YARRABILBA
PRECINCT 6 ROL1
STORMWATER MANAGEMENT PLAN

VERSION 1

DesignFlow
Prepared for Lendlease
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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 a 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 ROL1 (subject site) covers an area of approximately 52 hectares (ha) which includes just over 24 ha of development lots, 16.5 ha of roads and around 11.4 ha of open space, waterway corridor and stormwater treatment areas.

This document presents the stormwater management strategy for the subject site to meet the requirements set out in the Context Planning Area Strategy. These are generally consistent with the S*tate Planning Policy*, *Yarrabilba Total Water Cycle Management Strategy* (DesignFlow, 2021) and *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2021). This report provides details of the proposed stormwater treatment measures including location, conceptual sizing and functional earthworks.

This report focusses on the construction phase erosion/sediment control and operational phase stormwater quality and waterway elements specific to Precinct 6 ROL1. Flood management has been addressed separately in *the Yarrabilba (Quinzeh Creek) Flood Study – Version 1* (DesignFlow, 2017) as the flood management strategy spans numerous current and future precincts requiring site wide planning. No flood infrastructure is required within the subject precinct.

2 SITE CHARACTERISTICS

2.1 LOCATION

Development Precinct 6 ROL1 lies in the central portion of the Lendlease site bordering the western edge of existing Precinct 4 as shown in Figure 1. The precinct covers a total area of approximately 52ha. It forms the northern half 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 the majority of the precinct exhibits fairly consistent grades of around 4-5% falling north, east and west from a central ridgeline. Waterway corridors define the eastern and western edges of proposed development. The confluence of these waterways defines the northern apex of the proposed urban area with the northern access road extending north from this point. Elevations vary from 52mAHD to 28mAHD within the site. The site and topography is shown in Figure 2.

Precinct 6 ROL1 sits generally within Catchment 4 of the broad 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 ROL1 is to the existing waterways on the western and eastern boundaries which flow to the southern tributary of Quinzeh Creek as illustrated in Figure 1. These watercourses are mapped as drainage feature 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 ROL1.

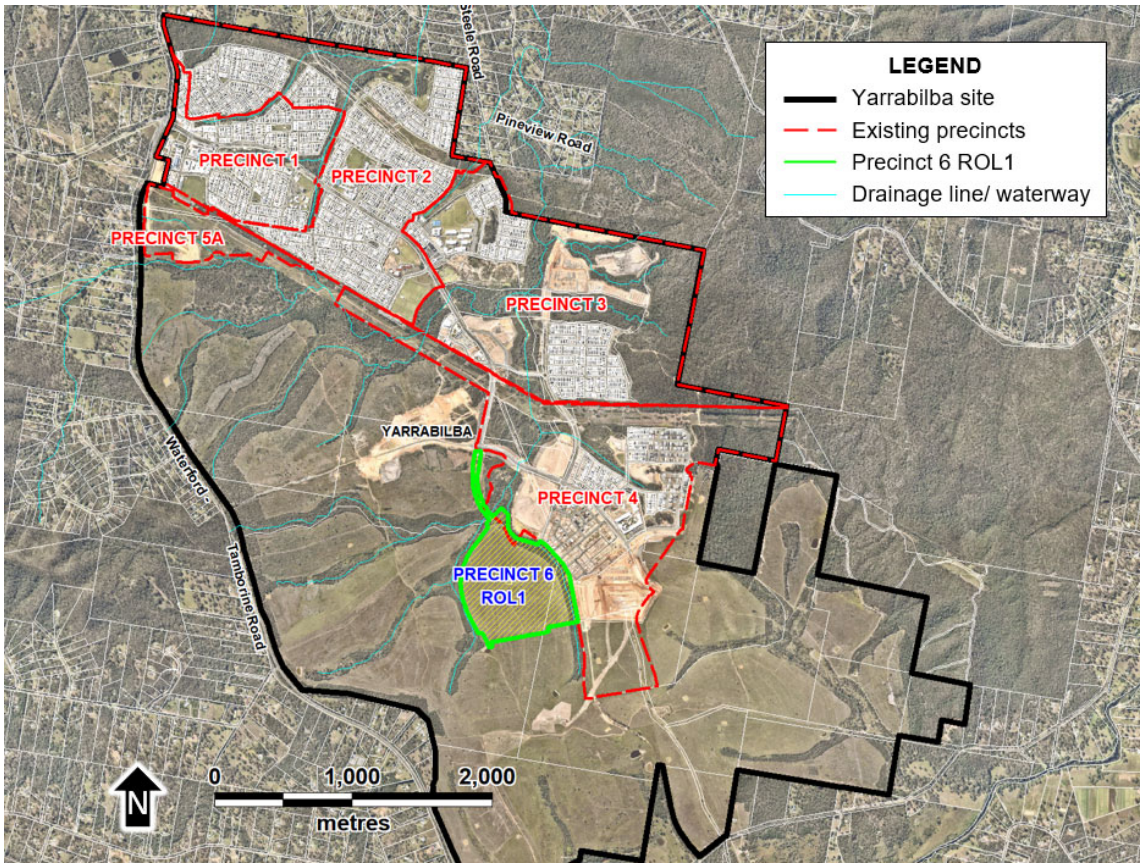


Figure 1: Yarrabilba Precinct 6 ROL1 locality

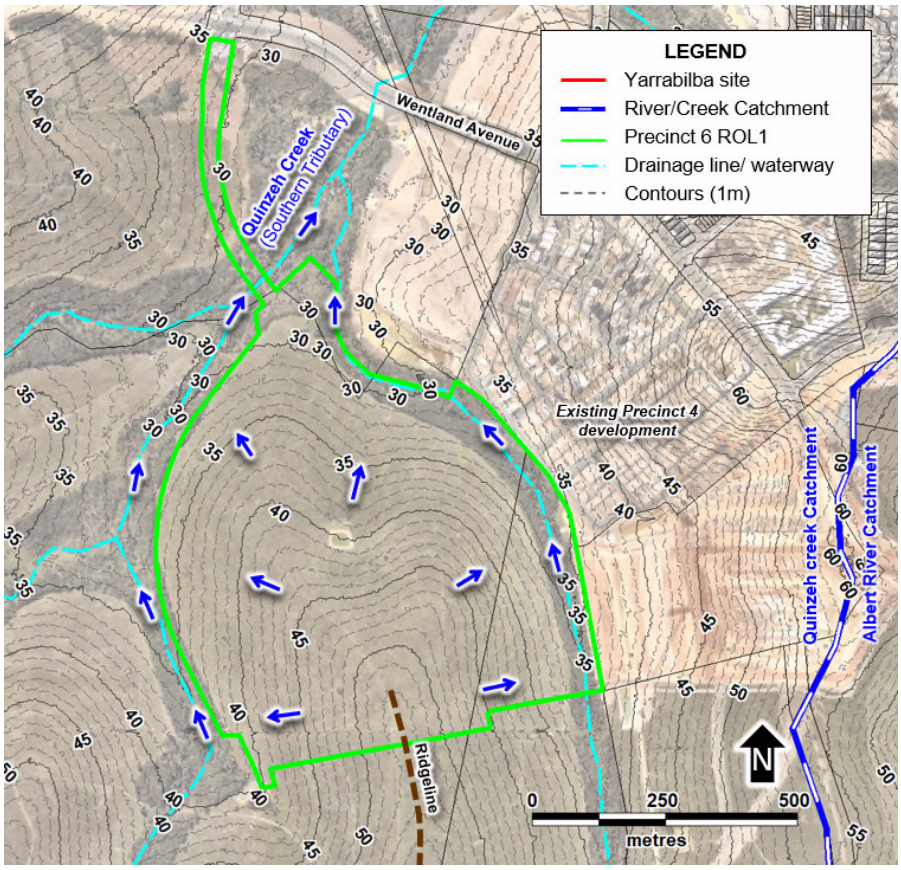


Figure 2: Existing topography, catchments and drainage

2.3 GEOLOGY AND SOILS

Geological mapping indicates Precinct 6 ROL1 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 ROL1 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 (perimeter of P6 ROL1) 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 ROL1 to confirm soil conditions for civil engineering design.

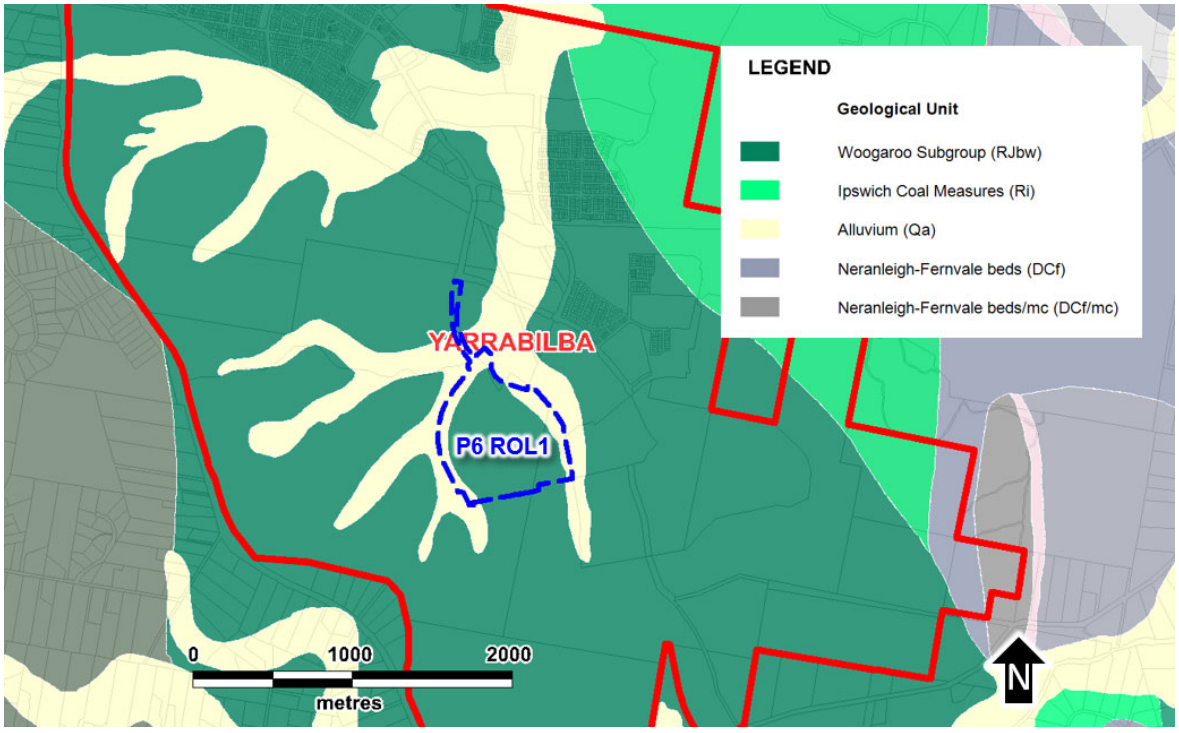


Figure 3: Geology and soils

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 roughly 80% of the existing land use across the Yarrabilba site, which have subsequently been covered with regrowth. 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, 2012) 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 ROL1 development.

