Weinam Creek Priority Development Area

Infrastructure Plan Background Report

February 2025

Economic Development Queensland
Creating and investing in sustainable places for Queensland to prosper

Queensland Government

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1 Preliminary

1.1 Weinam Creek PDA

The *Economic Development Act 2012* (the Act) establishes the Minister for Economic Development Queensland (MEDQ) as a corporation sole to exercise the functions and powers of the Act.

The main purpose of the Act[1] is to facilitate economic development, and development for community purposes, provision of diverse housing and provision of premises for commercial or industrial uses in the state. The Act[2] seeks to achieve this by establishing the MEDQ and providing for a streamlined planning and development framework for particular parts of the state declared as priority development areas (PDAs).

The Weinam Creek Priority Development Area (PDA) was declared on 21 June 2013 under the Act. It is located in the Redlands local government area and comprises approximately 42 hectares of land, including 36 hectares over land and nearly 6 hectares over water within the Moreton Bay Marine Park. The Weinam Creek PDA is bounded by Weinam Street to the west and Moreton Bay to the east, Peel Street in the north and Moores Road to the South. A map of the Weinam Creek PDA is located in **Appendix A**.

The Weinam Creek PDA Development Scheme (development scheme) is applicable to all land within the boundaries of the PDA and PDA-associated land. The development scheme became effective on 29 May 2014.

A Development Charges and Offset Plan (DCOP) has been prepared for the Weinam Creek PDA to provide guidance on infrastructure planning and charging matters. The DCOP states the development charges applicable to development within the PDA, identifies any trunk infrastructure within the water supply, sewerage, stormwater, transport, parks and community facilities networks made necessary by development of the PDA as well as matters relevant to calculating a credit, offset or refund for the provision of trunk infrastructure.

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[1] See section 3 of the Act.
[2] See section 4 of the Act.

1.2 Purpose of Infrastructure Planning Background Report

The purpose of the Infrastructure Planning background Report (IPBR) is to provide background information that has informed inputs and assumptions into the Weinam Creek Development Charges and Offsets Plan (DCOP). The report will assist users of the DCOP to understand how infrastructure planning has been undertaken and how development charges were determined. The IPBR includes further detail on:

- Growth projections;
- Infrastructure demand projections;
- Desired standards of service;
- Infrastructure planning;
- Infrastructure costs; and
- Charge calculations

2 Growth Projections

2.1 Introduction

Assumptions about the density, type and timing of residential growth inside the PDA were prepared by CDM Smith and are documented in a report titled ‘Demographic Assessment of Proposed Development within the Weinam Creek PDA’ dated 29 June 2020 (CDM Smith Report) included as **Appendix B**.

The residential growth projections prepared by CDM Smith (June 2020) were further refined using information provided by Economic Development Queensland. This involved distributing the total number of attached dwellings calculated for the PDA between attached (1-2 bedroom) dwellings and attached (3 or more bedroom) dwellings having regard to an analysis of existing development approvals and current market trends. No detached dwellings were projected to develop in the PDA.

The amount of non-residential growth (m² GFA) for the PDA was obtained from the ‘Weinam Creek PDA Draft Structure Plan Report’ prepared by Deicke Richards dated 1 November 2013 (Deicke Richards Report) included as **Appendix C**. This report stated that non-residential growth is forecast to occur within retail, mixed use, maritime services and community land use categories. These non-residential projections have been further refined by Economic Development Queensland into retail, office, maritime services and community land use categories.

The projections of future residential and non-residential growth in the Weinam Creek PDA provide a consistent basis for the planning of infrastructure to service the PDA. The following section is a summary of the growth projections prepared for the PDA.

2.2 Development Charges applicable to development in the PDA

The Weinam Creek PDA growth projections were prepared for:

- 2021 – the base year
- 2026 – projection year
- 2031 – projection year
- 2036 – ultimate development

2.3 Potential development capacity

The potential development capacity that may be achieved on premises within the PDA was calculated based on the type and density of development allowed by the landuse and built form requirements of the development scheme, after taking into account hard constraints such as ecological restrictions and drainage corridors.

Density is expressed within the development scheme as follows:

- For those parts of the PDA zoned for residential development - number of dwellings per hectare
- For those parts of the PDA zoned for non-residential development - plot ratio.

The maximum development capacity within the PDA was calculated in the CDM Smith Report as 1,588 attached dwellings, which with an estimated occupancy rate of 1.7 persons per attached dwelling equates to a population of 2,699. This was assumed to be reached in 15 years based on a medium growth take up scenario.

2.4 Development constraints

The CDM Smith Report identified nine residential allotments not able to be developed to maximum density. The key environmental constraints were ecological reserves and drainage corridors. A number of other allotments were unable to be developed due to existing use restrictions such as park, carpark or community uses.

2.5 Growth rates

The anticipated timing of population and dwelling growth within the Weinam Creek PDA were determined in the CDM Smith Report having regard to the following factors:

- Growth rates in the broader area
- Historical building approval activity for attached product in coastal communities in Redland City
- Review of medium density zoned land opportunities in the wider area and consideration of likely take up for the Weinam Creek PDA

A medium growth rate scenario was chosen, with an assumed take up of approximately 105 attached dwellings per annum.

2.6 Growth projection summary

The Weinam Creek PDA is forecast to experience notable growth in population, employment and residential dwellings from the base year (2021) to the ultimate development year (2036). Tables 1 and 2 identify the source information, and revised projections of population, employment and dwellings for the area which have informed the DCOP planning assumptions.

Table 1: Residential dwellings and non-residential floor space projections

Column 1 Description	**Column 2 Projections by 5 year cohort**				
	2021 (base date)	**2026**	**2031**	**2036**	**Total**
Multiple dwelling (1 or 2 bedroom)	0	359	381	387	1,127
Multiple dwelling (3 or more bedroom)	0	147	155	159	461
Commercial (office)(GFA)	0	409	2,045	2,046	4,500
Commercial (retail) (GFA)	0	409	2,045	2,046	4,500
Marine Services (GFA)	0	933	934	933	2,800
Community (GFA)	0	1,767	1,766	1,967	5,500

Source: CDM Smith 2020 & Deicke Richards 2013

Table 2: Population and employment projections

Column 1 Description	**Column 2 Projections by year**			
	2026	**2031**	**2036**	**Total**
Population	860	912	927	2,699
Employment	78	197	202	477

Source: CDM Smith 2020 & Deicke Richards 2013

3 Demand projections

Demand projections have been informed by the CDM Smith Report and Deicke Richards Report. Growth projections were subsequently converted into demand projections to enable infrastructure planning to be undertaken.

Networks express demand using different demand units. The demand units utilised by each local network in the PDA are as follows:

- for the water supply network, equivalent persons (EP)
- for the sewerage network, equivalent persons (EP)
- for the transport network, trips per day (trips)
- for the parks and community facilities network, equivalent persons (EP)

Typical demand generation rates used by each network to convert growth projections into demand are stated in Table 3.

The demand projections for each network are stated in Table 4.

Table 3: Demand generation rates

Column 1 **Development type**	**Column 2** **Demand generation rate (EP / person or EP / m^2 floorspace)**			
	Water supply network (EP)	**Sewerage network (EP)**	**Transport network (trips per day)**	**Parks and community facilities network (EP)**
Attached dwellings	1.70	1.70	6.5	1.70
Office	0.006	0.006	0.16	0
Retail	0.0135	0.0135	0.4	0
Marine Services	0.003	0.003	0.12	0
Community	0.0117	0.0117	0.2	0
Source	*South East Queensland Water Supply and Sewerage Design and Construction Code (SEQ Code)*	*South East Queensland Water Supply and Sewerage Design and Construction Code (SEQ Code)*	*Rates reflect typical industry averages*	*Rates calculated using an occupancy rate of 1.70 persons per attached dwelling*

Table 4: Demand projections

Projected demand for the water supply network

Column 1 Service catchment	Column 2 Projected demand (EP)			
	2026	**2031**	**2036**	**Total**
Weinam Creek PDA	892	975	994	2,860

Projected demand for the sewerage network

Column 1 Service catchment	**Column 2 Projected demand (EP)**			
	2026	**2031**	**2036**	**Total**
Weinam Creek PDA	892	975	994	2,860

Projected demand for the transport network

Column 1 Service catchment	**Column 2 Projected demand (trips)**			
	2026	**2031**	**2036**	**Total**
Weinam Creek PDA	3,528	4,612	4,709	12,849

Projected demand for the parks and community facilities network

Column 1 Service catchment	**Column 2 Projected demand (EP)**		
	2026	**2031**	**2036**
Weinam Creek PDA	860	911	928

4 Desired standard of service

4.1 Water supply

EDQ have adopted the water supply network desired standards of service contained in the Redland City Council Local Government Infrastructure Plan, as may be amended from time to time.

The desired standard of service for the water supply network is to:

(a) ensure drinking water complies with the National Health and Medical Research Council Australian Drinking Water Guidelines 2004 drinking water guidelines for colour, turbidity and microbiology;

(b) convey potable water from the South East Queensland Water Grid supply points to premises in accordance with the Water Act 2000 and Water Supply (Safety and Reliability) Act 2008;

(c) minimise non-revenue water loss;

(d) design the water supply network in accordance with:

  (i) the South East Queensland Water Supply and Sewerage Design and Construction Code 2013;

  (ii) the key standards stated in Table 4.1.1—Key standards for the water supply network.

Table 4.1.1 – Key standards for the water supply network

Column 1 Description of standard	Column 2 Standard
Average day demand	215 L/EP/day plus 15L/EP/day non-revenue water
Minimum service pressure – Operating conditions (PH)	22m at the property boundary
Maximum service pressure	55m at the property boundary
Fire flow (Urban)	Detached Res (<= 3 stories): 15Ls for 2hrs w background demand Multi storey Res (=> 4 levels): 30L/s for 4 hours w background demand Commercial/Industrial buildings: 30L/s for 4 hours w background demand Risk Hazard Buildings – assessed on needs basis
Fire flow (Rural and Small Communities)	Rural Residential only: 7.5L/s for 2 hours Rural Commercial: 15L/s for 2 hours

4.2 Sewerage

EDQ have adopted the sewerage network desired standards of service contained in the *Redland City Council Local Government Infrastructure Plan*, as may be amended from time to time. The desired standard of service for the sewerage network is to:

(a) provide a reliable network that collects, stores, treats and releases sewage from premises;

(b) design the sewerage network in accordance with:

  (i) the South East Queensland Water Supply and Sewerage Design and Construction Code 2013;

  (ii) the key standards stated in Table 4.2.1—Key standards for the sewerage network.

Table 4.2.1 – Key standards for the sewerage network

Column 1 Description of standard	Column 2 Standard
Average dry weather flow (ADWF)	210L/EP/day
Peak dry weather flow (PDWF)	C2 x ADWF where C2 = 4.7x $(EP)^{-0.105}$
Peak wet weather flow (PWWF) for RIGS	5 x ADWF
Minimum velocity	0.75m/s
Maximum velocity	3m/s
Preferred velocity	1.0-1.5m/s

4.3 Transport

EDQ have adopted the transport network desired standards of service contained in the Redland City Council Local Government Infrastructure Plan, as may be amended from time to time.

The desired standard of service for the trunk road network is to:

(a) provide a functional urban and rural hierarchy of roads that supports settlement patterns, commercial and economic activities, and freight movement;

(b) plan and design the network to ensure the operation of a trunk road or intersection is no worse than level of service C;

(c) design the local road network to comply with Council's adopted standards identified in Planning Scheme Policy 2 – Infrastructure Works;

(d) design road crossing structures to provide an appropriate level of flood immunity in accordance with Council's adopted standards identified in Planning Scheme Policy 2 – Infrastructure Works;

(e) transport corridors are planned to provide for future capacity needs.

The desired standard of service for the cycleway network is to:

(a) provide a cycleway and shared path network that is safe, attractive and convenient, which links residential areas to major activity nodes, employment centres and public transport interchanges, thereby encouraging walking and cycling as acceptable travel alternatives;

(b) design the cycleway network to comply with Council's adopted standards identified in Planning Scheme Policy 2 – Infrastructure Works;

(c) ensure a minimum width of:

    (i) for the Moreton Bay Cycleway, 3 metres;

    (ii) for on-road trunk cycle lanes, 1.5 metres;

    (iii) for other trunk cycleways or shared paths, 2.5 metres;

(d) provide lighting along paths to meet Council's adopted standards identified in Planning Scheme Policy 2 – Infrastructure Works to ensure visibility, safety and security;

(e) design concrete or sealed cycleways or shared paths to provide an appropriate level of flood immunity in accordance with Council's adopted standards identified in Planning Scheme Policy 2 – Infrastructure Works;

(f) ensure the grade on shared paths and exclusive cycleways are kept to a minimum but are not less than 0.4%. Grades greater than 8% are undesirable over an extended path length;

(g) ensure sealed shoulders intended for bicycle lanes are continuous through intersections.

The desired standard of service for the public transport (bus stops) network is to:

(a) provide public transport (bus stops) infrastructure to support future mode share in accordance with the Planning Scheme Part 3 Strategic framework – Theme: liveable communities and housing, Part 9 Development codes – Transport, servicing, access and parking code, and Zone codes;

(b) provide bus stops including bus stations, bays, shelters, seating and transport information in accordance with the Department of Transport and Main Roads' Public Transport Infrastructure Manual 2016;

(c) provide a public transport stop within approximately 400m of each dwelling in an urban area;

(d) provide an electrical connection to all new bus stops;

(e) gutter mesh is required for all new bus stops;

(f) ensure public transport infrastructure complies with the Disability Standards for Accessible Public Transport 2002 (Transport Standards).

4.4 Parks and community facilities

EDQ have adopted the parks and open space network desired standards of service contained in the Redland City Council Local Government Infrastructure Plan, as may be amended from time to time.

The desired standard of service for the public parks and land for community facilities network is to:

(a) provide a connected and accessible network of public parks, recreational facilities and community purpose land that meet the needs of residents through the implementation of the Redland Open Space Strategy 2026;

(b) design the public parks and land for community facilities network to comply with Council's adopted standards identified in Planning Scheme Policy 2 – Infrastructure Works;

(c) new public parks will not be acceptable if they:

  (i) have an overland drainage function;

  (ii) predominately lie below the defined flood event level;

  (iii) are wholly below 2.4m AHD;

  (iv) have road frontage of less than 50% of the perimeter;

  (v) are contaminated land;

  (vi) are adjacent or close to noxious or noisy activities;

  (vii) are less than 100m wide;

  (viii) have a gradient greater than 20% (recreation parks);

  (ix) comprise less than 60% flat to gentle slope (sports parks);

  (x) are the common property common property for a community titles scheme under the Body Corporate and Community Management Act 1997; or

  (xi) are constrained by environmental protection through a planning instrument.

(d) ensure public parks and land for community facilities meet the following standards:

  (i) minimum public park land size and accessibility standards stated in Table 4.4.1—Minimum public park land size and accessibility standards;

  (ii) rate of provision for public parks stated in Table 4.4.2—Rate of provision for public parks;

  (iii) land size and rate of provision for land for community facilities stated in Table 4.4.3—Land size and rate of provision for land for community facilities standards;

  (iv) embellishment standards for public parks and land for community facilities identified in Table 4.4.4—Embellishment standards for public parks and land for community facilities.

Table 4.4.1: Minimum public park land size and accessibility standards

Column 1 Park type	Column 2 Minimum public park land size (ha)	Column 3 Accessibility standard (km)
Recreation park T1 – Destination	5.0 – 20.0 ha	5.0 – 10.0 km
Recreation park T2 - Community	2.0 – 10.0 ha	2.5 – 5.0 km
Recreation park T3 – Neighbourhood	0.5 – 2.0 ha	0.5 – 0.8 km
Recreation park T4 – Meeting place	Location specific	0.5 km
Recreation park T5 – Civic	Location specific	0.5 km
Sport park	5.0 – 20.0 ha	5.0 – 10.0 km

Table 4.4.2: Rate of provision for public parks

Column 1 Park type	Column 2 Rate of provision (ha per 1,000 persons)
Recreation park T1 – Destination	0.25
Recreation park T2 - Community	1.2
Recreation park T3 – Neighbourhood	1.2
Sport park	1.65

Table 4.4.3: Land size and rate of provision for land for community facilities standards

Column 1 Hierarchy	Column 2 Community facility	Column 3 Rate of provision (facility per persons)	Column 4 Land size (ha)
Local	Community meeting space	1:10,000	0.3
District	Multi-purpose community centre	1:30,000	1
	Branch library	1:35,000	0.5
	Arts and cultural space	1:50,000	0.5
Regional	Swimming pool	1:80,000	1

Table 4.4.4: Embellishment standards for public parks and land for community facilities

Column 1 Embellishment type	Column 2 Recreation park					Column 3 Sport park	Column 4 Land for community facilities
	T1	T2	T3	T4	T5		
Barbecues (electric)	✓	✓		✓			
Bicycle racks	✓	✓	✓	✓	✓	✓	
Bins	✓	✓		✓	✓		
Bus parking and turnaround	✓					✓	
Car parking	✓	✓		✓		✓	
Community Garden			✓				
Community sport infrastructure		✓					
Cultural – historic	✓	✓	✓	✓	✓		
Dog off-leash park		One in each catchment	✓				
Fencing or bollards and lock rail	✓	✓	✓	✓	✓	✓	
Festivals and events space	There will be at least one festival and event space in each service catchment				✓		
Fields / Courts						✓	
Fields / Courts lighting						✓	
Footpaths (see also Paths)	✓	✓	✓	✓	✓	✓	
Goal posts / Line marking						✓	
Internal roads	✓					✓	
Irrigation	✓	✓				✓	
Kick-about space	✓	✓	✓				
Landscaping	✓	✓	✓	✓	✓	✓	
Lighting	✓	✓	If required		✓	✓	
Natural heritage	Across all park types heritage trees or other important natural heritage items (fauna and flora) will be provided						
Paths (see also Footpaths)	✓	✓	✓	✓	✓	✓	

Column 1 Embellishment type	Column 2 Recreation park					Column 3 Sport park	Column 4 Land for community facilities
	T1	T2	T3	T4	T5		
Physical Activity Stations—dynamic or static		✓					
Playspace–primary school level	✓	✓			✓	✓	
Playspace–secondary school level	✓	✓	✓		✓		
Playspace–toddler	✓	✓	✓		✓		
Public toilet	✓	✓			✓	✓	
Ramp park		✓					
Seating and tables	✓	✓	✓	✓	✓		
Shade	✓	✓	✓	✓	✓		
Signage	✓	✓	✓	✓	✓	✓	
Spectator seating						✓	
Storage facilities						✓	
Water connection	✓	✓	✓	✓	✓	✓	✓
Wedding space		A limited number of event spaces will be provided					

5 Infrastructure planning

5.1 Planning horizon

Infrastructure planning for the Weinam Creek PDA was undertaken using a planning horizon of 15 years. It is expected that the ultimate dwelling yield within the PDA will be achieved in this planning horizon.

5.2 Water supply

Planning of water supply infrastructure to service development within the PDA is documented in the following:

- Water and Wastewater Planning Review – Weinam Creek Priority Development Area prepared by Calibre Professional Services Pty Ltd and dated 7 April 2020 (included as **Appendix D**)
- Infrastructure Agreement – Weinam Creek PDA executed by Redland Investment Corporation Pty Ltd, Redland City Council and Minister for Economic Development Queensland on 1 December 2021 (included as **Appendix E**)
- Water Supply Master Plan for the Weinam Creek PDA prepared by Redland City Council and dated 11 December 2019 (included as **Appendix F**)

The infrastructure planning identified that to service growth within the PDA, augmentations to the water supply network are required both within and external to the PDA.

Infrastructure which has been determined to be trunk water supply infrastructure is identified in Section 7.

5.3 Sewerage

Planning of sewerage infrastructure to service development within the PDA is documented in the following:

- Water and Wastewater Planning Review – Weinam Creek Priority Development Area created by Calibre Professional Services Pty Ltd and dated 7 April 2020 (included as **Appendix D**)
- Infrastructure Agreement – Weinam Creek PDA executed by Redland Investment Corporation Pty Ltd, Redland City Council and Minister for Economic Development Queensland on 1 December 2021 (included as **Appendix E**)
- Sewerage Network Master Plan for the Weinam Creek PDA prepared by Redland City Council and dated 24 February 2020 (included as **Appendix G**)
- Victoria Point Sewage Treatment Plant Upgrades for New Developments prepared by TYR Group and dated 2 July 2020 (included as **Appendix H)**

The infrastructure planning identified that to service growth within the PDA, augmentations to the sewerage network are required both within and external to the PDA.

Infrastructure which has been determined to be trunk sewerage infrastructure is identified in Section 7.

5.4 Transport

Planning of transport infrastructure to service development within the PDA is documented in the:

- Weinam Creek General Approved Overall Layout Plan Drawings SK400 (Rev 3), SK401 (Rev 3) and SK402 (Rev 3) prepared by Calibre on 3 December 2021 and Approved by EDQ on 22 December 2021 (included as **Appendix I**)
- Infrastructure Agreement – Weinam Creek PDA executed by Redland Investment Corporation Pty Ltd, Redland City Council and Minister for Economic Development Queensland on 1 December 2021 (included as **Appendix E**)
- Intersection upgrade Hamilton Street and Pitt Street Drawings Z-051 and Z-052 (Rev 0) prepared by Engineering Solutions Queensland on 17 July 2023 (included as **Appendix J**)
- Intersection upgrade Meissner Street and Moores Road Drawing Z-049 (Rev 1) prepared by Engineering Solutions Queensland on 17 July 2023 (included as **Appendix K**)

The infrastructure planning identified that to service growth within the PDA, augmentations to the road network are required within the PDA.

Infrastructure which has been determined to be trunk transport infrastructure is identified in Section 7.

5.5 Parks and community facilities

Planning of parks and community facilities infrastructure to service development within the PDA is documented in the following report:

- Landscape Masterplan Design Report – Weinam Creek Priority Development Area prepared by 02LA and dated 14 July 2021 (included as **Appendix L**)
- Infrastructure Agreement – Weinam Creek PDA executed by Redland Investment Corporation Pty Ltd, Redland City Council and Minister for Economic Development Queensland on 1 December 2021 (included as **Appendix E**)

The infrastructure planning identified that to service growth within the PDA, augmentations to the parks and community facilities network are required within the PDA.

Infrastructure which has been determined to be trunk parks and community facilities infrastructure is identified in Section 7.

6 Infrastructure costs

6.1 Cost of land

No future infrastructure (land) is proposed to be acquired for the Weinam Creek PDA.

6.2 Cost of works

The cost of future infrastructure (works) for each network is stated in Table 5: Cost of future trunk infrastructure (works).

Table 5: Cost of future trunk infrastructure (works)

Column 1 Network	Column 2 Report
Water supply	Cost estimates provided by Redland Water
Sewerage	Cost estimates provided by Redland Water
Transport	Cost estimates provided by Redland Investment Corporation
Parks and land for community facilities	Cost estimates provided by Redland City Council
PDA Infrastructure Contributions under the Weinam Creek PDA Infrastructure Agreement	Cost estimates provided by Redland Investment Corporation

The unit rates for the water supply and sewerage network are outlined in Table 6 – Water Supply Main Unit Rates and Table 7 – Sewerage Unit Rates and are presented in March 2024 dollars. The unit rates are base rates and are exclusive of on-cost and contingency allowances.

Table 6: Water Supply Main Unit Rates

Column 1 Diameter	Column 2 Rate $/m
150	$503
200	$667
250	$901
300	$1,196
375	$1,762

Table 7: Sewerage Main Unit Rates

Column 1 Diameter	Column 2 Asset Type	Column 3 Rate $/m
150	Gravity Main	$836
200	Rising Main	$2,501
200	Gravity Main	$953
225	Gravity Main	$1,207

6.3 On-cost allowance

On-costs represent the owner's project costs and may include:

- survey for the work
- geotechnical investigations for the work
- strategic planning
- detailed design for the work
- project management, procurement and contract administration
- environmental investigations for the work
- portable long service leave payment for a construction contract for the work.

The on-costs allowances that have been applied to infrastructure costs in the PDA are stated in Table 8.

Table 8: On-cost allowance

Column 1 Network	Column 2 On-costs allowance
Water supply	15% applied to the works base cost
Sewerage	15% applied to the works base cost
Transport	15% applied to the works base cost
Parks and community facilities	15% applied to the works base cost
PDA Infrastructure Contributions under the Weinam Creek PDA Infrastructure Agreement	15% applied to the works base cost

6.4 Contingency allowance

A contingency allowance is included in the cost of future infrastructure works to deal with known risks. The contingency allowance typically reduces in accordance with the level of planning undertaken for the infrastructure item. The level of contingency allowance applied for infrastructure works in each network are stated in Table 9.

Table 9: Contingency allowance

Column 1 Network	Column 2 Contingency allowance
Water supply	20% applied to the total of the works base cost and works on-costs
Sewerage	20% applied to the total of the works base cost and works on-costs
Transport	20% applied to the total of the works base cost and works on-costs
Parks and land for community facilities	20% applied to the total of the works base cost and works on-costs
PDA Infrastructure Contributions under the Weinam Creek PDA Infrastructure Agreement	20% applied to the total of the works base cost and works on-costs

6.5 Cost sharing arrangements

The cost of certain trunk infrastructure items is to be shared between EDQ and Redland City Council. The cost sharing arrangement will apply to those infrastructure items which will service users beyond the boundary of the PDA. The proportion of the cost to be funded by Redland City Council will reflect the estimated amount of usage of the infrastructure item by development outside the PDA. The trunk infrastructure items subject to cost sharing arrangements are shown in Table 10.

Table 10: Infrastructure items subject to cost sharing arrangements

Column 1 Network	Column 2 DCOP ID	Column 3 Cost sharing arrangement	Column 4 Amount funded by DCOP Infrastructure Charges[1]
Transport	TR_3	50% funded by DCOP Infrastructure Charges	$732,747
Transport	TR_4	50% funded by DCOP Infrastructure Charges	$6,600,016
Transport	TR_5	50% funded by DCOP Infrastructure Charges	$477,399
Parks and land for community facilities	PARK_1	20% funded by DCOP Infrastructure Charges	$1,872,166
Sewerage	WW_6	Amount to be funded by DCOP Infrastructure Charges	$2,800,567
Sewerage	WW_7	Amount to be funded by DCOP Infrastructure Charges	$524,815
Sewerage	WW_8	Amount to be funded by DCOP Infrastructure Charges	$129,473
Sewerage	WW_9	Amount to be funded by DCOP Infrastructure Charges	$1,913,105

Notes:

1 – The estimated cost is expressed in March 2024 dollars

7 Trunk Infrastructure included in DCOP

Table 11 identifies the criteria that was used to identify trunk infrastructure to be included in the DCOP. This table should be read in conjunction with the remainder of the IPBR document to determine:

- Scope of planned infrastructure (i.e., Infrastructure planning, IPBR section 5)
- Scope of inclusions in infrastructure delivery cost (i.e., Infrastructure costs, IPBR section 6)

Trunk infrastructure to be included in the DCOP is identified at the discretion of MEDQ. In addition to the criteria below, consideration may also be given to the overall network function to deliver a coherent, contiguous network. This may include alternative and innovative infrastructure solutions that provide an equivalent level of service at a lower cost to the community (e.g., efficient staging of works, or alternative design/alignment).

Table 11: Trunk infrastructure criteria

Column 1 Network	Column 2 Asset Type	Column 3 Infrastructure Criteria
Water Supply	Water Main	• All mains identified in the DCOP mapping.
	Pressure Reducing Valve	• All pressure reducing valves identified in the DCOP mapping.
Sewerage	Gravity Main	• All gravity mains identified in the DCOP mapping.
	Rising Main	• All rising mains associated with DCOP identified pump stations
	Pump Station	• All pump stations identified in the DCOP mapping.
	Treatment Plant	• All treatment plant upgrades and treatment plant transfers identified in the DCOP mapping.
Transport	Roads	• Road upgrades identified in the DCOP mapping.
	Intersection	• Intersection upgrades identified in the DCOP mapping.
	Cycle Path	• Cycle paths identified in the DCOP mapping.
Parks	Recreation Park	• Park embellishment upgrades identified in the DCOP mapping.
PDA Infrastructure Contributions	Various	• PDA Infrastructure Contributions identified in Schedule 1 of the Infrastructure Agreement – Weinam Creek PDA

8 Development charges

Development charges are imposed on development in the PDA to fund trunk infrastructure and other services that have been provided or are planned to be provided to service the PDA. The following charges types make up a development charge and apply to development in the PDA.

- Infrastructure charges

8.1 Funding trunk infrastructure

Infrastructure charges imposed on development within the Weinam Creek PDA will fund the provision of trunk infrastructure necessary to service that development. Trunk infrastructure is identified in:

- Table 12 – Water supply schedule of works.
- Table 13 – Sewerage schedule of works.
- Table 14 – Transport schedule of works.
- Table 15 – Parks and community facilities schedule of works.
- Table 16 – PDA Infrastructure Contributions under the Weinam Creek PDA Infrastructure Agreement

8.2 Funding non-trunk infrastructure

Non-trunk infrastructure and other infrastructure that is made necessary by development of the Weinam Creek PDA will be delivered and/or funded by parties undertaking development.

Table 12: Schedule of works – Schedule of future trunk infrastructure works – Water supply

DCOP ID	Map number	Infrastructure type	Infrastructure description	Estimated timing	Land cost	Works base cost	Works on-costs	Works contingency	Total works cost[1]	Estimated cost[2]
WS_1	Map 3	Water Supply Main	Giles Rd - Approximately 1,135m of DN375 Water Supply Main	2031	$0	$2,000,071	$300,011	$460,016	$2,760,099	$2,760,099
WS_2	Map 3	Water Supply Main	Gordon Rd – Approximately 830m of DN300 Water Supply Main	2031	$0	$993,157	$148,974	$228,426	$1,370,557	$1,370,557
WS_3	Map 3	Water Supply Main	German Church Rd – Approximately 420m of DN250 Water Supply Main	2031	$0	$378,413	$56,762	$87,035	$522,210	$522,210
WS_4	Map 3	Water Supply Main	Gordon Rd - Approximately 280m of DN200 Water Supply Main	2031	$0	$187,018	$28,053	$43,014	$258,085	$258,085
WS_5	Map 3	Water Supply Main	School of Arts Rd - Approximately 280m of DN200 Water Supply Main	2031	$0	$187,018	$28,053	$43,014	$258,085	$258,085
WS_6	Map 3	Water Supply Main	Ridge Pl - Approximately 280m of DN200 Water Supply Main	2031	$0	$187,018	$28,053	$43,014	$258,085	$258,085
WS_7	Map 2	Water Supply Main	Banana St, Outridge St, Pitt St, Loop Rd, Hamilton St, Weinam St, Meissner St Water Supply Mains - Approximately 1,510m of DN150 Water Supply Main	2022	$0	$759,641	$113,946	$174,717	$1,048,305	$1,048,305
WS_8	Map 3	Pressure Reducing Valve	Pressure Reducing Valve - 1 Unit	2031	$0	$206,963	$31,044	$47,601	$285,609	$285,609

Notes:

i The total works cost is the sum of the following: construction cost, construction on costs and construction contingency.

ii The estimated cost is the sum of the following: land cost and total works cost. This is expressed in current cost terms as at March 2024.

Table 13: Schedule of works – Schedule of future Trunk Infrastructure works – Sewerage

DCOP ID	Map number	Infrastructure type	Infrastructure description	Estimated timing	Land cost	Works base cost	Works on-costs	Works contingency	Total works cost[1]	Estimated cost[2]
WW_1	Map 4	Sewerage Rising Main	Sel Outridge Park - Approximately 800m of DN200 Wastewater Rising Main	2026	$0	$2,000,918	$300,138	$460,211	$2,761,266	$2,761,266
WW_2	Map 4	Sewerage Gravity Main	Neville Stafford Park - Approximately 65.8m of DN225 Wastewater Gravity Main	2026	$0	$79,417	$11,913	$18,266	$109,595	$109,595
WW_3	Map 4	Sewerage Gravity Main	Banana St to Outridge St - Approximately 172m of DN200 Wastewater Gravity Main	2026	$0	$163,905	$24,586	$37,698	$226,189	$226,189
WW_4	Map 4	Sewerage Gravity Main	Outridge St - Approximately 154m of DN150 Wastewater Gravity Main	2026	$0	$128,842	$19,326	$29,634	$177,802	$177,802
WW_5	Map 4	Sewerage Pump Station	SPS 90 upgrade	2026	$0	$977,621	$146,643	$224,853	$1,349,117	$1,349,117
WW_6	Map 5	Sewerage Treatment Plant	Upgrade Victoria Point Wastewater Treatment Plant	2024-2026	$0	$2,029,396	$304,409	$466,761	$2,800,567	$2,800,567
WW_7	Map 5	Sewerage Treatment Plant	Victoria Point WWTP release upgrade	2024-2027	$0	$380,301	$57,045	$87,469	$524,815	$524,815
WW_8	Map 5	Sewerage Treatment Plant	Upgrade Cleveland Wastewater Treatment Plant	2028	$0	$93,821	$14,073	$21,579	$129,473	$129,473
WW_9	Map 5	Sewerage Treatment Plant	Cleveland catchment transfer upgrade	2024-2026	$0	$1,386,308	$207,946	$318,851	$1,913,105	$1,913,105

Notes:

i– The total works cost is the sum of the following: construction cost, construction on costs and construction contingency.

ii– The estimated cost is the sum of the following: land cost and total works cost. This is expressed in current cost terms as at March 2024.

Table 14: Schedule of works – Schedule of future Trunk Infrastructure works – Transport

DCOP ID	Map number	Infrastructure type	Infrastructure description	Estimated timing	Land cost	Works base cost	Works on- costs	Works contingency	Total works cost[1]	Estimated cost[2]
TR_1	Map 6	Transport Intersection	Hamilton St and Pitt St Intersection – Roundabout	2025	$0	$1,142,953	$171,443	$262,879	$1,577,275	$1,577,275
TR_2	Map 6	Transport Intersection	Meissner St and Moores Rd Intersection – Signalised	2031	$0	$1,061,953	$159,293	$244,249	$1,465,495	$1,465,495
TR_3	Map 6	Transport Intersection	Meissner St and Weinam St Intersection – Signalised	2031	$0	$1,061,953	$159,293	$244,249	$1,465,495	$1,465,495
TR_4	Map 6	Road Upgrade	Pitt St, Weinam St and Hamilton St - Road Upgrade	2031-2036	$0	$9,565,241	$1,434,786	$2,200,005	$13,200,032	$13,200,032
TR_5	Map 6	Active Transport	Pitt St, Weinam St and Hamilton St - New 2.5m Off-Road Cycle Path	2024-2029	$0	$691,882	$103,782	$159,133	$954,797	$954,797
TR_6	Map 6	Active Transport	Weinam St and Esplanade - New 2.5m Off-Road Cycle Path	2024-2029	$0	$403,068	$60,460	$92,706	$556,234	$556,234
TR_7	Map 6	Active Transport	Outridge St to Auster St - New 2.5m Off-Road Cycle Path	2029-2034	$0	$18,472	$2,771	$4,249	$25,491	$25,491

Notes:

[i] The total works cost is the sum of the following: construction cost, construction on costs and construction contingency.

[ii] The estimated cost is the sum of the following: land cost and total works cost. This is expressed in current cost terms as at March 2024

Table 15: Schedule of works – Schedule of Trunk Infrastructure Works – Parks and community facilities

DCOP ID	Map number	Infrastructure type	Infrastructure description	Estimated timing	Land cost	Works base cost	Works on- costs	Works contingency	Total works cost[1]	Estimated cost[2]
PARK_1	Map 7	Recreation Park – T2 (Medium)	Sel Outridge Park Embellishments	2025	$0	$6,783,211	$1,017,482	$1,560,139	$9,360,831	$9,360,831

Notes:

[i] The total works cost is the sum of the following: construction cost, construction on costs and construction contingency.

[ii] The estimated cost is the sum of the following: land cost and total works cost. This is expressed in current cost terms as at March 2024

Table 16: Schedule of works – Schedule of future Trunk Infrastructure works – PDA Infrastructure Contributions under the Weinam Creek PDA Infrastructure Agreement

DCOP ID	Map number	Infrastructure type	Infrastructure description	Estimated timing	Land cost	Works base cost	Works on- costs	Works contingency	Total works cost[1]	Estimated cost[2]
IA_1A	Map 8	Item 1: Roadworks and associated works	Item 1A: Hamilton St Modification	2025	$0	$7,122,967	$1,068,445	$1,638,282	$9,829,694	$9,829,694
IA_1B	Map 8	Item 1: Roadworks and associated works	Item 1B: Initial section of Loop Rd	2026	$0	$6,135,142	$920,271	$1,411,083	$8,466,496	$8,466,496
IA_1C	Map 8	Item 1: Roadworks and associated works	Item 1C: Completion of Loop Rd	2031	$0	$3,167,092	$475,064	$728,431	$4,370,587	$4,370,587
IA_2	Map 8	Item 2: Parks and foreshore improvements	Parks and foreshore improvements - Neville Stafford Park, Foreshore and Town Plaza Works	2026	$0	$630,898	$94,635	$145,107	$870,639	$870,639
IA_3	Map 8	Item 3: Parks and foreshore improvements	Parks and foreshore improvements – Weinam Creek Foreshore and Linear Park Connection to Precinct 1A	2028	$0	$1,804,795	$270,719	$415,103	$2,490,617	$2,490,617
IA_4	Map 8	Item 4: Boat ramp and associated works	Recreational Boat Ramp and Associated Works	2028	$0	$955,718	$143,358	$219,815	$1,318,890	$1,318,890
IA_5	Map 8	Item 5: Meissner Street works -	Works in front of the Satellite Hospital Site	2028	$0	$718,526	$107,779	$165,261	$991,566	$991,566

Notes:

[i] The total works cost is the sum of the following: construction cost, construction on costs and construction contingency.

[ii] The estimated cost is the sum of the following: land cost and total works cost. This is expressed in current cost terms as at March 2024.

9 Financial modelling inputs and assumptions

9.1 Indexation and escalation of costs

All infrastructure costs presented in the cost schedules of the financial model have been adjusted to bring into alignment with the base year (i.e., March 2021).

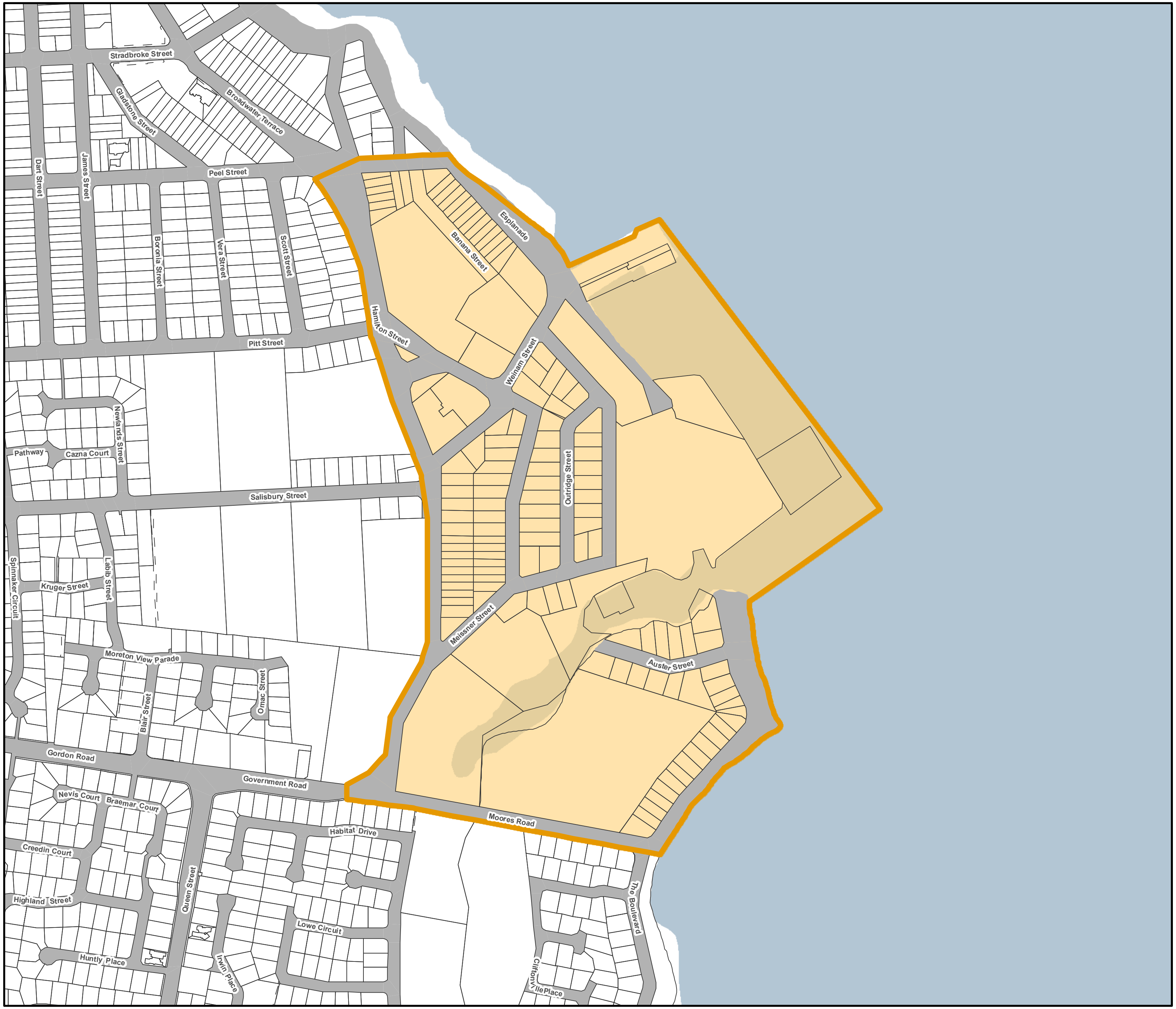
A discounted cashflow methodology is used by the financial model to undertake the analysis of revenue and expenditure.

Key inputs used to undertake the discounted cashflow analysis are identified in Table 17 – Financial Model Inputs.

Table 17: Financial model inputs

Column 1 Input	Column 2 Adopted value	Column 3 Source
Base year	2021	This is the base year for the DCOP.
End year	2036	This is the end year for the DCOP.
Infrastructure charge rate escalation	1.34%	The adopted charge escalation rate for the networks is the 10-year average (2012-2021) of movements to the Producer Price Index series A2333727L (i.e., 3101 – Road and bridge construction, Queensland) published by the Australian Bureau of Statistics.
Discount rate	3.00%	The adopted discount rate has been calculated by using the ten-year government bond rate.
Land value escalation	1.70%	The adopted land value escalation rate is the 10-year average (2012-2021) of movements to the Consumer Price Index series A2325816R (i.e. All groups CPI Brisbane) published by the Australian Bureau of Statistics.
Construction cost escalation	1.34%	The construction cost escalation rate for the networks is the 10-year average (2012-2021) of movements to the Producer Price Index series A2333727L (i.e. 3101 – Road and bridge construction, Queensland) published by the Australian Bureau of Statistics.

Appendix A – Weinam Creek PDA boundary map



Map No: PDA 4 - Weinam Creek Priority Development Area

Declared by Regulation on: 21/06/2013

Key

▨ Weinam Creek PDA

Cadastre

☐ Parcel Boundaries

Easements

▨ Road Dedications

0 100 200 Metres

Source: Department of Natural Resource Management and Mines: Digital Cadastre Database: April 2013.

Map generated by Spatial Services Branch of the Department of State Development, Infrastructure and Planning, 12/01/2015

Queensland Government

Appendix B – Demographic Assessment of Proposed Development within the Weinam Creek PDA

Economic Development Queensland

Demographic Assessment of Proposed Development within the Weinam Creek PDA

29 June 2020

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Section 5 Summary

The product delivered within the Weinam Creek PDA is likely to appeal to an older age cohort, with persons residing in attached product in the comparator locations of Redland Bay SA2, Victoria Point SA2 and Cleveland SA2 most likely to be empty nesters, relying on accumulated wealth to fund their lifestyle. Interestingly, a significant proportion of attached dwellings in Victoria Point SA2 represent retirement village accommodation, which could represent a potential opportunity for the Weinam Creek PDA.

We are of the view that the demographics of the SMBI are not likely to influence the build out demography of the Weinam Creek PDA. The socio-economic profile highlights that residents within the SMBI have significantly lower average household incomes than residents on the mainland, approximately half of the Redland City average. It is not considered that provision of attached dwellings within the Weinam Creek PDA would entice these residents to shift to the mainland.

Our review of the RIC estimates of population and dwellings within the Weinam Creek PDA indicates that these estimates were broadly representative of the likely trajectory of growth under a high population growth scenario. Historic evidence has indicated that the average household size of comparator coastal locations in Redland City typically achieved an average household size of 1.6 – 1.7 persons / dwelling, lower than the RIC assumptions of 1.9 persons per dwelling.

Based on these assumptions, the residential build out population of the Weinam Creek PDA is likely to be in the order of approximately 2,500 – 3,000 persons.

The residential build out of the Weinam Creek PDA is likely to occur over a ten to twenty year horizon, with the approval of the application within Precinct 14 anticipated to kick start residential redevelopment activity. Our assessment has assumed that the sequencing of residential development is such that large englobo allotments that can accommodate at least 50 dwellings are taken up first, with Precincts 4-6 likely to be fully built out first, with Precincts 7 and 9 likely to reach build out capacity last due to the fragmented nature of allotments (allotments within these precincts can typically accommodate less than ten dwellings each).

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Section 1 Introduction

1.1 Purpose of Study

CDM Smith was engaged by Economic Development Queensland (EDQ) to provide economic advisory services in relation to proposed development concepts within the Weinam Creek Priority Development Area (PDA). These services comprised two parts:

- Part A: Provision of economic and demographic analysis advice in relation to development yields and planning assumptions; and
- Part B: Review of analysis supporting retail development proposals.

This document relates to Part A.

1.2 Report Structure

This report is structured as follows:

- **Section 1 – Introduction:** Provides an overview of the purpose of the study and report structure;
- **Section 2 – Overview of Weinam Creek and Comparator Areas:** Provides a socio-economic overview of Weinam Creek and the comparator areas
- **Section 3 –Estimated Population and Dwelling Capacity of Weinam Creek PDA:** Provides an overview of the population and dwelling capacity estimates for Weinam Creek PDA provided by Redland Investment Corporation (RIC) and whether we are of the view these are appropriate for the Weinam Creek PDA;
- **Section 4 – Anticipated Timing of Population and Dwelling Growth of Weinam Creek PDA:** Provides an assessment of the likely take-up horizon of dwellings within the Weinam Creek PDA, including the potential population within these dwellings; and
- **Section 5 – Summary:** Provides a summary of the key findings of the assessment.

1.3 Glossary and Abbreviations

Term	Definition
EDQ	Economic Development Queensland
ha	Hectare
LGA	Local Government Area
LGIP	Local Government Infrastructure Plan
PDA	Priority Development Area
RIC	Redland Investment Corporation
SA1	Statistical Area Level 1
SA2	Statistical Area Level 2
SMBI	Southern Moreton Bay Islands

Section 2 Overview of Weinam Creek and Comparator Areas

The purpose of this chapter is to provide an overview of the characteristics of the existing community within the Weinam Creek PDA, benchmarked to other coastal communities in Redland City (i.e. Redland Bay SA2, Victoria Point SA2, Cleveland SA2), the Southern Moreton Bay Islands (SMBI), Redland City and Queensland.

This chapter has considered the following characteristics:

- Socio-economic profile of the Weinam Creek PDA as of the 2016 Census, benchmarked to other coastal communities, the SMBI, Redland City and Queensland;
- Socio-economic profile of residents within attached dwellings in the comparator areas of Redland Bay SA2, Victoria Point SA2 and Cleveland SA2 to obtain an understanding of the demographic characteristics of the existing population in attached product;
- Historic trends in average household size for attached dwellings in the coastal communities in Redland City (i.e. Redland Bay SA2, Victoria Point SA2 and Cleveland SA2).

2.1 Socio Economic Profile

For the purposes of comparison, the Study Area (Weinam Creek PDA) has been benchmarked against the Redland Bay SA2, Victoria Point SA2, Cleveland SA2, Redland Local Government Area (LGA) and Queensland.

2.1.1 All Residents

A summary of the demographic and socio-economic characteristics of the Study Area against these benchmarks is as follows:

- The population of the Study Area accounted for approximately 0.1% of the total population in the Redland LGA in 2016. Within the population of the Study Area, the incidence of persons aged 65 years and over was the largest, representing 25.3% of the total population in 2016. This trend is consistent across Victoria Point SA2, Cleveland SA2 and Southern Moreton Bay Islands (SMBI) as of the 2016 Census. Conversely, the incidence of persons aged 0 to 14 years was the largest for Redland Bay SA2, Redland LGA and Queensland.
- In 2016, the average age of residents within the Study Area was 46.5 years, this was higher than the average recorded for the Redland LGA and Queensland (40.3 years and 38.2 years, respectively). Redland Bay SA2 had the lowest average age amongst all geographies analysed (37.5 years), whilst the SMBI had the highest average age (50.7 years).
- The incidence of couple families without children in 2016 was the most common household composition across the Study Area, Victoria Point SA2, Cleveland SA2 and SMBI. Meanwhile, couple families with children were the most common household composition in Redland Bay SA2, Redland LGA and Queensland.
- The average household size in the Study Area was 2.8 persons in 2016, which is marginally higher than the averages recorded for Redland LGA and Queensland (2.7 persons and 2.6 persons respectively). Redland Bay SA2 recorded the highest average household size of all geographies analysed (3.0 persons), whilst SMBI recorded the lowest average household size (2.0 persons).
- As of the 2016 Census, the incidence of households fully owning a home in the Study Area (34.4%) was above the incidences recorded for Redland LGA (30.9%) and Queensland (27.4%). The proportion of households renting was also higher in the Study Area (32.8%), compared to the Redland LGA (23.9%) and Queensland (32.2%).
- The average weekly household income was lower in the Study Area ($1,260) relative to Redland LGA ($1,839) and Queensland ($1,735). Redland Bay SA2 had the highest weekly household income of all geographies analysed ($1,958), whilst SMBI had the lowest weekly household income ($856).

- In 2016, the average monthly housing loan repayment in the Study Area ($2,100 per month) and in the Redland LGA ($2,007 per month) were higher than the State average ($1,902 per month). However, trends in average weekly rental payments in 2016 reveal that on average the Study Area was more expensive than Redland LGA and the State to rent.
- Average housing costs as a proportion of income reveals that the Study Area required residents to spend a higher proportion of their income on housing costs when compared to the Redland LGA and Queensland in 2016.
- Labour market participation data from 2016 reveals that the Study Area (15.7%) and SMBI (16.6%) had significantly higher unemployment rates compared to the other areas analysed. During this timeframe, Redland LGA had an unemployment rate of 6.1%, whilst the State recorded an unemployment rate of 7.6%.
- In 2016, approximately 44.7% of persons in the Study Area aged 15 years and over had a non-school qualification. This incidence rate was lower than both Redland LGA and Queensland (50.5% and 48.3%, respectively). The most common non-school qualification for all areas analysed was at the certificate level.
- As of the 2016 Census, the incidence of lower white-collar workers was the largest cohort in all areas analysed, representing well over a third of all employees. Relative to Redland LGA and Queensland, the Study Area recorded a lower incidence of white-collar workers and a higher incidence of blue-collar workers.
- In 2016, the construction industry was the largest employing sector in the Study Area and Redland Bay SA2 (24.6% and 14.3% of all employment, respectively). Meanwhile, the health care and social assistance industry was the largest employing industry for the remaining areas analysed (Victoria Point SA2, Cleveland SA2, SMBI, Redland LGA and Queensland).

Table 2-1 summarises the demographic and socio-economic characteristics of the Study Area against the Redland Bay SA2, Victoria Point SA2, Cleveland SA2, Redland Local Government Area (LGA) and Queensland in 2016.

Table 2-1 Demographic and Socio-Economic Profile, Weinam Creek PDA and Select Benchmarks, 2016

	Weinam Creek PDA	Redland Bay SA2	Victoria Point SA2	Cleveland SA2	SMBI	Redland LGA	Queensland
Population	182	15,608	15,013	14,782	6,075	147,022	4,703,188
Age Distribution							
0-14 years	16.5%	22.1%	17.3%	14.2%	11.6%	18.8%	19.4%
15-24 years	7.1%	12.1%	11.8%	11.3%	6.7%	12.2%	13.0%
25-34 years	16.5%	11.0%	8.9%	8.6%	5.2%	10.7%	13.7%
35-44 years	7.1%	14.0%	10.9%	10.2%	8.2%	12.6%	13.4%
45-54 years	10.4%	14.6%	14.0%	14.0%	13.1%	14.4%	13.4%
55-64 years	17.0%	11.7%	12.4%	15.8%	21.0%	13.5%	11.8%
65+ years	25.3%	14.4%	24.6%	25.8%	34.2%	17.8%	15.3%
Average age (years)	46.5	37.5	43.7	45.7	50.7	40.3	38.2
Household Type (% of families)							
Couple families with children	26.4%	47.8%	41.2%	36.1%	17.5%	44.2%	42.5%
Couple families without children	52.8%	38.0%	44.0%	45.3%	57.8%	39.5%	39.4%
Single parent family	20.8%	13.5%	14.1%	17.4%	22.6%	15.3%	16.5%
Other families	0.0%	0.7%	0.7%	1.2%	2.1%	1.1%	1.6%

	Weinam Creek PDA	Redland Bay SA2	Victoria Point SA2	Cleveland SA2	SMBI	Redland LGA	Queensland
Average household size	2.8	3.0	2.7	2.4	2.0	2.7	2.6
Household Finances							
% of households fully owning home	34.4%	26.8%	33.0%	34.9%	38.5%	30.9%	27.4%
% of households purchasing home	12.5%	43.6%	33.0%	25.4%	22.7%	38.5%	31.4%
% of households renting	32.8%	23.3%	22.2%	31.7%	29.4%	23.9%	32.2%
Average weekly household income	$1,260	$1,958	$1,699	$1,741	$856	$1,839	$1,735
Average monthly housing loan repayment	$2,100	$2,194	$1,970	$2,068	$899	$2,007	$1,902
Average weekly rent payment	$413	$435	$404	$368	$231	$375	$334
Average housing costs (as a % of income)	15.6%	16.4%	14.1%	13.7%	13.5%	14.5%	14.1%
Labour Market							
Full-time employment (% labour force)	56.6%	59.0%	58.1%	57.9%	36.0%	58.8%	57.7%
Part-time employment (% labour force)	24.1%	30.0%	31.8%	31.7%	40.9%	30.6%	29.9%
Total employment (% labour force)	84.3%	94.0%	94.2%	94.0%	83.4%	93.9%	92.4%
Unemployment rate (% labour force)	15.7%	6.0%	5.8%	6.0%	16.6%	6.1%	7.6%
Participation rate (% of population > 15 years)	49.1%	65.1%	56.6%	55.2%	30.9%	62.6%	61.0%
Qualifications							
% of persons with a non-school qualification	44.7%	50.3%	48.2%	49.2%	44.2%	50.5%	48.3%
% of persons with Bachelor or higher	8.6%	13.0%	12.8%	17.0%	10.9%	15.5%	18.3%
% of persons with Diploma	13.2%	10.1%	9.9%	10.4%	8.5%	10.3%	8.7%
% of persons with Certificate	23.0%	27.1%	25.4%	21.8%	24.9%	24.7%	21.3%
Occupation							
Upper White Collar							
Managers	10.7%	13.3%	11.3%	15.5%	8.8%	12.4%	12.1%
Professionals	14.3%	15.4%	14.3%	19.0%	12.6%	17.2%	19.8%
Subtotal	25.0%	28.7%	25.6%	34.5%	21.5%	29.6%	31.9%
Lower White Collar							
Clerical and Admin Workers	14.3%	16.1%	15.6%	15.3%	10.1%	16.0%	13.6%
Community & Personal Service Workers	19.6%	10.3%	13.0%	10.8%	14.5%	10.9%	11.3%
Sales Workers	0.0%	10.2%	10.3%	10.5%	12.0%	10.1%	9.7%

	Weinam Creek PDA	Redland Bay SA2	Victoria Point SA2	Cleveland SA2	SMBI	Redland LGA	Queensland
Subtotal	33.9%	36.6%	38.9%	36.7%	36.6%	36.9%	34.7%
Upper Blue Collar							
Technicians & Trades Workers	23.2%	16.3%	17.2%	13.4%	15.3%	15.9%	14.3%
Subtotal	23.2%	16.3%	17.2%	13.4%	15.3%	15.9%	14.3%
Lower Blue Collar							
Machinery Operators & Drivers	5.4%	6.6%	6.2%	4.8%	9.1%	6.3%	6.9%
Labourers	12.5%	10.2%	10.5%	9.2%	14.6%	9.8%	10.5%
Subtotal	17.9%	16.8%	16.7%	14.0%	23.6%	16.1%	17.5%
Employment by Industry (% of employees)							
Agriculture, forestry & fishing	0.0%	1.3%	0.9%	1.0%	1.3%	0.8%	2.8%
Mining	0.0%	1.0%	1.2%	1.0%	0.5%	1.1%	2.3%
Manufacturing	10.1%	8.0%	7.7%	7.6%	4.2%	7.6%	6.0%
Electricity, gas, water & waste services	0.0%	1.0%	1.5%	1.1%	0.6%	1.1%	1.1%
Construction	24.6%	14.3%	12.3%	11.8%	13.6%	11.9%	9.0%
Wholesale trade	0.0%	3.7%	3.5%	3.2%	1.6%	3.5%	2.6%
Retail trade	7.2%	10.3%	10.2%	9.6%	12.2%	10.3%	9.9%
Accommodation & food services	0.0%	4.9%	6.2%	6.3%	6.5%	5.5%	7.3%
Transport, postal & warehousing	13.0%	5.9%	5.4%	4.9%	7.3%	5.9%	5.1%
Information media & telecommunications	0.0%	1.3%	1.3%	1.3%	0.0%	1.3%	1.2%
Financial & insurance services	0.0%	2.7%	2.7%	3.0%	2.4%	2.7%	2.5%
Rental, hiring & real estate services	0.0%	1.7%	1.9%	2.9%	2.7%	1.9%	2.0%
Professional, scientific & technical services	0.0%	4.8%	4.7%	6.8%	4.5%	5.8%	6.3%
Administrative & support services	0.0%	3.3%	3.8%	3.6%	4.4%	3.6%	3.5%
Public administration & safety	4.3%	5.4%	5.3%	5.5%	6.0%	5.8%	6.6%
Education & training	8.7%	8.4%	8.7%	7.9%	6.6%	8.3%	9.0%
Health care & social assistance	13.0%	11.6%	13.1%	12.8%	14.8%	12.6%	13.0%
Arts & recreation services	0.0%	1.2%	1.3%	1.5%	2.2%	1.3%	1.6%
Other services	13.0%	4.1%	4.5%	3.7%	3.0%	4.3%	3.9%

Source: ABS (2017), 2016 Census of Population and Housing, Australian Bureau of Statistics, Canberra; ABS (2012), 2011 Census of Population and Housing, Australian Bureau of Statistics, Canberra; and ABS (2007), 2006 Census of Population and Housing, Australian Bureau of Statistics, Canberra

2.1.2 Residents in Attached Dwellings

An additional socio-economic profile was prepared for persons in the SA2s of Redland Bay, Victoria Point and Cleveland that lived in attached dwellings, as of the 2016 Census. Key findings from this analysis are detailed below:

- The average age of persons living in an attached dwelling was 46.7 years in Redland Bay SA2, 62.4 years in Victoria Point SA2 and 50.7 years in Cleveland;
- Approximately one third of residents in attached product in Redland Bay SA2 and Cleveland SA2 were aged 65 years and over, whereas just under two thirds of residents in attached product in Victoria Point SA2 were 65 years and over;
- The most common household type across all three geographies analysed was couple families without children;
- Renting was the most common tenure type for attached dwellings in Redland Bay SA2 and Cleveland SA2;
- Approximately a third of attached dwellings in Victoria Point SA2 were described as other tenure type which is likely due to the significant provision of retirement village accommodation within Victoria Point SA2;
- Cleveland SA2 recorded the highest average weekly household income, whilst Redland Bay SA2 recorded the highest average monthly mortgage payment and the lowest weekly rent payment of all areas analysed;
- Average household incomes in all areas analysed were significantly lower than the overall averages for all regions analysed, indicative of a retired population utilising accumulated wealth; and
- Average housing costs (as a proportion of total household income) for attached dwellings were highest in Cleveland SA2 and lowest in Victoria Point SA2.

Table 2-2 Socio-Economic Indicators, Attached Dwellings, 2016

	Redland Bay SA2	Victoria Point SA2	Cleveland SA2
Population	292	1,744	3,916
Age Distribution			
0-14 years	17.5%	6.7%	10.0%
15-24 years	5.5%	6.2%	9.0%
25-34 years	12.7%	5.8%	8.7%
35-44 years	7.9%	3.8%	9.7%
45-54 years	11.0%	7.6%	12.0%
55-64 years	14.0%	7.3%	16.2%
65+ years	31.5%	62.4%	34.4%
Average age (years)	46.7	62.4	50.7
Household Type (% of families)			
Couple families with children	14.1%	8.3%	16.7%
Couple families without children	53.1%	72.2%	51.7%
Single parent family	32.8%	19.5%	29.8%
Other families	0.0%	0.0%	1.9%
Household Finances			

	Redland Bay SA2	Victoria Point SA2	Cleveland SA2
% of households fully owning home	20.7%	25.1%	24.8%
% of households purchasing home	9.8%	8.7%	12.8%
% of households renting	48.2%	25.0%	50.8%
% of households other tenure type	0.0%	33.5%	4.4%
Average weekly household income	$1,017	$948	$1,125
Average monthly housing loan repayment	$2,300	$1,435	$1,539
Average weekly rent payment	$265	$301	$308
Average housing costs (as a % of income)	17.6%	10.9%	18.0%

Source: ABS (2017), 2016 Census of Population and Housing, Australian Bureau of Statistics, Canberra

2.2 Average Household Size by Product Type

In 2016, the average household size of detached dwellings was 2.9 persons in Redland Bay SA2, 2.8 persons in Victoria Point SA2 and 2.7 persons in Cleveland SA2. Similarly, the average household size of attached dwellings was 1.7 persons in Redland Bay SA2, 1.6 persons in Victoria Point SA2 and 1.7 persons in Cleveland SA2.

Table 2-4 denotes the average household size of coastal communities by dwelling structure within Redland LGA in 2016.

Table 2-3 Average Household Size by Dwelling Structure within Coastal Communities in Redland City, 2016

Dwelling Structure	Redland Bay SA2	Victoria Point SA2	Cleveland SA2
Detached	2.9	2.8	2.7
Attached	1.7	1.6	1.7
Townhouse	1.9	1.6	1.7
Unit	1.3	1.5	1.6

Source: ABS (2017), 2016 Census of Population and Housing, Australian Bureau of Statistics, Canberra

2.3 Implications for Weinam Creek PDA

The product delivered within the Weinam Creek PDA is likely to appeal to an older age cohort, with persons residing in attached product in comparator locations most likely to be empty nesters, relying on accumulated wealth to fund their lifestyle. Interestingly, a significant proportion of attached dwellings in Victoria Point SA2 represent retirement village accommodation, which could represent a potential opportunity for the Weinam Creek PDA.

We are of the view that the demographics of the SMBI are not likely to influence the build out demography of the Weinam Creek PDA. The socio-economic profile highlights that residents within the SMBI have significantly lower average household incomes than residents on the mainland, approximately half of the Redland City average. It is not considered that provision of attached dwellings within the Weinam Creek PDA would entice these residents to shift to the mainland.

As of the 2016 Census, the average household size for attached dwellings ranged between 1.6 and 1.7 persons per household, with the average dwelling size in Victoria Point SA2 marginally lower, likely due to the influence of retirement village accommodation (which typically has an average household size of 1.3 persons / dwelling).

Section 3 Estimated Population and Dwelling Capacity of Weinam Creek PDA

The purpose of this chapter is to derive the estimated dwellings and population at build out within the Weinam Creek PDA, under a low, medium and high scenario. In undertaking this assessment, consideration has been given to the appropriateness of build out population and dwelling estimates prepared by Redlands Investment Corporation (RIC).

3.1 Estimated Residential Capacity of Weinam Creek PDA

The purpose of this section of the report is to assess the appropriateness of the residential capacity estimates prepared by RIC for the Weinam Creek PDA. The review has considered the following assumptions which inform the residential capacity estimates prepared by RIC:

- Appropriateness of the areas identified within the Weinam Creek PDA for residential development and whether this is broadly consistent with the Weinam Creek PDA Development Scheme;
- Appropriateness of the assumed dwelling densities applied to allotments within the Weinam Creek PDA;
- Appropriateness of the exclusion of parts of selected allotments for residential purposes within the Weinam Creek PDA; and
- Appropriateness of average household size assumptions and how these relate to historic trends within comparable communities within Redland City Council.

3.1.1 Areas within the Weinam Creek PDA Identified for Residential Development

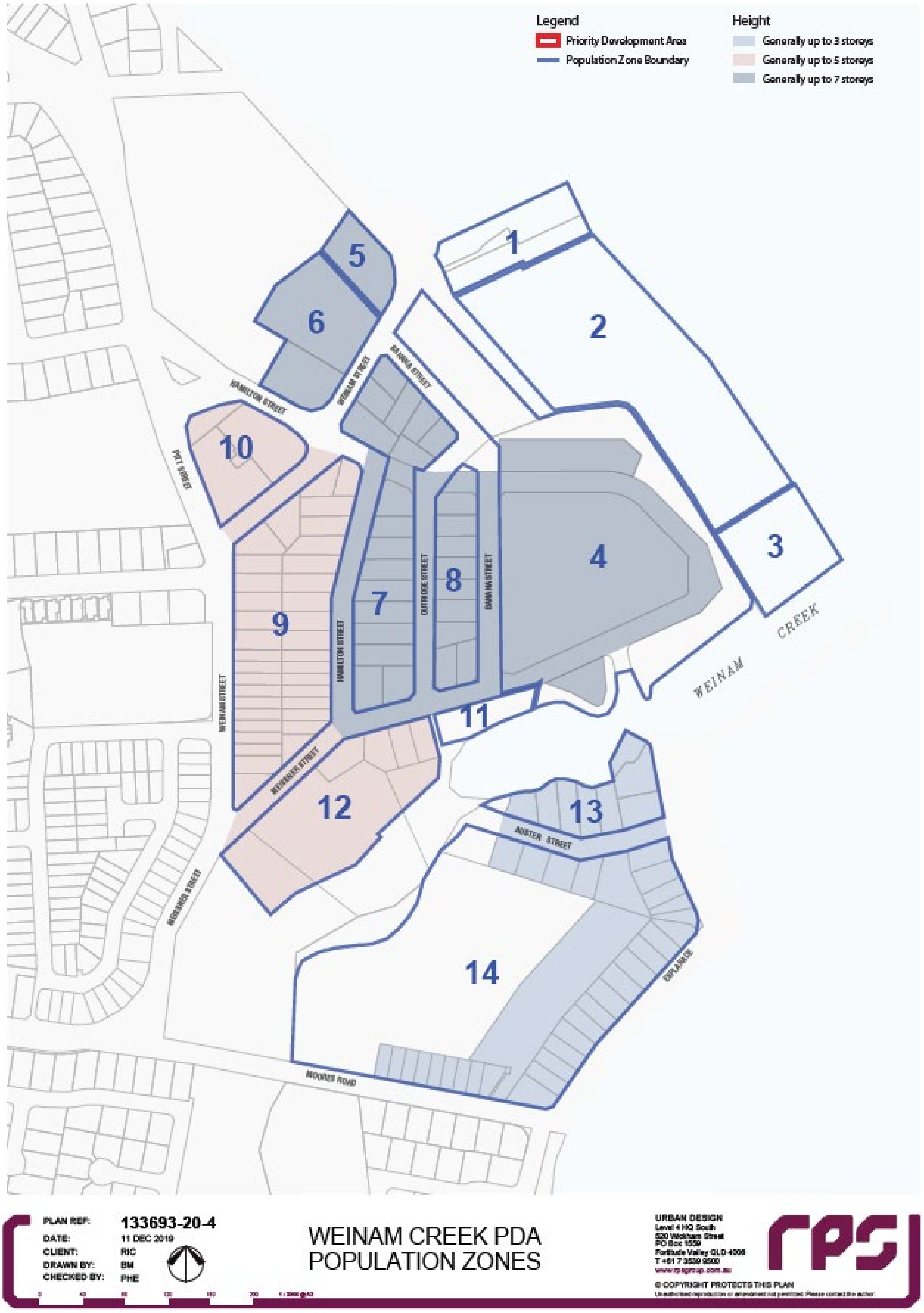
RIC have provided data relating to the likely residential yield within the Weinam Creek PDA by lot and zone area. Figure 3-1 provides a geographic representation of the height allowances by various population zone boundaries within the Weinam Creek PDA.

Figure 3-1 highlights that the height allowances within each population zone boundary are as follows:

- Precincts 4-8: Height generally up to 3 storeys;
- Precincts 9, 10 and 12: Height generally up to 5 storeys; and
- Precincts 13 and 14: Height generally up to 7 storeys.

Population growth is not anticipated to occur within population zone boundary 1, 2, 3 and 11.

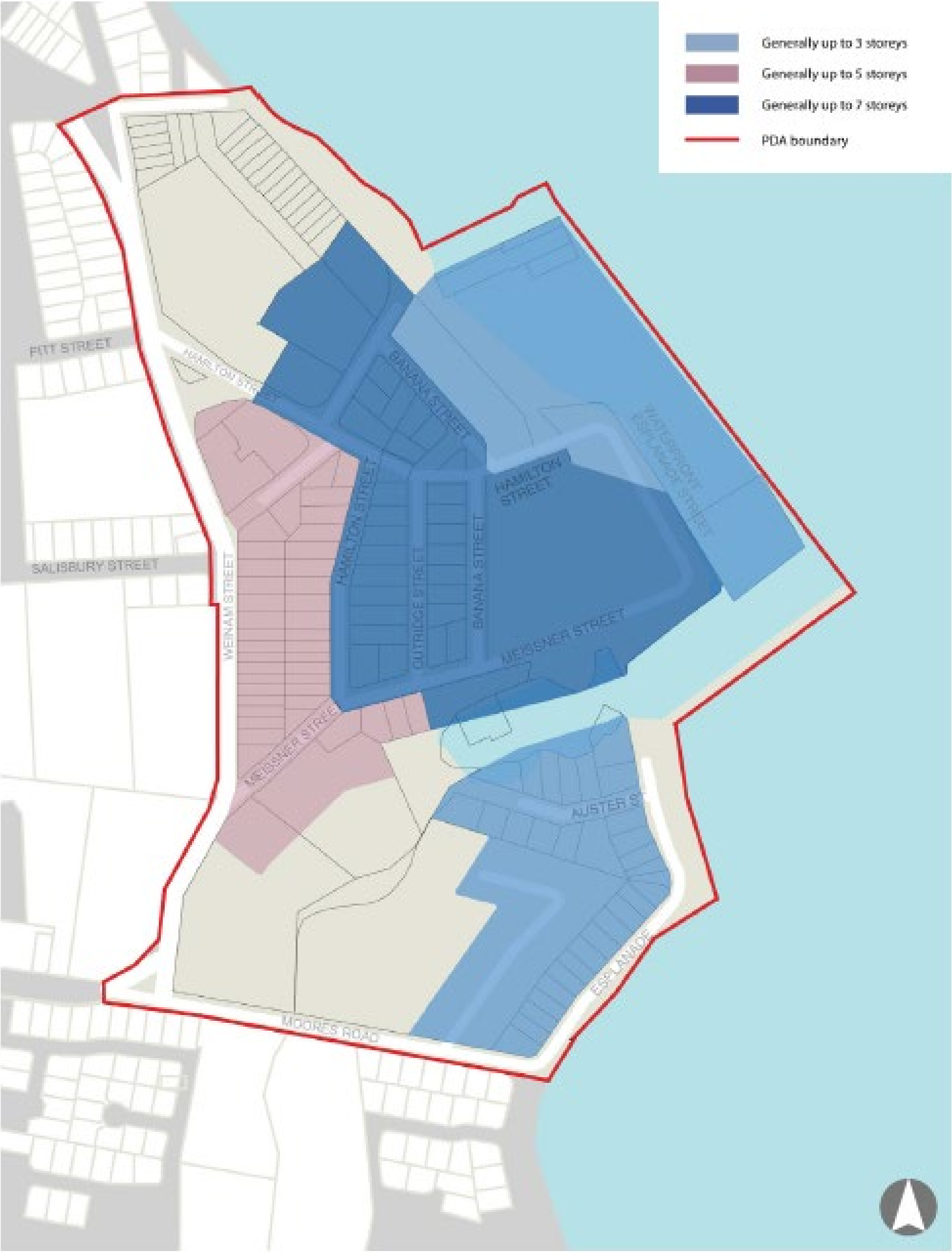
Figure 3-1 Zones for Residential Development within Weinam Creek PDA



Source: Data provided by RIC

This map mostly aligns with the intended outcomes as outlined in the Weinam Creek PDA Development Scheme, as illustrated in Figure 3-2.

Figure 3-2 Weinam Creek PDA Development Scheme Provisions



Source: Weinam Creek PDA Development Scheme (Map 4)

The differences between Figure 3-1 and Figure 3-2 are detailed below:

- The Weinam Creek PDA development scheme identifies development of generally three storeys can occur within the easternmost part of the PDA boundary. However, the development intent within this precinct is for non-residential uses, with preferred land uses including a hotel, function facility, food and drink outlet, community use and club. The RIC assessment has correctly removed this precinct from the assessment of residential dwelling capacity. However, consideration should be given to the potential size and scale of hotel development that could establish within the Weinam Creek PDA, as this has implications for the provision of appropriate trunk infrastructure.

- The defined boundary for activity within the southernmost part of the Weinam Creek PDA varies slightly, with RIC (Figure 3-1) extending the residential zone slightly further west than the map provided within the development scheme. This is anticipated to only have a minor impact on the assessment of the build out population within the Weinam Creek PDA; and
- The RIC assessment has excluded land from Precinct 11, which is currently utilised as car parking. The Weinam Creek PDA Development Scheme indicates that the longer-term intent of the area currently occupied by car parking is for the establishment of pedestrian and cycle connections along the waterfront. Therefore, we would accept RIC's assessment to exclude Precinct 11 for residential uses.

3.1.2 Assumed Dwelling Densities

In the assessment of build out population and dwelling estimates, RIC have made the following assumptions regarding population densities:

- Three storeys: Assumed density of 60 dwellings per hectare;
- Five storeys: Assumed density of 120 dwellings per hectare; and
- Seven storeys: Assumed density of 185 dwellings per hectare.

We are of the view that the assumed dwelling densities in the RIC assessment are appropriate and realistic within the Weinam Creek PDA, with this view substantiated by a recently lodged development application within the Weinam Creek PDA.

At the time of report compilation, there was a single residential development application within the Weinam Creek PDA, at 3 Moores Road, Redland Bay (otherwise described as Lot 100, SP309514). This application is on a 10,010m^2 allotment, comprising:

- 8 three bedroom townhouses, to be delivered in two buildings each with four two storey townhouses; and
- 54 1, 2 and 3 bedroom units, to be delivered in three buildings each three storeys in height.

The delivery of 62 attached dwellings on this site converts to an assumed dwelling density of 61.9 dwellings per hectare, broadly consistent with RIC's assumption relating to average dwelling densities for three storey developments within the Weinam Creek PDA.

3.1.3 Allotments not Anticipated to Achieve Maximum Dwelling Densities

RIC identified nine allotments within Figure 3-1 that would either not be developed or partially developed for residential purposes, as summarised in Table 3-1. These allotments occupy a combined 15.253 hectares, with only 3.72 hectares anticipated to be utilised for residential purposes.

