtle changes in climate, hydrology, soil and surrounding ecological conditions. Further to this, plant health is often closely linked to the level of maintenance provided. No warranty or guarantee, whether explicit or implied is made with respect to the suitability or performance of soils or plant species recommended in this report

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1 INTRODUCTION

The Yarrabilba Priority Development (PDA) is located within the Logan City Council area and occupies a former pine plantation situated south of Logan Village. The Yarrabilba PDA was declared by regulation under the Economic Development Act (2012). Yarrabilba is part of a regional growth area identified in the South East Queensland Regional Plan, which identifies a need for a further 70,000 dwellings across a number of localities in the Logan City Council area by 2031. The Yarrabilba development aims to provide approximately 17,000 dwellings for a population of 45,000.

Precinct 6 ROL3 (subject site) covers an area of approximately 5.66 ha which includes 2.71 ha of development lots, 1.37 ha of roads 0.31 ha of recreational park and 1.27 ha of drainage open space.

This document presents the stormwater management strategy for the subject site to meet the requirements set out in the *Context Planning Area Strategy – Precinct 6* (RPS, 2022). These are generally consistent with the S*tate Planning Policy*, *Yarrabilba Total Water Cycle Management Strategy* (DesignFlow, 2024) and *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2024). This report provides details of the proposed stormwater quality treatment and waterway stability management including location, conceptual sizing and functional earthworks. It represents an update to the strategy presented for the western catchments in the previous P6 ROL2 Stormwater Management Plan (DesignFlow, 2023) in line with the development layout prepared for P6 ROL3 and planning allowances for future development precincts adjacent. The overall outcomes remain consistent with the previous assessment.

This report focuses on the construction phase erosion/sediment control and operational phase stormwater quality and waterway elements specific to Precinct 6 ROL3. Flood management has been addressed separately in the *Yarrabilba Masterplan Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024) as the flood management strategy spans numerous current and future precincts requiring site wide planning. No flood detention infrastructure is required within the subject precinct.

2 SITE CHARACTERISTICS

2.1 LOCATION

Precinct 6 ROL3 (P6 ROL3) lies in the central portion of the Stockland Yarrabilba site and forms the south west corner of the broader Precinct 6 zone as shown in Figure 1. The subject development area covers a total area of approximately 5.66 ha. It forms part of the broader Precinct 6 Context Planning Area Strategy (CPAS) approved by EDQ (DEV2011/187/27, 13 July 2023)

2.2 TOPOGRAPHY, CATCHMENTS AND DRAINAGE

The existing topography across this minor area of Precinct 6 exhibits fairly consistent grades in the order of 4-5% falling generally south to north. The waterway corridor defines the western edge of development while existing P6 ROL2 zone adjoins to the east. Elevation varies from 53mAHD to 38mAHD within the P6 ROL3 site. The site topography is shown in Figure 2.

Precinct 6 ROL3 sits generally within flood Catchment 4 of the broader Yarrabilba development site as defined in the *Yarrabilba (Quinzeh Creek) Flood Study - Version 1* (DesignFlow, 2017).

2.2.1 Lawful Point of Discharge

The lawful point of discharge for stormwater from Precinct 6 ROL3 is to the existing waterway on the northern boundary, which flows north to the southern tributary of Quinzeh Creek as illustrated in Figure 2Figure 1. These watercourses (south of the Powerlink easement) are mapped as drainage features under the Water Act (2000). Quinzeh Creek flows through Yarrabilba before discharging north (between Precinct 3A and 3C) near Steele Road approximately 3 km downstream of Precinct 6 ROL3.

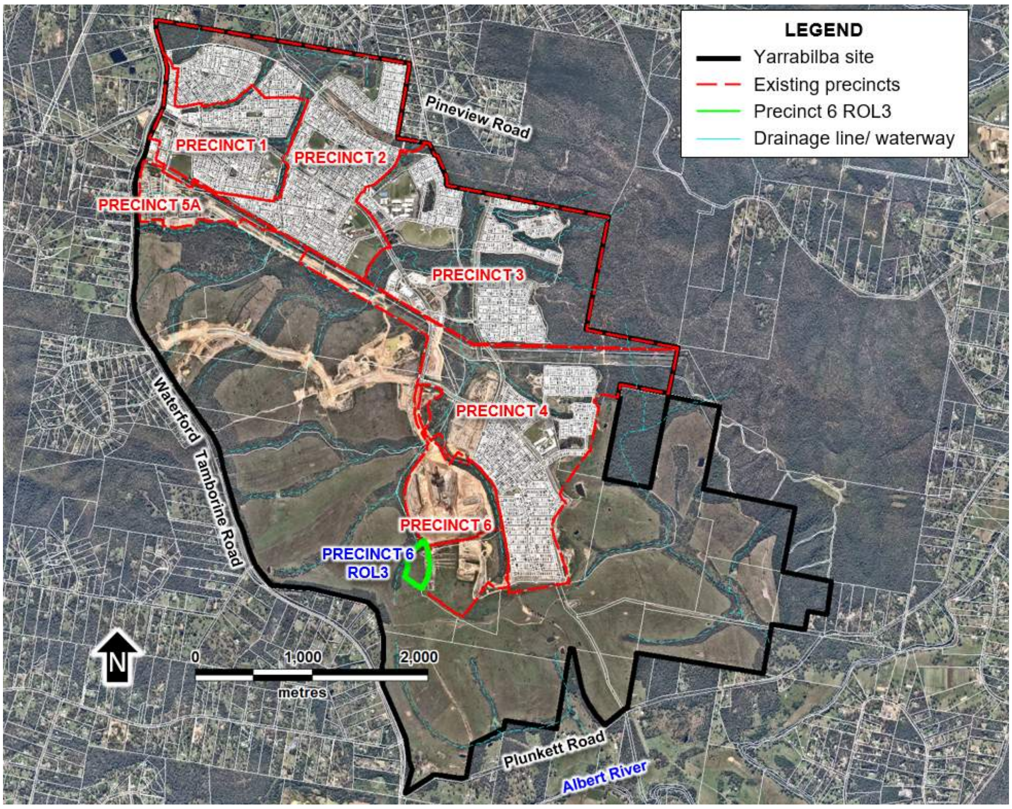


Figure 1: Yarrabilba Precinct 6 ROL3 locality

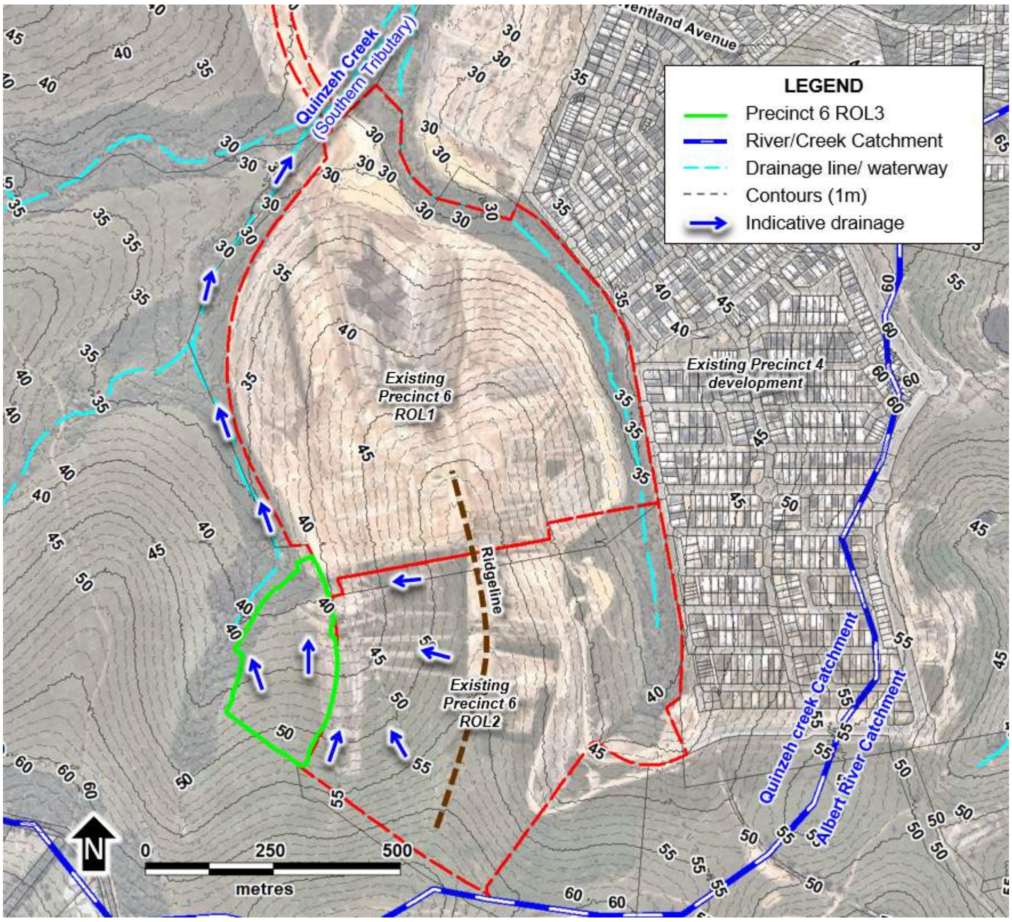


Figure 2: Existing topography, catchments and drainage

2.3 GEOLOGY AND SOILS

Geological mapping indicates Precinct 6 ROL3 is located across two geological units:

- Woogaroo sub-group (RJbw)
- Alluvium (Qa)

Broad scale geotechnical investigations completed across the site (Bowler, 2004) indicate subsurface soils are typically sands overlying silty clays and weathered sandstones. The soil conditions for much of Precinct 6 ROL3 are not expected to vary significantly from those encountered in the balance of Precinct 3 and 4 previously (i.e. those within the lower slope development zones). The alluvium zones (northern portion of P6 ROL3) have often displayed deep sand zones in localised areas where historic channel/creek incisions have been filled with sediment eroded from upslope catchments. Further site specific geotechnical investigations will occur within Precinct 6 ROL3 to confirm soil conditions for civil engineering design.

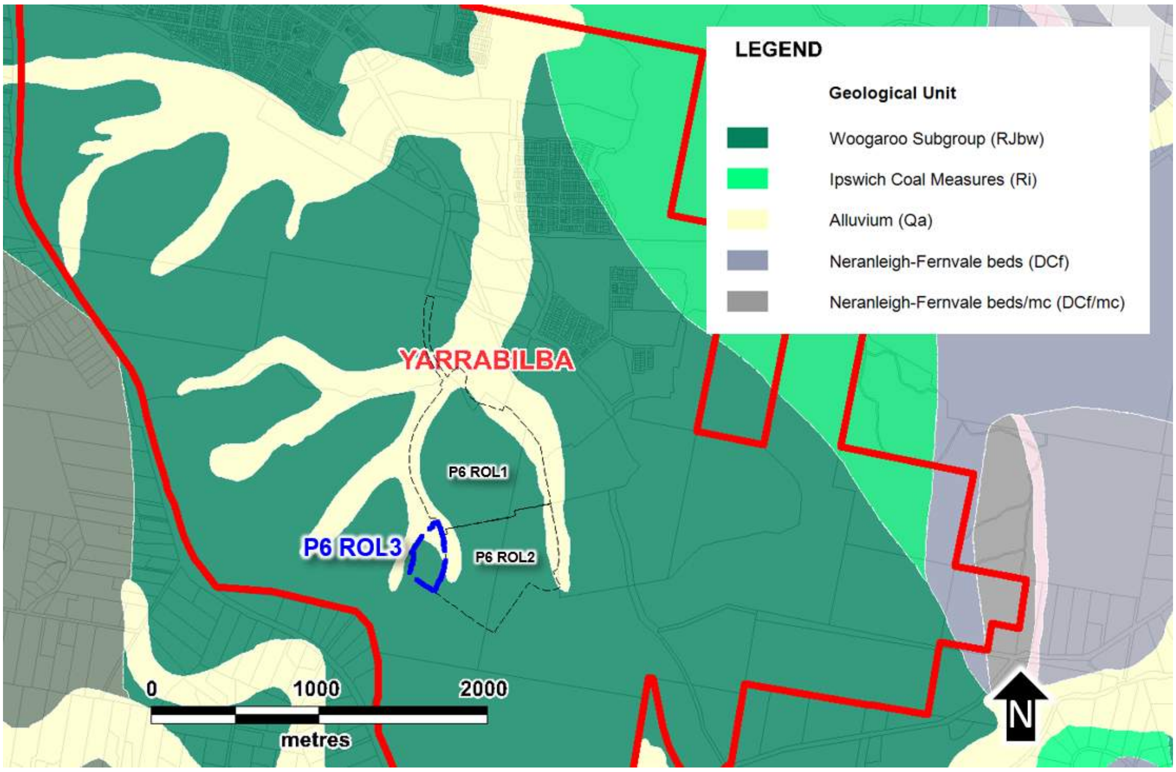


Figure 3: Geology and soils

2.4 VEGETATION

The majority of the Yarrabilba site was previously pine plantation, with most vegetation associated with grassland or pine and eucalypt/acacia regrowth of limited ecological value. Historical aerial imagery illustrates grassland and pine areas represent around 80% of the existing land use across the Yarrabilba site, which have subsequently been cleared and are currently grazed or covered with regrowth vegetation (refer Figure 2). Moderate to dense vegetation generally occurs along drainage lines in the development area.

Vegetation management will generally be undertaken in accordance with *Yarrabilba Development: Natural Environment Site Strategy* (Natura Consulting, 2024 or later) which highlights vegetation management procedures with regards to clearing approvals, revegetation, monitoring/compliance and design requirements. Strategy 14 in the CPAS provides the individual mapping for waterway, flora and fauna constraints as well as bushfire setbacks for the Precinct 6 ROL3 development.

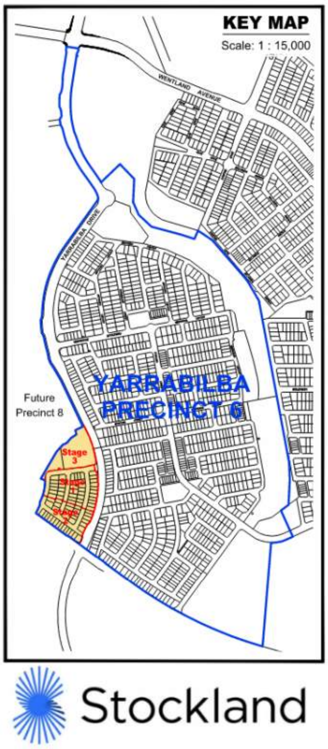
2.5 WATERWAYS

An ephemeral waterway exists on the western boundary P6 ROL3 (and extending north adjacent to P6 ROL1/ROL2). This waterway is broadly defined as being in good overall condition based on the previous Precinct 6 ROL2 condition assessment (DesignFlow, 2023), with the uppermost extent showing average conditions mainly due to reduced riparian habitat. This waterway interfaces with multiple future precincts so management of stability and vegetation values will be an important aspect of the planning for these development areas.

Minimum 15m waterway buffers set out in the *Stormwater Infrastructure Master Plan* (DesignFlow, 2024) have been applied to this waterway with any additional setbacks as required by the ecological and bushfire assessments also applied.

2.6 PROPOSED DEVELOPMENT

The proposed development covers an area of approximately 5.66 ha which includes 2.71 ha of development lots, 1.37 ha of roads 0.31 ha of recreational park and 1.27 ha of drainage open space. The precinct layout is shown in Figure 4.