2.5 WATERWAYS

Retained waterways exist on the western and eastern extents of P6 ROL1 and are ephemeral in nature. The overall condition of the eastern waterway is generally rated as a mix of poor (upper reaches) to average (lower reaches) with some areas of good condition (middle reaches) in the *Yarrabilba General Waterway Condition Assessment* (DesignFlow, 2021). Future management/rehabilitation will be important to the improvement of these waterways for long term ecological and geomorphological benefits.

The eastern waterway lies within the P6 ROL1 boundary and receives treated discharge from proposed bioretention basins in the eastern side of P6 ROL1. This waterway has been assessed in detail as part of previous Precinct 4 development assessment and the details provide in this report are derived directly from the previously approved strategy.

The western waterway is broadly defined as good overall condition based on the above condition assessment 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. The western waterway lies outside the P6 ROL1 boundary and no direct low flow discharge (less than 63.2% AEP) is proposed as part of this northern development zone of Precinct 6. Therefore, no further assessment in relation to waterway stability is included in this report (other than the relevant development setbacks to waterway buffers, vegetation and/or flooding). This waterway will be assessed further as part of future development to the south and west of P6 ROL1.

Both waterways have been included in the site planning for the purpose of assigning the minimum waterway buffers set out in the *Stormwater Infrastructure Master Plan* (DesignFlow, 2021). In conjunction with existing vegetation and bushfire considerations, the development extent has been defined outside this waterway corridor.

2.6 PROPOSED DEVELOPMENT

The proposed development covers an area of approximately 52 ha which includes just over 24 ha of development lots, 16.5 ha of roads and around 11.4 ha of open space, waterway corridor and stormwater treatment areas. The precinct layout is shown in Figure 4.

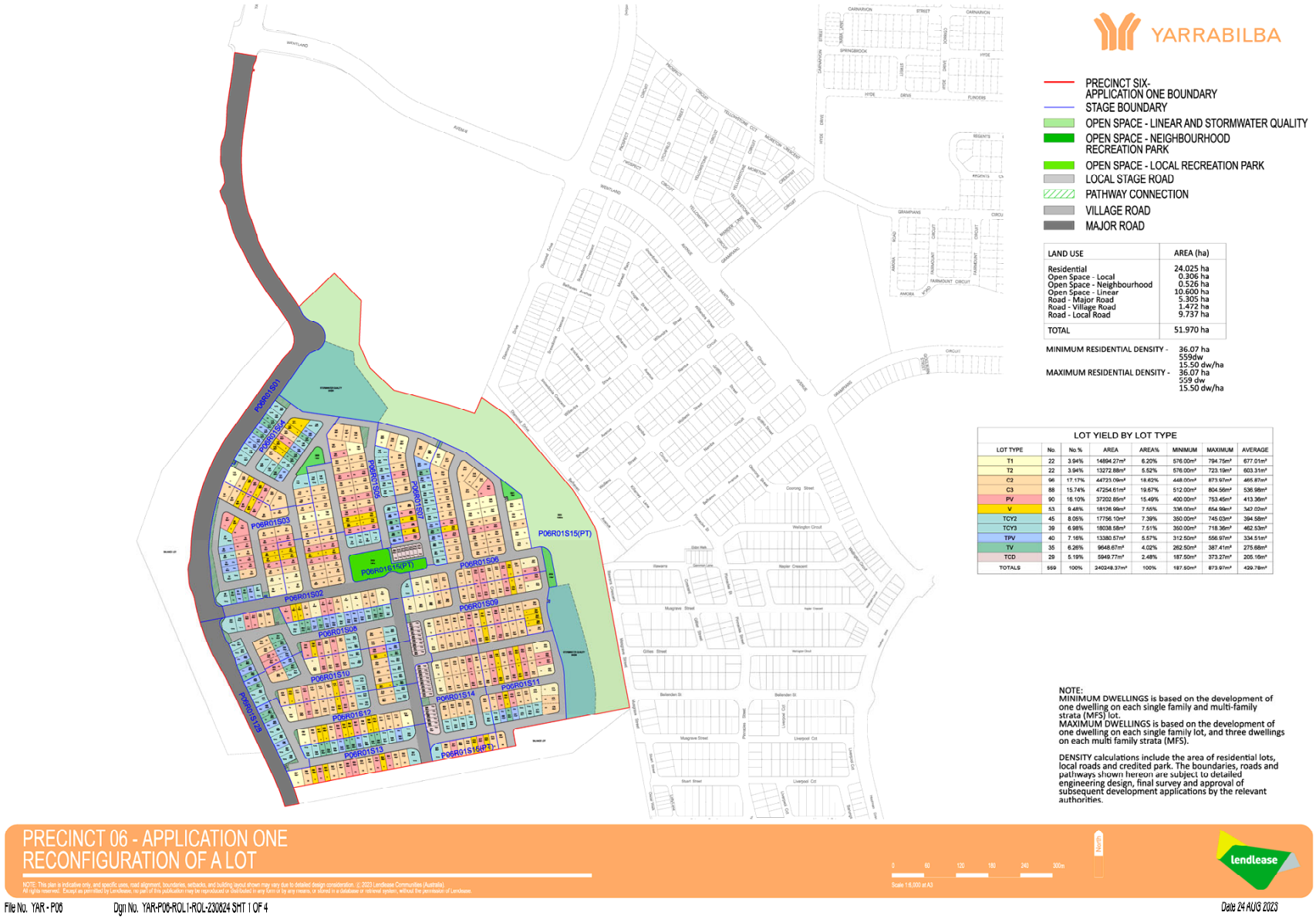


Figure 4: Precinct 6 ROL1 proposed layout

3 STORMWATER QUALITY

3.1 DESIGN OBJECTIVES

The stormwater quality management objectives that apply to the operational phase of Yarrabilba Precinct 6 ROL1 are listed in Table 5 as defined by *the Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2021), 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 ROL1 based on a review of the site characteristics, constraints, masterplan for the proposed development zones and discussions with Lendlease. 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.

When developing the treatment strategy, a number of 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, 2021)
- 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 ROL1 with details of treatment provided in Table 2 and the relevant flood immunity provided in Table 3 and Table 4. Further details of performance assessments of the proposed treatment strategy are presented in Section 3.3.

The treatment basin on the eastern side of P6 ROL1 will be expanded in future to capture development to the south of P6 ROL1 (preliminary catchment 6B2 shown in Figure 5). A Separate SMP will be prepared for this future development area with verification of the treatment strategy associated with this report.

Two minor catchments 6N1 and 6N2 (formed by the northern access road to Precinct 6 ROL1) discharge east into a future precinct which will ultimately form part of the Town Centre (a precinct scale stormwater treatment area). An allowance for temporary grassed swales has been made at these outlets. As development works in the surrounding precinct(s) proceeds, a high efficiency sediment (HES) basin will be installed here to capture discharge from this minor part of Precinct 6 ROL1 (and surrounding areas) until the ultimate town centre treatment systems are installed.

Table 2: Stormwater treatment elements

Treatment Type and ID	Size	Catchments	Comment
Sediment Pond 6A1/6A2 Bioretention 6A3-6A5	2 x 300 m² 3 x 800 m²	6A1, 6A2	Multi basin treatment system
Sediment Pond 6B1 [1] Bioretention 6B3 [1]	300 m² 700 m²	6B1	Multi basin treatment system
Sediment Pond 6B2 [2] *Bioretention 6B4 [2]*	*300 m²* *700 m²*	*6B2 [1]*	
Sediment pond/ wetland/ / bioretention (future town centre treatment)	TBA	6N1, 6N2 (plus future town centre zone)	Future precinct scale treatment system for town centre zone. Interim sediment basin function
Swale 6N1/6N2	2 x 40m	6N1, 6N2	Temporary (to be replaced in future with town centre treatment systems)

Note:

1. Sediment ponds 6B1 and/or 6B2 may be omitted and replaced with sediment forebays (depending on ultimate catchment, landscape and basin configuration). If this occurs further MUSIC modelling will occur to ensure overall treatment objectives are achieved.
2. Sed 6B2/Bio 6B4 (catchment 6B2) is shown for reference only as part of the overall multi-basin treatment area linked to Sed 6B1/Bio 6B3 (catchment 6B1). No MUSIC modelling of this system is provided here as this will be address as part of future ROL2.

The concept design for the proposed sediment ponds and bioretention basins has been documented in the functional design plans by KN Group (Appendix A). Key design parameters are summarised in Table 3 and Table 4. 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. sed ponds may be replaced with sediment forebays).

Table 3: Northern treatment zone concept design levels summary

Parameter	Sed 6A1/6A2	Bio 6A3-6A5
Area	2 x 300 m²	3 x 800 m²
Surface level	RL31.1	RL31.0
Bunds	RL32.0 (min.)	
1% AEP flood	29.33/29.64	29.56

Table 4: Eastern treatment zone concept design levels summary

Parameter	Sed 6B1 [1, 2]	Bio 6B3 [1]
Area	300 m²	700 m²
Surface level	RL37.6	RL37.5
Bunds	RL38.5 (min.)	
1% AEP flood	35.35	35.75

Note:

1. Future duplication of the sed pond and bioretention basin will occur as part of development area south of ROL1. A new sed pond 6B2 and Bio 6B4 will be included in this area with similar parameters to above.
2. Sed pond 6B1 may be replaced with sediment forebay where catchment or landscape design dictates layout changes in this zone.