Table 3-1 Residential Allotments Identified by RIC to not be Fully Developed for Residential Purposes

Zone	Lot Plan Description	Total Lot Area (ha)	Lot Area for Residential (ha)	Allowable Storeys
4	167 CP884275	0.9032	-	3
4	300 SP123870	0.5340	-	3
4	197 SP 123870	4.0480	0.5370	7
6	902 SP223465	0.7308	0.4590	7
7	27 RP80201	0.0814	-	7
12	1 RP90590	1.4670	0.9655	5
12	6 RP178363	0.7581	0.3856	5
12	143 SL843	2.2635	-	5

Zone	Lot Plan Description	Total Lot Area (ha)	Lot Area for Residential (ha)	Allowable Storeys
14	3 RP67164	4.4670	1.3710	3

Source: Data provided by RIC

In considering the appropriateness of the dwelling density assumptions for the allotments outlined in Table 3-1, consideration was given to the existing use on each site and any plans relating to future uses (as in the case of Lot 197 SP123870).

However, we would agree with RIC's adjustments to each allotment not fully utilised for residential purposes, as detailed in Table 3-2.

Table 3-2 Residential Allotments Identified by RIC to Not be Fully Developed for Residential Purposes

Zone	Lot Plan Description	Total Lot Area (ha)	Lot Area for Residential (ha)	CDM Smith Justification for Inclusion / Exclusion
4	167 CP884275	0.9032	-	Existing recreation area - Neville Stafford Park and associated parking
4	300 SP123870	0.5340	-	Currently utilised for car parking in its entirety - parking related to Neville Stafford Park
4	197 SP123870	4.0480	0.5370	Currently utilised for car parking in its entirety. Understood that this site to accommodate centre with full-line supermarket, with provision of multi deck parking. Preliminary plans for the proposed supermarket anchored centre do not seem to make any allowance for residential development on the site, however would represent a desirable use on the site. We would accept that most of this site would ultimately be used for non-residential purposes as assumed by RIC.
6	902 SP223465	0.7308	0.4590	Redland Bay Community Hall on this site - placement of building likely not conducive for residential development on part of the site. However, opportunity to redevelop site to accommodate community and residential uses.
7	27 RP80201	0.0814	-	Vacant land owned by Redland City Council and unlikely to be redeveloped, as it appears to represent a drainage reserve.
12	1 RP90590	1.4670	0.9655	Part of this site falls within ecological corridor hence exclusion of part of the subject site.
12	6 RP178363	0.7581	0.3856	Partially included as part of site currently used for car parking.
12	143 SL843	2.2635	-	Wildlife corridor owned by Redland City Council.
14	3 RP67164	4.4670	1.3710	Subdivision of lot to accommodate residential development and multi storey car parking, as identified in the Weinam Creek PDA development scheme. Development application for 62 attached dwellings represents part of this allotment.

Source: CDM Smith Analysis

3.1.4 Residential Capacity within the Weinam Creek PDA

Based on the preceding analysis, we would accept the residential build out estimate prepared by RIC of 1,588 dwellings, with the number of dwellings highest in Precincts 7 and 9 (each with an estimated 296 dwellings).

Table 3-3 summarises the estimated residential capacity within the Weinam Creek PDA by precinct.

Table 3-3 Dwelling and Population Estimates by Zone, Weinam Creek PDA

Zone	Total Area (ha)	Residential Area (ha)	Allowable Storeys	Assumed Dwellings per ha	Dwellings
1	0.7	0	-	-	-
2	0.0	0	-	-	-
3	0.8	0	-	-	-
4	5.5	0.5	3	185	99
5	0.4	0.4	7	185	65
6	1.0	0.8	7	185	141
7	1.7	1.6	7	185	296
8	0.8	0.8	7	185	151
9	2.5	2.5	5	120	296
10	0.8	0.8	5	120	95
11	-	-	7	120	-
12	4.9	1.7	5	120	207
13	0.8	0.8	3	60	45
14	6.3	3.2	3	60	193
Total	**26.1**	**13.0**	**-**	**-**	**1,588**

Source: Data provided by RIC

3.2 Estimated Population Capacity of Weinam Creek PDA

In their assessment, RIC have assumed an average household size of 1.9 persons per dwelling across the Weinam Creek PDA. We would accept this estimate is likely to represent an upper end estimate, given that achieving an average household size for attached product of two or more persons is generally challenging, even with the delivery of high quality three and four bedroom apartments, as these are typically purchased by empty nesters or widowers, as opposed to families, particularly in a coastal location such as Weinam Creek.

As of the 2016 Census, the average household size for attached dwellings within comparator locations in Redland City Council ranged between 1.6 persons per dwelling and 1.7 persons per dwelling, with the lower end estimate influenced by the delivery of retirement village product in Victoria Point.

In determining the likely build out population of the Weinam Creek PDA, three alternative scenarios have been considered, these being:

- Low scenario: Dwelling growth consistent with the assumptions presented in the RIC spreadsheet, with a downward revision in average household size to be consistent with Victoria Point SA2 (average household size of 1.6 persons per dwelling), to reflect the potential for the area to appeal to an older age cohort;
- Medium scenario: Dwelling growth consistent with the assumptions presented in the RIC spreadsheet, with the average household size to be consistent with the historic trend in Redland Bay SA2 for attached product (average household size of 1.7 persons per dwelling); and
- High scenario: Population and dwelling growth consistent with the assumptions presented in the RIC spreadsheet.

Based on the above assumptions, the build out population of the Weinam Creek PDA is likely to be approximately 2,500 to 3,000 persons, as outlined in Table 3-4.

Table 3-4 Estimated Population at Build Out by Scenario, Weinam Creek PDA

Scenario	Dwellings at Build Out	Average Household Size	Population at Build Out
Low	1,588	1.6	2,540
Medium	1,588	1.7	2,699
High	1,588	1.9	3,016

Source: CDM Smith estimates

Section 4 Anticipated Timing of Population and Dwelling Growth within Weinam Creek PDA

The purpose of this chapter is to assess the anticipated timing of population and dwelling growth within the Weinam Creek PDA. To determine the likely timing of development, the assessment has considered the following factors:

- Consideration of population and dwelling projections within the Redland Bay SA2, to understand the growth trajectory within the broader area, of which the Weinam Creek PDA is anticipated to be a key contributor to growth;
- Overview of historic building approval activity for attached product in coastal communities in Redland City (i.e. Redland Bay SA2, Victoria Point SA2 and Cleveland SA2) to consider the quantum and potential timing of demand for attached product within Weinam Creek PDA;
- Anticipated growth in demand for attached dwellings within Redland Bay SA2, through consideration of the likely split of demand for attached and detached dwelling development; and
- Consideration of the likely take-up of residential dwellings across the Weinam Creek PDA.

4.1 Population and Dwelling Projections

The population of the Redland Bay SA2 is projected to increase from 17,750 persons in 2019 to 28,313 persons in 2041, or by 2.1% per annum. The number of dwellings within Redland Bay SA2 is projected to increase from 6,057 dwellings in 2019 to 10,208 dwellings in 2041, or by 2.4% per annum.

Table 4-1 denotes the current and projected population and households within Redland Bay SA2 between 2019 and 2041.

Table 4-1 Population and Dwelling Projections, Redland Bay SA2, 2019-2041

	2019	2021	2026	2031	2036	2041	Ave. Ann Growth, 2019-41
Population	17,750	18,419	20,650	23,159	25,380	28,313	2.1%
Dwellings	6,057	6,317	7,171	8,143	9,037	10,208	2.4%
Average Dwelling Size	2.93	2.92	2.88	2.84	2.81	2.77	-0.2%

SourceABS (2020), Regional Population Growth, Australia, 2018-19, Cat. No. 3218.0, Australian Bureau of Statistics, Canberra; and QGSO (2018), Projected population (medium series), by five–year age group (males, females and persons), by statistical area level 2 (SA2), SA3 and SA4, Queensland, 2016 to 2041, Queensland Government, Brisbane

4.2 Historic Building Approvals

Between 2010 and 2019, Redland Bay SA2 recorded an average of 34 attached dwelling approvals. Similarly, Victoria Point SA2 recorded an average of 27 attached dwelling approvals whilst Cleveland SA2 recorded an average of 58 attached dwelling approvals.

Between 2015 and 2019, there was an uptick in the number of attached dwelling approvals in Redland Bay SA2 and Cleveland SA2. This increase is reflected in higher averages recorded for Redland Bay SA2 (57 attached dwelling approvals) and Cleveland SA2 (74 attached dwelling approvals). Meanwhile, Victoria Point SA2 recorded an average of 22 attached dwelling approvals during this timeframe.

A historical high of 146 attached dwelling approvals was recorded in 2018 for Redland Bay SA2, whilst a historical high of 140 attached dwelling approvals was recorded in 2016 for Cleveland SA2. As for Victoria Point SA2, a historical high of 86 attached dwelling approvals was recorded in 2010.

Table 4-2 details attached dwelling approvals within coastal communities in the Redland LGA between 2009 and 2019.

Table 4-2 Attached Dwelling Approvals in Coastal Communities in Redland City, 2009 to 2019

	Redland Bay SA2		Victoria Point SA2		Cleveland SA2	
Year ending 30 June	No. of Attached Approvals	% of Total Approvals	No. of Attached Approvals	% of Total Approvals	No. of Attached Approvals	% of Total Approvals
2009	18	16.8%	11	25.0%	24	55.8%
2010	20	14.8%	86	69.4%	66	64.1%
2011	38	31.4%	53	50.0%	36	67.9%
2012	0	0.0%	9	19.1%	8	25.8%
2013	0	0.0%	0	0.0%	36	62.1%
2014	0	0.0%	16	23.9%	65	60.7%
2015	4	2.5%	44	57.1%	30	46.9%
2016	71	20.2%	29	51.8%	140	74.5%
2017	63	24.5%	24	25.0%	89	66.4%
2018	146	43.8%	6	12.0%	102	69.4%
2019	0	0.0%	7	25.0%	10	27.8%
Average, 2010-2019	34	13.7%	27	33.3%	58	56.6%
Average, 2015-2019	57	18.2%	22	34.2%	74	57.0%

Source: ABS (2020), Building Approvals, Australia, Dec 2019, Cat. No. 8731.0, Australian Bureau of Statistics, Canberra

4.3 Assumed Take Up in Weinam Creek PDA

Within Redland Bay SA2, the key areas to accommodate residential growth are

- Weinam Creek PDA- ~1,600 attached dwellings at build out; and
- Shoreline residential development - ~3,000 dwellings at build out[1], likely to be a mix of both detached and attached dwelling product. Given the relative newness of the Shoreline residential development, the establishment of attached dwelling product within this precinct is likely to occur in the medium to long term, rather than in the next three to five years.

Historic residential building approval data for Redland Bay SA2 and the comparator coastal locations of Victoria Point SA2 and Cleveland SA2 highlights that average number of attached residential approvals in these precincts were:

- 153 dwellings per annum over the past five years; and
- 119 dwellings per annum over the past ten years.

A review of the medium density zone within Victoria Point SA2 and Cleveland SA2 highlights that multi-unit dwelling development opportunities are limited, particularly along the coastline. It is anticipated that the Weinam Creek PDA will account for the majority of demand within this segment.

Based on the above analysis, we have derived the following potential take-up scenarios for the Weinam Creek PDA:

- Low Scenario: Attached dwelling take-up to occur over 20 years, averaging ~80 dwellings per annum;

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[1] Refer to https://communities.lendlease.com/queensland/shoreline/living-in-shoreline/shoreline-at-a-glance/

- Medium Scenario: Attached dwelling take-up to occur over 15 years, averaging ~105 dwellings per annum; and
- High Scenario: Attached dwelling take-up to occur over 10 years, averaging ~160 dwellings per annum.

Based on activity within the Weinam Creek PDA to date, the take-up of residential development opportunities is not anticipated to occur prior to 2021.

Table 4-3 highlights that the take up of dwellings within the Weinam Creek PDA falls within the realms of the QGSO population projections for each scenario, but highlights that under all scenarios, attached dwellings represent a key component of new dwelling growth (ranging between 40.8% and 86.9% of new dwelling growth over the time horizons analysed).

Table 4-3 Comparison of Assumed Take-up to QGSO Projections, 2021-2041

	Build Out Dwellings in PDA	Dwelling Growth in QGSO	PDA as % of QGSO
Low Take-Up Scenario (10 years)	1,588	3,891	40.8%
Medium Take-Up Scenario (15 years)	1,588	2,720	58.4%
High Take-Up Scenario (20 years)	1,588	1,827	86.9%

Source: CDM Smith estimates

4.4 Sequencing of Residential Take Up within the Weinam Creek PDA

The RIC assessment identified six allotments with the capacity to accommodate at least fifty dwellings, as summarised in Table 4-4. The allotment within Zone 14 represents the 62 unit dwelling application plus capacity to accommodate an additional 20 dwellings.

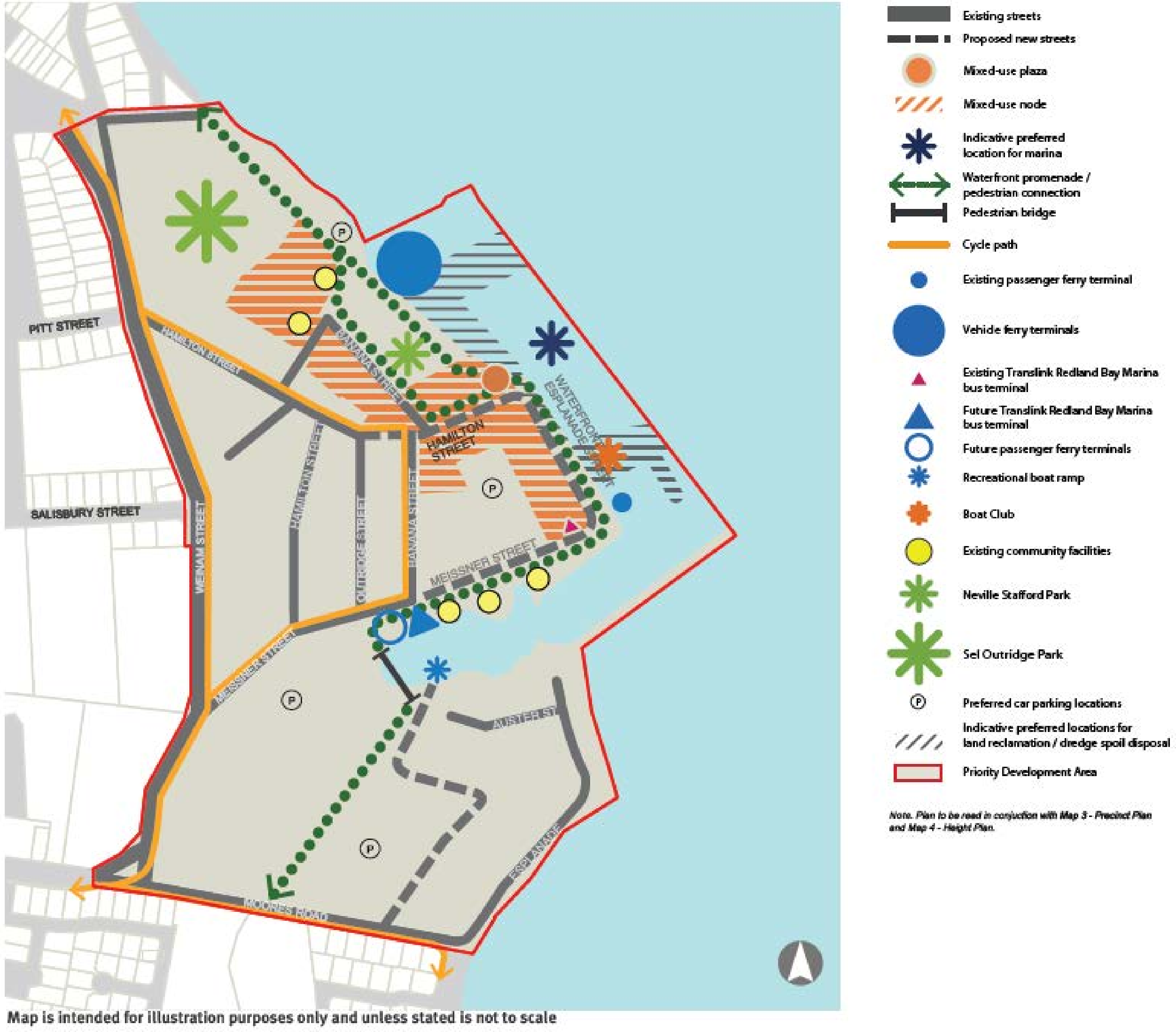
We would anticipate that these allotments are likely to be taken up earlier in the development horizon, due to the capacity of these allotments to accommodate significant development opportunities without the need for land assembly. It is considered likely that the opportunities in Zones 4-6 would likely be taken up prior to Zone 12, given the relative proximity of these sites to the coastline and the mixed-use node, as identified in the Structure Plan in the Weinam Creek PDA Development Scheme.

Table 4-4 Comparison of Assumed Take-up to QGSO Projections, 2021-2041

Zone	Lot Plan	No of Dwellings
4	197 SP123870	99
5	1 SP134603	65
6	902 SP223465	85
6	1 RP855150	56
12	1 RP90590	116
14	3 RP67164	82

Source: CDM Smith estimates

Figure 4-1 Weinam Creek PDA Structure Plan



Source: Weinam Creek PDA Development Scheme

Under all take-up scenarios, the following sequencing of development has been assumed:

- Take-up of development application in Zone 14 (analysis assumes the application is ultimately approved);
- Take up of land in Zones 4, 5 and 6 (all allotments in these zones allow for large residential developments);
- Take-up of land in Zones 10, 12 and the remainder of allotments in Zone 14 (some allotments in Zone 10 and 12 allow for developments of over 40 dwellings each);
- Take-up of land in Zone 8 (majority of allotments can accommodate a development approximately 15 dwellings in size, indicating some land assembly likely required); and
- Take-up of land in Zones 7 and 9 (allotments allow for developments less than 10 dwellings, indicating significant land assembly required).

Tables 4-5 to 4-7 provide an indicative schedule of dwelling development under the low, medium and high take-up scenarios.

Section 4 Anticipated Timing of Population and Dwelling Growth within Weinam Creek PDA

Tables 4-8 to 4-10 provide an overview of the indicative schedule of population growth within the Weinam Creek PDA under the low, medium and high take-up scenarios based on varying average household sizes (i.e. 1.6 persons / dwelling, 1.7 persons / dwelling and 1.9 persons / dwelling).

Table 4-5 Cumulative Dwelling Take-up – Low Take-Up Scenario, Weinam Creek PDA

Zone	Year																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4	0	79	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
5	0	0	52	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
6	0	0	0	56	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141
7	0	0	0	0	0	0	0	0	0	0	0	0	31	89	144	208	248	280	296	296
8	0	0	0	0	0	0	0	0	0	0	76	151	151	151	151	151	151	151	151	151
9	0	0	0	0	0	0	0	0	0	0	0	0	0	30	61	95	137	194	253	296
10	0	0	0	0	0	0	0	85	85	85	85	85	95	95	95	95	95	95	95	95
12	0	0	0	0	0	93	162	162	207	207	207	207	207	207	207	207	207	207	207	207
13	0	0	0	0	0	0	0	0	0	0	0	0	45	45	45	45	45	45	45	45
14	62	62	62	62	62	62	62	62	106	193	193	193	193	193	193	193	193	193	193	193
Total Dwellings	**62**	**141**	**213**	**282**	**367**	**460**	**529**	**614**	**703**	**790**	**866**	**941**	**1,027**	**1,115**	**1,201**	**1,300**	**1,381**	**1,470**	**1,545**	**1,588**

Source: CDM Smith estimates

Note: No residential development is anticipated in Zones 1-3 and 11.

Table 4-6 Cumulative Dwelling Take-up – Medium Take-up Scenario, Weinam Creek PDA

Zone	Year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99
5	0	0	65	65	65	65	65	65	65	65	65	65	65	65	65
6	0	0	45	124	141	141	141	141	141	141	141	141	141	141	141
7	0	0	0	0	0	0	0	0	0	0	89	208	280	296	296
8	0	0	0	0	0	0	0	32	61	136	151	151	151	151	151
9	0	0	0	0	0	0	0	0	30	61	61	61	95	194	296
10	0	0	0	0	0	53	95	95	95	95	95	95	95	95	95
12	0	0	0	39	139	192	207	207	207	207	207	207	207	207	207
13	0	0	0	0	0	0	0	0	45	45	45	45	45	45	45
14	62	62	62	62	62	62	114	193	193	193	193	193	193	193	193
Total Dwellings	**62**	**161**	**271**	**389**	**506**	**612**	**721**	**832**	**936**	**1,042**	**1,146**	**1,266**	**1,371**	**1,486**	**1,588**

Source: CDM Smith estimates

Note: No residential development is anticipated in Zones 1-3 and 11.

Table 4-7 Cumulative Dwelling Take-up – High Take-up Scenario, Weinam Creek PDA

Zone	Year									
	1	2	3	4	5	6	7	8	9	10
4	0	99	99	99	99	99	99	99	99	99
5	0	52	65	65	65	65	65	65	65	65
6	0	0	141	141	141	141	141	141	141	141
7	0	0	0	0	0	0	89	208	296	296
8	0	0	0	0	0	76	151	151	151	151
9	0	0	0	0	0	0	0	61	137	296
10	0	0	0	0	85	95	95	95	95	95
12	0	0	0	162	162	207	207	207	207	207
13	0	0	0	0	0	0	45	45	45	45
14	62	62	62	62	154	193	193	193	193	193
Total Dwellings	**62**	**213**	**367**	**529**	**706**	**876**	**1,085**	**1,266**	**1,429**	**1,588**

Source: CDM Smith estimates

Note: No residential development is anticipated in Zones 1-3 and 11.

Table 4-8 Cumulative Population Growth – Low Take-Up Scenario, Weinam Creek PDA

Zone	Year																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Low Average Dwelling Size (1.6 persons / dwelling)																				
4	0	127	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158
5	0	0	83	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104
6	0	0	0	90	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226
7	0	0	0	0	0	0	0	0	0	0	0	0	49	142	230	334	397	448	473	473
8	0	0	0	0	0	0	0	0	0	0	122	242	242	242	242	242	242	242	242	242
9	0	0	0	0	0	0	0	0	0	0	0	0	0	47	98	152	220	310	405	473
10	0	0	0	0	0	0	0	136	136	136	136	136	152	152	152	152	152	152	152	152
12	0	0	0	0	0	148	259	259	331	331	331	331	331	331	331	331	331	331	331	331
13	0	0	0	0	0	0	0	0	0	0	0	0	72	72	72	72	72	72	72	72
14	99	99	99	99	99	99	99	99	169	309	309	309	309	309	309	309	309	309	309	309
Total persons	**99**	**226**	**341**	**451**	**587**	**736**	**846**	**982**	**1,124**	**1,264**	**1,386**	**1,506**	**1,643**	**1,784**	**1,922**	**2,079**	**2,210**	**2,352**	**2,472**	**2,540**
Medium Average Dwelling Size (1.7 persons / dwelling)																				
4	0	135	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168
5	0	0	88	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
6	0	0	0	95	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240
7	0	0	0	0	0	0	0	0	0	0	0	0	52	151	245	354	421	476	503	503
8	0	0	0	0	0	0	0	0	0	0	130	257	257	257	257	257	257	257	257	257
9	0	0	0	0	0	0	0	0	0	0	0	0	0	50	104	161	234	330	430	503
10	0	0	0	0	0	0	0	145	145	145	145	145	162	162	162	162	162	162	162	162
12	0	0	0	0	0	158	275	275	352	352	352	352	352	352	352	352	352	352	352	352
13	0	0	0	0	0	0	0	0	0	0	0	0	77	77	77	77	77	77	77	77

Zone	Year																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
14	105	105	105	105	105	105	105	105	180	328	328	328	328	328	328	328	328	328	328	328
Total Persons	**105**	**240**	**362**	**479**	**624**	**782**	**899**	**1,044**	**1,195**	**1,343**	**1,473**	**1,600**	**1,746**	**1,895**	**2,042**	**2,209**	**2,349**	**2,499**	**2,626**	**2,699**
High Average Dwelling Size (1.9 persons / dwelling)																				
4	0	150	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188
5	0	0	99	124	124	124	124	124	124	124	124	124	124	124	124	124	124	124	124	124
6	0	0	0	106	268	268	268	268	268	268	268	268	268	268	268	268	268	268	268	268
7	0	0	0	0	0	0	0	0	0	0	0	0	58	169	273	396	471	532	562	562
8	0	0	0	0	0	0	0	0	0	0	145	287	287	287	287	287	287	287	287	287
9	0	0	0	0	0	0	0	0	0	0	0	0	0	56	116	180	261	368	481	562
10	0	0	0	0	0	0	0	162	162	162	162	162	181	181	181	181	181	181	181	181
12	0	0	0	0	0	176	308	308	393	393	393	393	393	393	393	393	393	393	393	393
13	0	0	0	0	0	0	0	0	0	0	0	0	86	86	86	86	86	86	86	86
14	118	118	118	118	118	118	118	118	201	367	367	367	367	367	367	367	367	367	367	367
Total Dwellings	**118**	**268**	**405**	**536**	**697**	**874**	**1,005**	**1,167**	**1,335**	**1,501**	**1,646**	**1,788**	**1,951**	**2,118**	**2,282**	**2,469**	**2,625**	**2,793**	**2,935**	**3,016**

Source: CDM Smith estimates

Note: No residential development is anticipated in Zones 1-3 and 11.

Table 4-9 Cumulative Population Growth –Medium Take-Up Scenario, Weinam Creek PDA

Zone	**Year**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Low Average Dwelling Size (1.6 persons / dwelling)															
4	0	158	158	158	158	158	158	158	158	158	158	158	158	158	158
5	0	0	104	104	104	104	104	104	104	104	104	104	104	104	104
6	0	0	72	198	226	226	226	226	226	226	226	226	226	226	226
7	0	0	0	0	0	0	0	0	0	0	142	334	448	473	473
8	0	0	0	0	0	0	0	50	98	218	242	242	242	242	242
9	0	0	0	0	0	0	0	0	47	98	98	98	152	310	473
10	0	0	0	0	0	85	152	152	152	152	152	152	152	152	152
12	0	0	0	62	222	307	331	331	331	331	331	331	331	331	331
13	0	0	0	0	0	0	0	0	72	72	72	72	72	72	72
14	99	99	99	99	99	99	183	309	309	309	309	309	309	309	309
Total persons	**99**	**258**	**433**	**622**	**810**	**979**	**1,154**	**1,330**	**1,498**	**1,668**	**1,834**	**2,025**	**2,194**	**2,377**	**2,540**
Medium Average Dwelling Size (1.7 persons / dwelling)															
4	0	168	168	168	168	168	168	168	168	168	168	168	168	168	168
5	0	0	111	111	111	111	111	111	111	111	111	111	111	111	111
6	0	0	76	211	240	240	240	240	240	240	240	240	240	240	240
7	0	0	0	0	0	0	0	0	0	0	151	354	476	503	503
8	0	0	0	0	0	0	0	54	105	232	257	257	257	257	257
9	0	0	0	0	0	0	0	0	50	104	104	104	161	330	503
10	0	0	0	0	0	90	162	162	162	162	162	162	162	162	162
12	0	0	0	66	236	326	352	352	352	352	352	352	352	352	352
13	0	0	0	0	0	0	0	0	77	77	77	77	77	77	77

Zone	Year														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
14	105	105	105	105	105	105	194	328	328	328	328	328	328	328	328
Total Persons	**105**	**274**	**460**	**661**	**860**	**1,040**	**1,226**	**1,414**	**1,591**	**1,772**	**1,949**	**2,152**	**2,331**	**2,526**	**2,699**
High Average Dwelling Size (1.9 persons / dwelling)															
4	0	188	188	188	188	188	188	188	188	188	188	188	188	188	188
5	0	0	124	124	124	124	124	124	124	124	124	124	124	124	124
6	0	0	85	236	268	268	268	268	268	268	268	268	268	268	268
7	0	0	0	0	0	0	0	0	0	0	169	396	532	562	562
8	0	0	0	0	0	0	0	60	117	259	287	287	287	287	287
9	0	0	0	0	0	0	0	0	56	116	116	116	180	368	562
10	0	0	0	0	0	101	181	181	181	181	181	181	181	181	181
12	0	0	0	73	264	365	393	393	393	393	393	393	393	393	393
13	0	0	0	0	0	0	0	0	86	86	86	86	86	86	86
14	118	118	118	118	118	118	217	367	367	367	367	367	367	367	367
Total Dwellings	**118**	**306**	**515**	**738**	**961**	**1,163**	**1,371**	**1,580**	**1,778**	**1,981**	**2,178**	**2,405**	**2,605**	**2,823**	**3,016**

Source: CDM Smith estimates

Note: No residential development is anticipated in Zones 1-3 and 11.

Table 4-10 Cumulative Population Growth –High Take-Up Scenario, Weinam Creek PDA

Zone	Year									
	1	2	3	4	5	6	7	8	9	10
Low Average Dwelling Size (1.6 persons / dwelling)										
4	0	158	158	158	158	158	158	158	158	158
5	0	83	104	104	104	104	104	104	104	104
6	0	0	226	226	226	226	226	226	226	226
7	0	0	0	0	0	0	142	334	473	473
8	0	0	0	0	0	122	242	242	242	242
9	0	0	0	0	0	0	0	98	220	473
10	0	0	0	0	136	152	152	152	152	152
12	0	0	0	259	259	331	331	331	331	331
13	0	0	0	0	0	0	72	72	72	72
14	99	99	99	99	246	309	309	309	309	309
Total persons	**99**	**341**	**587**	**846**	**1,129**	**1,402**	**1,736**	**2,025**	**2,287**	**2,540**
Medium Average Dwelling Size (1.7 persons / dwelling)										
4	0	168	168	168	168	168	168	168	168	168
5	0	88	111	111	111	111	111	111	111	111
6	0	0	240	240	240	240	240	240	240	240
7	0	0	0	0	0	0	151	354	503	503
8	0	0	0	0	0	130	257	257	257	257
9	0	0	0	0	0	0	0	104	234	503
10	0	0	0	0	145	162	162	162	162	162
12	0	0	0	275	275	352	352	352	352	352
13	0	0	0	0	0	0	77	77	77	77

Zone	**Year**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
14	105	105	105	105	261	328	328	328	328	328
Total Persons	**105**	**362**	**624**	**899**	**1,200**	**1,490**	**1,845**	**2,152**	**2,430**	**2,699**
High Average Dwelling Size (1.9 persons / dwelling)										
4	0	188	188	188	188	188	188	188	188	188
5	0	99	124	124	124	124	124	124	124	124
6	0	0	268	268	268	268	268	268	268	268
7	0	0	0	0	0	0	169	396	562	562
8	0	0	0	0	0	145	287	287	287	287
9	0	0	0	0	0	0	0	116	261	562
10	0	0	0	0	162	181	181	181	181	181
12	0	0	0	308	308	393	393	393	393	393
13	0	0	0	0	0	0	86	86	86	86
14	118	118	118	118	292	367	367	367	367	367
Total Dwellings	**118**	**405**	**697**	**1,005**	**1,341**	**1,665**	**2,062**	**2,405**	**2,715**	**3,016**

Source: CDM Smith estimates

Note: No residential development is anticipated in Zones 1-3 and 11.

Section 5 Summary

The product delivered within the Weinam Creek PDA is likely to appeal to an older age cohort, with persons residing in attached product in the comparator locations of Redland Bay SA2, Victoria Point SA2 and Cleveland SA2 most likely to be empty nesters, relying on accumulated wealth to fund their lifestyle. Interestingly, a significant proportion of attached dwellings in Victoria Point SA2 represent retirement village accommodation, which could represent a potential opportunity for the Weinam Creek PDA.

We are of the view that the demographics of the SMBI are not likely to influence the build out demography of the Weinam Creek PDA. The socio-economic profile highlights that residents within the SMBI have significantly lower average household incomes than residents on the mainland, approximately half of the Redland City average. It is not considered that provision of attached dwellings within the Weinam Creek PDA would entice these residents to shift to the mainland.

Our review of the RIC estimates of population and dwellings within the Weinam Creek PDA indicates that these estimates were broadly representative of the likely trajectory of growth under a high population growth scenario. Historic evidence has indicated that the average household size of comparator coastal locations in Redland City typically achieved an average household size of 1.6 – 1.7 persons / dwelling, lower than the RIC assumptions of 1.9 persons per dwelling.

Based on these assumptions, the residential build out population of the Weinam Creek PDA is likely to be in the order of approximately 2,500 – 3,000 persons.

The residential build out of the Weinam Creek PDA is likely to occur over a ten to twenty year horizon, with the approval of the application within Precinct 14 anticipated to kick start residential redevelopment activity. Our assessment has assumed that the sequencing of residential development is such that large englobo allotments that can accommodate at least 50 dwellings are taken up first, with Precincts 4-6 likely to be fully built out first, with Precincts 7 and 9 likely to reach build out capacity last due to the fragmented nature of allotments (allotments within these precincts can typically accommodate less than ten dwellings each).

Appendix C – Weinam Creek PDA Draft Structure Plan Report

WEINAM CREEK PRIORITY DEVELOPMENT AREA DRAFT STRUCTURE PLAN REPORT

FOR REDLAND CITY COUNCIL
1 NOVEMBER 2013 / ISSUE C

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CONTENTS

1. INTRODUCTION

The Weinam Creek structure plan document represents the vision for development within the Priority Development Area (PDA) around Weinam Creek. The plan responds to the social, economic and cultural pressures and circumstances that imbue and overlay a place with meaning and identity over time.

This structure plan report provides key inputs to inform the preparation of a Development Scheme for Weinam Creek.

It lays the foundation for the design of this place into a strengthened centre and a transit facility for the Southern Moreton Bay Island (SMBI) residents. Weinam Creek can act as a focal place within the broader Redland Bay area delivering long-term, sustainable economic growth for Redland City Council.

This document outlines the objectives, principles and design ideas that have influenced the shape of the structure plan, providing the boundaries and parameters within which good development can occur.

1.1 Joint Statement of Objectives

Weinam Creek is the third PDA to be declared in Queensland by the State Government. The declaration provides an opportunity to support economic development and create mixed-use residential, tourism and retail based development at the gateway to the Southern Moreton Bay Islands.

The Weinam Creek PDA is approximately 42 hectares in size with the Queensland Government being the major landholder in the area. Development of the PDA will seek to reinforce Weinam Creek as a community focus and a regional gateway to the Moreton Bay Islands including Macleay, Lamb, Karragarra and Russell islands. Development will include opportunities for mixed-use and medium density residential development and will need to accommodate island transport needs.

Initial stakeholder scoping indicates interest from Translink and local transport providers, peak business associations, marina users, island and local residents.

Planning of the Weinam Creek PDA will be managed by Economic Development Queensland (EDQ) in partnership with Redland City Council. Redland City Council has responsibility for development assessment.

1.2 Vision for the Priority Development Area

Weinam Creek is a point of community focus and a regional Gateway to Moreton Bay. The bus stop and ferry interchange provide an integral link between the mainland, SMBI (Macleay, Lamb Karragarra and Russell islands) and the Greater Brisbane area. The area surrounding the marina features a mix of urban development with significant areas of open space along the foreshore.

The vision for delivery of the Weinam Creek PDA includes:

> **New water transport services** and support facilities including a commercial ferry terminal, a marina, boat industries and marine services

> **Relocation of the passenger terminal upstream** of the existing terminal and integration with bus interchange and car parking.

> Improved **access to the waterfront** through the **consolidation of facilities**

> **Improvements to public open spaces** linking Sel Outridge Park to Weinam Creek

> A**n accessible and connected place** with an efficient traffic circulation, board walks, cycling paths and a bus terminal

> An upgrade to Redland Bay Ferry Terminal incorporating additional bus bays and upgraded passenger waiting facilities

> A **sense of place** with communal areas to provide opportunities for social interaction and recreation activities such as parks and board walks

> Opportunities for **mixed-use and medium density residential development** including a neighbourhood shopping centre comprising a supermarket and speciality retail, commercial offices, cafes, medium density residential apartments and a public car parking facility

> Appropriate **infrastructure** that meets market expectations for safety, comfort, convenience, information and service delivery

> **Embracing the waterfront location**, enhance areas presenting significant **views to Moreton Bay and the SMBI**

> Protecting the local marine and land-based ecology including saltmarsh, mangroves and flying-fox colony.

> Expanded marine service industries utilising opportunities provided by Weinam Creek as one of few creeks entering the bay between Southport and the Port of Brisbane.

> Opportunities for **aboriginal stewardship and reconciliation**

> Development with the potential to stimulate tourism to the islands, improving the SMBI economies and the wider sub regional economy.

1.3 Location

The Weinam Creek PDA is located on Moreton Bay at the intersection of Banana and Meissner Streets, Redland Bay, approximately 45kms south-east of the Brisbane CBD (see Figure 1). The site acts as a transit node for vehicular ferry and water taxi services between the mainland and residents, visitors and tourists accessing the SMBI.

The PDA covers a total area of approximately 42 hectares (36.2 hectares over land, and 5.8 hectares within Moreton Bay). It extends from Peel Street south to Moores Road and is bounded by Weinam Street to the west and Moreton Bay to the east.

On the edge of the PDA is a bus interchange and pedestrian ferry terminal with large expanses of associated short and long-term at-grade car parking. These facilities are integral in providing access for the SMBI residents to shopping, health, education, employment and entertainment opportunities throughout Redland City and the greater Brisbane area. The ferries link Macleay, Lamb, Karragarra and Russell Islands with the mainland. This link also allows visitors and tourists to access the islands.

The remaining area of the PDA features a mix of urban development, predominantly suburban in character, with significant areas of coastal processes along the foreshore. These areas vary from walkway corridors and small picnic areas to large sporting areas. This foreshore open space presents significant views to Moreton Bay and the SMBIs. Activities within this space include a vehicle ferry, low density residential uses, a small amount of maritime industry and boat ramp onto Weinam Creek itself, a small amount of retail and key community facilities.

Two environmental corridors, one next to Sel Outridge Park and the other along Weinam Creek, extend west of the PDA. Both have fragmented pedestrian linkages. A pedestrian linkage exists along the foreshore with a break at the Weinam Creek mouth.

Facilities at the small marina on Weinam Creek include a jetty used by various commercial ferry operators servicing the Moreton Bay islands, recreation boat ramp facilities and long-term parking areas for SMBI residents to park their 'mainland' vehicle. The existing bus stop, is located within the marina car park adjacent to the jetty building and is configured as a linear stop with space for up to three buses.

The site and the extent of the PDA boundary are shown in Figure 2.

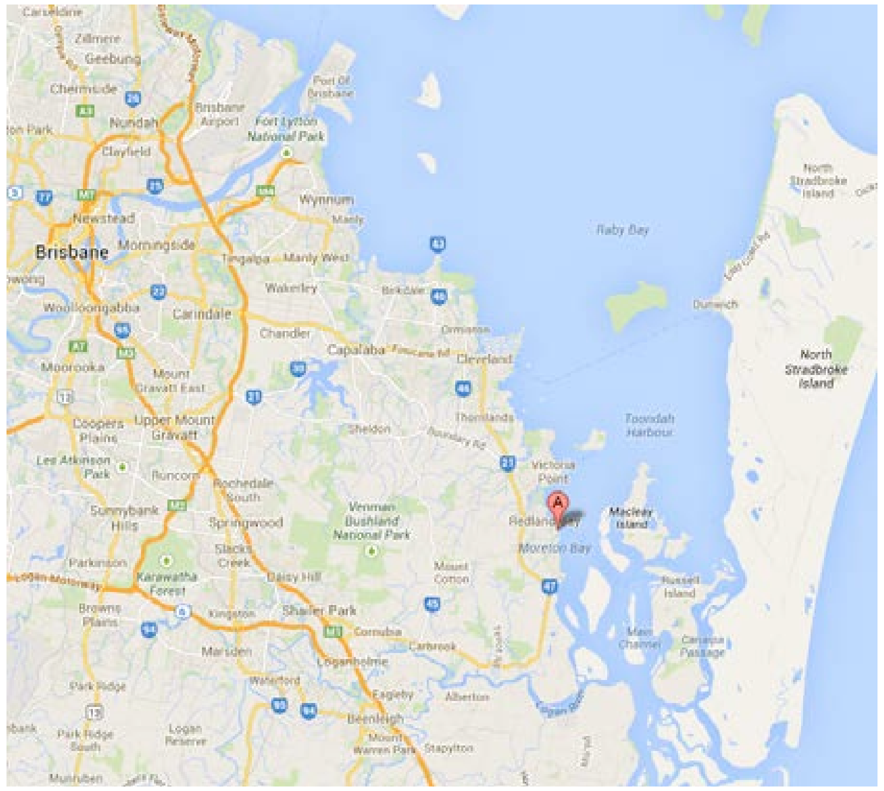


Figure 1. Weinam Creek PDA location plan

Figure 2. Weinam Creek PDA site aerial and boundary


Redland Bay Ferry Terminal


Parkland on Weinam Creek near the passenger ferry terminal


Neville Stafford Park


Existing marine services on Weinam Creek

2. BACKGROUND ANALYSIS

2.1 Context

The Weinam Creek PDA sits within an existing urban fabric of land uses, community facilities, environment and open space areas, streets and infrastructure. These, along with the physical features of the site, set the context on which the proposed structure plan has been developed.

Urban Context

The Weinam Creek PDA is located on Moreton Bay just south of the Redland Bay Centre, and surrounded immediately by predominantly low-rise residential development interspersed with a number of community facilities (see Figure 3).

The Redland Bay Shopping Centre on Broadwater Terrace is currently designated as a Neighbourhood Centre although Council is moving for this to be elevated to a District Centre. This precinct, and the Redland Bay Hotel opposite, sit just outside the PDA boundary but is a key gathering place and retail area for the Redland Bay community and SMBI residents.

This precinct is serviced by bus from the passenger ferry terminal interchange and is about a 15 minute walk along the foreshore or via local streets.

This proximity means the retail and commercial offering at Weinam Creek has to be focused and complimentary to that both in the Redland Bay Centre but also on the SMBIs.

In addition to the Redland Bay Shopping Centre and within the PDA, there is a small café and convenience store located on the corner of Weinam and Banana Streets which serve the immediate residential area.

The PDA contains a number of community facilities — Redland Bay Police Station, Redland Bay Community Hall and the Redland Bay Amateur Fishing Club located along Weinam Street and the Coast Guard, Sea Cadets and Redlands Sea Dragons located along, and with direct access to, Weinam Creek.

In addition to the expansive foreshore and esplanade areas, the Weinam Creek PDA has large areas of open space to the north comprising Sel Outridge Park and Neville Stafford Park which are linked via formed pedestrian pathways.

Weinam Creek is part of a broader wetland and environmental area which extends further south to Cleveland-Redland Bay Road which is proposed to include pedestrian and cycle pathways, as well as a bridge over the mouth of the creek, as part of the Weinam Creek Wetlands Master Plan Report (April 2012) prepared by Lange Design for Redland City Council.

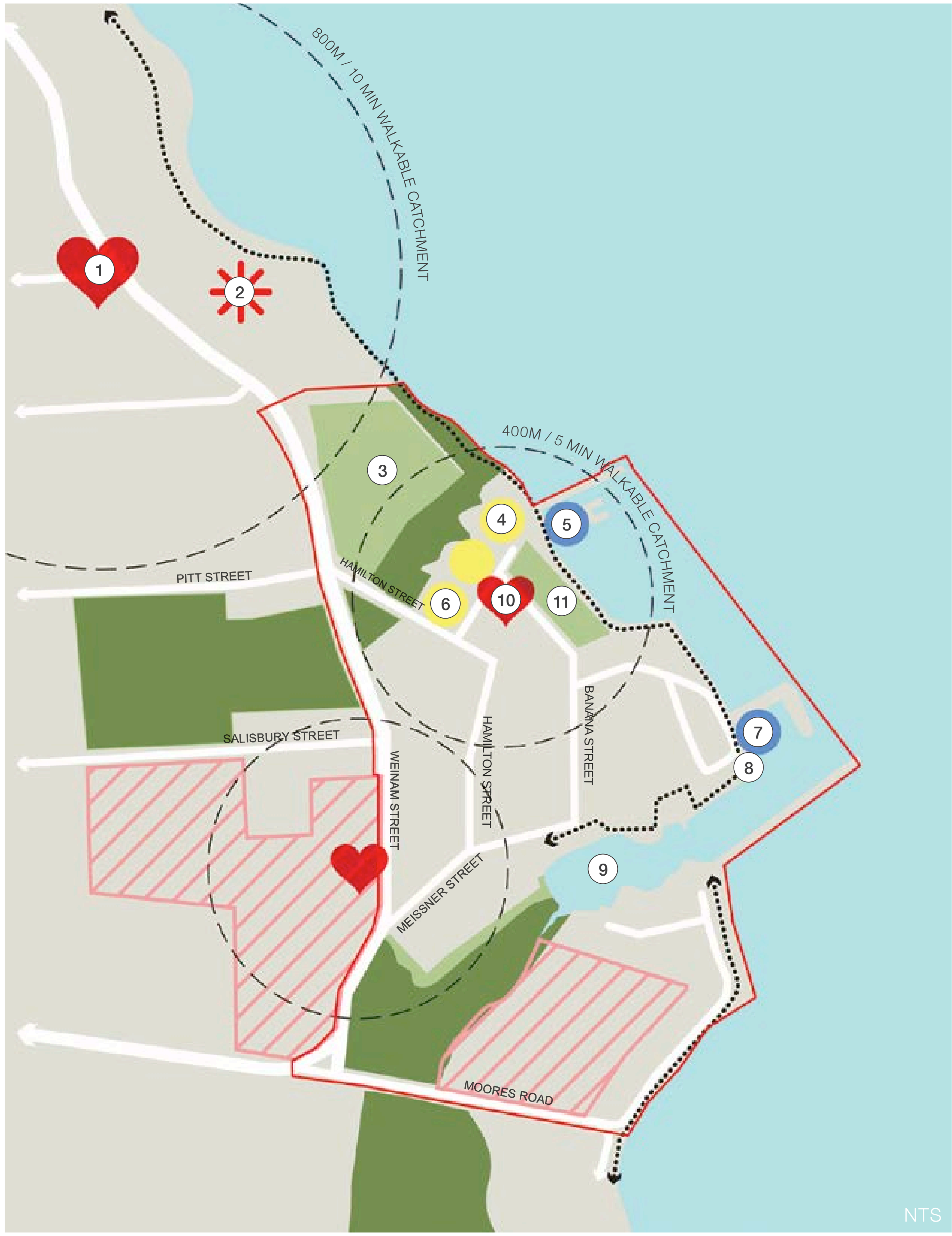


Figure 3. Context plan

Key Elements

① Redland Bay Shopping Centre
② Redland Bay Hotel
③ Sel Park Outridge
④ Amateur Fishing Club
⑤ Vehicle Ferries to Southern Moreton Bay Island
⑥ Police Station
⑦ Passenger Ferries to Southern Moreton Bay Island
⑧ Translink Bus Interchange
⑨ Weinam Creek
⑩ Convenience Store / Cafe
⑪ Neville Stafford Park
♥ Existing & Approved nodes of Activity
● Community Facility
● Ferry Terminals
▨ Large Undeveloped Areas for Future Development
🟩 Existing Parks / Open Space
🟩 Existing Vegetation
✱ Landmark Building
←···→ Existing Pedestrian Connection
— PDA Boundary

Economic Context

Located around 26kms south-east of the Brisbane CBD, Redland City has a strong and diverse economy with a long history of strong economic performance. Gross Regional Product (GRP) has increased by an estimated 16% in the last six years to $4.3 billion in 2012 , and is forecast to continue this strong performance on the back of solid population and employment growth in the region.

The Redland City has an estimated resident workforce of 75,942 as at 2012 and has low unemployment levels. The region has a high level of local employment, which has increased by around 10% since 2006-07 to 44,996 in 2011-12. The key industry sectors by employment are retail trade (16.1%), health care and social assistance (14.2%), education and training (10%), and construction (8.4%) as at the 2011 Census .

Population growth for Redland City has historically been strong and is forecast to continue this trend over the long term. The estimated resident population (ERP) for the broader Redland City LGA as at 2012 was 145,507 people. Over the past 10 years the Redlands region has increased in population at a strong average annual growth rate of 2.1% per annum.

Weinam Creek is situated at the southern end of the Redland LGA within the suburb of Redland Bay. It is an area that has a robust level of population growth, driven by coastal lifestyle factors with a small localised centre of employment, concentrated around Redland Bay village centre.

Environmental Context

The Weinam Creek PDA is characterised by marine, intertidal and terrestrial ecological values that are valued by the community and protected at local, state and national levels. Intertidal mudflats and seagrass beds within the PDA are incorporated within the Moreton Bay Marine Park and Ramsar wetland, a wetland of international importance. These ecosystems provide foraging habitat for fish, but very limited habitat for migratory shorebirds, turtles and Dugong (*Dugong dugon*). Moreton Bay as a whole is recognised as a site of both national and international importance for migratory shorebirds, supporting a maximum abundance of nearly 36,000 migratory shorebirds that use intertidal mudflats and seagrass beds for feeding, and roost sites for resting. Marine plants within the PDA, particularly seagrass, mangroves and saltmarsh provide value to fisheries through provision of nursery habitat for fish and crabs, coastal protection from storm surge, and nutrient cycling.

Redland City supports part of a nationally significant Koala (*Phascolarctos cinereus*) population of relatively high density and genetic distinctiveness. The number of individuals in this population has declined by 68% between 1996 and 2010 due to habitat loss and mortality associated with urbanisation. Koalas in this population utilise scattered habitat trees and parkland within the urban environment, but only very occasionally within the PDA itself. Remnant vegetation in Weinam Creek provides a natural filter to improve water quality of runoff to the bay and supports one of the key flying-fox roost sites in the Redlands used seasonally by up to tens of thousands of flying-foxes, including as a maternity camp for birthing and raising their young.

Development of the Weinam Creek PDA will need to respect to the ongoing conservation of those values, with provisions for safe fauna movement, habitat protection and enhancement, maintenance of water quality, community education and engagement, and ongoing monitoring to manage and maintain environmental values through all phases of the development.

Movement Context

The PDA of Weinam Creek is a focal point as a residential area as well as being the major transit hub for access to the southern Moreton Bay Islands. This brings a unique mix of water based and land based travel modes. Movement context in such a location requires consideration of how transport from these two mode types can operate in partnership providing optimum accessibility for all users.

The key focus from a land-based perspective is providing direct connectivity to the rest of Redlands, and South East Queensland. The strategy for providing connectivity should focus on all modes of travel, including pedestrians, cyclist, public transport users as well as private cars. The issue for the water-based modes is how the existing ferry facilities coexist with the proposed development with effective operation, while not impacting detrimentally on local amenity.

Infrastructure Context

Transport

Transport infrastructure will be defined by two factors, the traffic capacity and active/public transport network. Road cross sections will be determined by the anticipated traffic volumes for the PDA and suitable capacity thresholds for each road classification. The active and public transport facilities will be driven by the need for an integrated and accessible network, with particular focus on connectivity between land uses and suitable roadside facilities, such as waiting areas which meet Translink standards.

Water and Sewer

Water and sewer services to the Weinam Creek PDA are required to meet minimum service standards adopted by Redland City Council. Required upgrades for servicing the PDA have proved simplistic for water and comparatively complex for sewer.

The PDA is supplied by the Serpentine Creek Demand Management Area, primarily via a 200mm main along Gordon Street. Water supply to the PDA will meet the desired standards of service with only minor infrastructure installed.

Two sewerage pump stations service the PDA on the north and south of Weinam Creek respectively, with the downstream network of pump stations, rising mains and gravity man network transporting the sewerage to the Victoria Point WWTP. The PDA will require new infrastructure upgrades and may slightly influence the timing and size of programmed upgrades.

Victoria Point WWTP currently has 1000EP remaining capacity available, which may be used in the near future due to other anticipated development in the catchment. The DEHP operating license is expected to be reached at this time, which will require license negotiations and/ or alternate servicing.

Examples of existing marina developments

2.2 Site Analysis

Urban Design Site Analysis

A number of issues and opportunities for the Weinam Creek structure plan were identified as part of the initial site analysis. These are outlined below and summarised visually in Figure 5.

Access into the centre of the Weinam Creek PDA is via either Hamilton or Meissner Streets off Weinam Street which connects north back to the Redland Bay Centre. Weinam Creek splits the PDA into two precincts with the southern area accessed via Moores Road.

On the foreshore, Redland Bay Ferry Terminal provides passenger ferries to the SMBIs, whilst the Bay Islands Vehicle Ferry caters for vehicles movements. These uses are separated by Neville Stafford Park, each with their own associated at-grade car parking areas. Whilst Weinam Street connects directly to the vehicle ferry, the street network throughout the PDA does not clearly direct vehicles to the passenger ferry terminal which is a major generator of trips in the area.

A Translink upgrade to the Redland Bay Ferry Terminal is proposed to incorporate additional bus bays and upgraded waiting facilities for passengers (see Figure 4).

At-grade parking associated with the passenger ferry terminal dominates a larger area close to the foreshore. Access, both vehicle and pedestrian, through this area is difficult due to the nature of the parking and street network. Whilst not a formal road, there is a loop street off Banana Street providing access to the passenger ferry terminal, bus interchange and short term parking. The long-term secure paid parking compound provided by Council is fenced with access from this loop street.

The boat ramp and associated trailer parking is also accessed directly from Banana Street. The configuration of this boat ramp means there are possible conflicts with pedestrians, trailers and vehicles within this area.

There is an additional long-term at-grade parking area located on Meissner Road provided by Council and also a number of private residents in the area charging vehicles to park on their private property.

Given the extent of parking in the Weinam Creek PDA, there is an opportunity for these areas to be rationalised to ensure the demand is met, whilst celebrating the foreshore and natural features of this area.

There is a café and small store located on the corner of Weinam and Banana Streets. This sits outside the 400m, 5 minute, walkable catchment of the Redland Bay Centre providing convenience retailing for the immediate local community.

Community facilities are grouped in two precincts within the PDA. The Redland Bay Police Station, Redland Bay Community Hall and the Redland Bay Amateur Fishing Club are located along Weinam Street and the Coast Guard, Sea Cadets and Redlands Sea Dragons located along, and with direct access to, Weinam Creek. There are opportunities to improve access and links to and between these facilities to strengthen the offering of uses within the PDA.

Existing residential development west of Banana Street is typically 1-2 storey detached houses. The topography, and proximity to facilities, lends itself to conversion into higher density forms of development over time.

In addition to the residential and community uses in the Weinam Creek PDA, there are a number of marine industry uses located on the southern side of Weinam Creek, accessed via Moores Road. A small Council owned marina is also located within this area on the northern side of the creek.

Large areas of open space and parkland dominate the northern part of the Weinam Creek PDA. Sel Outridge Park contains a cricket pitch, direct foreshore access including some small picnic facilities and a small amount of off-street car parking as well as a distinctive row of large trees. This park, and the vegetated waterway corridor, provides opportunities for amenity and outlook for the surrounding development.

At Weinam Creek in the south, areas of subtropical coastal saltmarsh and mangroves exist. These need to be protected and considered as part of the redevelopment of the PDA. In addition, the marine environment needs consideration including any impact on seagrass.

As well as being part of a broader wetland system, this vegetated area at Weinam Creek also provides habitat for a flying-fox colony located on both sides of Moores Road. This area also provides an opportunity for amenity and to form part of the broader pedestrian and cycle network linking the open spaces areas within and outside of the PDA.

A pedestrian foreshore link exists in part within the Weinam Creek PDA but there are opportunities for this to be extended, and the conflicts with other uses, and vehicles, resolved. Particularly at the boat ramp launching point.

Figure 4. Proposed upgrade to Redland Bay Ferry Terminal (source: Translink)

🟥	Higher Density Aged Care
🟨	Community Facility
🟪	Marine Industry
▨	Council Owned Marina
▨	Large Residential Sites, Mostly Undeveloped
▭	Interface To Be Resolved
↔	Existing Pedestrian Connection
→	Existing Streets
Ⓟ	Car Parking
🟩	Existing Vegetation
🟩	Parkland
🟫	Mangroves
⁘	Flying-fox Camp
🟦	Butterfly Habitat
🟪	Saltmarsh
⁘	Seagrass
┅	Storm Surge Line
▨	Previous Dredge Spoil Area
—	PDA Boundary
①	Vehicle Ferry Terminal
②	Redland Bay Ferry Terminal / Translink Upgrade
③	At-grade Car Parking Area
④	Secure Long Term Car Parking Compound
⑤	Existing Foreshore Pedestrian Link
⑥	Neville Stafford Park
⑦	Sel Park Outridge
⑧	Existing Marine Industry Uses
⑨	Community Precinct
⑩	Existing Shop / Cafe
⑪	Council Owned Site

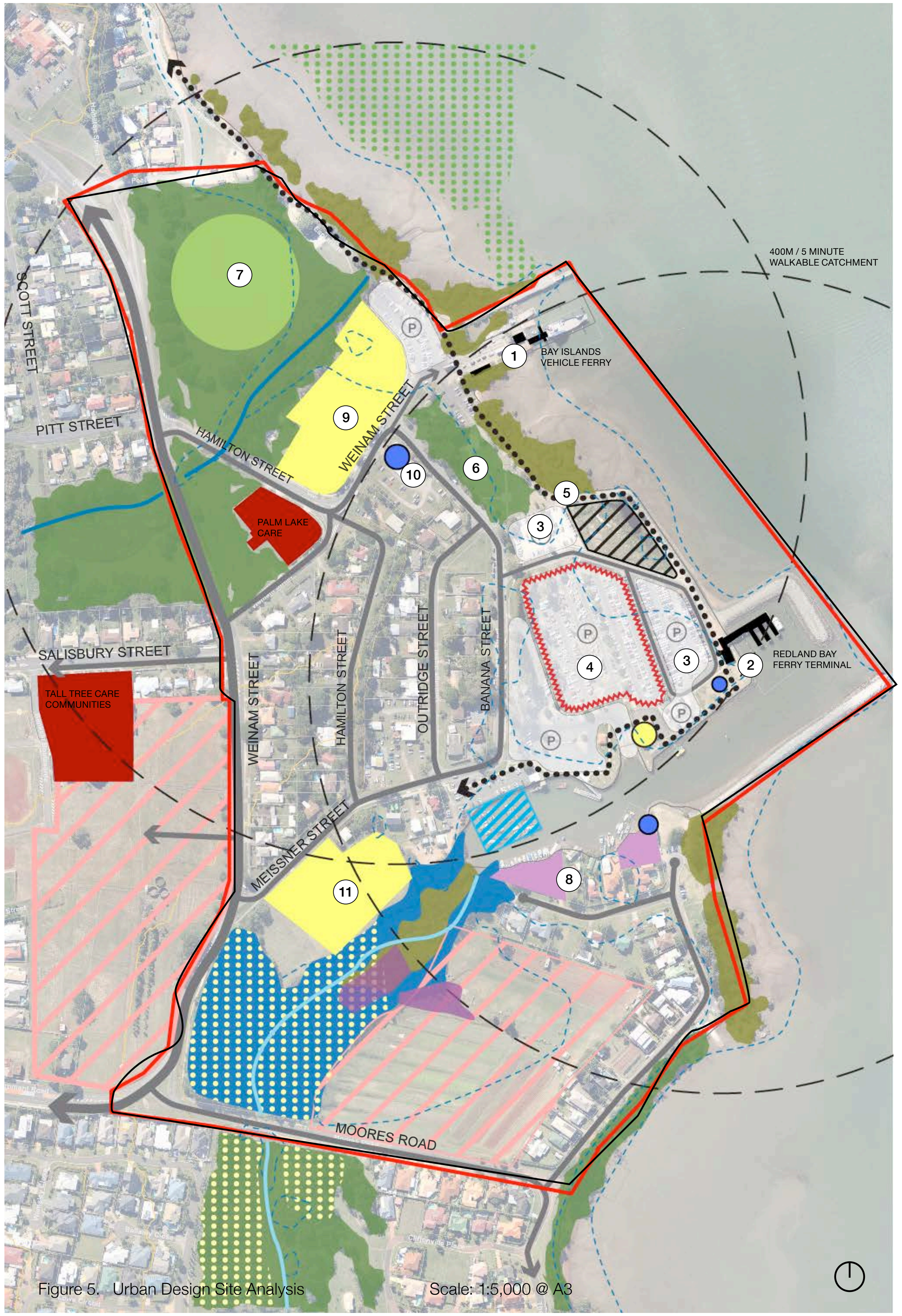


Figure 5. Urban Design Site Analysis

Scale: 1:5,000 @ A3

Environmental Site Analysis

Key ecological values and issues identified within the Weinam Creek PDA are shown in Figure 6 and include:

- Subtropical coastal saltmarsh, although already protected in Queensland under the Fisheries Act, has recently been listed as a threatened ecological community under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- Intertidal and shallow sub tidal habitat, including extensive flats supporting seagrass, mangroves and saltmarsh, that are of importance to fish and fisheries
- Seagrass (to the north of the PDA) and intertidal and subtidal foraging habitat of marginal importance to migratory shorebirds, dugongs and marine turtles within the Ramsar site of Moreton Bay
- Koalas and Koala habitat trees
- Important roost and maternity camp for three species of flying-fox
- Potential habitat for the NC Act listed Illidge's Ant-Blue Butterfly
- Weinam Creek (high cultural heritage and environmental value)
- Potential acid sulfate soils
- Erosion-prone shorelines.

Economic Site Analysis

The population of Redland Bay SA2 (Redland Bay) was 14,284 in June 2012, up from 14,006 in June 2011 (2.0% growth). This strong growth is consistent with the growth rates across the broader Redland City region and the Greater Brisbane region. Current medium growth series forecasts indicate the Redland Bay population is expected to continue to record strong growth and reach 22,000 residents by 2031 (i.e. 1.9% per annum growth continuing through to 2031).

Redland Bay is the key access point to the Southern Moreton Bay Islands (SMBI) and population growth for this component of the region has been more modest and increasing off a relatively low ERP base. In June 2011 the ERP was 5,844, which increased to an estimated 5,914 in June 2012 (1.2% growth).

The main characteristics of the Redland Bay population (compared with Greater Brisbane) are:

- A relatively high proportion of children (24% under 15 years vs 20.1% in Greater Brisbane)
- A large population from the UK (9.2% vs 5.6% in Greater Brisbane)
- Relatively high level of home ownership (73.9% either own or are buying their home vs 65.5% in Greater Brisbane)
- Dominance of detached dwellings – 98% of all dwellings
- Dominance of family households with very few lone person and group households.

Individual incomes for Redland Bay residents are in line with Greater Brisbane while average household incomes are 5.5% higher, reflecting the larger average household size, which translates to more households with more than one income earner. Incomes of SMBI residents are considerably lower.

It is envisaged that Weinam Creek will support a mixed-use residential, tourism and retail based development. The importance of Weinam Creek and its ferry terminal is of particular significance as the gateway to SMBI, providing access for the island residents to shopping, health, education, employment and entertainment opportunities throughout the Redlands and the greater Brisbane area as well as tourists and visitors to the islands. It is therefore an important economic link between SMBI and the mainland. It has the potential to provide a regional focus for Redland Bay and act as a major destinational node for the area. The importance of this role will continue to increase on the back of strong population growth which is forecast to continue for the primary catchment of 3.5% p.a. to 2016 and 1.9% from 2016 to 2021.

The major driver for population and economic growth in the area that will influence the development of the site is the attractive coastal lifestyle.

Movement and Parking

There is currently significant traffic congestion at Weinam Creek around the ferry terminal and boat ramp facilities and car parks, particularly at weekends. The Weinam Creek PDA has a variety of stakeholders, with different needs and uses for the space. This demonstrates a need for better separation of pedestrian, vehicle and bus traffic.

Parking is a serious issue at the passenger ferry terminal with long term parking dominating the area. The existing parking conditions are shown in Figure 7. Car parking for island residents, local residents, visitors and service providers needs to be provided. There is considerable competition between SMBI residents and patrons of the boat ramp for car parks and for vehicle access into the Weinam Creek precinct. There are currently 1,094 Council parking spaces in the areas around the ferry terminal, these are all at or close to capacity.

Several intersections will require upgrading. In the north of the site the arrangement of Hamilton Street and Weinam Street does not provide a direct route to the ferry terminal / boat ramp that forms the centre of the PDA. Towards the southern edge of the site the existing intersections with the major link of Pitt Street / Gordon Street have poor visibility and would need upgraded for safety reasons if traffic volumes increased. The existing traffic conditions are shown in Figure 8.

In terms of pedestrian links, footpaths range in widths of between 1.2m to 2.5m shared paths. However, the standard of the walking and cycling network involves a number of road crossings and missing links, particularly along Hamilton Street where the footpath at Weinam Street does not extend to the major road at Pitt Street.

The area is a major transit hub, particularly for bus and ferry interchanges. Although there is a reasonable frequency of bus services, the waiting area at Redland Bay Ferry Terminal is small for the number of people utilising it and could be made more attractive and comfortable given its importance as a major hub. In addition the fragmented street network means that although all buses serve the ferry terminal, some only go through the north of the site and some the south. This is an inefficient routing which means that the existing bus services do not provide maximum penetration of the PDA.

Figure 6. Key ecological values within the Weinam Creek PDA

2.3 Community

The purpose of engagement for the Weinam Creek PDA was to:

- To engage proactively with the community in advance of planning for the Weinam Creek PDA and inform residents of the PDA process
- To inform residents of the constraints to development at Weinam Creek identified by consultants engaged by Council and EDQ
- To report back issues already identified by residents through previous planning studies, to report any changes that may have mitigated these issues and seek community input on whether these issues were still current and if there were any additional issues outside of Council's knowledge.

Three different engagement techniques were used to maximise community knowledge and participation in this stage of the Weinam Creek PDA project. These were targeted stakeholder meetings, Open House community forums and online surveys.

Key Themes and Learnings

Potential to expand marine service industries — The site has a pre-existing four- lane boat ramp, ferry terminal and commercial slipway. There are large numbers of fishing enthusiasts, powered and unpowered boats already using the precinct. This and the very large number of boaties regularly travelling north into the bay from the Gold Coast makes Weinam Creek well positioned to service recreational and small- scale commercial marine industries.

Need for better traffic separation between boaties, islanders and public transport providers — there is currently significant traffic congestion at Weinam Creek, particularly on weekends.

Better car parking — Car parking continues as the greatest issue and constraint in this area. All stakeholders have raised the problem of car parking for island residents, local residents, visitors and service providers. A variety of options were listed including:

- Remote long stay car parks linked to the ferry terminal by a shuttle service
- Multi-deck car parks at Meissner Street or on the site of the current secure parking compound
- Long-stay car parking on the current farmland off Moores Road.

SMBI residents are optimistic that the PDA will generate a sustainable long- term parking solution for all users.

Impact on Southern Moreton Bay Islands — In addition to ensuring that development does not compromise available parking for islanders, islanders noted that if Weinam Creek development brought more tourists to the islands there would need to be greater investment and better basic infrastructure (including sewerage) on the islands.

Preference for mixed-use waterfront precinct —Many residents suggested a mixed- use precinct on or near the waterfront that included cafes, boardwalks, restaurants and some residential development.

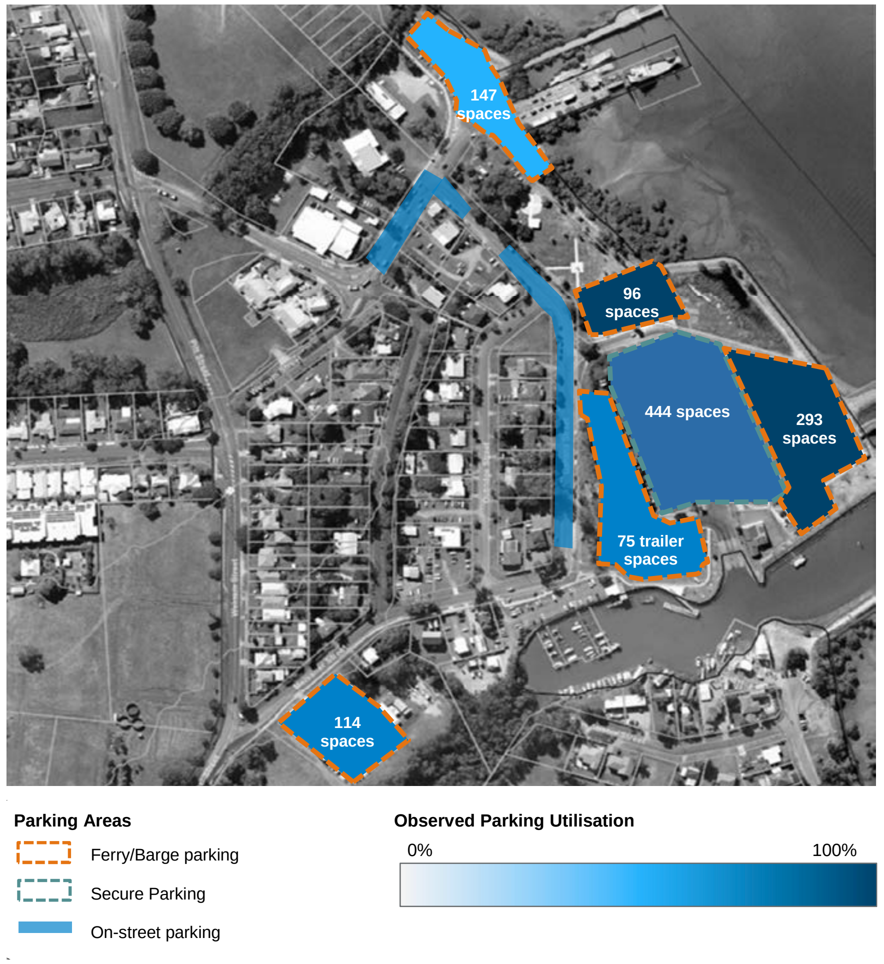


Figure 7. Existing parking conditions

Figure 8. Existing traffic conditions

Artificial beach — Residents and stakeholders noted the increasing popularity of unpowered boats including kayaks and dragon boats. They recommended an artificial beach as an ideal launch area for these vessels.

Aboriginal cultural heritage — The Aboriginal Cultural Heritage Act 2003 requires Council to exercise due diligence and reasonable precaution that activity does not harm Aboriginal cultural heritage. The views of the Quandamooka people through their recognised cultural body the Quandamooka Yoolooburrabee Aboriginal Corporation (QYAC) are key in assessing and managing any activity likely to excavate, relocate, remove or harm Aboriginal cultural heritage.

Marina — A variety of locations for a marina were indicated including:

> Extending into the sea from the end of the current ferry terminal
> In an excavated area at the top of Weinam Creek
> In an excavated area off Moores Road and linking to the creek.

How do we achieve this vision? — Generally residents said that change should be funded through commercial development or by the State and/or Federal Government. Residents did not want any change that increased rates.

Issues summary

> Stakeholders reported considerable competition between SMBI residents and boaties for car parks and for vehicle access into the Weinam Creek precinct. This congestion makes it difficult for boaties and the Water Police to access the boat ramp, especially on weekends. All stakeholders say any increase in population, island or mainland will make this problem worse. All stakeholders felt that this was an issue beyond Council’s control and that help from State Government and the development sector was required.
> Stakeholders said there should be better separation of pedestrian, vehicle and bus traffic. They also said there should be separation between parking for island residents and parking for boat trailers. These stakeholders suggested that the boat ramp, ferry and barge services could be located closer together.
> Concern about impact on marine life resulting from any waterfront and on-water development. Seagrass, wetlands and mangrove damage was seen as the greatest constraint. Strong ecological values were also identified in terms of concern for wildlife unique to the area such as dugongs, turtles, native birds, pelicans and flying-foxes.
> Barge service is too expensive. Community would like to see opportunity for competing barge service.
> Many island residents are highly dependent on their mainland car to access health and other community services. Any change at Weinam Creek that increases the cost of storing a car on the mainland or that makes it difficult to store a car on the mainland would have a negative impact on island residents.
> Lack of local employment and underutilised tourism opportunities were the key economic concerns from the majority of residents. The concern for the ability of local businesses to survive due to lack of daily parking was also strongly expressed. Regional access arose as an issue, with participants reporting that public transport from the Gold Coast to Weinam Creek currently takes three and a half hours.

Specific stakeholder issues

Quandamooka Yoolooburrabee Aboriginal Corporation

> QYAC are the lead agency in assessing cultural heritage.

Redland Bay Water Police

> Will require suitable berthing for new (larger) rapid response cruiser
> Would prefer direct access to boat ramp that is separated from island traffic and boat traffic.

Southern Moreton Bay Islands Forum

> The Weinam Creek PDA has the potential to stimulate tourism to the islands, improving the island economies. Council and State must recognise that development that promotes traffic from the mainland to the islands will increase demand on current island infrastructure and that improvements to island infrastructure should be considered alongside the PDA process to make the most of this opportunity.

Redland Bay Amateur Fishing Club

> The boat club reports they have invested in their club house and would oppose any compulsory acquisition.
> As members of Sunfish and as keen fishing enthusiasts the club also opposes any habitat destruction that may impact the marine ecology.
> The club reports that the entrance to Weinam Creek is dangerous in a south easterly wind.

3. STRUCTURE PLAN DESIGN

The development of a preferred structure plan option for Weinam Creek has been informed by a succinct design, review and evaluation process. This process involved urban design, environmental, economic, traffic and infrastructure input as well as that of the community, Council and State Government agencies.

This information has been collated and developed over a series of workshops in which issues and opportunities were identified and analysed, structure plan options developed and assessed.

The following section of the report summarises this design process and assessment of options.

3.1 Options Development

Workshop 1 — Options Development Workshop

The options development workshop was held with key State and local stakeholders on Tuesday the 16 July 2013. The intention of this session was to clarify the key design issues and opportunities and to establish a series of structure plan options for each PDA.

Workshops for both the Weinam Creek and Toondah Harbour PDAs were held on the same day with a combined briefing. The workshop agenda is shown in Figure 9.

The workshop was attended by the consultant team, representatives from Redland City Council and State Government agencies as listed below.

- **Consultant team** — Deicke Richards, Jones Lang LaSalle, BAAM, frc environmental and Cardno
- **Redland City Council** officers including the following departments — City Planning and Assessment, Environment and Regulation, Corporate Governance, Communications, Water and Waste Infrastructure, City Infrastructure and City Spaces
- **State agencies** — Economic Development Queensland, Translink, Transport and Main Roads, Maritime Safety Queensland, Environment and Heritage Protection, Natural Resources and Mines, National Parks Recreation Sport and Racing and State Development Infrastructure and Planning.

The objective of the workshop was to:

1. Develop a shared understanding of the key issues of the project
2. Identify and document the most important issues and constraints that will uniform design responses for the precinct
3. Generate a range of ideas, principles and design concepts that can inform more detailed testing of key issues e.g. public realm, transit, land-uses, density, parking etc.

The outcomes of the workshop process are shown in Figure 10.

These outcomes of this workshop were refined following review and further analysis into three structure plan options which formed the basis of workshop 2.