Yield Breakdown

Allotment Typology	Typical Area	Stage 1	Stage 2	Overall	
25m Deep Product					
25m x 10.5m	263m²	4	4	8	11%
25m x 12.5m	313m²	10	3	13	18%
25m x 14m	350m²	3	6	9	12%
25m x 16m	400m²	1	2	3	4%
Subtotal		**18**	**15**	**33**	**45%**
28m Deep Product					
28m x 10.5m	280m²	3	7	10	14%
28m x 12.5m	350m²	7	6	13	18%
28m x 14m	392m²	2	—	2	3%
Subtotal		**12**	**13**	**25**	**34%**
30m Deep Product					
30m x 10.5m	294m²	4	1	5	7%
30m x 12.5m	350m²	4	3	7	9%
30m x 14m	392m²	1	—	1	1%
30m x 16m	448m²	1	—	1	1%
Subtotal		**10**	**4**	**14**	**19%**
Multi-unit Dwellings (MFS)	550m²+	—	**2**	**2**	**3%**
Total Residential Allotments		**40**	**34**	**74**	**100%**
Density (calc. includes area of residential lots, local roads and local park)				**16.8 dw/ha**	

Land Budget

Land Use	Stage 1	Stage 2	Stage 3	Overall	
Residential Allotments	1.467 ha	1.245 ha	—	2.712 ha	47.9%
Local Roads	0.805 ha	0.565 ha	—	1.370 ha	24.2%
Local Recreation Park	—	—	0.311 ha	0.311 ha	5.5%
Drainage Open Space	—	—	1.267 ha	1.267 ha	22.4%
Total Stage Area	**2.272 ha**	**1.810 ha**	**1.578 ha**	**5.660 ha**	**100.0%**

Legend

- Precinct Boundary
- Application Boundary
- Stage Boundary
- Constraints Limit

PLAN REF: AU13933 – 26
Rev No: A
DATE: 14 May 2025
CLIENT: Stockland
DRAWN BY: MM / BM
CHECKED BY: BM

0 20 40 60 80 100 1 : 1,500 @ A3

YARRABILBA
PRECINCT 6 - APPLICATION 3
RECONFIGURATION OF A LOT

URBAN DESIGN
Level 8, 31 Duncan Street
PO Box 1559
Fortitude Valley QLD 4006
T +61 7 3539 9500
W rpsgroup.com

A TETRA TECH COMPANY

Figure 4: Precinct 6 ROL3 proposed layout

3 STORMWATER QUALITY

3.1 DESIGN OBJECTIVES

The stormwater quality management objectives that apply to the operational phase of Yarrabilba Precinct 6 ROL3 are listed in Table 1 as defined by *the Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2024), which are consistent with the State Planning Policy (DSDIP, 2017).

These objectives require the reduction of pollutant loads discharged from the development site once all construction works are complete. These load reductions are aimed at protecting the environmental values of downstream receiving waterways from the impacts of urban stormwater runoff.

Table 1: Stormwater quality objectives

Pollutant	Discharge criteria (% reduction in mean annual load)
Total suspended solids (TSS)	80%
Total phosphorous (TP)	60%
Total nitrogen (TN)	45%
Gross pollutants (GP)	90%

3.2 STORMWATER QUALITY MANAGEMENT STRATEGY

A stormwater management strategy has been developed for Precinct 6 ROL3 based on a review of the site characteristics, constraints, masterplan for the proposed development zones and discussions with Stockland. The proposed strategy has been developed in collaboration with the design team to ensure it is well integrated with both engineering and landscape aspects of the design.

The report presents an updated strategy assessment for the western catchments of P6 ROL2 which included catchment estimates for future development precincts adjacent to P6 ROL2. The overall intent and outcomes remain consistent with the previous assessment but are now based on more up-to-date development and catchment information.

When developing the treatment strategy, several key principles were considered:

- Adopt multiple use open space principles where possible
- Locate treatments in waterway buffer zones, where applicable, as per *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2024)
- Adopt similar treatment philosophy as per Precinct 1, 2, 3 and 4 developments to maintain consistency across the development
- Integrate with landscape outcomes

- Minimise the impact on existing vegetation and ecosystems
- Ensure future development/catchments are allowed for in precinct scale treatment systems.

Figure 5 shows the overall proposed treatment strategy for Precinct 6 ROL3 (including parts of existing P6 ROL2 zone and future development south of P6 ROL3) with details of treatment systems provided in Table 2. Design levels and the relevant flood immunity details are provided in Table 3. Further details of performance assessments of the proposed treatment strategy are presented in Section 3.3.

Table 2: Stormwater treatment elements

Treatment Type and ID	Size	Catchments	Comment
Sediment Pond 6C1 Bioretention 6C2-6C3	350 m² 2 x 850 m²	6C1, 6C2a, 6C2b, 6C3	Multi basin treatment system

Note:

1. Sed 6C1/Bio 6C2-6C3 receives inflow from existing development areas in P6 ROL2 plus future development areas south of P6 ROL3.

The concept layout for the proposed sediment pond and bioretention basins has been documented in the functional design plans by KN Group (Appendix A). Key design parameters are summarised in Table 3. These are subject to detailed design as part of operational works and some flexibility in configuration exists in these basins to enable design response to ultimate catchment and landscape outcomes in these zones (e.g. sediment ponds may be replaced with sediment forebays where future drainage design dictates).

Table 3: P6 ROL3 Basin 6C concept design summary

Parameter	Sed 6C1	Bio 6C2-6C3
Area	350 m²	2 x 1000 m²
Surface level	RL39.6	RL39.5
Bunds	RL41.0 (min.)	
1% AEP flood (in adjacent waterway)	RL38.0	RL38.0

Notes:

1. Sed 6C1/Bio 6C2-C3 incorporates 63.2% AEP (Q1) minor flood storage zone above the treatment area to manage waterway stability in the downstream western waterway. Refer to Section 5.2 for the hydraulic assessment of this basin.
2. Regional flood mapping does not interface directly with this treatment system. Local overland flow within upper waterway extent is well below basin design levels stated above.

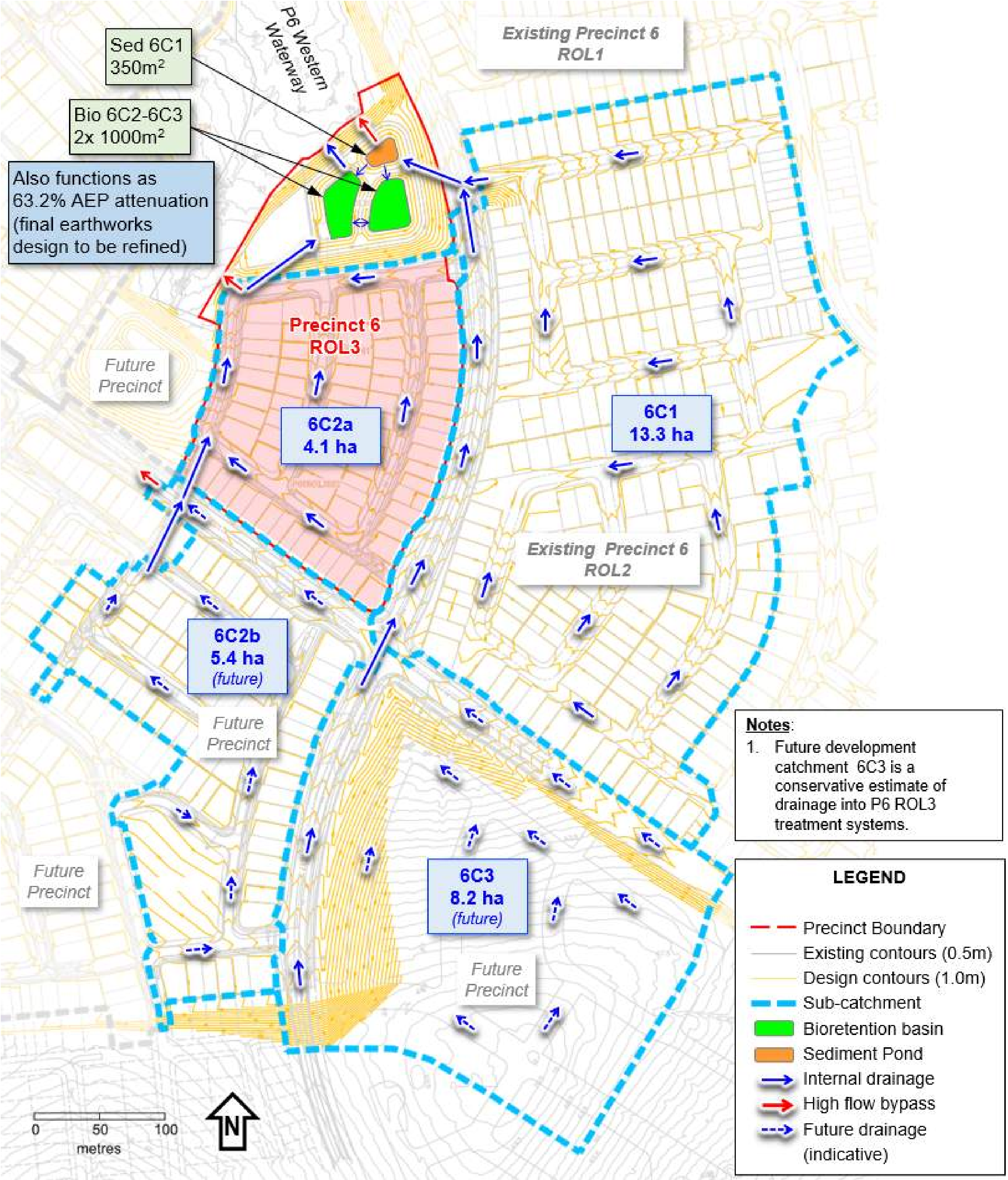


Figure 5: Precinct 6 ROL3 stormwater quality management strategy

3.3 STORMWATER QUALITY ASSESSMENT

MUSIC modelling was undertaken to assess the stormwater treatment performance of the proposed treatment strategy. MUSIC Version 6.3 was used for the assessment.

3.3.1 Model Structure

The structure of the MUSIC model is shown in Figure 6 with the general data provided in Table 4. MUSIC model parameters were adopted generally in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010/2018) using 10 years (1990-2000) of modified Shailer Park meteorological data. Six minute rainfall data and monthly average evapotranspiration data was used. The Shailer Park station was selected for adoption as it is the closest rainfall station to the site with 6 minute data. The rainfall data set was modified to generate a data set closer representing Logan Village rainfall. The Shailer Park 6 minute rainfall was reduced by a factor of 0.849 to produce a rainfall data set with a similar annual total to Logan Village (950mm) for the period considered. Discussion of this was provided in Section 5.1 of the *Precinct 1 Stormwater Management Plan* (DesignFlow, 2011) and has been consistently used in all subsequent applications since that time.

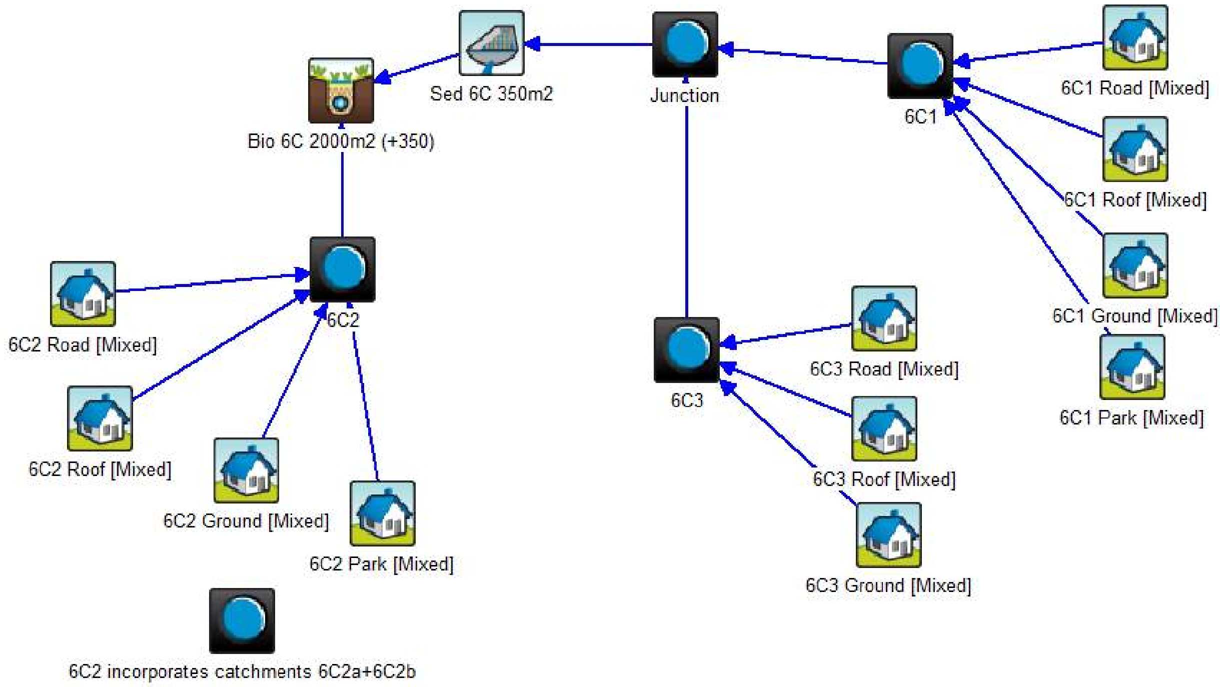


Figure 6: MUSIC model layout

Table 4: MUSIC modelling parameters

Parameter	Value
Source Data	
Rainfall data set	1990-99– Modified Shailer Park Station 040715
Modelled time step	6 minute
Mean annual rainfall 1990-2000	950 mm
Potential evapotranspiration	1,446 mm
Soil properties (runoff generation parameters)	Table 3.7 Music Modelling Guidelines (as appropriate depending on land use)
Pollutant concentrations (base flow and storm flow concentration)	Table 3.8 Music Modelling Guidelines (as appropriate depending on land use)
Percent impervious	Table 3.5 and 3.6 Music Modelling Guidelines (as appropriate depending on land use)
Treatment Devices	
Bioretention	Filter media depth = 0.6 m Extended detention depth = 0.3 m Extended detention area = Bio area (when stand-alone) or Bio + wetland + sed pond (when in combined system) Seepage = 0 mm/hr TN content 400 mg/kg Orthophosphate content 30 mg/kg Overflow weir width = bio area/10
Sediment Basin	Extended detention depth (EDD) = 0.01 m (extended detention depth over 0.01m is included in bio basin where linked) Evaporative loss 75% of PET Notional detention time = <0.1hr (upstream of wetland or bioretention basin) Overflow weir width = sediment pond area/10

3.3.2 Assumptions

1. A split catchment approach was adopted for modelling. Split land use percent imperviousness is generally in accordance with Table 3.5 in MUSIC Modelling Guidelines (Water by Design, 2010/2018).

2. Sediment ponds connect via culverts or weirs to bioretention basins with minimal flow restriction (i.e. minimum allowable 0.01m extended detention adopted in MUSIC with large pipe connection to freely convey inflows)

3. Bioretention basin cells 6C2-6C3 are modelled as combined total surface area (where actual design will split these into multiple cells to ensure flow distribution across filter).

4. Bioretention basins have 0.3m extended detention depth before overflowing to discharge pits. Extended detention area is taken as the sum of 'shared' area over bioretention <u>and</u> sediment pond (see notes regarding extended detention depths assumed in item 2 above) as bioretention controls rapid water level drawdown for all these systems.