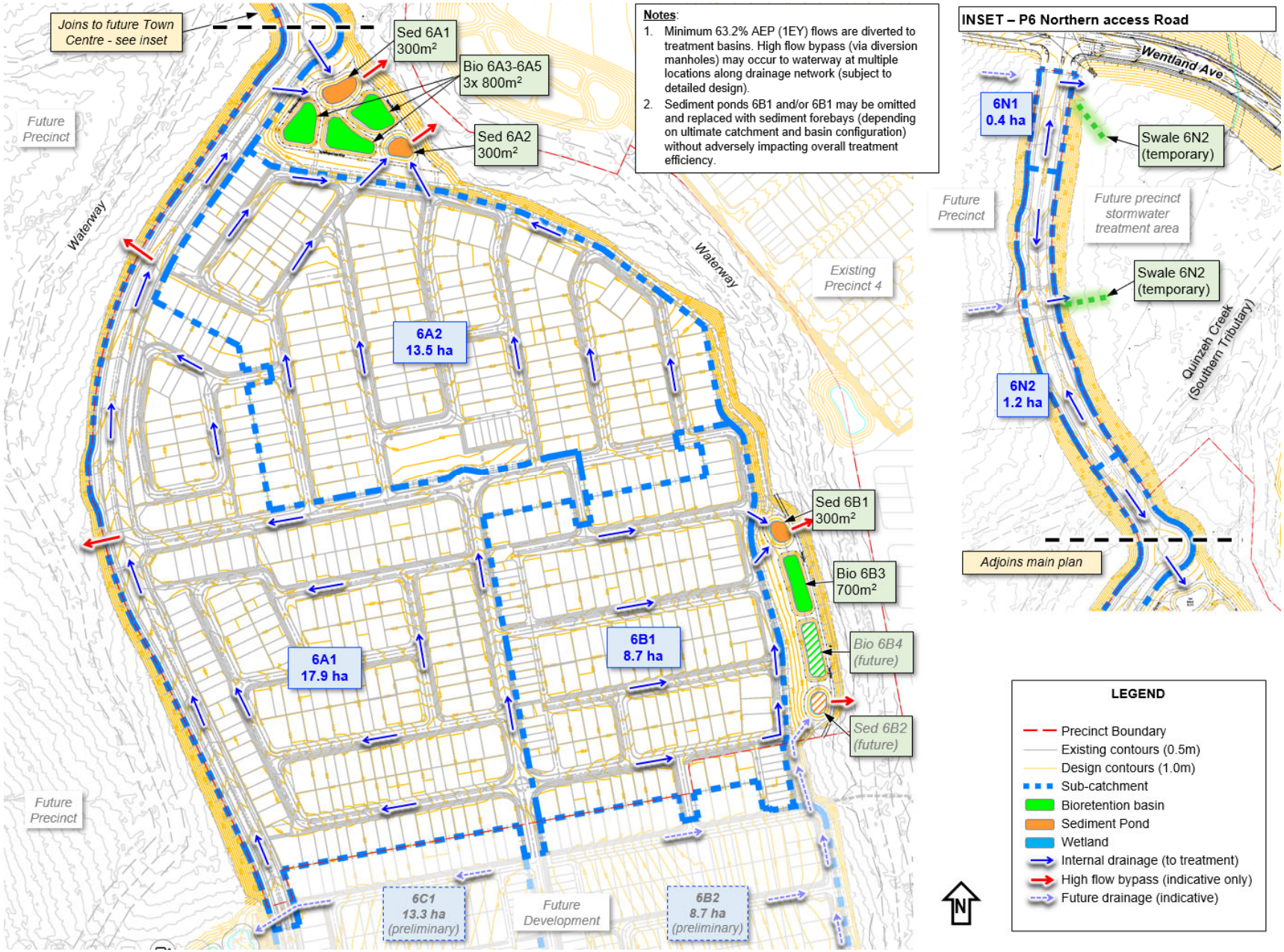


Figure 5: Precinct 6 ROL1 stormwater quality management strategy

3.3 STORMWATER QUALITY ASSESSMENT

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

3.3.1 Model Structure

The structure of the MUSIC model is shown in Figure 6 with the general data provided in Table 5. MUSIC model parameters were adopted generally in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010/2019) 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.

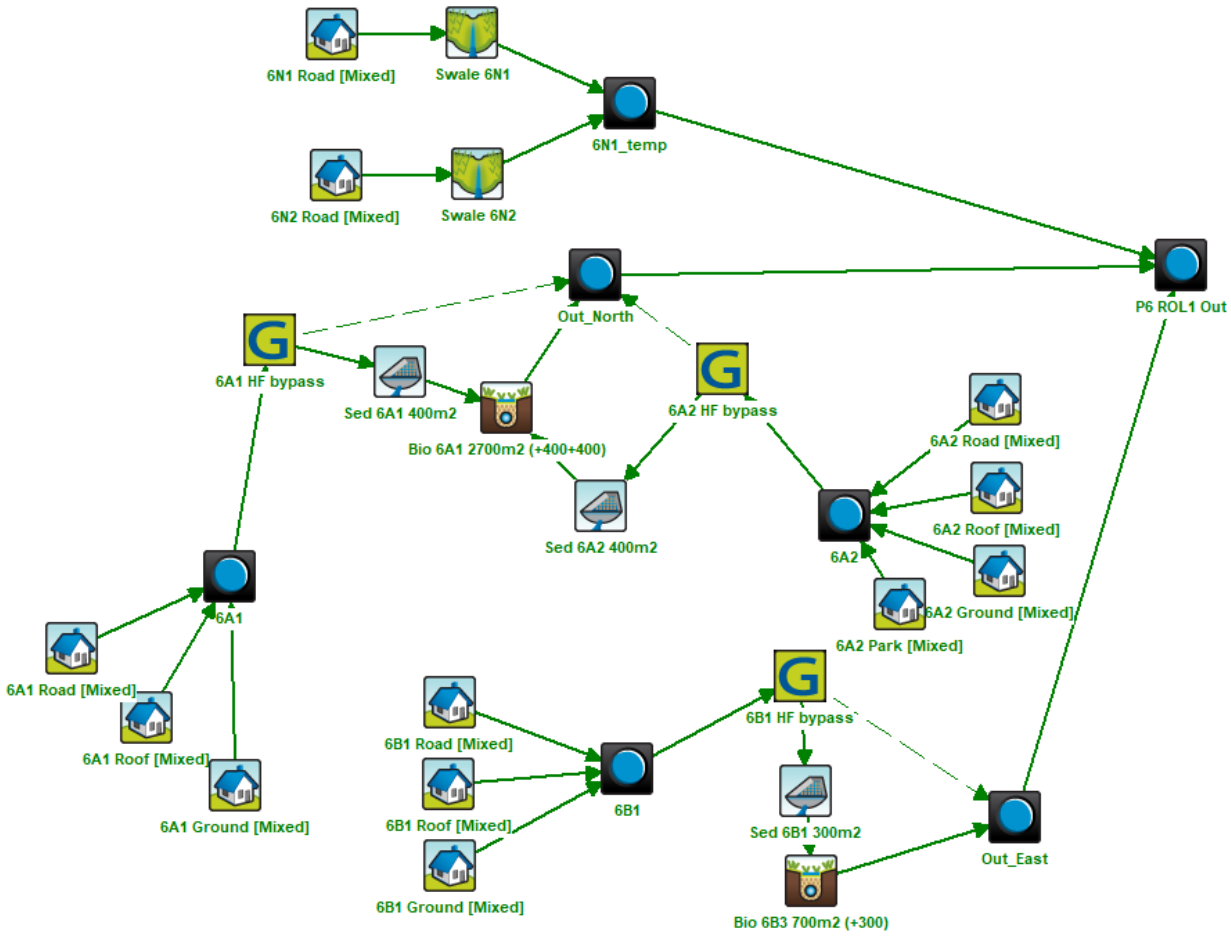


Figure 6: MUSIC model layout

Table 5: 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
Swale	Length = 40 m Slope = 2.5% Base width = 1.0 m Depth = 0.3 m Vegetation = 0.05 m

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, 2010/2019).

2. Bioretention default values for TN and OP content have been adopted as 400mg/kg and 30mg/kg respectively as per Water by Design advice (and in line with MUSIC Guideline 2019)

3. High flow bypass thresholds (based on future development estimates of 63.2% AEP) are set at Generic nodes upstream of all treatment nodes for easy identification. Refer to Section 3.3.4 for details.

4. Sediment ponds connect via culverts 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)

5. Bioretention basin cells 6A3-6A5 are modelled as combined total surface area (where actual design will split these into multiple cells to ensure flow distribution across filter).

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

7. 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. Detailed design will resolve actual weir sizes (as well as pit sizing where applicable) with accompanying MUSIC model verification.

The above assumptions ensure the current functional design of all treatment systems is conservative and allows for more than adequate earthworks, treatment and maintenance space allowances within the current development layout. All systems will be subject to detailed catchment, hydraulic and MUISC 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 6 below lists the catchment area, land use and percent impervious for each sub-catchment modelled with the detailed breakdown of surface types.

Table 6: MUSIC model catchment split data

Catchment ID	Total Area (ha)	% Impervious	Surface Type	Sub-Area (ha)	Impervious %
6A1	17.9	60%	Road	4.48	60%
			Roof	6.71	100%
			Ground	6.71	20%
6A2	13.5	58%	Road	3.38	60%
			Roof	5.06	100%
			Ground	5.06	20%
			Park	0.52	5%
6B1	8.7	60%	Road	2.18	60%
			Roof	3.26	100%
			Ground	3.26	20%
6N1	0.4	70%	Road	0.40	70%
6N2	1.2	70%	Road	1.20	70%
Total	**41.7**	**60%**		**41.7**	**60%**

Notes:

1. Catchments 6N1 and 6N2 included for completeness while acknowledging that these will actually combine with upslope undeveloped areas when discharging. Modelling of the significant undeveloped areas is beyond the scope of this report and will be subject to future development and stormwater treatment.
2. Catchment 6B1 includes a minor portion of future P6 development area to the south of the current precinct boundary

3.3.4 Secondary Link Data

Table 7 summarises the secondary links used in the updated MUSIC modelling and the relevant high flow bypass (HFB) threshold (where relevant) or flow component (from upstream treatment node). Where HFB applies, a dedicated Generic node has been used in the model to readily identify the bypass location and downstream connection node. All flows above HFB thresholds are diverted around treatment via secondary links.

Table 7: High flow bypass / secondary link data

From Node	To Node	Outflow Components	HFB Threshold	Comment
6A1 HF Bypass	Out_North	High flow bypass	1.9 m3/s	HFB estimated at Q1 flow from 17.9 ha
6A2 HF Bypass	Out_North	High flow bypass	1.4 m3/s	HFB estimated at Q1 flow from 13.5 ha
6B1 HF Bypass	Out_East	High flow bypass	0.9 m3/s	HFB estimated at Q1 flow from 8.7 ha

3.3.5 Results

The results of the MUSIC modelling are presented in Table 8. All water quality objectives can be readily achieved with the proposed treatment strategy.

Table 8: MUSIC results

Catchments	Treatment ID	Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction (%)
6A1, 6A2	Sed/Bio 6A1-6A5	TSS	28600	4220	85.2 %
		TP	61.6	14.8	75.9 %
		TN	392	186	52.7 %
		GP	4740	80.2	98.3 %
6B1	Sed	TSS	7530	947	87.4 %
		TP	16.3	3.7	77.4 %
		TN	104	48.1	53.7 %
		GP	1310	21.5	98.4 %
6N1, 6N2	Swale 6N1/6N2	TSS	4060	2470	39.2 %
		TP	6.54	4.65	28.9 %
		TN	21.7	21.1	2.9 %
		GP	285	0	100 %
Total Precinct P6 ROL1 (✓ denotes compliance with water quality objectives)		TSS	40400	7760	80.8 % ✓
		TP	85.2	23.6	72.3 % ✓
		TN	519	256	50.6 % ✓
		GP	6340	102	98.4 % ✓

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 provide 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 STORMWATER QUANTITY

Precinct 6A ROL1 is generally in accordance with the *Yarrabilba (Quinzeh Creek) Flood Study – Version 1* (DesignFlow, 2017). 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 (Fauna Way) (approved 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 7. This indicates that P6 ROL1 is well above the 1% AEP flood level being conveyed through the adjacent waterways to the southern tributary of Quinzeh Creek.