Workshop 1 — Options Development Workshop	
8:00 am	**Assemble in the venue (coffee provided)**
8:30 am	**Workshop welcome & introduction (plenary session)** Project introduction (Scott Hutchison & John Loneragan) Participant introductions — all participants to introduce themselves Purpose of the workshop sessions — expected outcomes, what will be produced etc. (John Loneragan) Workshop agenda — how the workshop will be run, timing & report back stages, house rules etc.
8:45 am	**Welcome from Redland City Council (plenary session)** Welcome and introduction (Nick Clarke, General Manager, Organisation Services, Redland City Council)
Session 1: Background Briefings	
9:00 am	**Site specific design priorities** > Traffic & infrastructure — car parking, Translink interchange at Weinam Creek, vehicle access & road hierarchy (Cardno, 15 mins) > Environment & ecology — terrestrial & marine (e.g. Ramsar), marine parks, koalas, other habitat, open space & recreation (BAAM / frc environmental / NPRSR, terrestrial 15 mins, marine 15 mins) > Market / economics (JLL, 15 mins) > Initial site analysis, urban form & harbour exemplars (Peter Richards 15 mins, Cameron Davies 15 mins)
Session 2: Weinam Creek	
10:30 am	**Weinam Creek Structure plan opportunities (in 3 design teams)** Designing at a strategic scale working over consolidated site analysis drawings, consider: > Opportunities, car parking strategy, public transport & transit integration, development footprint, public realm & environmental enhancement, ecology, flooding & storm surge, pedestrian movement & connectivity (cycleways, footpaths), social infrastructure, tourism opportunities, centre strategy, identify any additional constraints.
12:30 pm	**Report back (desktop review around the room)** Each design team to give a 10mins. presentation of their team's approach. Discussion to consolidate the direction for up to 3 structure plan options.
1:15 pm	**Lunch**
Session 3: Toondah Harbour	
2:00 pm	**Toondah Harbour Structure plan opportunities (in 3 design teams)** Designing at a strategic scale working over consolidated site analysis drawings, consider: > Opportunities, ferry operations, tourism opportunities & marina, built form & scale, public realm & environmental enhancement, flooding & storm surge, pedestrian movement & connectivity (cycleways, footpaths), public transport and & integration, including car parking, integration with Cleveland & complimentary uses / measures, identify any additional constraints.
4:00 pm	**Toondah Harbour Report back (desktop review around the room)** Each design team to give a 10mins. presentation of their team's approach. Discussion to consolidate the direction for up to 3 structure plan options.
4:45 pm	**Wrap up / where to from here (plenary session)**
5:00 pm	**Workshop close**

Figure 9. Workshop 1 Agenda

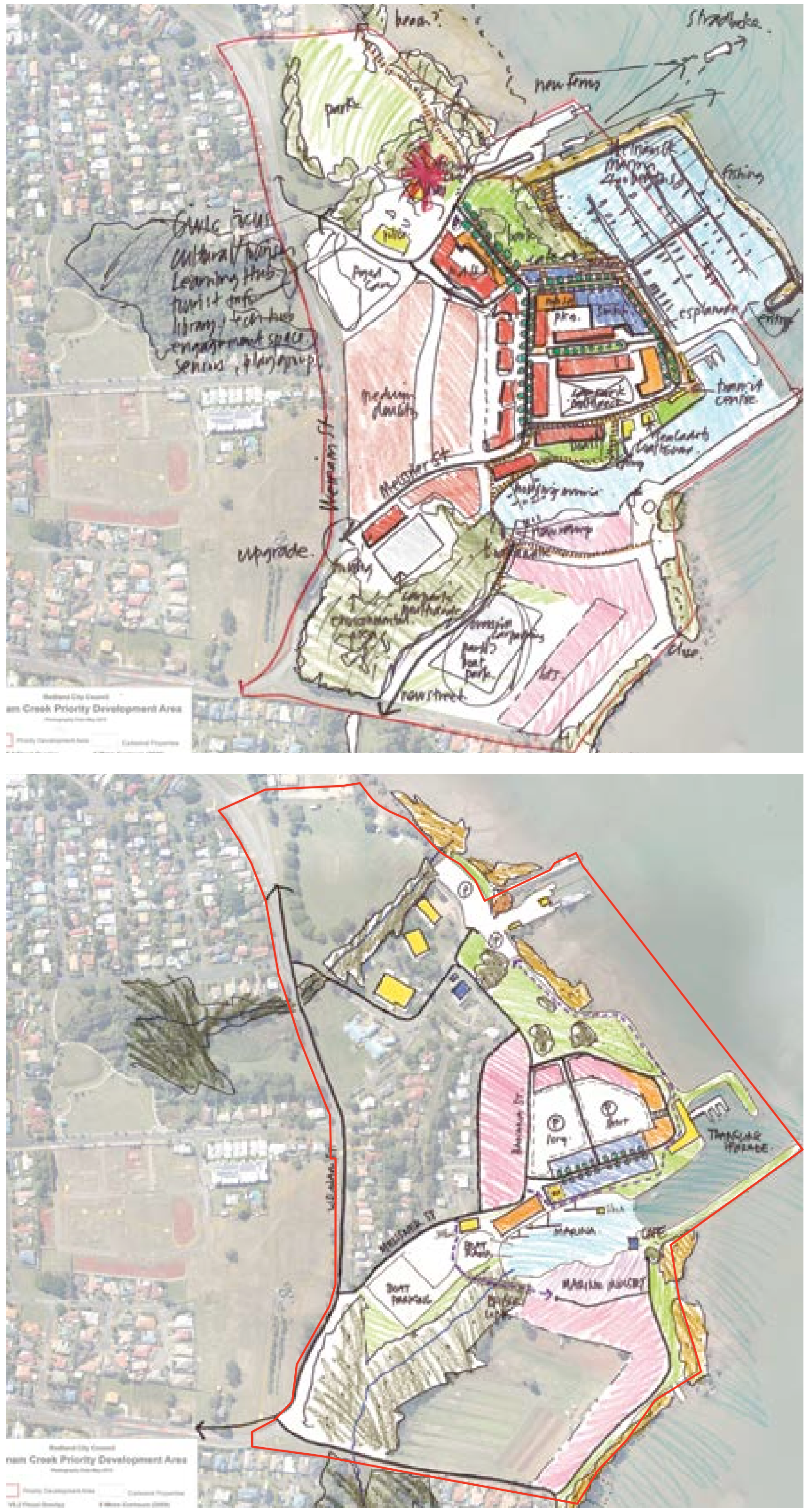


Figure 10. Workshop 1 outcomes

Photos of participants at workshop 1

3.2 Structure Plan Options

Three structure plan options were developed as a result of the discussion and further refinement following the options development workshop. These are used to describe the alternative futures for the Weinam Creek PDA and were further considered during workshop 2.

Option 1 — New Redland and SMBI Centre

The key elements of Option 1 are summarised below and shown in Figure 11.

① Option 1 develops an urban centre and 2-300 berth marina as the focus of the precinct.

② Land reclamation allows the construction of the marina and creates additional foreshore parkland against Neville Stafford Park.

③ Hamilton Road is extended directly through Banana Street to the foreshore creating an esplanade street. This change in the street network unlocks development parcels and improves the legibility for people moving to, from and within the PDA.

④ The esplanade street forms the main street with retail and mixed-use development overlooking the parkland to the north.

⑤ The extension of Hamilton Road creates opportunity for an additional community node within the precinct midway between the existing facilities on Weinam Street and along the creek.

⑥ The mixed-use core along the esplanade street and Banana Street are supported by increased residential density on Outridge and Hamilton Streets.

⑦ The vehicle and passenger ferry terminals remain in their current location. They continue to be linked by pedestrian connections along the foreshore and an improved street network.

⑧ At-grade parking within the Weinam Creek PDA is consolidated into a multi-deck structure located in the centre of the precinct and sleeved by development. Additional long-term parking is provided on Council's existing site on Meissner Street.

⑨ The Coast Guard and boat ramp also remain in their current location with the Sea Cadets and Redlands Sea Dragons relocated close by to strengthen this community node and provide improved access to Weinam Creek.

⑩ The marine industry uses located on the southern side of Weinam Creek remain and compliment the community uses opposite. They may also benefit from, and provide services to, the marina. Opportunities for additional small scale marine industry may exist on the northern side of the creek over time.

⑪ The southern part of the PDA is linked physically to the centre with a pedestrian bridge over the mouth of Weinam Creek. This connects into the improved foreshore path, linking key elements within the PDA.

⑫ The large undeveloped parcel on Moores Road is developed for residential with a new street connection to Auster Street. Higher density residential development is located along this new connection, taking advantage of the amenity provided by Weinam Creek and the associated saltmarsh and mangrove area.

Figure 11. Structure Plan Option 1

🟦 Retail
🟧 Mixed-use
🟪 Higher Density Residential
🟨 Community
🟩 Park / Open Space
🟩 Vegetation
🟫 Plaza / Boardwalk
Ⓟ Car Parking
— PDA Boundary
- - - 400m / 5 min. Walkable Catchment
↔ Pedestrian Connection
➡ Vehicle Ferry
⇢ Passenger Ferry
□ Proposed Traffic Lights

Figure 12. Structure Plan Option 2

Option 2 — Weinam Creek Village

The key elements of Option 2 are summarised below and shown in Figure 12.

① Option 2 develops new small mixed-use centre at the end of Banana Street and makes Weinam Creek the focus of the precinct.

② It is anticipated that the existing centre on the corner of Banana and Weinam Streets would continue in its current location servicing adjoining community facilities and Neville Stafford Park.

③ To achieve a critical mass of development on the northern side of Weinam Creek the existing boat ramp is relocated to the west in the location of the existing Sea Scouts.

④ The Sea Scouts can be relocated adjacent to the existing boat ramp where they can share the existing ramp with the Coast Guard.

⑤ A new esplanade street links provides a loop from Banana through to Meissner Street following the shoreline. This new esplanade improves the legibility of the development area and efficiency of bus services.

⑥ The vehicle and passenger ferry terminals remain in their current location. They continue to be linked by pedestrian connections along the foreshore and an improved street network.

⑦ At-grade parking within the Weinam Creek PDA is consolidated into a multi-deck structure located in the centre of the precinct and sleeved by development. Additional long-term parking is provided on Council's existing site on Meissner Street.

⑧ The marine industry uses located on the southern side of Weinam Creek are redeveloped over time as higher density residential uses with a public boardwalk along the edge of the creek. There may be opportunities for a small number of marina berths associated with this residential in Weinam Creek.

⑨ The southern part of the PDA is linked physically to the centre with a pedestrian bridge over the mouth of Weinam Creek. This connects into the improved foreshore path, linking key elements within the PDA.

⑩ The large undeveloped parcel on Moores Road is developed for residential with a new street connection to Auster Street. Higher density residential development is located along this new connection, taking advantage of the amenity provided by Weinam Creek and the associated saltmarsh and mangrove area.

Option 3 — Weinam Creek Marina

The key elements of Option 3 are summarised below and shown in Figure 13.

① Option 3 creates a new 100-150 berth marina between the mouth of Weinam Creek and Moores Road in the location of the existing flying-fox colony, saltmarsh and mangroves.

② As with Option 2, a small centre is developed to Weinam Creek however the supporting denser residential uses and focus of the development gravitates towards the marina in the south and a number of undeveloped parcels around it. With this option there is less short to medium term pressure to relocate the existing parking areas that service the passenger ferry terminal.

③ It is anticipated the existing centre on the corner of Banana and Weinam Streets would continue in its current location servicing adjoining community facilities and Neville Stafford Park.

④ The existing boat ramp is relocated to the south of Weinam Creek and the Sea Scouts can be relocated adjacent to the existing boat ramp where they can share the ramp with the Coast Guard.

⑤ A new esplanade street links provides a loop from Banana through to Meissner Street following the shoreline. This new esplanade improves the legibility of the development area and efficiency of public bus services.

⑥ The vehicle and passenger ferry terminals remain in their current location. They continue to be linked by pedestrian connections along the foreshore and an improved street network.

⑦ Ultimately at-grade parking within the Weinam Creek PDA is consolidated into a multi-deck structure sleeved by residential development. Parking associated with the marina is developed on the Moores Road site where it can be integrated with residential development.

⑧ The marine industry uses located on the southern side of Weinam Creek are redeveloped over time as higher density residential uses. There may be opportunities for a small number of marina berths associated with this residential in Weinam Creek.

⑨ The southern part of the PDA is linked physically to the centre with a pedestrian bridge over the mouth of Weinam Creek. This connects into the improved foreshore path, linking key elements within the PDA. The bridge may constrain the height of boats that utilise the main marina.

Figure 13. Structure Plan Option 3

3.3 Assessment of Structure Plan Options

Workshop 2 — Options Selection and Refinement Workshop

The options selection and refinement workshop was held on Monday 9 September 2013 again with a number of key State and local stakeholders. The first part of this session took the three developed structure options and assessed them against a number of criteria in order to select a preferred structure plan option for the PDA. The second part of the workshop involved discussion and refinement of the preferred option.

Sessions for both the Weinam Creek and Toondah Harbour PDAs were held on the same day. The workshop agenda is shown in Figure 14.

Workshop 2 was again attended by the consultant team, representatives from Redland City Council and State Government agencies as listed below.

- **Consultant team** — Deicke Richards, Jones Lang LaSalle, BAAM, frc environmental, Cardno and KBR
- **Redland City Council** Councillors and officers including the following departments — City Planning and Assessment, Environment and Regulation, Corporate Governance, Communications, Water and Waste Infrastructure, City Infrastructure and City Spaces
- **State agencies** — Economic Development Queensland, Translink, Transport and Main Roads, Maritime Safety Queensland, Environment and Heritage Protection, Natural Resources and Mines, National Parks Recreation Sport and Racing and State Development Infrastructure and Planning.

This workshop was also attended by representatives from QYAC.

The options and assessment criteria are detailed in the following sections.

Options Assessment

The assessment criteria were developed using a combination of elements detailed within the RCC's 2030 Community Plan and EDQ's Strategic Direction. It should be noted that the community plan is an extensive document so only relevant criteria were included and that the criteria has been adapted to suit the specific role of the PDA within the context of Redland City.

The structure plan options for Weinam Creek were initially assessed by the project team and then reviewed and recalibrated as part of the options assessment and refinement workshop with the additional stakeholders.

Table 1 details the assessment of the options.

Within the table each structure plan option has been assessed against each criteria on a sliding scale using shades of blue to indicate the score. A light blue cell indicates where an option does not meet the criteria and a dark blue cell indicates where an option strongly meets the criteria. The mid blue indicates a moderate score.

The cells within the table are coloured according to the score and a commentary of the rationale also provided within.

Workshop 2 — Options Selection & Refinement Workshop	
8:00 am	**Assemble in the venue (coffee provided)**
8:30 am	**Workshop welcome & introduction (plenary session)** Project introduction (Scott Hutchison & Phil Smith) Participant introductions — all participants to introduce themselves Purpose of the workshop sessions — expected outcomes, what will be produced etc. (Phil Smith) Workshop agenda — how the workshop will be run, timing & report back stages, house rules etc.
8:45 am	**Welcome from Redland City Council (plenary session)** Welcome and introduction (Nick Clarke, General Manager, Organisation Services, Redland City Council)
Session 1: Toondah Harbour	
9:00 am	**Presentation of structure plan options (plenary session)** Heritage & Country (QYAC representative, 15 mins) Distillation of previous urban analysis (DR, 10 mins) Market / economics (JLL, 10 mins) Harbour & marina engineering (KBR, 10 mins)
9:45 am	**Option selection & refinement (plenary session facilitated by DR)** Review of options assessment table and updates as required. Facilitated discussion to select preferred structure plan option.
10:45 am	**Detailed investigations (in 3 design teams)** Further investigation and detailed design of specific elements of the preferred structure plan option.
12:00 pm	**Report back (desktop review around the room)** Each design team to give a 10mins. presentation of their team's approach. Discussion on implications for preferred structure plan option (if any).
12:30 pm	**Lunch**
Session 2: Weinam Creek	
1:00 pm	**Presentation of structure plan options (plenary session)** Heritage & Country (QYAC representative, 15 mins) Distillation of previous urban analysis (DR, 10 mins) Market / economics (JLL, 10 mins) Harbour & marina engineering (KBR, 10 mins)
1:45 pm	**Option selection & refinement (plenary session facilitated by DR)** Review of options assessment table and updates as required. Facilitated discussion to select preferred structure plan option.
2:45 pm	**Detailed investigations (in 3 design teams)** Further investigation and detailed design of specific elements of the preferred structure plan option.
4:00 pm	**Report back (desktop review around the room)** Each design team to give a 10mins. presentation of their team's approach. Discussion on implications for preferred structure plan option (if any).
4:30 pm	**Wrap up / where to from here (plenary session)**
5:00 pm	**Workshop close**

Figure 14. Workshop 2 agenda

Participants at Workshop 2

Weinam Creek Structure plan options assessment table		**Option 1** New Redland and SMBI Centre	**Option 2** Weinam Creek Urban Village	**Option 3** Weinam Creek Marina
				
Local and State Economy	Short Term Opportunities for Economic Growth	- New esplanade street and small mixed-use development next to existing ferry terminal - Lower density residential south of Weinam Creek	- Boat ramp relocation may delay establishment of mixed-use centre - Lower density south of Weinam Creek	- Comparatively less short term opportunity - Boat ramp relocation may delay establishment of mixed-use centre - Lower density south of Weinam Creek
	Long Term Opportunities for Economic Growth — 10 plus years	- Marina stimulates denser residential growth subject to market acceptance - Multi-deck car parking enables extension of mixed-use centre to north to join up with existing centre - Boat ramp limits land for residential growth - Reclamation areas to enable marina development	- Multi-deck car parking enable significant residential development on foreshore - Lack of marina may provide comparatively less demand for high density residential - High density residential subject to market acceptance - Questionable viability of three centres at Redland Bay	- Marina and multi-deck car parking enable significant residential development on foreshore - Boat height restriction in marina may limit some of the market - Questionable viability of three centres at Redland Bay
Traffic and Parking	Street Efficiency	- 11,000 VPD - Extending Hamilton to Banana Streets enhances movement economy - New esplanade street unlocks development parcels - Street arrangement needs to better suit marina activity	- 5,700 VPD - New esplanade street unlocks development parcels	- 5,500 VPD - New esplanade street unlocks development parcels - Requires upgrade of Meissner and Moores Road intersection initially
	Effective Parking	- 1,484 car parks required - Existing parking consolidates	- 1,000 car parks required - Existing parking consolidates in short term	- 1,090 car parks required - Existing parking consolidates in short term
	Effectiveness of vehicle ferry services	- Space for additional ferry ramp and associated parking	- Space for additional ferry ramp and associated parking	- Space for additional ferry ramp and associated parking
Environment and Heritage	Protect, Restore & Enhance Environment	- Low marine environment impact from marina - Protection of saltmarsh and flying-fox camp - Low koala impact, easily offset - Proximity of high-density residential to flying-fox camp may pose nuisance	- Low marine environment impact - Protection of saltmarsh and flying-fox camp - Low koala impact, easily offset - Proximity of high-density residential to flying-fox camp may pose nuisance	- Significant impact on existing saltmarsh and flying-fox colony - Significant impact on marine environment - Removal of saltmarsh will result in decreased water quality due to lack of filtering - Low koala impact, easily offset
	Opportunities to interact with nature	- Direct access to bay tidal area possible with large park - Flying-fox interaction possible	- Direct access to all existing ecosystems possible - Flying-fox interaction possible	- Removal of salt mash reduces opportunities to interact with this ecosystem
	Opportunities for Aboriginal stewardship and reconciliation	- Requires clarification - For consideration – ticketing centre permitting tourism, education, information centre, aquaculture & marine based tourism - Need to acknowledge and respond to the heritage on the site	- Requires clarification - For consideration – ticketing centre permitting tourism, education, information centre, aquaculture & marine based tourism - Need to acknowledge and respond to the heritage on the site	- Considerable impact on Weinam Creek as a significant heritage site and piece of Country - Requires clarification - For consideration – ticketing centre permitting tourism, education, information centre, aquaculture & marine based tourism - Need to acknowledge and respond to the heritage on the site

Table 1 Structure plan options assessment table

Weinam Creek Structure plan options assessment table		**Option 1** New Redland and SMBI Centre	**Option 2** Weinam Creek Urban Village	**Option 3** Weinam Creek Marina
				
Sustainable Transport	Effective Passenger Ferry & Bus Services	- Improved street efficiency good for bus service - Hamilton Street extension and esplanade loop street improves bus efficiency	- No change - Esplanade loop street improves bus efficiency	- Relocated ferry terminal may increase ferry trip length but improves residential catchment - More likelihood of conflicts between ferry traffic and other boating traffic
	Effective Cycle and Pedestrian Connectivity	- Continuous linkages, uninterrupted by traffic possible along edge of the bay - More direct pedestrian links into the middle of the site and to the north-west	- Continuous linkages, uninterrupted by traffic possible along edge of the bay	- Continuous linkages, uninterrupted by traffic possible along edge of the bay - Strong connection to the south
Community and Recreation	Effectiveness of community facilities	- Community facilities enhanced by close proximity of large centre	- Some additional community facilities can be integrated with new mixed-use centre	- Some additional community facilities can be integrated with new mixed-use centre
	Support for recreational boating (boat ramps & marinas)	- New marina and enhanced maritime industry - Consider relocation and expansion of boat ramp	- New boat ramp	- New marina - Pedestrian bridge may limit boat height
	Creating green recreational opportunities	- Increased parkland on foreshore	- Increased parkland on foreshore	- Increased parkland on foreshore but reduced passive recreation outlook through the removal of saltmarsh vegetation
Character and Livability	Vibrancy of centres and gathering places	- Large centre with variety of uses and greater opportunity for residential density in long term - New centre reinforces existing centre - Dispersed retail - Need to consider limits to 'out-of-centre' retail/commercial amounts	- Improved vibrancy with new centre and recreation - Existing centre and new mixed-use centre separated	- Improved vibrancy with new centre - Marina supports a vibrant residential community
	Strengthening Physical Character & Heritage	- Retention of existing maritime industry activities enables greater depth of legitimate character - Need to map heritage components	- Improved character possible through careful interpretation of existing built form - Need to map heritage components	- Improved character possible through careful interpretation of existing built form - Impacts on Weinam Creek heritage and vegetation - Need to map heritage components
Risk and Cost	Efficient cost of infrastructure	- Costly marina excavation - Cost and timing of changing car parking regime - Relocate and resolve boat ramp and car parking	- Cost and timing of changing car parking regime - Relocate and resolve boat ramp and car parking	- Costly marina excavation - Cost and timing of changing car parking regime - Relocate and resolve boat ramp and car parking - Relocation of ferry terminal and transit interchange
	Likeliness to succeed	- Staged marina improves apartment appeal - Unproven apartment residential market - Removal of free parking areas - Cost of maintenance dredging	- Unproven apartment residential market - Removal of free parking areas	- Lots of apartments in unproven market - Removal of free parking areas - Removal of saltmarsh, flying-fox colony and Weinam Creek heritage - Cost of maintenance dredging - Cost of pedestrian bridge, may limit market

Table 1 Structure plan options assessment table (continued)

3.4 Preferred and Refined Structure Plan Option

The assessment and discussions held as part of the options assessment and refinement workshop resulted in a preference for Option 1 for the Weinam Creek PDA structure plan which focused on new centre with opportunity for a 300-400 berth marina.

Following the selection of the preferred option, a number of elements and items to refine the structure plan were discussed. These include:

- Relocation of the existing boat ramp to the South or West of the PDA to create more opportunities for redevelopment at the core of the PDA and to reduce boating and centre traffic conflicts
- Inclusion of a new Boating Club extending into the marina next to the existing passenger ferry terminal
- Providing for some at-grade long term parking areas on the southern side of Weinam Creek on the vacant Moores Road site
- Rationalising marina walls and wave breaks
- Placing dredged material into a northern marine services groyne
- Providing flexibility for the passenger ferry terminal to be relocated to the End of Banana Street where it can more effectively service at grade parking areas.

The refined structure plan option for the Toondah Harbour PDA is shown at Figure 15. This forms the outcome of workshop 2, subsequent stakeholder negotiations and the basis of the structure plan documented in Section 4.

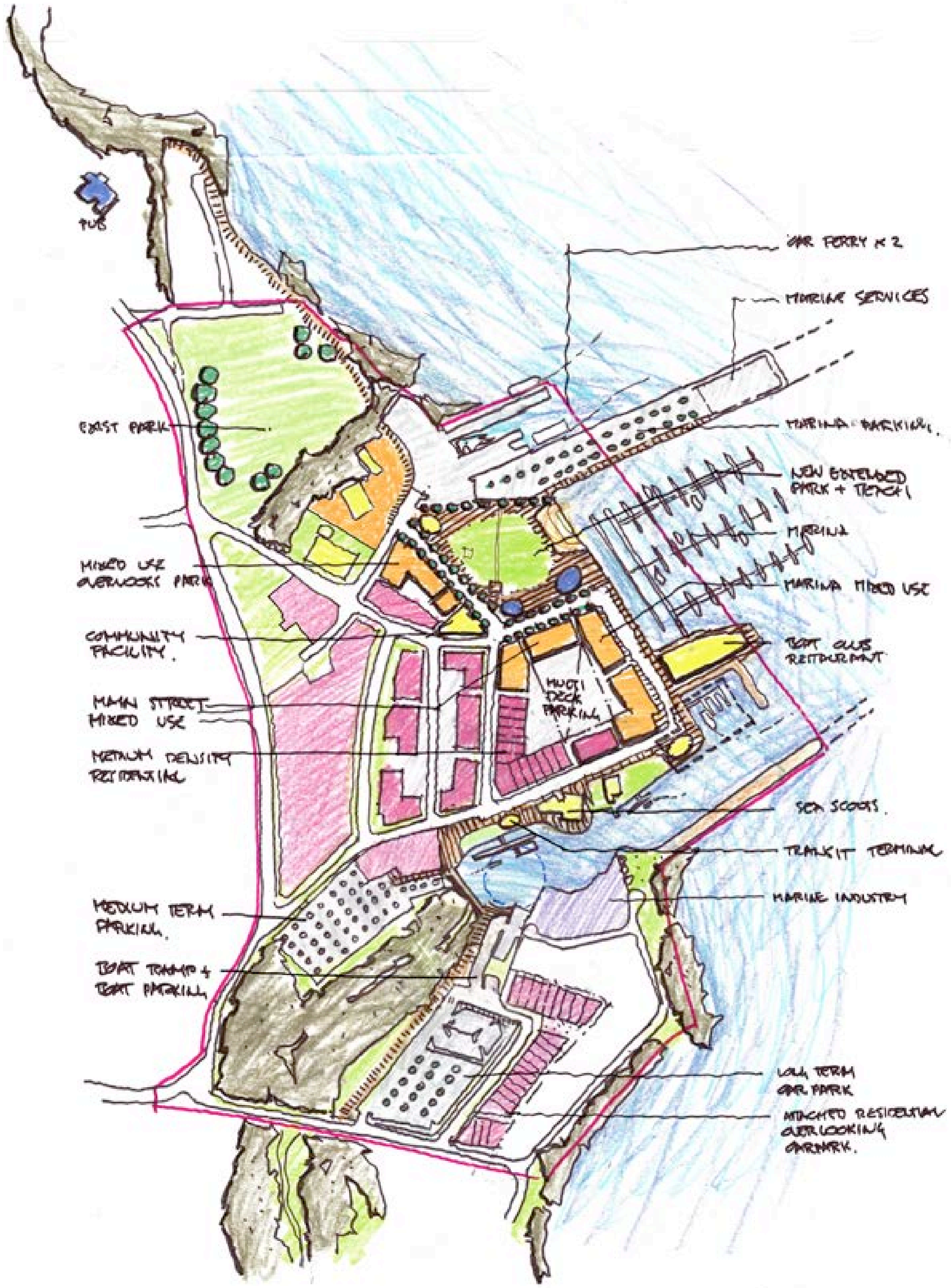


Figure 15. Weinam Creek PDA preferred structure plan option

4. STRUCTURE PLAN

The structure plan describes the physical economic responses with in the PDA. It distills the analysis and design phases of the master planning process into a concise structure for the Weinam Creek PDA area. The structure plan has the following key elements:

- > Principles – the key design principles that have guided decision-making and within the development area
- > Economic strategy –the strategic economic initiatives that will drive growth within the PDA
- > Movement and access – An outline of the vehicle and pedestrian movement functionality also integrating car ferry and passenger ferry activity
- > Land use and urban form – the integration of built form opportunity with land use outcomes
- > Open space and public realm
- > Environmental strategy
- > Infrastructure strategy

The implementation of this plan is further explored in Section 5.

4.1 Design Principles

The many opportunities for change within the Weinam Creek PDA have broader economic implications for Redland City and the City's islands population. To guide the decision making around the opportunities the structure plan proposes four key design principles. Principles are relevant to all functional and experiential aspects of the development area. These are described and illustrated to the right.

Transformative Village

Weinam Creek has the potential to transform the community. It will lead the way for Redland Bay in establishing new and highly sought after housing and business choices, capitalising on the bay front location.

Docking and Mooring

Weinam Creek continues to be the key access point to the SMBI communities and associated waters. As these areas draw more permanent residents and temporary visitors over time, Weinam Creek will grow to offer a diverse range of facilities that enable convenient access to this part of the bay and engender value and understanding of its assets.

Embracing Communities

Weinam Creek strengthens an important role as provider of community services and as a meeting point for a diverse range of interest groups. Integrating these services and organisations at this location will improve their viability and effectiveness but also leverage growth of allied businesses. Physically the location of these uses will embrace the existing parkland.

Bay Side Garden

People will flourish at Weinam Creek. The PDA brings together a number of favourable conditions for the establishment of a high quality garden setting on the edge of Moreton Bay. The extensive and diverse range of open space areas, from formal through to natural, offer an opportunity to deliver a rich tapestry of landscape experienced through the precinct.

4.2 Overall Structure Plan

The overall structure plan for the Weinam Creek PDA provides for a new bay side community village with easy access to the SMBI communities (see Figure 16). It provides a range of recreational opportunities and community services.

① The Esplanade

A new esplanade street connects Hamilton Street directly to the foreshore and back through to Meissner Street. This street provides easy and more legible access into the PDA and improves the functionality of public transport connections with the passenger ferry terminal. The esplanade street also removes conflicts between vehicle ferry traffic and general traffic on Weinam Street. Resultant redundant road reserves and truncated parcels are amalgamated and incorporated into the mixed-use frame.

② Neville Stafford Park

At the heart of Weinam Creek is Neville Stafford Park. The park unites the economic and community activity of the PDA within a flourishing and desirable parkland setting. The park overlooks a new marina and includes a tidal area against the bay to provide opportunities to people to interact with the marine environment. On the edge of the park, a series of pavilions are located which contain a mixture of retail and community services. These pavilions are activated on all sides and allow people to move into, and around, the park with ease. The creation of this park can occur early in the redevelopment and encourages investment in the PDA whilst also transforming perceptions of potential of this location.

③ Mixed-use and Community Frame

A crescent of mixed-use building embraces Neville Stafford Park. At ground level these provide an active frontage of community uses, commercial and retailing servicing the SMBI and Redland Bay communities. Retailing is concentrated on the new esplanade street with its stronger movement economy. Frontages are linked by continuous awnings that provide shelter and a high level of pedestrian access between uses. Upper levels are predominantly residential with views to the bay beyond the park. The larger parcel to the south will include a multi-deck car park providing short-term parking associated with the ferry movements and retailing.

④ Marina

A staged marina is established at Weinam Creek. The marina expands the range of recreational activities currently available at Weinam Creek and attracts a broader range of housing choices. The marina is designed to enable gradual expansion up to 400 berths and is accessed from the existing channel. A new boat club extends into the marina which can act as the primary licensed and function area for the PDA. The on-land component of the marina will include residential and marina mixed-use buildings that activate the esplanade street and overlook the marina. The northern edge of the marina is formed by a marina parking area and fenced dredge spoil disposal areas. It is anticipated that parking will be extended and dredge spoil disposal activity will be relocated to the end of the pier area each time suitable land is reclaimed.

⑤ Weinam Creek

Weinam Creek continues to provide for a diverse range of recreational and marine service activities associated with the bay and islands. The creek itself is an egalitarian focal point for boating. Boat ramps, mooring areas and slipways line the creek edges and there is constant activity in this area associated with boating. A new transit terminal is located at the western end of Weinam Creek along with a new Sea Scouts facility. A new pedestrian bridge links the northern and southern ends of Weinam Creek. The boat ramp is relocated to the southern side of the creek that improves access for recreational boat users. This location also reduces the conflicts between trailer boats and core PDA pedestrian and vehicle traffic.

⑥ Long-term Parking

The relocation of the passenger ferry service to the west on the mouth of Weinam Creek creates opportunities for convenient and affordable longer term parking areas at the edge of the PDA. In this location parking utilises less valuable land and has better accessibility to the trunk road infrastructure on the edge of the PDA.

⑦ Vehicle Ferry Precinct

A parking and vehicle ferry precinct is located in the northern part of the PDA and concentrates the vehicle ferry movements associated with access to the SMBI communities. The precinct is accessed from Weinam Street and keeps essential vehicle movements away from the highly pedestrianised parts of the development area. Facilities for two independent ferry operators are provided along with at-grade parking areas.

⑧ Residential Frame

Residential intensifies around the frame of the Weinam Creek PDA. This intensification will be ongoing and accommodate a range of housing solutions. Frame areas include housing on Moores Road, The Esplanade (south of Weinam Creek) as well as Hamilton, Banana and Weinam Streets. Frontage requirements are relaxed along Outridge Street to enable this street to provide vehicle service and access points to development fronting Hamilton and Banana Streets. Relaxing frontage requirements in Outridge Street will improve yield and outcomes on these properties.

⑨ Sel Outridge Park

Sel Outridge Park continues to provide active recreational choices that require more space than can be achieved at the core of the PDA. It provides opportunities to interact with the marine ecology and habitat areas to the south. The eastern edge of the park includes a north-south coastal linkage.

🟦 Retail
🟧 Mixed-use
🟥 Medium – High Density Residential
🟨 Community
🟪 Marine Services
🟩 Park / Open Space
🟩 Vegetation
▨ Plaza
▭ Beach
⬚ Dredge Spoil Disposal Area
● Community Node
Ⓟ Car Parking
— PDA Boundary
Boat Ramp
Passenger Ferry
Vehicle Ferry
① The Esplanade
② Neville Stafford Park
③ Mixed-use and Community Frame
④ Marina
⑤ Weinam Creek
⑥ Long-term Parking
⑦ Vehicle Ferry Precinct
⑧ Residential Frame
⑨ Sel Outridge Park

Figure 16. Structure Plan

Scale: 1:5,000 @ A3

4.3 Economic Strategy

Retail Development Opportunities

Retail development within the PDA is a critical component of the urban renewal of Weinam Creek, helping to create activity, a sense of community and identity as well as supporting other commercial and residential activity.

Weinam Creek complements rather than competes with the existing nearby Redland Bay Shopping Village, which has been rezoned to develop as a District Shopping Centre, incorporating a large supermarket.

Achieving both local buy-in from its primary catchment of Redland Bay as well as providing services to residents of SMBI is critical to the success of a retail development at Weinam Creek.

While a full-line supermarket could be supported at Weinam Creek, Redland Bay Shopping Village is recommended as a superior location for such an anchor tenant. This is for a wide range of reasons including but not limited to: better retailing alignment with grocery shopping with other town centre uses; the ability to fully utilise high value waterfront land for higher and better uses delivering a stronger economic return; and enabling waterfront land to be utilised for activities that are consistent with the vision for the site in creating a strong mixed-use destination.

Retailing at Weinam Creek focuses on leisure / lifestyle and incorporates a restaurant / dining precinct of 800-900 square metres. Possible uses include day spas, health and beauty services, boating related retail products, leisure wear, specialty food retailing and local services to serve both residents and ferry patrons.

Café / dining precincts are difficult to support in isolation but are a core land use in most successful waterfront precincts. Leveraging the water views and north facing opportunities where possible will be important. Quality urban design and integration of the retail with the surrounding uses ensures maximum potential for activation and the highest possible levels of pedestrian connectivity with strong linkages to other activators on or adjoining the site. This is an important component of supporting strong retail turnover levels and creating an economically sustainable retail precinct at Weinam Creek.

The amount of retailing supportable depends on how much of a destination Weinam Creek can become. While the retail component is an important attractor to the site, it is considered it will not be the major attractor in its own right. Instead it will form a component of an integrated mixed-use precinct with other attractors including a marina, its waterfront location and tourism associated with Weinam Creek being the gateway to SMBI. This is supported by a high quality recreational amenity along the waterfront, together forming the cluster of key uses that are likely to create the destination appeal.

Residential Development

Redland Bay has experienced limited residential development in the past two years, but has seen strong growth over the past decade. Residential estates of note in Redland Bay include AMEX Corporation's Valencia Springs and Fiteni Homes' Redland Bay Grove. Longer term, the mooted development of areas south of Redland Bay, known as 'Shoreline', has the potential to provide significant population growth for an extended period of time for the suburb if it proceeds.

The market for apartments and units is expected to be shallow, at least in the short to medium term as 98% of all stock is detached housing. However, factors such as proximity to a new marina, water views, high quality amenity and proximity to services will all assist in building a market for denser residential development.

The market will be price sensitive and the majority of apartments / units in the initial stage will need to be priced competitively given the local demographic profile, particularly product aimed at the investor market.

With medium density product being a new market the early stages of development, an incremental approach to increasing density ensures product is financially viable and market supportable as well as being brought on-line as the retail and recreational amenity becomes established. The structure plan has small lot terrace and townhouse packages followed by smaller apartment projects of around 20 units with views over water, which are delivered as part of a mixed-use scheme over the core of the waterfront retail precinct.

Marina Development

A marina at Weinam Creek would provide direct access to open water and the Southern Moreton Bay Islands (SMBI). It also has the potential to provide a strong anchor to an attractive precinct, incorporating retailing (convenience based; leisure / lifestyle; cafes and restaurants), a tavern, housing and marine related uses.

The main market for wet berths will come from boat owners with vessels at least 10 metres in size, from Redland LGA and to a lesser extent, from Logan LGA and Brisbane South. Weinam Creek may be preferred to alternative locations such as Manly Boat Harbour due to its smaller scale.

A marina of around 200 berths is considered supportable over the next 15-20 years, with demand coming from existing nearby boat owners with a preference for Weinam Creek over their existing berth as well as expected growth in boat ownership in the main catchment of Redland LGA, Logan LGA and Brisbane South.

The structure plan marina can be staged to take into account the growing demand for marina berths as the population base increases.

The marina appears particularly well suited to the site due to: 1) financial feasibility due to existing deeper water conditions requiring less dredging and pre-existing infrastructure;, 2) ability to stage appears easier compared with Toondah Harbour; and 3) ability to develop the marina as a stand-alone component is considered a major plus that enables the marina to be staged as market demand conditions support it.

Other Development Opportunities

The main location for health services in Redland LGA is at Cleveland (two hospitals and supporting allied health services). With solid population growth, there is expected to be future demand for a more comprehensive medical and health services clinic at Redland Bay, such as a GP Super Clinic. A GP Super Clinic is expected to require a site of around 5,000 square metres. Weinam Creek could accommodate such a facility.

There is not considered to be significant scope for Weinam Creek to support visitor accommodation in the short to medium term. Even if Weinam Creek attracts some tourist visitation, it is expected that the market will primarily be day-trippers not requiring overnight accommodation. Visitors looking for a longer stay are more likely to be attracted to one of the nearby islands, particularly North Stradbroke.

There is a major opportunity for future retirement living with Redland LGA set to experience very strong growth in its population aged 65 and over (from 21,496 in 2011 to 52,728 in 2031, an increase of 31,252). This will support additional retirement villages / accommodation.

Over 3,000 additional retirement units will be supportable across Redland LGA to 2031. With large sites in the northern suburbs of Redland LGA becoming rarer, a sizable proportion of this demand could be accommodated in Redland Bay, including Weinam Creek.

Over time, integrated communities including retirement living and other complementary uses, multi storey complexes and small clusters of retirement units are likely to be demanded by an ever evolving sector. The lifestyle / leisure attributes of Weinam Creek are well suited to attract this important market sector.

Indicative illustrative perspective looking west

4.4 Movement and Access

The movement and access strategy focuses on providing for better traffic separation between boaties, islanders and public transport providers. The strategy also focuses on providing maximum connectivity to the PDA.

The strategy is designed to improve pedestrian movement through the site and align this with the transport options provided in the PDA. A balance is achieved between the place and movement function of streets. Streets within the PDA have multiple functions. Where movement functions of a street conflict with place functions, the place function should take priority.

The Weinam Creek access and movement network (shown in Figure 17) has been designed to:

- Promote pedestrian movement as the priority form of movement within, to and through the PDA
- Provide a legible network of streets, spaces and linkages within the PDA
- Make future infrastructure adapt to the urban environment and conditions, not adapting the urban environment to the infrastructure
- Provide safe and attractive connections to adjoining uses and places in particular facilitating a coastal edge connection from the north to the south of the PDA
- Deliver direct and effective public transport connections and facilities that promote the PDA as a convenient destination and interchange point for services connecting with the islands
- Ensure that public and passenger transport access is legible and clear and well connected to key services in the PDA
- Actively manage on-site car parking to encourage alternative forms of travel to and from the PDA without creating impacts on the existing SMBI residents
- Reduce the visual impact of long term parking areas in the PDA while maintaining effective access to passenger ferry services.
- Carefully arrange the street network and land uses and achieve a grid system of street connections. Ensure access to the site does not detrimentally impact on the amenity and safety of residents and visitors to the site will be a priority;
- Use industry best practice with regards movement to ensure optimum accessibility for pedestrians, cyclists and public transport users;
- Integrate land uses to ensure that the facilities, including parking, for boat ramp and ferry terminals are closer together
- Sufficient parking facilities are provided for the ferry patrons without the area being dominated by parking.

Key elements of the access and movement network are detailed in the following sections.

Street Network

A workable street network is achieved by improving the street connectivity to the heart of the site. Key infrastructure includes:

- The extension of Hamilton Street to create a direct link to the mixed-use, marina and public transport areas;
- An upgrade of the intersections with Pitt Street/Gordon Street. This provides a workable, alternate southern access to the PDA;
- An esplanade, providing improved access to the waterfront and an easing to traffic congestion. This allows for a one way public transport route which will improve the frequency and efficiency of the route.

Pedestrian and Cyclists

The Weinam Creek PDA is a walkable and very active urban environment, rich in transport options. A network of footpaths, open space, plazas, boardwalks and mid block linkages and bikeways provide high levels of connectivity internally and externally.

The pedestrian and cyclist network is well connected to land and water transport facilities to ensure excellent access to buses and ferries for longer journeys. Long-term parking areas associated with the passenger ferry service are well lit, secure with passive surveillance from adjoining streets and public walkways.

Pedestrians are well catered for with generous footpaths and boardwalks. Pedestrian spaces next to primary active frontages will be comfortable and protected from the sun and rain by awnings and street trees reflecting the subtropical feel and nature of the place.

Conflicts between pedestrian movement and marina access will need to be managed. It is imperative that views are retained therefore marina access points will enable clear views of marina from the promenade and the surrounding development. The minimum width of pedestrian waterfront promenade is to be 4.5m.

Formal road crossings are provided along the preferred pedestrian desire lines such as the intersection of Banana Street and the new esplanade street.

The major pedestrian and cycle facilities which are critical to the success of the PDA include:

- Completed links in the pedestrian and cycle network, key missing links include sections of Banana Street, Weinam Street and Hamilton Street;
- General improvements to pedestrian connectivity along the waterfront, including opening up the area currently occupied by the car parking and providing access along the southern edge of Weinam Creek;
- A pedestrian and cycle connection to the south of the Weinam Creek by way of a pedestrian/cycle bridge. This incorporates the area bordering Moores Road into the PDA, providing links to the residential areas, southern waterfront and proposed long term parking
- New connections are well integrated with the existing path network.

Land Use and Public Transport

A range of measures will contribute to the shift from private vehicle trips that will achieve a high usage of sustainable transport modes. These include:

- The relocation of the public transport hub and passenger ferry facilities to the south west corner of Weinam Creek allows for these facilities to be integrated with the proposed new car parking spaces bordering Meissner Street and north of Moores Road;
- The esplanade loop allows for a one way public transport route which improves the frequency and efficiency of the route. The use of this loop allows all public transport services to provide full penetration of the PDA, this allows for all residents and users to access public transport services with minimum walking distances;
- Direct and immediate transfers between ferry and bus services maximises sustainable transport opportunities;
- The vehicle ferry terminal is to remain in its current location.

Figure 17. Movement and Access Plan

Scale: 1:5,000 @ A3

Parking and Vehicle Ferry

Currently long term parking associated with the passenger ferry to SMBIs has taken over all parking provision in the area. This has caused friction between SMBI residents and users of the boat ramp. In order to prevent this in the future the parking facilities associated with the PDA are segregated in who uses them and what the purpose of this use are. Table 2 details the indicative parking requirements of the PDA.

Therefore, it has been assumed that 1,094 spaces are currently provided at Weinam Creek. This is split between medium and long term parking. However, the many of the patrons utilise the current medium term parking areas for long term. Therefore, the numbers identified for use by SMBI ferry passengers should be focused on provision of long term parking.

Based upon population projections from Council and trip making data from previous reports, it has been estimated that the growth of SMBI resident vehicle trips would be in the order of 4.5% p.a. By 2031, this would represent an 81.4% increase in daily trips made in 2013, which, assuming a proportionate increase in parking demand, is unsustainable given the land constraints. Therefore, at a minimum, it is considered crucial that parking for ferry users is retained with high priority given to maximising secure parking for these users.

Where it is practical, parking will be sleeved, by buildings, to ensure that the parking does not dominate the urban space.

With regards residential parking provision, new townhouses have parking provision within the development lot. In line with Redland City Planning Scheme, residential parking would be as follows:

> Townhouses would require a provision of 2 spaces per dwelling

> Unit development would require 1 space per dwelling plus 1 visitor space per every 4 dwellings.

The preferred location for visitor parking to rear access terrace houses is on the principle street frontage incorporated into the road reserve

The vehicle ferry terminal would remain in its current location, and the parking provision associated with its use would be retained.

Acceptable Solutions

Parking provision for development is required to be provided in line with Redland City Council Planning Scheme to ensure that the area is not impacted by illegal on street parking.

Development in excess of that anticipated by the structure plan requires detailed traffic and transport capacity assessment to ensure its suitability.

Street hierarchy and function is in line with that outlined in Table 3.

Table 2 Indicative Parking Requirements of the PDA

Parking Type	Description of User	Location	Parking Rate	Indicative Parking Spaces
Short Term	Customers of the retail and commercial centre (including visitors to the marina/waterfront) of the PDA with allocation for staff	Sleeved parking bordered by the new Esplanade and Banana Street at the foreshore	5 spaces per 100sqm	212 spaces[^]
Medium Term	Marina Parking	To the north of the marina built on reclaimed land into the bay.	0.6 spaces per berth	240 spaces[*]
Medium Term	SMBI Residents, this level of parking would allow for day/overnight parking for user of the ferry who are using their cars to travel to work etc	To the south of Meissner Street and to the east of Weinam Creek.	Total of 967 spaces are currently allocated for passenger ferry patrons (calculated from total provision minus marina & boat ramp spaces)	At least 500 spaces[†]
Medium Term Parking	Provision of parking at for the users of the boat ramp.	To the immediate south of Weinam Creek, accessed via Moores Road	90 spaces per boat ramp	90 spaces[#]
Long Term Parking	Provision of secure long term parking for SMBI residents who require secure parking facilities	Bordering Moores Road between the residential and wetland area.	Total of 967 spaces are currently allocated for passenger ferry patrons (calculated from total provision minus marina & boat ramp spaces)	At least 500 spaces[†]

[^] Assuming the preliminary yields calculations are correct; mixed-use areas comprise 4,230sqm GFA
[*] Assuming 400 berth marina
[†] Total existing passenger ferry spaces provided, to be retained at minimum, between long term and medium term facilities
[#] Assuming a single boat ramp

Table 3 Street hierarchy and function

Road Classification	AADT	Equivalent Residential Lots	Design Speed	Number of Lanes	Carriageway Width	Minimum Verge Width	Reserve Width
Access Street	1,000	100	30 km/h	2	6m	4m	15m
Local Collector	<3,000	300	40 km/h	2	7m	4m	18m
Trunk Collector	3,000 – 10,000	1,000	50 km/h	2	11 to 14m	4 to 6.5m	19 to 27m
Sub-arterial	<15,000 – 20,000	2,000	60 km/h	2 or 4	12 to 20m	4 to 6.5m	20 to 33m

4.5 Land Use and Built Form

Land uses at Weinam Creek are intended to reflect the complimentary nature of this centre to the existing Redland Bay Centre and the role it plays in providing key land based services to the SMBI community. Within this mix there is a focus on community services, health services and residential along with ancillary commercial and retail uses.

Land Use

Land uses and their location within the village (see Figure 18) will deliver the following outcomes:

- Generate economic activity within the existing and future development markets
- Be transit supportive — maximise use of active and public transport by locating workers and residents within walking distance of the transit options and convenience retailing
- A mix of land use that promotes activity weekdays and at weekends
- Retail destination activities providing for the ancillary convenience needs to PDA residents as well as providing opportunities for cafes, restaurants and marina related retailing. These will be concentrated on the new esplanade street where it overlooks the Neville Stafford Park and new marina
- Commercial uses provide employment related to community facilities and services on Banana Street overlooking Neville Stafford Park
- A range of residential housing options, which contribute to village activation and generate ongoing economic activity
- Marina berths and associated access ways
- Public open space to bring the broader community in contact with Moreton Bay and adjoining habitat areas
- Marine services areas and marine based community facilities meeting the service needs of the marina and ferry traffic.

Ultimately, the private sector will be developing the PDA and deliver the land use mix. Due to the varied and cyclical nature of property markets, developers will need a certain level of flexibility to accommodate changing demand and supply. However, they will be required to deliver the outcomes described above.

The proposed land use location and mix is based on advice and research of the current market conditions.

Height and Intensity

The Weinam Creek PDA will be characterised by building forms generally ranging in height from 3-5 storeys. Taller buildings generally cluster around Neville Stafford Park and towards the marina. These are generally mixed-use containing retail, residential and employment opportunities. Maximum building heights in storeys are shown in Figure 18.

Built Form

Buildings are not the same from roof to street level — they have a distinct bottom, middle and roof. Buildings with continuous undifferentiated facades from top to bottom are not appropriate. Building façades may maintain a zero setback to these streets for the full height of the building provided that some form of differentiation is maintained between bottom (podium), middle and top. This may include changes in storey height, the inclusion of a building waist, materials etc.

Ground levels are built to the street frontage adjacent to Neville Stafford Park and the marina. On-site car parking areas, loading bays and service areas are either integrated within or under buildings and sleeved by active frontages, or are located away from the public realm behind buildings. The use of large blank screens to mask loading areas is not appropriate. Basement car parking is unlikely due to geological constraints.

Perimeter buildings reinforce street edges regardless of their inherent land use and provide year round weather protection along all active street frontages. Regardless of height, buildings maintain a strong relationship with the street by defining the public realm through podiums or other façade elements. Towers in plazas are not acceptable.

Gateways and Landmarks

To improve legibility a clear hierarchy of spaces and streets within the Weinam Creek PDA is proposed. The hierarchy relates to the pattern of movement creating a clear legible structure. The following urban design ideas are integrated into the layout for the PDA.

The main vehicle access into the PDA, Hamilton Street from the north and Meissner Street from the south, are rationalised and link to the new esplanade street. Buildings and landscaping along these streets will be part of the sequence of entry to the site. At the core of the site these streets open up to Neville Stafford Park, Weinam Creek and the new marina. A new landmark building will mark the heart of the PDA on the corner of Banana and the new esplanade street as shown in Figure 18.

Frontages

Three frontage types are proposed to deliver built form with a graduation of definition and activity from high to low. The frontage types proposed are primary active frontages, secondary active frontages and tertiary frontages.

Primary Active Frontage

Primary active frontages refer to ground level facades which face streets, plazas and boardwalks. They are built up to, or near, the public realm edge, are generally parallel to streets alignment and contain uses characterised by high pedestrian footfall such as retail. They are visually and physically permeable containing many windows and entrances. They do not include blank walls, louvre grills for plant rooms or parking areas and rows of fire escapes. Upper floors of a primary active frontage provide opportunities to overlook the street, increasing surveillance and reinforcing the active frontage. The location of primary active frontages within the PDA is illustrated in Figure 18.

Secondary Active Frontage

Secondary active frontages are located away from major gateways and more intense pedestrian spaces. In these areas, buildings are setback slightly from their front alignments to define streets and public spaces. Frontages contain landscaping and well-detailed and articulated access points at frequent intervals along pedestrian networks. Awnings are generally not continuous with an emphasis on key entry points. Secondary frontages may be activated by commercial uses or residential uses. Entries are emphasised through architectural and landscape treatment, pedestrian movement paths, awnings and height. The location of secondary active frontages within the PDA is illustrated in Figure 18.

Tertiary Frontage

Tertiary frontages in the PDA maintain strong street setbacks but allow for servicing and other activities where they do not impact upon pedestrian movement and access. These frontages are generally against lanes or areas of vegetation. The location of tertiary frontages within the PDA is illustrated in Figure 18.

Figure 18. Land Use and Built Form Plan

Scale: 1:5,000 @ A3

Building Interface

The interface between buildings and streets is important to create a vibrant centre. Figure 19 provides and example of typical interfaces which aim to:

- Activate the street
- Visually and physically connect the buildings to the street
- Ensure car parking and service areas are screened.

Built Form Typologies

A variety of retail, mixed-use and residential uses within the PDA ensures a suitable mix and intensity of population and activity. Several built form typologies are required to cater for these uses in a compatible manner, deliver street activation and amenity and support the differing intensities of development. Figure 20 provides examples of built form typologies which maybe developed as part of the Weinam Creek PDA, including:

- 3 – 5 storey medium rise mixed-use housing over retail / commercial
- 3 storey lift / walk up
- Sleeved mutli-deck car park
- 2-3 storey row house / live / work.

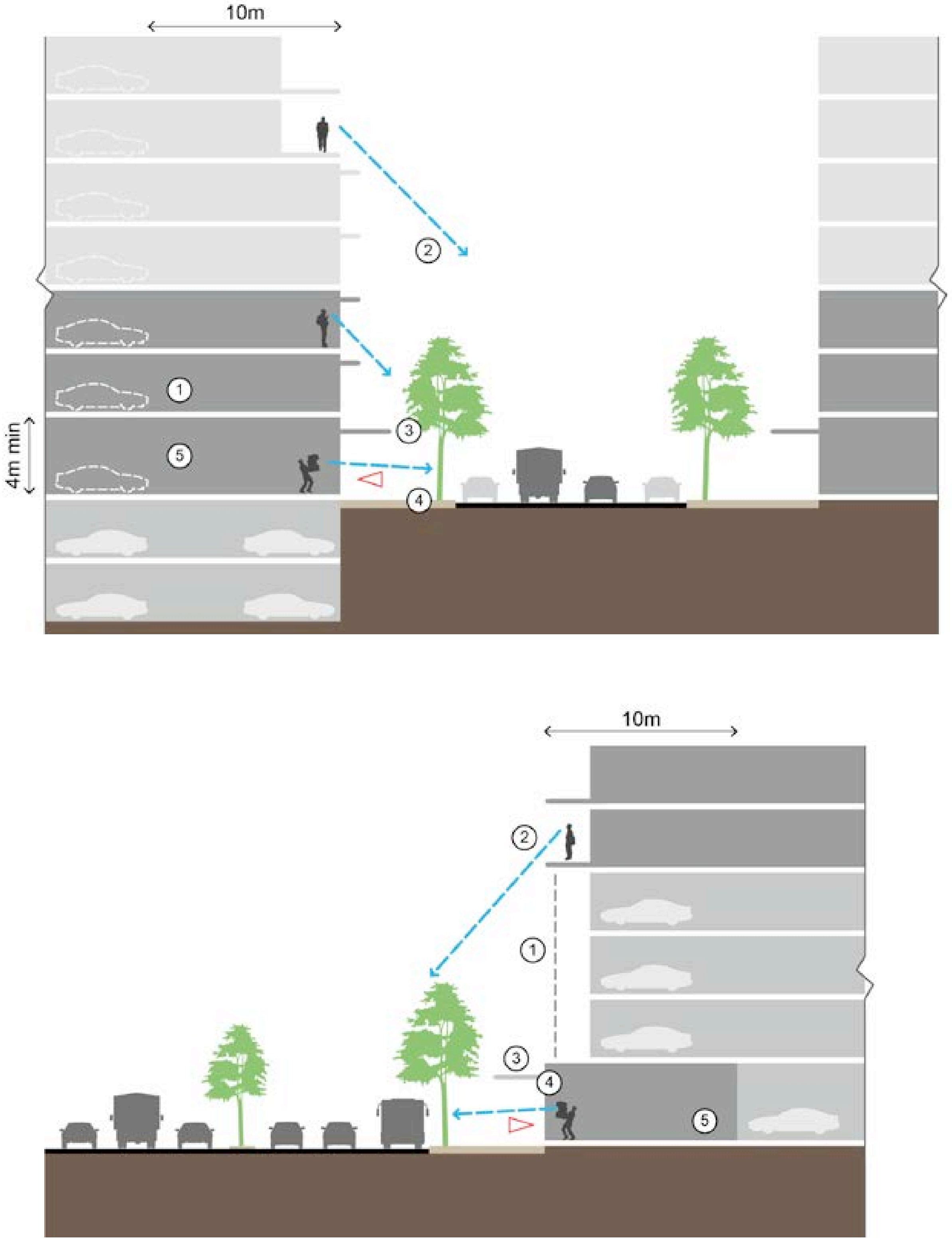
Character

Subtropical design

South East Queensland is Australia's only subtropical metropolitan region. The buildings within the Weinam Creek PDA will exhibit a strong urban and subtropical character.

Building design will be climatically responsive, and will:

- Incorporate light and shade providing well detailed and articulated façades
- Be orientated to promote seasonal solar access
- Enable cross ventilation and support a naturally ventilated and comfortable environment
- Provide weather protection and sun shading (including eaves and overhangs) into façades and roof forms
- Have visible and expressive roof forms
- Integrate indoor and outdoor spaces through the use of balconies, courtyards and large windows creating open facades.



① Parking to be screened by 10m minimum of occupied space (retail, commercial or residential)

② Windows and balconies above ground facilitate casual surveillance of street

③ Continuous awning to street

④ Ground floor on same level as associated footpath

⑤ Ground floor residential uses to be adaptable to future commercial / retail (toilets and drainage at the rear of unit)

① Parking to be screened from the street

② Strong outdoor relationship with street

③ Awnings at building entry

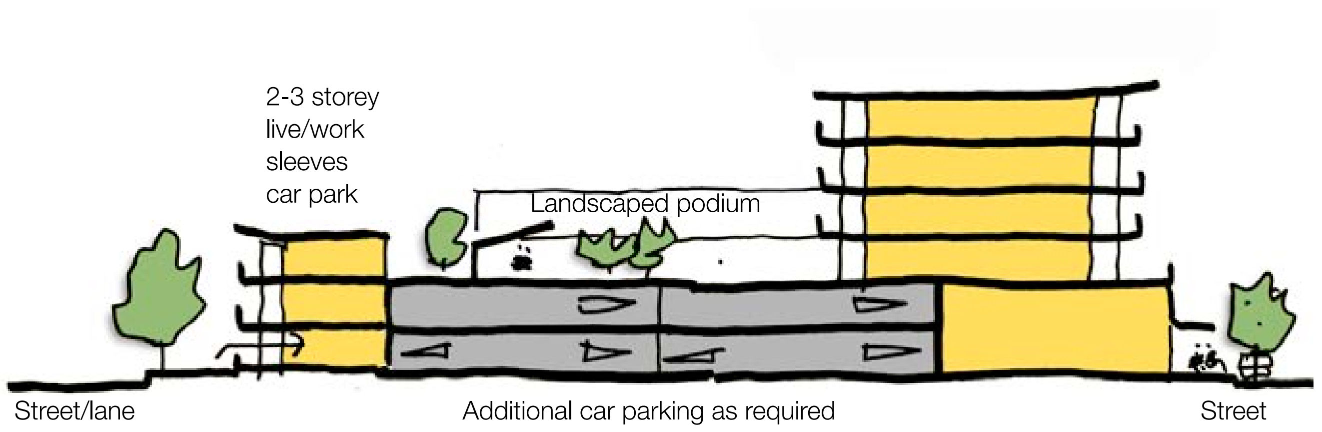
④ 80% windows

⑤ Ground floor to have 10m setback minimum depth of occupied space (retail, commercial, residential)

Figure 19. Typical Building Interface

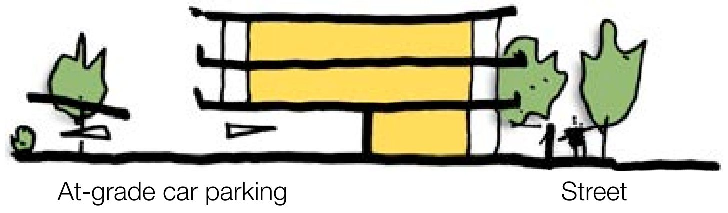
3 – 5 Storey Medium Rise Mixed-use Housing over Retail / Commercial

2 levels above ground, parking sleeved by street facing uses



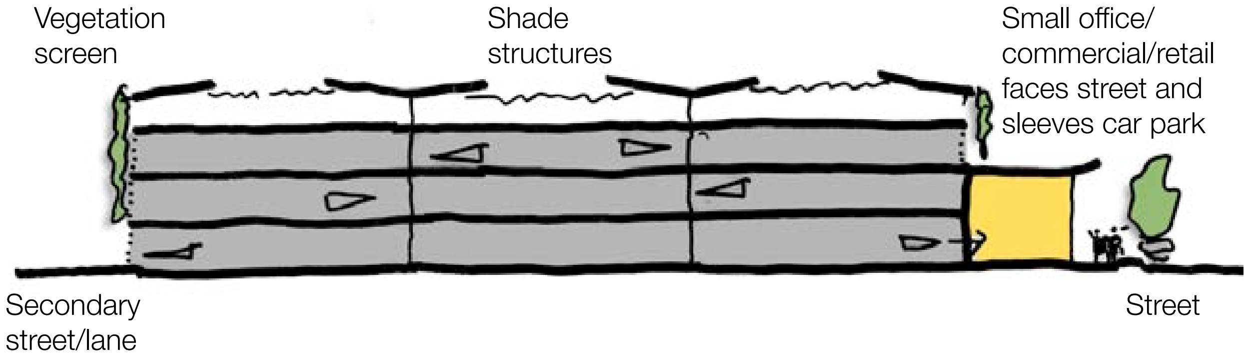
3 Storey Lift / Walk Up

Parking at-grade at rear under building and in car ports



Sleeved Multi-deck Car Park

Car access from rear



2-3 Storey Row House / Live/Work

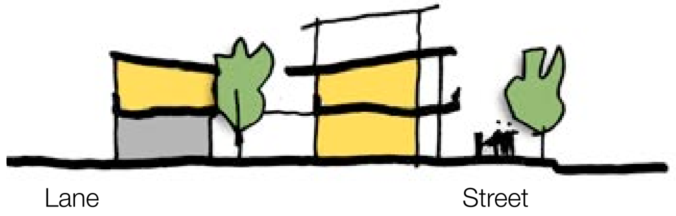


Figure 20. Built Form Typologies

Land Budget

The following land budget table gives an indication of potential population capacity within the Weinam Creek PDA. It is based on a number of assumptions including number of residents / dwelling and average dwelling sizes within the PDA.

No.	Description	% of Total Area	Area (m²)	Residential (Dwelling Units)	Residential Population (2.0pp/ dwelling)	Residential GFA (120m²/ unit)	Retail GFA (m²)	Commercial GFA (m²)	Marine Services GFA (m²)	Community Use GFA (m²)	Total GFA (m²)	Total GFA/ Area (Plot Ratio)
1	Public Streets	23.45	97,161	0	0	0					0	0.00
2	Recreational Parkland and Plazas	16.89	69,996	0	0	0				200	200	0.00
3	Environment—Vegetation	11.72	48,550	0	0	0					0	0.00
6	Retail	0.72	2,974	0	0	0	500				500	0.17
7	Mixed-Use	6.46	26,773	114	228	13,680	2,500	2,000			18,180	0.68
8	Mixed-Use	1.87	7,740	59	118	70,80	1,500	1,500		500	10,580	1.37
9	Mixed-Use	1.85	7,678	50	100	6,000		1,000		1,000	8,000	1.04
10	Community	0.71	2,957	0	0	0				1,800	1,800	0.61
11	Residential	1.78	7,358	100	200	12,000					12,000	1.63
12	Residential	2.51	10,393	130	260	15,600					15,600	1.50
13	Residential	5.93	24,588	200	400	24,000					24,000	0.98
14	Residential	1.67	6,920	55	110	6,600					6,600	0.95
15	Residential	0.91	3,762	60	120	7,200					7,200	1.91
16	Residential	6.17	25,583	76	152	9,120					9,120	0.36
17	Maritime Services	1.34	5,541	0	0	0			2,500		2,500	0.45
18	Car Park, Boat Ramp & Vehicle Ferries	14.81	61,366	0	0	0			300		300	0.00
19	Boat Club	1.20	4,965	0	0	0		0		2,000	2,000	0.40
		100.00	414,305	844	1,688	101,280	4,500	4,500	2,800	5,500	118,580	
	Water Areas											
4	Environment—Water		42,917									
5	Marina		17,734									

Key Statistics

Population: 1,688

24.3 dwellings/ha*

(excluding maritime services and car parking / vehicle ferry services)

28.6% passive and recreational open space#

NOTES:

* Density is based on all areas within the PDA excluding areas that have regional purpose such as Moreton Bay, vehicle and ferry services associated with the SIMBI Islands, boat ramp and maritime services.

Passive and recreational open space includes areas of parkland and areas of environment vegetation on land.

The land budget is based on 2–3 storey built form generally.

Residential population assumes 2.0 people per dwelling unit on average across the PDA.

Residential GFA assumes an average of 120m² of residential GFA per dwelling unit across the PDA.

Figure 21. Land Budget Plan

Scale: 1:5,000 @ A3

4.6 Open Space and Public Realm

The aim of the public realm strategy for the Weinam Creek PDA is to create a range of relaxing spaces with a strong sense of place and rich variety of recreational opportunities. The public spaces of the PDA will provide places that are both active and vibrant. They will be well loved by the Redland Bay community and enable them to interact with Moreton Bay and water based recreational pursuits. They will also provide opportunities for interaction between the island and mainland communities.

This will be achieved through colourful and traditionally designed spaces that link together to form an effective network. Visitors and local users will be offered many alternative routes of travel between each.

Key places and spaces within the PDA are shown in Figure 22 and summarised as follows:

① Neville Stafford Park

This is a generous open space area in the centre of the PDA where the island and mainland community can meet and relax. The park will be a colourful garden overlooking the tidal area of Moreton Bay. Uses will activate the park and there will be convenient points of access. Detailing within the park will acknowledge the history and heritage of the area.

② Marina and Boardwalk

Despite the tight scale of the marina and the proposed intensity of the development surrounding it, the boardwalk will become a unique and memorable aspect of Weinam Creek. It will facilitate exchange and be a vibrant space with genuine marina based activities. The boat club will be integrated with the boardwalk solution.

③ Sel Outridge Park

This traditional park provides active recreational choices that require more space than can be achieved at the core of the Weinam Creek PDA. It provides opportunities to interact with the marine ecology and habitat areas to the south. The eastern edge of the park includes a north-south coastal link.

④ Weinam Creek Edge

This busy edge of Weinam Creek brings together a number of gathering spaces, community facilities and a new pedestrian ferry terminal. It is a point where the SMBI community can safely and conveniently access mainland services. Pathways radiate out from this space to other key parts of the PDA including the southern side of Weinam Creek and Neville Stafford Park.

Spaces will be constructed using forms and textures and materials which tangibly relate to the character and features of Moreton Bay, its history and development as a place. A base pallet of materials and colours unify spaces and reinforce a clear identity.

🟩 Park / Open Space
🟩 Vegetation
▨ Plaza
Ⓟ Car Parking
— PDA Boundary
←•••••→ Pedestrian Connection
▬ Street Network
▬ Key Pedestrian Realm
① Neville Stafford Park
② Marina and Boardwalk
③ Sel Outridge Park
④ Weinam Creek Edge

Figure 22. Open Space and Public Realm Plan

Scale: 1:5,000 @ A3

4.7 Environmental Strategy

Habitat trees important for koala (Phascolarctos cinereus) are widely scattered across the PDA as a component of the urban environment, but are relatively isolated from more important koala habitat approximately 1km to the west of the PDA and a minor corridor along Weinam Creek to the south of the PDA. Habitat trees within the PDA appear to be visited infrequently by koalas. Koala habitat trees within the PDA comprise 74 primary food trees and at least 112 other habitat trees. Development and contingent offsetting measures ensures no net loss of koala habitat trees, particularly primary food trees available to the local koala population and no net increase in koala mortality, particularly from vehicle strike.

Habitat that may support Illidge's Ant-Blue Butterfly Acrodipsas illidgei occurs in mature coastal she oak (Casuarina glauca) and grey mangrove (Avicennia marina) trees in Weinam Creek, in the south-east corner of the PDA. Field surveys are required to confirm the presence or absence of this species and its habitat will be maintained and enhanced. This habitat is being conserved and enhanced as part of the PDA scheme to reduce any impact in the wetland habitats in the creek.

A flying-fox roosting camp currently exists in the Weinam Creek swamp, primarily on the northern side of Moore's Road, but occasionally spilling over to the southern side of Moore's Road when very large numbers of flying-fox are present. This is one of the key flying-fox roost sites in the Redlands used by tens of thousands of flying-foxes of three species: Black Flying-fox, Grey-headed Flying-fox and Little Red Flying-fox. The development will not result in negative impacts to the roost. Interpretive signage may encourage appreciation of the ecological assets of the roost, and discourage disturbance of the camp and resultant potential for conflict with local residents.

Intertidal habitat within the PDA consists largely of bare rubble and sand ('bare', but supporting highly productive benthic microalgae), with a seagrass bed immediately north of the PDA boundary. This habitat is of marginal value to migratory shorebirds due to the nature of the substrate, proximity to existing sources of disturbance, and large distance to suitable roost habitat.

Dugongs, dolphins and marine turtles may occur within 1km of the PDA and are susceptible to boat strike, causing injury and death (Maitland et al. 2006). The seagrass beds comprise species that are consumed by (Dugong dugon) and marine turtles (particularly Chelonia mydas); however, the seagrass in the PDA is considered of lower quality relative to seagrass surrounding the bay islands, and on the eastern side of Moreton Bay. Increasing the marine traffic during construction or as a direct result of the development of a marina and ferry terminal could lead to increased boat strike of federally listed species.

Remnant vegetation communities within the PDA comprise RE 12.5.2 with an 'endangered' status under the Vegetation Management Act 1999 (VM Act), estuarine wetland (RE 12.1.1) with an 'of concern' status, and mangroves (RE 12.1.3) and (RE12.1.2) with a 'least concern' status under the VM Act. A portion of this remnant vegetation is mapped as essential habitat for Wallum Froglet Crinia tinnula under the VM Act. The structure plan considered these constraints and restricts clearing of this vegetation to mangroves on the coastal edge within the new marina footprint in the north east of the PDA.

Elements of the environmental strategy are shown in Figure 23.

4.8 Infrastructure Strategy

Marine Infrastructure

The existing marine infrastructure experiences significant upgrades. Assumptions and findings on the extent of the required infrastructure is set out below:

Design of Marina

> The marina is developed in stages

> Each stage with a balance between cut (dredging) and fill volumes to avoid the cost and other issues associated with the import or export of large volumes of material

> Initially a small marina is placed to north. It has protection from the north. Protection from the north could be provided by a floating breakwater, which could be relocated in the future

> Marina shares entrance channel with passenger ferry terminal and creek

> Car ferry channel is separate as per present

> Wrap around breakwaters and/or floating breakwaters provided due to fetches being too long for an unprotected marina.

Weinam channel width

> Weinam Creek appears to be just wide enough to accommodate this terminal without an excessive dredging requirement. 30m wide two way channel toe to toe

> Potential adjustment to existing finger jetties.

Weinam channel bends

> No significant channel bends.

Weinam channel swing basin

> 60m diameter swing basin (2 times vessel length).

Weinam dredging

> Somewhere between 75,000m³ - 100,000m³ of dredging at insitu volume

Weinam dredge disposal

> Large onsite area required.

Figure 23. Environmental strategy elements

5. IMPLEMENTATION

5.1 Staging

The implementation strategy identifies a number of geographical areas within the Weinam Creek PDA that are dependent, to differing degrees, on infrastructure and market conditions. Implementation stages are broad and are split between catalyst projects, short term and long term opportunities. A general description of the these is as follows and shown in Figure 24.

Core Catalyst Project

There is an immediate opportunity for investment in Neville Stafford Park. Landscaping improvement along with opportunities for lower scale retail pavilions will create the heart of the Weinam Creek PDA. This will change perceptions of this precinct and create a place people want to come to and stay in for an extended period of time. The new setting will improve values and stimulate growth.

Short Term Opportunities

Intensification around Neville Stafford Park

There are many existing opportunities to invest within the PDA currently. The catalyst project will improve the viability of these opportunities and stimulate some development activity. This may be initially focused on mixed-use development on sites adjacent to Neville Stafford Park. Mixed-use development will also include the rationalisation of existing community facilities and residential density uplift.

Intensification of PDA Frame

Intensification around the frame of PDA will be more attractive once core catalyst projects are complete and key vehicle infrastructure is in place. Intensification will be ongoing and will spread across all development stages. Along with redevelopment of existing residential sites there may be some limited opportunity for medium density residential growth on Moores Road.

Ferries and Parking

Relocating the existing passenger ferries and associated long-term parking areas to the western end of the Weinam Creek PDA will improve the existing bus interchange facility and overall proximity of parking. The existing boat ramp is also relocated in this stage to the southern side of the creek. A new bridge link is established across the creek mouth at the same time. The Sea Scouts are relocated to the edge of Weinam Creek where they can share the existing boat ramp with the Coast Guard. This significant rearrangement of transport, parking and recreation facilities unlocks the more valuable parts of the PDA site for redevelopment and establishes robust travel and parking arrangements for the SMBI community. An additional vehicle ferry operator will improve competition and capacity at Weinam Creek.

Foreshore Development

The decanting of parking areas and the boat ramp from the foreshore area unlocks a significant development parcel on the edge of Morton Bay. A parcel of this size can cater for an intense mixed-use development outcome that can effectively integrate a new esplanade street and multi-deck car parking arrangements at the core of the PDA.

Transport Infrastructure

A number of transport upgrades would be associated with short term development within the PDA. These are as follows:

- An upgrade to the Meissner Street / Weinam Street intersection is considered imperative before any further works involving access via Meissner Street are required
- Construction of the link connecting Hamilton Street to Banana Street will establish a legible link into the site and to the new esplanade street
- The upgrade of the waterfront car park circulation road to a local street standard to form a new esplanade
- Access for the residential development on Moores Road
- An upgrade to Weinam and Banana Streets
- An upgrade to Hamilton and Meissner streets to include cycle paths
- The Meissner Street / Moores Road intersection will be upgraded to a safe standard. Parking areas along Meissner Street and Moores Road, in addition to the boat ramp and associated facilities, will be constructed
- Relocation of the bus / ferry terminal will commence, requiring bus services to use the Hamilton, Banana and Meissner Street loop route
- Pedestrian safety throughout the PDA, especially in the car park areas, is improved utilising Crime Prevention Through Environmental Design (CPTED) principles.

Long Term Opportunities

Marina and Land Reclamation

A new 200 berth marina will leverage the strategic location of this site and broaden the range of activities and people that utilise it. The marina includes a new licensed club facility, which projects into Moreton Bay.

Growth of Marina

There is long term opportunity for the marina to grow to the east to form a larger marina basin. This development may occur gradually through the ongoing disposal of dredge spoil and balance cut and fill.

Figure 24. Staging Plan

Scale: 1:5,000 @ A3

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Appendix D – Water and Wastewater Planning Review

Water & Wastewater Planning Review

Weinam Creek Priority Development Area

PREPARED FOR REDLAND INVESTMENT CORPORATION

Calibre Professional Services Pty Ltd
ABN 55 070 683 037

18-003165.WER01 | 7 April 2020

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DOCUMENT CONTROL

ISSUE	DATE	ISSUE DETAILS	AUTHOR	CHECKED	APPROVED
A	07.04.2020	Final	T. Chalmers	D. Collins	T. Chalmers

COMMERCIAL IN CONFIDENCE

Contents

Tables

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Appendices

1 Introduction

Calibre Professional Services Pty Ltd have been engaged by Redland Investment Corporation (RIC) to undertake a review of the water and wastewater network planning completed by Redland City Council (RCC) in support of the Weinam Creek Priority Development Area (PDA).

The PDA is located within Redland Bay, with Redland City Council (RCC) the local government and responsible distributor-retail water authority. The PDA is proposed to consist of mixed land use, with the majority being medium to high density residential living. Figure 1-1 illustrates the approximate extents of the proposed PDA.