5. All overflow weirs from all treatment systems have adopted the treatment area/10 for the weir width as per the *MUSIC Modelling Guideline* which ensures conservatively large weirs and avoids any additional treatment resulting from extended detention above weirs. No allowances have been made for the minor flood attenuation function of the basin has been made in the water quality modelling.

The above assumptions ensure the current functional design of all treatment systems is conservative and allows for more than adequate earthworks, treatment and maintenance access space allowances within the current development layout. All systems will be subject to detailed catchment, hydraulic and MUSIC model verification at detailed design stage to optimise the system sizing for the contributing catchments and surrounding open space integration.

3.3.3 Catchment Data

The catchment areas draining to each treatment system have been derived from the urban design and drainage layouts for sub-stages where available. Table 2 previously identified catchments contributing to each treatment element. Table 5 below lists the catchment area, land use and percent impervious for each sub-catchment modelled with a detailed breakdown of surface types.

Table 5: MUSIC model catchment split data

Catchment ID (refer to Figure 5)	Total Area (ha)	% Impervious	Surface Type	Sub-Area (ha)	Impervious %
6C1	13.3	59%	Road	3.25	60%
			Roof	4.87	100%
			Ground	4.87	20%
			Park	0.32	10%
6C2 (incl. 6c2a + 6C2b)	9.5	57%	Road	2.24	60%
			Roof	3.36	100%
			Ground	3.36	20%
			Park	0.55	10%
6C3	8.2	60%	Road	2.05	60%
			Roof	3.08	100%
			Ground	3.08	20%
Total	31.0	59%		31.0	59%

Notes:

1. Future development catchment 6C3 is a conservative estimate of drainage into P6 ROL3 treatment systems from future precinct(s).

3.3.4 Results

The results of the MUSIC modelling are presented in Table 6. All water quality objectives can be readily achieved with the proposed treatment strategy.

Table 6: MUSIC results

Catchments	Treatment ID	Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction (%)
6C1, 6C2, 6C3	Sed 6C1, Bio 6C2-6C3	TSS	26500	5150	80.6 ✓
		TP	58	17	70.8 ✓
		TN	366	190	48.2 ✓
		GP	4580	0	100 ✓

These results indicate conservative outcomes which enables the detailed design of the basins or stormwater drainage network (or earthworks updates) to divert flows to different parts of the catchment without adversely impacting overall treatment performance. It also provides flexibility in design for integration (and downsizing) of treatment systems in open space areas. This will be resolved in conjunction with civil and landscape design with verification MUSIC modelling provided with each basin.

3.4 COMPLIANCE AND CERTIFICATION

Design and construction certification of operational stormwater quality measures is to occur in accordance with the following guidelines:

- Water by Design (2014). *Bioretention Technical Design Guidelines (Version 1.1)* Healthy Waterways Ltd, Brisbane
- Water by Design (2009), *Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands*, SEQ Healthy Waterways Partnership. Brisbane, Queensland.
- Water by Design (2012), *Transferring Ownership of Vegetated Stormwater Assets Version 1*. Healthy Waterways Partnership. Brisbane, Queensland.

4 WATERWAY MANAGEMENT

The assessment of receiving waterways for P6 ROL3 draws on existing waterway assessment and management strategies from the previous Precinct 6 ROL2 Stormwater Management Plan as these are common areas with the current precinct. The components of the previous assessment that are relevant to the P6 ROL3 zone are reproduced below.

4.1.1 Waterway Stability

The waterway stability objectives adopted for the site are based on protecting high value waterways from erosion due to increased flow from urban development or providing improvements to average or degraded waterways under developed hydrology. This applies to waterways and drainage lines within the site as well as downstream receiving waterways beyond the development boundary. Due to the large size of the site and significant variation in waterway types and riparian and in-stream condition, the waterway stability objective has been derived for a range of situations as shown in Table 7. These objectives are consistent with *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2024) and *State Planning Policy* (DSDIP, 2017).

Table 7: Derived waterway stability objectives

Waterway classification	Waterway Stability Criteria
Site waterway reach in good condition [1] (i.e. well vegetated and stable waterway)	Limit post development 63.2% AEP flows in waterway to pre-development conditions; <u>OR</u> Review the geomorphic conditions under pre- and post development hydrology to determine stability risks and if required define a waterway specific response [2]
Site waterway reach in average to poor condition[3] (i.e. poorly vegetated or active erosion)	Where ecological assessment justifies the retention of the waterway/drainage line[3], reconstruct / rehabilitate waterway to convey the post development 63.2% AEP flows without the risk of increased erosion [4]
External waterways	Limit 63.2% AEP flows at site boundary for critical duration event to pre-development conditions

Notes:

1. Refer to Stormwater IMP for preliminary waterway condition rating
2. Localised increases in 63.2% AEP flows can be accepted provided a geomorphic assessment by a suitably qualified geomorphologist can justify accordingly. Note: This approach of focussing on outcomes within the specific waterway rather than pre and post development flows was adopted successfully in the waterways within the early Precincts of Yarrabilba (i.e. waterways remain stable even with an increased flows). It focusses on the requirements of the particular waterway and proposed rehabilitation rather than a coarse flow objective which was derived as a broad target for the State Planning Policy.
3. Ephemeral waterways which are average to poor condition may be assessed in further detail to identify if they should be retained and rehabilitated or removed and greater resources/efforts put into rehabilitation of adjacent/downstream waterway reaches. This shall be undertaken in accordance with the *PDA Guideline no. 12 – Environmental values and sustainable resource use* (EDQ, 2015).

4. The approach supports the rehabilitation of degraded waterways and allows local increases in 63.2% AEP flow provided the rehabilitation design provides an appropriately stable waterway for the increased flows. The rehabilitation is to be designed / reviewed by a suitable qualified geomorphologist.

4.2 WATERWAY ASSESSMENT

The stability assessment for the waterways in or adjacent to P6 ROL3 has been based on previous site investigations (for Precinct 6 ROL2) and the detailed hydraulic (Tuflow) modelling undertaken as part of the *Yarrabilba Masterplan Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024) which included modelling of the 6..2% AEP discharge as well as velocity and bed shear stress analysis of minor and major flood flows. The assessment included below is generally confined to those areas of waterway that are within the extent of waterway mapping and/or within the modelled floodways. The overall waterway layout is provided in Figure 7.

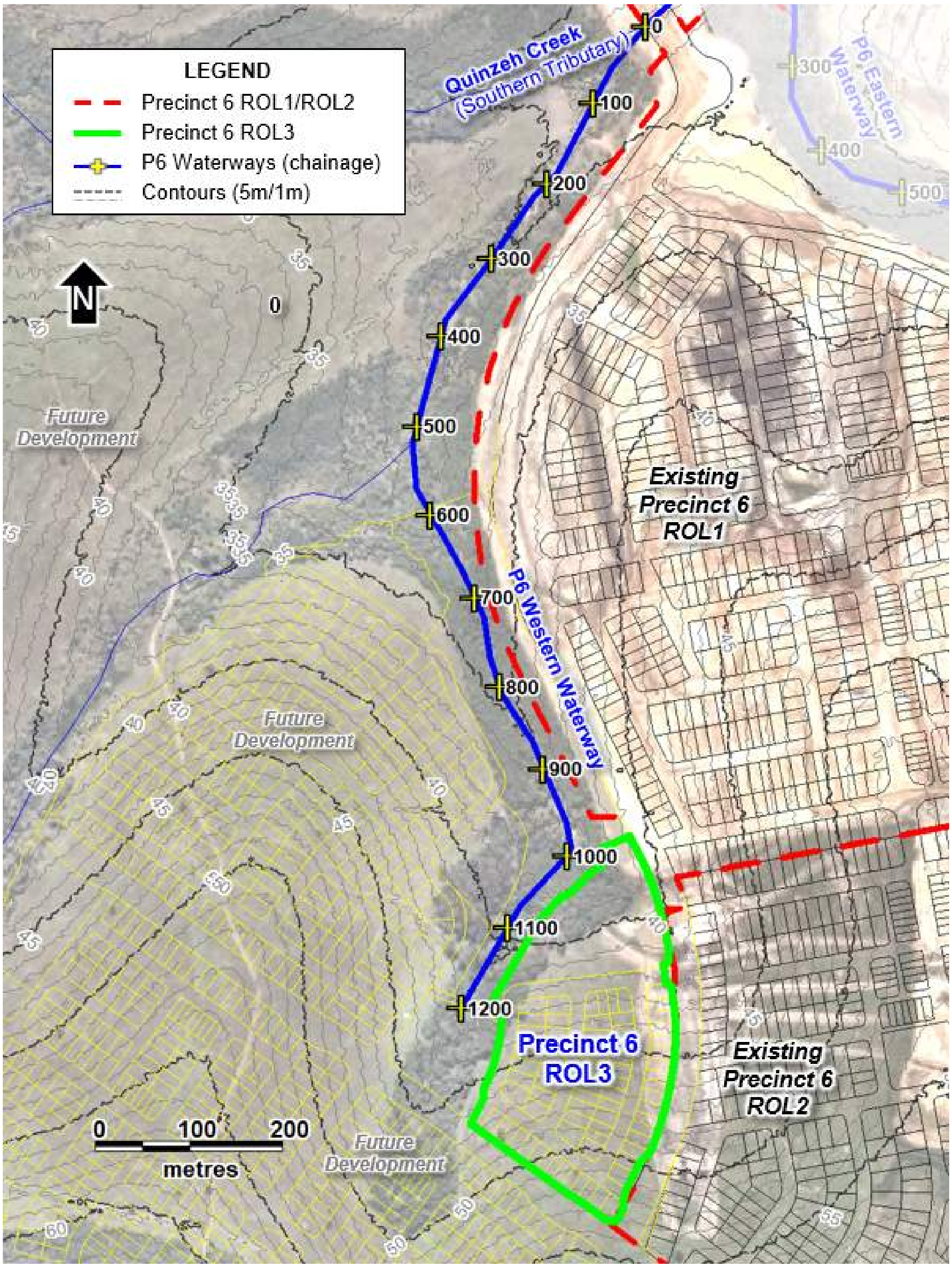


Figure 7: Precinct 6 ROL3 waterway layout

4.2.1 Characteristics

The P6 western waterway grades up at around 0.7% from the upper Quinzeh Creek confluence (adjacent to the northern part of P6 ROL1) increasing to just under 2.6% in the uppermost reaches adjacent to P6 ROL3. These grades are greater than the P6 eastern waterway (reported in previous P6 ROL1 and ROL2 stormwater management plans) and indicate potential for locally higher velocity flows and potential for greater instability.

The overall waterway condition ratings provided in the *Yarrabilba Waterway Condition Assessment* (DesignFlow, 2023) indicates P6 western waterway was reported to be in generally good overall condition based on habitat and stability considerations.

A more detailed review of the P6 western waterway carried out on 29 August 2023. This was done to further assess the characteristics and condition of the waterways in Precinct 6 ROL2 (and ROL3) since the original field work undertaken in 2013 for the overall site waterway condition assessment.

A brief overview of these findings (as relevant to P6 ROL3) is provided below with additional information provided in Appendix B. Figure 7 provides the Precinct 6 western waterway layout and chainage locations referred to in the following sections.

P6 Western Waterway Inspection

This inspection occurred in late winter 2023 following an extended period of low rainfall. No surface or groundwater seepage was observed throughout the waterway at this time.

The western waterway of P6 extends generally south-west to south from the main upper Quinzeh Creek floodway (at the northern part of P6 ROL1). The lower reach (chainage 0-500 in Figure 7) is very broad with low gradient (~0.7%) and intermittent low flow channel (very narrow and shallow) and localised scour pools. Generally good grass groundcover exists with scattered trees and shrubs and local areas of more dense trees (regrowth). Localised ground disturbance and grazing was evident from native and feral animals (kangaroos and pig observed) and livestock (horses and goats in adjacent areas) but no significant instabilities present. While no standing water was present, evidence of scattered shallow scour holes/former ponds and emergent water plants was observed (now died back and dry).

The mid reach (chainage 500-1000 in Figure 7) shows a gradual increase in slope to around 1.1% with the broad, well vegetated waterway profile continuing. Tree density increased in this area compared to lower reach. Localised and scattered scour pools were evident (now dry) towards the upper end of this reach and typically associated with livestock tracks. Just upstream of CH950, a localised open area with lower tree density exists just south of a vehicle access track (slightly mounded) crossing the waterway. Evidence of former shallow ponding and water plants (now died back and dry) exists in this location.

The upper reach (CH1000-1200) is characterised by an increase in grade to around 2.5% with greater presence of a localised low flow channel (scour gully) and localised scour/head cut. Between about Ch1150-1200, a pronounced scour has occurred and moved upstream evidenced by an expanded erosion head at CH1200. Weak and/or dispersive soils appear to be partly responsible combined with increased waterway slope and flow concentration. Surrounding areas remain wooded and partially grassed.

4.2.2 Modelling

The existing flood model for the Yarrabilba site (within Quinzeh Creek) was used to extract hydraulic information to assist with the assessment and development of an appropriate waterway stability management strategy. This model does not include any localised waterway stability detention basins so represents the unmitigated 63.2% AEP case within these waterways. The resolution of the flood model (5m grid) is such that very localised scour issues will not necessarily be identifiable from model outputs and therefore should not be relied upon solely for the management of specific areas. The adoption of both targeted engineering approaches as well as an adaptive monitoring and management of stability issues will ensure that the strategy presented in Section 4.3 below responds to changes over time.

Table 8 provides a broad scale analysis of the flow characteristics at the mid and lower reaches of the P6 western waterway for pre and post-development (unmitigated) catchment conditions adjacent to and downstream of P6 ROL1 (receiving P6 ROL3 flows). This data is based on the fully developed site conditions (i.e. Precinct 6 plus future Precinct 8 and 9 developed) and therefore Precinct 6 (in the short term) will show lower developed flows and velocities accordingly.

Table 8: 63.2% AEP discharge in Precinct 6 ROL1/ROL3 waterway (unmitigated)

Waterway Chainage	Tuflow PO Location	Flow (m^3/s)		Peak Velocity (m/s)	
		Existing	Developed	Existing	Developed
CH200	L_40	3.5	12.1	0.32	0.62
CH600	L_42	1.6	9.0	0.54	0.92

Notes:

1. Data extracted from Tuflow models B01d and P01d at the respective plot output reporting locations
2. Peak velocity is highest point velocity within cross section (typically near invert) and not an average velocity over total cross section.

This data indicates that while the peak discharge at the lower (CH200) and mid (CH600) reaches of the P6 western drainage line increases significantly because of urbanisation, the actual velocity increases are comparatively small and very low in overall magnitude under both pre- and post-development (unmitigated) scenarios. This is in most parts due to the broad flat profile of the drainage lines that can experience significant increase in flow rate (and flow width) with only very minor increase in flow depth and velocity. Further analysis and discussion of the pre and post-development flood modelling is provided Section 4.2.3 below with reference to Figure 8.

Further detailed review of the upper western waterway has also been undertaken due to the increased waterway slope in the mid to upper reaches and the presence of existing scour and potential adverse soil conditions.