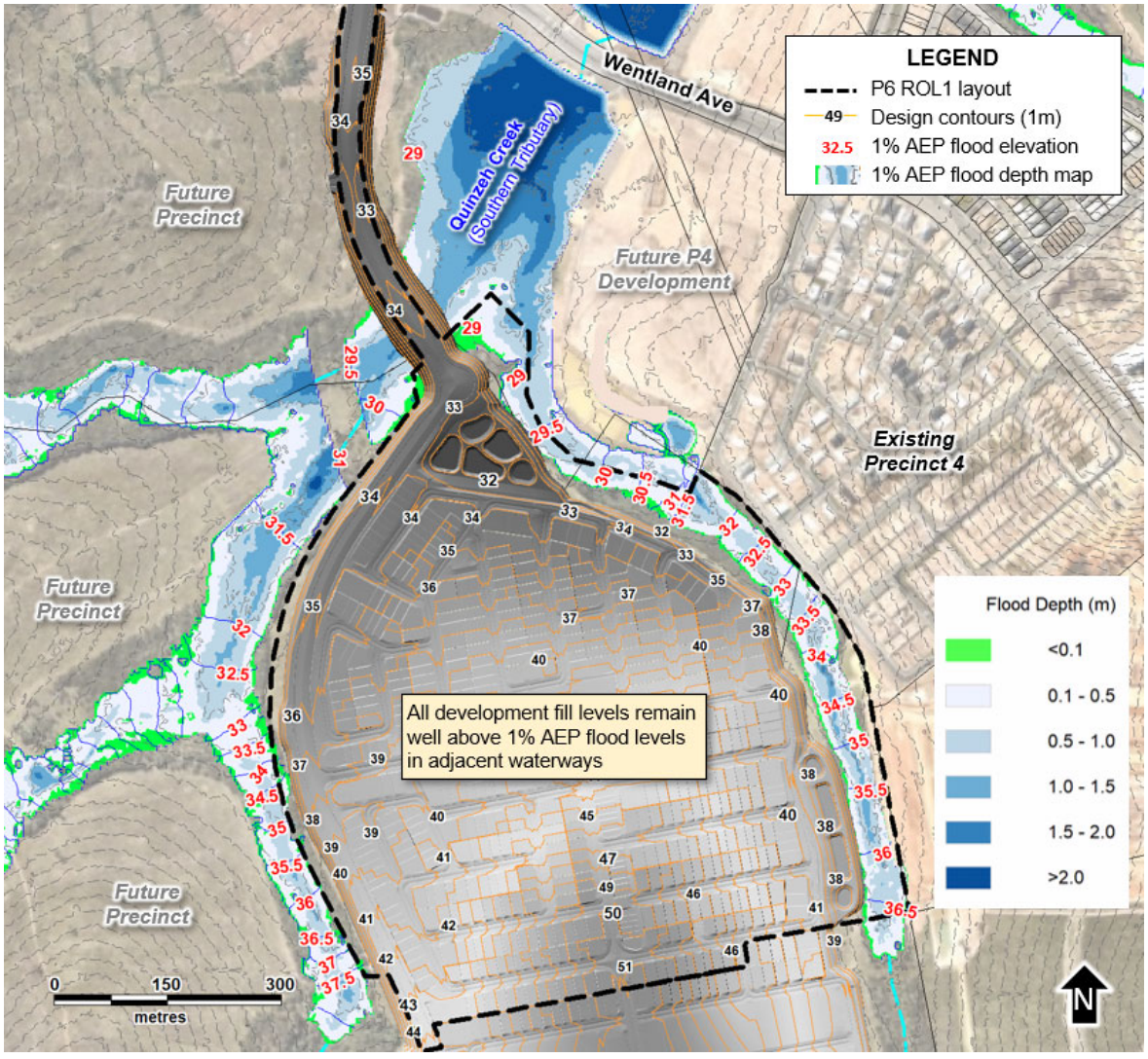


Figure 7: 1% AEP Flood levels and preliminary earthworks

5 WATERWAY MANAGEMENT

As noted in Section 2.5 previously, the waterway bounding the western edge of the P6 ROL1 development does not receive any flows below 63.2% AEP from the subject development area. The eastern waterway therefore remains the focus of the waterway management strategy presented below. The information provided remains consistent with the latest *Yarrabilba Precinct 4F Stormwater Management Plan – Version 2* (DesignFlow, 2023) approved by EDQ (DEV2022/1341) as this waterway borders both Precinct 4 and Precinct 6. The information and mapping below has been updated to reflect the P6 ROL1 development zone and to refer to the 'Eastern waterway' of P6 rather than the 'Southern tributary' in Precinct 4 (both referring to the same waterway).

5.1 WATERWAY OBJECTIVES

5.1.1 Waterway Stability

The waterway stability objectives adopted for the site are based on protecting high value waterways from erosion as a result of increased flow from urban development and 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 9. These objectives are consistent with the *Yarrabilba Total Water Cycle Management Strategy* (DesignFlow, 2021), *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2021) and *State Planning Policy* (DSDIP, 2017).

Table 9: Derived waterway stability objectives

Waterway classification	Waterway Stability Criteria
Site waterway reach in good condition (i.e. well vegetated and stable waterway)	Limit post development 1 year ARI flows in waterway to pre-development conditions*
Site waterway reach in average/poor condition (i.e. poorly vegetated or active erosion)	As per above OR Rehabilitate waterway to convey the post development 1 year ARI flows without the risk of erosion*
External waterways	Limit 1 year ARI flows at site boundary for critical duration event (60 minutes or longer) to pre-development conditions

* Localised increases in 1 year ARI flows can be accepted provided the erosion criteria for sandy vegetated soils (50% cover for native grasses) is achieved in accordance with QUDM. The objective supports the rehabilitation of waterways and allows local increases in 1 year ARI provided the rehabilitation design provides an appropriately stable waterway for the increased 1 year ARI flows.

5.2 WATERWAY STABILITY ASSESSMENT

The stability assessment for the eastern waterway in P6 ROL1 has been based on both site investigations and the detailed hydraulic (Tuflow) modelling undertaken as part of the *Yarrabilba (Quinzeh Creek) Flood Study – Version 1* (DesignFlow, 2017) which included modelling of the 1 year ARI 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. Details below are supported by the photographic log and waterway reference plan in Appendix B.

5.2.1 Characteristics

The eastern waterway within the precinct is characterised by very low gradients with broad shallow profile and minimal low flow channel definition. The upper Quinzeh Creek section within Precinct 6 ROL1 (and extending downstream to Precinct 4) has an overall average longitudinal gradient of less than 0.25% with many flat areas of no discernible or measurable gradient, including wetland areas. The uppermost portion of this drainage line increases to just under 0.4% which is still very flat. The eastern waterway grades at around 0.7%. None of these drainage slopes represent a concern for long term instability due to high velocity.

The overall waterway condition ratings provided in the *Yarrabilba General Waterway Condition Assessment* (DesignFlow, 2021) indicates the main drainage line (Quinzeh Creek southern tributary) is generally in good condition while the eastern waterway extending up into Precinct 6 ROL1 to the east was more varied with mostly average condition along most of the waterway and local areas of poor and good condition.

A site investigation was undertaken on 20 April 2017 to further assess the characteristics and condition of the waterways in Precinct 6 ROL1 since the original work undertaken in 2013. This inspection occurred around 3 weeks after the significant rainfall event of late March 2017 that caused widespread flooding in the surrounding Logan and Albert River catchments. The observations are therefore based on a comparatively wet catchment (as base flow) compared to waterway inspections in previous years and therefore reference to any ponds may be only temporary in nature based on the timing. A brief overview of these findings is provided below with additional information provided in Appendix B. Figure 9 in Section 5.3 provides the waterway layout and chainage locations referred to in the following sections.

Upper Quinzeh Creek

This waterway forms the major flow path for the southern portion of the Yarrabilba site draining to Quinzeh Creek. No major unstable areas immediately downstream of P6 were evident due to the very broad flat nature of the waterway and lack of concentrated flow path. Localised areas of iron bacteria were observed, which are characterised by orange/brown slimy deposits.

The current Wentland Avenue crossing is approximately 350m downstream of the proposed northern access road to P6. Localised soil disturbance around the Wentland Avenue embankment due to the civil construction has occurred with vegetation currently re-establishing in these areas. No significant ongoing erosion or instability issues within the natural drainage line downstream were evident, partly due to the dense groundcover and sedge growth within the wet areas. Upstream of the Wentland Avenue embankment is characterised by a broad flat area of ephemeral drainage line and floodplain with dense vegetation gradually giving way to scattered ponded/vegetated areas at the fringe (as ground levels increase upslope). Very isolated pockets of bare ground were observed (due to historic livestock damage) but do not represent any widespread instability or erosion issue and are likely to regenerate naturally once livestock is removed.

P6 Eastern Waterway

The Eastern Waterway of P6 ROL1 extends generally south-east to south off the main upper Quinzeh Creek floodway. The lower end (chainage 0-500m in Figure 9) is characterised by a broad cross section, very low gradient with no discernible low flow channel. Scattered saturated areas exist where seepage accumulates in depressions. Dense grass cover interspersed with dense shrubs/immature trees dominates the lower drainage line with no instability evident here. Again (similar to descriptions above), the Eastern Waterway contains iron bacteria (visual observations only) which is more extensive than seen in Upper Quinzeh Creek. Orange/brown slimy deposits and oily sheens (in stagnant pools) was observed mainly along the low flow channel where it was defined, often masked by groundcover vegetation. As noted previously, the significant rainfall of late March 2017 (3 weeks prior to observations) meant groundwater stores were recharged and low flow seepage was quite prevalent. In areas where groundwater contains iron, this creates ideal conditions for iron bacteria proliferation.

The mid and upper reaches are characterised by localised scour pools between areas of dense undergrowth and scattered trees. Low flow channel(s) are evident periodically along the reach and can often be associated with livestock/wild animal tracks (longitudinal and transverse). Some ponding/scour holes also appear to be livestock watering points (when wet) and show disturbance and vegetation trampling/dieback at the edges. At approximately 1300m chainage, a ponded zone of approximately 30m wide extending 50m upstream has been formed upstream of a track crossing. Review of previous inspection notes and historical aerial photos indicates that this is very ephemeral in nature, with open water not persisting long term (returns to wet depression via infiltration and low flow seepage to downstream channel).