Approximate Weinam Creek PDA Extents

Figure 1-1: Proposed PDA Master Plan Layout (Source: RCC Water Supply Master Plan, 2019)

A detailed PDA master plan layout is included in Appendix A.

1.1 Background

As part of the PDA servicing investigations, RCC have assessed existing and planned water and wastewater infrastructure associated with the PDA. The following information has been provided by RCC for review:

- Redland Water Network Model
    - EPA Net and Mike Urban format
- Water Supply Master Plan for Weinam Creek PDA (RCC, 2019)
- Sewerage Network Master Plan for Weinam Creek PDA (RCC, 2020)
- Redland Sewer Network Model
    - EPA SWMM and Mike Urban format
- Redland Sewer Pump Station & Network Data

1.2 Project Scope

The following scope of work has been undertaken by Calibre in support of the proposed Weinam Creek PDA:

- Review network information provided by RCC.
- Verify network model outputs and confirm infrastructure augmentations proposed by RCC.
- Prepare an opinion of cost for the proposed infrastructure augmentations.
- Document the infrastructure augmentation review and opinion of cost prepared by Calibre.

Each of the above items have been addressed within the following report.

2 Development Yield

For the purpose of water and wastewater planning, RCC adopted a development demand of 3,000 Equivalent Persons (EP) for the proposed PDA. Existing Local Government Infrastructure Plan (LGIP) demands were removed and replaced by the projected demand of 3,000 EP. Table 2-1 provides a comparison of the proposed development demands for the PDA.

Table 2-1: PDA Demand Projection

Zone	Approved Density	Redlands LGIP	Variance from LGIP
1	0	0	0
2	0	0	0
3	0	0	0
4	189	82	+107
5	124	54	+70
6	268	116	+152
7	562	243	+319
8	287	124	+163
9	562	281	+281
10	181	90	+90
11	0	0	0
12	393	196	+196
13	86	63	+23
14	367	269	+98
Total	3,018	1,518	+1,500

The approved demands are 18 EP higher than the demand adopted by RCC for modelling purposes. It is unlikely that an additional 18 EP will influence network modelling results and therefore the difference has been deemed negligible from a network analysis perspective.

3 Water Network Analysis

Modelling of water network conditions pre and post development has been completed by RCC. The supporting information provided by RCC (refer Section 1.1) has been reviewed by Calibre and documented in the following sections.

3.1 Methodology

Calibre have reviewed the Weinam PDA Water Supply Master Plan prepared by RCC and evaluated the impact that proposed PDA demands will have on network conditions. Infrastructure found to have sufficient capacity has not been reviewed as part of this analysis with the focus being verification of RCC proposed augmentations.

The following horizons were reviewed under Maximum Day & Fire Flow conditions:

- Baseline 2041 Horizon – Representation of LGIP network conditions (excludes additional PDA demands).
- 2041 Horizon + PDA – Representation of ultimate PDA development.

3.2 RCC Modelling Summary

The following provides a summary of the network analysis and findings documented by RCC:

- Weinam Creek PDA is supplied by the Heinemann Road tank set, with a total combined storage of approximately 60 ML and Bottom Water Level (BWL) of RL 77.3 m AHD. Assessment on the capacity of the water supply tanks was not undertaken, as the additional loading (3,000 EP) was considered a minor impact to the existing storage capacity.
- Most of the PDA is located within the Serpentine Creek District Metered Area (DMA), serviced by an existing PRV with a setting of approximately 60 m residual pressure, and ground level of RL 12.5 m AHD.
- The north-west area of the PDA is located within the Boundary Street DMA, with an existing fixed PRV setting of approximately 42 m residual pressure, and ground level of RL 9.7 m AHD.
- The PDA is directly serviced by a trunk system of DN200, DN225 and DN300 trunk mains downstream of each PRV.
- RCC's current LGIP only considers augmentations and demand projections up to 2036, which identified 6 pipe upgrades to service fire flow deficiencies, with no upgrades required to service standard flow. Of these 6 upgrades the only augmentations that would directly impact Weinam Creek PDA are as follows:
    - DN150 cross-connection between Auster Street and Moores Road.
    - DN150 cross-connection between Banana Street and the Weinam Creek boat ramp.
- For the post-development scenario, residential (15 L/s) and commercial (30 L/s) fire flow allocations were applied to the local pipe network servicing the PDA.
- Network modelling indicates that the Serpentine Creek DMA can achieve minimum pressures within Weinan Creek PDA however the additional demands create failures external to the PDA.
- Network modelling indicates the following:
    - Peak day network node failures within the DMA increase from 30 to 185 with inclusion of PDA under 2041 horizon.
    - Fire flow network node failures within the DMA increase from 41 to 90 with inclusion of PDA under 2041 horizon.
- Failures primarily generated by head loss through wider trunk network due to additional demand of Weinam PDA.
- A 5m increase in Serpentine Creek PRV can resolve pre-development failures under 2041 horizon, however this is not an acceptable long-term solution for aging network assets subject to additional growth.
- The proposed PDA generated network failures due to peak day and fire flow demands. Two servicing options were investigated as follows:
    - Option 1 – Split Serpentine Creek DMA with a new supply point from the DN750 along Cleveland Bay Road.
    - Option 2 – Split Serpentine Creek DMA with a new supply point from the DN600 along Giles Road.
- Both options resolve pressure deficiencies, however Option 2 was found to be favourable based on a lower RCC capital cost estimate of $3.6M versus $4.5M for Option 1.
- Summary of timing for network augmentations as follows:
    - All standard flow upgrades are required prior to ultimate development of PDA (3,000 EP)
    - All fire flow upgrades are required prior to the PDA reaching a demand of 600 EP.

Both options are included within Appendix B, with Option 2 the preferred servicing strategy. On the basis that Option 2 is the preferred strategy, Option 1 will not be discussed any further within this report.

3.3 Augmentation Review

As described in Section 3.1, Calibre has reviewed the network augmentations proposed by RCC and tested if these are directly triggered by the proposed PDA. Table 3-1 provides a summary of the proposed Option 2 augmentations and Calibre's review comments.

Table 3-1: Water Augmentation Summary

Item	RCC Proposed Augmentation	Trigger	Calibre Comments
1	1,135m of DN375 Water Main	PDA Maximum Day Demands	Agreed, critical connection to trunk main required to achieve minimum pressure requirements. Existing network is undersized to cater for PDA demands. Note, 260m of DN150 augmentations triggered by Maximum Day Demands are in addition to Fire Flow augmentations below.
2	830m of DN300 Water Main		
3	420m of DN250 Water Main		
4	640m of DN200 Water Main		
5	260m of DN150 Water Main		
6	PRV / Meter Assembly		Agreed, new PRV and boundary to configuration required for new connection to DN600 trunk main on Giles Road.
7	200m of DN200 Water Main	PDA Fire Flows	Reticulation augmentations are reasonable considering fire flows have increased from 15 L/s to 30 L/s.
8	1,250m of DN150 Water Main		

As described in Table 3-1, most augmentations identified by RCC are directly triggered by the proposed PDA. The augmentation identified within the RCC PIP are illustrated in Figure 3-1. It is assumed that these augmentations will be included in the

Figure 3-1: Proposed PIP Augmentation (Source: RCC Water Master Plan)

The network modelling outcomes and proposed augmentations are consistent with those identified in the RCC Water Master Plan 2016. The augmentations triggered by the PDA have been included in the opinion of cost provided in Section 5.

4 Wastewater Network Analysis

Modelling of wastewater network conditions pre and post development has been completed by RCC. The supporting information provided by RCC (refer Section 1.1) has been reviewed by Calibre and documented in the following sections.

4.1 Methodology

Calibre have reviewed the Weinam PDA Sewerage Network Master Plan prepared by RCC and evaluated the impact that proposed PDA demands will have on network conditions. In addition to review of the master plan report, Calibre have reviewed the GIS network information provided by RCC and calculated the impact that proposed PDA demands will have on network conditions. Infrastructure found to have sufficient capacity has not been reviewed as part of this analysis with the focus being verification of RCC proposed augmentations.

The following horizons were assessed under Peak Wet Weather Flow (PWWF) conditions:

- Baseline 2041 Horizon – Representation of LGIP network conditions (excludes additional PDA demands).
- 2041 Horizon + PDA – Representation of ultimate PDA development.

4.2 RCC Network Modelling Summary

The following provides a summary of the network analysis and findings documented by RCC:

- The Weinam Creek PDA is split across two existing Sewage Pumping Station (SPS) catchments.
- SPS 90 is located north of Weinam Creek, while SPS 132 is located to the south.
- SPS 132 and its associated catchment infrastructure has enough capacity to service proposed PDA catchment demands.
- SPS 90 and its associated catchment infrastructure experience failures and require several upgrades to service the PDA catchment demands. These augmentations include:
    - Upgrade to SPS 90 rising main required (Approx. 800m of DN150 upgraded to DN225).
    - Pumps oversized following rising main upgrade and need to be downgraded to operate efficiently.
    - SPS 90 to be refurbished with internal pipework replaced and Polyethylene liner installed.
    - Emergency storage fails with additional 41 kL offline storage vessel required.
    - Approximately 392m of gravity network fails upstream of SPS 90 and required upgrade.
- No upgrades required to SPS 90 switchboard and controls following pump replacement

The existing infrastructure and augmentations proposed by RCC are illustrated on Drawing No. 18-003165-SK01 within Appendix C.

4.3 SPS 90 Performance Review

Table 4-1 summarises the performance of existing SPS 90 catchment infrastructure under each scenario.

Table 4-1: Existing SPS 90 Performance Summary

Performance Criteria	Existing	2017 Horizon + PDA	2041 Horizon + PDA
Total Pump Capacity (PWWF)	44.00	48.50	53.20
Calculated Pump Duty (DN150 Rising Main)[1]	44 L/s @ 40.7 m	48.5 L/s @ 49.4 m	53.2 L/s @ 59.3 m
DN150 Rising Main Velocity @ PWWF[2]	2.49	2.74	3.01
Rising Main Velocity Acceptable	Yes (<3.0 m/s)	Yes (<3.0 m/s)	No (>3.0 m/s)
Existing Pump Capacity Sufficient	Yes	No (-4.5 L/s)	No (-9.2 L/s)
Available Emergency Storage	Approx. 112 kL		
Required Emergency Storage	74.7 kL	139.7 kL	153 kL
Sufficient Emergency Storage	Yes (+37.3 kL)	No (-27.7 kL)	No (-41 kL)

Notes: 1) Assumes total fitting loss (k = 20) and Colebrook-White friction factor of k = 0.150.
2) Nominal diameter adopted for velocity and pump duty calculations.

Review of the existing SPS 90 catchment infrastructure indicates that the upgrades required are generally consistent with those identified by RCC through their network modelling.

Table 4-2 provide a summary of SPS 90 network performance following the proposed augmentations.

Table 4-2: Augmented SPS 90 Performance Summary

Performance Criteria	Baseline 2041 Horizon[1]	2041 Horizon + PDA
Total Pump Capacity (PWWF)	48.50	53.20
Calculated Pump Duty (DN2225 Rising Main)[1]	48.5 L/s @ 6.7 m	53.2 L/s @ 8.1 m
Calculated Pump Duty (DN200 Rising Main)[1]	48.5 L/s @ 8.4m	53.2 L/s @ 11.3 m
DN225 Rising Main Velocity @ PWWF[2]	1.22 m/s	1.34 m/s
DN200 Rising Main Velocity @ PWWF[2]	1.29 m/s	1.69 m/s
Rising Main Velocity Acceptable	Yes (<3.0 m/s)	Yes (<3.0 m/s)

Notes: 1) Assumes total fitting loss (k = 20) and Colebrook-White friction factor of k = 0.150.
2) Nominal diameter adopted for velocity and pump duty calculations.

Assessment of the rising main augmentation proposed by RCC indicates that there is potential to upgrade the rising main to a DN200 main instead of DN225. Alternatively, a DN150 rising main in parallel could be utilised if the existing alignment has sufficient space for a dual rising main. Both options achieves suitable operating conditions and remain in accordance with the SEQ Code approved products list.

With alignment constraint unknown at the time of reporting, replacement of the existing DN150 rising main with a DN200 has been adopted as the preferred strategy. This also supports a conservative cost estimate as detailed in Section 5.

4.4 Gravity Network Assessment

Assessment of the gravity sewer upstream of SPS 90 was undertaken to verify the augmentations proposed by RCC. Table 4-3 provides a summary of calculated capacity in the gravity network upstream of SPS 90.

Table 4-3: SPS 90 Upstream Gravity Network Capacity Review

Pipe ID	Diameter	Length	Grade[1]	Capacity[2]	Baseline 2041 PWWF[3]	2041 + PDA PWWF	Upgrade Required
14170	DN225	3.5 m	1 : 22	97.5 L/s	40.49 L/s	59.78 L/s	No
14716	DN150	26.2 m	1 : 238	10.02 L/s	12.03 L/s	21.05 L/s	Yes
14715	DN150	39.6 m	1 : 180	11.53 L/s	10.92 L/s	21.05 L/s	Yes
14712	DN150	65.9 m	1 : 199	10.95 L/s	10.54 L/s	20.09 L/s	Yes
14711	DN150	15.1 m	1 : 189	11.26 L/s	9.94 L/s	19.13 L/s	Yes
14698	DN150	34.2 m	1 : 263	9.54 L/s	9.94 L/s	19.13 L/s	Yes
14697	DN150	56.8 m	1 : 405	7.57 L/s	9.74 L/s	18.93 L/s	Yes
14695	DN150	85.2 m	1 : 147	12.58 L/s	9.48 L/s	18.67 L/s	Yes
14677	DN150	69.5 m	1 : 162	11.99 L/s	9.32 L/s	18.51 L/s	Yes

Notes: 1) Grade calculated with GIS information provided by RCC and rounded to nearest whole number.
2) Capacity calculated at 100% depth flow within existing pipe.
3) Baseline PWWF estimated in accordance with demand allocation GIS information provided by RCC.

The existing DN150 pipes require augmentation to service the PDA demands under the 2041 horizon. Calculations indicate that capacity within Pipes 14698 and 14697 is insufficient under the Baseline 2041 horizon and will likely require upgrades regardless of the PDA development.

Table 4-4 provides a summary of the augmentations required to service the baseline 2041 horizon and PDA demands.

Table 4-4: SPS 90 Upstream Gravity Network Augmentations

Pipe ID	Existing Diameter	Proposed Duplication	Length	Grade[1]	2041 + PDA PWWF	Augmented Capacity[2]	Augmentation Trigger
14716	DN150	DN225	26.2 m	1 : 238	21.05 L/s	36.98 L/s	2041 + PDA
14715	DN150	DN225	39.6 m	1 : 180	21.05 L/s	42.53 L/s	2041 + PDA
14712	DN150	DN200	65.9 m	1 : 199	20.09 L/s	32.48 L/s	2041 + PDA
14711	DN150	DN200	15.1 m	1 : 189	19.13 L/s	33.35 L/s	2041 + PDA
14698	DN150	DN200	34.2 m	1 : 263	19.13 L/s	28.27 L/s	Baseline 2041
14697	DN150	DN200	56.8 m	1 : 405	18.93 L/s	22.66 L/s	2041 + PDA
14695	DN150	DN150	85.2 m	1 : 147	18.67 L/s	24.21 L/s	Baseline 2041
14677	DN150	DN150	69.5 m	1 : 162	18.51 L/s	23.07 L/s	2041 + PDA

Notes: 1) Grade maintained in accordance with existing pipe grade, assumes direct replacement.
2) Combined capacity calculated at 75% depth flow within existing & proposed pipes (duplicated system).

The augmented capacity has been calculated as a combined network capacity under the assumption that pipe will be duplicated, laid on the same grade and existing sewers kept in service.

A total of 392m of gravity sewer requires augmentation to service the PDA. Of the total 392m, approximately 119m of augmentation is triggered under the Baseline 2041 horizon.

4.5 Augmentation Review

As described in Section 4.1, Calibre has reviewed the network augmentations proposed by RCC and tested if these are directly triggered by the proposed PDA. Table 4-5 provides a summary of the proposed augmentations and Calibre's review comments.

Table 4-5: Wastewater Augmentation Summary

Item	RCC Proposed Augmentation	Calibre Comments
1	Upgrade SPS 90 DN150 Rising Main to DN225.	Upgrade of existing DN150 rising main required to service PDA. Calculation indicate a DN200 pressure main can achieve suitable velocities and pump duties under 2041 + PDA horizon.
2	Downgrade SPS 90 pumps following rising main upgrade.	Agreed, increased rising main results in pumps operating at undesirable duties.
3	Refurbish SPS 90 internal pipework and install wet well liner.	Pump augmentation will likely require new pedestals which should be upgraded to suit SEQ Code requirements. Other wet well augmentations including refurbishment of wet well pipework and installation of PE liner don't appear to be directly linked to PDA. Pump augmentation and SPS shutdown does provide an opportunity to carry out the proposed refurbishment and is sensible from a maintenance perspective.
4	Provide additional 41 kL offline emergency storage.	Demands associated with PDA trigger requirement for additional emergency storage at SPS 90.
5	Upgrade gravity sewer upstream of SPS 90	Approximately 392m of DN150 gravity sewer upstream of SPS 90 requires augmentation. Of this total 392m, calculation show that approximately 119m of augmentations are triggered under Baseline 2041 horizon.

As described in Table 4-5, most augmentations identified by RCC are directly triggered by the proposed PDA. The revised augmentations proposed by Calibre are illustrated in Drawing No. 18-003165-SK02 within Appendix C. The augmentations triggered by the PDA have been included in the opinion of cost detailed in Section 5.

5 Opinion of Cost

An opinion of cost has been prepared for the infrastructure augmentations triggered by the proposed PDA. Table 5-1 provides a summary of each infrastructure augmentation and the associated cost estimate.

Table 5-1: Augmentation Opinion Cost Estimate

Item	Description	Quantity	Opinion of Cost Estimate
1	Proposed DN375 water main	1,135m	$1,390,000
2	Proposed DN300 water main	830m	$690,000
3	Proposed DN250 water main	420m	$260,000
4	Proposed DN200 water main	840m	$390,000
5	Proposed DN150 water main	1,510m	$530,000
6	Proposed PRV & Meter Assembly	1 Unit	$200,000
7	Proposed DN200 rising main (replace existing)	800m	$510,000
8	Proposed DN225 sewer duplication (existing DN150)	65.8m	$150,000
9	Proposed DN200 sewer duplication (existing DN150)	172m	$350,000
10	Proposed DN150 sewer duplication (existing DN150)	154.7m	$270,000
11	Additional offline emergency storage	1 Unit	$200,000
12	SPS pump replacement	2 Pumps	$40,000
		Total Estimated Cost	**$4,980,000**

Notes: 1) Rates adopted based on recent tender rates, including multiplier for brownfield development.
2) Rates assume good ground conditions with standard open trench construction methods
3) Gravity sewer rates include allowance for maintenance hole replacement / augmentation.
4) Total item cost estimates include 20% On Cost & 10% contingency.
5) Total item cost estimates rounded to the nearest $10,000.

A total value of approximately $4.98 million has been estimated for the water and wastewater augmentations required to service the proposed Weinam Creek PDA. It should be noted that the $4.98 million is the total value of infrastructure and does not separate augmentations which may have been triggered without the PDA (i.e. 119m of DN150 gravity sewer augmentation).

A detailed breakdown of rates, contingencies and on-costs are included in Appendix D. It is recommended that these costs are refined once further design has been completed for the proposed augmentations.

6 Conclusions

The following conclusions can be drawn from Calibre's review of the water and wastewater network investigations completed by Redland City Council:

- The Weinam Creek PDA results in an additional 1,518 EP over RCC PIP demand projections.
- To service additional PDA demands, augmentations to the local water and wastewater networks are required.
- Two water network augmentation strategies were investigated as follows:
    - Option 1 – Split Serpentine Creek DMA with a new supply point from the DN750 along Cleveland Bay Road.
    - Option 2 – Split Serpentine Creek DMA with a new supply point from the DN600 along Giles Road.
- Both options resolve pressure deficiencies, however Option 2 was found to be favourable based on a lower RCC capital cost estimate of $3.6M versus $4.5M for Option 1.
- Water network augmentations include a combination of PIP augmentation and new network augmentations triggered directly by the PDA. Water network augmentations required to service Weinam Creek PDA include the following:
    - 1,135m of DN375 Water Main
    - 830m of DN300 Water Main
    - 420m of DN250 Water Main
    - 840m of DN200 Water Main
    - 1,510 of DN150 Water Main
    - PRV / Meter Assembly
- Weinam Creek PDA is split across two existing Sewage Pumping Station (SPS) catchments.
    - SPS 90 located north of Weinam Creek and SPS 132 located south of Weinam Creek.
- SPS 90 is located north of Weinam Creek, while SPS 132 is located to the south.
- SPS 132 and its associated catchment infrastructure has enough capacity to service proposed PDA catchment demands.
- SPS 90 and its associated catchment infrastructure experience failures and require several upgrades to service the PDA catchment demands. These augmentations include:
    - Upgrade to SPS 90 rising main required (Approx. 800m of DN150 upgraded to DN200).
    - Pumps oversized following rising main upgrade and need to be downgraded to operate efficiently.
    - Emergency storage fails with additional 41 kL offline storage vessel required.
    - Approximately 392m of DN150 gravity sewer upstream of SPS 90 requires augmentation. Of this total 392m, calculation show that approximately 119m of augmentations are triggered under Baseline 2041 horizon.
- The proposed water and wastewater network augmentations triggered by the Weinam Creek PDA have a total estimated capital cost of $4.98 million.
    - Water network augmentations estimate value = $3,460,000
    - Wastewater network augmentations estimated value = $1,520,000
- The total opinion of cost value ($4.98 million) does not separate augmentations that may be triggered regardless of the PDA and is a representation of the total value of infrastructure augmentations regardless of their trigger.

7 Recommendations

Calibre make the following recommendations based on the findings within this report:

- Verify population triggers for network augmentations and define these within PDA Development Approval conditions.
- Undertake conceptual design for the preferred servicing strategies to confirm opportunities and constraints.
- Update opinion of cost estimates based on conceptual designs and review feasibility of preferred strategies.
- Undertake detailed engineering design and construction of augmentations prior to population triggers defined in DA conditions.

WEINAM CREEK PRIORITY DEVELOPMENT AREA

Appendix A Proposed Development Layout

REDLAND INVESTMENT CORPORATION

weinam creek

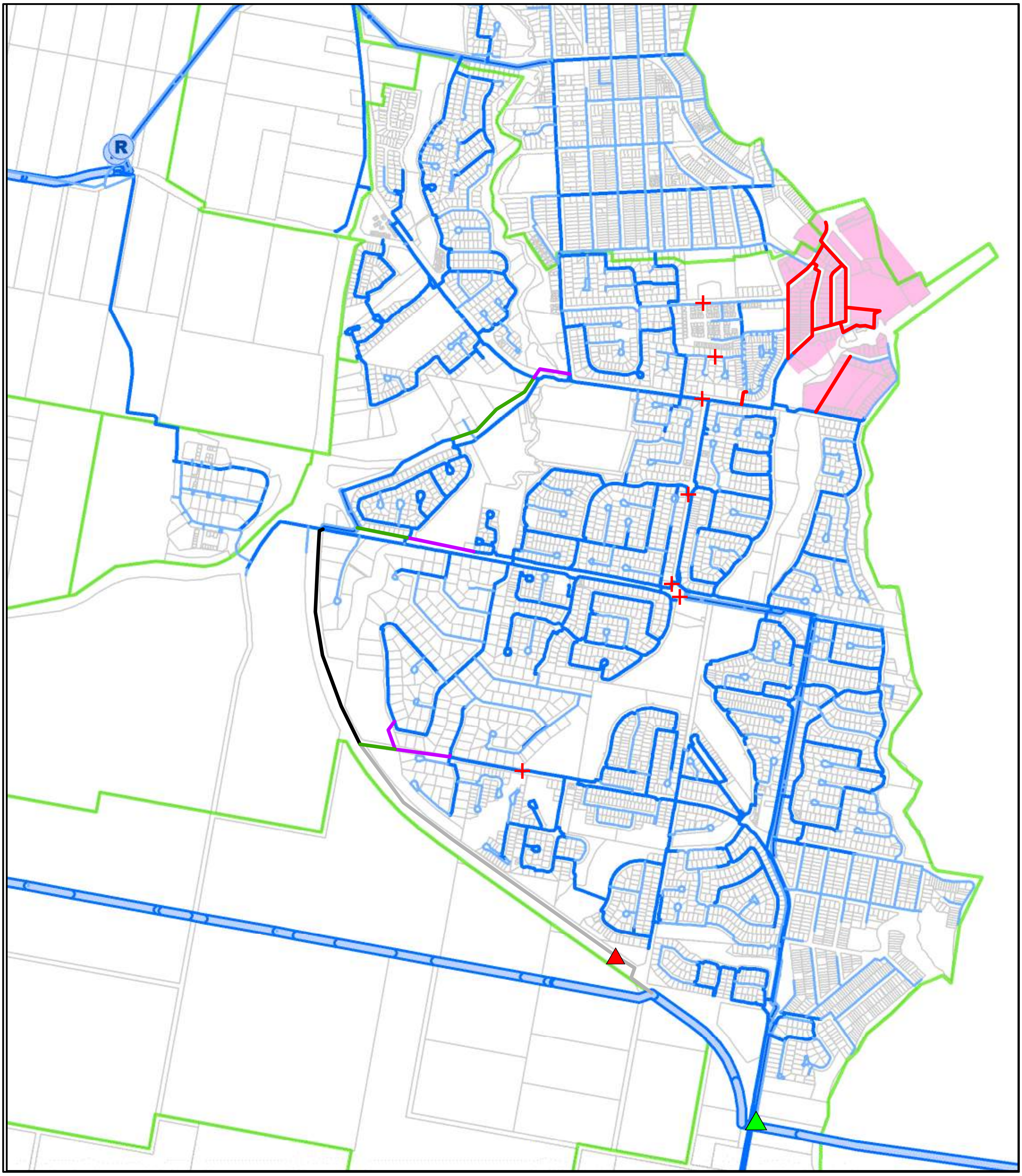
master plan - OPTION ONE

Ref. No. 133693 Date October 2018 Scale 1 : 1500@A1

WEINAM CREEK PRIORITY DEVELOPMENT AREA

Appendix B Water Network Augmentation

REDLAND INVESTMENT CORPORATION



Legend

Water Mains - Operating Diameter

- 20 - 100 mm
- 101 - 250 mm
- 251 - 500 mm
- 501 - 900 mm

Proposed Option 1 (mm)

- 200
- 225
- 300
- 375

Proposed FF (mm)

- 150

- + Proposed Closed Valves
- ▲ Proposed Option 1 PRV
- ▲ Serpentine Creek PRV
- 🟩 Distribution Maintenance Areas
- ☐ Current Land
- ▨ Weinam Creek PDA

Issue	Date	By	Chkd	Appd
D1	5/11/2019	JM	MI	MI

Redland City Council

Redland Water
PO Box 21
Cleveland QLD 4163

Job Title **Weinam Creek PDA**
Drawing Title **Option 1 Pipe Upgrades**
Scale at A3 **1:406,300** Drawing Status **Draft V1**
Coordinate System **GDA 1994 MGA Zone 56**
Date of Print **5/11/2019** Drawing No **001**

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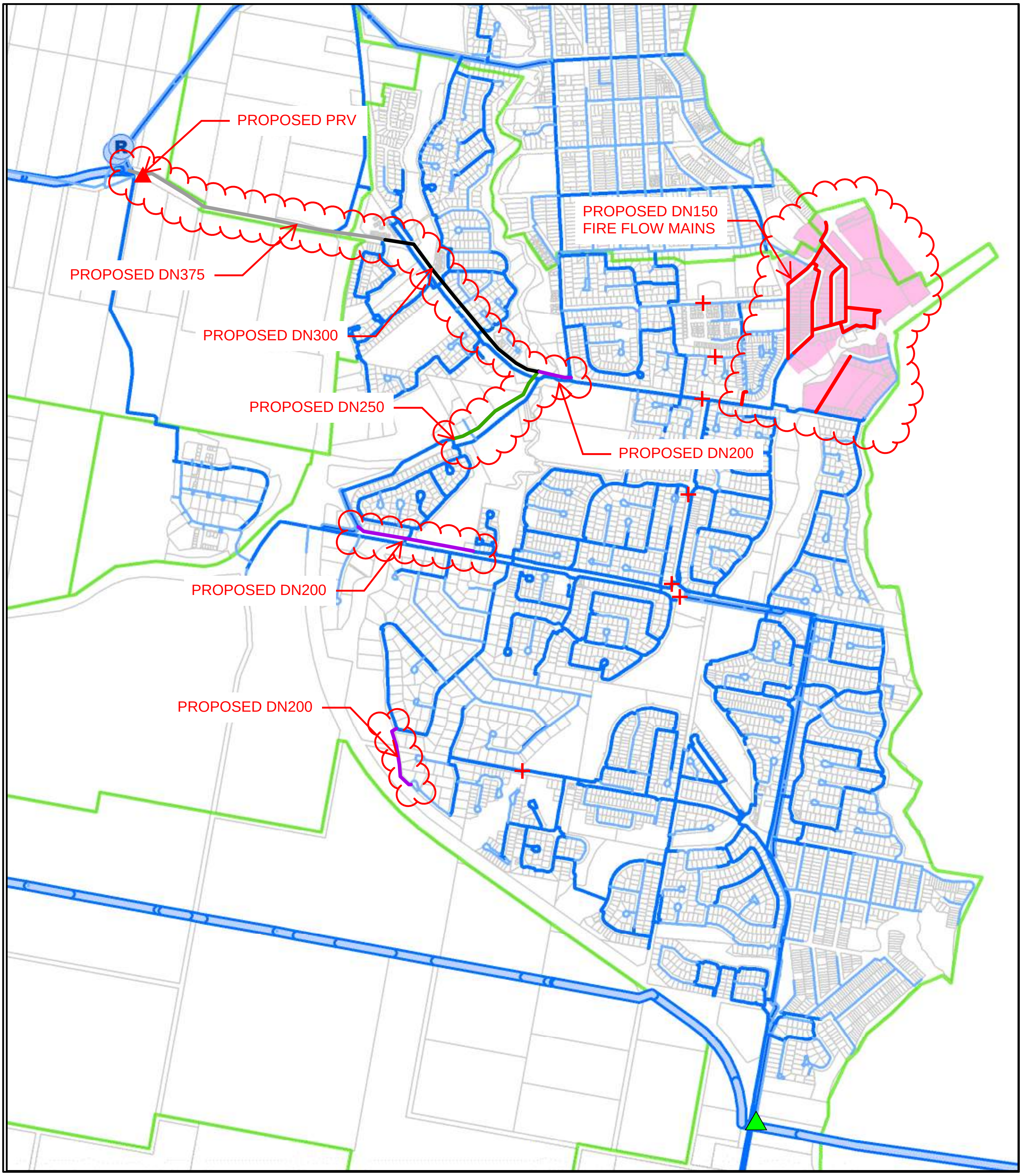

Legend

Water Mains - Operating Diameter

- 20 - 100 mm
- 101 - 250 mm
- 251 - 500 mm
- 501 - 900 mm

Proposed Option 2 (mm)

- 200
- 250
- 300
- 375

Proposed FF (mm)

- 150

- \+ Proposed Closed Valves
- ▲ Proposed Option 2 PRV
- ▲ Serpentine Creek PRV
- 🟩 Distribution Maintenance Areas
- ☐ Current Land
- ▨ Weinam Creek PDA

Issue	Date	By	Chkd	Appd
D1	5/11/2019	JM	MI	MI

Redland CITY COUNCIL

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Job Title **Weinam Creek PDA**
Drawing Title **Option 2 Pipe Upgrades**
Scale at A3 **1:406,300** Drawing Status **Draft V1**
Coordinate System **GDA 1994 MGA Zone 56**
Date of Print **5/11/2019** Drawing No **001**

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WEINAM CREEK PRIORITY DEVELOPMENT AREA

Appendix C Sewer Network Augmentation

REDLAND INVESTMENT CORPORATION

LEGEND

PDA SITE BOUNDARY

CADASTRE

LOT BOUNDARY

EXISTING DN100 SEWER GRAVITY MAIN

EXISTING DN150 SEWER GRAVITY MAIN

EXISTING DN225 SEWER GRAVITY MAIN

EXISTING DN300 SEWER GRAVITY MAIN

EXISTING SEWER RISING MAIN

PROPOSED DN150 SEWER GRAVITY MAIN

PROPOSED DN200 SEWER GRAVITY MAIN

PROPOSED DN225 SEWER GRAVITY MAIN

PROPOSED DN225 SEWER RISING MAIN

● EXISTING SEWER PUMP STATION

▨ PROPOSED DEVELOP AREA

NOTES:

1. THIS PLAN IS CONCEPT ONLY AND SUBJECT DETAILED ANALYSIS.
2. INFRASTRUCTURE SIZE, LOCATION AND ALIGNMENT ARE INDICATIVE ONLY SUBJECT TO SURVEY.
3. EXISTING INFRASTRUCTURE CAPACITY SUBJECT TO FURTHER INVESTIGATION.
4. PROPOSED STRATEGY IS SUBJECT TO FUTURE PLANNING AND DETAILED DESIGN.

FILE: 18-003165-SK01-SK02.dwg DATE: 24-02-2020 USER: JOSE MOLINA
XREFS: X_18-003165-TITLE X_18-003165-EX-CADASTRE X_18-003165-PUMP-STATION X_18-003165-CATCHMENTS X_18-003165-MAINTENANCE HOLE X_18-003165-EX-SRM X_18-003165-AERIAL IMAGE X_18-003165-EX-SGM X_18-003165-DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	25.02.20	ORIGINAL ISSUE	JM	TC
B	07.04.20	RE-ISSUE FOR APPROVAL	JM	TC
C				
D				
E				
F				
G				
H				

DRAWN CHECK

DESIGN CHECK

STATUS

NOT FOR CONSTRUCTION

SCALE

0 200 400 600 800 1000 1200 1400 1600

SCALE 1:20000 (A1) SCALE 1:40000 (A3)

CLIENT

REDLAND INVESTMENT CORPORATION

calibre

calibregroup.com

©

PROJECT

WEINAM CREEK PDA WATER & WASTEWATER SERVICING REVIEW

DISCLAIMER

ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE

RCC PROPOSED NETWORK AUGMENTATIONS

PROJECT No. 18-003165

DRAWING No. SK01

REVISION B

LEGEND

▬ ▬	PDA SITE BOUNDARY
──	CADASTRE
──	LOT BOUNDARY
— S —	EXISTING DN100 SEWER GRAVITY MAIN
— S —	EXISTING DN150 SEWER GRAVITY MAIN
— S —	EXISTING DN225 SEWER GRAVITY MAIN
— S —	EXISTING DN300 SEWER GRAVITY MAIN
— RM —	EXISTING SEWER RISING MAIN
▬▬	PROPOSED DN150 SEWER GRAVITY MAIN
▬▬	PROPOSED DN200 SEWER GRAVITY MAIN
▬▬	PROPOSED DN225 SEWER GRAVITY MAIN
▬▬	PROPOSED DN200 SEWER RISING MAIN
●	EXISTING SEWER PUMP STATION
▨	PROPOSED DEVELOP AREA

NOTES:

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REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	25.02.20	ORIGINAL ISSUE	JM	TC
B	07.04.20	RE-ISSUE FOR APPROVAL	JM	TC
C				
D				
E				
F				
G				
H				

DRAWN CHECK

DESIGN CHECK

STATUS

NOT FOR CONSTRUCTION

SCALE

0 200 400 600 800 1000 1200 1400 1600

SCALE 1:20000 (A1) SCALE 1:40000 (A3)

CLIENT

REDLAND INVESTMENT CORPORATION

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PROJECT

WEINAM CREEK PDA WATER & WASTEWATER SERVICING REVIEW

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE

CALIBRE PROPOSED NETWORK AUGMENTATIONS

PROJECT No.	DRAWING No.	REVISION
18-003165	SK02	B

Appendix D Cost Estimate Table

calibre

Project Weinam Creek W&WW Review
Date 7th April 2020

Description	Quantity	Diameter	Base Unit Rate	Site Condition Multiplier	Adjusted Unit Rate	Base Cost	On Cost	Contingency	Total Estimated Cost	Rounded Total
Proposed DN375 water main	1,135	DN375	$ 620	1.5	$ 930	$ 1,055,550	$ 211,110	$ 126,666	$ 1,393,326	$ 1,390,000
Proposed DN300 water main	830	DN300	$ 421	1.5	$ 632	$ 524,145	$ 104,829	$ 62,897	$ 691,871	$ 690,000
Proposed DN250 water main	420	DN250	$ 317	1.5	$ 476	$ 199,710	$ 39,942	$ 23,965	$ 263,617	$ 260,000
Proposed DN200 water main	840	DN200	$ 235	1.5	$ 353	$ 296,100	$ 59,220	$ 35,532	$ 390,852	$ 390,000
Proposed DN150 water main	1,510	DN150	$ 177	1.5	$ 266	$ 400,905	$ 80,181	$ 48,109	$ 529,195	$ 530,000
Proposed PRV & Meter Assembly	1 Unit	-	$ 100,000	1.5	$ 150,000	$ 150,000	$ 30,000	$ 18,000	$ 198,000	$ 200,000
Proposed DN200 rising main (replace existing)	800	DN200	$ 320	1.5	$ 480	$ 384,000	$ 76,800	$ 46,080	$ 506,880	$ 510,000
Proposed DN225 sewer duplication (existing DN150)	65.8	DN225	$ 294	6	$ 1,764	$ 116,071	$ 23,214	$ 13,929	$ 153,214	$ 150,000
Proposed DN200 sewer duplication (existing DN150)	172	DN200	$ 254	6	$ 1,524	$ 262,128	$ 52,426	$ 31,455	$ 346,009	$ 350,000
Proposed DN150 sewer duplication (existing DN150)	154.7	DN150	$ 223	6	$ 1,338	$ 206,989	$ 41,398	$ 24,839	$ 273,225	$ 270,000
Additional offline emergency storage	1 Unit	-	$ 100,000	1.5	$ 150,000	$ 150,000	$ 30,000	$ 18,000	$ 198,000	$ 200,000
SPS pump replacement	2 Pumps	-	$ 10,000	1.5	$ 15,000	$ 30,000	$ 6,000	$ 3,600	$ 39,600	$ 40,000
					Total	$ 3,775,598	$ 755,120	$ 453,072	$ 4,983,789	$ 4,980,000

Site Condition Multipliers	
Development Type	
Greenfield	1
Brownfield	1.5
Dense Urban	2.2
Depth	
0-3m	1
3-5m	1.4
> 5m	2
Soil	
Good Soil	1
ASS	1.5
Rock	2
Length	
< 100 m	3
100 - 200 m	2
> 200 m	1
Other	
Environmental	3.0
Dense Urban	4.0
Trenchless	10

Notes:

1) Base rates adopted in accordance with recent tender rates.

2) Rates assume good ground conditions with standard open trench construction methods

3) Gravity sewer rates include allowance for maintenance hole replacement / augmentation.

4) Total item cost estimates include 20% On Cost & 10% contingency.

5) Total item cost estimates rounded to the nearest $10,000.

Appendix E – Infrastructure Agreement – Weinam Creek PDA

HopgoodGanim
LAWYERS

Infrastructure Agreement – Weinam Creek PDA

PDA infrastructure

Redland Investment Corporation Pty Ltd ACN 603 164 503 (**RIC**)

Redland City Council (**Council**)

Minister for Economic Development Queensland ABN 76 590 288 697 (**MEDQ**)

Contact - James Ireland, Partner, j.ireland@hopgoodganim.com.au

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Infrastructure Agreement – Weinam Creek PDA

Date 1 December 2021.

Parties

Redland Investment Corporation Pty Ltd ACN 603 164 503 (**RIC**)

Redland City Council (**Council**)

Minister for Economic Development Queensland ABN 76 590 288 697 (**MEDQ**)

Background

A. The Hospital Lot and the State Land are located within the Weinam Creek Priority Development Area, and within the Redland City Council local government area.

B. The State is progressing the development of a satellite hospital for Redlands and, through EDQ, has identified the Hospital Lot (which is owned by RIC) as a suitable site for the project.

C. Under the Hospital Lot Contract, the State (represented by Queensland Health) will become the owner of the Hospital Lot.

D. Council and RIC are progressing development within the Weinam Creek Priority Development Area including on the State Land.

E. Under the State Land Contract, RIC will become the owner of the State Land and part of the purchase price for the State Land is to be satisfied by the Council agreeing to forgo its entitlement to offsets for the PDA Infrastructure Contributions up to $8.025 million (being the difference between the State Land Value and the Hospital Lot Value).

F. Council and RIC have agreed to provide their respective PDA Infrastructure Contributions in accordance with the terms of this document and at the times stated in this document.

G. MEDQ has agreed that the PDA Infrastructure Contributions are eligible for offsets in accordance with this document.

H. The PDA Infrastructure Contributions will support development on the Hospital Lot, the State Land and other development in the Weinam Creek Priority Development Area.

I. The proposed satellite hospital and the PDA Infrastructure Contributions will deliver social and economic benefits to the community.

Now this deed witnesses

1. Reference Schedule, definitions and interpretation

1.1 Reference Schedule

Where a term used in this deed appears in bold type in the Reference Schedule, that term has the meaning shown opposite it in the Reference Schedule.

ADI	has the meaning given in section 5 of the *Banking Act 1959* (Cth)
Approval	a consent, permit, licence, certificate, authorisation, notice or approval under a law, or that is required under or in relation to this document
Appropriately Qualified Person	a person having the qualifications and experience appropriate to perform the relevant function or task to prepare the relevant document
Approval Authority	an entity or body with relevant power or authority to issue an Approval
Bank	an ADI that is permitted under section 66 of the *Banking Act 1959* (Cth) to call itself a bank
Call Option Deed	the deed to be entered into between RIC and MEDQ which contains options for MEDQ to buy back the State Land
Commence	for a Works Contribution or part of a Works Contribution means that: (a) an Approval has been given (if required); (b) the land required has been established as a work site as demonstrated by the installation of safety fencing, site sheds, signs and other relevant infrastructure; (c) a contractor has been engaged to carry out the works if the works are not being carried out by Council employees; and (d) work has materially commenced (in accordance with any relevant Approval if required).
Commencement Date	the date the last party executes this document
Contributions Start Date	means the date 22 Business Days after the date that the State Land is transferred to RIC or the later date from an extension under clause 9.
Council Land	Lot 3 on SP309555, Lot 200 on SP174264, Lot 1 on SP309555, Lot 7 on RP80201, Lot 27 on RP80201, Lot 1 on RP99388, Lot 902 SP223465, Lots 70-71 on RP30543, Lots 72- 77 on RP129864, Lots 1-9 on RP30543, Lots 10-13 on RP30543, Lot 901 on SP223464, Lot 903 on SP223465, Lot 900 on SP134603, Lot 2 on SP297847, Lot 7 on RP75327, Lot 500 on SP287108
Council's Address Details	Address: Council Building, cnr Middle and Bloomfield Streets, Cleveland Electronic Mail: andrew.ross@redland.qld.gov.au
Council's Obligations	the obligations set out in clause 4.2
CPM	EDQ's Certification Procedure Manual Version 5 as amended from time to time

Default Event	any breach of this agreement by Council or RIC, including if Council or RIC: (a) fail to duly perform or fulfil their obligations under this document, including the PDA Infrastructure Obligations; or (b) assign their interests, liabilities, rights or obligations other than in accordance with clause 8; or if the RIC becomes an externally-administered body corporate as defined by the *Corporations Act 2001* (Cth).
ED Act	the *Economic Development Act 2012* (Qld)
Final Offset	means the offset for a PDA Infrastructure Contribution that is land or works determined in accordance with section 1.2 in Schedule 2
Force Majeure Event	any occurrence or omission outside a party's reasonable control, as a direct or indirect result of which the party relying on the event is prevented from or delayed in performing its obligations under this agreement and includes one or a combination of any of the following events and circumstances (provided the foregoing conditions are met): (a) a physical natural disaster including fire, flood, lightning, storm, act of God or earthquake; or (b) ionising radiation or contamination by radioactivity from any nuclear waste or from combustion of nuclear fuel; or (c) riot, civil commotion, malicious damage, sabotage, war (whether declared or not), act of terrorism, explosion or revolution; or (d) epidemic, pandemic or public health emergency (including COVID-19), or any resulting governmental action including work stoppages, mandatory business, service or workspace closures, full or partial lockdown of affected areas, quarantines, border closures and travel restrictions; (e) legal proceedings (threatened or actual), order of a court, tribunal or authority; or (f) strike, lock-out, stoppage, labour dispute or shortage including industrial disputes that are specific to a party or the party's subcontractors.
Hospital Lot	the land located at 22-28 Meissner Street, Redland Bay, described as Lot 2 on SP309555
Hospital Lot Contract	the contract to be entered into between RIC, Council and the State of Queensland (represented by Queensland Health) for the purchase of the Hospital Lot
Hospital Lot Value	$2.85 million (excluding GST)

IFF	the Infrastructure Funding Framework as amended from time to time which, at the commencement date, is the version dated 1 July 2021
Land Contribution	a PDA Infrastructure Contribution that is land
MEDQ's Address Details	Address: GPO BOX 2022, Brisbane, Queensland 4001 Electronic Mail: edq@dsdmip.qld.gov.au Attention: Manager, Infrastructure, Economic Development Queensland and Executive Director, Development Strategy, Economic Development Queensland
MEDQ's Obligations	the obligations in clause 4.3
PDA Infrastructure Contributions	the infrastructure contributions described in the PDA Infrastructure Contributions Schedule
PDA Infrastructure Contributions Schedule	Schedule 1 to this document
PDA Infrastructure Obligations	the obligation to provide the PDA Infrastructure Contributions
Planning Act	the *Planning Act 2016* (Qld)
Planning Regulation	the *Planning Regulation 2017* (Qld)
Practical Completion	For a Works Contribution means accepted on-maintenance by MEDQ in accordance with the CPM For a Land Contribution means transferred or dedicated in accordance with the conditions of any relevant Approval and the terms of this document, to MEDQ's satisfaction. Note: "**Practically Completed**" has a corresponding meaning
Quantity Surveyor	a quantity surveyor who is a Certified Quantity Surveyor designated by the Australian Institute of Quantity Surveyors or a Chartered Surveyor designated by the Royal Institution of Chartered Surveyors and has been a Corporate Member of the Australian Institute of Quantity Surveyors or the Royal Institution of Chartered Surveyors for at least 10 years
RPEQ	an engineer registered as a registered professional engineer with the Board of Professional Engineers of Queensland in accordance with the *Professional Engineers Act 2002* (Qld).
RIC's Address Details	Address: Level 1, 48 Bloomfield Street, Cleveland Electronic Mail: anca.butcher@redlandinvestcorp.com.au
RIC's Obligations	the obligations contained in clause 4.1
Security	a security in the amount of 5% of the value of the relevant Works Contribution
State Land	the land located at 9-9A Meissner Street, Redland Bay, Queensland and 46 Banana Street, Redland Bay, Qld, currently described as Lot 167 on SP279927, Lot 197 on SP123870 and Lot 300 on S123870 and includes any subsequent description for the land created for the purpose of the issue of the deed of grant

State Land Contract	the contract to be entered into between MEDQ, Council and RIC for the purchase of the State Land once freeholded-
State Land Value	$10.875 million (excluding GST)
Weinam Creek Priority Development Area	the area identified within the PDA boundary on "*Map 1: Weinam Creek Priority Development Area boundary*" in the Weinam Creek Priority Development Area Development Scheme
Weinam Creek Priority Development Area Development Scheme	Weinam Creek Priority Development Area Development Scheme May 2014
Works Contribution	a PDA Infrastructure Contribution that is works

1.2 Definitions

In this deed:

Authorised Officer means, in relation to a corporation which is a party:

(a) an employee of the party whose title contains either of the words Director or Manager;

(b) a person performing the function of any of them;

(c) a solicitor acting on behalf of the party; or

(d) a person appointed by the party to act as an Authorised Officer for the purposes of this deed and notified to the others.

Business Day means:

(a) if determining when a notice, consent or other communication is given, a day that is not a Saturday, Sunday or public holiday in the place to which the notice, consent or other communication is sent; and

(b) for any other purpose, a day (other than a Saturday, Sunday or public holiday) on which banks are open for general banking business in Brisbane.

Electronic Signature means an electronic method of signing that identifies the person and indicates their intention to sign

Excluded Tax means a Tax imposed by a jurisdiction on, or calculated by reference to, the net income of a person in the jurisdiction because the person is a resident of or receives income from a source in or has some other connection with that jurisdiction, other than a Tax:

(a) which is assessed by reference to the gross amount of a payment derived under this deed or another document referred to in this deed (without the allowance of a deduction); or

(b) which is imposed on a person in the jurisdiction only because the person is a party to this deed or a transaction contemplated by this deed.

Government Body means:

(a) any person, body or other thing exercising an executive, legislative, judicial or other governmental function of any country or political subdivision of any country;

(b) any public authority constituted by or under a law of any country or political subdivision of any country; and

(c) any person deriving a power directly or indirectly from any other Government Body.

Tax means any present or future tax, levy, deduction, impost, withholding, charge or duty which is levied or imposed by any Government Body together with any interest, penalty or fine on those amounts.

1.3 Interpretation

(a) Unless the contrary intention appears, a reference in this deed to:

   (1) this deed or another document includes any variation or replacement of it despite any change in the identity of the parties;

   (2) one gender includes the others;

   (3) the singular includes the plural and the plural includes the singular;

   (4) a person, partnership, corporation, trust, association, joint venture, unincorporated body, Government Body or other entity includes any other of them;

   (5) an item, recital, clause, subclause, paragraph, schedule or attachment is to an item, recital, clause, subclause, paragraph of, or schedule or attachment to, this deed and a reference to this deed includes any schedule or attachment;

   (6) a party includes the party's executors, administrators, successors, substitutes (including a person who becomes a party by novation) and permitted assigns;

   (7) any statute, ordinance, code or other law includes regulations and other instruments under any of them and consolidations, amendments, re-enactments or replacements of any of them;

   (8) money is to Australian dollars, unless otherwise stated; and

   (9) a time is a reference to Queensland time unless otherwise specified.

(b) The words include, including, such as, for example and similar expressions are not to be construed as words of limitation.

(c) Where a word or expression is given a particular meaning, other parts of speech and grammatical forms of that word or expression have a corresponding meaning.

(d) Headings and any table of contents or index are for convenience only and do not affect the interpretation of this deed.

(e) A provision of this deed must not be construed to the disadvantage of a party merely because that party or its advisers were responsible for the preparation of this deed or the inclusion of the provision in this deed.

1.4 Other expressions

If a term is not defined in this document it shall, unless the context otherwise requires, have the meaning given to it by the following, in the following sequence:

(a) the Planning Act;

(b) the Planning Regulation;

(c) the ED Act;

(d) Council's Adopted Infrastructure Charges Resolution (No.3.1) (2020);

(e) the Weinam Creek Priority Development Area Development Scheme;

(f) the Macquarie Dictionary; or

(g) the common understanding of the term or expression in the absence of any other applicable definition.

1.5 Business Days

(a) If anything under this deed must be done on a day that is not a Business Day, it must be done instead on the next Business Day.

(b) If an act is required to be done on a particular day, it must be done before 5.00pm on that day or it will be considered to have been done on the following day.

1.6 Parties

(a) If a party consists of more than one person, this deed binds each of them separately and any two or more of them jointly.

(b) An agreement, covenant, obligation, representation or warranty in favour of two or more persons is for the benefit of them jointly and each of them separately.

(c) An agreement, covenant, obligation, representation or warranty on the part of two or more persons binds them jointly and each of them separately.

2. Commencement

2.1 Commencement

This document commences on the Commencement Date.

3. Infrastructure agreement

3.1 Application of Planning Act and ED Act

This document is an infrastructure agreement as referred to in the Planning Act and the ED Act.

3.2 Agreement to bind successors in title

The obligations of the parties attach to the Council Land and the State Land only to the following extent:

(a) Council's Obligations do not attach to, and are not affected by a change in the ownership of, the Council Land or the State Land. Council's Obligations remain Council's responsibility at all times.

(b) From the day RIC becomes the owner of the State Land, RIC's Obligations will attach to the State Land and be binding on the owner and the owner's successors in title.

(c) Despite clause 3.2(b), if MEDQ exercises an option under the Call Option Deed, the State Land is released from RIC's Obligations in so far as they are unperformed or unfilled.

3.3 No fetter

Nothing in this document fetters the rights, powers, authorities, functions or discretions of MEDQ, any other Approval Authority or any other government agency under the provisions of any law.

3.4 Effect of planning change

The PDA Infrastructure Obligations under this document do not depend on entitlements that may be affected by a change to a planning instrument.

3.5 Cessation of Priority Development Area

If any part of the land in the Weinam Creek Priority Development Area ceases to be in a priority development area this document will continue in force in accordance with section 121 of the ED Act.

4. Parties' Obligations

4.1 RIC's obligations

RIC must:

(a) once it becomes owner of the State Land, provide Council with access to the State Land to allow it to fulfil its obligations under this document;

(b) provide any Land Contributions relating to the State Land in accordance with the PDA Infrastructure Contributions Schedule and clause 5.3;

(c) not sell or transfer the State Land, or any part thereof, prior to the performance and fulfilment of the PDA Infrastructure Obligations other than to provide a Land Contribution;

(d) otherwise comply with the terms of this document.

4.2 Council's obligations

(a) Council must:

(1) once RIC becomes owner of the State Land, provide the PDA Infrastructure Contributions in accordance with this document;

(2) accept the transfer of any Land Contribution for park relating to the State Land in accordance with the PDA Infrastructure Contributions Schedule, and accept responsibility for the ongoing management and maintenance of that land (including any improvements on that land) even if MEDQ has exercised an option under the Call Option Deed;

(3) otherwise comply with the terms of this document.

(b) If MEDQ exercises an option under the Call Option:

(1) Council must, where it has Commenced the Works Contribution for any of items 1A, 1B, 1C, 2, 3, 4, or 5 in the PDA Infrastructure Contributions but not finished the works for that particular item, ensure that all of the works for that item are Practically Completed within a reasonable time;

(2) Council's obligation to provide any PDA Infrastructure Contributions that have not Commenced continues but the timing for Practical Completion is in Council's discretion. This clause 4.2(b)(2) does not override any Approval for the PDA Infrastructure Contributions.

4.3 MEDQ's obligations

(a) MEDQ must comply with the terms of this document.

(b) If MEDQ exercises an option under the Call Option, Council and RIC acknowledge that MEDQ is not responsible for completing any Works Contribution that has Commenced but not been finished or for delivering any other PDA Infrastructure Contributions.

5. Infrastructure Contributions

5.1 PDA Infrastructure Contributions

A PDA Infrastructure Contribution must be provided in accordance with the PDA Infrastructure Contributions Schedule.

5.2 Works Contributions

For a Works Contribution, Council must:

(a) apply for and obtain from an Approval Authority all necessary Approvals to provide the PDA Infrastructure Contributions;

(b) provide copies of all Approvals obtained to MEDQ within 10 Business Days of an Approval being issued by an Approval Authority;

(c) ensure that all materials and work associated with or in any way connected with the PDA Infrastructure Contributions:

(1) comply with all relevant standards, codes, regulations and/or specifications of the Standards Association of Australia;

(2) comply with MEDQs requirements, including those set out in EDQ PDA guideline no. 6 Street and movement network February 2019, the CPM, EDQ Guideline 13: Engineering Standards, SEQ Water Supply and Sewerage Design and Construction Code, Queensland Urban Drainage Manual, State Planning Policy (2017): Appendix 2 – Stormwater management design objectives, IPWEA: Street Design Manual: Walkable Neighbourhoods;

(3) comply with all necessary Approvals;

(4) are Practically Completed and are fit for their intended purpose or reasonably inferred by this document;

(5) are executed by appropriately qualified or licensed personnel in a thorough, skilful and professional manner; and

(6) otherwise comply in all respects with this document.

5.3 Land contributions

For a Land Contribution, Council and RIC must:

(a) apply for and obtain from an Approval Authority all necessary Approvals to provide the Land Contribution;

(b) provide copies of all Approvals obtained to MEDQ within 10 Business Days of an Approval being issued by an Approval Authority;

(c) comply with all necessary Approvals; and

(d) transfer the land to the relevant authority or dedicate the land at no cost to MEDQ.

5.4 Timing for contributions

(a) Council may Commence to provide the Works Contribution before RIC becomes the owner of the State Land and must:

  (1) Commence works for a material part of the Works Contribution for each of items 1A and 2 in the PDA Infrastructure Contributions Schedule by the Contributions Start Date, and provide written evidence to MEDQ that the works have Commenced as required; and

  (2) subject to clause 5.6, ensure Practical Completion of the PDA Infrastructure Contributions in accordance with the timing specified in the PDA Infrastructure Contributions Schedule, or any Approval (whichever is sooner).

(b) Subject to clause 5.6, RIC must ensure Practical Completion of any Land Contributions relating to the State Land in accordance with the timing specified in the PDA Infrastructure Contributions Schedule, or any Approval (whichever is sooner).

5.5 Reporting requirement

(a) Council and RIC must prepare and submit to MEDQ a written quarterly report addressing:

(1) the works program for the PDA Infrastructure Contributions, addressing design, tender, approvals and construction activities relating to the works by item number;

(2) whether the PDA Infrastructure Contributions are on track for Practical Completion in accordance with the PDA Infrastructure Contributions Schedule and, if not, the reasons for any delay;

(3) for any Land Contributions, any survey plan registration confirmation and/or title search demonstrating the transfer or dedication of the relevant land.

(b) The first report must be submitted within 12 Business Days of RIC becoming the owner of the State Land, and the report must be updated and submitted to MEDQ at three monthly intervals.

5.6 Extension of time to Commence and for Practical Completion

(a) Council may give Notice to MEDQ requesting an extension of time to Commence items 1A and 2 in the PDA Infrastructure Contributions Schedule, or an extension of time for Practical Completion of an infrastructure contribution identified in the PDA Infrastructure Contributions Schedule.

(b) RIC may give Notice to MEDQ requesting an extension of time for Practical Completion of a Land Contribution relating to the State Land identified in the PDA Infrastructure Contributions Schedule.

(c) Any Notice must identify the relevant item from the PDA Infrastructure Contributions Schedule and be given:

(1) for a request relating to an extension of time to Commence items 1A and 2 in the PDA Infrastructure Contributions Schedule, within 12 Business Days of RIC becoming the owner of the State Land; and

(2) for a request relating to an extension of time for Practical Completion, at least 20 Business Days before the time for Practical Completion specified in the PDA Infrastructure Contributions Schedule.

(d) MEDQ may, in its absolute discretion, decide whether or not to extend the time for Practical Completion for that item.

(e) If MEDQ decides to extend the time for Practical Completion, it must give Notice to Council and RIC, and the time for Practical Completion for that item is varied as set out in that Notice.

(f) To be clear, this clause 5.6 is in addition to extension rights under clause 9.

5.7 Future Development

No construction may occur (other than for the PDA Infrastructure Contributions) and no new use may commence on the State Land until all the PDA Infrastructure Contributions reach Practical Completion, and Council and RIC have otherwise complied with this document.

6. Security

6.1 Security

(a) Before Commencing each Works Contribution, Council must ensure that its head contractors provide Security for that item to Council.

(b) The Security must be maintained at all times until the relevant Works Contribution is accepted off maintenance by Council or MEDQ.

(c) The clause does not apply where Council is carrying out works using its own staff.

6.2 No limitation

The provision of the Security will not in any way limit the liabilities or obligations of Council under this document.

7. Offset

7.1 Entitlement to offset

(a) Council is entitled to offsets for providing the PDA Infrastructure Contributions in accordance with this document.

(b) The offsets for the PDA Infrastructure Contribution accrue when the value of the offsets (calculated in accordance with clause 7.2) exceeds $8.025 million being the difference between the State Land Value and the Hospital Lot Value, at which time, Council is only entitled to apply that part of the offset above $8.025 million.

(c) Neither Council nor RIC are entitled to offsets for any Land Contribution relating to the State Land.

7.2 Calculation of offset

The offsets for the PDA Infrastructure Contributions will be calculated in accordance with the process set out in Schedule 2.

7.3 Application of offset

(a) The final value of offsets for the PDA Infrastructure Contributions that may be applied will be reduced by $8.025 million being the difference between the State Land Value, and the Hospital Lot Value (**Adjusted Offsets**).

(b) The Adjusted Offsets may be applied in accordance with the PDA Infrastructure Contributions Schedule for development in accordance with any Approval for development on the Council Land or the State Land in accordance with the process for claiming an offset set out in Schedule 2.

(c) A refund will not be provided under any circumstances.

(d) Cross crediting is not permitted.

7.4 Offsets following State Land buyback

If MEDQ exercises an option under the Call Option Deed:

(a) Clauses 7.1(b), 7.3(a) and 7.3(b) do not apply; and

(b) The offsets for the PDA Infrastructure Contributions that have been Practically Completed may be applied in accordance with the PDA Infrastructure Contributions Schedule for development in accordance with any Approval for development on land in the Weinam Creek PDA area in accordance with the process for claiming an offset set out in Schedule 2.

7.5 Offset register

(a) MEDQ must keep a register for the purpose of keeping a true and accurate account of the accrual and set off, if any, of an offset. After offsets have accrued under this clause 7 and Schedule 2, Council may give MEDQ a notice stating that:

  (1) the offsets are allocated to specific lots within the Council Land or the State Land; or

  (2) the offsets will be recorded as unallocated until specified in a later notice given to MEDQ by RIC.

(b) The MEDQ must comply with a Notice given by Council stating that Council wishes to:

  (1) inspect the register kept under clause 7.5(a); or

  (2) obtain a copy of an extract from the register kept under clause 7.5(a).

(c) Council and RIC must comply with a Notice given by the MEDQ requiring Council and RIC to provide reasonable or relevant information for the purpose of enabling the MEDQ to keep the register under clause 7.5(a).

8. Restriction on assignment and sale

8.1 Restriction on assignment

Council and RIC must not assign, transfer or novate all or any part of their rights, interests or obligations under this document.

8.2 Restriction on sale

RIC must not sell or transfer the State Land (other than in accordance with the Call Option Deed or to provide a Land Contribution), prior to the performance and fulfilment of the PDA Infrastructure Obligations.

9. Force Majeure Event

9.1 Notice of Force Majeure Event

If a party is affected, or likely to be affected, by a Force Majeure Event, that party (**Affected Party**) must as soon as reasonably practicable give each other party notice of that fact specifying:

(a) full particulars of the Force Majeure Event;

(b) an estimate of its likely duration;

(c) the obligations of the Affected Party affected by the Force Majeure Event and the extent of its effect on those obligations; and

(d) any steps taken or proposed to be taken by the Affected Party to remove, remedy or minimise the effects of the Force Majeure Event.

9.2 Suspension of obligations

(a) On the giving of a notice under clause 9.1, the obligations under this document of the Affected Party are suspended but only to the extent and for so long as those obligations are affected by the Force Majeure Event.

(b) To be clear, this clause 9 applies to the obligation to Commence the Works Contribution for each of items 1A and 2 in the PDA Infrastructure Contributions Schedule and the Contributions Start Date must be extended by the reasonable period that the Commencement of those works is delayed by a Force Majeure Event occurring after the date that RIC becomes of the Owner of the State Land.

9.3 Delay or failure to perform

The Affected Party is not liable for:

(a) any delay or failure in the performance of the Affected Party's obligations under this document; or

(b) any Loss suffered by any other party as a result of the delay or failure in the performance of the Affected Party's obligations under this document,

to the extent that the obligations of the Affected Party are suspended under clause 9.2.

9.4 Effort to overcome

The Affected Party must use reasonable endeavours to remove, remedy or minimise the effects of that Force Majeure Event as quickly as possible but this obligation does not require the Affected Party to settle any industrial dispute in any way that it considers inappropriate.

9.5 End of Force Majeure

On removal or resolution of the effects of the Force Majeure Event, the Affected Party must:

(a) notify each other party within ten days of such removal or resolution; and

(b) re-commence carrying out its obligations under this document promptly and no later than 10 Business Days after the removal or resolution of the effects of the Force Majeure Event.

9.6 No Termination

No party is entitled to terminate this document because of the occurrence and continuation of a Force Majeure Event.

10. Indemnity and Release

On and from the Commencement Date, RIC and Council release and indemnify MEDQ from any Claim arising from or connected with the PDA Infrastructure Contributions.

11. Dispute resolution

11.1 Dispute

(a) If a dispute arises between the parties in relation to the interpretation of this document or the rights of any party under this document (**Dispute**), a party must not commence court or arbitration proceedings relating to the Dispute unless that party has participated in the dispute resolution procedures set out in this clause 11.

(b) Nothing in this clause 11 will prevent a party instituting proceedings for the purposes of seeking urgent injunctive or similar interim relief from a court.

11.2 Dispute Notice

A party claiming that a Dispute has arisen must give a written notice specifying the nature of the Dispute (**Dispute Notice**) to each other party.

11.3 Negotiation

As soon as practicable after the giving of a Dispute Notice, the parties must attempt to resolve the Dispute by negotiation.

11.4 Mediation procedure

(a) If the parties are unable to reach a resolution of the Dispute within ten Business Days of the giving of a Dispute Notice, any party may, by notice in writing (**Mediation Notice**), inform each other party that it seeks to have the Dispute resolved by mediation.

(b) On the giving of a Mediation Notice, the parties may refer the Dispute to a mediator agreed by them. If no agreement is reached on an appropriate mediator within ten Business Days of the giving of a Mediation Notice, any party may ask the President of the Queensland Law Society Inc to appoint a mediator in relation to the Dispute.

(c) A mediator appointed in relation to a Dispute:

  (1) has the right to determine:

    (A) the time, place and procedures for the mediation; and

    (B) whether to allow the appearance of lawyers on behalf of the parties; and

  (2) may engage other expert assistance to assist in the mediation.

(d) Each party must attend the mediation and make a determined and genuine effort to resolve the Dispute.

(e) Proceedings of the mediator will be as informal as is consistent with the proper conduct of the matter and will allow the mediator to communicate privately with the parties or with their lawyers.

(f) The parties agree that:

  (1) everything that occurs before the mediator will be in confidence;

  (2) no documents brought into existence specifically for the purpose for the mediation process will be called into evidence in any subsequent litigation by any party;

  (3) it will be the role of the mediator to act fairly, in good faith and without bias with the purpose of seeking a resolution of the Dispute and to treat all matters in confidence;

  (4) the parties to the mediation will bear the mediation costs on an equal basis and grant immunity from liability to the mediator;

  (5) no party will have any cause of action against the mediator or arising out of the conduct of the mediation; and

  (6) the mediator will not have any power to make any decision, determination or recommendation binding on the parties to resolve the Dispute.

11.5 Continuing obligations

Notwithstanding the existence of a Dispute, each party must continue to perform its obligations under this document.

11.6 Effect on Call Option Deed

Nothing in this clause 11 affects the ability of MEDQ to exercise an option under the Call Option Deed.

12. Warranties

Each of the parties represents and warrants for the benefit of the other that:

(a) it has taken, or has had the opportunity to take, independent legal advice as to the nature, effect and extent of this document;

(b) neither the party nor the Related Persons of the party have made any promise, representation or inducement or been party to any conduct material to the other parties entering into this document other than as set out in this agreement; and

(c) each party is aware that the other is relying on the warranties in this clause in executing this document.

13. GST

13.1 Interpretation

Words which have a defined meaning in the GST Law have the same meaning in this document unless the context otherwise requires.

13.2 GST exclusive amounts

Unless expressly stated to the contrary all amounts expressed in this document are exclusive of GST.

13.3 Taxable supplies

If a party (**Supplier**) is obliged under the GST Law to pay an amount of GST for a taxable supply made by the Supplier to another party (**Recipient**) under this document, the Recipient must pay the Supplier an amount equal to the GST payable on the supply by the Supplier.

13.4 Time for payment

The Recipient must pay the amount referred to in clause 13.3 and any interest, penalty, fine or expense relating to the GST, in addition to and at the same time as the consideration otherwise payable by the Recipient for the supply.

13.5 Tax invoice

If requested by the Recipient, the Supplier must provide the Recipient with a Tax Invoice for the supply by the earlier of either:

(a) five Business Days from the request being made; or

(b) on or before payment of the amounts required by this clause 13.

13.6 Adjustment events

If an adjustment event arises for a taxable supply under clause 13.3, the amounts required to be paid must be recalculated (**Recalculated Amount**) and the Recipient must pay the Supplier the Recalculated Amount.

13.7 Reimbursements

Where a party is required to pay for or reimburse an expense or outgoing of another party, the amount required to be paid or reimbursed is the amount of the expense or outgoing less any input tax credits to which the other party, or the representative member of a GST group to which they belong, is entitled.

14. Notices

14.1 Form

Any notice or other communication to or by any party must be:

(a) in writing and in the English language;

(b) addressed to the address of the recipient in clause 14.4 or to any other address as the recipient may have notified the sender; and

(c) be signed by the party or by an Authorised Officer of the sender.

14.2 Manner

In addition to any other method of service authorised by law, the notice may be:

(a) personally served on a party;

(b) left at the party's current address for service;

(c) sent to the party's current address for service by prepaid ordinary mail or if the address is outside Australia by prepaid airmail;

(d) sent by facsimile to the party's current numbers for service; or

(e) sent by electronic mail to the party's electronic mail address.

14.3 Time

If a notice is sent or delivered in the manner provided in clause 14.2 it must be treated as given to or received by the addressee in the case of:

(a) delivery in person, when delivered;

(b) delivery by post:

    (1) in Australia to an Australian address, the fourth Business Day after posting; or

    (2) in any other case, on the tenth Business Day after posting;

(c) facsimile, when a transmission report has been printed by the sender's facsimile machine stating that the document has been sent to the recipient's facsimile number; or

(d) electronic mail, when the sender's computer reports that the message has been delivered to the electronic mail address of the addressee,

but if delivery is made after 5.00pm on a Business Day it must be treated as received on the next Business Day in that place.

14.4 Initial details

The addresses and numbers for service are initially:

(a) for RIC, RIC's Address Details;

(b) for the Council, Council's Address Details; and

(c) for MEDQ, MEDQ's Address Details.

14.5 Changes

A party may from time to time change its address or numbers for service by notice to each other party.

15. Governing law and jurisdiction

15.1 Governing law

This deed is governed by and construed in accordance with the laws of Queensland.

15.2 Jurisdiction

Each party irrevocably:

(a) submits to the non-exclusive jurisdiction of the courts of Queensland and the courts competent to determine appeals from those courts, with respect to any proceedings which may be brought at any time relating to this deed; and

(b) waives any objection it may now or in the future have to the venue of any proceedings, and any claim it may now or in the future have that any proceedings have been brought in an inconvenient forum, if that venue falls within paragraph 15.2(a).

16. Miscellaneous

16.1 Exercise rights

A single or partial exercise or waiver by a party of any right under or relating to this deed will

16.2 Legal effect

Each party acknowledges and agrees for the benefit of each other party that this document is intended to take effect as a deed. Each party executes this document with the intention that it will be immediately legally bound by this document.

16.3 Merger

If the liability of a party to pay money under this deed becomes merged in any deed, judgment, order or other thing, the party liable must pay interest on the amount owing from time to time under that deed, judgment, order or other thing at the higher of the rate payable under this deed and that fixed by or payable under that deed, judgment, order or other thing.

16.4 Moratorium legislation

Any law which varies prevents or prejudicially affects the exercise by a party of any right, power or remedy conferred on it under this deed is excluded to the extent permitted by law.

16.5 Remedies cumulative

The rights and remedies under this deed are cumulative and not exclusive of any rights or remedies provided by law.

16.6 Relationship of the parties

This document is not intended to create a partnership, joint venture or agency relationship between the parties.

16.7 Severability

If a provision of this deed is illegal, invalid, unenforceable or void in a jurisdiction it is severed for that jurisdiction and the remainder of this deed has full force and effect and the validity or enforceability of that provision in any other jurisdiction is not affected. This clause has no effect if the severance alters the basic nature of this document or is contrary to public policy.

16.8 Further assurance

Each party must promptly at its own cost do all things (including executing and delivering all documents) necessary or desirable to give full effect to this deed and the transactions contemplated by it.

16.9 Costs

RIC will pay the MEDQ's legal costs of and incidental to this deed capped at $35,000 (excluding GST) within 10 Business Days of receipt of a Tax Invoice.

16.10 Taxes

Council must:

(a) pay all Taxes which may be payable or determinable in connection with the execution, delivery, performance or enforcement of this deed or any payment or receipt or of any transaction contemplated by this deed; and

(b) indemnify MEDQ against any liabilities resulting from any delay or omission by Council to pay any Taxes.

16.11 Time

(a) Time is of the essence of this deed.

(b) If the parties agree to vary a time requirement, the time requirement so varied is of the essence of this deed.

(c) An agreement to vary a time requirement must be in writing.

16.12 Variation

An amendment or variation to this deed is not effective unless it is in writing and signed by the parties.

16.13 Waiver

(a) A party's waiver of a right under or relating to this deed, whether prospectively or retrospectively, is not effective unless it is in writing and signed by that party.

(b) No other act, omission or delay by a party will constitute a waiver of a right.

16.14 Counterparts

(a) This agreement may consist of a number of counterparts and the counterparts taken together constitute one and the same instrument. The exchange of executed counterparts by email or facsimile will create a binding agreement.

(b) If this agreement is signed by any person using an Electronic Signature, the parties:

  (1) agree to enter into this agreement in electronic form;

  (2) consent to one or all of the parties signing the agreement using an Electronic Signature; and

  (3) agree a counterpart may be electronic and signed using an Electronic Signature.

(c) After all parties that are signing with an Electronic Signature have done so, any print-out showing the final Electronic Signature will be taken to be an executed original counterpart of this agreement.

(d) Each signatory to this agreement confirms that their signature appearing in the agreement through use of an Electronic Signature, and including any such print-out (irrespective of which party printed it), is their personal signature authenticating this agreement.

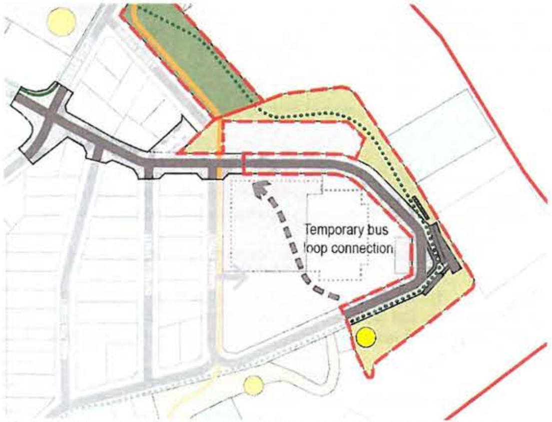
16.15 **Whole agreement**

This deed:

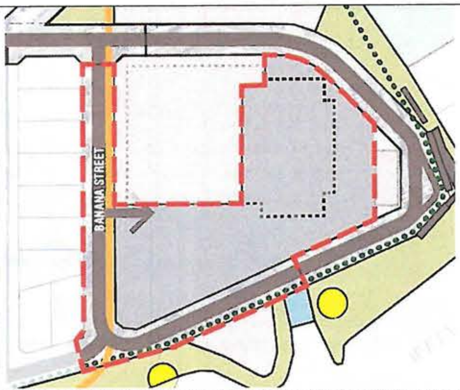
(a) is the entire agreement and understanding between the parties relating to the subject matter of this deed; and

(b) supersedes any prior agreement, representation (written or oral) or understanding on anything connected with that subject matter.