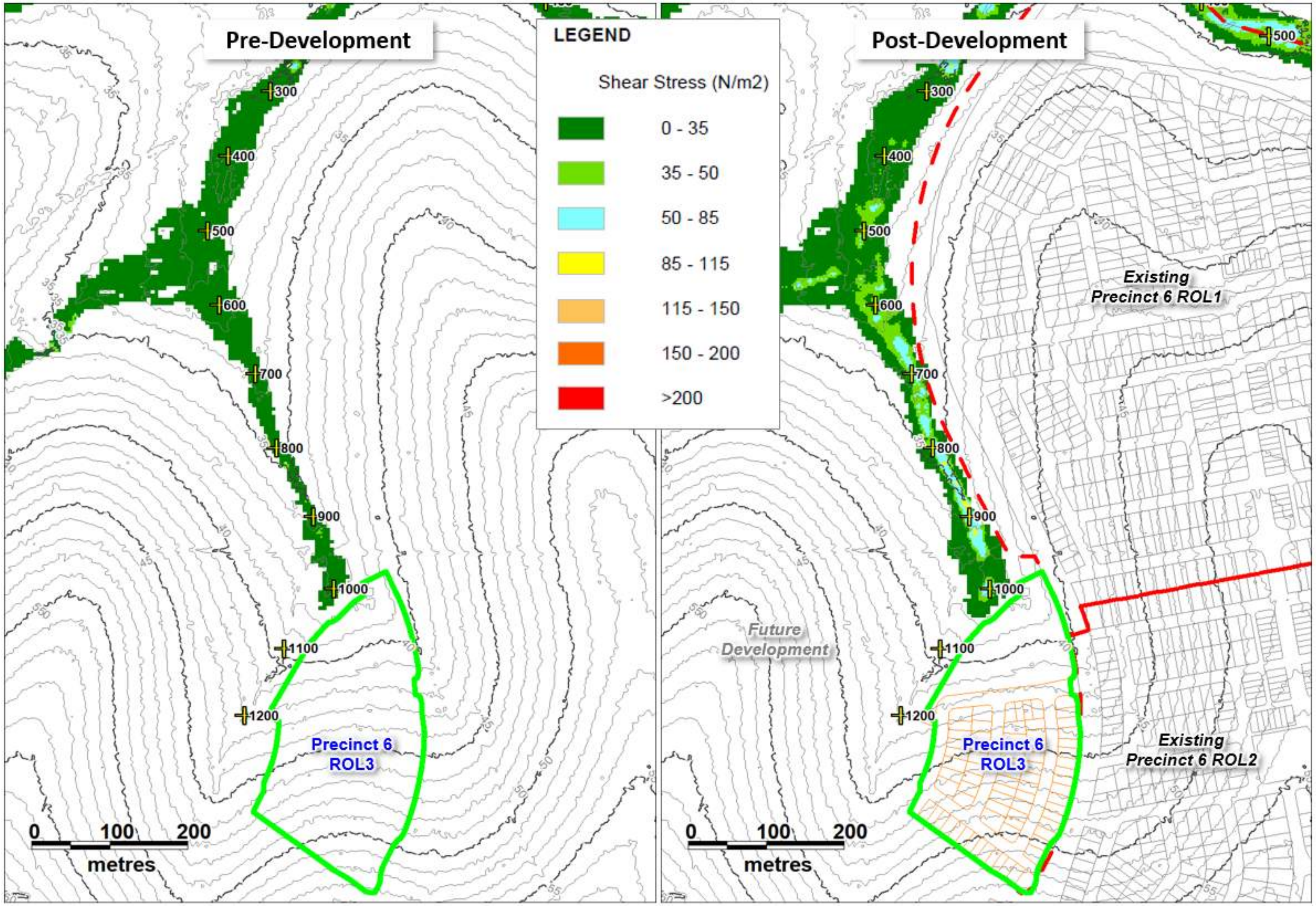


Figure 8: 63.2% AEP bed shear stress comparison (no local mitigation)

4.2.3 Discussion

Bed shear stress modelling provided in Figure 8 has been derived from of the *Yarrabilba Masterplan Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024) at a 5m grid to broadly identify the relative bed shear stress changes and does not specifically account for:

- Any localised precinct stormwater quality management basins
- Very localised spatial variations in vegetation and tree coverage (i.e. Tuflow roughness/materials layers are more broad scale and representative of a total reach)
- Very minor areas of bare soil and scour and/or woody debris causing flow deflection
- Longer term rehabilitation and regrowth of channel vegetation

Due to these constraints and the limited justification for updating the catchment flood model to this level of detail, the bed shear stress mapping was used as a reference point for the development of the Waterway Stability Management Strategy (Section 4.3 below).

P6 Western Waterway

Bed shear stress mapping in the lower and mid reaches of the P6 western waterway indicates that under pre-development conditions, the bed shear stress (in the order of 35 N/m^2 or less) represents relatively minor and localised instability (i.e. model outputs were broadly correlated with site based investigations/observations of current conditions in Appendix B). Under post-development hydrology, the bed shear stress magnitude generally remains in this range for much of the lower waterway but extends over a broader area across the channel invert (refer Figure 8). The mid to upper reach (chainage 600-1000) there are areas of higher bed sheer stress that may be attributed to the gradual increase in waterway slope in the western waterway and these are expected to be exacerbated in the areas at and upstream of the limit of flood modelling available (where slopes increase to around 2.5%).

The targeted waterway management strategy therefore aims to mitigate the increase in local 63.2% AEP discharge into the upper waterway via minor flow attenuation (detention) over stormwater treatment basin(s) while managing existing scour issues and revegetation/natural regeneration coupled with an adaptive management strategy that responds to the uncertainties in channel geomorphology. Preliminary hydraulic assessment of the local detention requirements for this waterway is provided in Section 5.2.

4.3 WATERWAY STABILITY MANAGEMENT STRATEGY

As described in Section 4.2.1, the waterways adjacent to and downstream of Precinct 6 ROL3 are considered to be in good condition (ecologically) while being relatively stable owing largely to the very low gradients and vegetation cover of these drainage lines. The exception being the upper reaches of the western waterway that exhibit steeper gradients and increased risk of instability. The localised areas of instability combined with impacts of historical livestock interaction and future increases in flows from development dictates the need to provide protection and improvements to these areas to ensure long term sustainability of these waterways.

The following provides the recommended waterway stability management strategy which can be broadly defined by a number of main actions:

- Removal of livestock and feral animal access to waterways.

- Areas of very minor instability should be monitored to assess the success of natural regeneration of groundcover vegetation following the removal of livestock from waterways.

- Targeted stabilisation (local regrading/filling and revegetating, or rock and/or engineering structures) of scour pools and significant areas of instability.

- Scour protection at in-stream structures such as road crossing culverts and stormwater outlet headwalls.

- Ongoing monitoring of channel stability as development proceeds (including future adjacent precincts) to guide reactive management of channel stability. Particular attention should be given to those areas identified as currently eroding and those adjacent to infrastructure.

- Control of 63.2% AEP (Q1) peak discharge from local development areas into the upper reaches of the P6 western waterway (i.e. minor attenuation of Q1 discharge to match pre-development Q1 for equivalent catchment area).

Figure 9 provides a localised extract of the waterway stability management strategy developed previously as part of P6 ROL2 that targets the degraded and/or future disturbance areas associated with development. Typical stabilisation techniques applicable to this strategy (and adopted in previous precincts onsite) area described in Section 4.3.1.

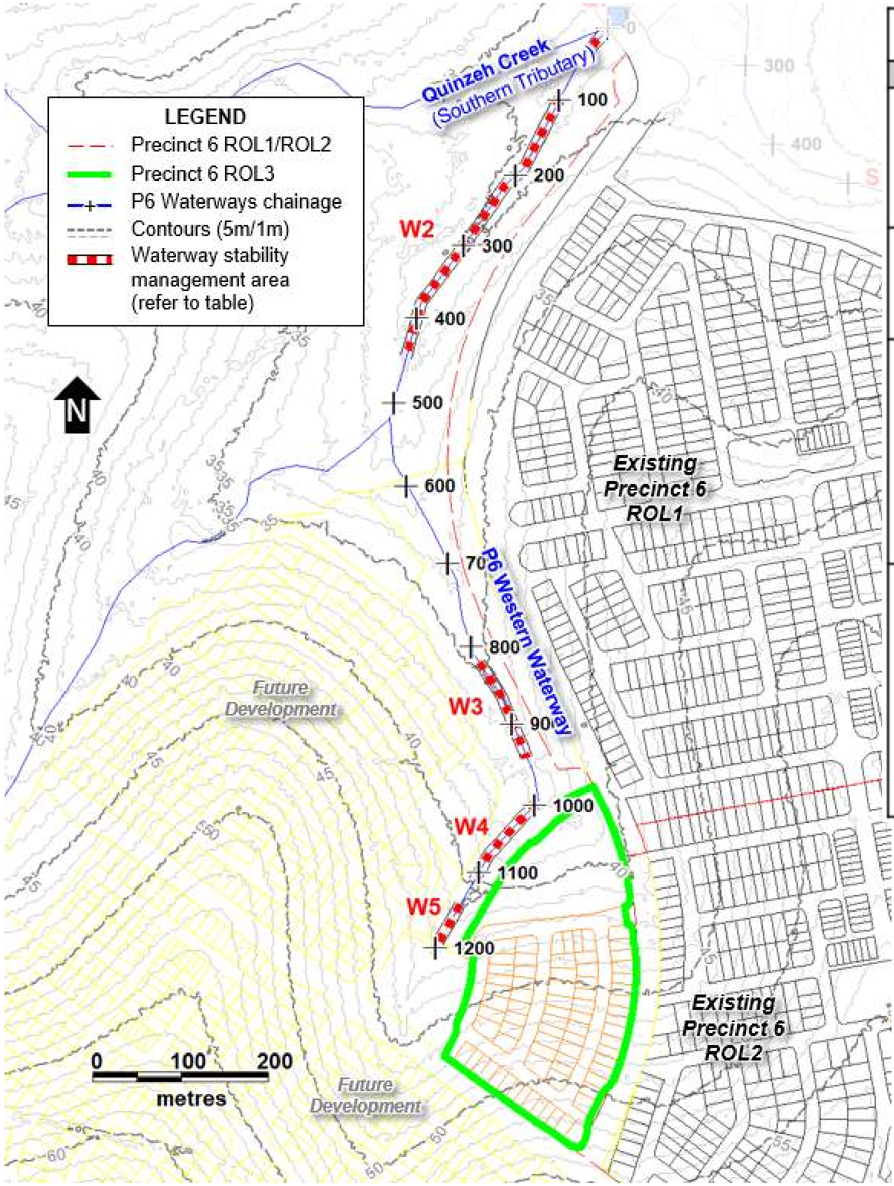


Figure 9: Waterway stabilisation management strategy

ID	CHAINAG (APPROX.)	WATERWAY STABILITY MANAGEMENT
WESTERN WATERWAY		
W2	100-450	Broad grassed flow path with scattered trees. No defined low flow or scour zones. Minor livestock/feral pig disturbance locally. Occasional shallow flow path evident on animal trail but low gradient minimizes instability. Grazing of grasses evident from vegetation height. Monitor and plant disturbed areas if natural regeneration is slow.
W3	820-950	Minor low flow channel (periodically) but very localised and on very low gradient. Scattered shallow scour pools (dry) likely partly from livestock trail and disturbance. Low risk. Monitor and plant disturbed areas if natural regeneration is slow.
W4	1000-1120	Shallow low flow channel commences and extends upstream with gradual deepening and evidence of scour. Fallen logs increase scour locally (while still shallow). Surrounding area broad, flat and well grassed. Vehicle track crossing at CH1120 with localised washout of gravel. Local filling with non-dispersive soil and revegetation. Monitor stability and natural regeneration of vegetation surrounding. Where continued instability occurs in low flow, local rock scour protection may be required.
W5	1150-1200	Commencement of incised low flow channel with vertical sides and local undercutting of trees. Depth varies <0.5. to 1m. Soil appears to be weak/dispersive. Fallen logs may be exacerbating local scour in flow path. At CH1200, a significant head-cut exists ~0.8-1m deep and 5-6m across. No obvious steep or defined flow paths into this location. Soils may be an issue here. Cemented layer at ~0.6-0.8m depth which appears to have been weaker in wet period. Reshape and backfill with non-dispersive soil, revegetate and monitor stability. Rock may be required to manage grade change at head-cut.

4.3.1 Stabilisation Techniques

Rock Protection

Scoured areas and incised channels can be reshaped to flatten vertical edges and placement of rock or rock mattress over geofabric to armour underlying soil. Integrate planting within rock voids where practical. Rock protection must be formed with depressed centre to ensure flows are directed into and through the area and set down slightly below the natural ground level to avoid flow redirection around the edges (creating new scour).

Revegetation

Areas with little or no vegetation cover should be replanted with a mix of locally established species to create both a soil anchor (via roots) as well as flexible grasses that can lay flat during flow (as a surface armouring) to create a stable flow path. This is most appropriate to broad low gradient flow paths (where rock channel linings are not required). The use of pinned down jute or coir mat (not net) prior to planting is required to create a short term soil stabiliser until vegetation is established. Revegetation should also form part of any rock protection works.

In addition to stabilisation, revegetation (and landscape planting of development edges) will be an important part of the management of iron bacteria in waterways. While being a naturally occurring phenomenon in waterways with no known health risks, iron reducing bacteria (and the slimy deposits/oily sheens that result) can be unsightly when adjacent to urban areas. Further, the modification to the frequency and amount of stormwater input to local waterways (and infiltration to groundwater) will have potential to increase the prevalence of the iron bacteria. Vegetative screening is therefore critical to managing the amenity of local waterways.

Stormwater Outlets

All stormwater headwalls to be provided with rock aprons configured appropriately (in accordance with QUDM) to the size and number of pipes. Where natural channel just downstream of apron is susceptible to further instability, aprons should be enlarged or lengthened beyond unstable area. Further, if instream stabilisation has been identified, the rock apron should be linked to this zone to avoid potential scour between two areas.

Ongoing Monitoring

Where no (or very minor) erosion exists or potential future scour areas may occur based on high bed shear values (refer to Figure 8 previously) consideration should be given to minimising intervention in these areas where surrounded by very stable and/or well vegetated waterways zones. The potential impact of accessing these zones to undertake remedial activities (i.e. with earthmoving machinery) would likely create greater disturbance than benefit. Therefore, in the first instance, these areas will be monitored over the course of Precinct 6 development as well as into the adjoining precinct(s) development to review if these areas are degrading further. Reactive and targeted remediation can therefore be undertaken as required.

The adoption of this approach in Precinct 1-4 development areas indicates there is merit in limiting the intervention in degraded and disturbed waterways until development within the catchment has neared completion (unless major issues are evident prior). Allowing natural regeneration and succession of vegetation species within waterways (including weeds initially) has been shown to represent a beneficial and cost effective outcome for particular waterways. However, where overriding requirements for other fauna/flora management outcomes exist, these must be taken into consideration and adopted where necessary.

5 STORMWATER QUANTITY

5.1 FLOODING

Precinct 6 ROL3 is generally in accordance with the *Yarrabilba Masterplan Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024). No flood detention infrastructure is required as part of this precinct as it falls within the regional strategy that is managed by Flood Basin 15 (Expedition Rd/Fauna Way) (approved and constructed previously as part of Precinct 3B). No further flood impact assessment is therefore required as part of this stormwater management plan.

A review of the preliminary earthworks design of the proposed development area in relation to local flood levels is provided in Figure 10. The development lies adjacent to the uppermost reach of local waterway and at the reporting limit of the flood mapping. This indicates that P6 ROL3 is well above the 1% AEP flood level being conveyed through the adjacent waterways and ultimately downstream to the southern tributary of Quinzeh Creek.