5.2.2 Modelling

The existing flood model for the Yarrabilba site (within Quinzeh Creek) was used to extract waterway stability information to assist with the assessment and development of an appropriate waterway stability management strategy. It should be noted however that the resolution of the flood model (3m grid) is such that very localised scour issues will not necessarily be identifiable from model outputs and therefore

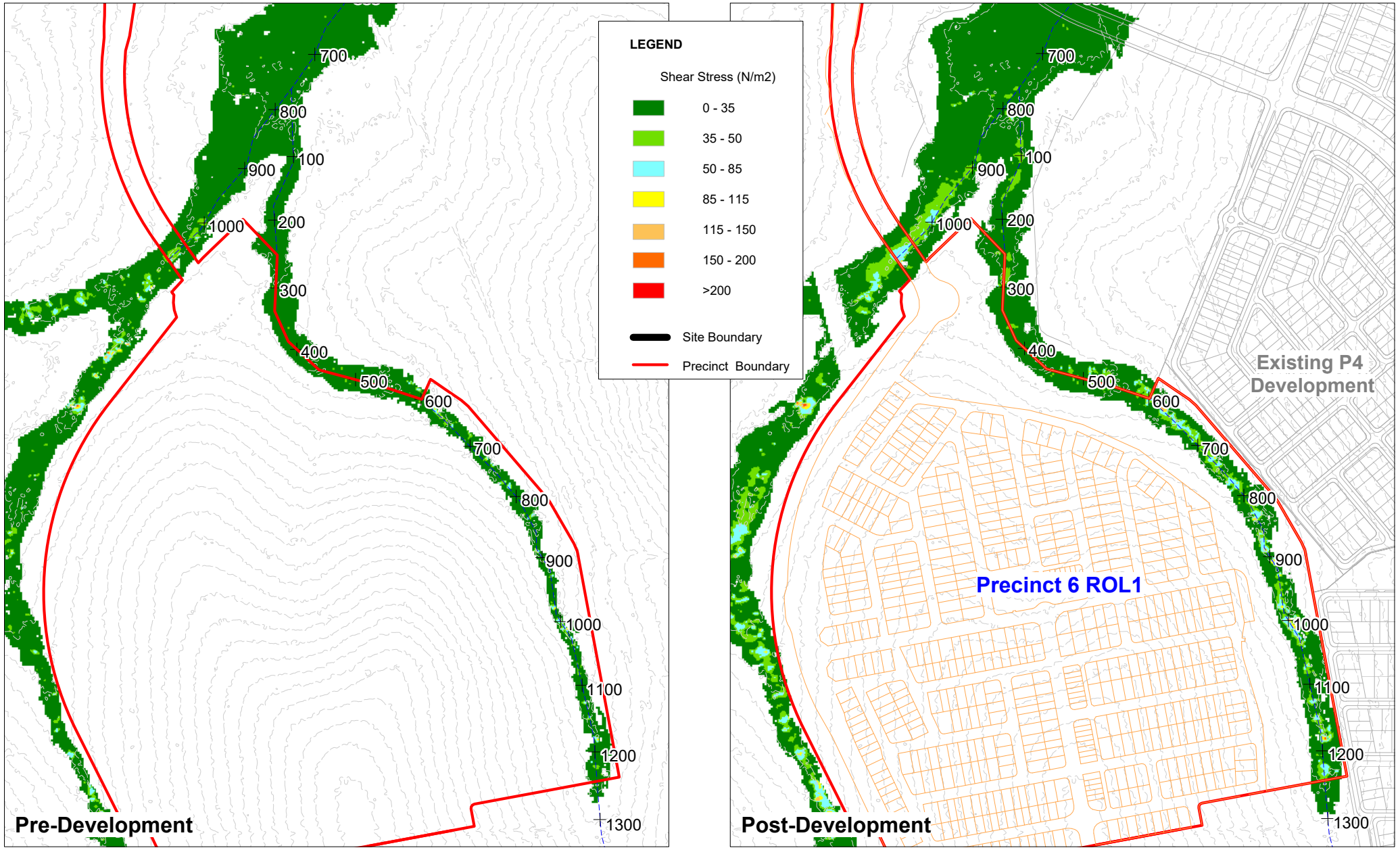
should not be relied upon solely for the management of specific areas. As noted in Section 5.3, the adoption of both targeted engineering approaches as well as an adaptive monitoring and management of stability issues ensures that the strategy responds to changes over time.

Table 10 provides a broad scale analysis of the flow characteristics at the downstream end of the main drainage lines for pre and post-development catchment conditions adjacent to and downstream of P6 ROL1. It should be noted that this data is based on the fully developed site conditions (i.e. Precinct 6 plus existing Precinct 4 and upstream precincts developed) and therefore Precinct 6 (in the short term) will show lower developed flows and velocities accordingly.

Table 10: 1 year ARI discharge in Precinct 6 ROL1 Waterways (downstream ends)

	Flow (m^3/s)		Velocity (m/s)	
	PRE	DEV	PRE	DEV
Upper Quinzeh Creek	20.9	24.8	0.57	0.66
P6 Eastern Waterway	3.9	13.9	0.53	0.80

This data indicates that while the peak discharge (at bottom of each drainage line) increases as a result of urbanisation (particularly in tributaries), the actual velocity increases are comparatively small and very low in overall magnitude under both pre- and post-development scenarios. This is in most parts due to the broad flat profile of the drainage lines that can experience significant increase in flow rate with only very minor increase in flow depth and velocity. Further analysis and discussion of the pre and post-development flood modelling is provided in Figure 8 and Section 5.2.3 below.



Prepared by: DesignFlow For: lendlease	Project: 4494 Yarrabilba Precinct 6 ROL1 Stormwater Management Plan	N W E S Scale: 1 : 750 (A4)	**Figure 8** **1 year ARI** **Bed Shear Stress Comparison**
	Client: Lendlease	Date: 24/07/2023	

5.2.3 Discussion

Shear stress modelling provided has been derived from the Quinzeh Creek catchment flood model at a 3m grid to broadly identify the relative shear stress changes and does not specifically account for:

- Minor flow attenuation that occurs within stormwater treatment basins (and the fact that pipe drainage network will input flows generally lower down in the local waterway than the flood model accounts for).

- 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 5.3 below). The bed shear stress indicates that under pre-development conditions, the P6 ROL1 eastern waterway shear stresses (in the order of 35-85 N/m2) 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 shear stress magnitude generally remains in this range but over a broader area through the channel invert (refer Figure 7 in Section 5.2.2). The targeted waterway management strategy therefore aims to manage existing scour issues while also allowing rehabilitation/stabilisation to target the expected post development flow regime coupled with an adaptive management strategy that responds to the uncertainties in channel geomorphology.

With comparison to the QUDM permissible velocities (QUDM Table 9.5.2) assuming 50% stable vegetation cover on easily erodible soils, the above post development velocities (at downstream end of reach where flows are greatest) are significantly below the maximum suggested of 1.2m/s and therefore represents low risk in terms of increased susceptibility to broad scale erosion. However, localised areas of scour may be likely where surface features such as mounds, pools or fallen trees create concentrated or high energy flow (beyond the resolution of the abovementioned flood modelling).

Review of bed shear stress data from the minor 1 year ARI flow against threshold values derived by Prosser and Slade (1994) and Prosser *et. al.* (1995) for a number of vegetation types indicate that bed shear stress values derived from the broadscale flood model are below those for tussock and sedges in various states of disturbance (240 N/m^2 undisturbed and 180 N/m^2 disturbed) and bunch grasses long and short (184 to 104 N/m^2

respectively). This evidence suggests that for a range of vegetation types, erosion thresholds are generally higher than modelled for this waterway. However, recognition that higher values are likely due to localised conditions and flow patterns, that are beyond the resolution of modelling and therefore management strategies are adaptive.

Locations where shear stress is at its highest (typically between chainage CH600-CH1300) is also where targeted waterway stability management strategies are focussed. This enables the stabilisation works to ensure post development hydrology is considered. Where the post-development 1 year ARI flow extent is broader than pre-development, bed shear stress is very low (green areas <35N/m^2 in Figure 8) and does not present risk of instability.

The inclusion of localised detention basins targeting waterway stability of waterways adjoining Precinct 6 ROL1 is therefore not warranted and the proposed waterway stability management strategy adopted for previously Precinct 4 remains valid and appropriate for Precinct 6 ROL1.

5.3 WATERWAY STABILITY MANAGEMENT STRATEGY

As described in Section 5.2.1, the waterways downstream of Precinct 6 ROL1 are considered to be in varying condition (ecologically) while being relatively stable owing largely to the very low gradients and vegetation cover of these drainage lines. However, 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 access to waterways and revegetation of degraded areas.
- 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 (laying back batters 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 paid to those areas identified as currently eroding and those adjacent to infrastructure

Unlike previous waterway stability concerns in the steep incised gully areas of Precinct 3B and 3C, there is no need for major works associated with drop structures, rock chutes or re-battering of steep banks in Precinct 6 ROL1 as both the longitudinal and cross sectional profile of the waterways are comparatively broad and flat, presenting minimal erosion and instability risk.

Figure 9 provides the overall precinct waterway stability management strategy 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 5.3.1.

5.3.1 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.

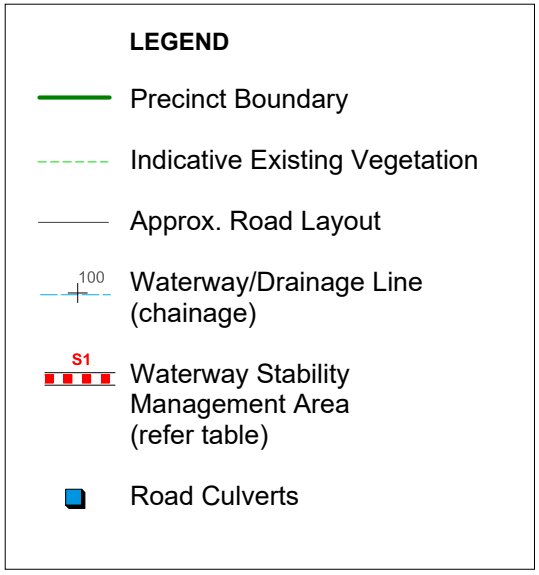
Ongoing Monitoring

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 and 2 development 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 exist, these must be taken into consideration and adopted where necessary.

Waterway Stability Management Strategy Notations

ID	CHAINAGE (APPROX.)	WATERWAY STABILITY MANAGEMENT
UPPER QUINZEH CREEK		
Q5	1050	Future road crossing – provided stabilised culvert outlets and rehabilitate any areas disturbed by civil works in conjunction with open space/ecological corridor rehabilitation plans.
EASTERN WATERWAY		
S2	550-570	Minor scour pool – fill, provide rock channel lining and interplant with grasses/flexible shrubs.
S4	600-630	Established scour pool with mature vegetation – reshape/batter scour pool edges, install rock lining and batter protection, revegetate banks and (depth dependent) plant emergent macrophytes in pool.
S5	630-750	Livestock/animal tracks merging with low flow channel – revegetate tracks, monitor stability of low flow channel following upstream development, and vegetate/stabilise where issues arise.
S7	850-880	Sediment deposition – revegetate and monitor establishment and longer term stability.
S8	880-930	Chain of ponds (scour pools) with establish trees – review habitat value with ecologist and undertake targeted works to stabilise banks, remove/relocated woody debris causing high energy flow, revegetate livestock damaged banks, and monitor zone following upstream development.
S10	980-1300	Intermittent livestock tracks/disturbance zones - revegetate livestock disturbed areas and monitor establishment/stability. Reshape/rock where issues arise.
S11	1300-1350	Ephemeral wetland/pond - review habitat value with ecologist and undertake targeted works to stabilise banks, decommission or stabilise track crossing at downstream edge, formalise ephemeral wetland vegetation, revegetate livestock damaged banks, and monitor zone following upstream development.



Prepared by: DesignFlow

For: lendlease

Project: 4494

Yarrabilba Precinct 6 ROL1 Stormwater Management Plan

Client: Lend Lease

N W E S

Scale: 1 : 7,500 (A4)

Date: 24/07/2023

Figure 9

Waterway Stability Management Strategy

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 11 which are generally in accordance with the *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2021) and the State Planning Policy (DSDIP, 2017).

Table 11: 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 ROL1, 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 11.

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 ROL1. 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
    - 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 ROL1 development has been prepared to meet the requirements of the *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2021) and Context Plan Area Strategy.

The strategy includes a range of stormwater treatment measures including sediment ponds and bioretention systems that manage the Precinct 6 ROL1 development area. 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 earthworks 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 local 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.