Items of PDA Infrastructure Contribution	PDA Infrastructure Contribution	Specifications for the PDA Infrastructure Contribution	Timing for the PDA Infrastructure Contribution (Date for Practical Completion)	Party responsible for providing Works Contribution	Party responsible for providing Land Contribution (if applicable)	Entity to whom Land Contribution dedicated	Is the PDA Infrastructure Contribution eligible for an offset and, if so, against which type of charge may the offset be claimed under the IA?	Amount of the Offset
Item 1 Roadworks and associated works and land.	Construction of Hamilton Street, Banana Street and new loop road, and associated works. Land Contribution of road beyond the existing road reserve.	The Works Contribution comprises the works identified at Item 1A, Item 1B and Item 1C below. Where the Works Contribution requires the delivery of a road, this also requires the provision of: • street lighting • relocation of existing services • stormwater network to suit roadworks • water and sewer reticulation, and • verge, including footpaths, street trees and landscaping. The Land Contribution for dedication of new road is as specified at Item 1A, Item 1B and Item 1C below.	As identified for Item 1A, Item 1B and Item 1C below					
		Item 1A Hamilton Street Modification  *(Source:133693-27 Sequencing Plans (9 June 2020) Stage 3A)* The Works Contribution comprises all works generally in accordance with the works identified in drawing numbers SK211 – SK213 Rev 1 by Calibre. The Land Contribution comprises all land for roads (beyond the existing road) to be dedicated as road (noting that offsets are not available for any Land Contribution for land that is part of the State Land).	The Works Contribution must have reached Practical Completion within 2 years of the Contributions Start Date of the Infrastructure Agreement. The Land Contribution must have reached Practical Completion within 2 years of the Contributions Start Date of the Infrastructure Agreement.	Council	RIC and Council	State	The PDA Infrastructure Contribution is eligible for offsets, other than Land Contribution where it involves the State Land. Offset may be claimed against the charges under EDQ's Infrastructure Funding Framework current 1 July 2021 as amended from time to time or replaced with an alternative charging framework (e.g. Development Charges and Offset Plan), currently being the "adopted charge" for the relevant development, for the Transport and Public parks and land for community facilities networks under the Redland Adopted Infrastructure Charges Resolution (No. 3.1) 2020, in accordance with the process in Schedule 2.	To be determined on application to EDQ in accordance with the process in Schedule 2.

		Item 1B Initial section of loop road
		
		
		(Source:133693-27 Sequencing Plans (9 June 2020) Stage 3B)
		The Works Contribution comprises all roadworks generally in accordance with the works identified in drawing numbers SK213 – SK215 Rev 1 by Calibre, and:
		• Construction of interim at grade carparking, during and after construction of the loop road that optimizes the availability of public carparking at all stages of the loop road construction
		• Provision of the following works particularised on pages 10 and 15 of the Landscape Masterplan Design Report, Further Issues Response by 02LA dated 14 July 2021:
		  • Page 10, item 8: Priority crossing in new road
		  • Page 10, item 18: Main Street works
		  • Page 10, item 23: Pedestrian crossings and connections
		  • Page 15, item 19 (printed as item 18): Full width concrete verge (as identified in sequencing plan Stage 3B above).
		The Land Contribution comprises being all land for roads (beyond the existing road) to be dedicated as road (noting that offsets are not available for any Land Contribution for land that is part of the State Land).
			The Works Contribution must have reached Practical Completion within 3 years of the Contributions Start Date of the Infrastructure Agreement
			The Land Contribution must have reached Practical Completion within 2 years of the Contributions Start Date of the Infrastructure Agreement.
				Council	RIC and Council	State	The PDA Infrastructure Contribution is eligible for offsets, other than Land Contribution where it involves the State Land.
							Offset may be claimed against the charges under EDQ's Infrastructure Funding Framework current 1 July 2021 as amended from time to time or replaced with an alternative charging framework (e.g. Development Charges and Offset Plan), currently being the "adopted charge" for the relevant development, for the Transport and Public parks and land for community facilities networks under the Redland Adopted Infrastructure Charges Resolution (No. 3.1) 2020, in accordance with the process in Schedule 2.
								To be determined on application to EDQ in accordance with the process in Schedule 2.

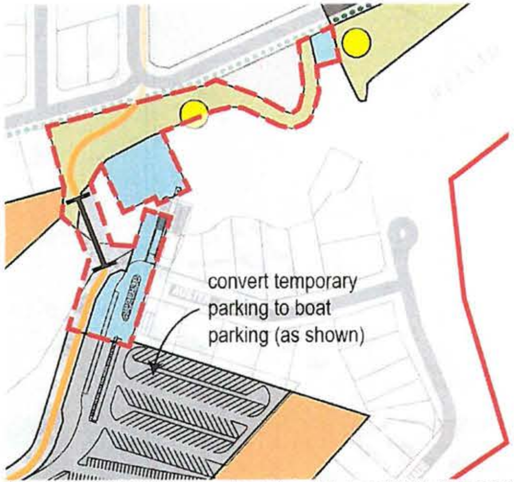
		Item 1C Completion of loop road	The Works Contribution must have reached Practical Completion within 5 years of the Contributions Start Date of the Infrastructure Agreement. The Land Contribution must have reached	Council	RIC and Council	State	The PDA Infrastructure Contribution is eligible for offsets, other than Land Contribution where it involves the State Land. Offset may be claimed against the charges under EDQ's Infrastructure Funding Framework current 1 July 2021 as amended from time to time or replaced with an alternative charging	To be determined on application to EDQ in accordance with the process in Schedule 2.

		
		Source: 133693-27 Sequencing Plans (9 June 2020) Stage 3D
		The Works Contribution comprises all roadworks generally in accordance with the works identified in drawing numbers SK213 and SK216 Rev 1 by Calibre, and:
		• Provision of interim at grade carparking, during and after construction of the loop road that optimizes the availability of public carparking at all stages of the loop road construction and
		• Provision of the following works identified on page 15, and further particularised on pages 14 – 18, of the Landscape Masterplan Design Report, Further Issues Response by 02LA dated 14 July 2021:
		  • Item 7: Priority crossing in new road
		  • Item 13: Shared path
		  • Item 15: Three (3) bus standing bays associated with the bus mealing station
		  • Item 19 (printed as item 18): Full width street verge (as identified in sequencing plan Stage 3D above).
		The Land Contribution comprises all land for roads (beyond the existing road) to be dedicated as road (noting that offsets are not available for any Land Contribution for land that is part of the State Land).
			Practical Completion within 2 years of the Contributions Start Date of the Infrastructure Agreement.				framework (e.g. Development Charges and Offset Plan), currently being the "adopted charge" for the relevant development, for the Transport and Public parks and land for community facilities networks under the Redland Adopted Infrastructure Charges Resolution (No. 3.1) 2020, in accordance with the process in Schedule 2.	

Item 2 Parks and foreshore improvements	Neville Stafford Park and Foreshore as identified in the Weinam Creek Priority Development Area Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021 (pages 9 – 13). Land Contribution of public park land.	**Neville Stafford Park, Foreshore and Town Plaza Works** The Works Contribution comprises the following items identified on page 10, and further particularised on pages 9 – 13, of the Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021: • Item 4: Shared path including cycleway • So much of Item 6: Plaza extension that the connectivity between Items 10, 11 and 13 are maintained around the foreshore to the park at a high standard of finish, but noting that the works may not be fully completed to enable the development parcels to be developed without requiring rectification of public realm. For the avoidance of doubt, this item is about continuation of walkability	The Works Contribution must have reached practical completion within 3 years of the Contributions Start Date of the Infrastructure Agreement. The Land Contribution must have reached Practical Completion within 2 years of the	Council	RIC and Council	Council for public parks State for roads	The PDA Infrastructure Contribution is eligible for offsets, other than Land Contribution where it involves the State Land. Offset may be claimed against the charges under EDQ's Infrastructure Funding Framework current 1 July 2021 as amended from time to time or replaced with an alternative charging framework (e.g. Development Charges and	To be determined on application to EDQ in accordance with the process in Schedule 2.

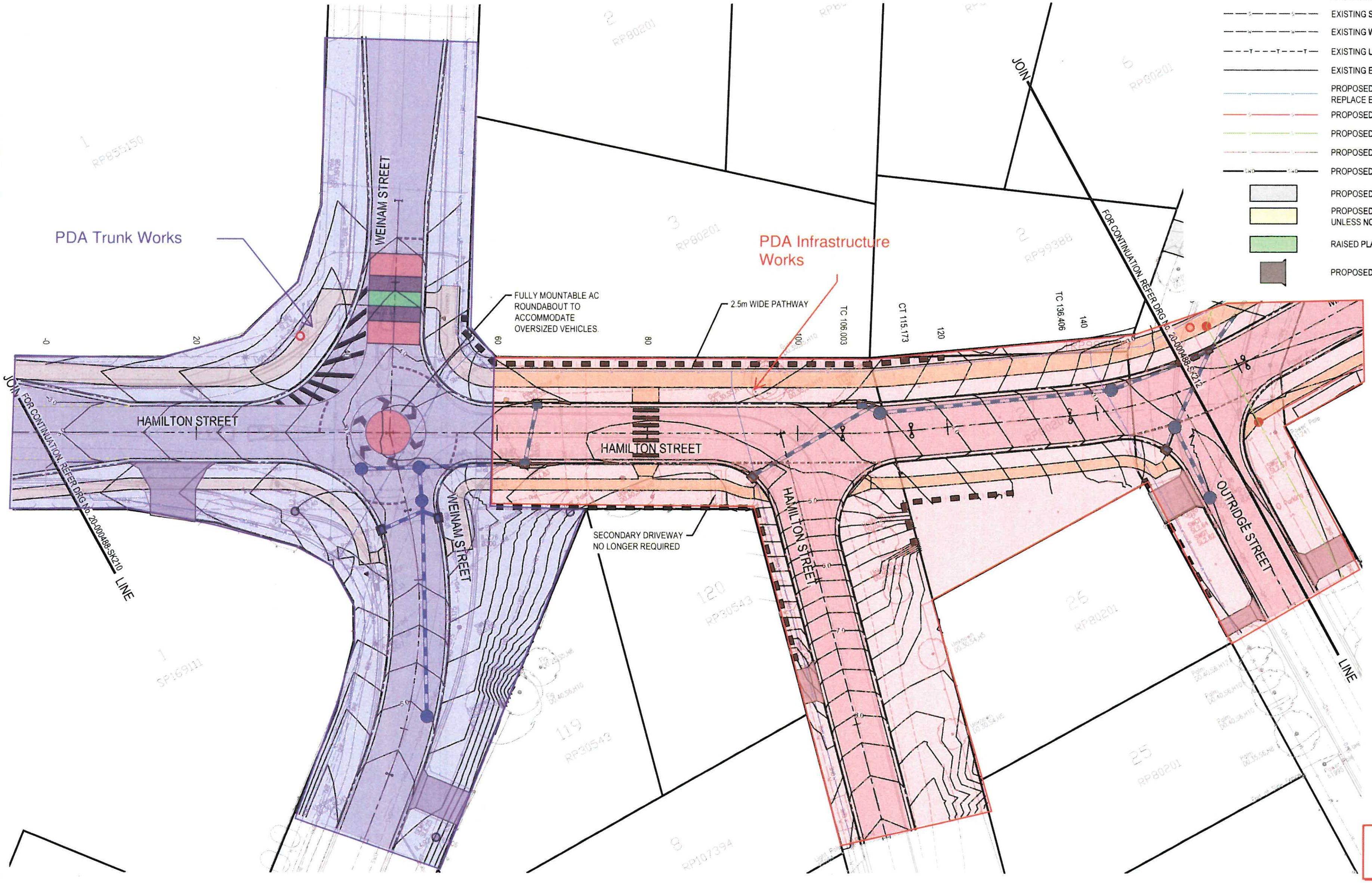
		and access at a high standard of finish as envisaged by the masterplan. - So much of Item 7: Decking that the connectivity between Items 10, 11 and 13 are maintained around the foreshore to the park at a high standard of finish, but noting that the works may not be fully completed to enable the development parcels to be developed without requiring rectification of public realm. For the avoidance of doubt, this item is about continuation of walkability and access at a high standard of finish as envisaged by the masterplan. - Item 10: Pod deck - Item 11: Civic foreshore promenade including high amenity pavements, feature sculpture, garden beds, pockets of lawn, seats, water points, signage and picnic facilities - Item 12: Steps to beach - Item 13: Mixed use plaza - Item 21: Pocket park – this area will be finished with turf and left aesthetically pleasing until development of the adjoining development parcels. The Land Contribution comprises the following: - All park and foreshore land to be dedicated as public park; (noting that offsets are not available for any Land Contribution for land that is part of the State Land).  *(Source: Weinam Creek Priority Development Area Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021 -page 10)*	Contributions Start Date of the Infrastructure Agreement.				Offset Plan), currently being the "adopted charge" for the relevant development, for the Transport and Public parks and land for community facilities networks under the Redland Adopted Infrastructure Charges Resolution (No. 3.1) 2020, in accordance with the process in Schedule 2.	
Item 3 Parks and foreshore improvements	Weinam Creek Foreshore as identified in the Weinam Creek Priority Development Area Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021 (pages 14 – 18)	**Weinam Creek Foreshore and Linear Park connection to precinct 1A** The Works Contribution comprises the following items identified on page 15, and further particularised on pages 14 – 18, of the Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021: - Items 3 and 6: Linear Creek parkland including pathway, seating, shade trees, picnic facilities and water points - Item 8: Pedestrian and cyclist node including crossing point to Banana Street, lawn, water point, seating and pod deck to water - Item 9: Amenities block and service zone - Item 14: Vehicular access to water police facility.	The Works Contribution must have reached practical completion within 5 years after the Contributions Start Date of the Infrastructure Agreement. The Land Contribution must have reached	Council	RIC and Council	Council for public parks State for roads	The PDA Infrastructure Contribution is eligible for offsets, other than Land Contribution where it involves the State Land. Offset may be claimed against the charges under EDQ's Infrastructure Funding Framework current 1 July 2021 as amended from time to time or replaced with an alternative charging	To be determined on application to EDQ in accordance with the process in Schedule 2.

	Land Contribution of public park land.	The Land Contribution comprises the following: • All park and foreshore land to be dedicated as public park; (noting that offsets are not available for any Land Contribution for land that is part of the State Land).  *(Source: Weinam Creek Priority Development Area Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021 - page 15)*	Practical Completion within 2 years of the Contributions Start Date of the Infrastructure Agreement.				framework (e.g. Development Charges and Offset Plan), currently being the "adopted charge" for the relevant development, for the Transport and Public parks and land for community facilities networks under the Redland Adopted Infrastructure Charges Resolution (No. 3.1) 2020, in accordance with the process in Schedule 2.	
Item 4 Boat ramp and associated works	Recreational Boat Ramp and associated works as identified in the Weinam Creek Priority Development Area Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021 (page 19) Land Contribution of public park land.	**Recreational Boat Ramp and associated works** The Works Contribution comprises the following: • The following items identified on page 19 of the Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021 and further particularised in drawing numbers 200, 300, 310, 350, 360, 370 and 600 Revision 1 by Calibre: o Item 1: Three-lane boat ramp provided generally in accordance with drawing number 790486-001-SK-1000 Rev C by Cardno o Item 3: Car and boat parking, including alteration of existing carparks to establish 90 boat and trailer parks to service the boat ramp • Construction of the vehicular access to connect the boat ramp to the car and trailer parking area, including rigging and securing areas generally in accordance with drawing number 370 Rev 1 by Calibre. Extend the lighting and CCTV facilities from the existing car park to the access and rigging area. • • Demolition and removal of the existing mooring facility on the northern side of Weinam Creek The Land Contribution comprises the following:	The Works Contribution must have reached Practical Completion within 5 years after the Contributions Start Date of the Infrastructure Agreement. The Land Contribution must have reached Practical Completion within 2 years of the Contributions Start Date of the Infrastructure Agreement.	Council	Council and RIC	Council for public parks State for roads	The PDA Infrastructure Contribution is eligible for offsets, other than Land Contribution where it involves the State Land. Offset may be claimed against the charges under EDQ's Infrastructure Funding Framework current 1 July 2021 as amended from time to time or replaced with an alternative charging framework (e.g. Development Charges and Offset Plan), currently being the "adopted charge" for the relevant development, for the Transport and Public parks and land for community facilities networks under the Redland Adopted Infrastructure Charges Resolution (No. 3.1) 2020, in accordance with the process in Schedule 2.	To be determined on application to EDQ in accordance with the process in Schedule 2.

		- All park and foreshore land to be dedicated as public park; (noting that offsets are not available for any Land Contribution for land that is part of the State Land).  *(Source:133693-27 Sequencing Plans (10 June 2020) Stage 3C)*						
Item 5 Meissner Street works	Construction of Meissner Street, ancillary roads and associated works.	**Works in front of the Satellite Hospital Site** The Works Contribution comprises the construction of works on Meissner Street identified on drawing numbers SK216, SK217 and SK218 Rev 1 by Calibre as follows: - major pedestrian path (2.5m wide minimum) on the Southern side of Meissner Street only (identified on page 4 of the Landscape Master Plan Design Report, Further Issues Response by 02LA dated 14 July 2021) - bus stop pair (Meissner Street only). The Land Contribution comprises all land for roads (beyond the existing road) to be dedicated as road (noting that offsets are not available for any Land Contribution for land that is part of the State Land).	The Works Contribution must have reached Practical Completion within 5 years after the Contributions Start Date of the Infrastructure Agreement. The Land Contribution must have reached Practical Completion within 2 years of the Contributions Start Date of the Infrastructure Agreement.	Council	Council	State	The PDA Infrastructure Contribution is eligible for offsets, other than Land Contribution where it involves the State Land. Offset may be claimed against the charges under EDQ's Infrastructure Funding Framework current 1 July 2021 as amended from time to time or replaced with an alternative charging framework (e.g. Development Charges and Offset Plan), currently being the "adopted charge" for the relevant development, for the Transport and Public parks and land for community facilities networks under the Redland Adopted Infrastructure Charges Resolution (No. 3.1) 2020, in accordance with the process in Schedule 2.	To be determined on application to EDQ in accordance with the process in Schedule 2.

LEGEND

- PROPOSED BARRIER KERB & CHANNEL TYPE 'B1'
- PROPOSED RETAINING WALL AND FENCING AS REQUIRED (APPROX. EXTENT)
- EXISTING STORMWATER DRAINAGE
- EXISTING SEWERAGE RETICULATION
- EXISTING WATER RETICULATION
- EXISTING UNDERGROUND TELECOMMUNICATION
- EXISTING EDGE OF BITUMEN
- PROPOSED 150 DIA WATER PIPE TO REPLACE EXISTING 100 DIA WATER AC
- PROPOSED 150 DIA SEWER RETICULATION
- PROPOSED 200 DIA SEWER RETICULATION
- PROPOSED 225 DIA SEWER RETICULATION
- PROPOSED STORMWAER RETICULATION
- ☐ PROPOSED ASPHALT SURFACING
- ☐ PROPOSED 1.5m CONCRETE FOOTPATH. UNLESS NOTED OTHERWISE.
- 🟩 RAISED PLATFORM
- ▨ PROPOSED DRIVEWAY



FULLY MOUNTABLE AC ROUNDABOUT TO ACCOMMODATE OVERSIZED VEHICLES.

2.5m WIDE PATHWAY

SECONDARY DRIVEWAY NO LONGER REQUIRED

CONCEPT ONLY SUBJECT TO REFINEMENT DURING DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	RT	BB

DRAWN

DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE
1:250 5 0 5 10m A1
1:500 A3

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PROJECT
WEINAM CREEK PDA PRECINCT 1

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE
ROADWORKS LAYOUT
MASTER PLAN
SHEET 2 OF 9

PROJECT No	DRAWING No	REVISION
20-000488	SK211	1

PDA Infrastructure Works

PDA Trunk Works
(Not Part of Land Swap Agreement)

Trunk sewer to be built
with Infrastructure Works

CONCEPT ONLY SUBJECT
TO REFINEMENT DURING
DETAILED DESIGN

LEGEND

▬ ▬ ▬	PROPOSED BARRIER KERB & CHANNEL TYPE 'B1'
■ I ■ I ■	PROPOSED RETAINING WALL AND FENCING AS REQUIRED (APPROX. EXTENT)
— —SWD— —	EXISTING STORMWATER DRAINAGE
— —S— —	EXISTING SEWERAGE RETICULATION
— —W— —	EXISTING WATER RETICULATION
- - -T- - -T-	EXISTING UNDERGROUND TELECOMMUNICATION
——	EXISTING EDGE OF BITUMEN
—W—	PROPOSED 150 DIA WATER PIPE TO REPLACE EXISTING 100 DIA WATER AC
—S—	PROPOSED 150 DIA SEWER RETICULATION
—S—	PROPOSED 200 DIA SEWER RETICULATION
—S—	PROPOSED 225 DIA SEWER RETICULATION
—SWD—	PROPOSED STORMWAER RETICULATION
☐	PROPOSED ASPHALT SURFACING
☐	PROPOSED 1.5m CONCRETE FOOTPATH. UNLESS NOTED OTHERWISE.
🟩	RAISED PLATFORM
■	PROPOSED DRIVEWAY

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	RT	BB

DRAWN

DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE
1:250 5 0 5 10m A1
1:500 A3

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WEINAM CREEK PDA PRECINCT 1

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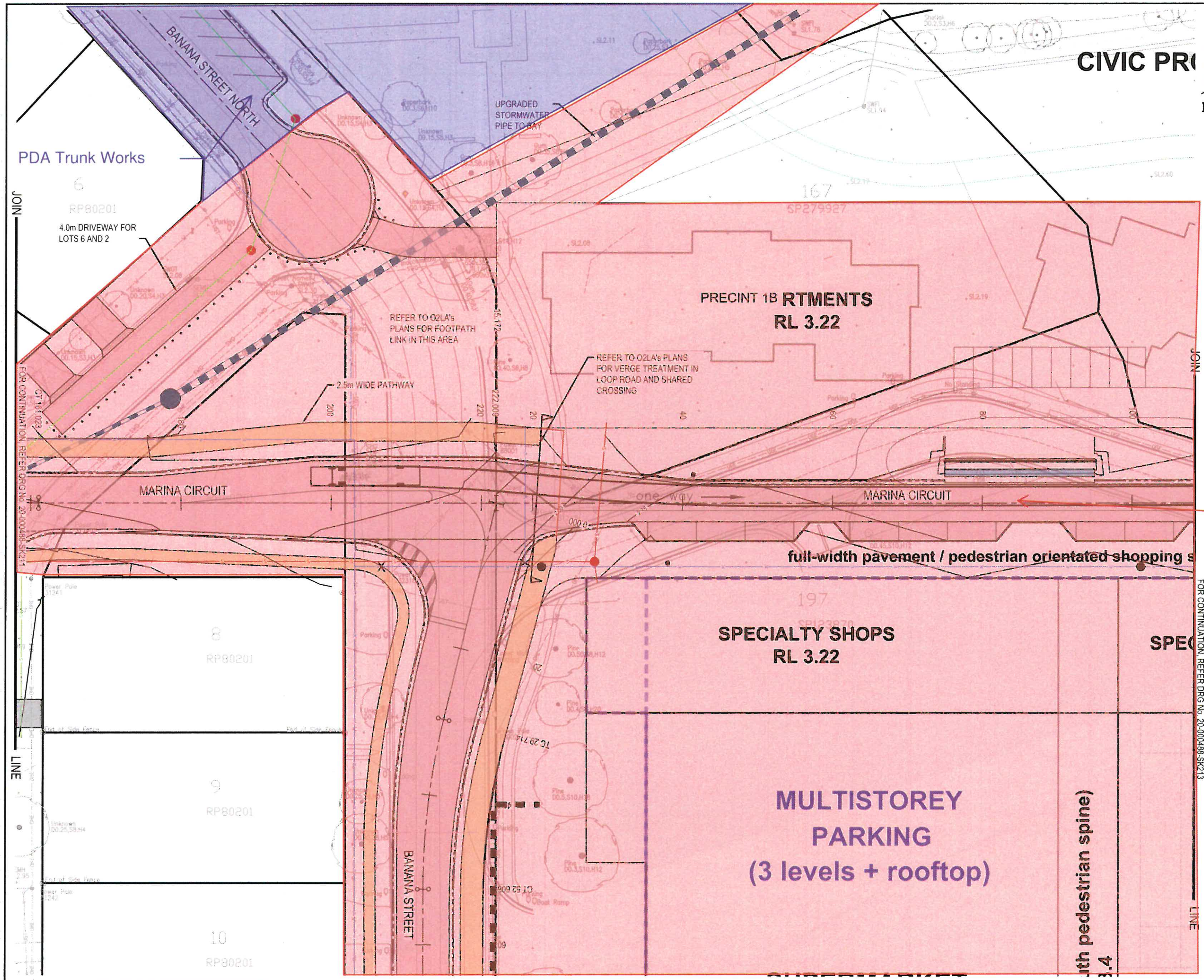
DRAWING TITLE
ROADWORKS LAYOUT
MASTER PLAN
SHEET 3 OF 9

PROJECT No	DRAWING No	REVISION
20-000488	SK212	1



LEGEND

━ ━ ━	PROPOSED BARRIER KERB & CHANNEL TYPE 'B1'
▪ ▪ ▪	PROPOSED RETAINING WALL AND FENCING AS REQUIRED (APPROX. EXTENT)
— SWD —	EXISTING STORMWATER DRAINAGE
— S —	EXISTING SEWERAGE RETICULATION
— W —	EXISTING WATER RETICULATION
— T —	EXISTING UNDERGROUND TELECOMMUNICATION
——	EXISTING EDGE OF BITUMEN
— W —	PROPOSED 150 DIA WATER RETICULATION
— S —	PROPOSED 150 DIA SEWER RETICULATION
— SWD —	PROPOSED STORMWAER RETICULATION
▨	PROPOSED ASPHALT SURFACING
▨	PROPOSED 1.5m CONCRETE FOOTPATH. UNLESS NOTED OTHERWISE.
▨	PROPOSED DRIVEWAY
▨	PROPOSED BIO RETENTION BASIN

PDA Infrastructure Works

CONCEPT ONLY SUBJECT TO REFINEMENT DURING DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	RT	BB

DRAWN

DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE
1:250 5 0 5 10m A1
1:500 A3

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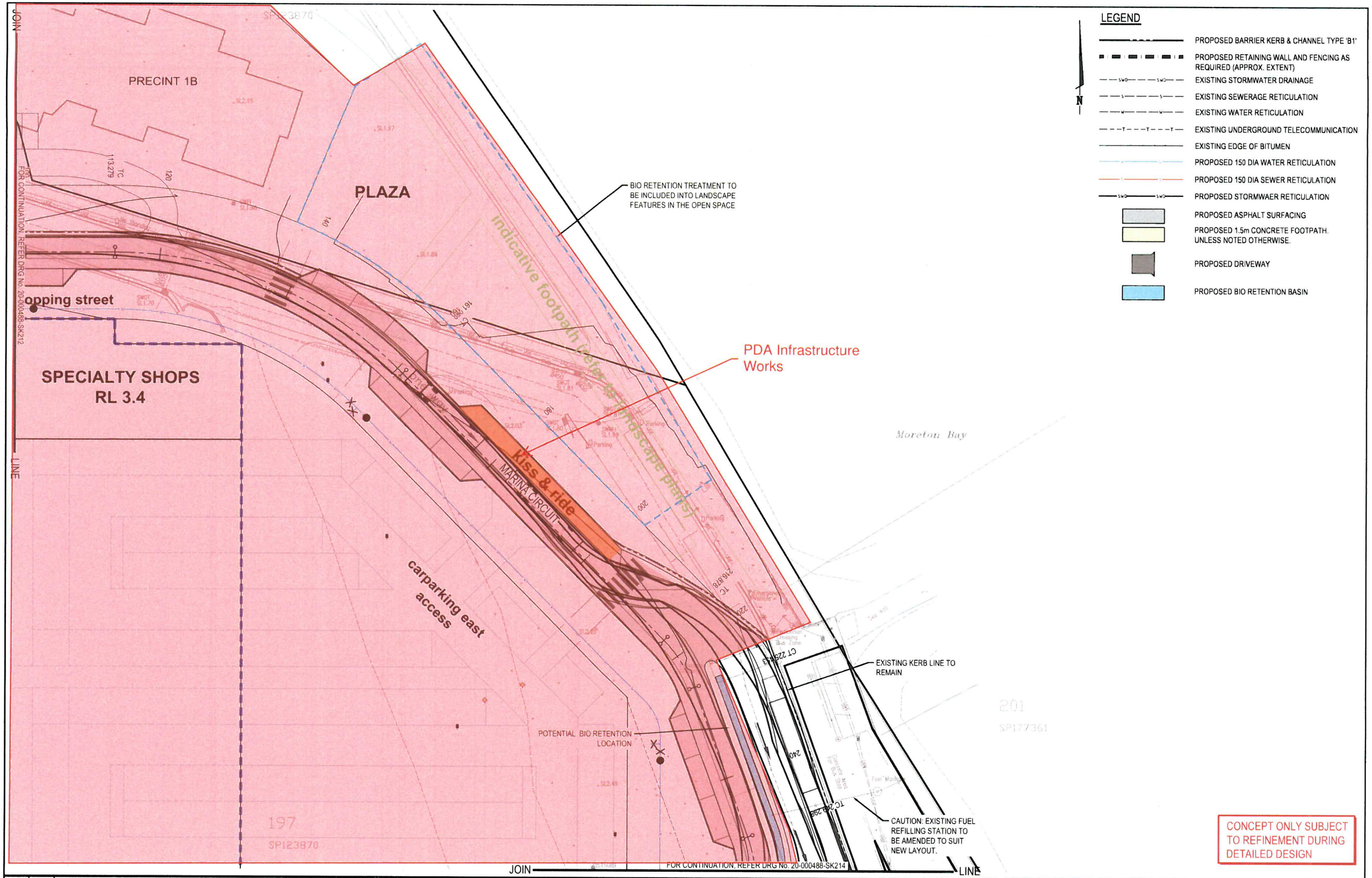
DRAWING TITLE
ROADWORKS LAYOUT
MASTER PLAN
SHEET 4 OF 9

PROJECT No	DRAWING No	REVISION
20-000488	SK213	1



REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	RT	BB

DRAWN

DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE
1:250 5 0 5 10m A1
1:500 A3

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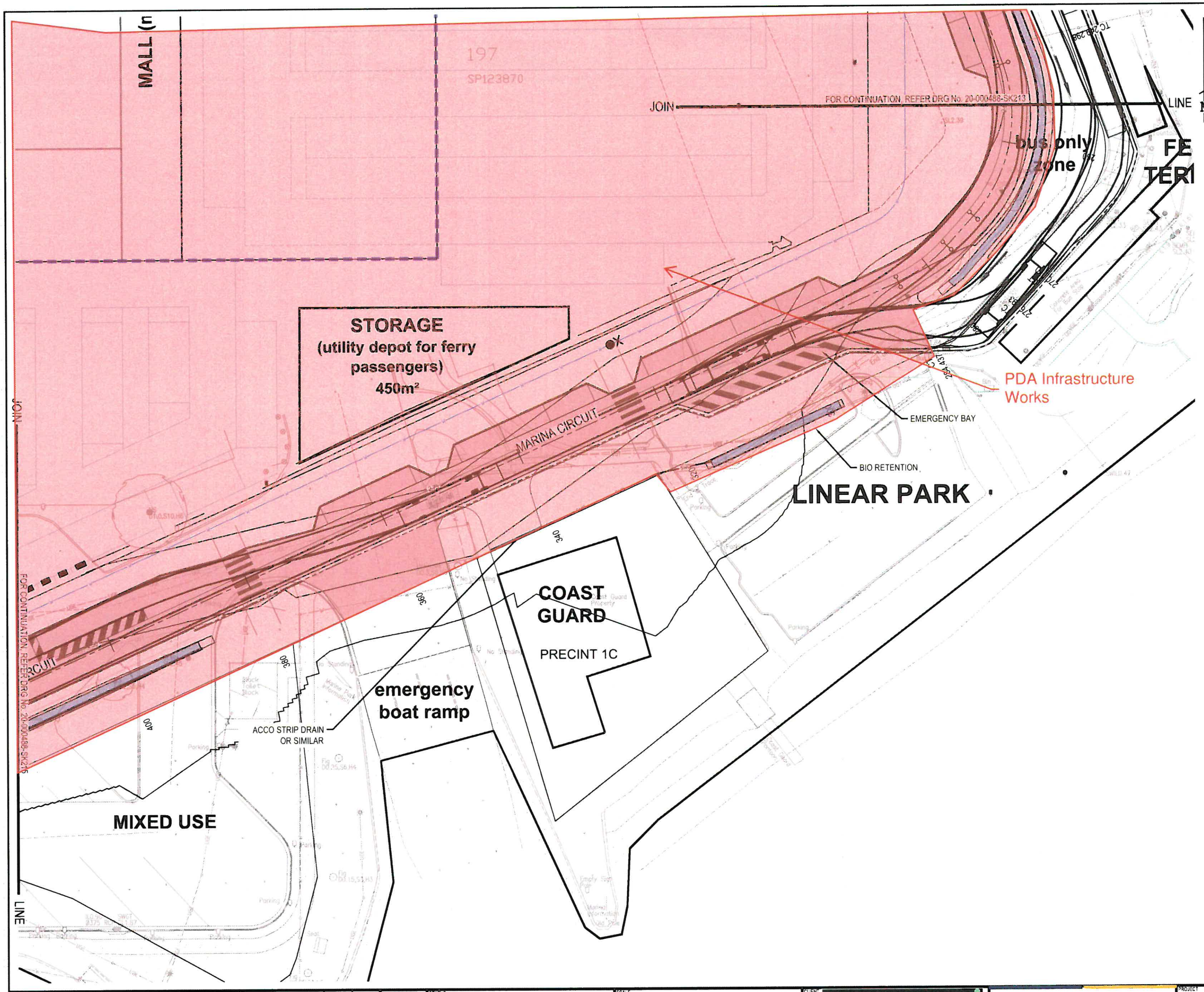
DRAWING TITLE
ROADWORKS LAYOUT
MASTER PLAN
SHEET 5 OF 9

PROJECT No	DRAWING No	REVISION
20-000488	SK214	1



LEGEND

▬ ▬ ▬	PROPOSED BARRIER KERB & CHANNEL TYPE 'B1'
▪ ▬ ▪ ▬	PROPOSED RETAINING WALL AND FENCING AS REQUIRED (APPROX. EXTENT)
— SWD — SWD —	EXISTING STORMWATER DRAINAGE
— S — S —	EXISTING SEWERAGE RETICULATION
— W — W —	EXISTING WATER RETICULATION
— T — T —	EXISTING UNDERGROUND TELECOMMUNICATION
——	EXISTING EDGE OF BITUMEN
——	PROPOSED 150 DIA WATER RETICULATION
——	PROPOSED 150 DIA SEWER RETICULATION
— SWD — SWD —	PROPOSED STORMWAER RETICULATION
▭	PROPOSED ASPHALT SURFACING
▭	PROPOSED 1.5m CONCRETE FOOTPATH. UNLESS NOTED OTHERWISE.
■	PROPOSED DRIVEWAY
▭	PROPOSED BIO RETENTION BASIN

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DESIGN

STATUS

DEVELOPMENT APPLICATION

SCALE

1:250 5 0 5 10m A1
1:500 A3

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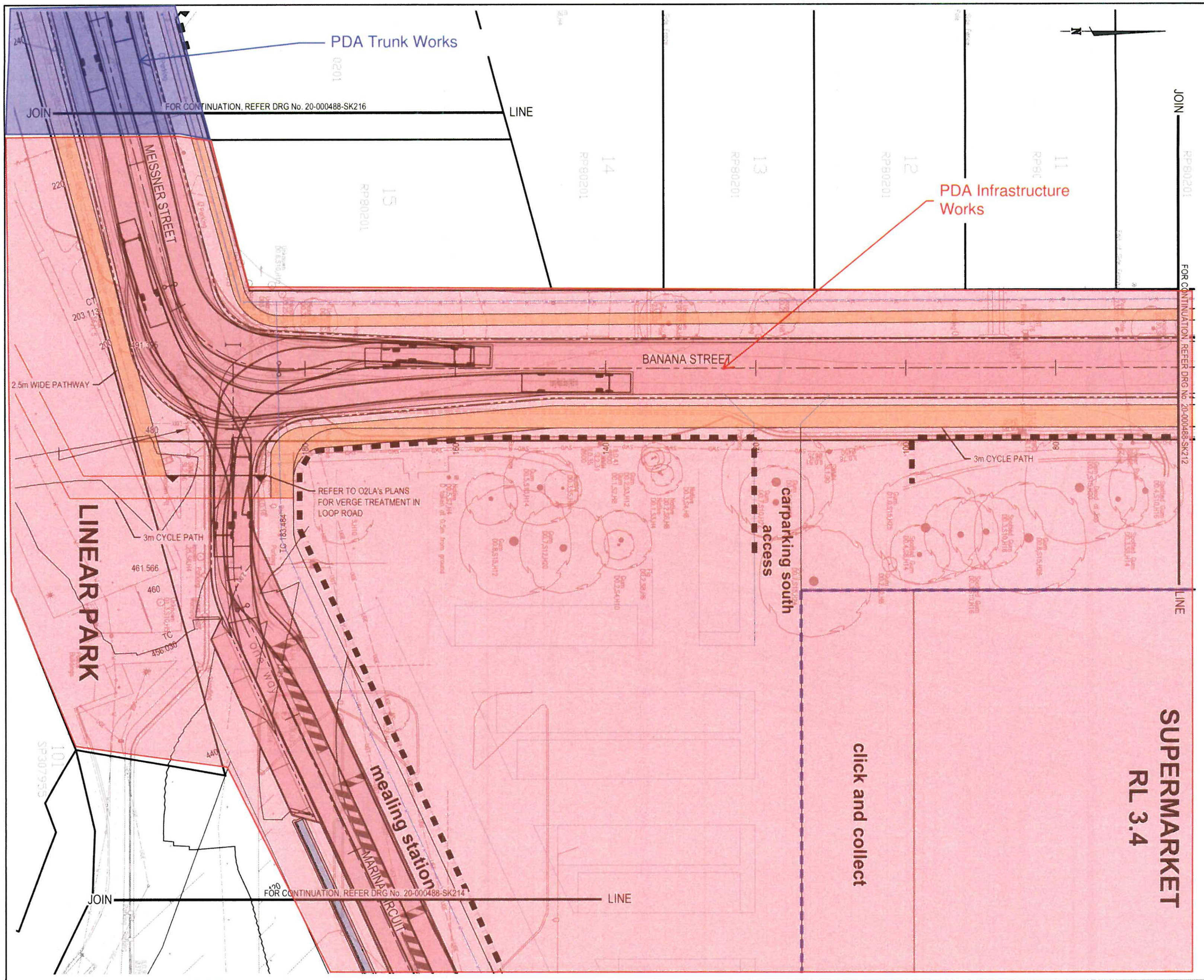
DRAWING TITLE

ROADWORKS LAYOUT
MASTER PLAN
SHEET 6 OF 9

PROJECT No	DRAWING No	REVISION
20-000488	SK215	1



LEGEND

▬ ▬ ▬	PROPOSED BARRIER KERB & CHANNEL TYPE 'B1'
■ ■ ■ ■	PROPOSED RETAINING WALL AND FENCING AS REQUIRED (APPROX. EXTENT)
— —SWD— — —SWD— —	EXISTING STORMWATER DRAINAGE
— —S— — —S— —	EXISTING SEWERAGE RETICULATION
— —W— — —W— —	EXISTING WATER RETICULATION
— — —T— — —T— — —T—	EXISTING UNDERGROUND TELECOMMUNICATION
———	EXISTING EDGE OF BITUMEN
—W——W—	PROPOSED 150 DIA WATER RETICULATION
—S——S—	PROPOSED 150 DIA SEWER RETICULATION
—SWD——SWD—	PROPOSED STORMWAER RETICULATION
▭	PROPOSED ASPHALT SURFACING
▭	PROPOSED 1.5m CONCRETE FOOTPATH. UNLESS NOTED OTHERWISE.
■	PROPOSED DRIVEWAY
▭	PROPOSED BIO RETENTION BASIN

CONCEPT ONLY SUBJECT
TO REFINEMENT DURING
DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	RT	BB

DRAWN

DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE
1:250 A1
1:500 A3
5 0 5 10m

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PROJECT
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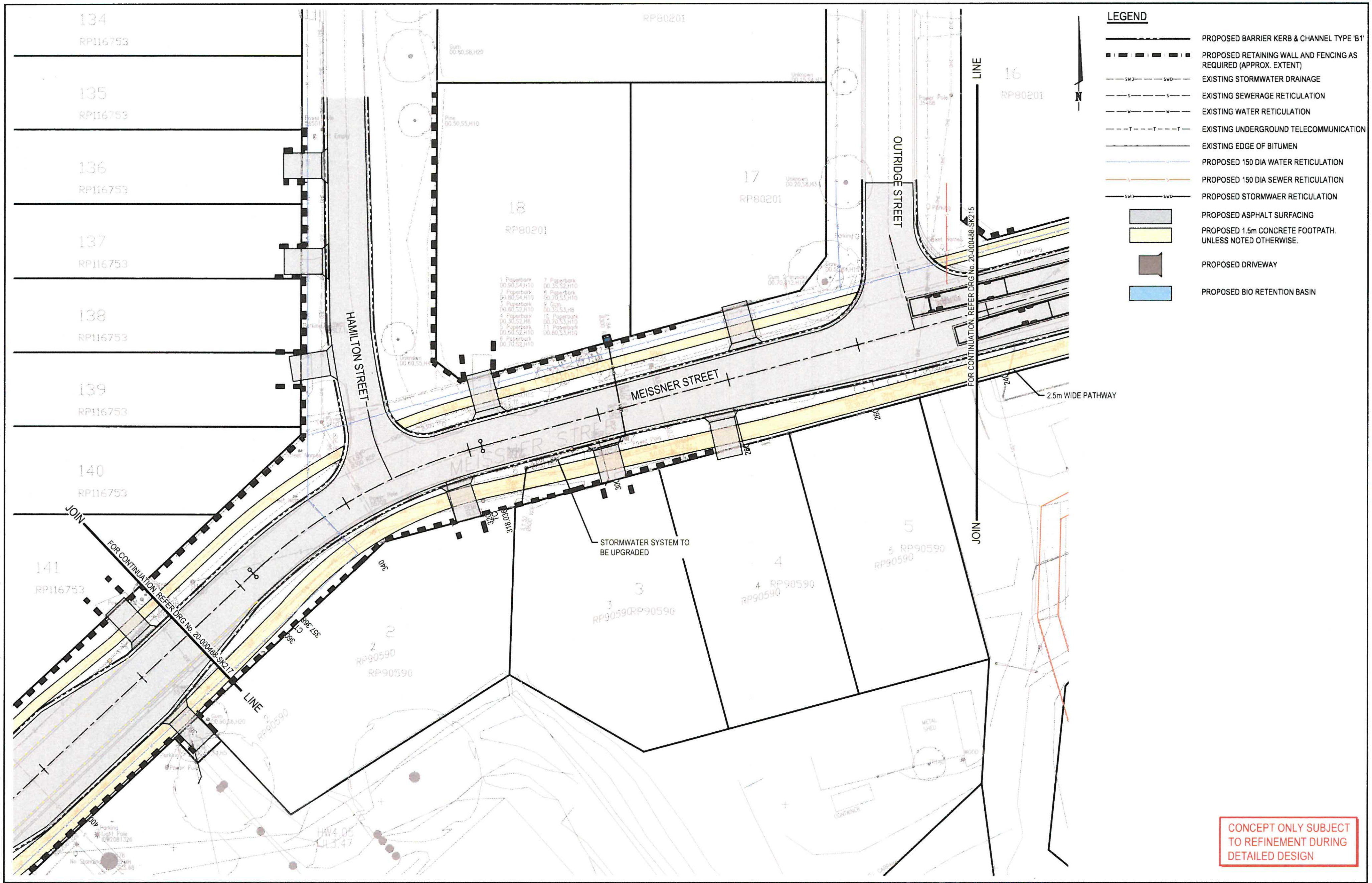
DRAWING TITLE
ROADWORKS LAYOUT
MASTER PLAN
SHEET 7 OF 9

PROJECT No	DRAWING No	REVISION
20-000488	SK216	1



CONCEPT ONLY SUBJECT TO REFINEMENT DURING DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	RT	BB

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DESIGN

STATUS

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SCALE

1:250 5 0 5 10m A1
1:500 A3

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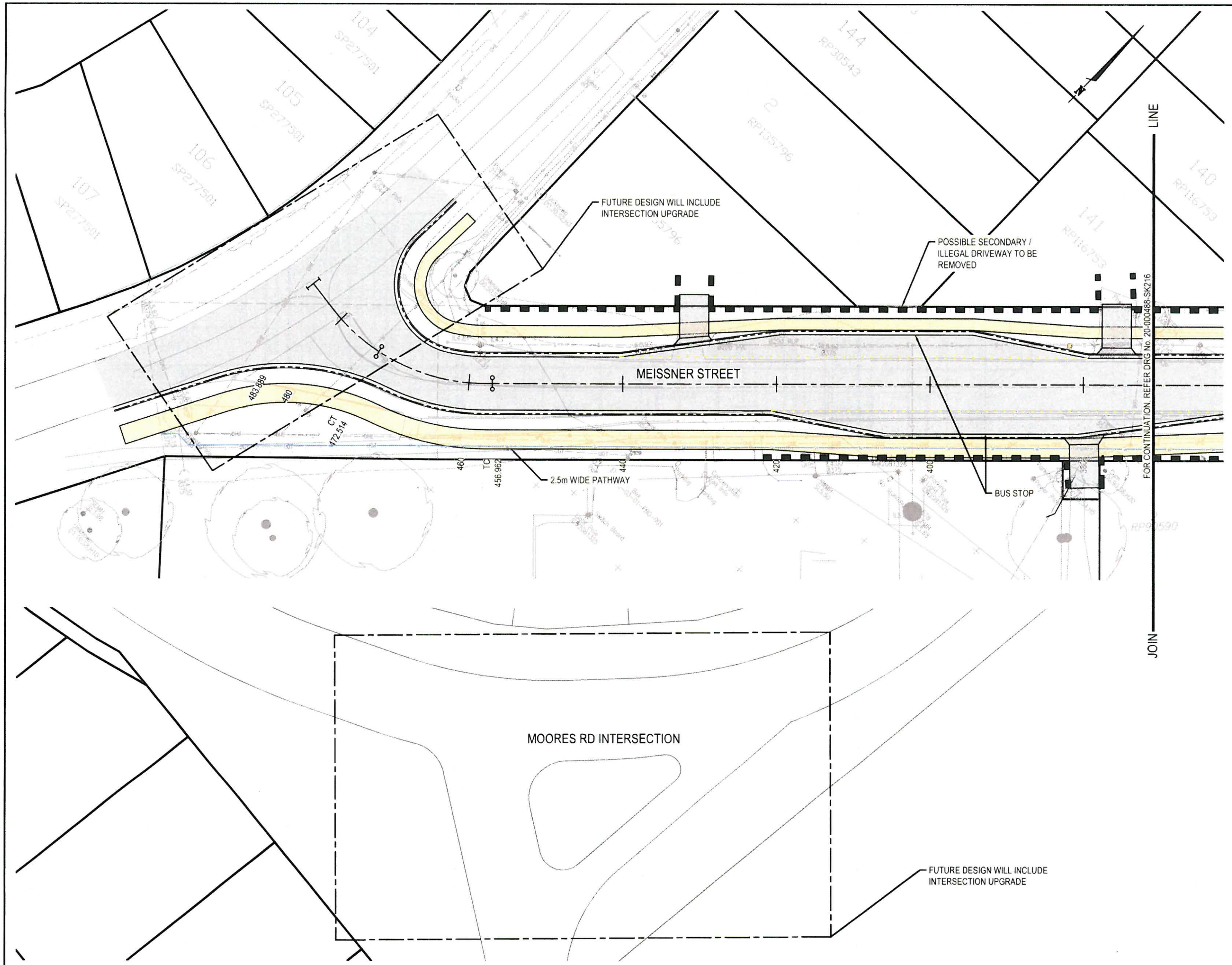
DRAWING TITLE
ROADWORKS LAYOUT
MASTER PLAN
SHEET 8 OF 9

PROJECT No	DRAWING No	REVISION
20-000488	SK217	1



LEGEND

▬ ▬	PROPOSED BARRIER KERB & CHANNEL TYPE 'B1'
▪ ▬ ▪ ▬	PROPOSED RETAINING WALL AND FENCING AS REQUIRED (APPROX. EXTENT)
— SWD — SWD —	EXISTING STORMWATER DRAINAGE
— S — S —	EXISTING SEWERAGE RETICULATION
— W — W —	EXISTING WATER RETICULATION
— T — T — T —	EXISTING UNDERGROUND TELECOMMUNICATION
——	EXISTING EDGE OF BITUMEN
——	PROPOSED 150 DIA WATER RETICULATION
——	PROPOSED 150 DIA SEWER RETICULATION
— SWD — SWD —	PROPOSED STORMWAER RETICULATION
▨	PROPOSED ASPHALT SURFACING
▨	PROPOSED 1.5m CONCRETE FOOTPATH. UNLESS NOTED OTHERWISE.
■	PROPOSED DRIVEWAY
▨	PROPOSED BIO RETENTION BASIN

CONCEPT ONLY SUBJECT TO REFINEMENT DURING DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	RT	BB

DRAWN

DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE
1:250 A1
1:500 A3
5 0 5 10m

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PROJECT
WEINAM CREEK PDA
PRECINCT 1

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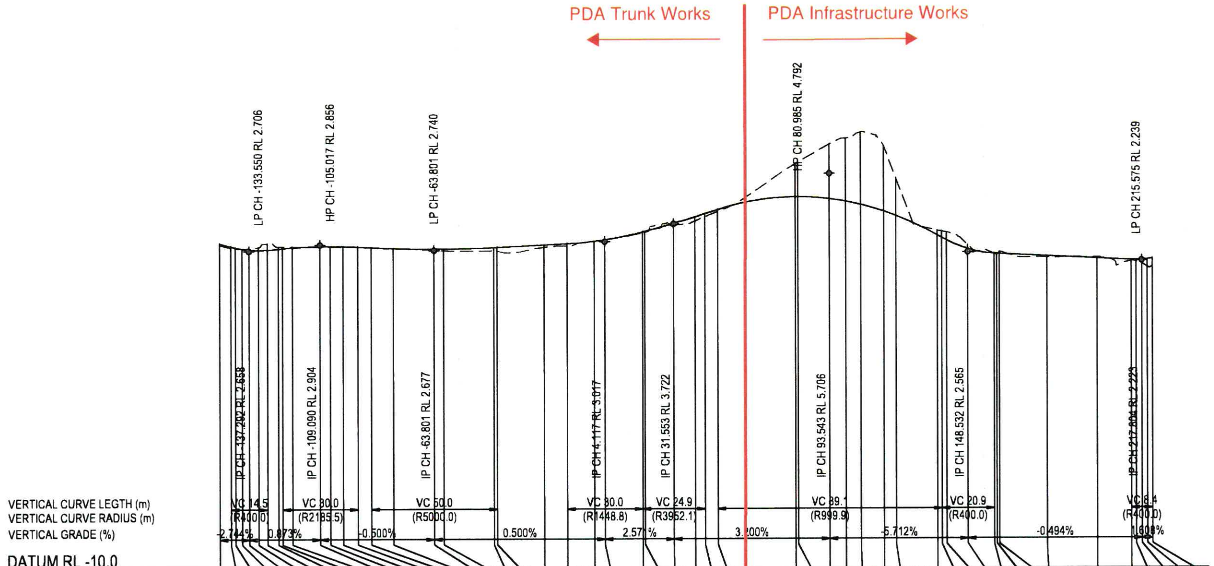
DRAWING TITLE
ROADWORKS LAYOUT
MASTER PLAN
SHEET 9 OF 9

PROJECT No. 20-000488
DRAWING No. SK218
REVISION 1

ROAD	POST SPEED
HAMILTON STREET - MARINA CIRCUIT	50 km/h
MARINA CIRCUIT FROM BANANA STREET TO BANANA STREET	30 km/h
BANANA STREET	50 km/h
MEISSNER STREET	50 km/h



CUT (-) / FILL	0.063	0.049	0.034	0.001	-0.055	-0.113	-0.244	-0.088	-0.073	-0.036	0.033	0.033	0.025
DESIGN SURFACE	2.978	2.856	2.812	2.758	2.723	2.706	2.721	2.759	2.773	2.805	2.852	2.856	2.850
EXISTING SURFACE	2.914	2.807	2.778	2.757	2.778	2.818	2.965	2.847	2.846	2.841	2.819	2.823	2.825
CHAINAGES	-148.953	-144.525	-142.768	-140.000	-137.292	-133.550	-130.059	-125.721	-124.090	-120.000	-109.090	-105.017	-100.000
HORIZONTAL CURVES			R30.000										

CUT (-) / FILL	0.003	-0.017	-0.013	0.037	0.058	0.129	0.146	0.095	0.093	-0.004	-0.005	0.036	0.040
DESIGN SURFACE	2.829	2.802	2.766	2.740	2.741	2.797	2.802	2.896	2.942	3.037	3.095	3.403	3.425
EXISTING SURFACE	2.826	2.820	2.779	2.703	2.683	2.667	2.656	2.801	2.849	3.042	3.100	3.366	3.385
CHAINAGES	-94.090	-88.801	-80.000	-63.801	-60.000	-40.000	-38.801	-20.000	-10.883	0.000	4.117	19.117	20.000
HORIZONTAL CURVES													

CUT (-) / FILL	0.091	0.167	0.129	0.079	-0.174	-1.293	-1.351	-2.165	-2.502	-2.871	-2.601	-1.505	-0.187
DESIGN SURFACE	3.742	3.995	4.120	4.280	4.572	4.792	4.792	4.713	4.611	4.479	4.208	4.031	3.256
EXISTING SURFACE	3.650	3.827	3.991	4.201	4.746	6.084	6.143	6.878	7.113	7.350	6.809	5.536	3.443
CHAINAGES	31.553	40.000	43.989	48.989	60.000	80.000	80.985	93.543	100.000	106.003	115.173	120.000	136.406
HORIZONTAL CURVES											R-100.000		

CUT (-) / FILL	-0.246	-0.310	-0.151	0.007	0.043	-0.070	0.055	-0.039	0.046	0.059	0.131	0.285	0.303
DESIGN SURFACE	3.161	3.057	2.701	2.513	2.508	2.503	2.410	2.311	2.244	2.239	2.245	2.263	2.290
EXISTING SURFACE	3.407	3.367	2.852	2.506	2.466	2.574	2.355	2.349	2.198	2.179	2.114	1.978	1.987
CHAINAGES	138.096	140.000	148.532	158.967	160.000	161.023	180.000	200.000	213.599	215.575	217.804	220.000	222.009
HORIZONTAL CURVES		R-60.000											

LONGITUDINAL SECTION - HAMILTON STREET - MARINA CIRCUIT

HORIZ SCALE: 1000
VERTICAL SCALE: 100

CONCEPT ONLY SUBJECT TO REFINEMENT DURING DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	BT	BB

DRAWN
DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE
AS SHOWN

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PROJECT
WEINAM CREEK PDA PRECINCT 1

DISCLAIMER
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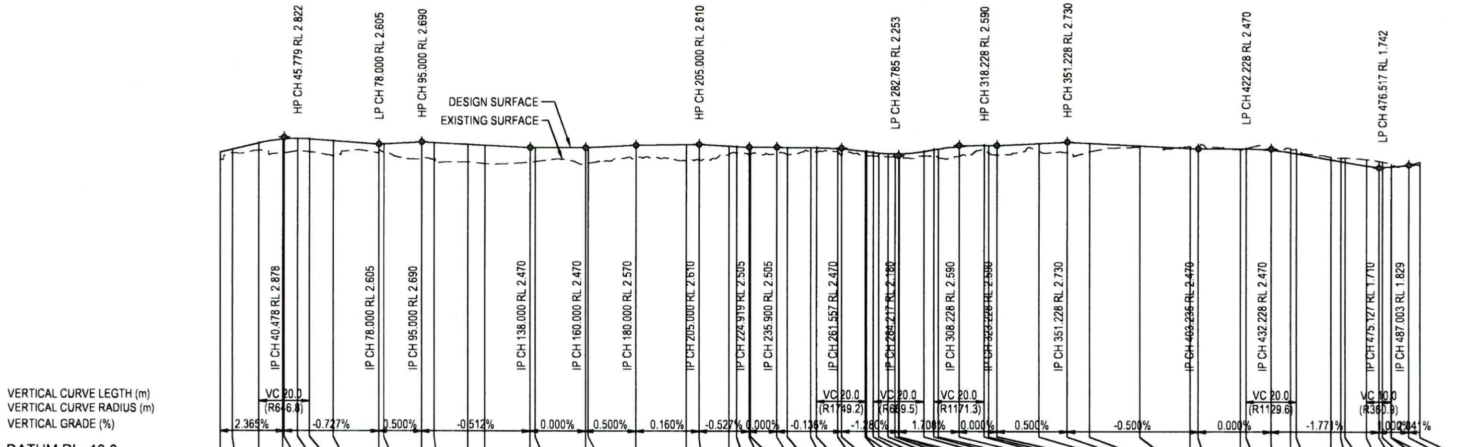
DRAWING TITLE
HAMILTON ST-MARINA CIRCUIT
LONGITUDINAL SECTION
1 OF 3

PROJECT No	DRAWING No	REVISION
20-000488	SK218	1

PDA Infrastructure Works



DATUM RL -10.0

CUT (-) / FILL	0.298	0.147	0.276	0.548	0.549	0.492	0.506	0.591	0.240	0.328	0.659	0.696	0.699	0.727
LHS LIP LEVEL	2.142	2.270	2.548	2.731	2.736	2.760	2.742	2.673	2.543	2.552	2.627	2.602	2.534	2.500
RHS LIP LEVEL		2.518	2.707	2.921	2.925	2.947	2.930	2.798	2.730	2.740	2.815	2.789	2.659	2.625
DESIGN SURFACE	2.279	2.393	2.641	2.796	2.800	2.822	2.805	2.736	2.605	2.615	2.690	2.664	2.596	2.562
EXISTING SURFACE	1.981	2.246	2.365	2.248	2.252	2.330	2.299	2.145	2.365	2.287	2.031	1.969	1.898	1.835
CHAINAGES	15.172	20.000	30.478	40.000	40.478	45.779	50.478	60.000	78.000	80.000	95.000	100.000	113.279	120.000
HORIZONTAL CURVES														

CUT (-) / FILL	0.570	0.547	0.629	0.619	0.480	0.633	0.601	0.326	0.255	0.273	0.253	0.267	0.264	0.149
LHS LIP LEVEL	2.408	2.408	2.345	2.377	2.445	2.477	2.548	2.369	2.306		2.442	2.442	2.437	2.424
RHS LIP LEVEL	2.532	2.533	2.533	2.538	2.633	2.665	2.673	2.610	2.593	2.568	2.567	2.630	2.624	2.579
DESIGN SURFACE	2.470	2.470	2.470	2.475	2.570	2.602	2.610	2.547	2.531	2.505	2.505	2.505	2.499	2.487
EXISTING SURFACE	1.900	1.923	1.841	1.856	2.090	1.969	2.009	2.221	2.276	2.232	2.252	2.238	2.235	2.338
CHAINAGES	138.000	140.000	160.000	161.060	180.000	200.000	205.000	216.878	220.000	224.919	225.453	235.900	240.000	249.298
HORIZONTAL CURVES	R60.000								R20.000					

CUT (-) / FILL	0.157	0.094	0.223	0.168	0.166	0.130	0.101	0.114	0.121	0.124	0.124	0.176	0.193	0.338
LHS LIP LEVEL	2.421	2.389	2.379	2.287	2.280	2.245	2.222	2.196	2.191	2.192	2.193	2.288	2.287	2.316
RHS LIP LEVEL	2.546	2.514	2.504	2.412	2.405	2.370	2.347	2.321	2.316	2.317	2.318	2.456	2.544	2.573
DESIGN SURFACE	2.484	2.452	2.441	2.349	2.342	2.308	2.285	2.259	2.253	2.255	2.255	2.351	2.419	2.448
EXISTING SURFACE	2.327	2.358	2.218	2.181	2.176	2.178	2.184	2.145	2.132	2.131	2.131	2.175	2.226	2.111
CHAINAGES	251.557	260.000	261.557	270.970	271.557	274.217	276.293	280.000	282.785	284.217	284.437	294.217	298.228	300.000
HORIZONTAL CURVES	R20.000			R20.000										

CUT (-) / FILL	0.386	0.175	0.292	0.368	0.301	0.414	0.340	0.033	-0.073	-0.028	0.024	-0.025	-0.007	-0.146
LHS LIP LEVEL	2.415	2.527	2.527	2.527	2.611	2.668	2.624	2.524	2.424	2.407	2.407	2.407	2.416	2.320
RHS LIP LEVEL	2.672	2.715	2.711	2.652	2.799	2.793	2.811	2.649	2.649	2.632	2.632	2.632	2.588	2.493
DESIGN SURFACE	2.547	2.590	2.590	2.590	2.674	2.730	2.686	2.586	2.486	2.470	2.470	2.470	2.426	2.330
EXISTING SURFACE	2.162	2.415	2.298	2.222	2.373	2.316	2.346	2.554	2.559	2.498	2.446	2.495	2.433	2.476
CHAINAGES	308.228	318.228	320.000	323.228	340.000	351.228	360.000	380.000	400.000	403.235	420.000	422.228	432.228	440.000
HORIZONTAL CURVES														

CUT (-) / FILL	-0.164	-0.106	-0.140	-0.173	-0.262	-0.247	-0.221	-0.105	-0.099	-0.022	0.118
LHS LIP LEVEL	2.283	1.986	1.916	1.888	1.736	1.683	1.680				
RHS LIP LEVEL	2.455	2.111	2.041	2.013	1.861						
DESIGN SURFACE	2.293	2.049	1.978	1.951	1.799	1.745	1.742	1.759	1.760	1.829	1.954
EXISTING SURFACE	2.457	2.155	2.118	2.123	2.061	1.992	1.963	1.864	1.859	1.851	1.836
CHAINAGES	442.228	456.030	460.000	461.566	470.127	475.127	476.517	480.000	480.127	487.003	491.395
HORIZONTAL CURVES			R13.000								

LONGITUDINAL SECTION - MARINA CIRCUIT

HORIZ SCALE: 1000
VERTICAL SCALE: 100

CONCEPT ONLY SUBJECT TO REFINEMENT DURING DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	BT	BB

DRAWN

DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE

CLIENT
REDLAND INVESTMENT CORPORATION

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PROJECT
WEINAM CREEK PDA PRECINCT 1

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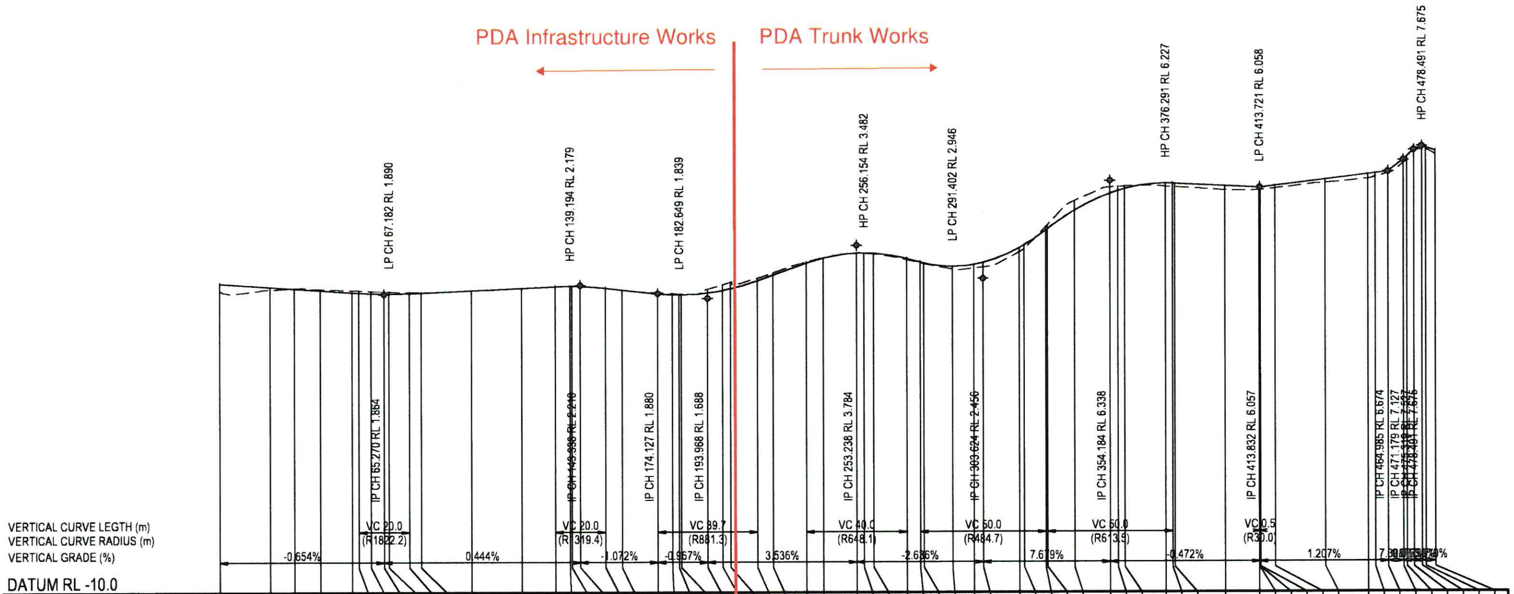
DRAWING TITLE
MARINA CIRCUIT
LONGITUDINAL SECTION
SHEET 2 OF 3

PROJECT No	DRAWING No	REVISION
20-000488	SK219	1



CUT (-) / FILL	0.303	0.100	-0.012	-0.035	-0.073	-0.085	-0.086	-0.083	-0.079	-0.041	-0.020	0.006	0.009	-0.006	-0.011	-0.012	-0.003	0.000	-0.002	-0.050	-0.043	-0.029
DESIGN SURFACE	2.290	2.160	2.096	2.029	1.947	1.929	1.904	1.891	1.890	1.908	1.929	2.018	2.107	2.166	2.179	2.179	2.172	2.103	2.032	1.880	1.843	1.839
EXISTING SURFACE	1.987	2.059	2.108	2.064	2.019	2.015	1.991	1.974	1.969	1.949	1.949	2.011	2.098	2.171	2.190	2.191	2.175	2.103	2.034	1.930	1.886	1.868
CHAINAGES	0.000	20.000	29.714	40.000	52.606	55.270	60.000	65.270	67.182	75.270	80.000	100.000	120.000	133.338	139.194	140.000	143.338	153.338	160.000	174.127	180.000	182.649
HORIZONTAL CURVES			R-96.000																			

CUT (-) / FILL	-0.023	-0.145	-0.217	-0.252	-0.101	-0.085	-0.051	-0.014	-0.010	0.002	0.018	0.037	0.024	0.022	0.106	0.151	0.187	0.170	0.142	-0.139	-0.155	-0.381
DESIGN SURFACE	1.839	1.912	2.010	2.077	2.390	2.609	3.077	3.281	3.475	3.482	3.471	3.257	3.115	3.081	2.946	3.023	3.101	3.678	3.790	4.376	4.419	5.154
EXISTING SURFACE	1.862	2.056	2.227	2.328	2.491	2.694	3.128	3.295	3.486	3.480	3.452	3.219	3.091	3.058	2.840	2.871	2.913	3.508	3.648	4.514	4.574	5.535
CHAINAGES	183.484	193.968	200.000	203.113	213.810	220.000	233.238	240.000	253.238	256.154	260.000	273.238	278.624	280.000	291.402	300.000	303.624	318.036	320.000	328.624	329.184	340.000
HORIZONTAL CURVES	R15.000																	R-80.000				

CUT (-) / FILL	-0.254	-0.167	-0.108	0.121	0.135	0.137	0.171	0.097	0.095	0.095	0.095	0.111	0.132	0.179	0.151	0.059	0.108	0.041	0.026	0.090	0.056	0.144
DESIGN SURFACE	5.829	5.935	6.011	6.227	6.220	6.216	6.122	6.058	6.058	6.058	6.060	6.131	6.373	6.577	6.614	6.674	7.127	7.256	7.527	7.675	7.625	7.496
EXISTING SURFACE	6.083	6.102	6.119	6.106	6.085	6.079	5.951	5.962	5.963	5.963	5.965	6.021	6.241	6.398	6.463	6.615	7.019	7.215	7.501	7.585	7.569	7.351
CHAINAGES	354.184	357.368	360.000	376.291	379.184	380.000	400.000	413.580	413.721	413.832	414.083	420.000	440.000	456.962	460.000	464.985	471.179	472.514	475.319	478.491	480.000	483.889
HORIZONTAL CURVES														R30.000								

LONGITUDINAL SECTION - BANANA ST - MEISSNER ST

HORIZ SCALE: 1000
VERTICAL SCALE: 100

CONCEPT ONLY SUBJECT TO REFINEMENT DURING DETAILED DESIGN

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1		ISSUED FOR INFORMATION	BT	BB

DRAWN
DESIGN

STATUS
DEVELOPMENT APPLICATION

SCALE

CLIENT
REDLAND INVESTMENT CORPORATION

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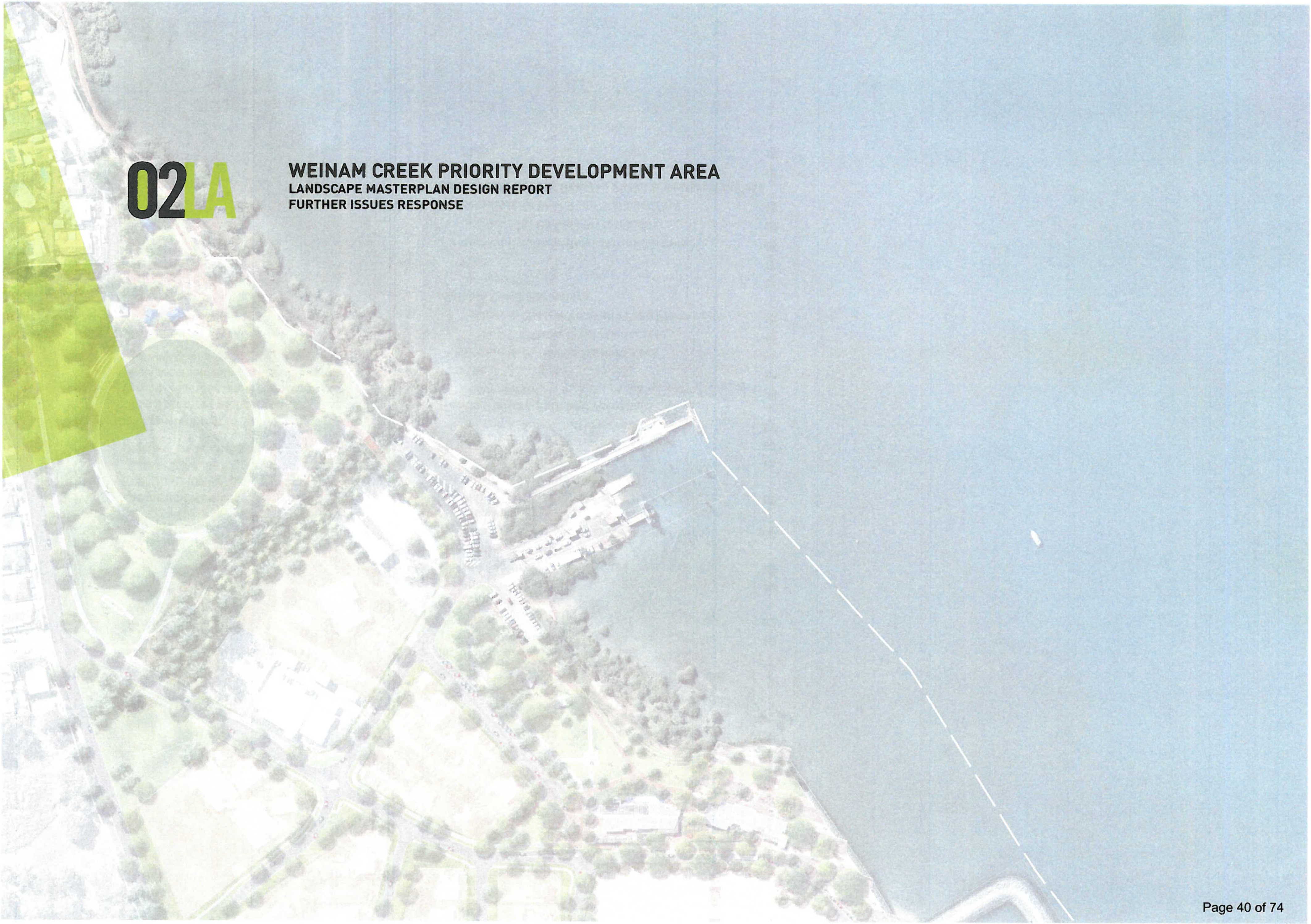
DRAWING TITLE
BANANA ST - MEISSNER ST
LONGITUDINAL SECTION
SHEET 3 OF 3

PROJECT No	DRAWING No	REVISION
20-000488	SK220	1



WEINAM CREEK PRIORITY DEVELOPMENT AREA
LANDSCAPE MASTERPLAN DESIGN REPORT
FURTHER ISSUES RESPONSE

Client
Redland Investment Corporation

Project Address
Weinam Creek PDA
Redland Bay, QLD

Contact
02 Landscape Architecture
(07) 3831 0681

Document Number
358 SD_LR002_G
Date: 14/07/2021
Further Issues Response

Acknowledgments
This document presents work from 02 Landscape Architecture in association with Calibre, Ellivo Architects and RPS.

Contents

Introduction

Background

This landscape masterplan has been commissioned as part of the ongoing work in the Weinam Creek PDA.

The Weinam Creek PDA is in Redland Bay on the Moreton Bay foreshore within the Redland City Council Local Government Area.

The total area of the PDA is approximately 42 hectares, including 36 hectares over land and nearly 6 hectares over water within the Moreton Bay Marine Park. The PDA is bounded by Weinam Street to the west and Moreton Bay to the east, Peel Street in the north and Moores Road to the south.

Weinam Creek serves as the main point of departure and arrival for vehicular ferry and passenger ferry services between the mainland and the Southern Moreton Bay Islands. The area incorporates marine activity, residential development and open space areas.

The PDA incorporates the Weinam Creek Marina located at the intersection of Banana Street and Meissner Street.

Vision

> *The landscape masterplan re-imagines the site as a community hub, centered around the new urban foreshore and ferry terminal. It embraces and takes advantage of the scenic amenity of the waterfront allowing residents and visitors alike to enjoy the foreshore and Moreton Bay.*

The masterplan creates a variety of integrated open space opportunities that focus on:

Public Realm

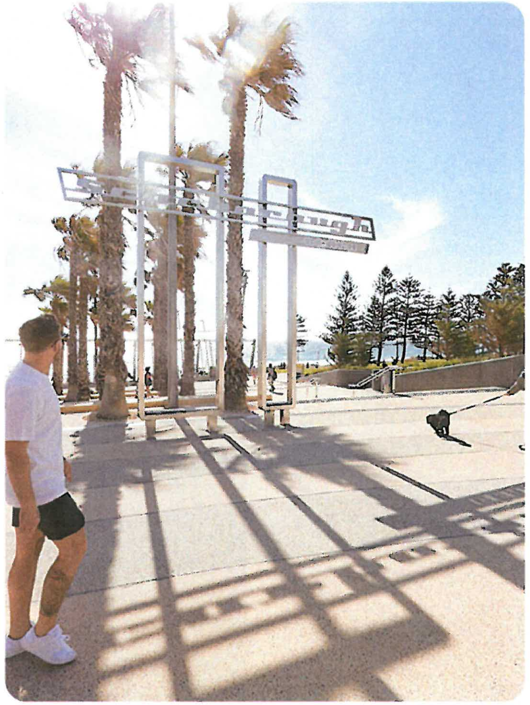
- Envisages a vibrant, urban public realm precinct on the heart of the foreshore that celebrates community based activities in both daytime and night time;
- Takes advantage of and embraces 1.5km of continuous foreshore experiences;
- Maximises and promotes views from the Foreshore to the Bay;
- Connects people to the water by designing flexible spaces that allow them to engage physically and visually with its natural assets;
- Maximises safety through design principles whilst ensuring no net loss of public open space;
- Incorporates outdoor dining and picnicking opportunities with waterfront experiences for all visitors; and
- Reflects the distinctive foreshore zones and proposes uses appropriate to these zones.