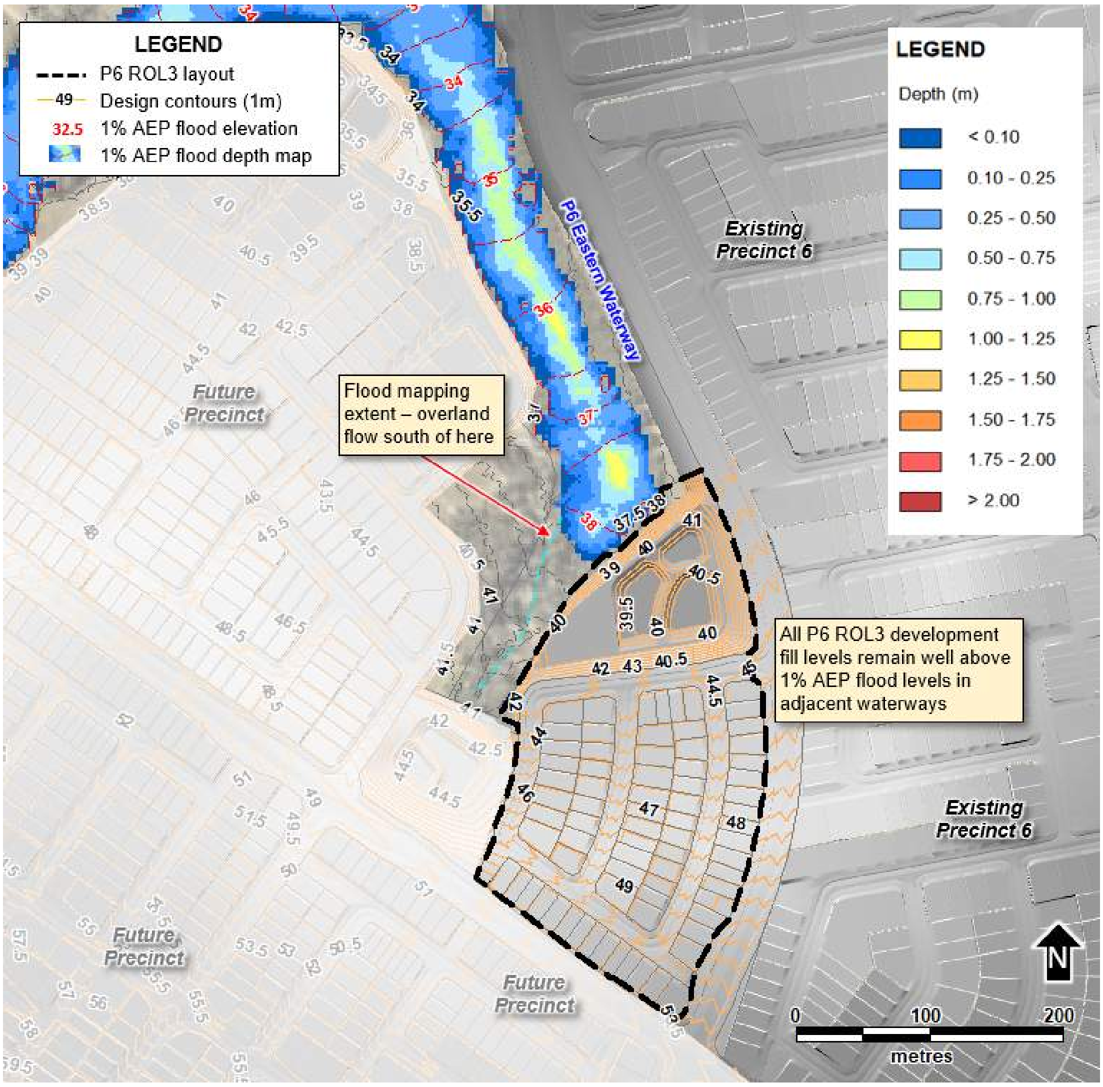


Figure 10: 1% AEP Flood levels and preliminary earthworks

5.2 WATERWAY STABILTY FLOW ATTENUATION

As noted previously in Section 4.3, the upper reaches of the P6 western waterway require post-development minor flow attenuation to manage the potential waterway stability issues outlined in Section 4.2.3. While this waterway will receive discharge from multiple future development precincts, the proposed approach to minor flow management (63.2% AEP / 1 Year ARI) is to maintain equivalent pre-development peak discharge from the respective development precincts at each location. The assessment below applies to the western stormwater treatment basin of P6 ROL3 (incorporating Sed 6C1 and Bio 6C2-6C3) which manages catchments 6C1, 6C2 and 6C3 in Figure 5 previously (totalling 31.0 ha).

5.2.1 Hydrological and Hydraulic Assessment

XPSWMM was used to assess the pre and post development catchment discharge and derive an appropriately sized storage (co-located with local stormwater treatment basin) to achieve the objectives. The ensemble storms approach was used in line with ARR2019 using the latest rainfall data from the Bureau of meteorology (BOM). Temporal patterns, losses and pre-burst data was sourced from the ARR Data Hub (Appendix C). Durations from 10 minutes to 6 hours were assessed with the critical duration for the basin storage and discharge being 1 hr duration for the minor 63.2% AEP

5.2.2 Catchments

The assessment was undertaken on equivalent areas pre and post development to derive an appropriate detention storage. The overall catchment area of 31.0 ha is based on catchments in Figure 11. Future development in adjoining precincts is expected to apply local detention storage at similar rates (m^3/ha). Catchment data used in XPSWMM for pre and post development are provided in Table 9 which is derived from the current layout and grading.

Pre-development area is taken as equivalent developed catchment in order to define indicative unit rate of detention required for this catchment (with adjoining developed catchments to apply similar approach in future). Pre-development slopes and roughness values have been taken from the corresponding catchment A_N12 in the *Yarrabilba Masterplan Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024). Post development slopes reduced from pre-development through cut and fill earthworks.

Table 9: Catchment data

Catchment	Area	Slope %	Impervious %	Pervious Roughness	Impervious Roughness
6C1	13.3	2.1%	65%	0.035	0.015
6C2a	4.1	2.8%	65%	0.035	0.015
6C2b	5.4	1.8%	65%	0.035	0.035
6C3	8.2	1.9%	65%	0.035	0.015
Pre Equiv. Area	31.0	4.1%	0%	0.08	n/a

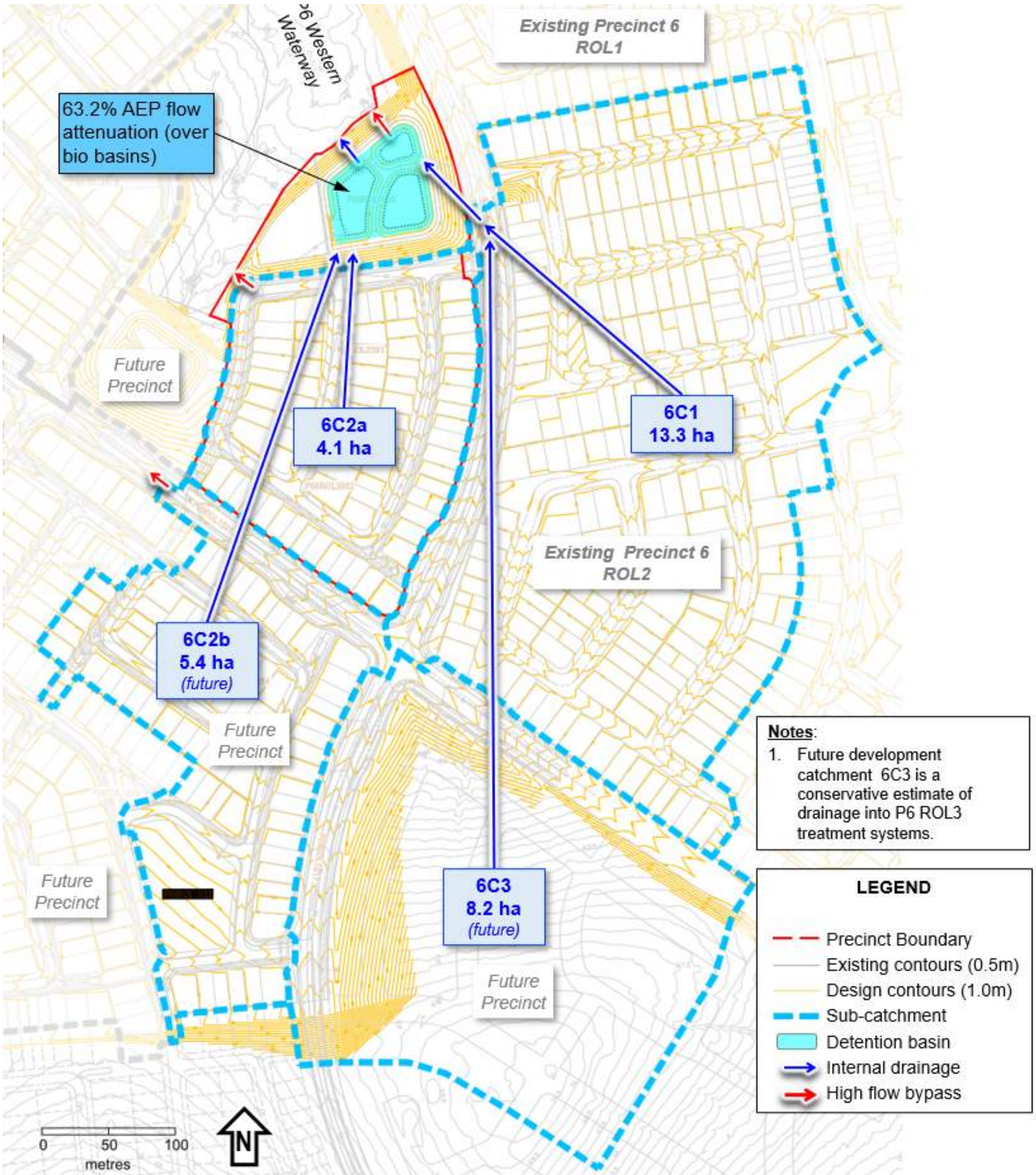


Figure 11: XPSWMM catchment layout

5.2.3 Rainfall and losses

Rainfall data has been obtained from the Bureau of Meteorology rainfall data system and losses (Table 10) and temporal patterns extract from the ARR Data Hub for the location co-ordinates below. The Data Hub extract is provided in Appendix C.

- Longitude 153.122°
- Latitude -27.835°
- ARR division: East Coast North

Table 10: Rainfall losses

	Pervious	Impervious
Initial Loss (mm)	26	1
Continuing Loss (mm/hr)	1.9	0

5.2.4 Pipe Drainage

Pipe inflows to the basin from the east (catchments 6C1 and 6C3) occur for all events up to 1% AEP due to the boulevard road (Yarrabilba Drive) pipe drainage necessitating major pipes to manage road flooding and overland flow conveyance to the north. This design outcome has been advised by KN Group civil engineers.

Pipe inflows to the western side of the basin (catchments 6C2a and 6C2b) occur up to the nominal 50% AEP event with larger event flows allowed to surcharge onto the surface and flow overland directly to the waterway corridor at the nominated sag locations shown in Figure 11 (high flow bypass).

5.2.5 Detention storage

The preliminary assumptions for the stage-storage relationship for the detention basin is represented by the volume over the sediment pond and bioretention basins, with the depth above this being dedicated to minor flood storage. Refined modelling of the detailed earthworks will occur as part of design with hydraulic model verification.

Table 11: Preliminary stage storage data

Depth (m)	Elevation (mAHD)	Stage Area (m^2) [1]
0	39.5 [2]	2959
1	40.5	5294
1.5	41.0	6673

Notes:

1. XPSWMM utilises stage-area relationship to calculate the incremental volume internal to the model.
2. A 0.1m initial depth has been applied to the sediment pond component of storage to account for normal water level at RL39.6.
3. Stage area tabulated above is combined for area over sediment pond and 2x bio basins. Storage areas are required to be greater than the minimum areas to accommodate the sediment pond (350m²) and bioretention basins (1000m² each).

Initial water levels have not been applied to bioretention basins in this model as the rainfall data includes pre-burst rainfall (prior to design storm burst) which will represent the pre-filling of bioretention basin extended detention depth prior to design storm burst. This also scales the initial water levels (pre-burst) to the AEP and duration of the storm.

Table 12: Basin preliminary design

Parameter	Value
Basin floor (bio filter surface)	RL39.5
Bund	RL41.0 (min.)
Stormwater quality	350m² sediment pond connected to 2x 1000m² bioretention basins (via culverts or weirs). Batters/storage areas outside treatment typically 1:6 or flatter.
Basin Outlet Structures	
Low level outlet	2 x 1.5m x 1.5m pits at RL39.8 (sets bio basins extended detention depth) 1/375 dia pipe from each pit at IL38.45, 1% grade (with orifice plate in pit to reduce outlet area to equiv. 340mm dia pipe).
Secondary outlet (Pit manhole)	1.5m x 1.5m pit opening (in manhole lid) at RL40.43, 900mm dia pipe at IL38.10, 1% grade to outlet.
High flow weir	20m at RL 40.55

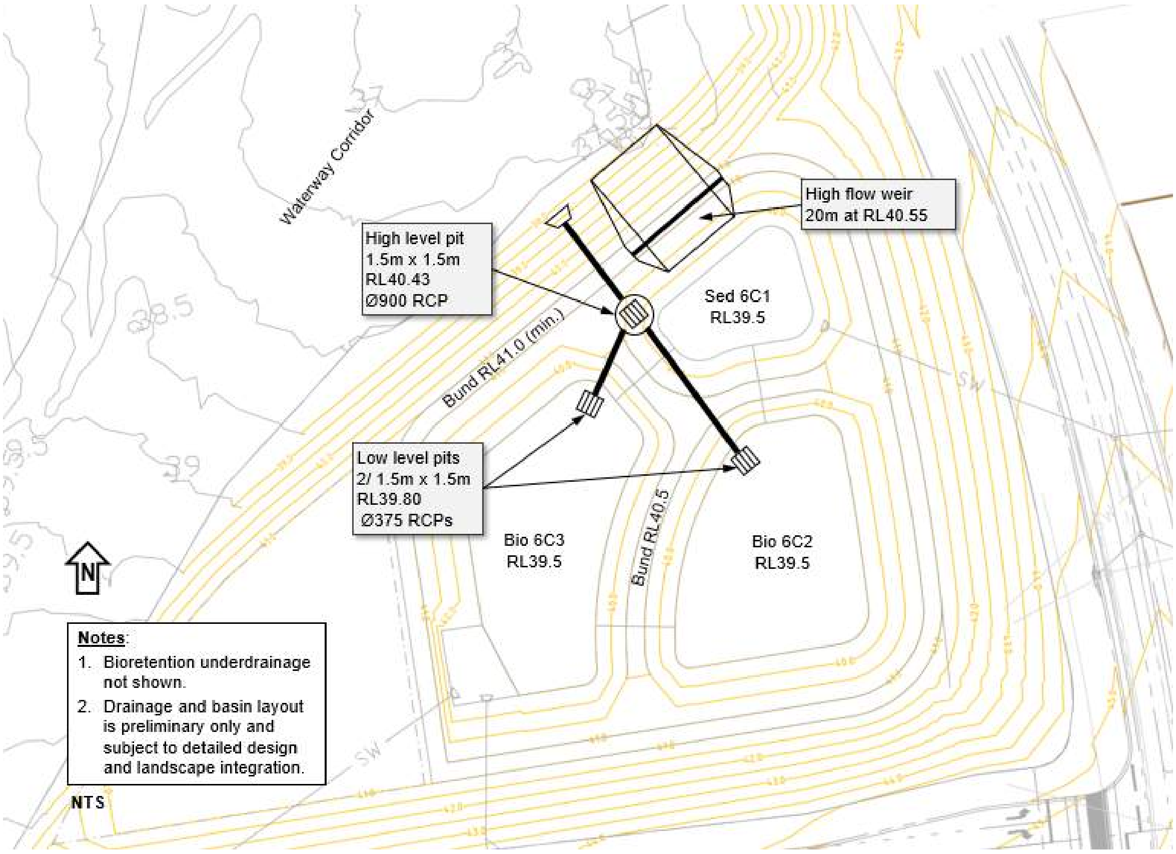


Figure 12: Basin 6C concept design

5.2.6 Results

Table 13 provides the pre and post development discharge results for the minor detention basin for P6 ROL3 western waterway which adequately manages the 63.2% AEP flows for downstream waterway stability. Results are reported as the median peak results for the full range of ensemble storms and durations. Discharge results for the larger events are not reported as they are not required to be mitigated to pre-development conditions. The broader flood mitigation strategy is provided through the regional scale detention basin downstream in Precinct 3 as described previously in Section 5.1.