Setback to local waterway and vegetation corridors have guided the development layout with due consideration for future development expansion and waterway rehabilitation to the east and west of the subject site.

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 (2021) *Yarrabilba Stormwater Infrastructure Master Plan*

DesignFlow (2021) *Yarrabilba General Waterway Condition Assessment*

DesignFlow (2021) *Yarrabilba Total Water Cycle Management Strategy*

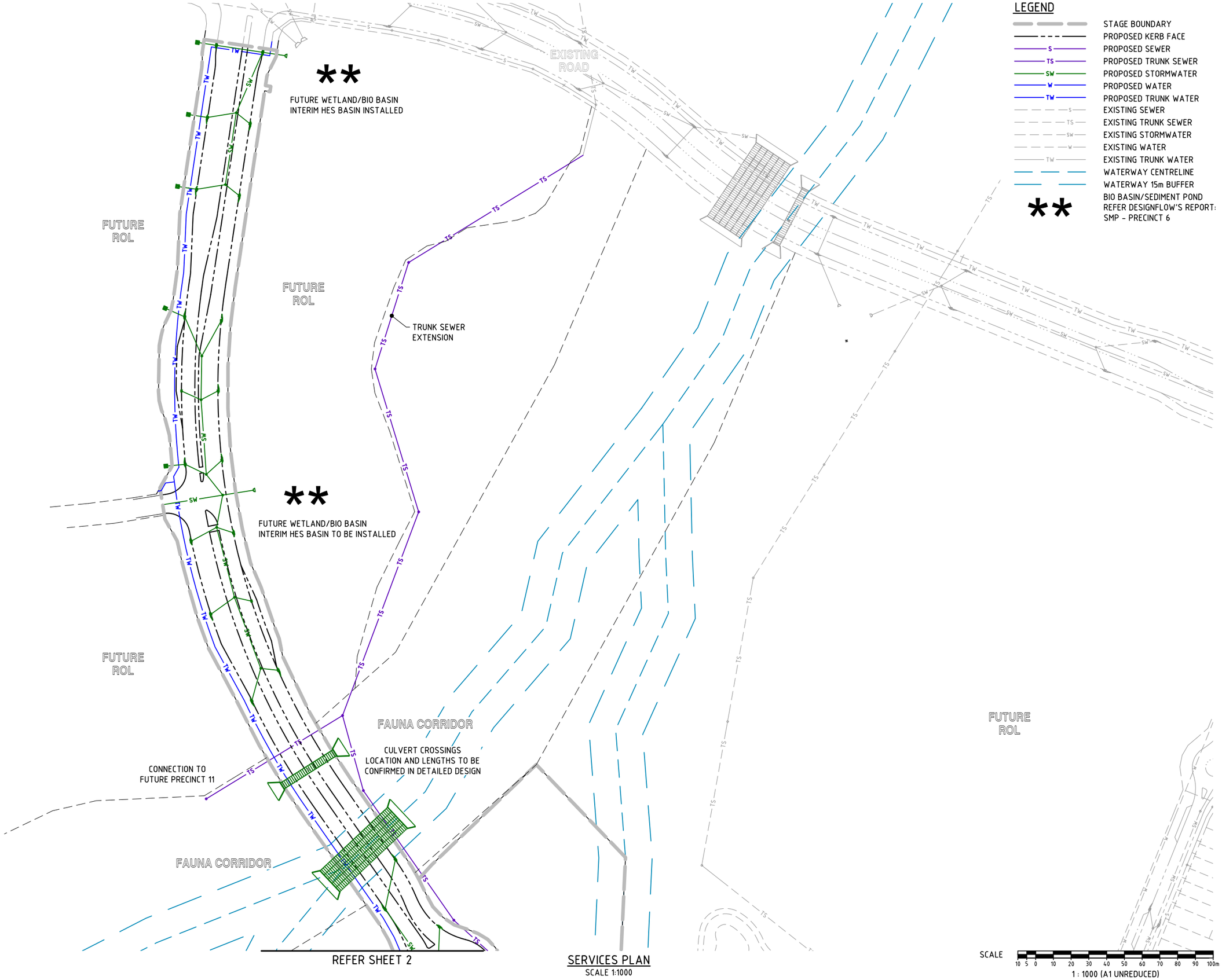
DesignFlow (2017) *Yarrabilba (Quinzeh Creek) Flood Study - Version 1*

DSDIP (2017) *State Planning Policy*

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

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

APPENDIX A FUNCTIONAL DESIGN PLANS



LEGEND

- STAGE BOUNDARY
- PROPOSED KERB FACE
- PROPOSED SEWER
- PROPOSED TRUNK SEWER
- PROPOSED STORMWATER
- PROPOSED WATER
- PROPOSED TRUNK WATER
- EXISTING SEWER
- EXISTING TRUNK SEWER
- EXISTING STORMWATER
- EXISTING WATER
- EXISTING TRUNK WATER
- WATERWAY CENTRELINE
- WATERWAY 15m BUFFER
- ** BIO BASIN/SEDIMENT POND REFER DESIGNFLOW'S REPORT: SMP - PRECINCT 6

SERVICES PLAN
SCALE 1:1000

SCALE
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1 : 1000 (A1 UNREDUCED)

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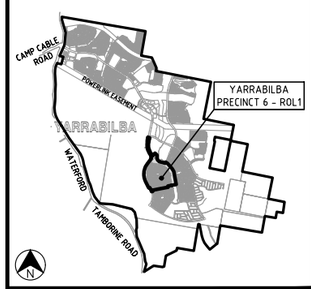
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
A	FOR APPROVAL	28.07.23	SLK

Associated Consultants
rps

Client
lendlease

Project
YARRABILBA
PRECINCT 6 - ROL1
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title
P06ROL1 FUNCTIONAL LAYOUT
SERVICES PLAN
SHEET 1

Drawn	Designed	Checked	Date
SLK	JAS	RM	JUL 23

Scale	Sheet
AS SHOWN	07 of 17

A1	Drawing No	Revision
	21-233-SK057	A

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REFER SHEET 1

FAUNA CORRIDOR

OPEN SPACE

CONNECTION TO FUTURE PRECINCT 9A

FUTURE ROL

EXISTING P04ROL1

OPEN SPACE

HIGH FLOW BYPASS

SED SL.31.1

PROPOSED BIORETENTION BUNDS RL.32.0

BIO SL.31.0

BIO SL.31.0

BIO SL.31.0

**

HIGH FLOW BYPASS

SED SL.31.1

3m MAINTENANCE ACCESS TRACK

3m MAINTENANCE ACCESS TRACK

REFER SHEET 3

REFER SHEET 4

SERVICES PLAN
SCALE 1:1000

SCALE
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1 : 1000 (A1 UNREDUCED)

LEGEND

- STAGE BOUNDARY
- PROPOSED KERB FACE
- S — PROPOSED SEWER
- TS — PROPOSED TRUNK SEWER
- SW — PROPOSED STORMWATER
- W — PROPOSED WATER
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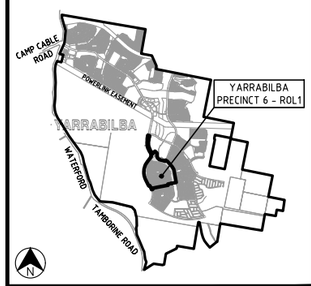
NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
A	FOR APPROVAL	28.07.23	SLK
B	MINOR AMENDMENTS	17.08.23	JS

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YARRABILBA

PRECINCT 6 - ROL1
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

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P06ROL1 FUNCTIONAL LAYOUT
SERVICES PLAN
SHEET 2

Drawn	Designed	Checked	Date
SLK	JAS	RM	JUL 23

Scale	Sheet
AS SHOWN	08 of 17

	Drawing No	Revision
A1	21-233-SK058	B

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REFER SHEET 2

REFER SHEET 4

OPEN SPACE

FUTURE P06ROL2

FUTURE P06ROL2

LEGEND

- STAGE BOUNDARY
- PROPOSED KERB FACE
- PROPOSED SEWER (S)
- PROPOSED TRUNK SEWER (TS)
- PROPOSED STORMWATER (SW)
- PROPOSED WATER (W)
- PROPOSED TRUNK WATER (TW)
- EXISTING SEWER (S)
- EXISTING TRUNK SEWER (TS)
- EXISTING STORMWATER (SW)
- EXISTING WATER (W)
- EXISTING TRUNK WATER (TW)
- WATERWAY CENTRELINE
- WATERWAY 15m BUFFER
- ** BIO BASIN/SEDIMENT POND REFER DESIGNFLOW'S REPORT: SMP – PRECINCT 6

SERVICES PLAN
SCALE 1:1000

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

M:\2021\21233 Yarrabilba Precinct 6 Preliminary Support\Engineering\Acad\21-233-SK057-SK060_P06ROL1-FUNC-SERVICES.dwg Plotted by: JS on 17/08/2023 1:56:26 PM

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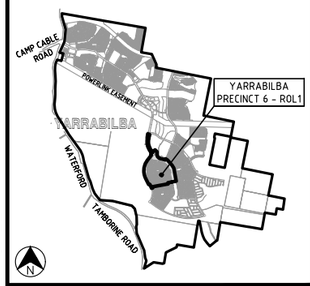
NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
A	FOR APPROVAL	28.07.23	SLK