Connectivity

- Prioritises pedestrians and cyclists by providing safe and efficient movement options which connect with public transport, the waterfront and community focal points;
- Provides a sequence of multi-use spaces of varying scales that include recreational, sporting and ecological functions;
- Maximises safety through design principles whilst ensuring no net loss of public open space; and
- Improves open space network connections by establishing linear movement corridors.

Respects Existing Features

- Conserves and leverages local site characteristics, settings, places of heritage significance, landmarks, breezes and views;
- Respects and values marine and land based ecology and seeks to protect matters of ecological significance; and
- Re-inforces existing vegetation character and utilises native and endemic plant species.

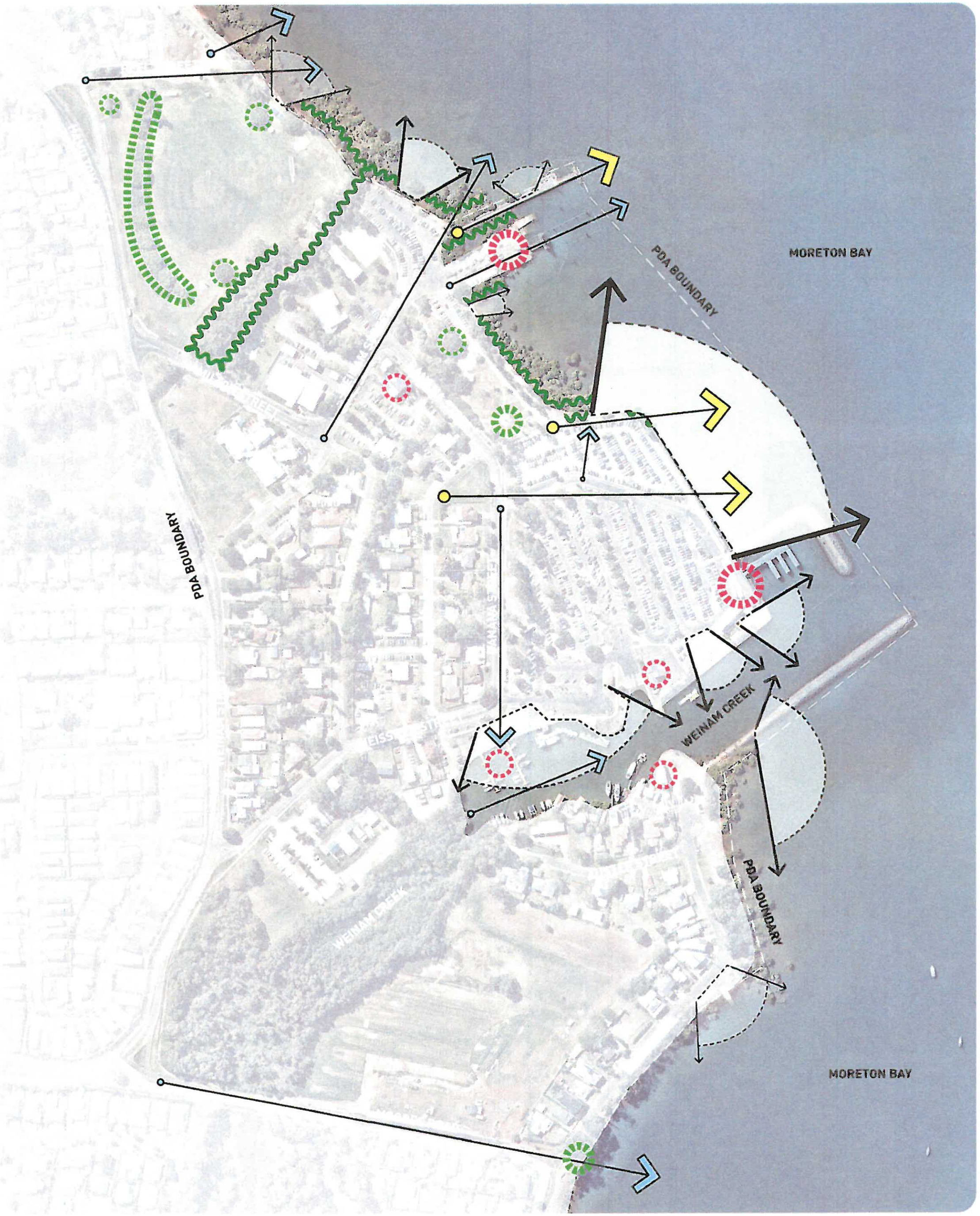


Conceptual Process

Analysis Diagram:
Site Features, Views & Vistas

LEGEND

Site Boundary
Landmarks
Site Features
Existing Views & Viewsheds
Existing Vistas
Edges



1:4000 - A3
0 20 40 80 200 300m

Circulation

Pedestrian and Cycleway Heirarchy Plan

LEGEND

- Site Boundary
- Moreton Bay Cycleway Off-Road Shared Path (3m wide min.)
- Moreton Bay Cycleway On-Road Bike Lanes as per LGIP
- Major Pedestrian paths - Civic Promenade - minimum 5m wide
- Major Pedestrian paths - Full width pavement - minimum 4.25m
- Major Pedestrian paths - minimum 3m wide
- Major Pedestrian paths - minimum 2.5m wide
- Minor Pedestrian paths - minimum 2.5m wide
- Minor Pedestrian paths - minimum 2.0m wide
- Minor Pedestrian paths - minimum 1.5m wide

1:4000 - A3 0 20 40 80 200 300m

Masterplan

Plan

LEGEND

- Ⓐ Sel Outridge Park
- Ⓑ Public Jetty
- Ⓒ Vehicle Ferry Barge
- Ⓓ Neville Stafford Park
- Ⓔ Passenger Ferry Terminal (Redland Bay Marina)
- Ⓕ Coast Guard
- Ⓖ Boat ramp - emergency access only
- Ⓗ Water Police
- Ⓘ Public boat jetty
- Ⓙ Tom's Park
- Ⓚ Pedestrian connection through apartments
- Ⓛ High Density Residential
- Ⓜ Medium Density Residential
- Ⓝ Storage Facility
- Ⓞ Civic Prominade
- Ⓟ Mixed Use Plaza (Town Centre)
- Ⓠ Boat Ramp
- Ⓡ Retail/commercial
- Ⓢ Residential/Retail
- Ⓣ Pedestrian & Cycle connection
- Ⓤ Vehicle and Boat carpark (servicing passenger ferry & boat ramp)

1:4000 - A3
0 20 40 80 200 300m

Sel Outridge Park and Surrounds

Design Intent

The parklands to the north and their surrounds encompasses the existing Sel Outridge Park, the existing skatepark and a new pocket park north of the Barge entry zone.

The existing character of these parkland areas is distinguished by:

- Views to the bay;
- Curvilinear pathways that hug the shoreline;
- Wide open expanses of lawn and large feature/landmark trees;
- Coastal and riparian vegetation;
- Places for residents and visitors to barbecue and picnic.

The masterplan endeavours to build upon the existing qualities through:

- Formalising an entry arrival plaza to Sel Outridge park;
- Creating an architecturally designed equitable access, multipurpose amentity block located out of the flood zone;
- Revegetation in key locations;
- Enhancing views to the bay and bay islands;
- Providing opportunities for visitors to access the water for water based play;
- Improving existing playgrounds and making provision for All Abilities play opportunities;
- Providing for small kickabout spaces for younger children and exercise zones for Seniors;
- Creating a high intensity fitness work out zone that allows for basketball, netball and boot camp activities; and
- Widening pedestrian and cyle pathways to improve ease of movement throughout the site and reinforce the importance of connectivity to the foreshore.

The following assets are proposed for the parklands:

- All Abilities play spaces (directly North of the PDA zone);
- Physical activity zones incl. AFL overflow oval, Senior fitness zone, Bootcamp zones, ball courts;
- A variety of circulation spaces including pedestrian and cycleways;
- Kickabout spaces, skate/ramp park & amphitheatre;
- Amenities building with architectural form that promotes a distinctive 'foreshore' character;
- Beach access zones;
- Pedestrian bridge connections across creek;
- Picnic facilities including shelters, barbecues, bins, water points and seating;
- Carparking infrastructure; and
- Flexible space that allows for pop up commercial facilities.

Sel Outridge Park and Surrounds

Plan

LEGEND

① Senior exercise zone - fenced and signed. Can be used in a 'senior safe' way by residents with or without trainers/ physiotherapists

② Parking including shade trees and amenity planting

③ Foreshore beach paddling zone/sand play and kayak/canoe launch area

④ All abilities playground, including seating, shade trees & fencing. This zone to be designed for maximum inclusion

⑤ Arrival/Entry Plaza - flexible design allows for uses including pop up shop, markets and community run events. Includes: water points, bins, seats, signage

⑥ Foreshore entry open space - connection to water, swimming/paddling zone, picnic facilities

⑦ Amphitheatre zone incl. picnic facilities, embankment playground & mixed ages play ground

⑧ Multi-purpose zone uses include: playground, seating, shade, market spill out zone

⑨ Informal seating mound

⑩ AFL overflow oval incl. lighting and goal posts and proprietary seating surrounding the oval

⑪ New fully accessible amenities facility incl. parents room, showers and toilets

⑫ Picnic including including: lawns, picnic facilities, seating, shade and capacity for marquees.

⑬ Sports zone incl. netball court, basketball half court, bootcamp zone, yoga and tai chi zone

⑭ Relocated cricket nets

⑮ Pedestrian connection

⑯ Riparian corridor - additional restoration work

⑰ Nature trail - low grade bush trail for walking and environmental activities

⑱ New pedestrian bridge - minimum 5m wide bridge (boardwalk style) to allow for increased Moreton Bay Cycleway traffic. Existing vegetation to be reduced around the site of the bridge to open views from north to south

⑲ Moreton Bay Cycleway (MBC) shared pedestrian and cycle path

⌜ ⌝ Not part of this application
⌞ ⌟ The concepts shown to the north of the PDA zone are coneept only. Co-ordination with Council has begun in this area to ensure a co-hesive design approach.

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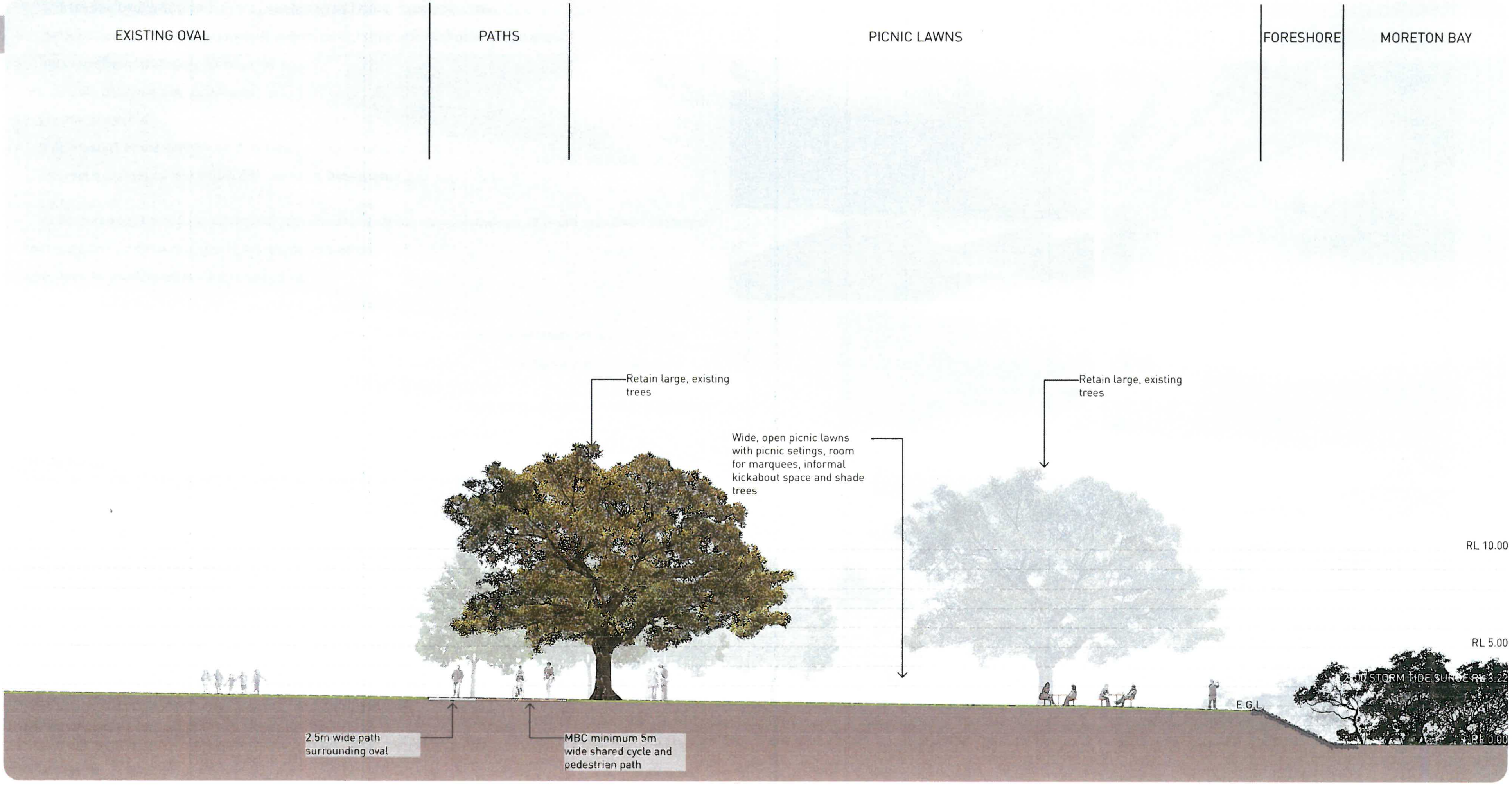
Sel Outridge Park and Surrounds

Section A-A: Sel Outridge Park



Retain large, existing trees

Wide, open picnic lawns with picnic setings, room for marquees, informal kickabout space and shade trees

Retain large, existing trees

2.5m wide path surrounding oval

MBC minimum 5m wide shared cycle and pedestrian path

1:200 - A3 0 1 2 4 10 15m

Neville Stafford Park and Foreshore

Design Intent

The parklands encompass the existing Neville Stafford Park, the Civic promenade north and east of the proposed apartment buildings reaching to the Redlands Marina.

The existing character of these parkland areas is distinguished by:

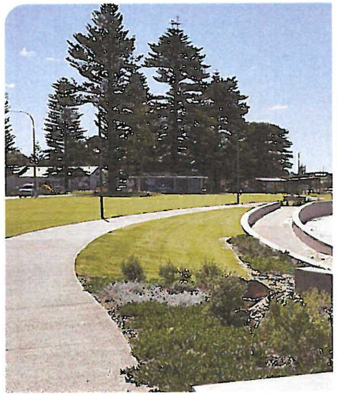
- Filtered and wide open panoramic views to the bay;
- Curvilinear pathways that transit across and through the parklands;
- Kickabout spaces;
- Coastal and Riparian vegetation;
- Monument - civic space; and
- Places for residents and visitors to barbecue and picnic.

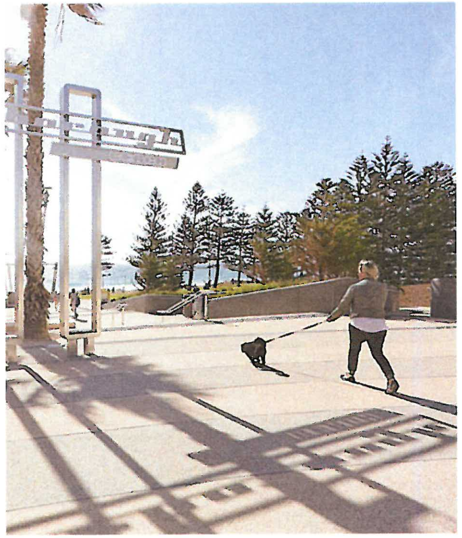
The masterplan endeavours to build upon the existing qualities by:

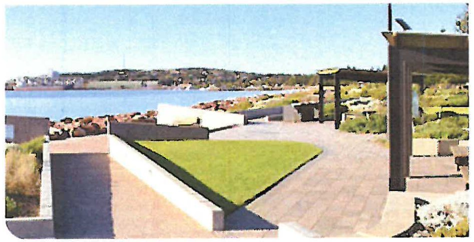
- Celebrating and enhancing a strong linear connection along the foreshore and integration with the mixed use development;
- The addition of 2 x linear parks that closely hug the shoreline/revetment wall;
- Enhancing views to the bay and bay islands by opening up vistas and creating opportunities for small decks/pods that protrude beyond the existing revetment walls;
- Increasing active transport links through the addition of new or extended wide pedestrian and cyle pathways; and
- Providing breakout opportunities for visitors to access the water easily and to enjoy water based recreation.

The following assets are proposed for the Linear Parklands:

- Full width pathway along the entire foreshore;
- An urban civic forehore and Town Centre that focuses on:
  - An activated edge along the mixed use development, allowing opportunities for spill-out activities and passive surveillance;
  - Increased circulation and gathering spaces for pedestrians
  - High amenity pavements, seating, shelters and decking pods; and a
  - Feature sculpture/art intervention.
- A foreshore parkland that focuses on:
  - Uninteruppted panoramic views to the ocean;
  - Decking pods for seating and viewing and terraced lawns that drop down to the water;
  - A plaza and path that draw visitors from the retail centre to the water; and
  - Picnic facilities including shelters, barbecues, bins, water points and seating.
- Upgrade to Neville Stafford Park that includes;
  - Widening of new pathways and re-alignment of pathways to accommodate shared cycleways;
  - Kickabout spaces and new playground; and
  - Upgraded amenity block.







Neville Stafford Park and Foreshore

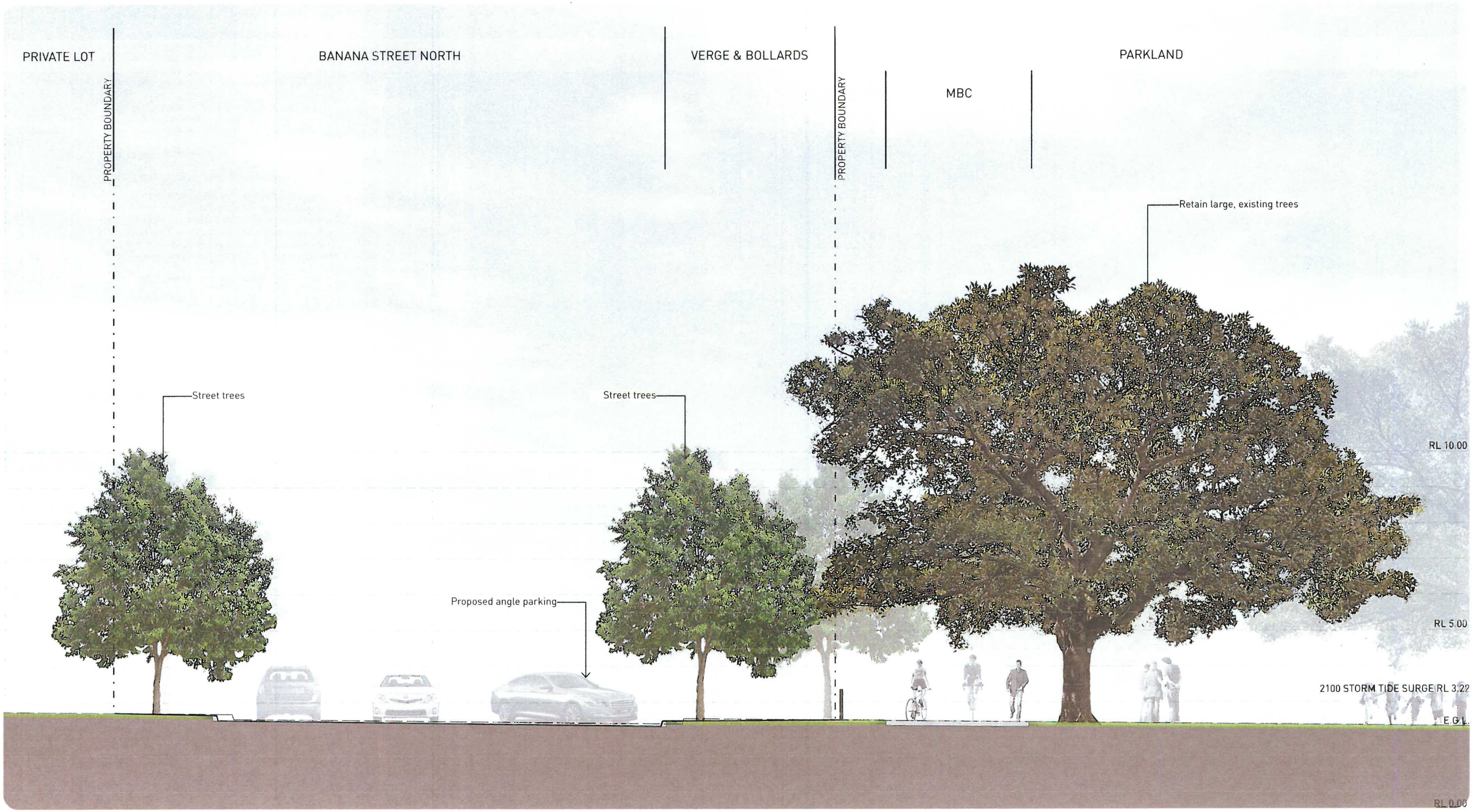
Plan

LEGEND

① Combined shared path road crossing incl. road threshold treatment to increase safety of cyclists and pedestrians moving north-south
② New amenities block and service zone co-located near existing carpark and barge entry/exit
③ New playground and toddler zone incl. new shelters
④ Upgraded shared path including Moreton Bay Cycleway
⑤ Terraced lawn access to pebble beach
⑥ Plaza extension path through parkland terminating in steps to water
⑦ Large deck and seats - extending beyond revetment wall
⑧ Priority crossing- combines Moreton Bay cycleway and NEW ROAD pedestrian link
⑨ Plaza with wide pedestrian connections from New Road to cafes and retail to the north of apartment buildings
⑩ Pod deck - extending beyond revetment wall incl. railings and telescopes
⑪ Civic foreshore promenade incl. high amenity pavements, feature sculpture, garden beds, pockets of lawn, seats, water points, signage and picnic facilities
⑫ Steps down to existing beach
⑬ Mixed Use Plaza (Town Centre) incl. gathering spaces, night/day time uses, space enough for markets, concerts, movies, outdoor dining & people watching, strong connection to mixed use node, shade, structural elements, public art, water features, bio-filtration, lighting, & seating.
⑭ Ferry Terminal (Redland Bay Marina)
⑮ Existing memorial
⑯ Retail precint
⑰ Multistorey carpark and open air carpark
⑱ Main Street - full width pavements inclucing shade trees and high amentity garden beds, bus stops, taxi and ride-share, car-share, kiss n ride and disability parking, street lighting, street furniture, flexible spaces for retail uses.
⑲ Covered connection - structural element (east-west) through carpark to Promenade and Ferry Terminal
⑳ Covered connection (north-south) through carpark from Southern New Road to Northern New Road (through supermarket frontage).
㉑ Pocket park - forming open space connection to Banana Street
㉒ MBC & Shared path
㉓ Pedestrian crossings/connections

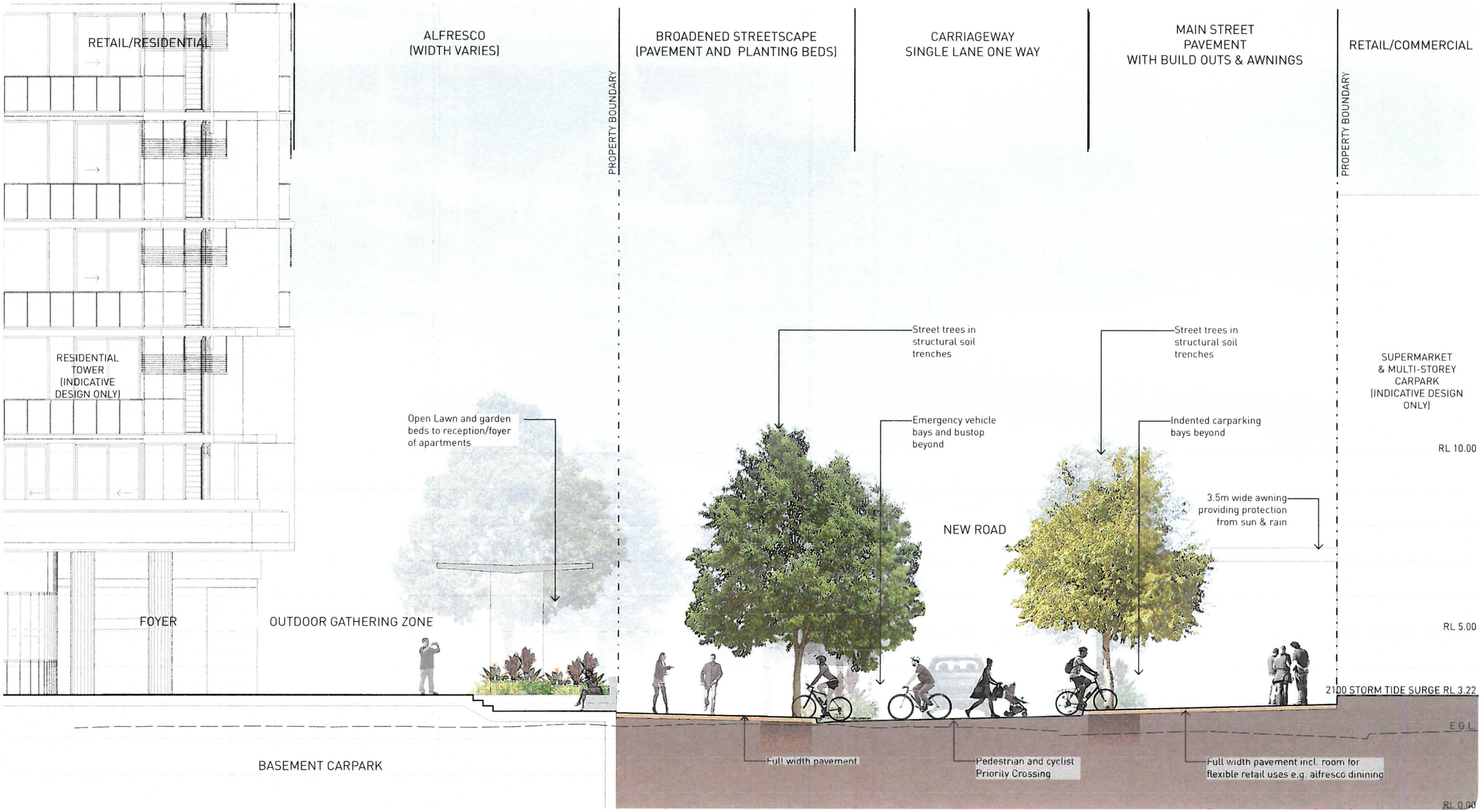
Neville Stafford Park and Foreshore

Section B-B: Neville Stafford Park



Neville Stafford Park and Foreshore

Section C-C: New Road Main Street



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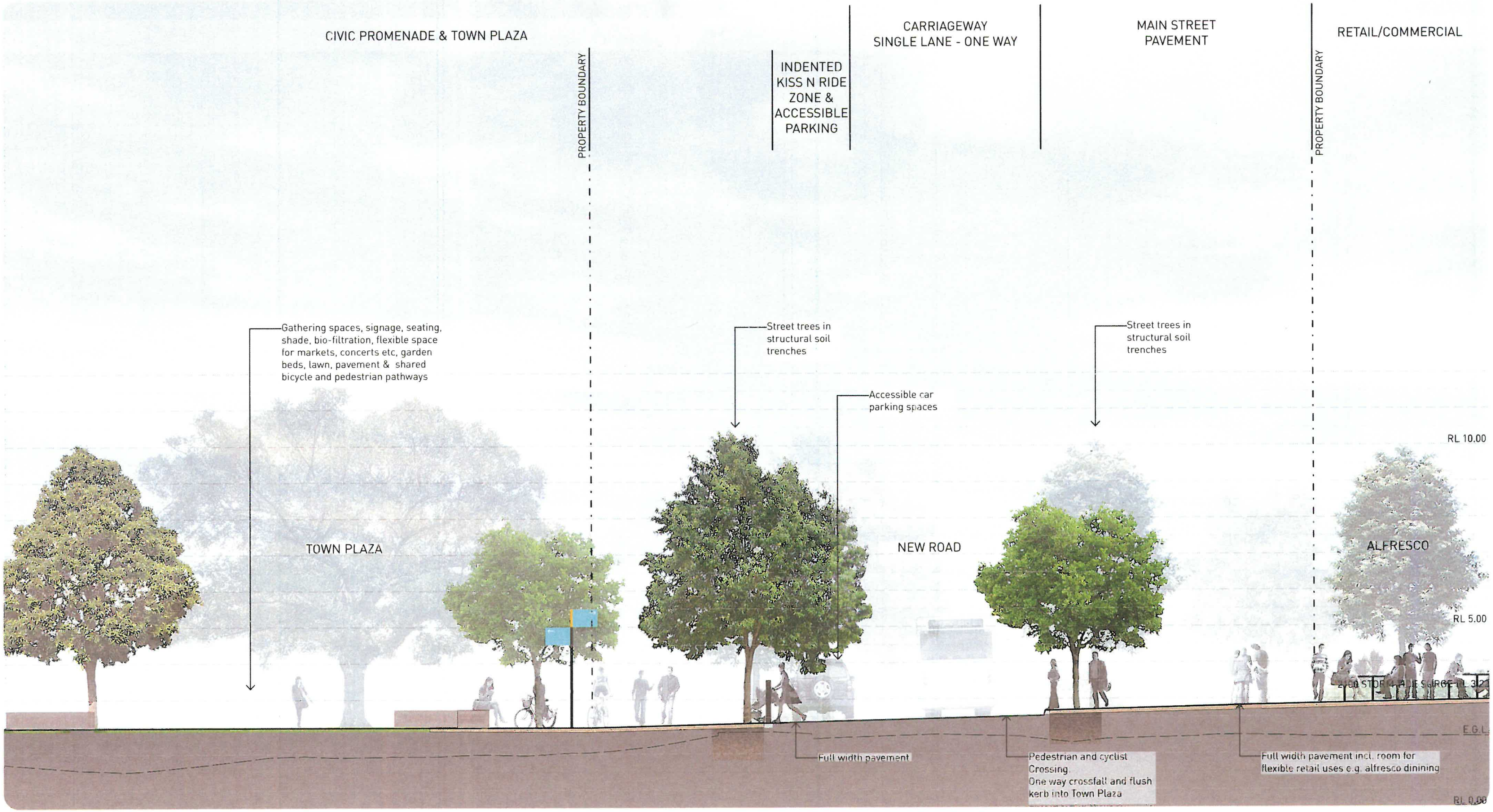
Neville Stafford Park and Foreshore

Section D-D: New Road and Civic Promenade



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0 0.5 1 2 5 7.5m

Weinam Creek Foreshore

Design Intent

The Weinam Creek Foreshore encompass the existing zone around the Ferry terminal and the new creek foreshore parks west of the Ferry terminal.

Currently there is very little parkland in this zone along Weinam creek.

The existing character of the small area of open space is distinguised by:

- Open views to the bay and the creek;
- Curvilinar pathways that transit across and through the parklands;
- Views to marine activities;
- Places for residents and visitors to walk and sit.

The masterplan endeavours to build upon the existing qualities through:

- Providing a strong linear consolidated 'lower order and intimate' connection alonge the foreshore of the creek and at the roads edge; and
- Increasing active transport links that connect to the new pedestrian bridge crossing Weinam Creek.

The following assets are proposed for the Southern Parklands:

- Pathways along the entire foreshore and at the road level;
- Bespoke architectural form amenity facilities;
- Small open plaza with decking pod protruding into Weinam creek; and
- Picnic facilities incl. shelters, BBQs, bins, water points and seating that reflect the character of Weinam foreshore.

Tom's Park and Rustler Reserve'D'

Tom's Park is an existing linear parkland that faces Moreton Bay.

The existing character of the park is distinguised by:

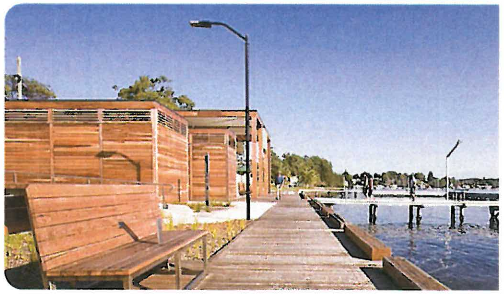
- Kayak and High tide boat ramp;
- Scar Tree;
- Open and filtered views to the bay and the creek;
- Clusters of native and coastal vegetation;
- Views to marine activities; and
- Gentle slopes to the water.

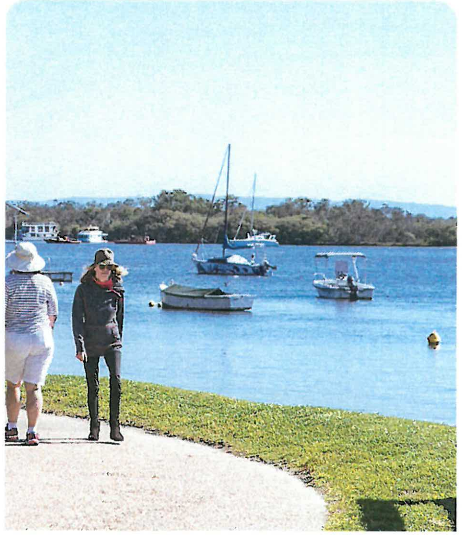
The masterplan endeavours to build upon the existing qualities through:

- Formalising 'lower order' pedestrian connections; and
- Providing place for visitors and residents to gather and/or rest.

The following assets are proposed for the Southern Parklands:

- Pathways along the entire foreshore (subject to discussions with residents); and
- Picnic facilities incl. shelters, barbeques, bins, water points and seating.





Weinam Creek Foreshore

Plan

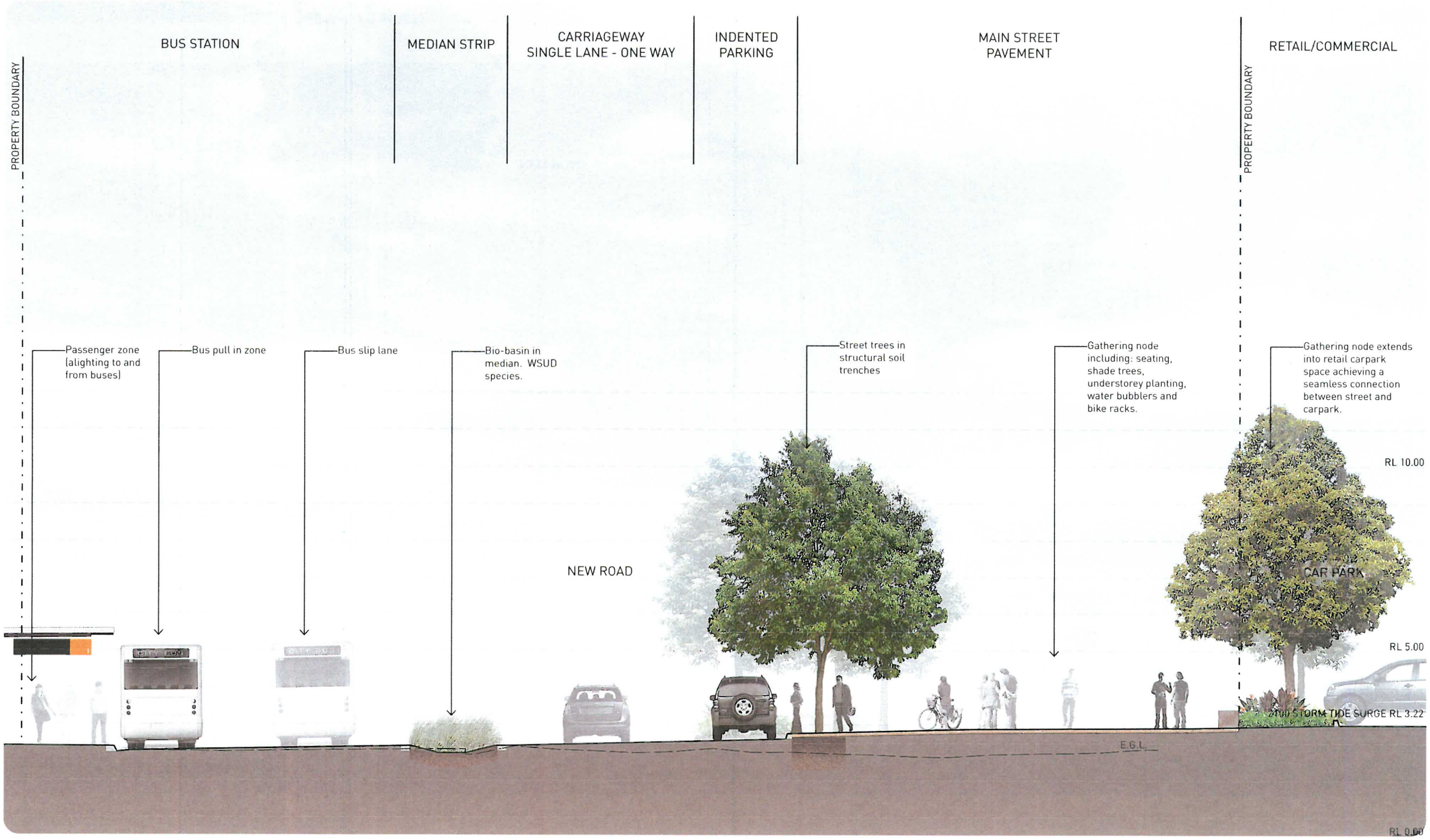
LEGEND

① Ferry Terminal
② Storage facility
③ Linear creek parkland incl. seating, shade trees, picnic facilities & water points
④ Coast Guard
⑤ Boat ramp - emergency access only
⑥ Linear creek parkland incl. seating & shade trees
⑦ Priority crossing- combines Moreteon Bay cycleway and NEW ROAD pedestrian link
⑧ Pedestrian and cyclist node incl. crossing point to Banana street, lawn, water point, seating and pod deck to water
⑨ Amenities block and service zone
⑩ Pedestrian bridge to boat/car parking
⑪ Boat ramp
⑫ Covered connection (north-south) through carpark from Southern New Road to Northern New Road (through supermarket frontage).
⑬ MBC and Shared path
⑭ Vehicle connection to jetty (Police access only)
⑮ Bus Mealing Station
⑯ Retail/Commercial
⑰ Shelters, seating, shade trees
⑱ Covered connection - structural element (east-west) through carpark to Promenade and Ferry Terminal
⑱ Full width concrete verge (4.25m) with gardens in buildouts, street trees and connections to Mixed Use Node, Supermarket, Storage Facility and Civic Promenade

1:1000 - A3 0 5 10 20 50 75m

Neville Stafford Park and Foreshore

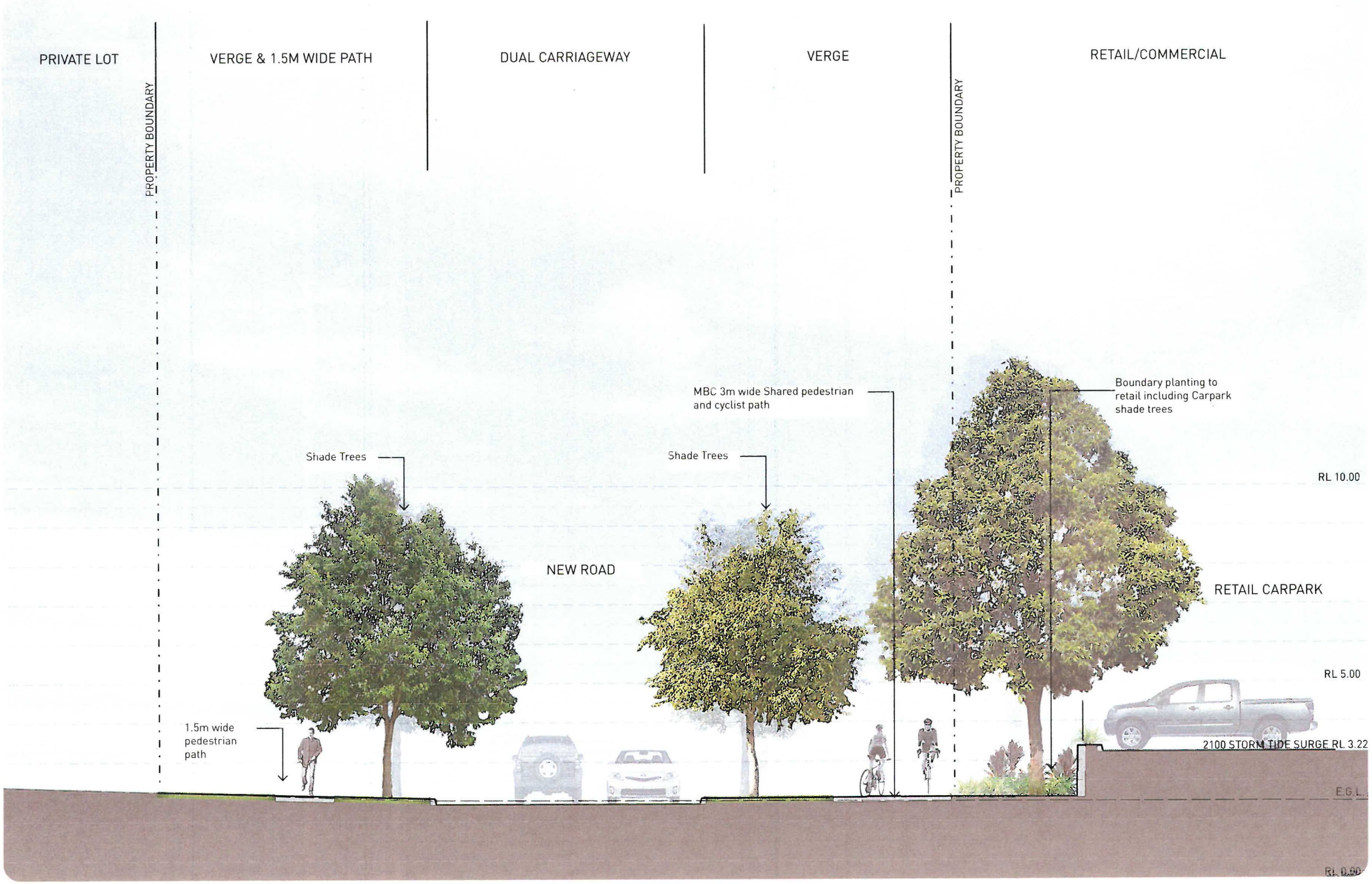
Section E-E: New Road Marina Terminal



1:100 - A3

Weinam Creek Foreshore

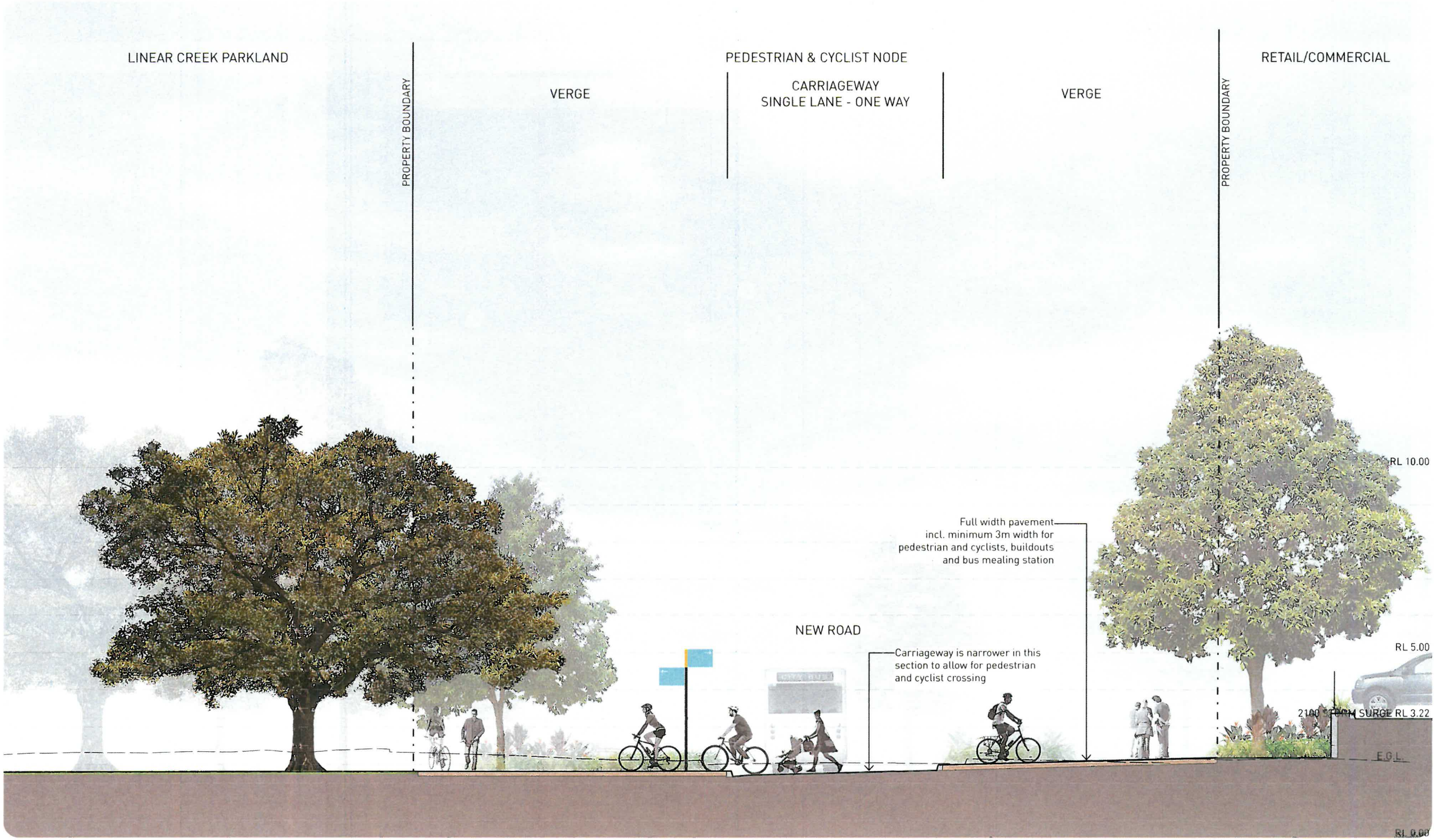
Section F-F: Banana Street South



1:100 - A3 0 0.5 1 2 5 7.5m

Weinam Creek Foreshore

Section G-G: New Road Southern End



1:100 - A3 0 0.5 1 2 5 7.5m

Tom's Park, Rustler Reserve Parks & Restoration Zone

Plan

LEGEND

①	Boat ramp
②	Restoration zone
③	Car and boat parking
④	Moreton Bay Cycleway
⑤	Existing amenities block, small boat ramp & CTV parking
⑥	Pedestrian path (proposed, consultation with local residents to be considered)
⑦	Shelters, seating, shade trees
⑧	Connection to the Moreton Bay Cycleway
⑨	Scar Tree
⑩	Pedestrian bridge to boat/car parking

1:2000 - A3 0 10 20 40 100 150m

O2 Landscape Architecture

ABN 22 704 400 505

Shop 3/42 Cordelia Street,
South Brisbane, QLD 4101

(07) 3831 0681

mail@o2la.com.au

www.o2la.com.au

Industry Affiliations

Australian Institute of
Landscape Architects

WEINAM CREEK PDA

REDLAND INVESTMENT CORPORATION

calibre

REDLAND BAY

PRECINCT 3A BOAT RAMP ACCESS - CIVIL WORKS

FOR REDLAND INVESTMENT CORPORATION

LOCALITY PLAN

N.T.S

DRAWING INDEX

GENERAL

100	COVER SHEET AND DRAWING INDEX
200	DEMOLITION PLAN

ROADWORKS

300	ROADWORKS AND DRAINAGE LAYOUT PLAN
310	ROAD WORKS CROSS SECTION
350	SIGNAGE AND LINEMARKING LAYOUT PLAN
360	PAVEMENT DETAIL PLAN
370	TURNING TEMPLATE LAYOUT PLAN

WATER RETICULATION

600	WATER RETICULATION LAYOUT PLAN

REDLANDS SHIRE COUNCIL

SURVEYOR

CONTOUR & FEATURE SURVEY
DATUM LEVEL
P.S.M. 203153
RL 6.31 AHD

CONSTRUCTION HOLD POINT

ONCE THE BASE OF MANHOLES, INSPECTION PITS, GULLIES AND FIELD INLETS FOR STORMWATER DRAINAGE AND SEWER RETICULATION HAVE BEEN POURED, FURTHER CONSTRUCTION SHALL NOT PROCEED UNTIL THE SUPERINTENDENT AND OR ENGINEER HAVE INSPECTED THE WORKS FOR FINISHED LEVELS AND APPROVED CONSTRUCTION TO CONTINUE.

CONSTRUCTION NOTES:

THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH:

- CALIBRE PROFESSIONAL SERVICES STANDARD SPECIFICATIONS AND JOB SPECIFICATIONS
- SEDIMENT AND EROSION HAZARD ASSESSMENT AND CONTROL PLAN (TO BE PREPARED BY CONTRACTOR)
- ACID SULPHATES SOILS REPORT (PREPARED BY XXXX)
- GEOTECHNICAL REPORT (PREPARED BY XXXX)
- VEGETATION MANAGEMENT PLAN (VMP) (PREPARED BY XXXX)
- ENVIRONMENTAL MANAGEMENT PLAN (EMP) (PREPARED BY XXXX)

CONSTRUCTION HOLD POINT

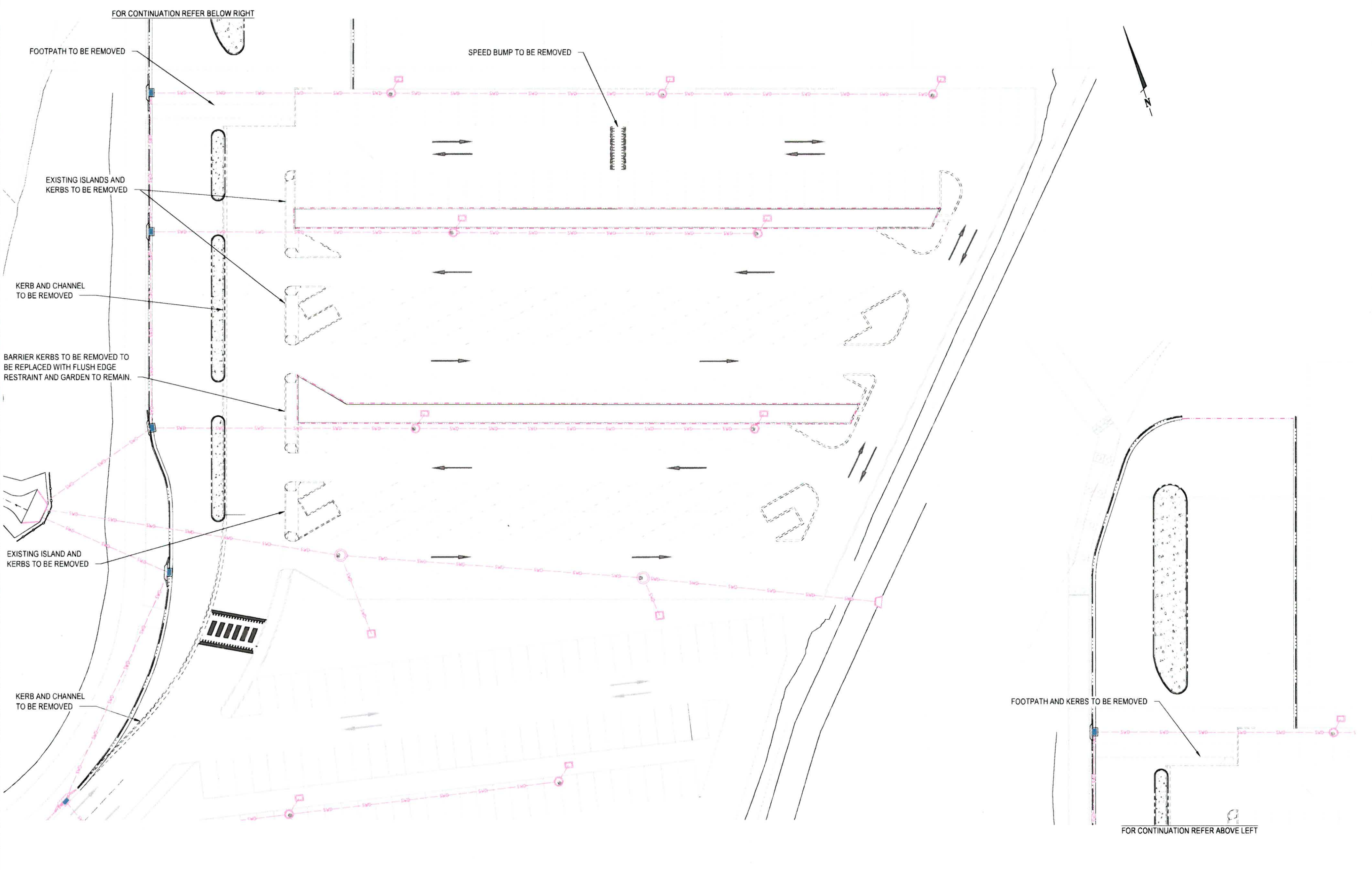
PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL VERIFY LEVELS OF ALL EXISTING CROSSINGS AND CONNECTION POINTS.

WEINAM CREEK

PRECINT 3A - BOAT RAMP ACCESS

EDQ REF NO. DEV2020/1143

Project No:	Stage:	Milestone:	Revision Date:	Drawing No:	Revision
18.003166	PRECINCT 1A	DEVELOPMENT APPLICATION	24.06.21	100	1



REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1			RT	CH

DRAWN

DESIGN

STATUS
FOR DEVELOPMENT APPLICATION
NOT FOR CONSTRUCTION

APPROVED

SCALE
1:250 5 0 5 10m A1
1:500 A3

CLIENT
REDLAND INVESTMENT CORPORATION
REDLAND INVESTMENT CORPORATION

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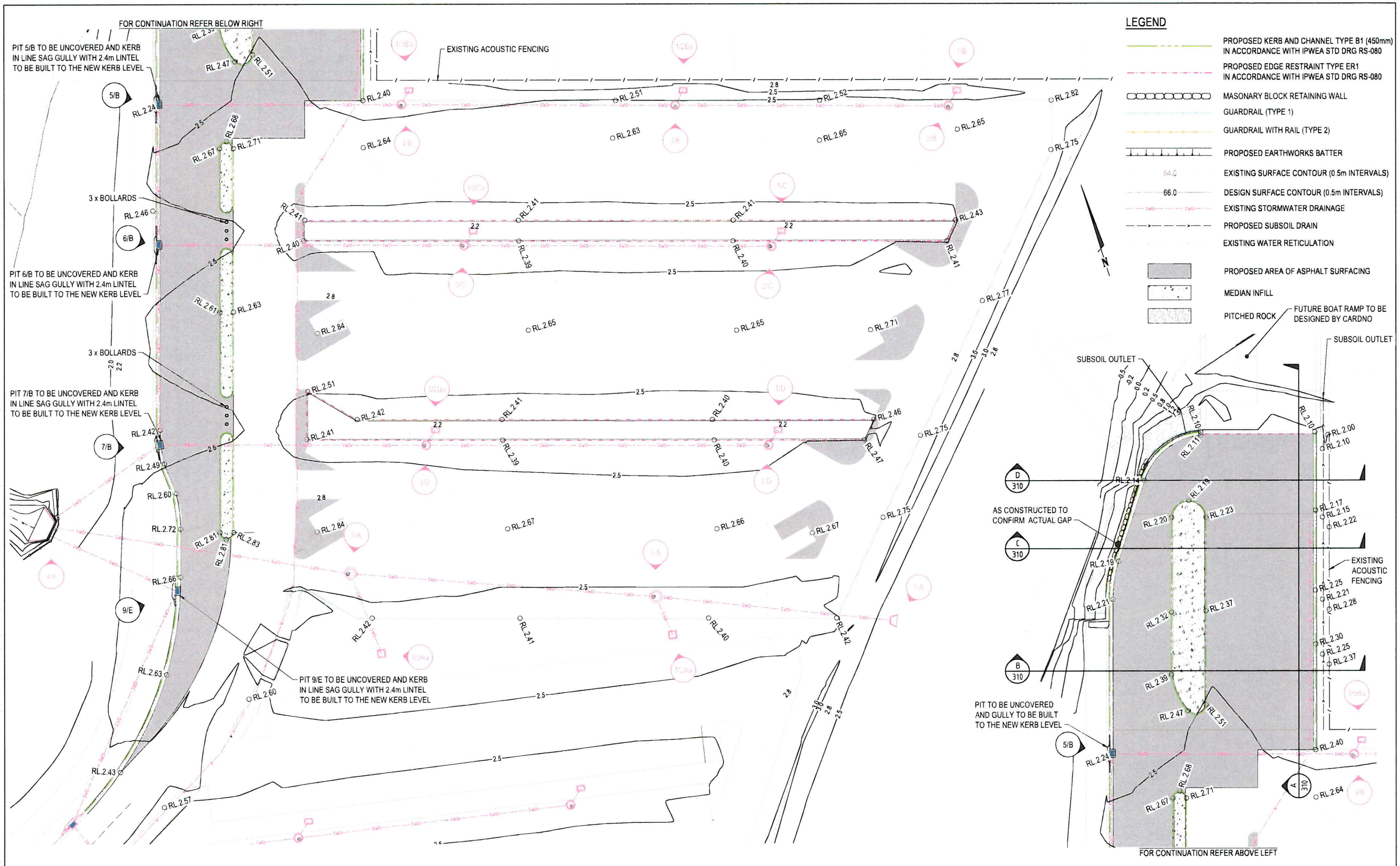
PROJECT
WEINAM CREEK PRECINCT 3A BOAT RAMP ACCESS

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE
DEMOLITION LAYOUT PLAN

PROJECT No	DRAWING No	REVISION
18-003166	200	1



LEGEND

— · — · —	PROPOSED KERB AND CHANNEL TYPE B1 (450mm) IN ACCORDANCE WITH IPWEA STD DRG RS-080
— · — · —	PROPOSED EDGE RESTRAINT TYPE ER1 IN ACCORDANCE WITH IPWEA STD DRG RS-080
○○○○○○○○○	MASONARY BLOCK RETAINING WALL
———	GUARDRAIL (TYPE 1)
———	GUARDRAIL WITH RAIL (TYPE 2)
┴┴┴┴┴	PROPOSED EARTHWORKS BATTER
64.0	EXISTING SURFACE CONTOUR (0.5m INTERVALS)
66.0	DESIGN SURFACE CONTOUR (0.5m INTERVALS)
— SWD — SWD —	EXISTING STORMWATER DRAINAGE
— → — → —	PROPOSED SUBSOIL DRAIN
———	EXISTING WATER RETICULATION
▩	PROPOSED AREA OF ASPHALT SURFACING
▨	MEDIAN INFILL
▨	PITCHED ROCK

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1			RT	CH

DRAWN
DESIGN

STATUS
FOR DEVELOPMENT APPLICATION
NOT FOR CONSTRUCTION
APPROVED

SCALE
1:250 5 0 5 10m A1
1:500 A3

CLIENT
REDLAND INVESTMENT CORPORATION
REDLAND INVESTMENT CORPORATION

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PROJECT
WEINAM CREEK
PRECINCT 3A
BOAT RAMP ACCESS

DISCLAIMER
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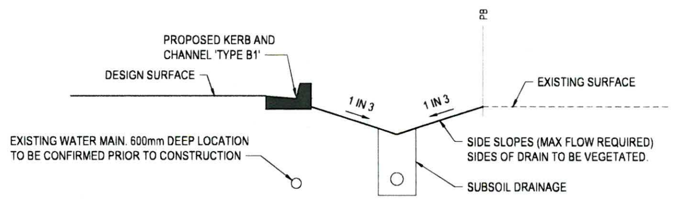
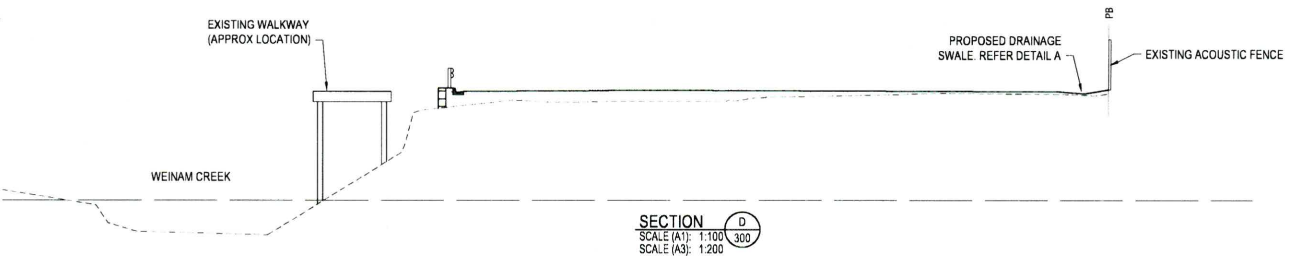
DRAWING TITLE
ROADWORKS AND DRAINAGE LAYOUT PLAN

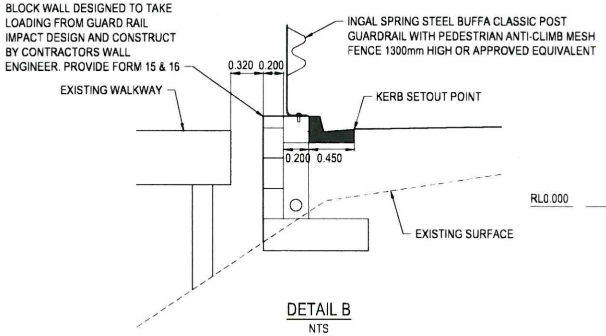
PROJECT No	DRAWING No	REVISION
18-003166	300	1



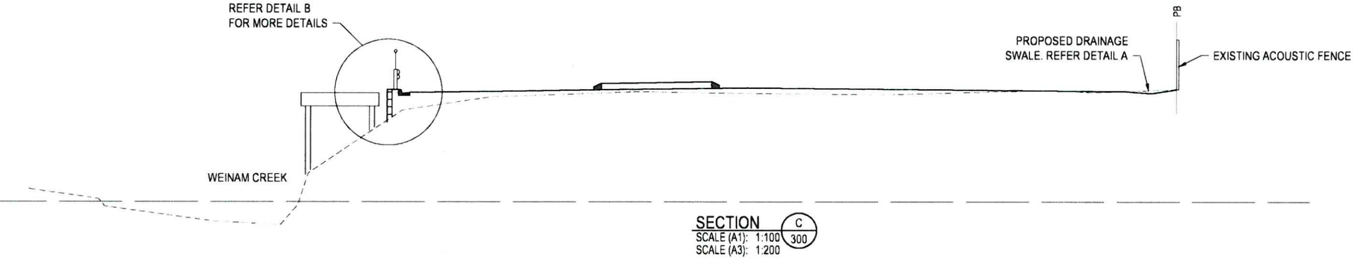
DETAIL A
NTS



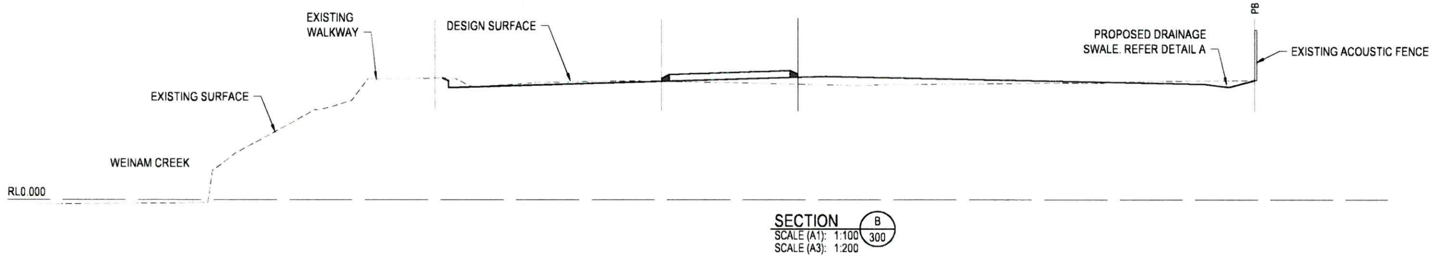
SECTION D
SCALE (A1): 1:100
SCALE (A3): 1:200
300



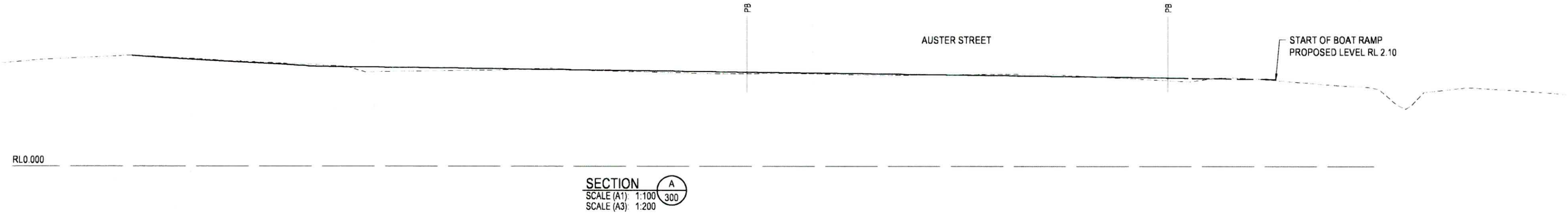
DETAIL B
NTS



SECTION C
SCALE (A1): 1:100
SCALE (A3): 1:200
300



SECTION B
SCALE (A1): 1:100
SCALE (A3): 1:200
300



SECTION A
SCALE (A1): 1:100
SCALE (A3): 1:200
300

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1			RT	CH

DRAWN
DESIGN

STATUS
FOR DEVELOPMENT APPLICATION
NOT FOR CONSTRUCTION

APPROVED

SCALE
1:100 1 0 1 2 3 4 5m A1
1:200 A3

CLIENT
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PROJECT
WEINAM CREEK
PRECINCT 3A
BOAT RAMP ACCESS

DISCLAIMER
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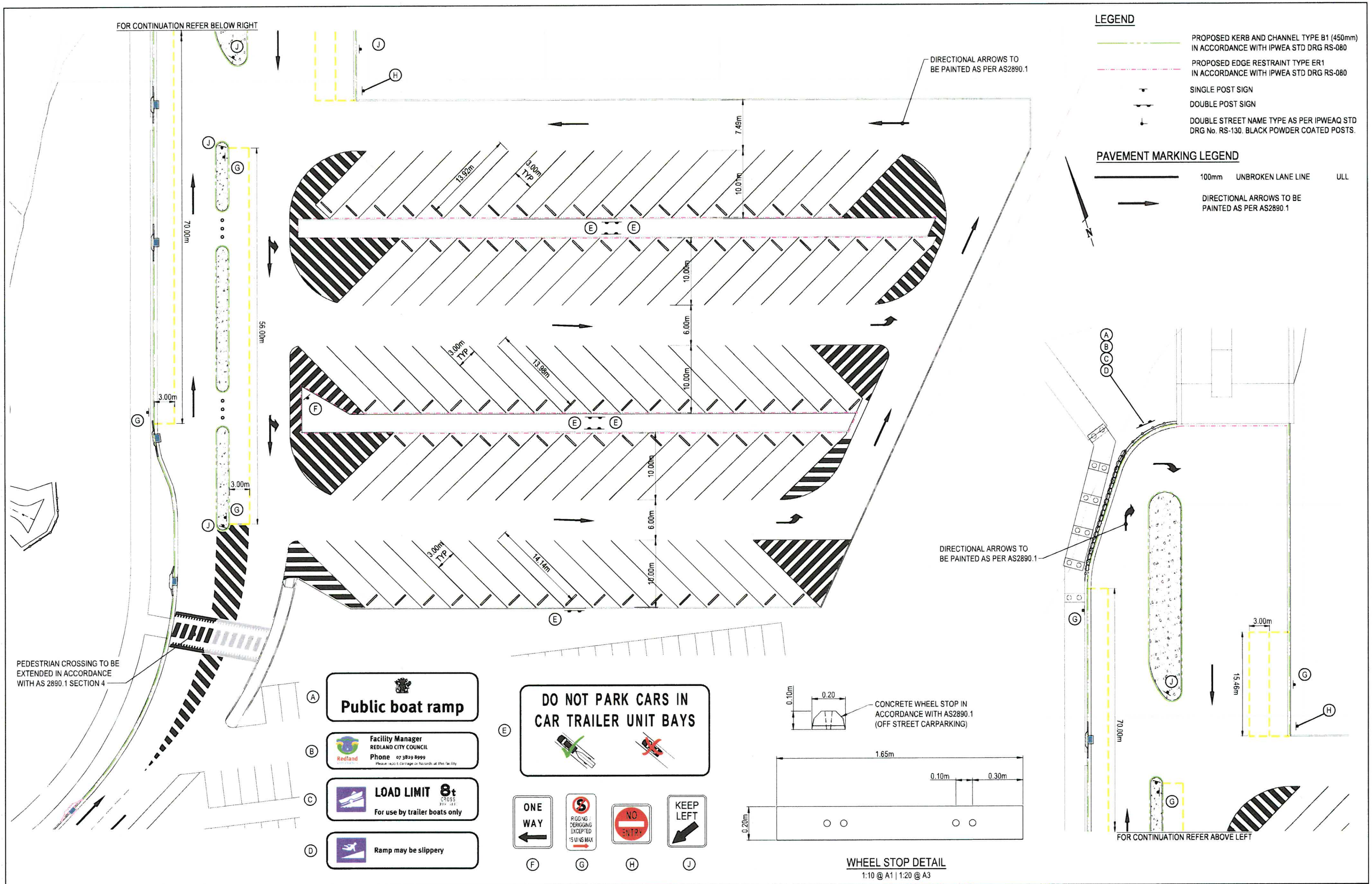
DRAWING TITLE
ROADWORKS
CROSS SECTIONS

PROJECT No	DRAWING No	REVISION
18-003166	310	1



LEGEND

🟩	PROPOSED KERB AND CHANNEL TYPE B1 (450mm) IN ACCORDANCE WITH IPWEA STD DRG RS-080
🟥	PROPOSED EDGE RESTRAINT TYPE ER1 IN ACCORDANCE WITH IPWEA STD DRG RS-080
┬	SINGLE POST SIGN
┬┬	DOUBLE POST SIGN
┴	DOUBLE STREET NAME TYPE AS PER IPWEAQ STD DRG No. RS-130. BLACK POWDER COATED POSTS.

PAVEMENT MARKING LEGEND

━	100mm UNBROKEN LANE LINE	ULL
→	DIRECTIONAL ARROWS TO BE PAINTED AS PER AS2890.1	

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1			RT	CH

DRAWN

DESIGN

STATUS
FOR DEVELOPMENT APPLICATION
NOT FOR CONSTRUCTION

APPROVED

SCALE
1:250 @ A1
1:500 @ A3
0 5 10m

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PROJECT
WEINAM CREEK PRECINCT 3A BOAT RAMP ACCESS

DISCLAIMER
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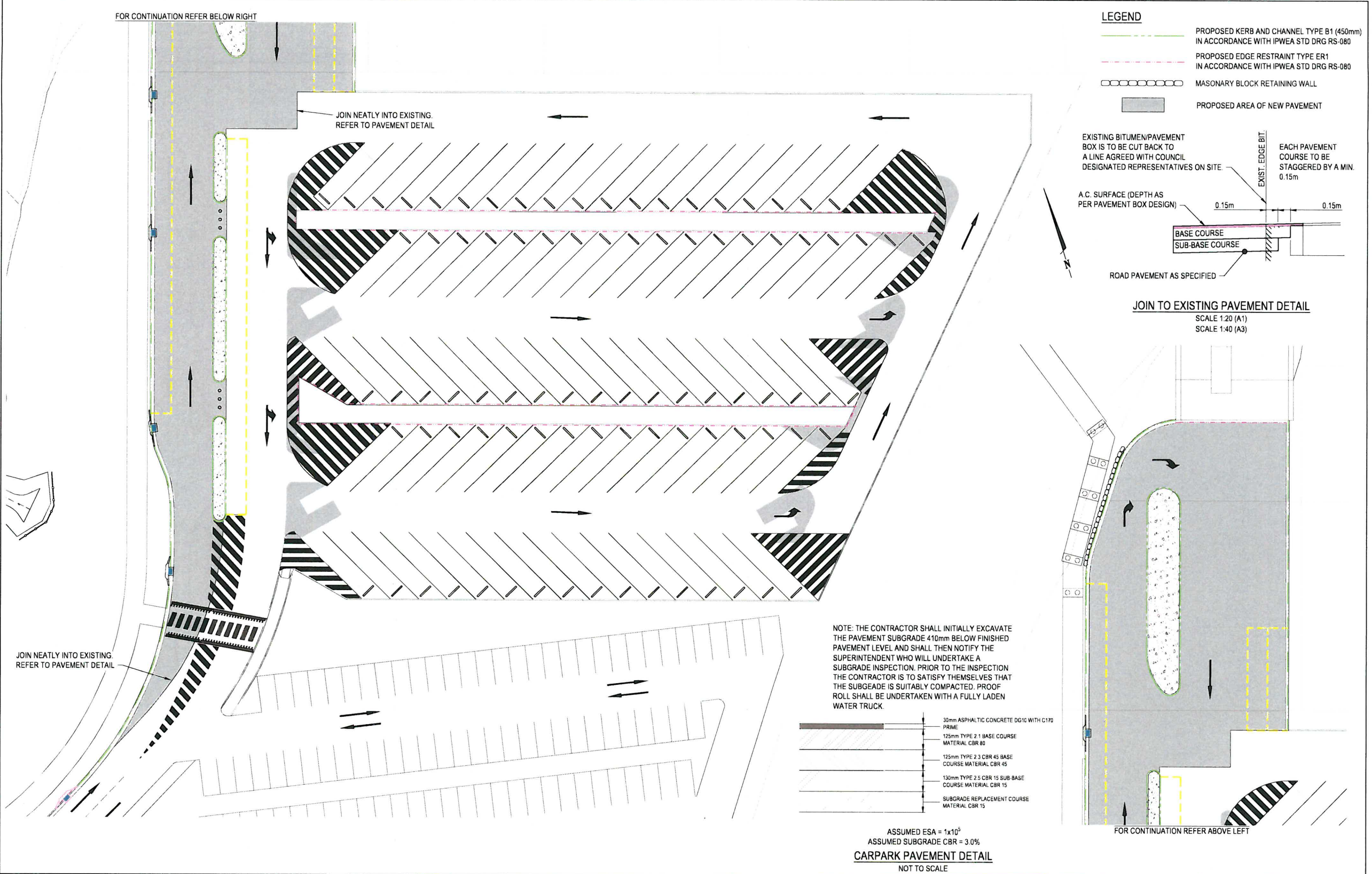
DRAWING TITLE
SIGNAGE AND LINEMARKING LAYOUT PLAN

PROJECT No	DRAWING No	REVISION
18-003166	350	1



LEGEND

— · — · —	PROPOSED KERB AND CHANNEL TYPE B1 (450mm) IN ACCORDANCE WITH IPWEA STD DRG RS-080
- · - · -	PROPOSED EDGE RESTRAINT TYPE ER1 IN ACCORDANCE WITH IPWEA STD DRG RS-080
▭▭▭▭▭▭▭▭▭	MASONARY BLOCK RETAINING WALL
▨	PROPOSED AREA OF NEW PAVEMENT

JOIN TO EXISTING PAVEMENT DETAIL

SCALE 1:20 (A1)
SCALE 1:40 (A3)

NOTE: THE CONTRACTOR SHALL INITIALLY EXCAVATE THE PAVEMENT SUBGRADE 410mm BELOW FINISHED PAVEMENT LEVEL AND SHALL THEN NOTIFY THE SUPERINTENDENT WHO WILL UNDERTAKE A SUBGRADE INSPECTION. PRIOR TO THE INSPECTION THE CONTRACTOR IS TO SATISFY THEMSELVES THAT THE SUBGEADE IS SUITABLY COMPACTED. PROOF ROLL SHALL BE UNDERTAKEN WITH A FULLY LADEN WATER TRUCK.