Table 13: Local 63.2% AEP basin discharge results

	Median Peak Discharge (m^3/s)	
Event	Existing	Developed (mitigated)
63.2% AEP	0.72	0.70

Notes: Discharge results based on zero blockage to outlets structures (i.e. no reliance of blockage to achieve discharge control)

Table 14 provides the basin water levels under a range of events up to the 1% AEP to verify the overall basin functionality for both the free basin discharge (no blockage) as well as with 50% blockage applied to all pit structures to review water level increases and freeboard. All results are reported as the median peak results for the full range of ensemble storms.

Table 14: Basin water levels

Design Event	Median Peak Water Level (mAHD) and depth (m)	
	No Pit Blockage	50% Pit Blockage
63.2% AEP	40.42 (0.92m)	40.49 (0.99m)
50% AEP	40.54 (1.04m)	40. 57 (1.07m)
10% AEP	40.71 (1.21m)	40. 74 (1.24m)
1% AEP	40.81 (1.31m)	40. 85 (1.35m)

5.2.7 Discussion

The 63.2% AEP detention storage level of RL40.42 corresponds to approximately 3625 m^3 of storage. For the total catchment of 31.0 ha, this equates to a unit storage volume of 117 m^3/ha of storage for the management of downstream waterway stability. This unit rate of storage is consistent with the previous P6 ROL2 assessment (120 m^3/ha) for this basin which was formerly based on a smaller contributing catchment.

Analysis of design blockage conditions within the basin (all pits 50% blockage) indicates that all events up to the 1% AEP remain below the top of bund with controlled discharge to the waterway corridor via the high flow bypass weir. With all basin pits designed with raised dome grates, this level of blockage is considered conservative and unlikely to occur in practice.

Detailed design of the basins will involve further review of the water quality basin design within the floor of the system, outlet structures and considerations of the ultimate pipe drainage network design to this location. This current assessment provides adequate support for the current functional design of this basin area for both water quality management and minor flow attenuation.

6 EROSION AND SEDIMENT CONTROL

6.1 DESIGN OBJECTIVES

The management of stormwater runoff during the construction phase is a critical part of protecting the Yarrabilba waterways and drainage lines. Construction phase design objectives for Precinct 6 ROL1 are provided in Table 15 which are generally in accordance with the *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2024) and the State Planning Policy (DSDIP, 2017).

Table 15: Construction phase stormwater quality

Issue	Desired outcomes
Drainage control	1. Manage stormwater flows around or through areas of exposed soil to avoid contamination. 2. Manage sheet flows in order to avoid or minimise the generation of rill or gully erosion. 3. Provide stable concentrated flow paths to achieve the construction phase stormwater management design objectives for temporary drainage works (part 2). 4. Provide emergency spillways for sediment basins to achieve the construction phase stormwater management design objectives for emergency spillways on temporary sediment basins (part 3).
Erosion control	1. Stage clearing and construction works to minimise the area of exposed soil at any one time. 2. Effectively cover or stabilise exposed soils prior to predicted rainfall. 3. Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces must be effectively stabilised* using methods which will achieve effective short-term stabilisation.
Sediment control	1. Direct runoff from exposed site soils to sediment controls that are appropriate to the extent of disturbance and level of erosion risk. 2. All exposed areas greater than 2500 metres2 must be provided with sediment controls which are designed, implemented and maintained to a standard which would achieve at least 80% of the average annual runoff volume of the contributing catchment treated (i.e. 80% hydrological effectiveness) to 50mg/L Total Suspended Solids (TSS) or less, and pH in the range (6.5–8.5).
Litter, hydrocarbons and other contaminants	1. Remove gross pollutants and litter. 2. Avoid the release of oil or visible sheen to released waters. 3. Dispose of waste containing contaminants at authorised facilities.
Waterway stability and flood flow management	1. Where measures are required to meet post-construction waterway stability objectives (specified in table B), these are either installed prior to land disturbance and are integrated with erosion and sediment controls, or equivalent alternative measures are implemented during construction. 2. Earthworks and the implementation of erosion and sediment controls are undertaken in ways which ensure flooding characteristics (including stormwater quantity characteristics) external to the development site are not worsened during construction for all events up to and including the 1 in 100 year ARI (1% AEP).

*Note: An effectively stabilised surface is defined as one that does not, or is not likely to result in visible evidence of soil loss caused by sheet, rill or gully erosion or lead to sedimentation water contamination.

6.2 MANAGEMENT STRATEGY

6.2.1 Local Erosion and Sediment Control

Erosion and sediment control (ESC) will occur on a development stage by stage basis in accordance with *Best Practice Erosion and Sediment Control* (IECA, 2008) to achieve the objectives listed in Table 1. This will involve a combination of:

- Erosion control - Ensuring that all exposed surfaces are stabilised as soon as possible and that erosion of un-stabilised areas of works are minimised
- Drainage control - Ensuring that provision is made to control all on site runoff to designated treatment areas and to enable appropriate bypass of external flows which do not require treatment
- Sediment capture - Ensuring that mobilised sediment is captured through a combination of source controls such as silt fences and appropriately designed sediment basins. Where possible sediment basins for construction will be located within the voids required for the future stormwater quality treatment systems (sediment basins, bioretention basins, wetlands etc.).

The details of the local erosion and sediment controls for bulk earthworks and for each stage of development are not provided in this report given the high level nature of the document. However, prior to any works commencing on a particular development stage in Precinct 6 ROL3, a site specific Erosion and Sediment Control Plan (E&SCP) will be documented for the development stage in question prior to works starting. This will occur as part of the operational works application but can be adjusted by the contractor and site supervisor prior to commencement of construction provided the E&SCP complies with Best Practice Erosion and Sediment Control (IECA, 2008) and delivers the objectives listed previously in Table 15.

6.2.2 High Efficiency Sediment (HES) Basins

Given the importance of managing construction runoff into the waterways downstream of Yarrabilba and the potential impact on the ecology and residents, HES sediment basins are being strategically adopted (where practical) across Precinct 6 ROL3. HES basins offer an improved technology for construction sediment management which essentially converts batch sediment basins into continuous flow treatment systems that respond in real time to storm events. The design sought to be achieved by HES basins that ensures at least 80% of the average annual runoff volume treated to 50mg/L TSS or less

The HES basin essentially comprises:

- Flocculent dosing system
- Inlet zone for mixing, flow distribution and efficient removal of coarse sediment
- Settling basin
- Outlet(s)

Implementation of HES basins have the potential to significantly reduce the fine and dispersive sediment load discharge from the site by a further 50% compared to traditional batch sediment basins.

6.3 MONITORING AND AUDITING

6.3.1 Principal Contractor

Site inspections and monitoring are to be undertaken by the principal contractor in accordance with Sections 6.17 and 7.4 of *the Best Practice Erosion and Sediment Control Document* (IECA, 2008) as detailed below. Best practice site management requires all ESC measures to be inspected at the following frequencies and include the following checks as a minimum:

Daily site inspections (during rainfall):

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- All site discharge points (including dewatering activities as appropriate)

Weekly site inspections (even if work is not occurring on-site)

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
- Litter and waste receptors
- Oil, fuel and chemical storage facilities

Prior to anticipated runoff producing rainfall (within 24 hours of expected rainfall)

- All drainage, erosion and sediment control measures
- All temporary flow diversion and drainage works

Following runoff producing rainfall (within 18 hours of rainfall event)

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements

6.3.2 CPESC Compliance Audits

The ESC measures implemented at the site are proposed to be inspected on a bi-monthly to quarterly basis by a CPESC (Certified Professional in Erosion and Sediment Control) who is independent of the principal contractor and an audit report kept on file. The purpose of the audits to is to ensure the developer and the contractors are meeting their obligations for ESC under the Environmental Protection Act (EP Act). The site will be assessed against these requirements in accordance with *Procedural Guideline: Standard work method for the assessment of the lawfulness of releases to waters from construction sites in South East Queensland EM1135* (DEHP, 2011).

The compliance audits will involve:

- Site inspection with the contractors to assess ESC actions on the site against the ESC plans and the requirements of EP Act and DEHP Procedural Guideline.
- Identifying non-compliances on the site, photographing and recording these for reporting.
- Where the rectification action is simple, these will be recorded and verbally communicated to the contractor for action.
- Review of any water quality and rainfall information for the site
- Compilation of a ESC Audit report which:
    - Identifies the ESC obligations;
    - ESC issue and non-compliances; and
    - Actions (simple) to be taken to rectify the issues and non-compliances.

The triggers for inspections and reporting by the CPESC are as follows:

- Prior to the commencement of clearing works in each catchment;
- Prior to the commencement of bulk earthworks;
- Prior to the commencement of civil works; and
- At regular monthly intervals during works.

7 CONCLUSION

A stormwater management strategy for Yarrabilba Precinct 6 ROL3 development has been prepared to meet the requirements of the *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2024) and Context Plan Area Strategy.

The strategy adopts stormwater treatment measures including sediment pond and bioretention basins that manage the Precinct 6 ROL3 development area with consideration of future development catchments also. These treatment systems integrate with the local urban and natural environment to ensure the stormwater quality objectives are achieved for the precinct while providing protection or enhancement to the local waterways and amenity. Sufficient space has been allowed for in the development layout for the stormwater treatment measures which have been verified via preliminary layout plans.

Site design has also ensured all development lots are above the local 1% AEP flood level and provided with adequate flow conveyance for external catchment discharge. No flood detention infrastructure is required as part of the precinct as the regional flood basin (at Fauna Way) has already been constructed downstream as part of existing Precinct 3B works.

Local waterway stability management has been integrated into the overall development by considering the current condition of receiving waterways and proposing protection and/or rehabilitation strategies that incorporate local scour protection works, revegetation and exploiting natural regeneration process where practical. Minor flow management (as 63.2% AEP storage over treatment basins) is proposed for the P6 ROL3 western waterway where localised instability risks have been identified and arrant minor flow management.

Construction phase stormwater management objectives have been established for the site, in accordance with State Planning Policy (DSDIP, 2017). Preparation of detailed erosion and sediment control plan(s) are required prior to works commencing plus ongoing staging and updates to these plans to ensure the ESC strategy responds to the changing site conditions. Audits will be completed during construction to ensure compliance with State Planning Policy and Environment Protection Act.

8 REFERENCES

DesignFlow (2024) *Yarrabilba Stormwater Infrastructure Master Plan*

DesignFlow (2023) *Yarrabilba Waterway Condition Assessment*

DesignFlow (2024) *Yarrabilba Masterplan Flood Risk Management Strategy*

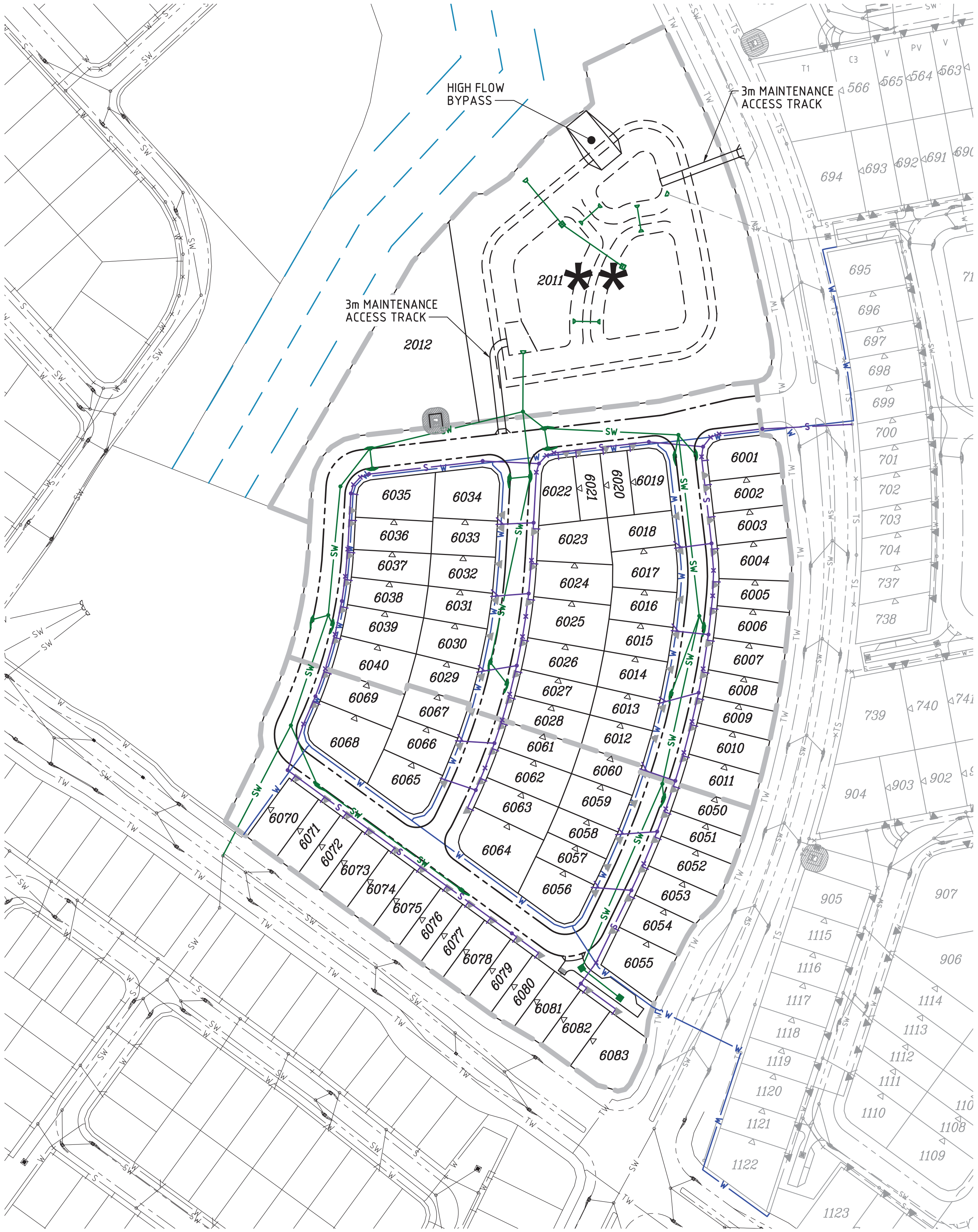
DSDIP (2017) *State Planning Policy*

IECA (2008) *Best Practice Erosion and Sediment Control*

Water by Design (2010). *MUSIC Modelling Guidelines. SEQ Healthy Waterways Partnership.*