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YARRABILBA

PRECINCT 6 - ROL1
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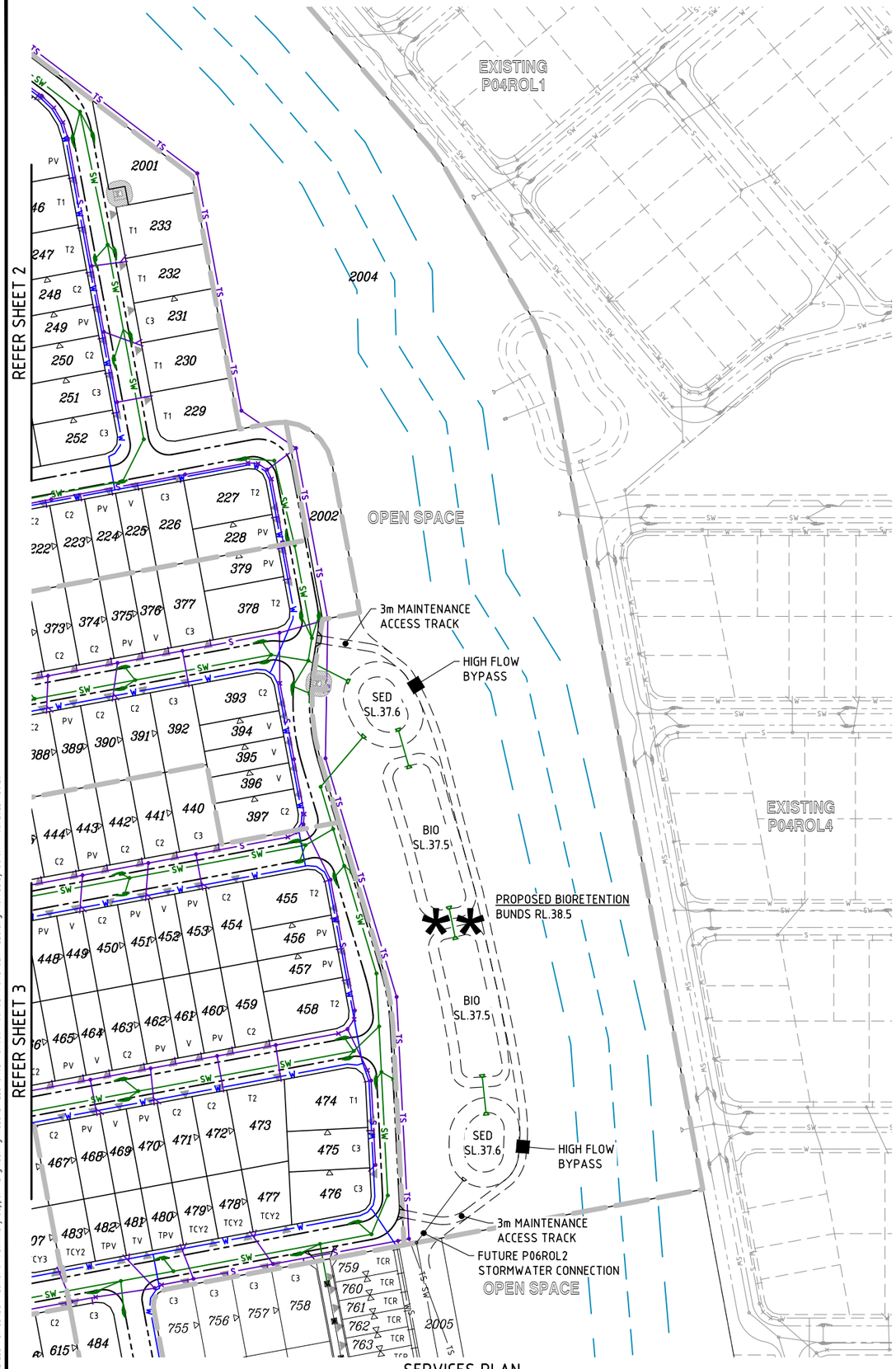
P06ROL1 FUNCTIONAL LAYOUT
SERVICES PLAN
SHEET 3

Drawn	Designed	Checked	Date
SLK	JAS	RM	JUL 23

Scale	Sheet
AS SHOWN	09 of 17

	Drawing No	Revision
A1	21-233-SK059	A



SERVICES PLAN
SCALE 1:1000

LEGEND

- STAGE BOUNDARY
- PROPOSED KERB FACE
- PROPOSED SEWER
- PROPOSED TRUNK SEWER
- PROPOSED STORMWATER
- PROPOSED WATER
- PROPOSED TRUNK WATER
- EXISTING SEWER
- EXISTING TRUNK SEWER
- EXISTING STORMWATER
- EXISTING WATER
- EXISTING TRUNK WATER
- WATERWAY CENTRELINE
- WATERWAY 15m BUFFER
- ** BIO BASIN/SEDIMENT POND REFER DESIGNFLOW'S REPORT: SMP - PRECINCT 6

SCALE
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DO NOT SCALE THIS DRAWING
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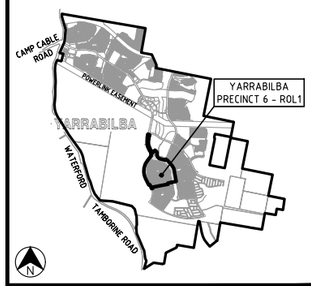
NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
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B	MINOR AMENDMENTS	17.08.23	JS

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PRECINCT 6 - ROL1
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P06ROL1 FUNCTIONAL LAYOUT
SERVICES PLAN
SHEET 4

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SLK	JAS	RM	JUL 23

Scale	Sheet
AS SHOWN	10 of 17

	Drawing No	Revision
A1	21-233-SK060	B

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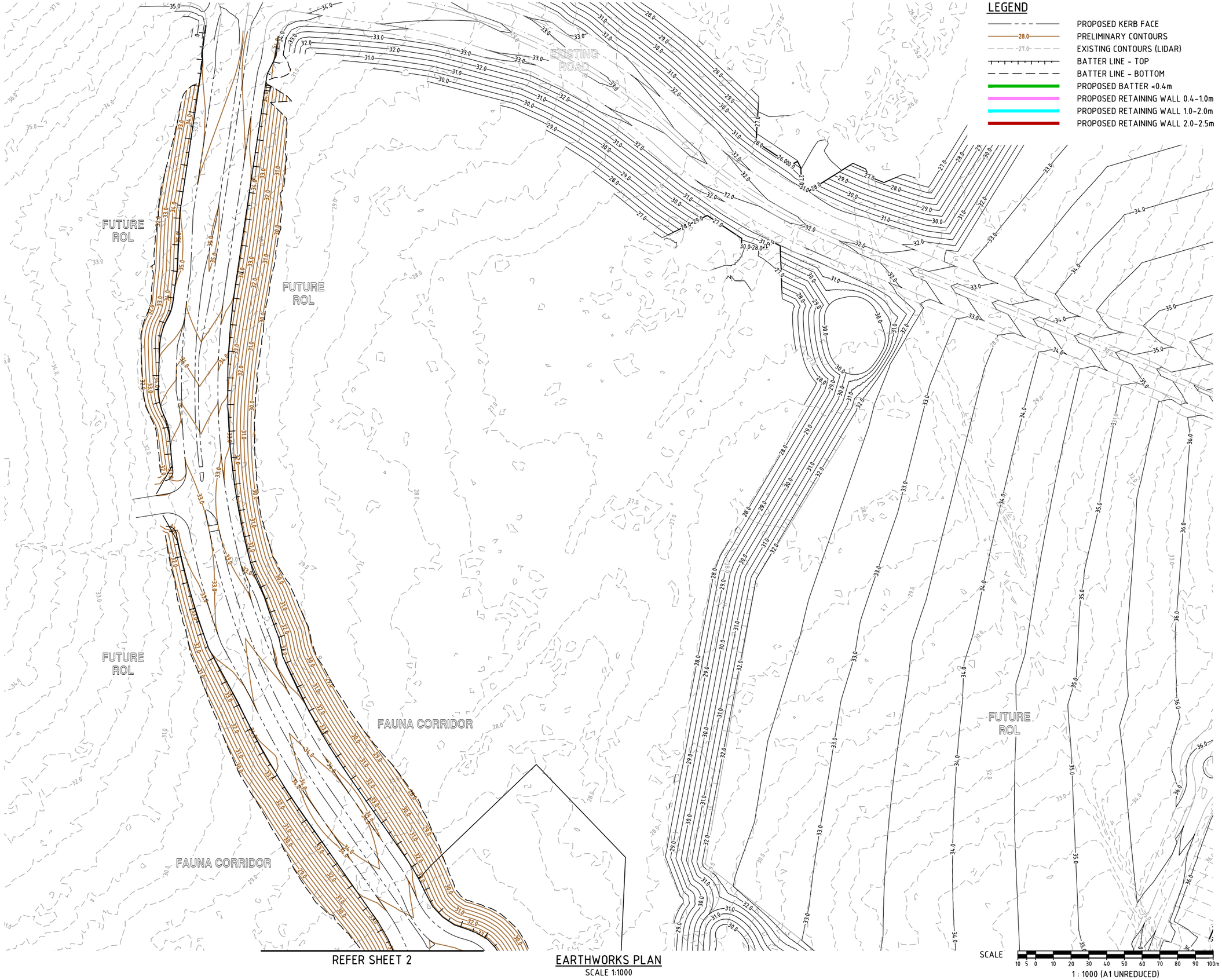

EARTHWORKS PLAN
SCALE 1:1000

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
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1 : 1000 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
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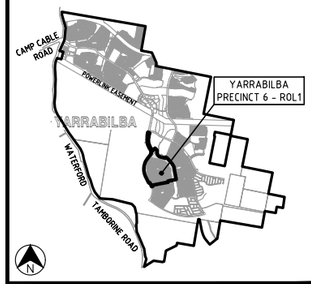
NORTH

LOCALITY PLAN



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P06ROL1 FUNCTIONAL LAYOUT
EARTHWORKS PLAN
SHEET 1

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SLK	JAS	RM	JUL 23

Scale	Sheet
AS SHOWN	11 of 17

	Drawing No	Revision
A1	21-233-SK061	A

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REFER SHEET 1

FAUNA CORRIDOR

OPEN SPACE

FUTURE ROL

EXISTING P04ROL1

OPEN SPACE

REFER SHEET 4

REFER SHEET 3

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

EARTHWORKS PLAN

SCALE 1:1000

SCALE
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1 : 1000 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
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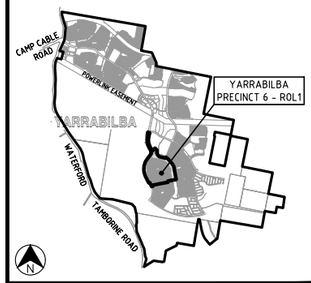
NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
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PRECINCT 6 - ROL1
PRELIMINARY PLANNING
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P06ROL1 FUNCTIONAL LAYOUT
EARTHWORKS PLAN
SHEET 2

Drawn	Designed	Checked	Date
SLK	JAS	RM	JUL 23
Scale			Sheet
AS SHOWN			12 of 17
A1	Drawing No		Revision
	21-233-SK062		A

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REFER SHEET 2

REFER SHEET 4

OPEN SPACE

FUTURE P06ROL2

FUTURE P06ROL2

LEGEND

- PROPOSED KERB FACE
- PROPOSED CONTOURS (28.0)
- EXISTING CONTOURS (LIDAR) (27.0)
- 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

EARTHWORKS PLAN

SCALE 1:1000

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

1 : 1000 (A1 UNREDUCED)

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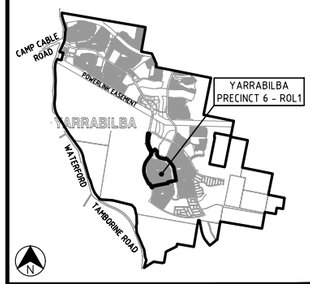
LOCALITY PLAN