ASSUMED ESA = $1x10^5$
ASSUMED SUBGRADE CBR = 3.0%

CARPARK PAVEMENT DETAIL

NOT TO SCALE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1			RT	CH

DRAWN

DESIGN

STATUS
FOR DEVELOPMENT APPLICATION
NOT FOR CONSTRUCTION

APPROVED

SCALE
1:250 5 0 5 10m A1
1:500 A3

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PROJECT
WEINAM CREEK
PRECINCT 3A
BOAT RAMP ACCESS

DISCLAIMER
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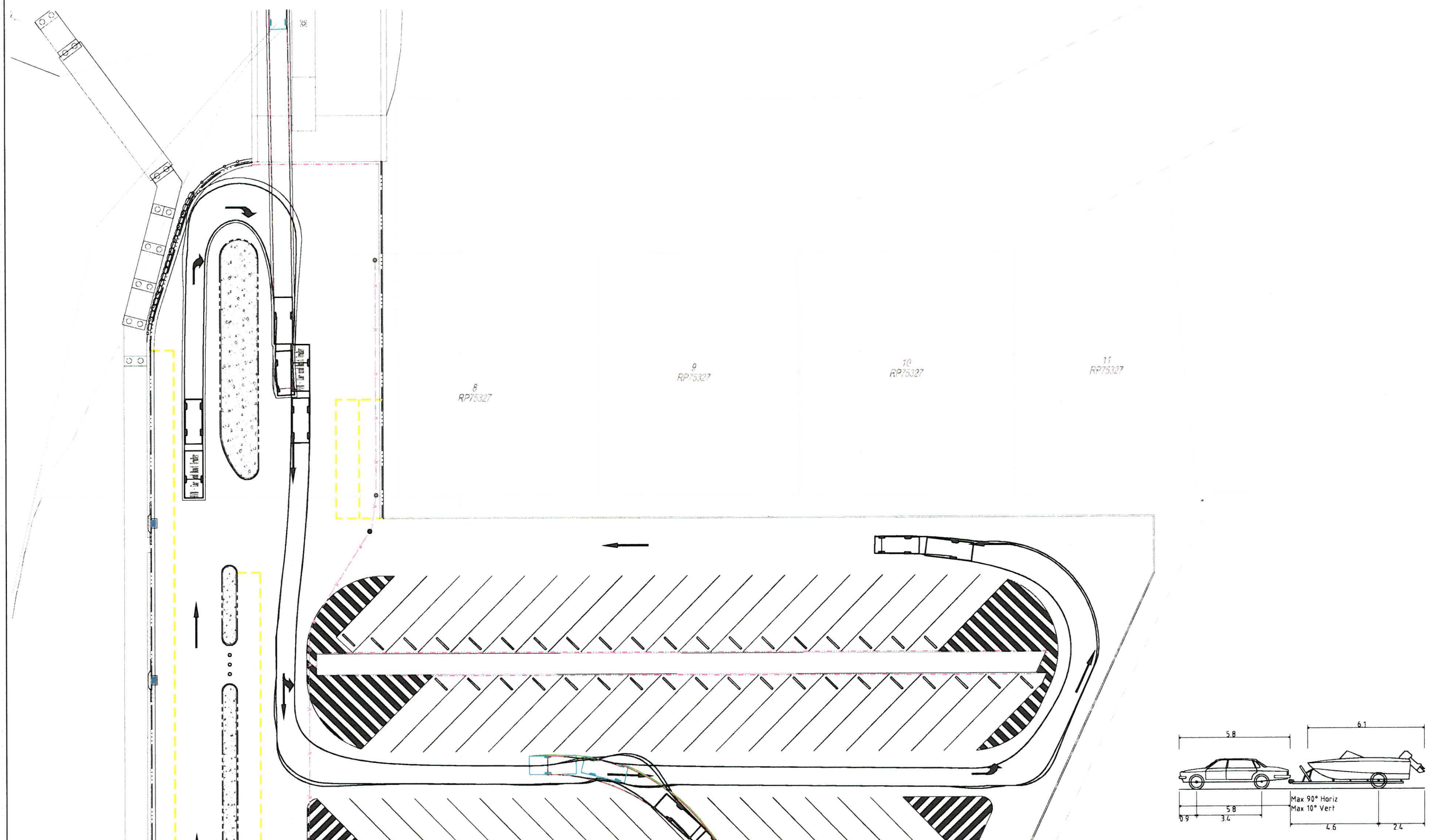
DRAWING TITLE
PAVEMENT DETAIL
PLAN

PROJECT No.	DRAWING No.	REVISION
18-003166	360	1



P/B - Car and Boat Trailer	
Overall Length	12.800m
Overall Width	2.400m
Overall Body Height	1.987m
Min Body Ground Clearance	0.273m
Max Track Width	2.400m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	7.300m

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1			RT	CH

DRAWN

DESIGN

STATUS
FOR DEVELOPMENT APPLICATION
NOT FOR CONSTRUCTION

APPROVED

SCALE
1:250 5 0 5 10m A1
1:500 A3

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WEINAM CREEK
PRECINCT 3A
BOAT RAMP ACCESS

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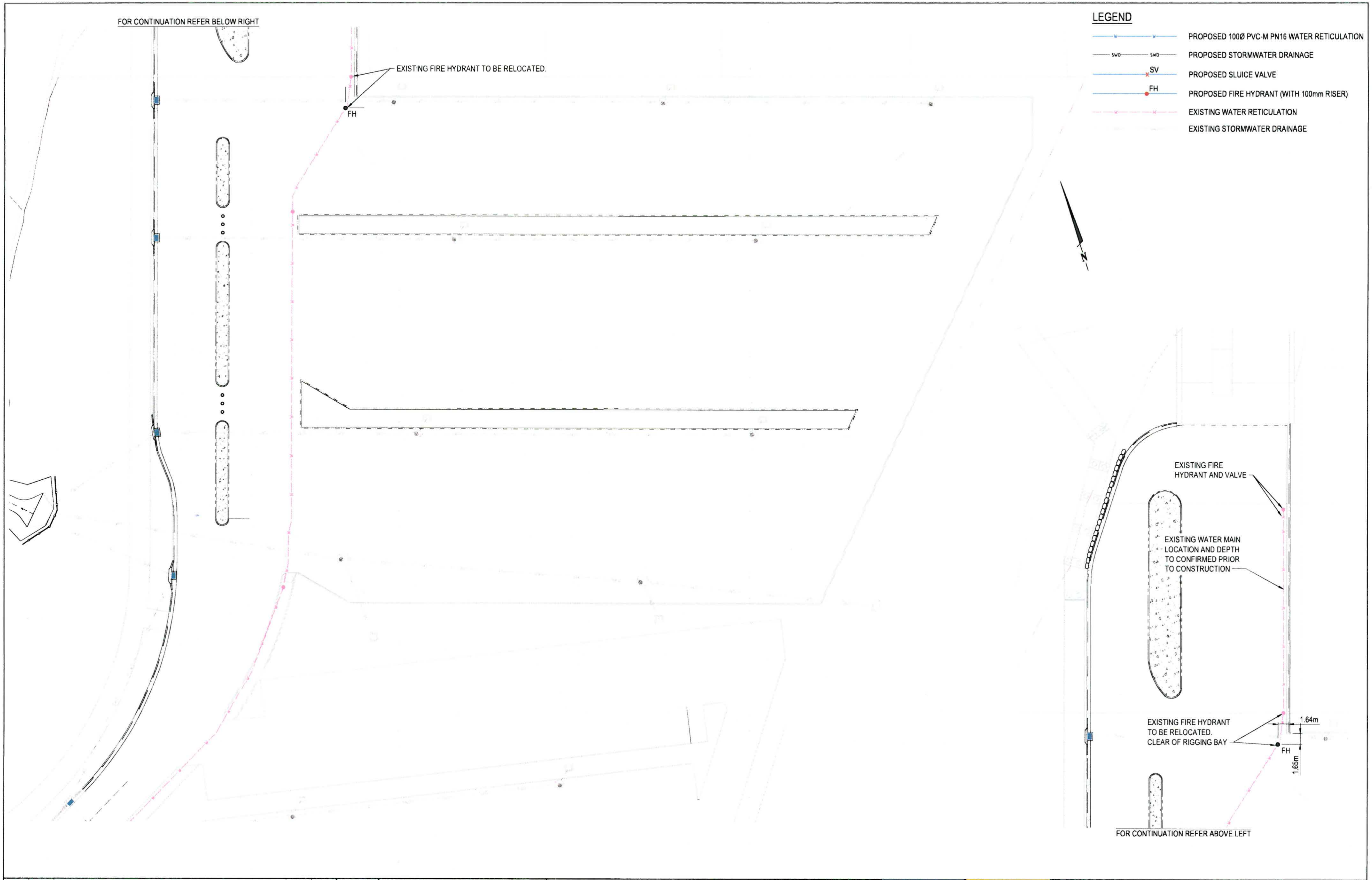
DRAWING TITLE
TURNING TEMPLATE
LAYOUT PLAN

PROJECT No	DRAWING No	REVISION
18-003166	370	1



LEGEND

	PROPOSED 100Ø PVC-M PN16 WATER RETICULATION
SWD SWD	PROPOSED STORMWATER DRAINAGE
SV	PROPOSED SLUICE VALVE
FH	PROPOSED FIRE HYDRANT (WITH 100mm RISER)
	EXISTING WATER RETICULATION
	EXISTING STORMWATER DRAINAGE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1			RT	CH

DRAWN

DESIGN

STATUS **FOR DEVELOPMENT APPLICATION**
NOT FOR CONSTRUCTION

APPROVED

SCALE
1:250 5 0 5 10m A1
1:500 A3

CLIENT
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INVESTMENT CORPORATION
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PROJECT
WEINAM CREEK
PRECINCT 3A
BOAT RAMP ACCESS

DISCLAIMER
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DRAWING TITLE
WATER RETICULATION
LAYOUT PLAN

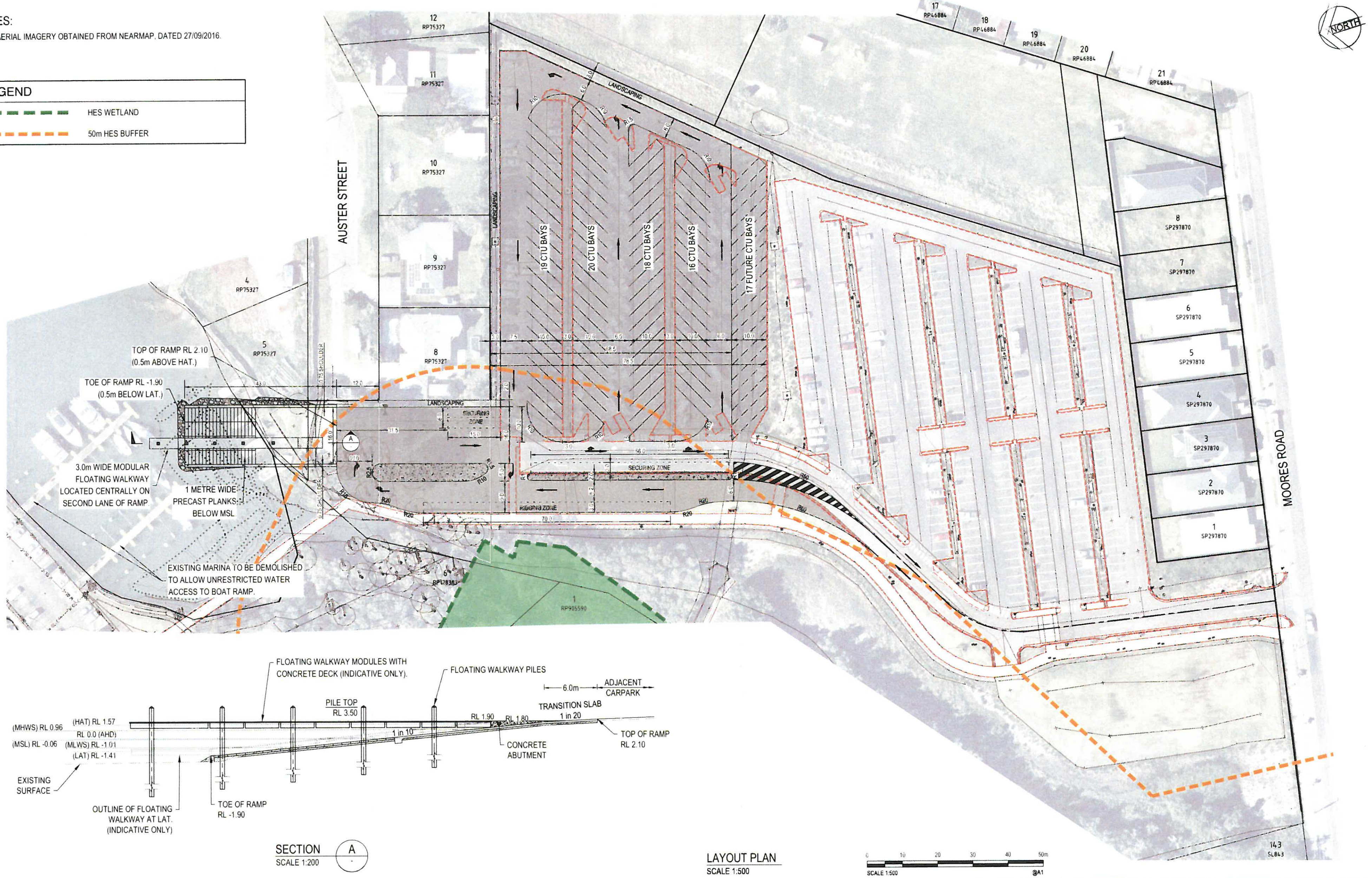
PROJECT No 18-003166
DRAWING No 600
REVISION 1

DATE PLOTTED: 1 July 2021 12:21 PM BY : MITCHELL DASS

NOTES:

1. AERIAL IMAGERY OBTAINED FROM NEARMAP, DATED 27/09/2016.

LEGEND	
🟩 🟩 🟩 🟩	HES WETLAND
🟧 🟧 🟧 🟧	50m HES BUFFER



SECTION A
SCALE 1:200

LAYOUT PLAN
SCALE 1:500

0 10 20 30 40 50m
SCALE 1:500 @A1

Rev	Date	Description	Des	Verif.	Appd
C	1/07/2021	DETAILED SURVEY ADDED	MD	GMc	GMc
B	17/06/2021	ACCESS ROAD & CTU PARKING AREA AMENDED	MD	GMc	GMc
A	1/06/2018	CTU PARKING AREA AMENDED	CE	GMc	GMc

XREF's: 139080 Street Detail_E
CAD File: W:\7904-86 Weinam Creek Boat Ramp Design\01 - DESIGN PHASE\ Drawings\790486-001-SK-1000.dwg

Cardno
Shaping the Future

Cardno (Qld) Pty Ltd | ABN 57 051 074 992
Level 11, 515 St Paul's Terrace
Fortitude Valley, QLD 4006
Tel: 07 3369 9822 Fax: 07 3369 9722
Web: www.cardno.com.au

Drawn	D McKENZIE	Date 15.05.2018
Checked	G MCILWAIN	Date 15.05.2018
Designed	G MCILWAIN	Date 15.05.2018
Verified	G MCILWAIN	Date 15.05.2018
Approved	RPEQ. 1470	Date 17.06.2021

Client: REDLAND INVESTMENT CORPORATION
Project: WEINAM CREEK BOAT RAMP
PROPOSED 3 LANE BOAT RAMP
Title: CONCEPT PLAN

Status: FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Datum	GRID	Scale	Size
AHD		AS SHOWN	A1

Drawing Number	Revision
790486-001-SK-1000	C

Schedule 2 Infrastructure offsets

1.1 Infrastructure Offsets

An applicant seeking a determination of an offset must request and obtain approval to claim the offset using the process in section 1.2.

1.2 Final Offset

(a) Following:

(1) for a Land Contribution, the provision of the Land Contribution in accordance with conditions of any relevant Approval and this Agreement;

(2) for a Works Contribution (other than a Works Contribution comprising roadworks), acceptance by the MEDQ of the Works Contribution on maintenance;

(3) for a Works Contribution comprising roadworks, acceptance by the MEDQ of the Works Contribution off maintenance,

an applicant seeking a determination of a Final Offset must submit a written request to the MEDQ for the determination of the Final Offset.

(b) The request must contain the following information:

(1) for a Land Contribution:

(i) evidence that the Land Contribution has been provided in accordance with conditions of any relevant Approval and this document;

(ii) the relevant identification number in the PDA Infrastructure Contributions Schedule;

(iii) for staged delivery of a Land Contribution, the part of the Land Contribution which is the subject of the request;

(iv) a plan showing the location of the Land Contribution, including the area of the land; and

(v) a statement certified by an Appropriately Qualified Person identifying:

- the total cost of the relevant item in the PDA Infrastructure Contributions Schedule that is applicable to the Land Contribution the subject of the request; or

- for staged delivery of a Land Contribution, the proportion of the total cost of the relevant item in the PDA Infrastructure Contributions Schedule that is applicable to the part of the Land Contribution the subject of the request;

(2) for a Works Contribution:

(i) the item's number in the PDA Infrastructure Contributions Schedule;

(ii) for staged delivery of an item, the portion of the item which is the subject of the request;

(iii) a detailed scope of works certified by an Appropriately Qualified Person;

(iv) a plan showing the spatial extent of the Works Contribution;

(v) a bill of quantities for the Works Contribution certified by an RPEQ or Quantity Surveyor;

(vi) a detailed design certified by an RPEQ;

(vii) a detailed landscape plan (if applicable) prepared by an Appropriately Qualified Person; and

(viii) a statement certified by a Quantity Surveyor or an Appropriately Qualified Person identifying:

- the total cost of the relevant item in the PDA Infrastructure Contributions Schedule that is applicable to each item of the Works Contribution the subject of the request; or

- for staged delivery of an item of the Works Contribution, the proportion of the total cost of that item in the PDA Infrastructure Contributions Schedule that is applicable to each item of the Works Contribution the subject of the request.

(c) Within 10 Business Days of the date of the request, the MEDQ may require the applicant to provide further information that will assist it in deciding the request.

(d) The applicant must comply with any request for further information from the MEDQ.

(e) Within 30 Business Days after the later of:

(1) the receipt by the MEDQ of the applicant's request under section 1.2(a); or

(2) if the MEDQ requests further information, the receipt by the MEDQ of that further information,

the MEDQ must decide the request for the Final Offset.

(f) Within 5 Business Days after deciding the request, the MEDQ must give a written notice to the applicant stating the following:

(1) whether the request is allowed, allowed in part or not allowed;

(2) if the request is allowed in part or not allowed, the reasons for the decision; and

(3) if the request is allowed or allowed in part:

(A) the Final Offset;

(B) the reasons for any difference between the amount of the Final Offset and the applicant's statement of cost for the PDA Infrastructure Contribution.

(g) Within 20 Business Days of receiving notice from the MEDQ advising that a request under section 1.2(a) has been rejected, an applicant may request that MEDQ review that notice, and repeat the process in 1.2(f). Only one notice may be given under this section.

1.3 Claiming an Infrastructure Offset

(a) To claim an offset, an applicant must submit a written request to EDQ to apply the approved Final Offset.

(b) The request may only be submitted to the MEDQ:

- (1) for a Land Contribution, after the PDA Infrastructure Contribution has been provided in accordance with the conditions of any relevant Approval and this Agreement;
- (2) for a Works Contribution (other than a Works Contribution comprising roadworks), acceptance by the MEDQ of the Works Contribution on maintenance;
- (3) for a Work Contribution comprising roadworks, after the MEDQ has issued an off maintenance letter for the PDA Infrastructure Contribution.

(c) The request must contain the following:

- (1) for a Land Contribution:
  - (A) a copy of the notice issued by the MEDQ under sections 1.2(f) allowing the Final Offset in whole or in part; and
  - (B) written evidence that the PDA Infrastructure Contribution has been provided in accordance with the conditions of any relevant Approval and this Agreement;
- (2) for a Works Contribution:
  - (A) a copy of the notices issued by the MEDQ under sections 1.2(f) allowing the Final Offset in whole or in part; and
  - (B) the on maintenance letter issued by the MEDQ; or
  - (C) where the Works Contribution comprises roadworks, the off maintenance letter issued by the MEDQ.

(d) Within 30 Business Days after receiving a request under section 1.3(a), the MEDQ must issue a written notice advising the applicant:

- (1) where the applicant's request has been accepted:
  - (A) the Final Offset to be offset against the relevant infrastructure charge payable; and
  - (B) the balance of any relevant infrastructure charge which is payable and the timing of payment; and
- (2) where an applicant's request has not been accepted, the reasons for rejecting the applicant's request.

(e) Within 20 Business Days of receiving notice from the MEDQ advising that a request under section 1.3(a) has been rejected, an applicant may request that MEDQ review that notice, and repeat the process in 1.3(d). Only one notice may be given under this section.

Signing page

Executed as a deed by Redland Investment Corporation Pty Ltd ACN 603 164 503

Director/Sole ~~Director~~/Sole ~~Director~~ ~~and Secretary~~
Under Power of Attorney

Peter Kelley
Print full name of ~~Director/Sole Director~~ Attorney

29.11.2021
Date

~~Director~~/Secretary (if applicable)

Anca Butcher
Print full name of ~~Director~~/Secretary

Executed as a deed for and on behalf of Redland City Council by the

Ross
Signature of Witness

Andrew Ross.
Print full name of Witness

Redland City Council – Authorised delegate, Andrew Chesterman

29.11.2021
Date

Executed as a deed by Deborah McNamara, General Manager, Economic Development Queensland, Department of State Development, Infrastructure, Local Government and Planning, Delegate under Instrument of Sub-delegation dated 9 December 2019, for and on behalf of the Minister for Economic Development Queensland (ABN 76 590 288 697) in the presence of:

x
Signature

x 1/12/21.
Date

x
Witness

x Petra Forwood
Print full name of Witness

Appendix F – Water Supply Master Plan for the Weinam Creek PDA

Redland
CITY COUNCIL

Water Supply Master Plan for the Weinam Creek PDA

Redland Bay, Qld

Redland City Council
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Redland City Council

WRITER TO COMPLETE TABLE BELOW FOR VERSION CONTROL PURPOSES

Document Status					
Rev No.	**Author**	**Reviewers**	**Approved for Issue**		
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Final	J. May	M. Ingerman	-	-	23/9/19
Final	J. May	M. Ingerman			11/12/19

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EXECUTIVE SUMMARY

The Weinam Creek Priority Development Area (PDA) is located in Redland Bay, on the Moreton Bay foreshore, within the Redland City Council (RCC) Local Government Area (LGA). The Economic Development Queensland (EDQ) Weinam Creek PDA Development Scheme has proposed a mixed-use master plan, majority of which will be high density residential apartment living, with buildings up to 7 storeys in height. The ultimate population density for the development scheme has been estimated at 3,000 Equivalent Population (EP) by Redland Investment Corporation (RIC).

EDQ's Weinam Creek PDA planning density (3,000 EP) far exceeds that of RCC's Local Government Infrastructure Plan (LGIP) ultimate planning demands (approximately 1,096 EP). A detailed water supply planning study was therefore undertaken to determine the impact that the additional loading will have on the existing network, and to identify infrastructure upgrades necessary to achieve RCC's minimum design standards.

The analysis identified that there is insufficient capacity for the existing water supply network to service the additional loading of the Weinam Creek PDA, and the increase in fire flow requirement (i.e. 15 L/s to 30 L/s) to service commercial land-use and buildings in excess of 3 storeys. Detailed hydraulic modelling identified two potential service strategy options to service the local network within RCC's minimum design standards, up to the 2041 planning horizon. Details are as follows.

Service Strategy Option	Proposed Infrastructure	$ / Unit Rate	Capital Cost ($)	Purpose
Option 1 - Split Serpentine Creek DMA with a new meter point located from the DN750 along Cleveland Bay Road	1,570 m of DN375	$1,535 / m	2.4M	Meet SF min. pressure and maintain pressure management
	905 m of DN300	$658 / m	0.6M	
	780 m of DN225	$522 / m	0.4M	
	770 m of DN200	$466 / m	0.4M	
	PRV/Meter assembly	$100k / unit	0.1M	
	200 m of DN200	$466 / m	0.1M	Meet FF min. pressure
	1,250 m of DN150	$394 / m	0.5M	
		TOTAL	**4.5M**	
Option 2 - Split Serpentine Creek DMA with a new meter point located from the DN600 along Giles Road	1,135 m of DN375	$1,535 / m	1.7M	Meet SF min. pressure and maintain pressure management
	830 m of DN300	$658 / m	0.5M	
	420 m of DN250	$553 / m	0.2M	
	640 m of DN200	$466 / m	0.3M	
	260 m of DN150	$394 / m	0.1M	
	PRV/Meter assembly	$100k / unit	0.1M	
	200 m of DN200	$466 / m	0.1M	Meet FF min. pressure
	1,250 m of DN150	$394 / m	0.5M	
		TOTAL	**3.6M**	

The hydraulic analysis of the two service options identified similar network pressures, with a minimum standard flow and fire flow pressure of 30-34 m and 12 m, respectively, at the 2041 planning horizon.

It is recommended that Option 2 is selected as the preferred service strategy for the following reasons.

- Improved security of supply for the downstream area.
- Less construction issues as pipe alignment is predominantly within non-urban areas and less involvement with State Government controlled roads.
- Caters for demand in the network up to the 2041 planning horizon.
- Lowest capital cost estimated.

1 INTRODUCTION

The Weinam Creek Priority Development Area (PDA) is located in Redland Bay, on the Moreton Bay foreshore, within the Redland City Council (RCC) Local Government Area (LGA). The total area of the PDA is estimated at 42 Hectares and is bounded by Weinam Street to the west, Moreton Bay to the east, Peel Street to the north, and Moores Road to the south.

The Economic Development Queensland (EDQ) Weinam Creek PDA Development Scheme has proposed a mixed-use master plan, majority of which will be high density residential apartment living, with buildings up to 7 storeys in height. The ultimate population density for the development scheme has been estimated at 3,000 Equivalent Population (EP). Refer to Appendix 1 for an overview of the PDA.

EDQ's Weinam Creek PDA planning density (3,000 EP) far exceeds that of RCC's Local Government Infrastructure Plan (LGIP) ultimate planning demands (approximately 1,096 EP). Therefore, the PDA will likely have a significant impact on the capacity of the existing water supply network, triggering the need for a review on the water supply infrastructure master plan for the relevant catchment.

1.1 Purpose

The purpose of this report is to quantify the impact of EDQ's Weinam Creek PDA planning demands on RCC's existing water supply network, and associated trunk infrastructure master planning. This information will form part of the revised headworks charges for approved Development Applications (DA), within the Weinam Creek PDA.

The hydraulic modelling was completed up to the 2041 planning horizon, to align with the Redland City Plan (2018) strategic framework. The 2016 Netserv Plan (and associated Water Supply Master Plan) were completed to a 2036 planning horizon to ensure compliance with minimum 20-year planning criteria required under the South-East Queensland Water (Distribution and Retail Restructuring) Act 2009.

1.2 Background

The Weinam Creek PDA is supplied by the Heinemann Road tank set, with a total combined storage of approximately 60 ML and Bottom Water Level (BWL) of RL 77.3 m AHD. The majority of the PDA is located within the Serpentine Creek District Metered Area (DMA), serviced by an existing PRV with a setting of approximately 60 m residual pressure, and ground level of RL 12.5 m AHD. The north-west area of the PDA is located within the Boundary Street DMA, with an existing fixed PRV setting of approximately 42 m residual pressure, and ground level of RL 9.7 m AHD.

The PDA is directly serviced by a trunk system of DN200, DN225 and DN300 trunk system downstream of each PRV. Refer to Appendix 2 for an overview of the existing water supply network.

RCC's current LGIP only considers augmentations and demand projections up to 2036, which identified 6 pipe upgrades to service fire flow deficiencies, with no upgrades required to service standard flow. The only LGIP upgrades that would directly impact the Weinam Creek PDA, would be the DN150 cross-connection between Auster Street and Moores Road, and DN150 cross-connection between Banana Street and the Weinam Creek boat ramp.

1.3 Relevant Reports

- The '*Redland Water Water Supply Master Plan*' (Oct 2016) report presents information on augmentations to support RCC's LGIP for water supply.
- The '*SEQ Water Supply and Sewerage Design and Construction Code (SEQ WS&S D&C Code)*' (Jul, 2013) report presents RCC latest design standards.

2 METHODOLOGY

2.1 Design Standards

The design standards of the "*South East Queensland Water Supply and Sewerage Design and Construction Code*" (2013) were utilised for the assessment. A summary of the most relevant requirements are as follows.

Table 2-1. SEQ WS&S D&C Code provisions relevant to the analysis

Provision	Specification
ET to EP conversion factor	2.7
Maximum pipe velocity	2.5 m/s
Maximum head loss	5 m head/km for <=DN150 3 m head/km >=DN200
Minimum service pressure	22 m at the property boundary
Maximum service pressure	55 m
Minimum fire flow network pressure and background demand	12 m at 2/3 peak hour demand (res.) 12 m at peak hour demand (com./ind.)
Fire flow	15 L/s (res. <= 3 storeys) 30 L/s (res. > 3 storeys) 30 L/s (com./ind.)

2.2 Hydraulic Modelling

The methodology adopted for the Weinam Creek PDA water supply master plan study is as follows.

1. RCC's latest Mike Urban LGIP water supply hydraulic model (IDM_Rev17) was adopted for the hydraulic analysis. For the post-development scenario, existing LGIP planning demands were removed and EDQ's Weinam Creek PDA planning demands (3,000 EP total) were allocated to the closest model node, on a lot by lot basis.
2. For the 2041 planning horizon, a detailed 1 x Maximum Day (MD) standard flow analysis was undertaken on the local pipe reticulation servicing the PDA, and DMA network, for both pre- and post-development scenarios. The assessment of the pre-development scenario was undertaken to merely identify the impact that the Weinam PDA demands has on RCC's existing LGIP.
3. A number of service strategy options were investigated for standard flow deficiencies triggered by the Weinam Creek PDA. This included network improvements such as pipe size upgrades, pipe cross-connections, DMA boundary changes, increase to PRV settings, operational changes etc.

   Note: An assessment on the capacity of the water supply tanks (Heinemann Road LLZ) was not undertaken, as the additional loading (3,000 EP) was considered a minor impact to the existing storage capacity, approximately 60 ML.
4. For the pre-development scenario, the Serpentine Creek DMA pipe network was allocated a 15 L/s @ 2/3 Peak Hour demand fire flow. This is due to RCC's existing LGIP based on a low density residential land-use, with buildings < = 3 storeys.
5. For the post-development scenario, Residential (15 L/s) and commercial (30 L/s) fire flow allocation was applied to the local pipe network servicing the PDA, as per the following.

   a. Pipework along Auster Street, Esplanade and Moores Road: 15 L/s @ 2/3 Peak Hour demand, due to the EDQ development zoning of high density residential @ 3 storeys or less.
   b. Pipework along the foreshore from Meissner Street to Weinam Street: 30 L/s @ Peak Hour demand, due to the mixed-use zoning including commercial use.
   c. All remaining pipework: 30 L/s @ 2/3 Peak Hour demand, due to high density residential above 3 storeys in height.

   Note: Tank MOL was not considered for both the standard flow and fire flow assessments, as the DMA PRV's operate as a "Break of Head".

6. In combination with the solutions identified for standard flow, a number of service strategy options were investigated for fire flow deficiencies triggered by the Weinam Creek PDA. This included network improvements such as pipe size upgrades, pipe cross-connections, PRV setting increases, DMA boundary changes etc.
7. To determine the most economical option, a capital cost assessment was undertaken on each service strategy.
8. Modelling results were verified and findings reported.

3 RESULTS

3.1 Standard Flow

As per the methodology described in Section 2.2 of this report, a detailed standard flow network analysis was undertaken on the 2041 planning horizon, pre- and post-development of the Weinam Creek PDA. The post-development analysis identified significant standard flow minimum pressure failures at elevated areas of the Serpentine Creek DMA, with approximately 185 nodes unable to meet the 22m residual pressure requirement. A summary of results is presented below in Table 3-1 and Appendix 3.

Table 3-1. Standard flow modelling results, pre- and post-development

Provision	2041 (Pre-develop. Demands)	2041 (Post-develop. - Weinam Creek PDA)
Weinam Creek PDA min. pressure (m)	43.7	29.2
Serpentine Creek DMA min. pressure (m)	16.9	9.4
No. of total min. pressure failures	30	185

Note 1: RCC's hydraulic model is showing pre-existing standard flow failures at the 2041 planning horizon, as RCC's latest LGIP was based on an ultimate planning horizon of 2036. The pre-development pressure failures can be resolved via a 5 m increase in the PRV setting for the Serpentine Creek DMA. This is however not considered a viable long-term option for aging network assets also subject to additional growth.

Note 2: The above results are with the existing Serpentine Creek DMA PRV setting @ 61 m residual pressure.

The pressure deficiencies demonstrated in Table 3-1 above were predominantly due to a cumulative head loss, through the existing DN375, DN300 and DN225 trunk system, from the increase in peak hour demand (25 L/s). Refer to Figures 3-1 and 3-2 below for the trunk HGL pre- and post-development of the Weinam Creek PDA, at the 2041 planning horizon.

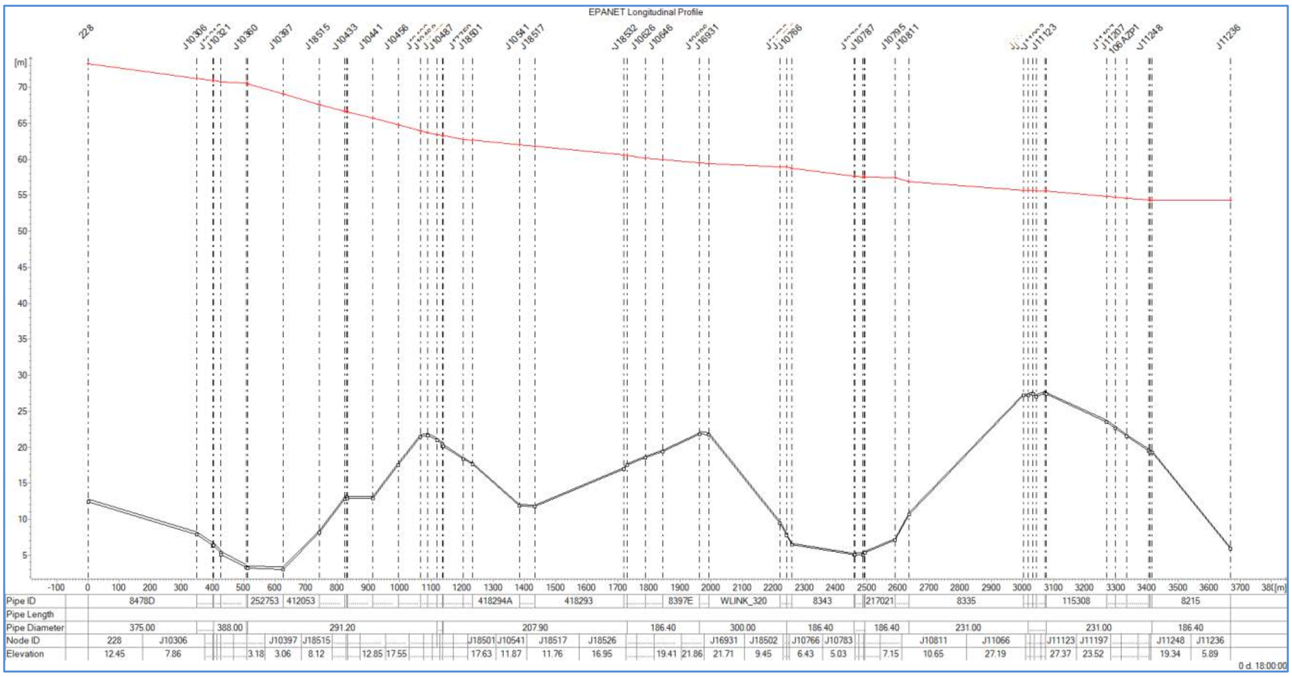

Figure 3-1. Peak demand HGL along Serpentine Creek DMA trunk system, pre-develop. Weinam Creek PDA

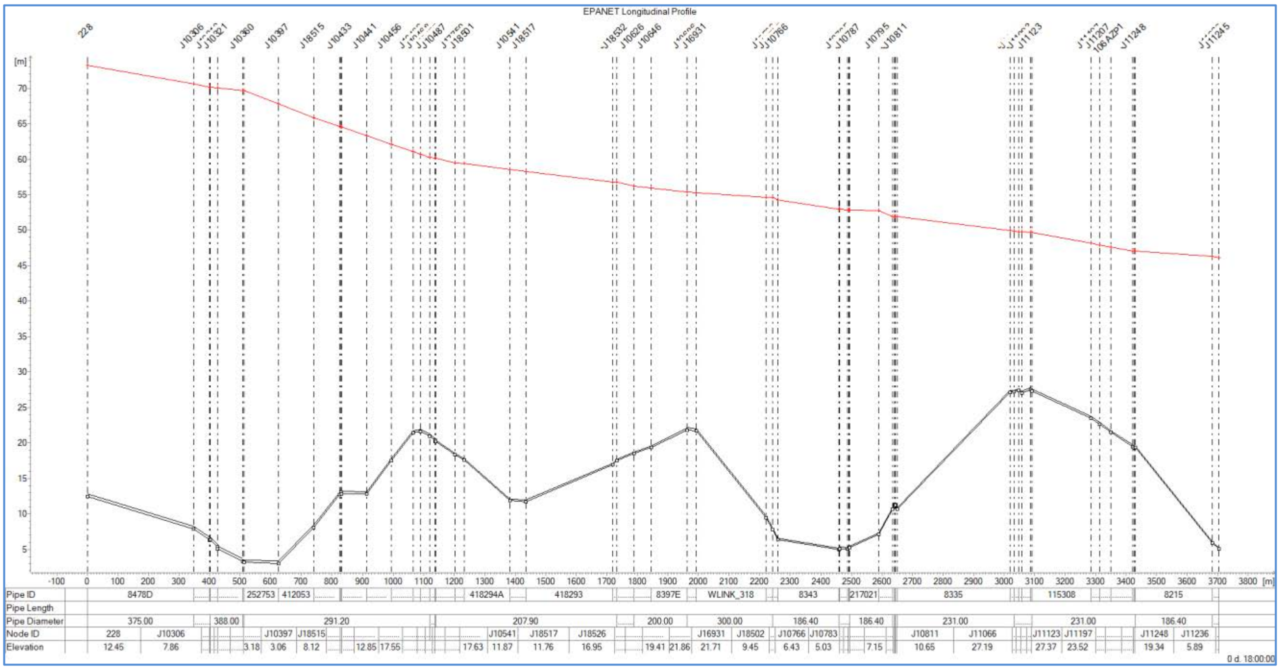

Figure 3-2. Peak demand HGL along Serpentine Creek DMA trunk system, post-develop. Weinam Creek PDA

As demonstrated in the figures above, the head loss over the length of the trunk system is cumulative and not the result of an isolated capacity deficiency. A wider network service strategy was therefore required to resolve the overall pressure deficiencies that were triggered by the Weinam Creek PDA. Refer to Section 3.3 for relevant service strategy options in order to achieve RCC's minimum design standards, up to the 2041 planning horizon.

3.2 Fire Flow

As per the methodology described in Section 2.2 of this report, a detailed fire flow network analysis was undertaken on the 2041 planning horizon, pre- and post-development of the Weinam Creek PDA. The post-development analysis identified significant fire flow minimum pressure failures within the reticulation network directly servicing the Weinam Creek PDA, and additional failures within the external network. A summary of results is presented below in Table 3-2 and Appendix 4.

Table 3-2. Fire flow modelling results, pre- and post-development

Provision	2041 (Pre-develop. Demands)	2041 (Post-develop. - Weinam Creek PDA)
Weinam Creek PDA min. pressure (m)	32.8	-53.2
Serpentine Creek DMA min. pressure (m)	-9.7	-53.2
No. of total min. pressure failures	41	90

Note 1: RCC's hydraulic model is showing pre-existing fire flow failures at the 2041 planning horizon, as RCC's latest LGIP is based on an ultimate planning horizon at 2036.

Note 2: The above results are with the existing Serpentine Creek DMA PRV setting @ 61 m residual pressure.

Note 3: 30 L/s @ peak hour demand was applied to pipework along Banana Street and The Esplanade, 30 L/s @ 2/3 peak hour demand was applied to pipework along Outridge Street, Weinam Street and Hamilton Street. All remaining pipework applied 15 L/s @ 2/3 peak hour.

The pressure deficiencies demonstrated in Table 3-2 were predominantly due to insufficient pipe sizes, to meet the increase in peak hour demand (25 L/s) from the Weinam Creek PDA, and escalation of fire flow requirements for commercial land-use and residential buildings in excess of 3 storeys, i.e. an increase from 15 L/s to 30 L/s for all allotments north of Weinam Creek. Significant pipe upgrades were therefore required to resolve these issues. Refer to Section 3.3 for relevant service strategy options, to achieve RCC's minimum design standards, up to the 2041 planning horizon.

3.3 Service Strategy Options

The following service strategy options were developed to resolve the identified standard flow and fire flow deficiencies triggered by the Weinam Creek PDA. The fire flow upgrades were identical for both options, as these were localised issues unrelated to the service strategies developed for standard flow requirements.

- Option 1 – Split Serpentine Creek DMA with a new meter point located from the DN750 along Cleveland Bay Road. Refer to Appendix 5 for further details.
- Option 2 – Split Serpentine Creek DMA with a new meter point located from the DN600 along Giles Road. Refer to Appendix 6 for further details.

In order to complete a comparison of both options, a capital cost estimation was undertaken for the proposed infrastructure works. The impact to the cost savings associated with the Serpentine Creek DMA pressure management scheme (e.g. leakage and pipe bursts) was not considered, as each option would provide identical zone boundaries and additional pressure reduction, estimated at 5 m for 46.6 km of pipe. General operational and maintenance costs were also excluded from the assessment as both options would have a negligible difference. A summary of the capital cost estimate is as follows.

Table 3-3. Summary of the capital cost estimate for each service option

Service Strategy Option	Proposed Infrastructure	$ / Unit Rate	Capital Cost ($)	Purpose
Option 1	1,570 m of DN375	$1,535 / m	2.4M	Meet SF min. pressure and maintain pressure management
	905 m of DN300	$658 / m	0.6M	
	780 m of DN225	$522 / m	0.4M	
	770 m of DN200	$466 / m	0.4M	
	PRV/Meter assembly	$100k / unit	0.1M	
	200 m of DN200	$466 / m	0.1M	Meet FF min. pressure
	1,250 m of DN150	$394 / m	0.5M	
		TOTAL	**4.5M**	
Option 2	1,135 m of DN375	$1,535 / m	1.7M	Meet SF min. pressure and maintain pressure management
	830 m of DN300	$658 / m	0.5M	
	420 m of DN250	$553 / m	0.2M	
	640 m of DN200	$466 / m	0.3M	
	260 m of DN150	$394 / m	0.1M	
	PRV/Meter assembly	$100k / unit	0.1M	
	200 m of DN200	$466 / m	0.1M	Meet FF min. pressure
	1,250 m of DN150	$394 / m	0.5M	
		TOTAL	**3.6M**	

Note 1: Unit capital costs sourced from 2016 Cardno rates and indexed 3% per annum (compounded), for 3 years.

Note 2: Assumed soft rock urban adjustment factor (1.16) for all pipework.

Note 3: Rates include valves/hydrants/services and 20% overheads. No contingency adjustments have been applied.

Note 4: For both options, approximately 465 m of the proposed DN150 fire flow upgrades are existing LGIP augmentations, i.e. cross connection between Auster St and Moores Rd, and cross-connection of Banana Street and Weinam Creek boat ramp.

Table 3-3 demonstrates that Option 2 should have a $0.9M (approximately) lower capital cost to that of Option 1. This is predominantly due to a lower pipe length and size to that of Option 2.

For information purposes only, a cost saving estimate was undertaken on the additional 4-5 m of pressure reduction that both service options can achieve. These savings are associated with leakage, pipe/connection bursts and asset life extension for approximately 46.6 km of pipe work, with the “splitting” of the Serpentine Creek DMA. These savings were based on the below assumptions.

- Current industry understanding for 150mm AC mains is every 10 metre reduction in Average Zone Night Pressure (AZNP) will increase the asset life by 2.3 years (source: WSAA / Allan Lambert).
- According to the WSAA Stage 3 LAPMET software, it is acceptable to assume that a 10% reduction in pressure provides a 10% reduction in leakage.
- The pipe burst saving estimate was calculated by comparing pre- and post- pressure reduction burst rates, as per RCC’s Maximo database, per metre of pressure reduction, for DMAs 202, 203, 204 and 205. This resulted in a 0.0059 burst saving, per metre of pressure reduction, per month. Service burst data was not available so was assumed at 50% of the burst rate and replacement cost to that of pipes. This was deemed acceptable as City of Gold Coast’s (CoGC) PLMP monitored a service burst saving rate approximately 50% lower to that of pipe bursts.

Hydraulic modelling identified the following maximum static pressure reduction achievable for both service options.

- 28.8 m on 38.4 km of pipe for the Western Zone
- 33.0 m on 46.6 km of pipe for the Eastern Zone.

Based on the previously discussed assumptions re unit costs related to pressure reduction, this resulted in the following additional 50 year NPV cost saving estimation.

- **Asset life extension** - $375k over 50 year total replacement program for 46.6 km of pipe, based on 1 year asset life extension. Adopted DN100 pipe replacement cost of $403 per metre, with an adjustment rate of 1.16 for Urban Soft Rock. Pipe replacement cost sourced from Cardno 2016 unit rates, compounded to 2019 (3 years) at 3% index, and 25% contingency.
- **Leakage** - $256k over 50 year time period, based on total combined zone leakage of 2.7 L/s (source: Redland Water 106 Serpentine Creek DMA Report, 2009) and 3.1% of additional pressure reduction for 55% (46.6 km of pipe) of the existing DMA. Adopted Retail Price of $3.536 per kL. Based on Bulk Water price of $2.935 per kL, this saving is reduced to $212k.
- **Pipe/service bursts** - $80k over 50 year time period, based on 0.006 pipe burst saving / m pressure reduction / month. A repair cost of $3,000 per pipe burst and $1,500 per service burst was adopted.

The above discussion shows that Options 1 and 2 is estimated to offset $700k in operational costs, for a 50-year time period, associated with the additional 5 m pressure reduction on 46.6 km of the pipe network.

3.4 Timing of Construction

A subsequent hydraulic analysis was undertaken to estimate timing of the identified pipe upgrades. Details are as follows.

Standard Flow

- With the ultimate Weinam PDA demands (3,000 EP) applied at the 2018 MD scenario, the Serpentine Creek DMA marginally passed the peak hour min. pressure standard (22 m).
- With the ultimate Weinam PDA demands (3,000 EP) applied at the 2031 MD scenario, the network failed (by approx. 5 m) and required all proposed standard flow upgrades to resolve.

Therefore, the standard flow upgrades will likely be triggered prior to the 2031 planning horizon. With the PDA at ultimate development, any significant growth within the Serpentine Creek DMA would likely result in standard flow pressures to falling below the minimum standard. It is therefore recommended that all standard flow upgrades are completed prior to 2030, assuming the PDA reaches ultimate development prior to this time and there is no significant population growth within the DMA.

Fire Flow

- With the existing LGIP demands applied at the 2018 MD scenario, the following upgrades were required to meet the increase in fire flow requirements, i.e. 15 L/s to 30 L/s.
    - DN150 cross connection between Banana St and Weinam Creek Boat Ramp.
    - DN150 upgrade for the existing DN100 that extends from Weinam St into the Jetty car park (east of Redland Bay Fishing Club).
- With the ultimate Weinam PDA demands (3,000 EP) applied at the 2018 MD scenario, all identified fire flow upgrades were required to meet the increase in fire flow (30 L/s) and ultimate PDA demand (3,000 EP).

Therefore, the extensive fire flow upgrades were triggered by both the increase to 30 L/s and the additional PDA demand. First stages of development (above 3 stories or commercial land-use) should install the two DN150 upgrades identified above (i.e. Banana St and Jetty car park). Modelling indicates that the remaining fire flow upgrades will be required at approximately 20% loading of the PDA (approx. 600 EP).

In summary, all standard flow upgrades are required prior to ultimate development of the PDA (3,000 EP), and all fire flow upgrades are required prior to the PDA reaching a density of 600 EP.

3.5 Non-financial Considerations

The key ‘non-financial’ considerations that should be factored into strategy selection are displayed in the tables below.

Table 3-4. 'Non-financial' advantages for each service strategy option

Option	Option Advantage	Comment
Option 1	Operations	High level of operational flexibility and redundancy
	Pressure management	Allows an additional 4-5m of pressure reduction for 46.6 km of network
	Network Capacity	Significantly improves network capacity, with a peak hour min. pressure of 34 m at the 2041 planning horizon
Option 2	Operations	Highest level of operational flexibility and redundancy
	Pressure management	Allows an additional 4-5m of pressure reduction for 46.6 km of network
	Network Capacity	Significantly improves network capacity, with a peak hour min. pressure of 30 m at the 2041 planning horizon

Table 3-5. 'Non-financial' disadvantages for each service strategy option

Option	Option Disadvantage	Comment
Option 1	Implementation	Significant pipe works required, including a long pipe alignment along Main Roads
	Operations	Requires some pipe lengths to be "dead-end" with the DMA boundary changes. This may result in water quality issues
Option 2	Implementation	Significant pipe works required
	Operations	Requires some pipe lengths to be "dead-end" with the DMA boundary changes. This may result in water quality issues

3.6 Recommended Service Option

Option 2 has been identified as the preferred option, due to the following reasons.

- Improved security of supply for the downstream network, due to the proposed DN375 trunk line from the existing DN600 along Giles Road.
- Less construction issues as pipe alignment is predominantly within non-urban areas and less involvement with State Government controlled roads.
- Caters for demand within the network (30 m @ peak hour) up to the 2041 planning horizon.
- Lowest capital cost estimated.

Modelling results with the implementation of this service option, are as follows.

Table 3-6. Standard flow peak hour modelling results for recommended service strategy option

Provision	2041 (Post-develop. Weinam PDA)
Weinam Creek PDA min. pressure (m)	51.5
Serpentine Creek DMA min. pressure (m)	30.0
No. of min. pressure failures	0

Table 3-7. Fire flow modelling results for recommended service strategy option

Provision	2041 (Post-develop. Weinam PDA)
Weinam Creek PDA min. pressure (m)	17.6
Serpentine Creek DMA min. pressure (m)	12.0
No. of min. pressure failures	0

4 CONCLUSION

The Weinam Creek Priority Development Area (PDA) is located in Redland Bay, on the Moreton Bay foreshore, within the Redland City Council (RCC) Local Government Area (LGA). The Economic Development Queensland (EDQ) Weinam Creek PDA Development Scheme has proposed a mixed-use master plan, majority of which will be high density residential apartment living, with buildings up to 7 storeys in height. The ultimate population density for the development scheme has been estimated at 3,000 Equivalent Population (EP).

EDQ's Weinam Creek PDA planning density (3,000 EP) far exceeds that of RCC's Local Government Infrastructure Plan (LGIP) ultimate planning demands (approximately 1,096 EP). A detailed water supply planning study was therefore undertaken to determine the impact that the additional loading will have on the existing network, and to identify infrastructure upgrades necessary to achieve RCC's minimum design standards.

The analysis identified that there is insufficient capacity for the existing water supply network to service the additional loading of the Weinam Creek PDA, and the increase in fire flow requirement (i.e. 15 L/s to 30 L/s) to service commercial land-use and buildings in excess of 3 storeys. Two service strategy options were therefore developed to service the local network within RCC's minimum design standards, up to the 2041 planning horizon. Details are as follows.

Table 4-1. Summary of the capital cost estimate for each service option

Service Strategy Option	Proposed Infrastructure	$ / Unit Rate	Capital Cost ($)	Purpose
Option 1 - Split Serpentine Creek DMA with a new meter point located from the DN750 along Cleveland Bay Road	1,570 m of DN375	$1,535 / m	2.4M	Meet SF min. pressure and maintain pressure management
	905 m of DN300	$658 / m	0.6M	
	780 m of DN225	$522 / m	0.4M	
	770 m of DN200	$466 / m	0.4M	
	PRV/Meter assembly	$100k / unit	0.1M	
	200 m of DN200	$466 / m	0.1M	Meet FF min. pressure
	1,250 m of DN150	$394 / m	0.5M	
		TOTAL	**4.5M**	
Option 2 - Split Serpentine Creek DMA with a new meter point located from the DN600 along Giles Road	1,135 m of DN375	$1,535 / m	1.7M	Meet SF min. pressure and maintain pressure management
	830 m of DN300	$658 / m	0.5M	
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	200 m of DN200	$466 / m	0.1M	Meet FF min. pressure
	1,250 m of DN150	$394 / m	0.5M	
		TOTAL	**3.6M**	

It is recommended that Option 2 is selected as the preferred service strategy for the following reasons.

- Improved security of supply for the downstream network.
- Less construction issues as pipe alignment is predominantly within non-urban areas and less involvement with State Government controlled roads.
- Caters for demands in the network up to the 2041 planning horizon.
- Lowest capital cost estimated.

It is also recommended that RCC completes the following.

- Undertake discussions with RCC’s IC Unit regarding the implementation of the preferred strategy including apportionment of headworks charges to this area.

5 APPENDICES

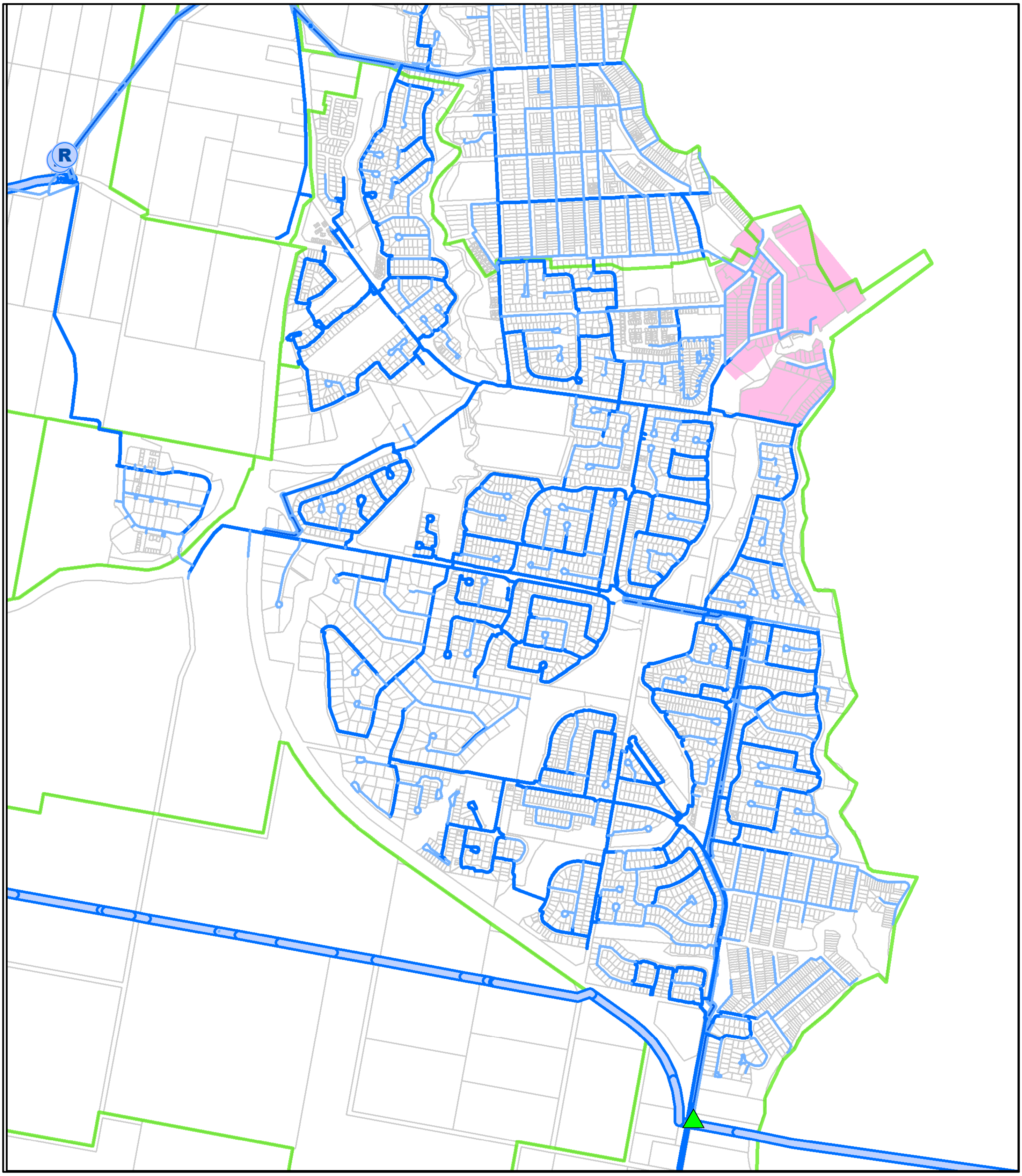
Appendix 1. Weinam Creek PDA Master Plan

weinam creek

master plan

Ref. No. 133693 Date : March 2019 Scale 1 : 1500@A1

Appendix 2. Existing water supply network



Legend

Water Mains - Operating Diameter

- 20 - 100 mm
- 101 - 250 mm
- 251 - 500 mm
- 501 - 900 mm

▲ Serpentine Creek PRV

🟩 Distribution Maintenance Areas

☐ Current Land

🟪 Weinam Creek PDA

Issue	Date	By	Chkd	Appd
D1	24/07/2019	JM	MI	MI

Redland Water
PO Box 21
Cleveland QLD 4163

Job Title **Weinam Creek PDA**

Drawing Title **Existing water supply network**

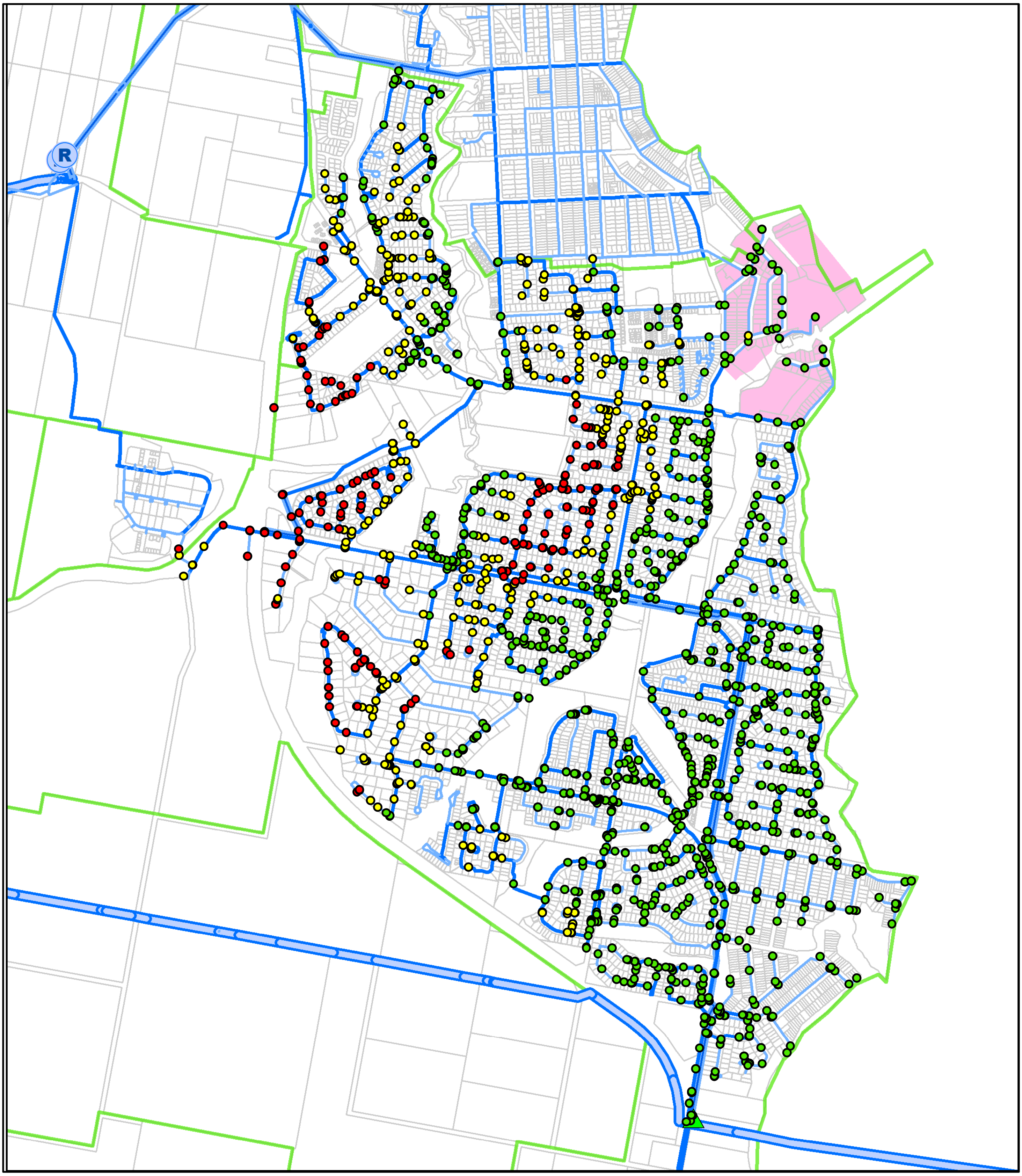
Scale at A3 **1:406,300** Drawing Status **Draft V1**

Coordinate System **GDA 1994 MGA Zone 56**

Date of Print **24/07/2019** Drawing No **001**

M:\06 Weinam PDA\GIS\Appendix 2.mxd

Appendix 3. Standard flow modelling results (peak hour) post-develop. Weinam PDA



Legend

Standard Flow Results

- 🟥 <22 m
- 🟨 22 to 30 m
- 🟩 >30 m

Water Mains - Operating Diameter

- 20 - 100 mm
- 101 - 250 mm
- 251 - 500 mm
- 501 - 900 mm

- ▲ Serpentine Creek PRV
- Distribution Maintenance Areas
- Current Land
- Weinam Creek PDA

D1	27/08/2019	JM	MI	MI
Issue	Date	By	Chkd	Appd

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CITY COUNCIL

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Job Title **Weinam Creek PDA**
Drawing Title **Standard flow modelling results**
Scale at A3 **1:406,300** Drawing Status **Draft V1**
Coordinate System **GDA 1994 MGA Zone 56**
Date of Print **27/08/2019** Drawing No **001**

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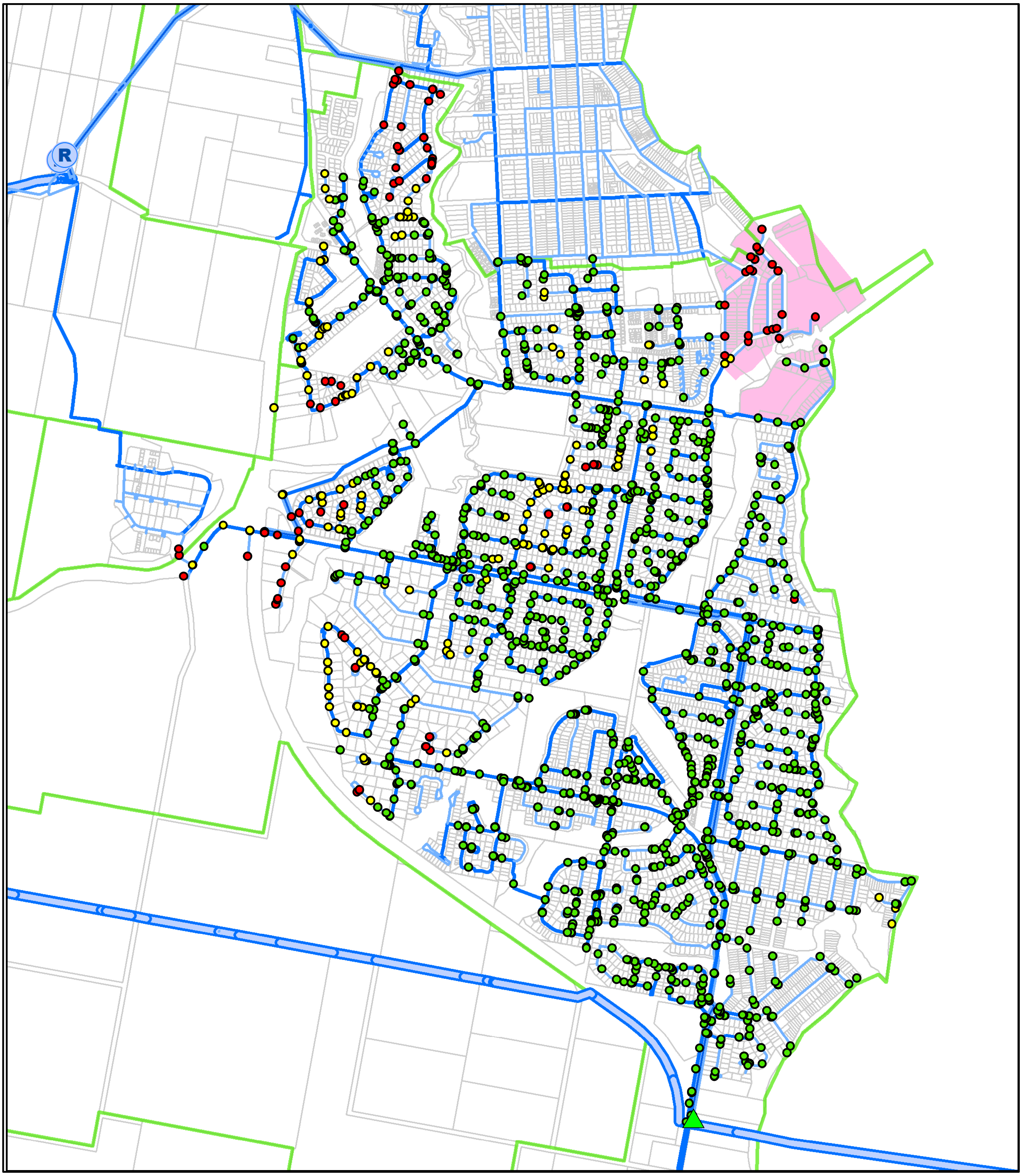
Appendix 4. Fire flow modelling results post-develop. Weinam PDA



Legend

Fire Flow Results

- 🟥 < 12 m
- 🟨 12 to 20 m
- 🟩 > 20 m

Water Mains - Operating Diameter

- — 20 - 100 mm
- — 101 - 250 mm
- — 251 - 500 mm
- — 501 - 900 mm

- ▲ Serpentine Creek PRV
- 🟩 Distribution Maintenance Areas
- ☐ Current Land
- 🟪 Weinam Creek PDA

D1	27/08/2019	JM	MI	MI
Issue	Date	By	Chkd	Appd

Redland City Council

Redland Water
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Job Title **Weinam Creek PDA**

Drawing Title **Fire flow modelling results**

Scale at A3 **1:406,300** Drawing Status **Draft V1**

Coordinate System **GDA 1994 MGA Zone 56**

Date of Print **27/08/2019** Drawing No **001**

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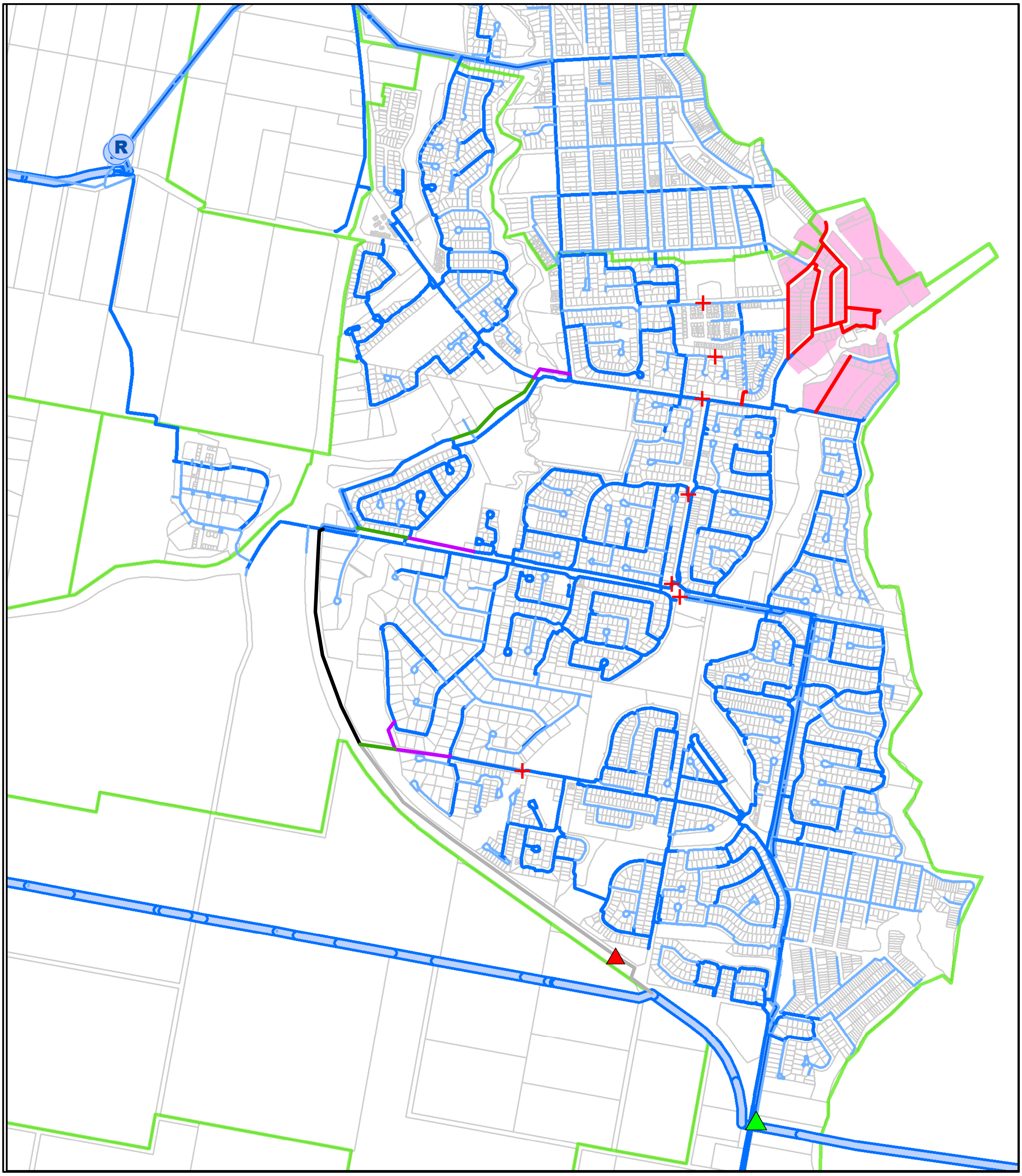
Appendix 5. Option 1 service strategy



Legend

Water Mains - Operating Diameter

- ━ 20 - 100 mm
- ━ 101 - 250 mm
- ━ 251 - 500 mm
- ━ 501 - 900 mm

Proposed Option 1 (mm)

- ━ 200
- ━ 225
- ━ 300
- ━ 375

Proposed FF (mm)

- ━ 150

- + Proposed Closed Valves
- ▲ Proposed Option 1 PRV
- ▲ Serpentine Creek PRV
- ☐ Distribution Maintenance Areas
- ☐ Current Land
- 🟪 Weinam Creek PDA

D1	5/11/2019	JM	MI	MI
Issue	Date	By	Chkd	Appd

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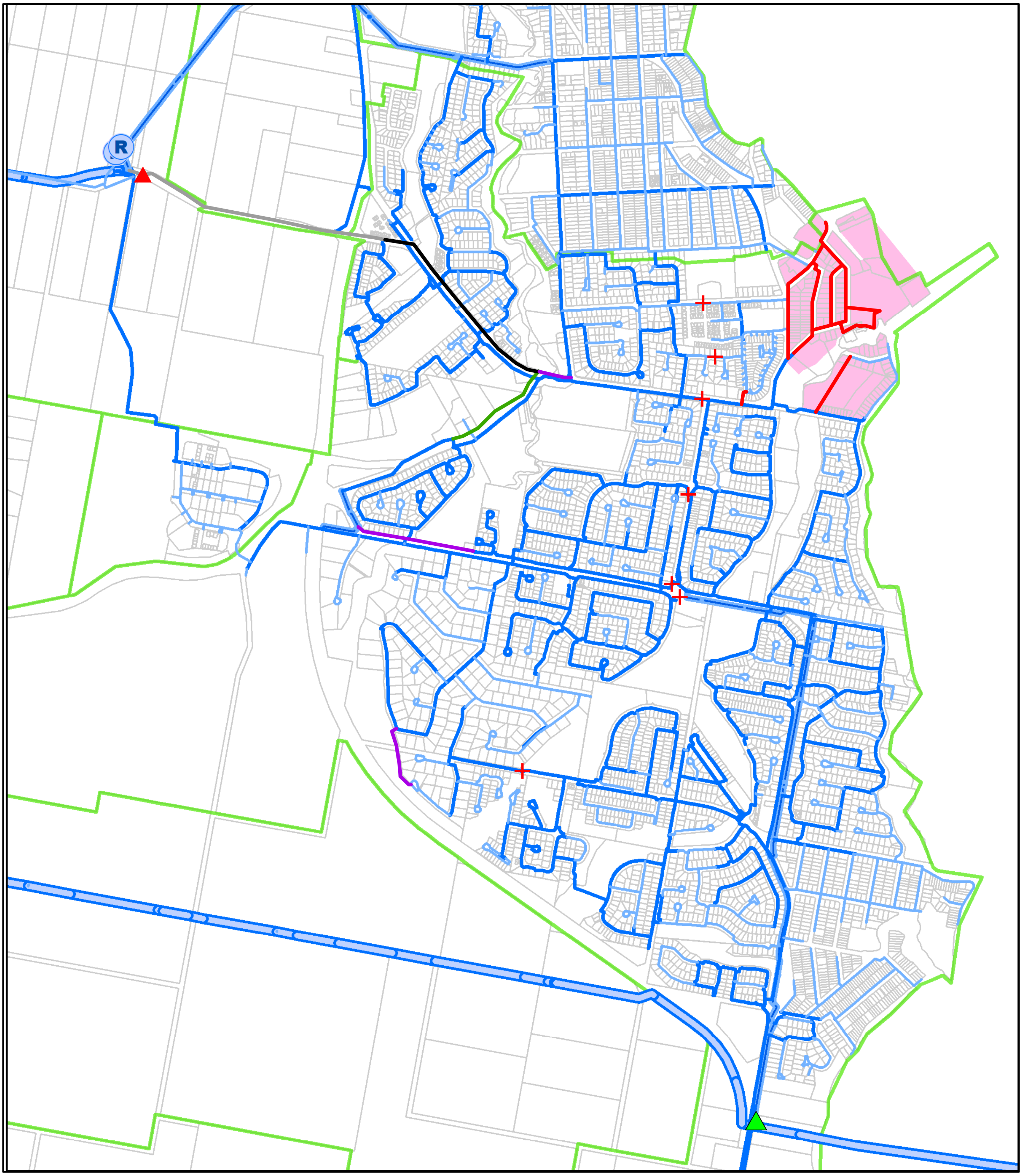
Job Title **Weinam Creek PDA**
Drawing Title **Option 1 Pipe Upgrades**
Scale at A3 **1:406,300** Drawing Status **Draft V1**
Coordinate System **GDA 1994 MGA Zone 56**
Date of Print **5/11/2019** Drawing No **001**

G:\RedlandWater&Waste\Data\TechSup\Planning\Water\02_Planning\002_Land Use Planning Advice\Weinam Creek PDA\GIS\Appendix 5.mxd

Appendix 6. Option 2 service strategy



Legend

Water Mains - Operating Diameter

- 20 - 100 mm
- 101 - 250 mm
- 251 - 500 mm
- 501 - 900 mm

Proposed Option 2 (mm)

- 200
- 250
- 300
- 375

Proposed FF (mm)

- 150

+ Proposed Closed Valves

▲ Proposed Option 2 PRV

▲ Serpentine Creek PRV

🟩 Distribution Maintenance Areas

☐ Current Land

▨ Weinam Creek PDA

Issue	Date	By	Chkd	Appd
D1	5/11/2019	JM	MI	MI

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Job Title **Weinam Creek PDA**
Drawing Title **Option 2 Pipe Upgrades**
Scale at A3 **1:406,300** Drawing Status **Draft V1**
Coordinate System **GDA 1994 MGA Zone 56**
Date of Print **5/11/2019** Drawing No **001**

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Appendix G – Sewerage Network Master Plan for the Weinam Creek PDA

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Sewerage Network Master Plan for the Weinam Creek PDA

Redland Bay, Qld

Redland City Council
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WRITER TO COMPLETE TABLE BELOW FOR VERSION CONTROL PURPOSES

Document Status					
Rev No.	**Author**	**Reviewers**	**Approved for Issue**		
			Name	**Signature**	**Date**
001	J. May	D. Heape	-	-	24/02/20

Table of Contents

EXECUTIVE SUMMARY

The Weinam Creek Priority Development Area (PDA) is located in Redland Bay, on the Moreton Bay foreshore, within the Redland City Council (RCC) Local Government Area (LGA). The Economic Development Queensland (EDQ) Weinam Creek PDA Development Scheme has proposed a mixed-use master plan, the majority of which will be high density residential apartment living, with buildings up to 7 storeys in height. The ultimate population density for the development scheme has been estimated at 3,000 Equivalent Population (EP) by Redland Investment Corporation (RIC).