Water by Design (2018) *MUSIC Modelling Guidelines.* Water by Design, Healthy Land and Water Limited, Brisbane, Queensland. (https://waterbydesign.com.au/download/music-guideline-2018)

APPENDIX A FUNCTIONAL DESIGN PLANS



SERVICES PLAN
SCALE 1:1000

LEGEND

	STAGE BOUNDARY
	PROPOSED KERB FACE
S	PROPOSED SEWER
TS	PROPOSED TRUNK SEWER
SW	PROPOSED STORMWATER
W	PROPOSED WATER
TW	PROPOSED TRUNK WATER
S	EXISTING SEWER
TS	EXISTING TRUNK SEWER
SW	EXISTING STORMWATER
W	EXISTING WATER
TW	EXISTING TRUNK WATER
**	BIO BASIN/SEDIMENT POND REFER DESIGNFLOW'S REPORT: SMP - PRECINCT 6

SCALE 10 5 0 10 20 30 40 50 60 70 80 90 100m
1 : 1000 (A1 UNREDUCED)

FOR APPROVAL

REVISIONS

No	Description	DR	DES	CHK	Date
A	FOR APPROVAL	JAS	JAS	RWM	12.05.25

Project
YARRABILBA
PRECINCT 6 - ROL3 FUNCTIONAL DRAWINGS

Client
Stockland

Approved - RPEQ 12805
Digitally signed by Robert William Mander BEng (Civil), CPEng, RPEQ 12805
Date: 2025.05.14 17:15:42+10'00'

NORTH
DO NOT SCALE THIS DRAWING
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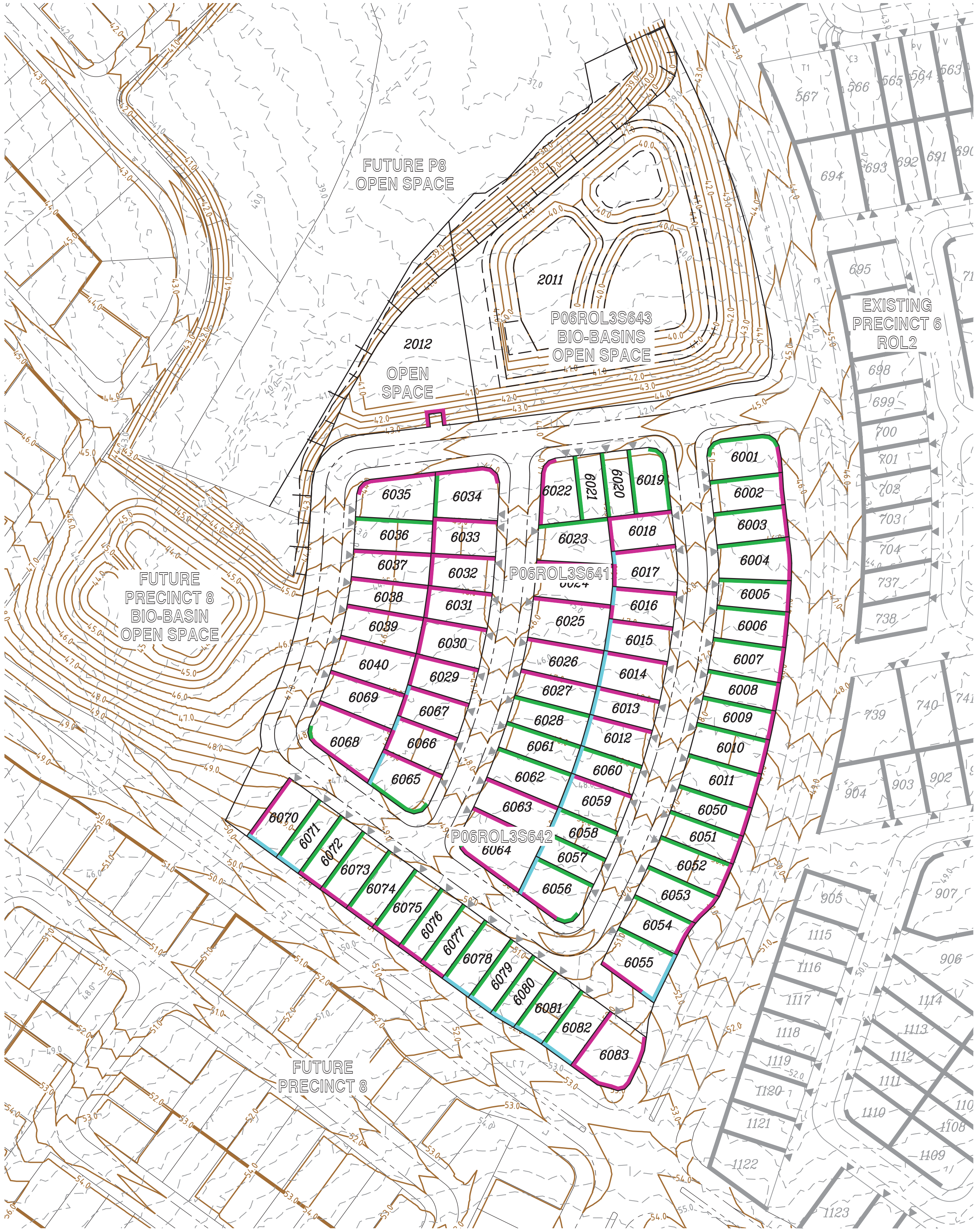
Application No.
-

kn group
L1, 62 Astor Terrace, Spring Hill, QLD 4000
www.kngroup.com.au | 07 3017 1900

Drawing Title
P06ROL3 FUNCTIONAL LAYOUT SERVICES PLAN

Scale: AS SHOWN
Sheet: 02 of 03
A1
Drawing No: 21-233-SK152
Revision: A

M:\2021\21233 Yarrabilba Precinct 6 Preliminary Support\Engineering\Acad\21-233-SK152-P06ROL3-FUNC-SERVICES.dwg Plotted by: JS on Wed May 14 17:12:55 2025



EARTHWORKS PLAN

SCALE 1:1000

LEGEND

- PROPOSED KERB FACE
- PRELIMINARY CONTOURS
- EXISTING CONTOURS (LIDAR)
- BATTER LINE - TOP
- BATTER LINE - BOTTOM
- PROPOSED BATTER <0.4m
- PROPOSED RETAINING WALL 0.4-1.0m
- PROPOSED RETAINING WALL 1.0-2.0m
- PROPOSED RETAINING WALL 2.0-2.5m

SCALE

10 5 0 10 20 30 40 50 60 70 80 90 100m

1 : 1000 (A1 UNREDUCED)

FOR APPROVAL

REVISIONS					
No	Description	DR	DES	CHK	Date
A	FOR APPROVAL	JAS	JAS	RWM	12.05.25

Project

YARRABILBA

PRECINCT 6 - ROL3 FUNCTIONAL DRAWINGS

Client

Stockland

Approved - RPEQ 12805

Digitally signed by Robert William Mander BEng (Civil), CPEng, RPEQ 12805
Date: 2025.05.14 17:15:42+10'00'

NORTH

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Application No.

-

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Drawing Title

P06ROL3 FUNCTIONAL LAYOUT EARTHWORKS PLAN

Scale: AS SHOWN

Sheet: 03 of 03

A1

Drawing No: 21-233-SK153

Revision: A

M:\2021\21233 Yarrabilba Precinct 6 Preliminary Support\Engineering\Acad\21-233-SK153-P06ROL3-FUNC-EWKS.dwg Plotted by: JS on Wed May 14 17:13:02 2025

APPENDIX B P6 ROL3 WATERWAY INSPECTION SUMMARY

P6 ROL3 Waterway Inspection

The Precinct 6 ROL3 waterway inspection photo log summary is provided in the following sections with chainage references identified in Figure B1. All chainages commence at zero at the downstream extent/confluence of P6 ROL1. Inspection was carried out 28 August 2023 as part of the previous P6 ROL1 andROL2 site planning.

Note: The waterway assessment has been reproduced from the previous Precinct 6 ROL2 assessment information as this is common to the subject development areas.

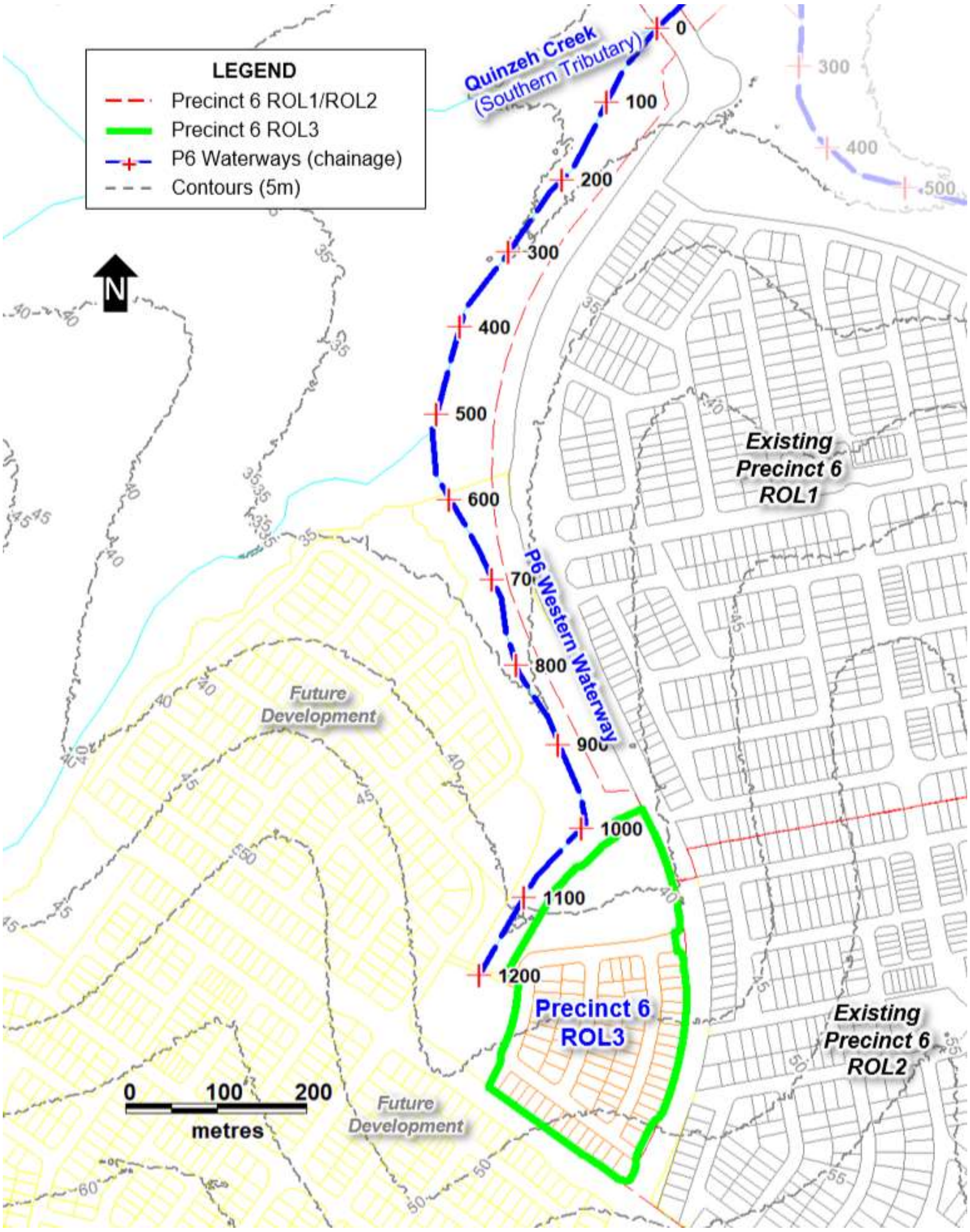


Figure B1: P6 western waterway inspection reference plan

P6 WESTERN WATERWAY


CH0-50 Low flow channel evident with isolated scour pool (dry) approx. 10m long, 3m wide surrounded by dense groundcover vegetation. Fill, provide rock lining and interplant with grasses/shrubs. Will likely form part of road crossing works.


CH50-100 Low flow channel evident with emergent wetland plants (now dry and died back). Surrounding area densely vegetated with grasses/shrubs. Monitor area as development progresses to assess resilience. No obvious instability at present.


CH100-450 Broad grassed flow path with scattered trees. No defined low flow or scour zones. Minor livestock/feral pig disturbance locally. Occasional shallow flow path evident on animal trail but low gradient minimizes instability. Grazing of grasses evident from vegetation height. Monitor and plant disturbed areas if natural regeneration is slow.

P6 WESTERN WATERWAY

CH450-820 Shrub/tree density increases (compared to downstream) with grass cover (and height) increasing. Broad well vegetated flow path with minimal defined low flow channel in most parts. No obvious instability observed.

CH820-950 Minor low flow channel (periodically) but very localised and on very low gradient. Scattered shallow scour pools (dry) likely partly from livestock trail and disturbance. Low risk. Monitor and plant disturbed areas if natural regeneration is slow.

CH950-1000 Localised open grassed area with lower tree density. Broad flat area likely shallow ponding in wet periods with scattered wetland plants now died back (now dry). Adjacent to former vehicle track crossing. No obvious scour or instability present.

P6 WESTERN WATERWAY


CH1000-1120 Shallow low flow channel commences and extends upstream with gradual deepening and evidence of scour. Fallen logs increase scour locally (while still shallow). Surrounding area broad, flat and well grassed. Vehicle track crossing at CH1120 with localised washout of gravel. Local filling with non-dispersive soil and revegetation. Monitor stability and natural regeneration of vegetation surrounding. Where continued instability occurs in low flow, local rock scour protection may be required.


CH1120-1150 Sand deposition zone from upstream scour zone. Minor low flow channel evident but remains shallow.