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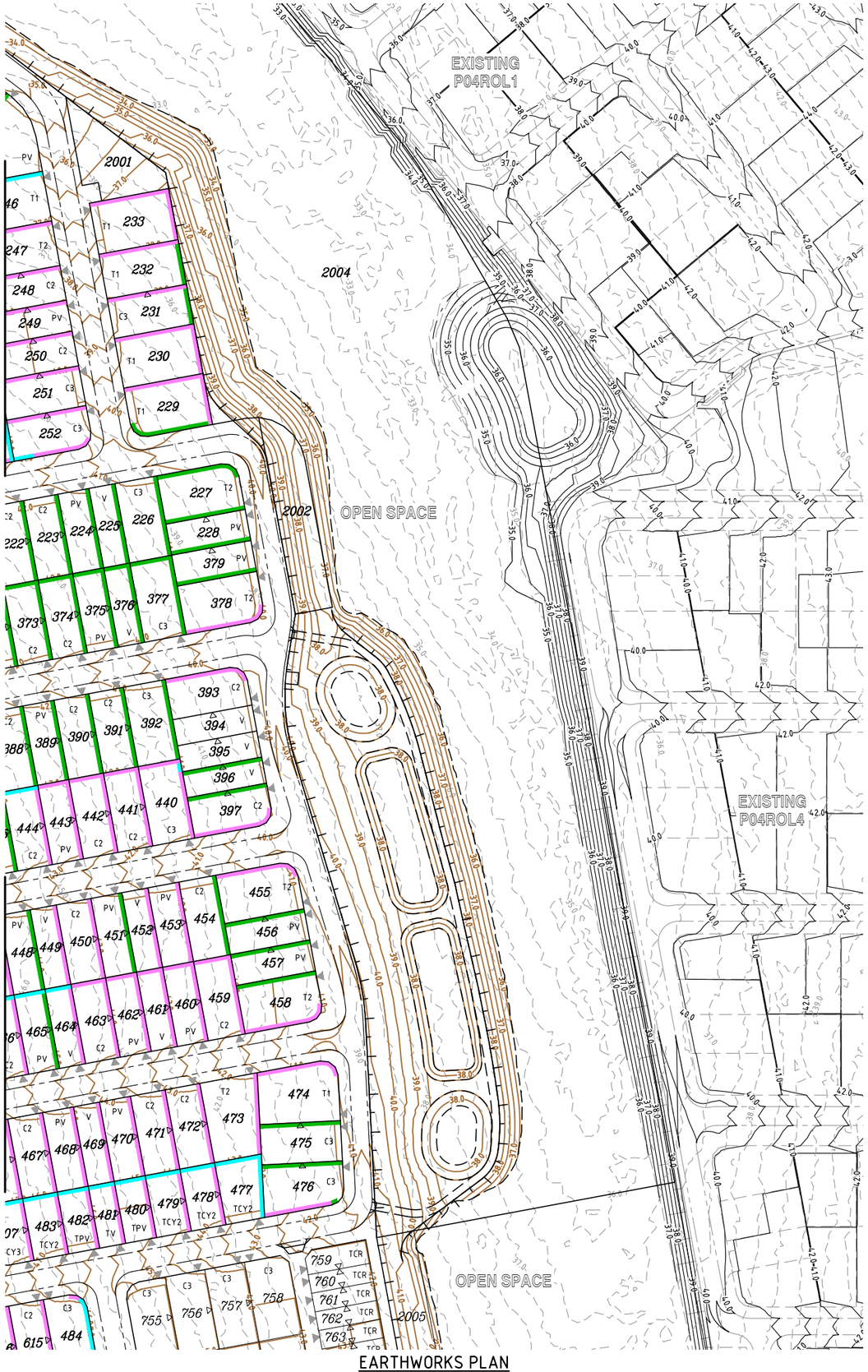
P06ROL1 FUNCTIONAL LAYOUT
EARTHWORKS PLAN
SHEET 3

Drawn	Designed	Checked	Date
SLK	JAS	RM	JUL 23

Scale	Sheet
AS SHOWN	13 of 17

	Drawing No	Revision
A1	21-233-SK063	A



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
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1 : 1000 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
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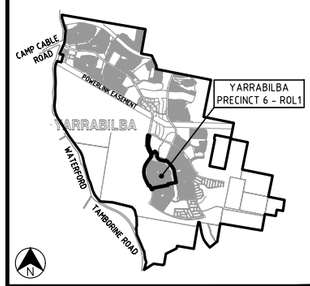
LOCALITY PLAN



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No	Description	Date	By
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PRECINCT 6 - ROL1
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Drawing Title
P06ROL1 FUNCTIONAL LAYOUT
EARTHWORKS PLAN
SHEET 4

Drawn	Designed	Checked	Date
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Scale	Sheet
AS SHOWN	14 of 17

	Drawing No	Revision
A1	21-233-SK064	A

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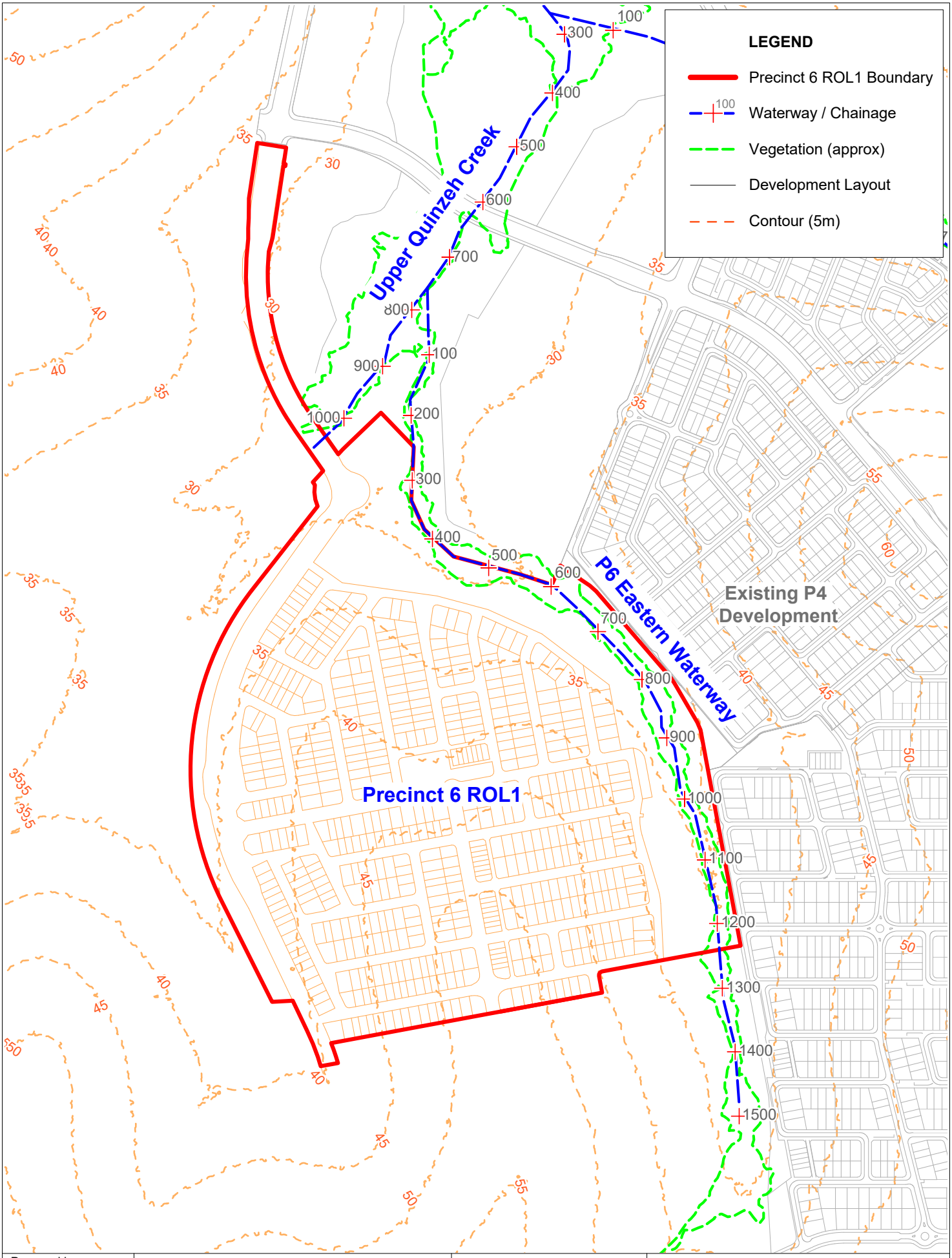
APPENDIX B P6 ROL1 EASTERN WATERWAY INSPECTION SUMMARY

Precinct 6 ROL1 eastern 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 each tributary. Inspection was carried out 20 April 2017. This assessment has been reproduced (and relabelled) from the *Yarrabilba Precinct 4F Stormwater Management Plan – Version 2* (DesignFlow, 2023) as this waterway forms the common boundary between these two precincts.



Prepared by: DesignFlow

For: Lendlease

Project: 4494

Yarrabilba Precinct 6 ROL1
Stormwater Management Plan

Client: Lendlease

N W E S

Scale: 1 : 7,500 (A4)

Date: 2 August 2023

Waterway Inspection Reference Plan

UPPER QUINZEH CREEK

CH0-200 Powerline easement is fully cleared (grasses and some immature regrowth remain), broad flat scattered boggy zones.

CH200-400 mapped wetland - upstream extent with standing water, lower extent damp only. Excellent vegetation coverage.

CH400-600 Dense wetland understorey, moderate canopy, broad, flat, profile, no defined channel. Standing water throughout, no instability.

CH600 Interim flood bund 16-INT (downstream side). Post-civil works so minimal established vegetation evident.

CH600-800 broad flat wetland zone, moderate/dense vegetation within standing water. Vegetation (u/s of flood bund 16-INT).

CH600-800 broad flat wetland zone, moderate/dense vegetation within standing water. Vegetation (u/s of flood bund 16-INT).

P6 EASTERN WATERWAY

CH0-500 open vegetation downstream transitioning into localised wooded zones, undefined low flow path within very broad flat waterway, scattered wet depressions throughout.

CH0-500 open vegetation downstream transitioning into localised wooded zones, undefined low flow path within very broad flat waterway, scattered wet depressions throughout.

CH500-600 moderate groundcover, clumps of trees, localised shallow pool and downstream sediment deposition area. Some livestock damage near pool.

CH500-600 moderate groundcover, clumps of trees, localised shallow pool and downstream sediment deposition area. Some livestock damage near pool.

CH600 stable pond, bare banks surrounded by mature and regrowth trees, some livestock damage to fringe.

CH600 stable pond, bare banks surrounded by mature and regrowth trees, some livestock damage to fringe.

P6 EASTERN WATERWAY

CH600-800 iron bacteria coloured low flow shallow channel surrounded by dense groundcover and moderate tree canopy. No significant instability within low flow.

CH600-800 iron bacteria coloured low flow shallow channel surrounded by dense groundcover and moderate tree canopy. No significant instability within low flow.

CH800-850 well grassed broad flow path with localised sediment slug interspersed (material from upstream chain of ponds/scour pool)

CH800-850 well grassed broad flow path with localised sediment slug interspersed (material from upstream chain of ponds/scour pool)

CH850-950 Chain of ponds surrounded by dense vegetation. Local areas of instability and/or livestock damage.

CH850-950 Chain of ponds surrounded by dense vegetation. Local areas of instability and/or livestock damage.

P6 EASTERN WATERWAY

CH950-1200 livestock disturbance, iron rich seepage within undefined low flow channel surrounded by dense ground and tree cover.

CH950-1200 livestock disturbance, iron rich seepage within undefined low flow channel surrounded by dense ground and tree cover.

CH1200-1300 dense grass surrounding iron rich low flow channel with pockets of livestock disturbance. Minimal instability issues.

CH1200-1300 dense grass surrounding iron rich low flow channel with pockets of livestock disturbance. Minimal instability issues.

CH1300-1350 moderate size pond ~30m x 50m (upstream of track crossing)

CH1300-1350 moderate size pond ~30m x 50m (upstream of track crossing)

P6 EASTERN WATERWAY	
 CH1350-1500 dense grass, regrowth and very low seepage evident in localised pockets (no defined channel)	 CH1350-1500 dense grass, regrowth and very low seepage evident in localised pockets (no defined channel)