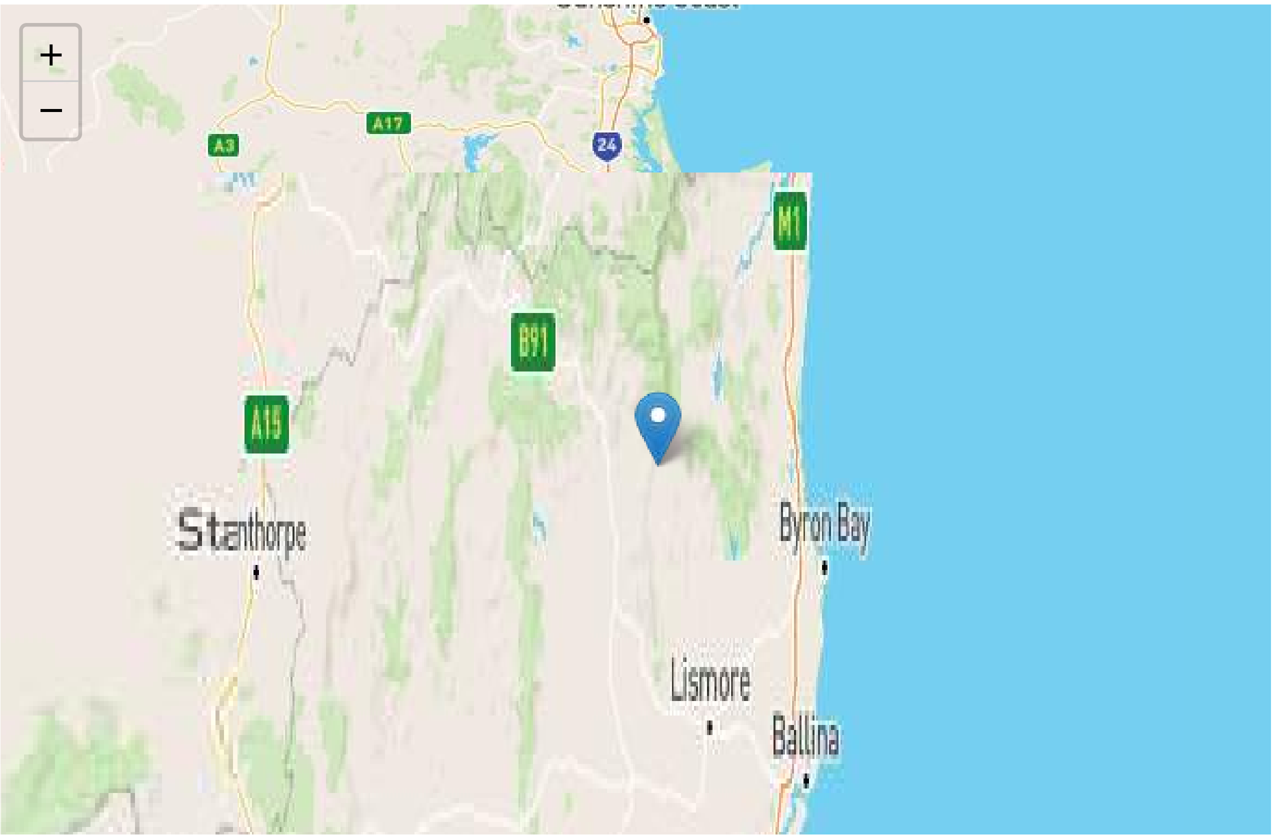

CH1150-1200 Commencement of incised low flow channel with vertical sides and local undercutting of trees. Depth varies <0.5. to 1m. Soil appears to be weak/dispersive. Fallen logs may be exacerbating local scour in flow path. At CH1200, a significant head-cut exists ~0.8-1m deep and 5-6m across. No obvious steep or defined flow paths into this location. Soils may be an issue here. Cemented layer at ~0.6-0.8m depth which appears to have been weaker in wet period. Reshape and backfill with non-dispersive soil, revegetate and monitor stability. Rock may be required to manage grade change at head-cut.

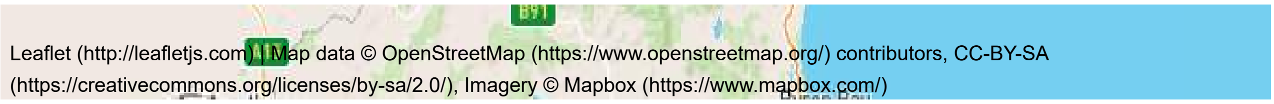
APPENDIX C ARR DATA HUB

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	153.122
Latitude	-27.835
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Climate Change Factors	show





Data

River Region

Division	North East Coast
River Number	45
River Name	Logan-Albert Rivers

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i
East Coast North	0.327	0.241	0.448	0.36	0.00096	0.48	-0.21	0.012	-0.0013

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26 \text{ x } 10^{-3} \text{ x } Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141 \text{ x } Area^{0.213} \text{ x } 10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

ID	5092.0
Storm Initial Losses (mm)	26.0
Storm Continuing Losses (mm/h)	1.9

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/ECnorth.zip)

code	ECnorth
Label	East Coast North

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_ECnorth.zip)

code	ECnorth
arealabel	East Coast North

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-27.835&longitude=153.122&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	01 May 2025 10:44AM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.9 (0.027)	3.0 (0.063)	4.4 (0.077)	5.7 (0.086)	8.4 (0.107)	10.4 (0.118)
90 (1.5)	0.5 (0.014)	2.7 (0.050)	4.2 (0.064)	5.5 (0.073)	11.9 (0.131)	16.7 (0.162)
120 (2.0)	0.4 (0.009)	7.0 (0.118)	11.4 (0.159)	15.6 (0.185)	17.6 (0.174)	19.2 (0.166)
180 (3.0)	0.8 (0.017)	8.4 (0.125)	13.5 (0.165)	18.3 (0.190)	23.3 (0.199)	27.0 (0.201)
360 (6.0)	2.1 (0.034)	12.6 (0.145)	19.5 (0.185)	26.2 (0.208)	44.5 (0.289)	58.2 (0.329)
720 (12.0)	2.7 (0.034)	11.0 (0.095)	16.4 (0.116)	21.7 (0.128)	41.3 (0.200)	56.0 (0.235)
1080 (18.0)	2.3 (0.024)	11.9 (0.086)	18.3 (0.108)	24.4 (0.121)	36.4 (0.147)	45.4 (0.160)
1440 (24.0)	3.6 (0.034)	7.7 (0.049)	10.3 (0.054)	12.9 (0.056)	29.2 (0.104)	41.4 (0.129)
2160 (36.0)	0.0 (0.000)	4.6 (0.025)	7.6 (0.033)	10.5 (0.039)	22.7 (0.068)	31.8 (0.083)
2880 (48.0)	0.0 (0.000)	1.2 (0.006)	2.0 (0.008)	2.8 (0.009)	13.1 (0.035)	20.8 (0.049)
4320 (72.0)	0.0 (0.000)	0.1 (0.000)	0.2 (0.001)	0.3 (0.001)	4.7 (0.011)	8.1 (0.017)

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.2 (0.004)	0.4 (0.006)	0.5 (0.007)	0.5 (0.006)	0.5 (0.006)
90 (1.5)	0.0 (0.000)	0.2 (0.003)	0.3 (0.004)	0.4 (0.005)	1.0 (0.011)	1.5 (0.014)
120 (2.0)	0.0 (0.000)	0.8 (0.013)	1.3 (0.018)	1.7 (0.021)	1.3 (0.013)	1.0 (0.009)
180 (3.0)	0.0 (0.000)	0.2 (0.003)	0.4 (0.005)	0.5 (0.005)	0.8 (0.007)	1.0 (0.007)
360 (6.0)	0.0 (0.000)	0.6 (0.007)	1.0 (0.009)	1.4 (0.011)	4.0 (0.026)	6.0 (0.034)
720 (12.0)	0.0 (0.000)	2.1 (0.019)	3.6 (0.025)	4.9 (0.029)	8.6 (0.042)	11.4 (0.048)
1080 (18.0)	0.0 (0.000)	1.9 (0.014)	3.1 (0.019)	4.3 (0.021)	6.2 (0.025)	7.6 (0.027)
1440 (24.0)	0.0 (0.000)	0.1 (0.000)	0.1 (0.001)	0.2 (0.001)	4.2 (0.015)	7.2 (0.022)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.4 (0.001)	0.7 (0.002)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	16.8 (0.483)	28.4 (0.592)	36.2 (0.632)	43.6 (0.656)	39.8 (0.505)	37.0 (0.418)
90 (1.5)	14.6 (0.372)	23.0 (0.423)	28.6 (0.438)	33.9 (0.446)	65.5 (0.717)	89.2 (0.863)
120 (2.0)	10.6 (0.249)	29.6 (0.498)	42.3 (0.590)	54.4 (0.648)	93.7 (0.924)	123.1 (1.068)
180 (3.0)	30.2 (0.628)	49.4 (0.730)	62.1 (0.757)	74.2 (0.768)	112.9 (0.961)	141.9 (1.056)
360 (6.0)	32.4 (0.533)	51.6 (0.595)	64.3 (0.608)	76.4 (0.608)	117.9 (0.767)	149.0 (0.842)
720 (12.0)	37.7 (0.472)	59.1 (0.512)	73.2 (0.518)	86.8 (0.514)	112.1 (0.543)	131.1 (0.552)
1080 (18.0)	21.8 (0.229)	51.6 (0.375)	71.4 (0.422)	90.3 (0.446)	109.2 (0.441)	123.3 (0.434)
1440 (24.0)	28.9 (0.270)	47.5 (0.304)	59.7 (0.311)	71.5 (0.311)	84.8 (0.302)	94.7 (0.294)
2160 (36.0)	12.6 (0.100)	24.8 (0.134)	32.8 (0.144)	40.5 (0.149)	60.3 (0.181)	75.0 (0.197)
2880 (48.0)	12.9 (0.092)	27.2 (0.132)	36.7 (0.144)	45.8 (0.150)	62.4 (0.168)	74.9 (0.176)
4320 (72.0)	0.2 (0.001)	10.6 (0.045)	17.5 (0.060)	24.1 (0.070)	45.7 (0.108)	62.0 (0.128)

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	62.6 (1.799)	98.4 (2.049)	122.1 (2.134)	144.8 (2.183)	135.1 (1.713)	127.7 (1.442)
90 (1.5)	51.1 (1.304)	76.1 (1.398)	92.7 (1.419)	108.5 (1.425)	190.8 (2.088)	252.5 (2.441)
120 (2.0)	37.0 (0.868)	76.9 (1.293)	103.4 (1.443)	128.7 (1.533)	190.3 (1.878)	236.4 (2.051)
180 (3.0)	70.6 (1.468)	108.2 (1.598)	133.0 (1.623)	156.9 (1.623)	241.6 (2.057)	305.2 (2.271)
360 (6.0)	59.6 (0.981)	106.5 (1.229)	137.6 (1.301)	167.3 (1.331)	245.1 (1.594)	303.4 (1.715)
720 (12.0)	88.8 (1.111)	125.2 (1.086)	149.3 (1.056)	172.4 (1.021)	220.3 (1.066)	256.2 (1.078)
1080 (18.0)	57.8 (0.609)	95.5 (0.693)	120.4 (0.711)	144.4 (0.714)	179.0 (0.724)	205.0 (0.722)
1440 (24.0)	77.7 (0.724)	103.3 (0.661)	120.3 (0.626)	136.6 (0.594)	166.3 (0.592)	188.6 (0.586)
2160 (36.0)	37.6 (0.297)	76.9 (0.415)	102.9 (0.451)	127.8 (0.469)	149.7 (0.449)	166.0 (0.435)
2880 (48.0)	44.2 (0.314)	75.2 (0.364)	95.7 (0.375)	115.4 (0.379)	147.8 (0.397)	172.1 (0.404)
4320 (72.0)	14.4 (0.090)	40.5 (0.172)	57.7 (0.199)	74.3 (0.215)	94.1 (0.222)	109.0 (0.224)

Layer Info

Time Accessed	01 May 2025 10:44AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Climate Change Factors

Rainfall Factors

SSP1-2.6

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.12**	**1.12**	**1.11**	**1.1**	**1.1**
2040	1.21	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.11	1.11
2050	**1.22**	**1.2**	**1.18**	**1.17**	**1.15**	**1.15**	**1.14**	**1.13**	**1.12**	**1.11**
2060	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2070	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2080	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2090	**1.23**	**1.21**	**1.2**	**1.18**	**1.17**	**1.16**	**1.15**	**1.14**	**1.13**	**1.12**
2100	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12

SSP2-4.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.12**	**1.12**	**1.11**	**1.1**	**1.1**
2040	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12
2050	**1.27**	**1.24**	**1.23**	**1.21**	**1.19**	**1.18**	**1.17**	**1.16**	**1.15**	**1.14**
2060	1.3	1.27	1.25	1.23	1.21	1.2	1.19	1.18	1.16	1.16
2070	1.33	1.3	1.28	1.26	1.24	1.22	1.21	1.19	1.18	1.17
2080	1.37	1.33	1.31	1.28	1.26	1.24	1.22	1.21	1.2	1.19
2090	**1.4**	**1.36**	**1.34**	**1.31**	**1.28**	**1.26**	**1.24**	**1.23**	**1.21**	**1.2**
2100	1.41	1.37	1.35	1.32	1.29	1.27	1.25	1.24	1.22	1.21

SSP3-7.0

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.12**	**1.12**	**1.11**	**1.1**	**1.1**
2040	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2050	**1.29**	**1.26**	**1.24**	**1.22**	**1.2**	**1.19**	**1.18**	**1.17**	**1.16**	**1.15**
2060	1.35	1.32	1.3	1.27	1.25	1.23	1.22	1.2	1.19	1.18
2070	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2080	1.5	1.45	1.42	1.38	1.35	1.33	1.3	1.28	1.26	1.25
2090	**1.59**	**1.53**	**1.49**	**1.44**	**1.4**	**1.38**	**1.35**	**1.33**	**1.3**	**1.29**
2100	1.66	1.59	1.55	1.5	1.45	1.42	1.39	1.37	1.34	1.32

SSP5-8.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.2**	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.13**	**1.12**	**1.11**	**1.11**
2040	1.26	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.14
2050	**1.34**	**1.31**	**1.29**	**1.26**	**1.24**	**1.23**	**1.21**	**1.2**	**1.18**	**1.18**
2060	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21
2070	1.52	1.47	1.43	1.4	1.36	1.34	1.31	1.29	1.27	1.26
2080	1.63	1.57	1.52	1.48	1.43	1.4	1.37	1.35	1.33	1.31
2090	**1.77**	**1.69**	**1.64**	**1.58**	**1.52**	**1.49**	**1.45**	**1.42**	**1.39**	**1.37**
2100	1.86	1.77	1.71	1.64	1.58	1.54	1.5	1.47	1.43	1.41

Loss Factors

Initial Loss (Adjustment Factors)

	Losses SSP1-2.6	Losses SSP2-4.5	Losses SSP3-7.0	Losses SSP5-8.5
2030	**1.02**	**1.02**	**1.02**	**1.03**
2040	1.03	1.03	1.03	1.03
2050	**1.03**	**1.03**	**1.04**	**1.04**
2060	1.03	1.04	1.04	1.05
2070	1.03	1.04	1.05	1.06
2080	1.03	1.05	1.06	1.07
2090	**1.03**	**1.05**	**1.07**	**1.08**
2100	1.03	1.05	1.07	1.09

Continuing Loss (Adjustment Factors)

	Losses SSP1-2.6	Losses SSP2-4.5	Losses SSP3-7.0	Losses SSP5-8.5
2030	**1.04**	**1.05**	**1.05**	**1.05**
2040	1.05	1.05	1.06	1.06

	Losses SSP1-2.6	Losses SSP2-4.5	Losses SSP3-7.0	Losses SSP5-8.5
2050	**1.06**	**1.06**	**1.07**	**1.08**
2060	1.06	1.07	1.08	1.1
2070	1.06	1.08	1.1	1.12
2080	1.06	1.09	1.11	1.14
2090	**1.06**	**1.09**	**1.13**	**1.16**
2100	1.06	1.1	1.14	1.18

Temperature Changes (Degrees, Relative to 1961-1990 Baseline)

Year	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
2030	**1.2**	**1.2**	**1.2**	**1.3**
2040	1.3	1.4	1.5	1.6
2050	**1.4**	**1.7**	**1.8**	**2.1**
2060	1.5	1.9	2.2	2.5
2070	1.5	2.1	2.5	3
2080	1.5	2.2	2.9	3.5
2090	**1.5**	**2.4**	**3.3**	**4.1**
2100	1.4	2.5	3.6	4.5

Layer Info

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Note	Updated climate change factors for IFD Initial loss and continuing loss based on IPCC AR6 temperature increases from the updated Climate Change Considerations (Book 1: Chapter 6) in ARR (Version 4.2). ARR recomends the use of Current and near-term (2030 midpoint). Medium-term (2050 midpoint) and Long-term (2090 midpoint)

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