EDQ's Weinam Creek PDA planning density (3,000 EP) far exceeds that of RCC's Local Government Infrastructure Plan (LGIP) ultimate planning demands (approximately 1,096 EP). A detailed sewerage planning study was therefore undertaken to determine the impact that the additional loading will have on the local existing network, and to identify infrastructure upgrades necessary to achieve RCC's minimum design standards.

The hydraulic analysis identified that there is sufficient capacity within the SPS 132 catchment south of the development, to incorporate the additional Weinam PDA loading, up to the 2041 planning horizon. For the SPS 90 catchment north of the development however, insufficient capacity was identified at both the existing (2017/18) and 2041 planning horizon. A summary of the deficiencies and proposed upgrades to resolve this are as follows.

- Insufficient gravity main flow depth capacity was identified along Outride Street and Banana Street across all planning horizons. A 390 m, DN150, DN200 and DN225 duplication main is therefore required to satisfy RCC's relevant Design Standards (d/D flow depth @ 75% for proposed pipework).
- Insufficient pump flow capacity was identified at SPS 90 across all planning horizons. This was identified to be a rising main capacity issue, as opposed to a pump capacity issues. Therefore, an 800 m, DN225 pipe upgrade is required to satisfy RCC's relevant Design Standard (3 m/s maximum flow velocity). To limit the impact on the downstream catchment, a renewal of the pump set and wet well will also be required.
- Insufficient emergency storage capacity was identified for the SPS 90 catchment, across all planning horizons. A 41 kL storage upgrade is therefore required to satisfy RCC's relevant Design Standard (4 hours ADWF storage).

A capital cost estimate for the proposed SPS 90 catchment infrastructure upgrade regime is as follows. See Appendix 8 for detailed calculations and assumptions.

Catchment	Proposed Infrastructure	$ / Unit Rate	Capital Cost ($)	Purpose
SPS 90	800 m x DN2225 pressure main	$440 / m	$352k	Comply SEQ Code flow velocity and increase pump capacity
	Duty/assist pump renewal/adjustment	$500 / kw + install $5k	$25k	Reduce flow to downstream catchment
	Well and internal pipework renewal	Nil	$500k	Extend asset life and reduce risk of failure
	41 kL offline ES tank	$4,389 / kL	$180k	Comply SEQ Code 4 hours ADWF retention
	154 m x DN150 GM 172 m x DN200 GM 66 m x DN225 GM	$594 / m $726 / m $796 / m	$269k	Comply SEQ Code flow depth
		TOTAL	**$1.326M**	

The approximate timing of construction for these items is as follows.

- Package 1, DN150/DN200/DN225 gravity main duplication required at approximately 500 EP growth upstream of Banana Street. It is estimated this package of works will be required between 2023 to 2025.
- Package 2, DN225 rising main upgrade, pump renewal, wet well renewal and offline emergency storage tank required at approximately 1,800 EP growth within the catchment, including population increase outside of the Weinam Creek PDA. It is estimated this packages of works will be required between 2025 to 2027.

It is therefore recommended the proposed augmentation works are undertaken prior to the identified EP trigger points above and detailed design works completed in the 2021/22 fiscal year.

1 INTRODUCTION

The Weinam Creek Priority Development Area (PDA) is located in Redland Bay, on the Moreton Bay foreshore, within the Redland City Council (RCC) Local Government Area (LGA). The total area of the PDA is estimated at 42 Hectares and is bounded by Weinam Street to the west, Moreton Bay to the east, Peel Street to the north, and Moores Road to the south.

The Economic Development Queensland (EDQ) Weinam Creek PDA Development Scheme has proposed a mixed-use master plan, the majority of which will be high density residential apartment living, with buildings up to 7 storeys in height. The ultimate population density for the development scheme has been estimated at 3,000 Equivalent Population (EP). Refer to Appendix 1 for an overview of the PDA.

EDQ's Weinam Creek PDA planning density (3,000 EP) far exceeds that of RCC's Local Government Infrastructure Plan (LGIP) ultimate planning demands (approximately 1,096 EP). Therefore, the PDA will likely have a significant impact on the capacity of the existing local sewerage network, triggering the need for a review on the infrastructure master plan for the relevant catchments.

1.1 Purpose

The purpose of this report is to quantify the impact of EDQ's Weinam Creek PDA planning demands on RCC's existing sewerage network, and associated trunk infrastructure master planning. This information will form part of the revised headworks charges for approved Development Applications (DA), within the Weinam Creek PDA.

The hydraulic modelling was completed up to the 2041 planning horizon, to align with the Redland City Plan (2018) strategic framework. The 2016 Netserv Plan (and associated Sewerage Master Plan) were completed to a 2036 planning horizon to ensure compliance with minimum 20-year planning criteria required under the South-East Queensland Water (Distribution and Retail Restructuring) Act 2009.

1.2 Background

The Weinam Creek PDA is serviced by two sewer catchments, i.e. SPS 132 servicing the PDA south of Weinam Creek, and SPS 90 servicing the PDA north of Weinam Creek. Both pump stations are a 'duty/assist' arrangement, with SPS132 possessing 1 x 27 kW and 1 x 30 kW pumps, and SPS 90 possessing 2 x 18 kW pumps.

SPS 132 and SPS 90 boost sewage west and discharge to the SPS 67 gravity pipe network, which is subsequently transferred to the Victoria Point Sewage Treatment Plan (STP). Within the PDA, the sewer reticulation gravity network consists of PVC and AC DN150 and DN225 gravity mains. Refer to Appendix 2 for an overview of the existing network.

RCC's current LGIP considers augmentations and demand projections up to 2036, which identified no upgrades required to achieve design standards from SPS 132 and SPS 90, to SPS 67.

1.3 Relevant Reports

- The '*Redland Water Sewer Network Master Plan*' (Aug 2016) report presents information on augmentations to support RCC's LGIP for sewerage.
- The '*SEQ Water Supply and Sewerage Design and Construction Code (SEQ WS&S D&C Code)*' (2020) report presents RCC latest design standards.

2 METHODOLOGY

2.1 Design Standards

The design standards of the "*South East Queensland Water Supply and Sewerage Design and Construction Code*" (2020) were utilised for the assessment. A summary of the most relevant requirements are as follows.

Table 2-1. SEQ WS&S D&C Code provisions relevant to the analysis

Provision	Specification
ET to EP conversion factor	2.7
Average Dry Weather Flow (ADWF)	210 L/EP/day
Peak Wet Weather Flow (PWWF)	5 x ADWF
Single pump capacity	C1 x ADWF (L/s) where; C1 = 3.5 to 5.0 C1 = 15 x $(EP)^{-0.1587}$
Pump station operational storage (m^3)	0.9 x Q / N where; Q = Single pump capacity (L/s) N = Number of pump starts per hour, where N = 12 for duty pump motor < 100 kW N = 8 for duty pump motor 100 – 200 kW N = 5 for duty pump motor > 200 kW
Pump station emergency storage (m^3)	4 hours ADWF
Total pump station capacity (L/s)	PWWF
Maximum depth of gravity flow (proposed system)	75% pipe diameter
Maximum depth of gravity flow (existing system)	1.0 m below manhole level
Minimum rising main flow velocity	0.75 m/s
Maximum rising main flow velocity	3.0 m/s

2.2 Hydraulic Modelling

The methodology adopted for the Weinam Creek PDA sewerage master plan study is as follows.

1. RCC's Mike Urban LGIP sewer hydraulic model (*VP72.3.8.4*) was adopted for the hydraulic analysis. For the post-development scenario, RCC's existing LGIP planning demands were removed from the model and EDQ's Weinam Creek PDA planning demands (3,000 EP total) were allocated to relevant model nodes, on a lot by lot basis. The analysis was undertaken at the existing (2017/18) and 2041 planning horizon scenarios.
2. The pump capacity of SPS 90 and SPS 132 was assessed by comparing the PWWF required to service the catchment, pre- and post-development, to available pump flow capacities presented in the hydraulic model and corporate records. In addition, dynamic model runs were undertaken to confirm findings via review of the wet well depth profiles.

   If the combined pump capacity was above the catchment's PWWF, relevant design standards were achieved. If it was below the PWWF, network upgrades were investigated until compliance was attained, up to SPS 67.

Note: A pump capacity assessment of SPS 67 was not undertaken as part of this study, as an independent assessment was previously completed as part of the South-west Victoria Point Local Area Plan (LAP).

3. The wet well operational storage of SPS 90 and SPS 132 was subsequently evaluated by comparing the required operational storage capacity, pre- and post-development, against the operational volumes between duty pump start/stop levels.

   If the wet well's operational storage volume was above the minimum requirement, compliance was achieved. If it was below the minimum requirement, upgrades were investigated until design standards were achieved.
4. The flow depth of the gravity main network servicing the PDA was assessed at pre- and post-development PWWF. To avoid surcharging from unrelated issues downstream, pumps were deactivated from the model and gravity mains discharged directly to a wet well outlet.

   If flow depths could not be maintained within RCC specifications, pipe augmentations were investigated until design standards were achieved.
5. The emergency storage capacity of the SPS 90 and SPS 132 catchments was assessed by determining the ADWF retention time, pre- and post-development. This was achieved by priming the hydraulic model with ADWF and simulating a pump shutdown at the duty pump start level. Using the wet well depth profiles, the time duration from pump shutdown to the overflow event was used to determine the sewage retention time.

   If the overflow event occurred at a duration beyond 4 hours, compliance was achieved. If it was below 4 hours, compliance was not achieved and storage upgrades were investigated.
6. Modelling results were reviewed and findings reported.

3 RESULTS

3.1 Pumps and Pressure Mains

A pump capacity assessment was undertaken on SPS 90 and SPS 132 as per the methodology described in Section 2.2 of this report. Refer to Table 3-1 below for a summary of results.

Table 3-1. Pump capacity modelling results for combined duty/assist flow rates (post-develop.)

SPS	Combined Pump Flow Capacity	2017 Flow Capacity Required (post-develop.)	2041 Flow Capacity Required (post-develop.)
SPS 90	44 L/s	48.5 L/s	53.2 L/s
SPS 132	50 L/s	23.5 L/s	25.0 L/s

The above results demonstrate that SPS 132 has sufficient pump capacity to incorporate the additional PDA loading for the relevant catchment. However, SPS 90 presented a flow deficiency of 11 L/s and will therefore require rectification works to achieve RCC's minimum design standards.

Further investigation identified that the SPS 90 deficiency was solely due to the downstream DN150 rising main (800 m length) being undersized, and not the power rating of the existing pumps. The DN150 pipework presented extensive headloss (in the order of 50 m) and flow velocities in excess of RCC's 3 m/s requirement. Hydraulic modelling indicated that a DN225 pipe upgrade should result in a combined pump flow velocity of 1.3 m/s and single pump flow velocity of 0.8-1.0 m/s, which is in compliance with RCC's minimum and maximum flow velocity requirements respectively. The pipe upgrade resulted in the friction headloss to significantly decrease to approximately 12 m along the length of the rising main, allowing the pumps to operate above the required PWWF of 53.2 L/s.

The proposed pipe upgrade did however result in the model to show the existing pumps operating at approximately 75-80 L/s combined flow, which resulted in the downstream gravity network to present capacity deficiencies. It is therefore recommended that the SPS 90 pump set is renewed and adjusted, in conjunction with the DN225 pipe upgrade, to achieve a combined pump flow rate that operates closer to the catchment's estimated PWWF (53 L/s). This flow rate resulted in the model to show sufficient capacity in the downstream gravity network, i.e. flow depths remained within pipe obvert. These works should also include renewal of the wet well (e.g. epoxy coating) and internal pipework.

Refer to Appendix 3 for dynamic pump modellings results.

3.2 Wet Wells

An assessment on the operational storage capacity of the SPS 132 and SPS 90 wet wells was undertaken, as per the methodology described in Section 2.2 of this report. Table 3-2 below shows a summary of results and Appendix 4 presents detailed calculations.

Table 3-2. Operational storage capacity assessment results (post-development)

SPS	2041 Op. Storage Capacity Available	2041 Op. Storage Capacity Required
SPS 90	1.7 kL	3.2 kL
SPS 132	4.3 kL	1.7 kL

The results in the above table demonstrate that there is sufficient operational storage capacity at SPS 132, to incorporate the PDA's ultimate sewage loading, however SPS 90 presented a 1.5 kL deficiency. Further modelling identified that adjustments to the SPS 90 duty pump start/stop levels could increase the available operational storage to 3.6 kL, avoiding the need for a well upgrade. This was based on a duty start level 50 mm below the invert of the discharging gravity line and a duty stop level 400 mm above the invert of the well floor. It is therefore recommended that the SPS 90 duty start and stop levels are adjusted to RL -3.2 m and RL -4.4 m to achieve RCC's minimum operational volume standard and avoid an upgrade to the well.

As previously discussed, it is recommended that the SPS 90 well (and internal pipework) is renewed, at the time of the proposed pump renewal/adjustment.

Refer to Appendix 4 for detailed modelling calculations.

3.3 Gravity Mains

As per the methodology described in Section 2.2 of this report, gravity pipe flow depths were assessed against RCC's minimum requirements, from site connection to each of the relevant pump stations. The analysis identified that SPS 132 gravity network should have sufficient capacity to incorporate the PDA's additional loading without the need for pipe upgrades. For SPS 90 however, there were significant deficiencies identified for pipework directly upstream of the pump station and along Outridge Street. The following upgrades were required to resolve within RCC's design standards.

- 154 m x DN150 duplication gravity main along Banana Street
- 172 m x DN200 duplication gravity main along Banana Street
- 66 m x DN225 duplication gravity main along Outridge Street

To determine the impact of the SPS 90 flow capacity increase identified in Section 3.1 of this report, downstream gravity mains were assessed up to SPS 67. This analysis identified no deficiencies with the combined flow increase to 53 L/s, avoiding the need for additional pipe upgrades.

Refer to Appendix 5 for detailed modelling results and gravity main profiles.

3.4 Emergency Storage

An emergency storage capacity assessment was undertaken on the SPS 132 and SPS 90 catchments, as per the methodology described in Section 2.2 of this report. Based on an overflow level of RL 1.47 m for SPS 132 and 1.01 m for SPS 90 (considering design standard of 300 mm below surface level), the analysis identified the following overflow time durations.

Table 3-3. Emergency storage ADWF retention time results

SPS	2041 ES Capacity Available (pre-develop.)	2041 ES Capacity Available (post-develop.)
SPS 90	6H 0M	2H 56M
SPS 132	11H 2M	9H 15M

The above table shows that SPS 132 has sufficient emergency storage capacity to incorporate the Weinam Creek PDA loading, however SPS 90 presented a 1 hour deficiency (approximately). Based on an ADWF of 10.6 L/s, SPS 90 will require an additional 41 kL storage to satisfy RCC's design requirement of 4 hours ADWF. The installation of a 41 kL offline storage tank is therefore recommended to incorporate the additional Weinam Creek PDA loading. The pump station is located within the Neville Stafford Park and a desktop review indicates there's sufficient space for the offline tank, adjacent to the existing well.

Refer to Appendix 6 for modelling results pre- and post-development

3.5 Sewer Infrastructure Upgrades

As previously discussed, the following infrastructure upgrades are required to incorporate the additional loading from the Weinam Creek PDA, within the SPS 90 catchment. Note the hydraulic analysis identified that the SPS 132 catchment does not require any infrastructure upgrades.

- Renew the wet well, including epoxy coating of the walls, replacement of internal pipework and adjustment/renewal of existing pumps to 53 L/s combined flow (in conjunction with rising main upgrade – refer below).
- Upgrade rising main from DN150 to DN225 (800m)
- Duplication gravity main along Banana Street and Outridge Street DN150, DN200 and DN225 (392 m)
- Install 41 kL offline emergency storage tank adjacent to existing SPS 90 well.

Refer to Appendix 7 for a layout plan of the proposed upgrades and the table below for associated capital cost estimates. Appendix 8 has detailed costing and assumptions.

Table 3-4. Summary of the capital cost estimate for sewer upgrades

Catchment	Proposed Infrastructure	$ / Unit Rate	Capital Cost ($)	Purpose
SPS 90	800 m x DN2225 pressure main	$440 / m	$352k	Comply SEQ Code flow velocity and increase pump capacity
	Duty/assist pump renewal/adjustment	$500 / kw + install $5k	$25k	Reduce flow to downstream catchment
	Well and internal pipework renewal	Nil	$500k	Extend asset life and reduce risk of failure
	41 kL offline ES tank	$4,389 / kL	$180k	Comply SEQ Code 4 hours ADWF retention
	154 m x DN150 GM 172 m x DN200 GM 66 m x DN225 GM	$594 / m $726 / m $796 / m	$269k	Comply SEQ Code flow depth
		TOTAL	**$1.326M**	

Note: Refer Appendix 8 for assumptions and calculation details.

3.6 Timing of Construction

The timing of construction is recommended as two separate works packages (details below). This is to achieve required network capacities and/or provide a more economical outcome from related works being undertaken simultaneously. Estimated trigger points for each of these packages are as follows.

- Package 1, DN150/DN200/DN225 duplication gravity main required at approximately 500 EP growth upstream of Banana Street. It is estimated this package of works will be required between 2023 to 2025.
- Package 2, DN225 rising main upgrade, pump renewal, wet well renewal and offline emergency storage tank. This would be required at approximately 1,800 EP growth within the catchment, including population growth outside of the Weinam Creek PDA. It is estimated this packages of works will be required between 2025 to 2027.

It is recommended the above work packages are installed with close monitoring of development and population growth within the SPS 90 catchment and Weinam Creek PDA.

4 CONCLUSION

The Weinam Creek Priority Development Area (PDA) is located in Redland Bay, on the Moreton Bay foreshore, within the Redland City Council (RCC) Local Government Area (LGA). The Economic Development Queensland (EDQ) Weinam Creek PDA Development Scheme has proposed a mixed-use master plan, majority of which will be high density residential apartment living, with buildings up to 7 storeys in height. The ultimate population density for the development scheme has been estimated at 3,000 Equivalent Population (EP) by Redland Investment Corporation (RIC).

EDQ's Weinam Creek PDA planning density (3,000 EP) far exceeds that of RCC's Local Government Infrastructure Plan (LGIP) ultimate planning demands (approximately 1,096 EP). A detailed sewerage planning study was therefore undertaken to determine the impact that the additional loading will have on the existing network, and to identify infrastructure upgrades necessary to achieve RCC's minimum design standards.

The hydraulic analysis identified that there is sufficient capacity within the SPS 132 catchment, to incorporate the additional Weinam Creek PDA loading, up to the 2041 planning horizon. For the SPS 90 catchment however, insufficient capacity was identified at both the existing (2017/18) and 2041 planning horizon. A summary of the deficiencies and proposed upgrades to resolve are as follows.

- Insufficient gravity main flow depth capacity was identified along Outride Street and Banana Street across all planning horizons. A 390 m, DN150, DN200 and DN225 duplication main is therefore required to satisfy RCC's relevant Design Standards (d/D flow depth @ 75% for proposed pipework).
- Insufficient pump flow capacity was identified at SPS 90 across all planning horizons. This was identified to be a rising main capacity issue, as opposed to a pump capacity issues. Therefore, an 800 m, DN225 pipe upgrade is required to satisfy RCC's relevant Design Standard (3 m/s maximum flow velocity). To limit the impact on the downstream catchment, a renewal of the existing pumps and wet well will also be required.
- Insufficient emergency storage capacity was identified for the SPS 90 catchment, across all planning horizons. A 41 kL storage upgrade is therefore required to satisfy RCC's relevant Design Standard (4 hours ADWF storage).

A capital cost estimate for the installation of the proposed sewer infrastructure upgrades is as follows.

Catchment	Proposed Infrastructure	$ / Unit Rate	Capital Cost ($)	Purpose
SPS 90	800 m x DN2225 pressure main	$440 / m	$352k	Comply SEQ Code flow velocity and increase pump capacity
	Duty/assist pump renewal/adjustment	$500 / kw + install $5k	$25k	Reduce flow to downstream catchment
	Well and internal pipework renewal	Nil	$500k	Extend asset life and reduce risk of failure
	41 kL offline ES tank	$4,389 / kL	$180k	Comply SEQ Code 4 hours ADWF retention
	154 m x DN150 GM 172 m x DN200 GM 66 m x DN225 GM	$594 / m $726 / m $796 / m	$269k	Comply SEQ Code flow depth
		TOTAL	**$1.326M**	

The approximate timing of construction for these items is as follows.

- Package 1, DN150/DN200/DN225 duplication gravity main required at approximately 500 EP growth upstream of Banana Street. It is estimated this package of works will be required between 2023 to 2025.
- Package 2, DN225 rising main upgrade, pump renewal, wet well renewal and offline emergency storage tank required at approximately 1,800 EP growth within the catchment, including population increase outside of the Weinam Creek PDA. It is estimated this packages of works will be required between 2025 to 2027.

It is recommended the proposed augmentation works is undertaken prior to the identified EP trigger points above, in addition to completing the following tasks.

- Validation of the modelling outcomes presented in this report against, field surveys, historical records, SCADA data etc. during the detailed design phase of works.
- Undertake discussions with RCC's IC Unit regarding the implementation of the proposed upgrades including apportionment of headworks charges to this area.

5 APPENDICES

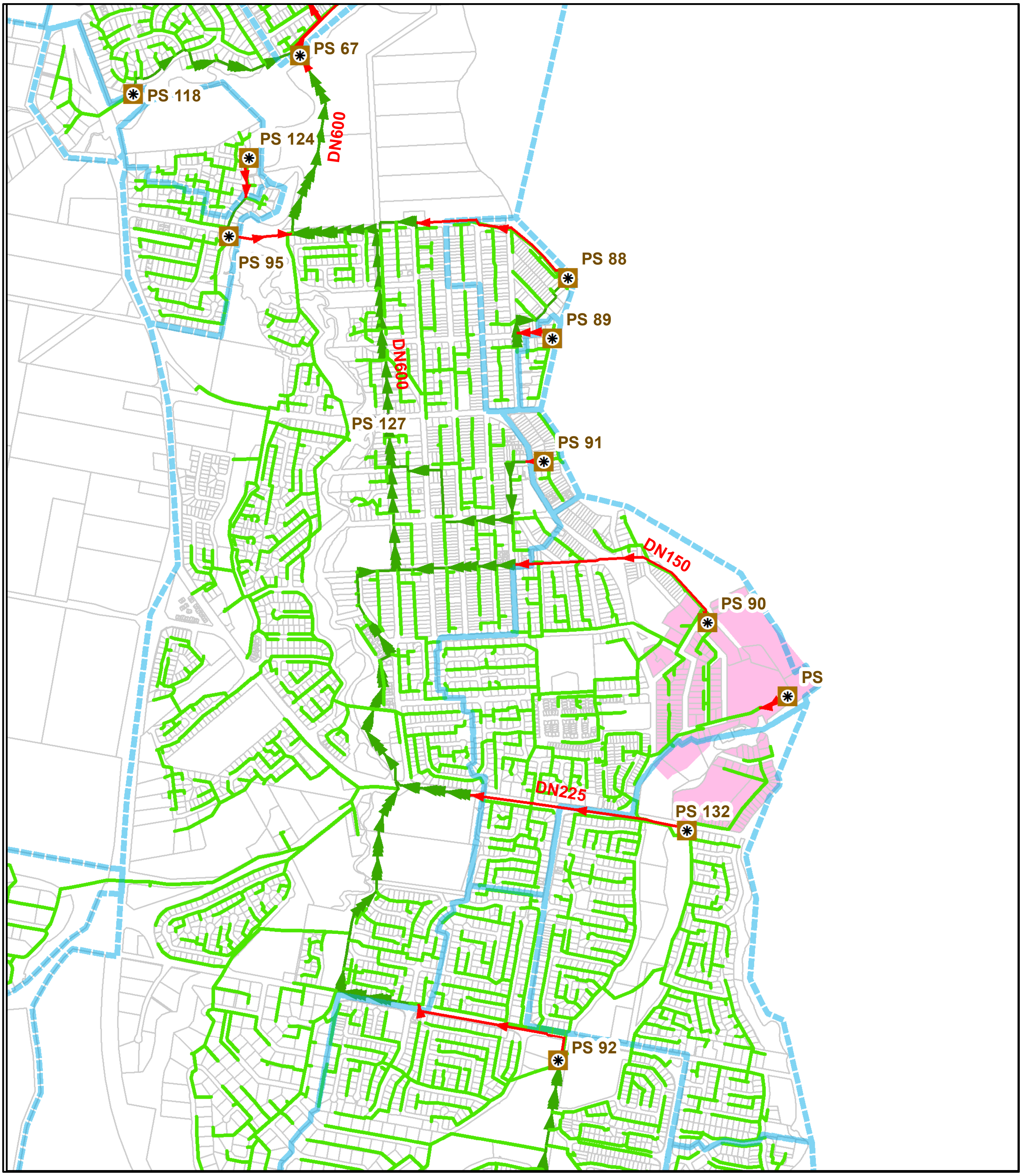
Appendix 1. Weinam Creek PDA Master Plan

weinam creek

master plan

Ref. No. 133693 Date : March 2019 Scale 1 : 1500@A1

Appendix 2. Sewerage catchments servicing the Weinam Creek PDA



Legend

☐ Current Land

▨ Weinam Creek PDA

▭ WW Catchment

WW Pumpstations

⊛ Operating

WW Pressure Pipes

▶▶▶ Operating

▶▶▶ Out of Service

– – Decommissioned

WW Non-pressure Pipes

▶▶▶ Trunk Gravity

— Reticulation

▶▶▶ Effluent Outflow

▶▶▶ Effluent Reuse

D1	17/02/2020	JM	MI	MI
Issue	Date	By	Chkd	Appd

Redland CITY COUNCIL

Redland Water
PO Box 21
Cleveland QLD 4163

Job Title **Weinam Creek PDA**

Drawing Title **Sewer catchments servicing PDA**

Scale at A3 **1:406,300** Drawing Status **Draft V1**

Coordinate System **GDA 1994 MGA Zone 56**

Date of Print **17/02/2020** Drawing No **001**

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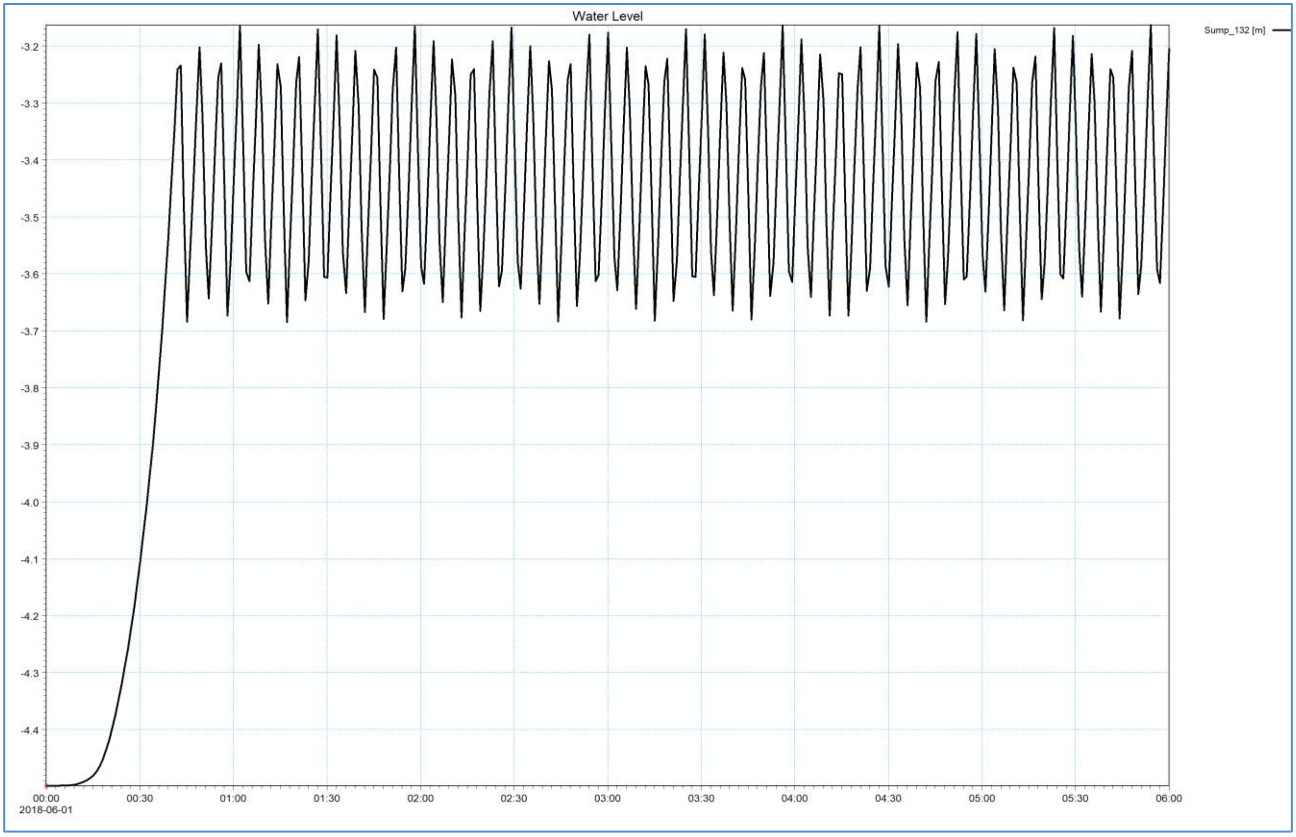
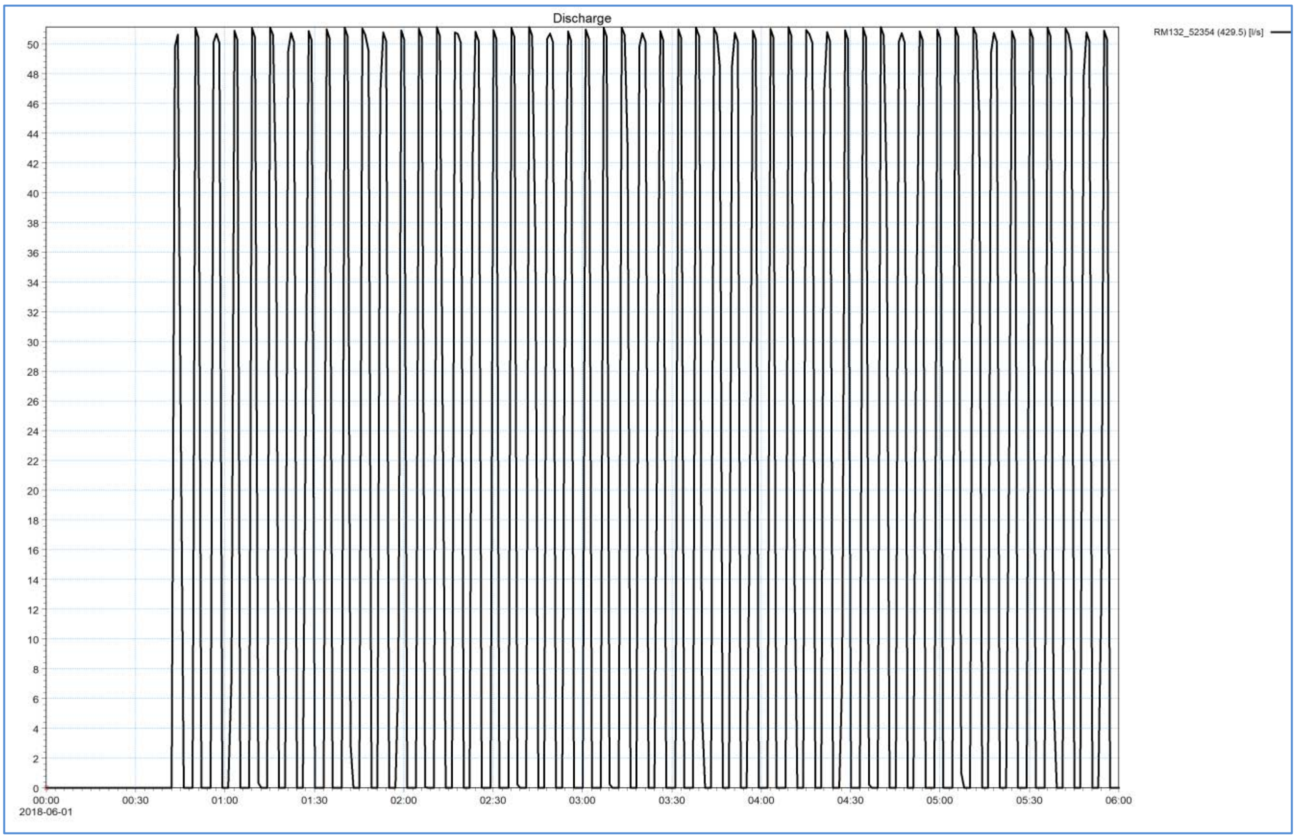
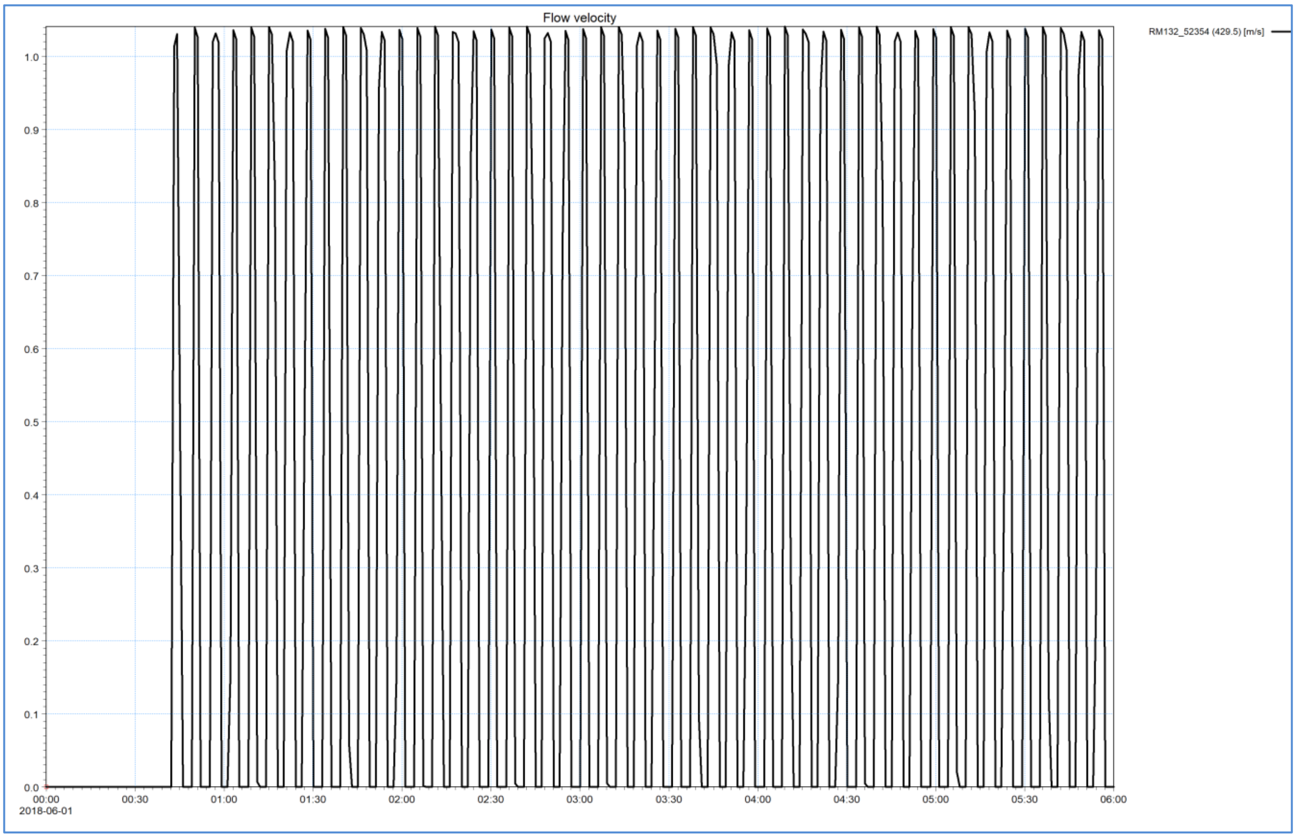
Appendix 3. Pump station modelling results for Weinam PDA

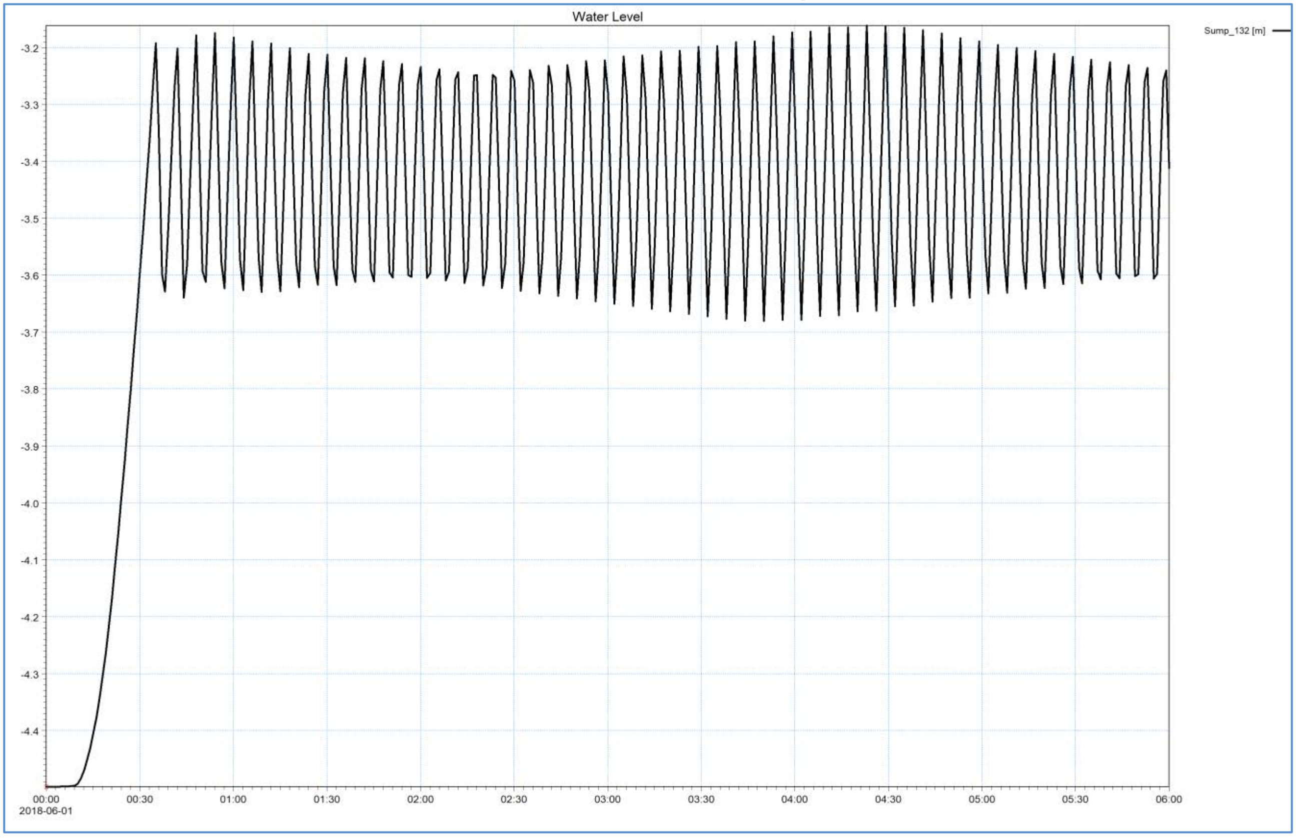
SPS 132, 2041 Pre-develop.

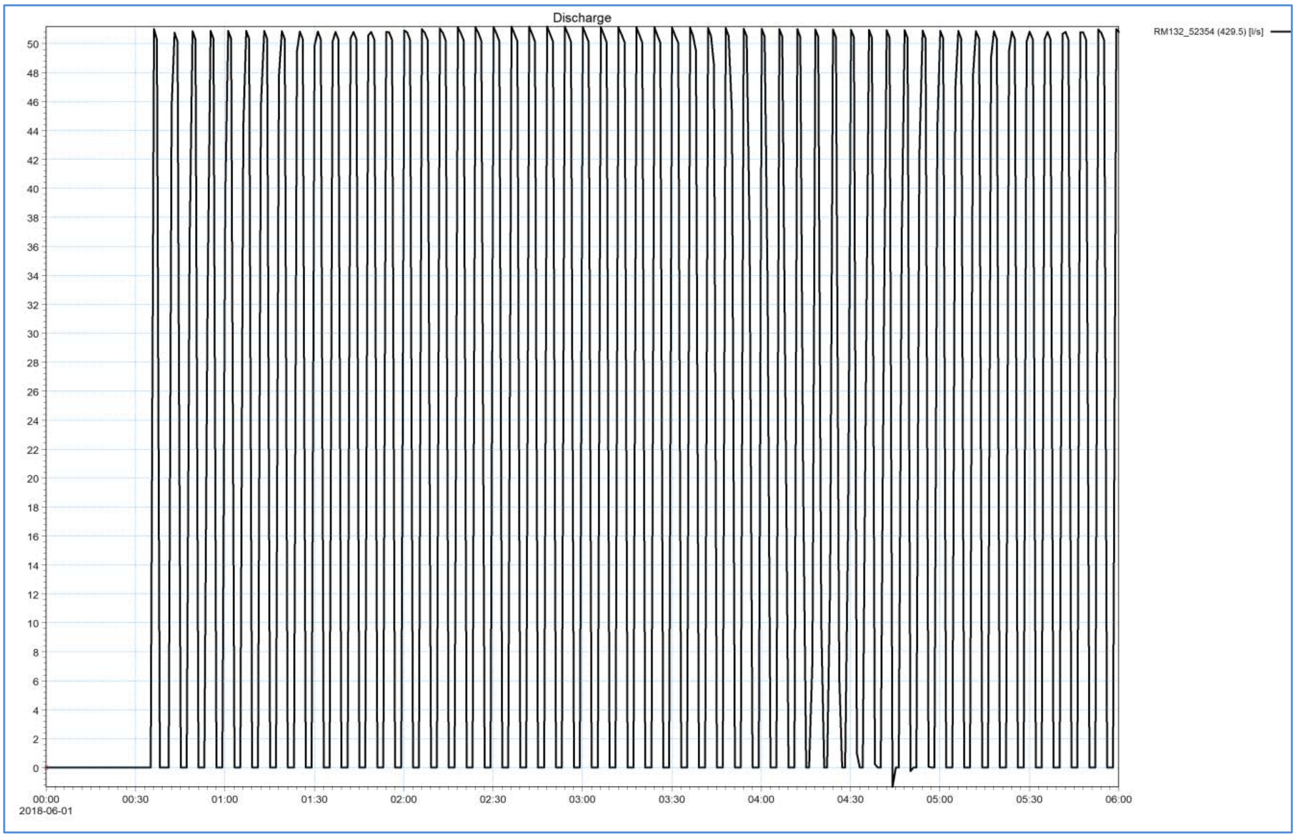


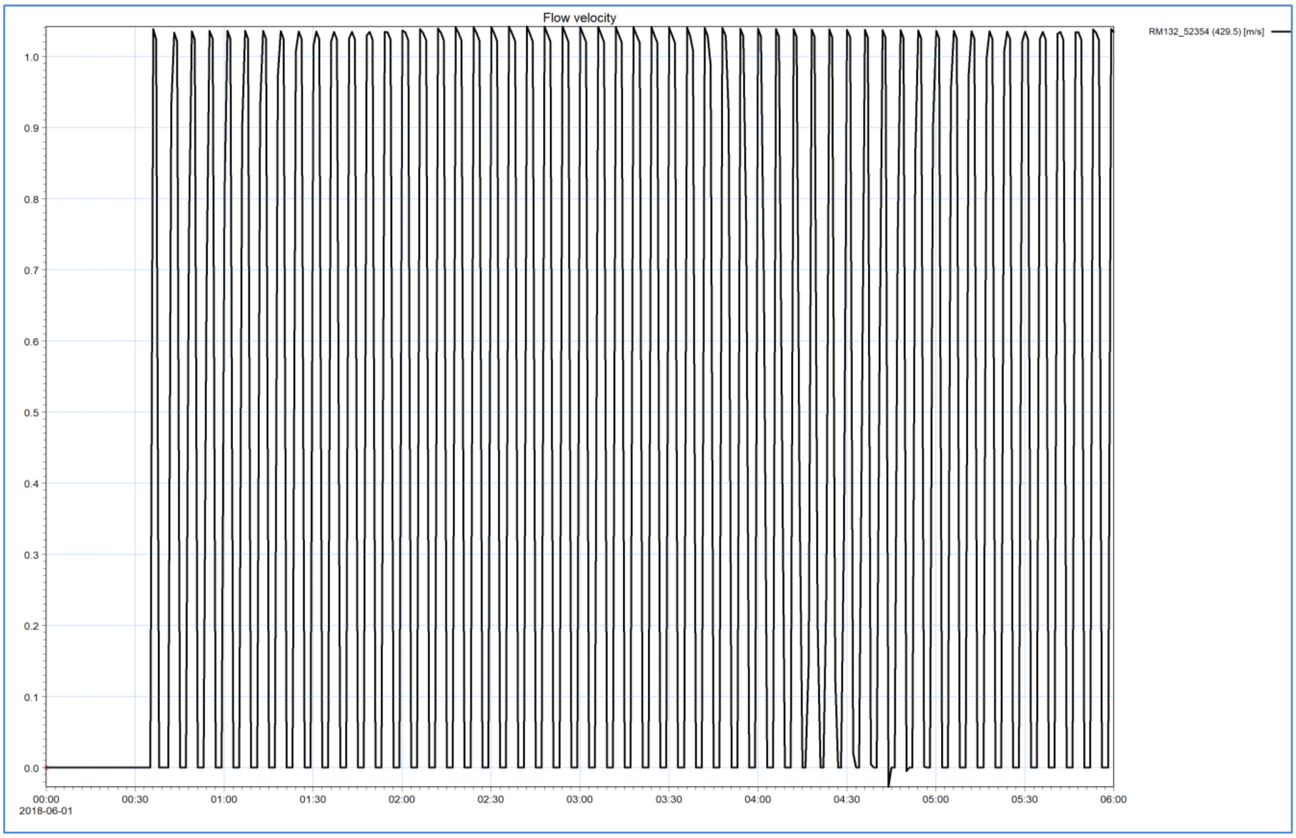




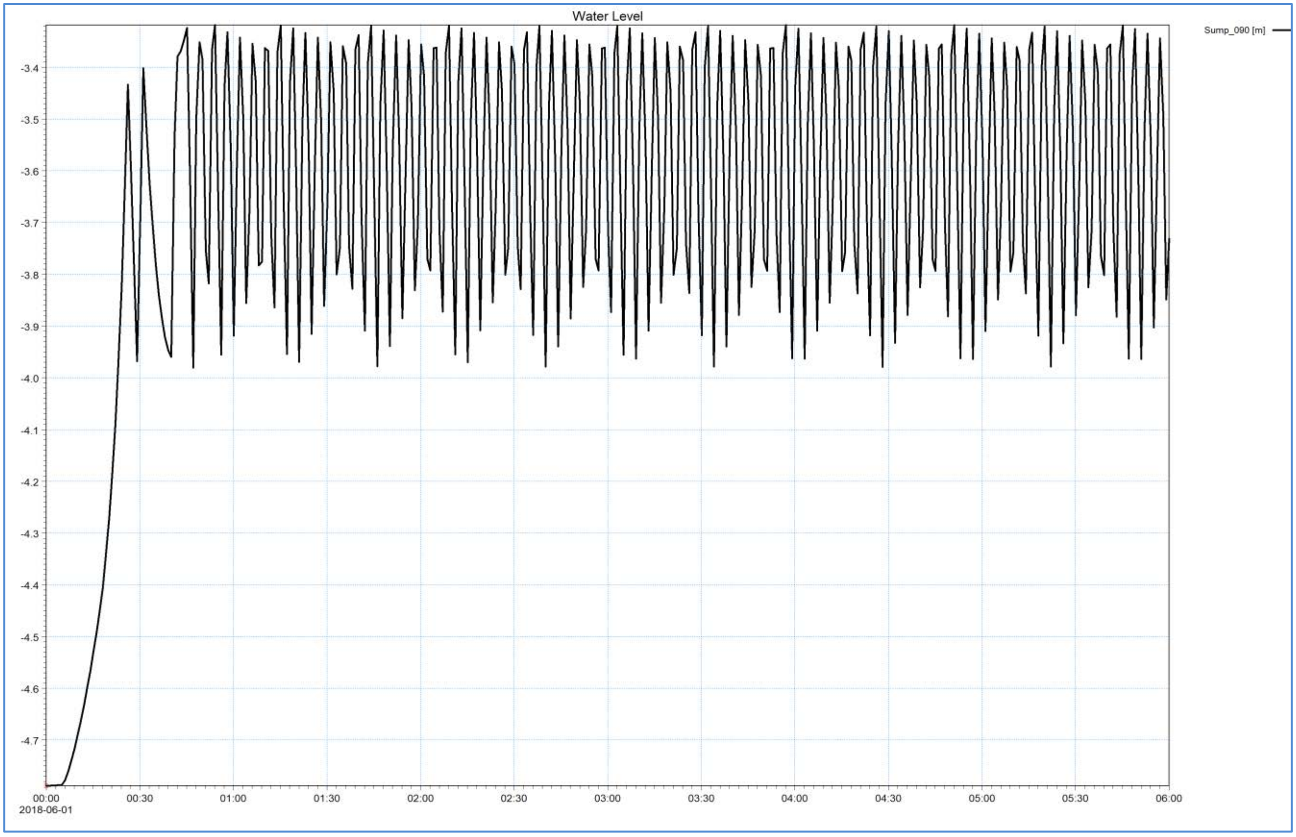
SPS 132, 2041 Post-develop.

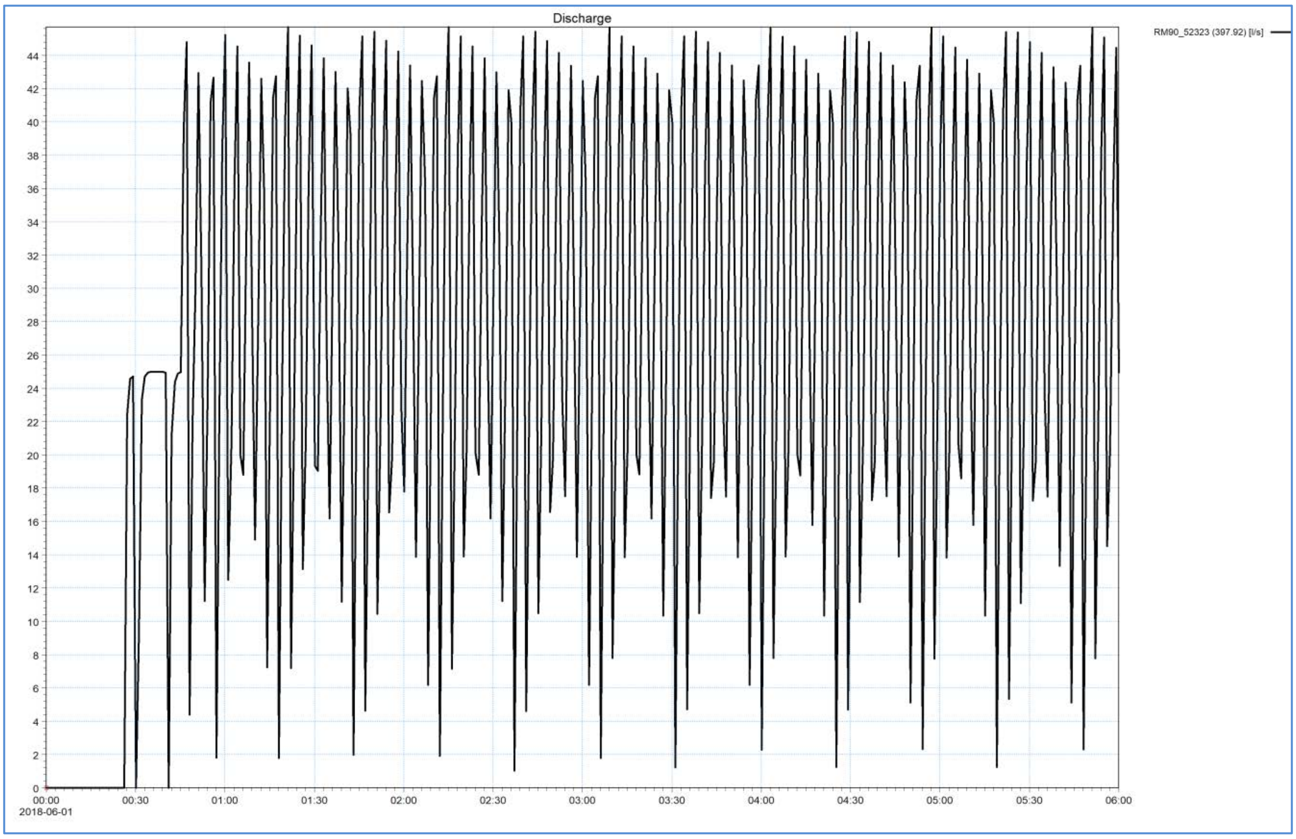


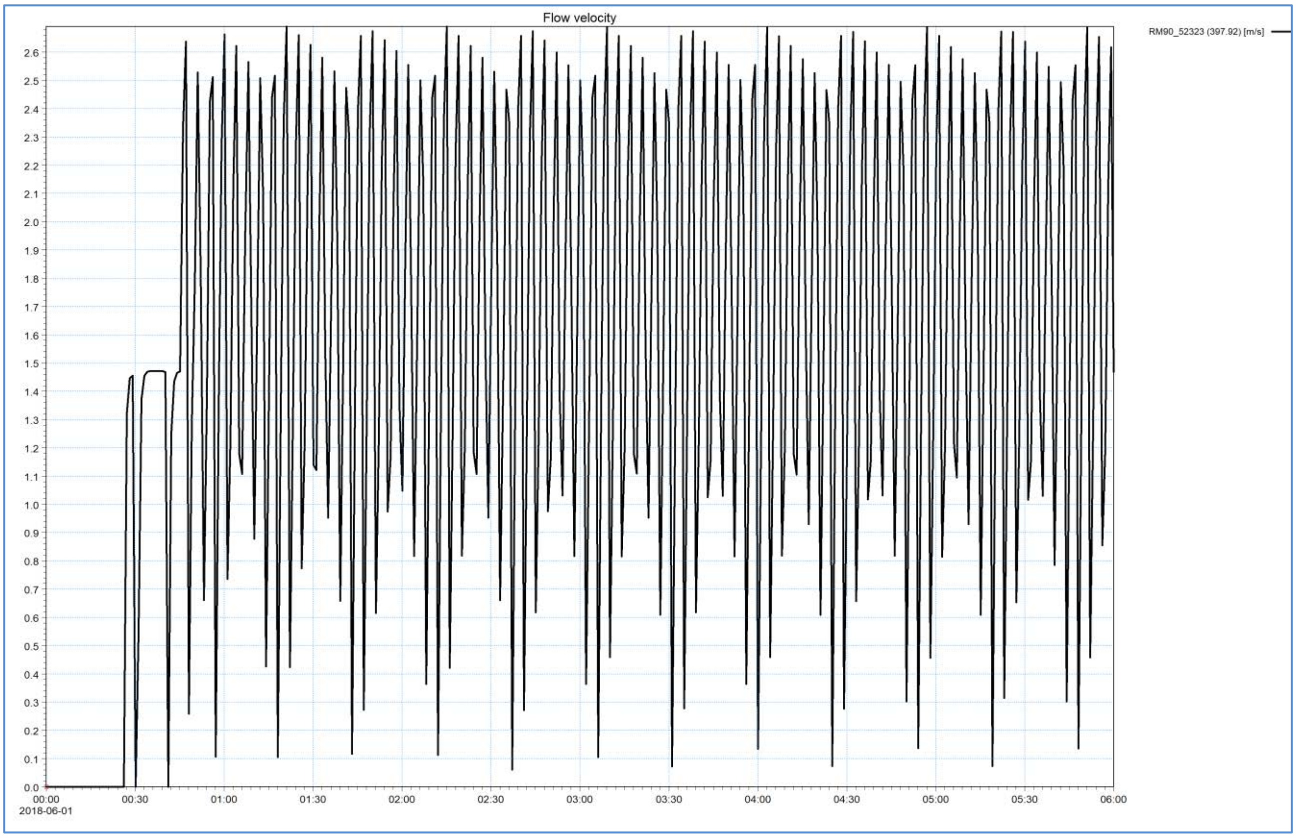

Discharge
RM132_52354 (429.5) [l/s]
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
00:00
2018-06-01
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00


Flow velocity
RM132_52354 (429.5) [m/s]
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
2018-06-01
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00

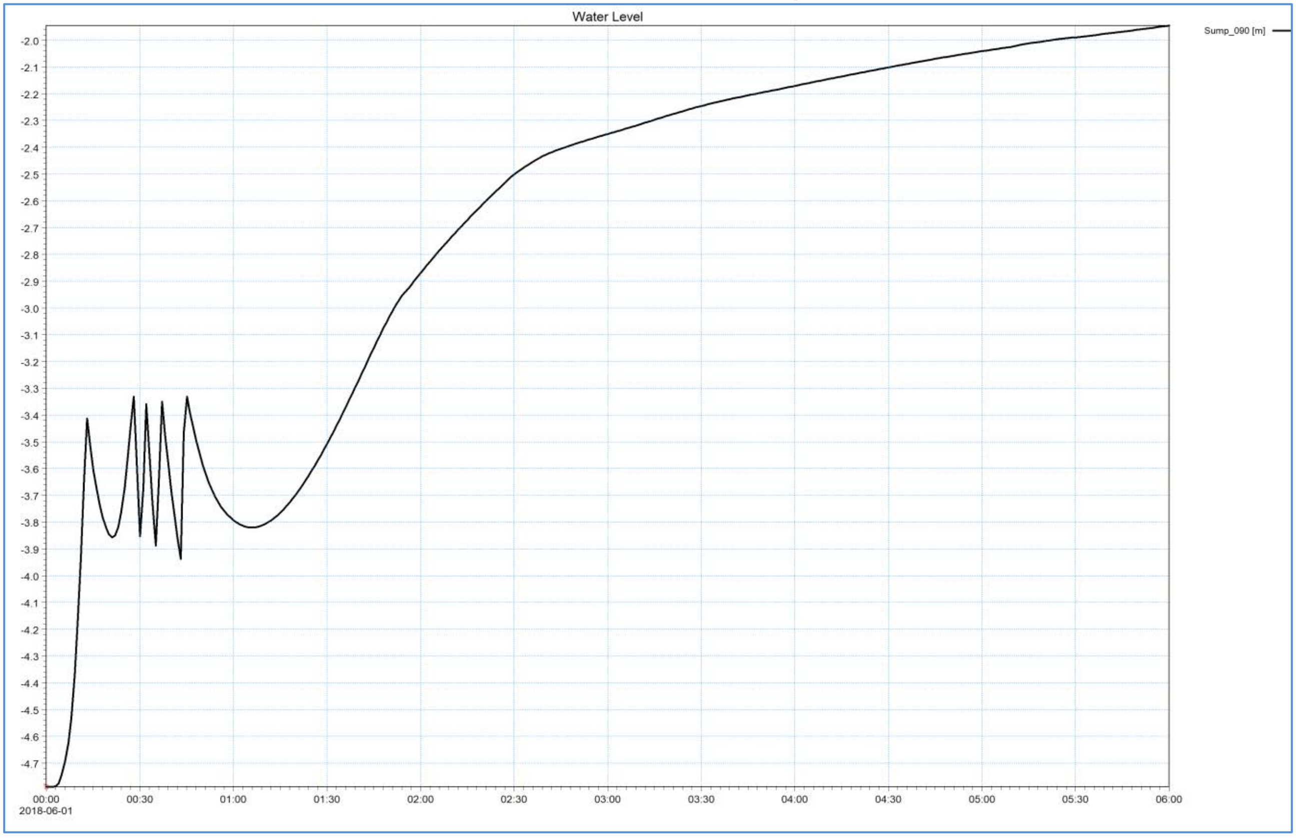
SPS 90, 2041 Pre-develop.

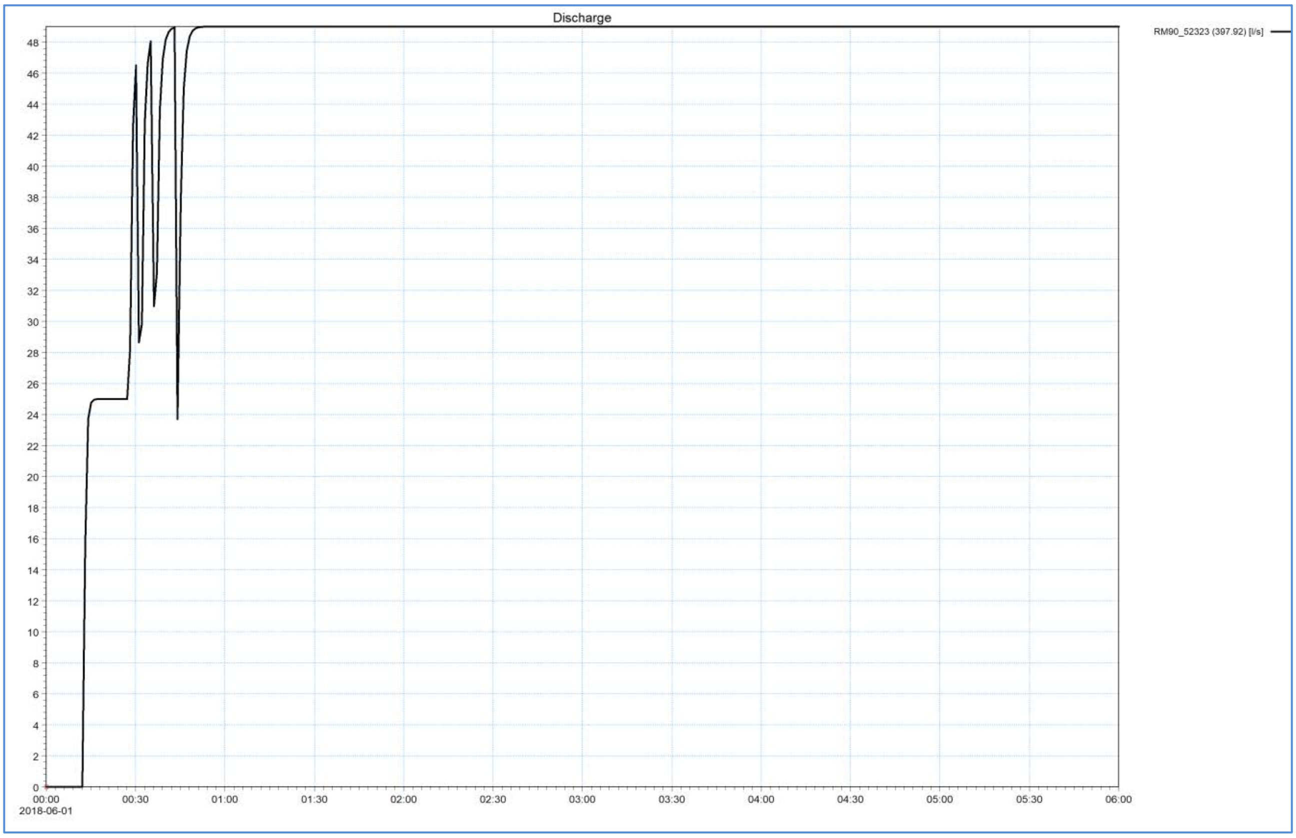


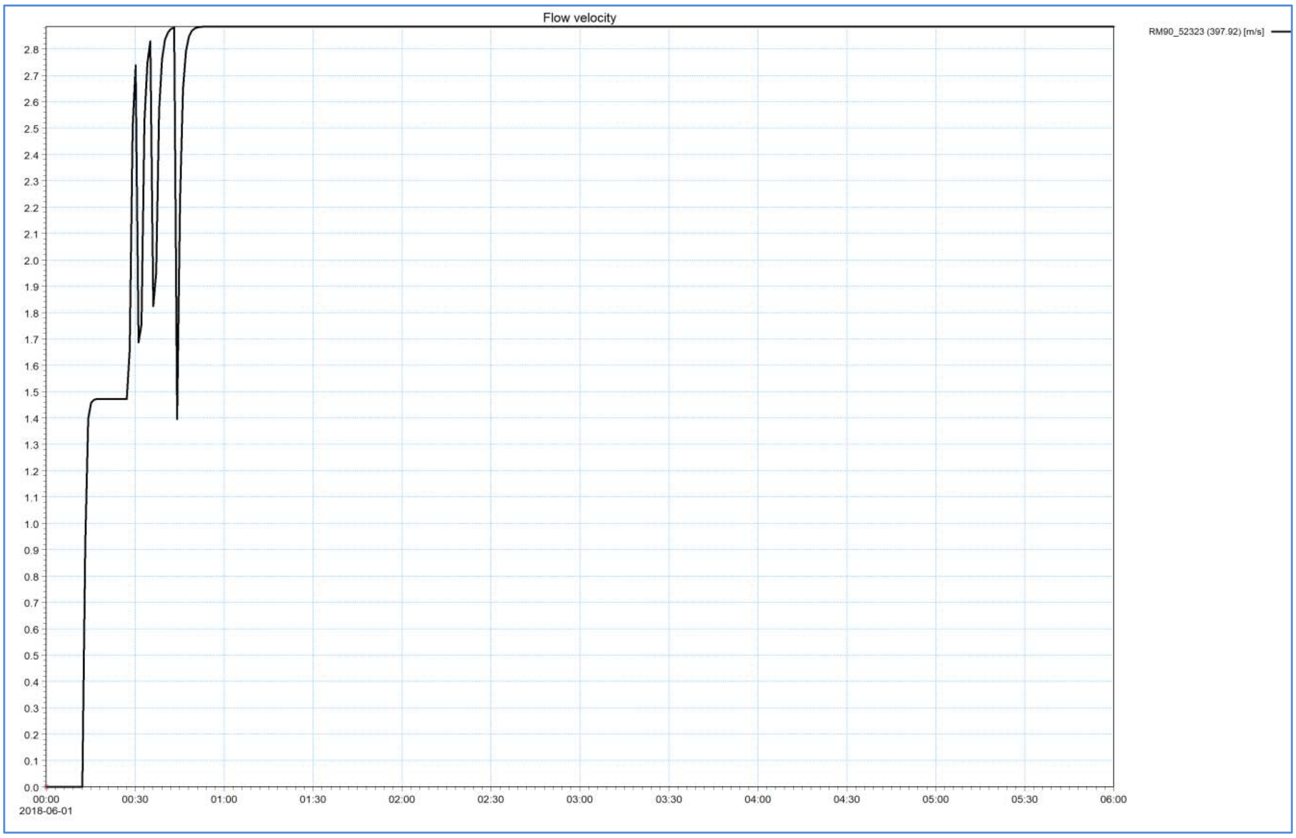




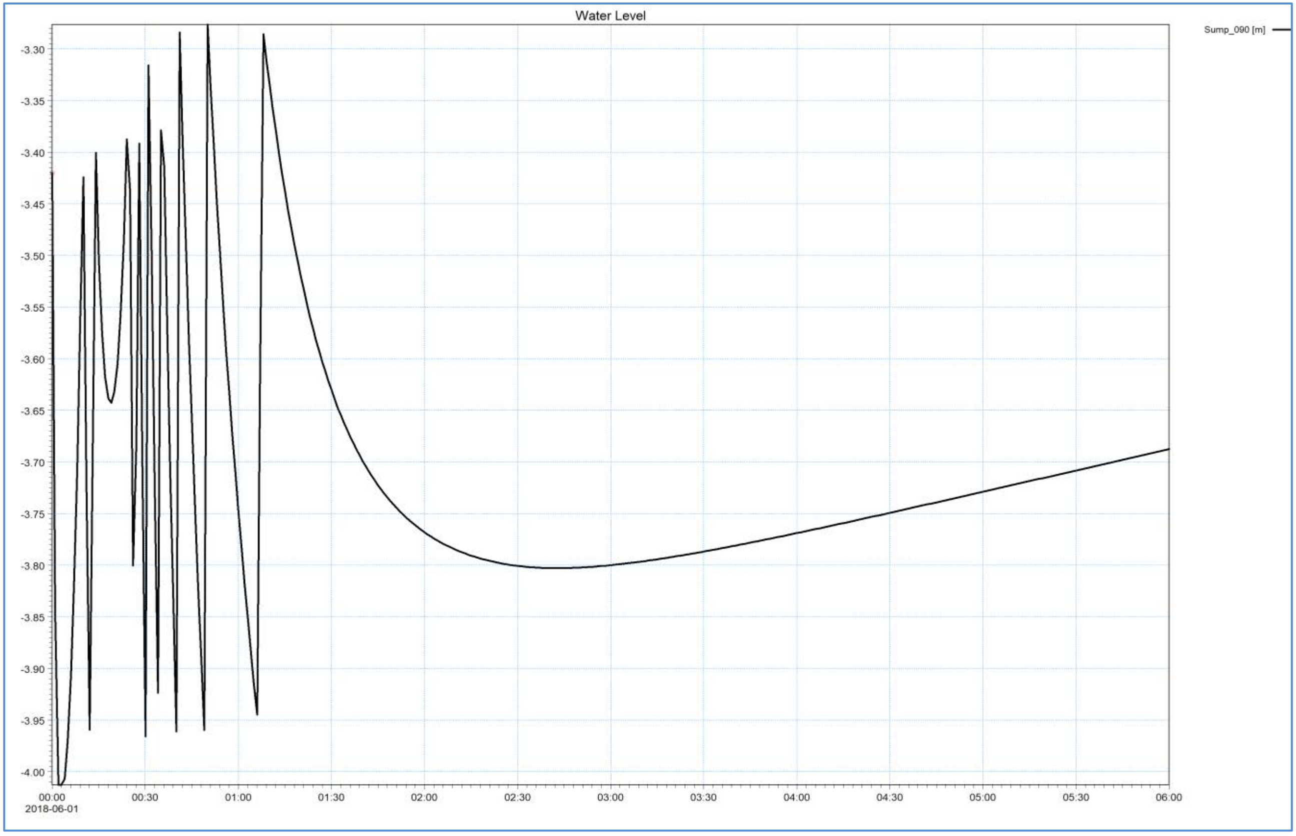
SPS 90, 2041 Post-develop.

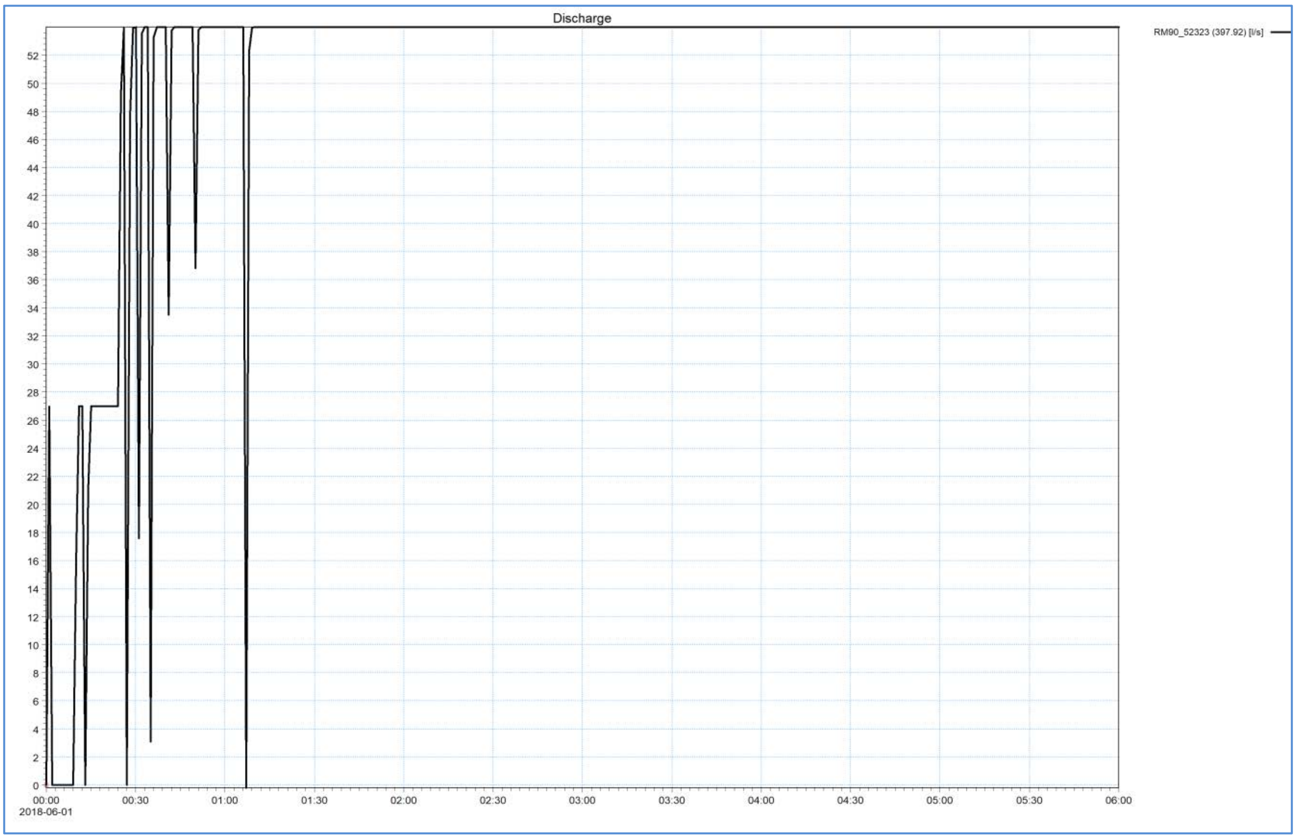


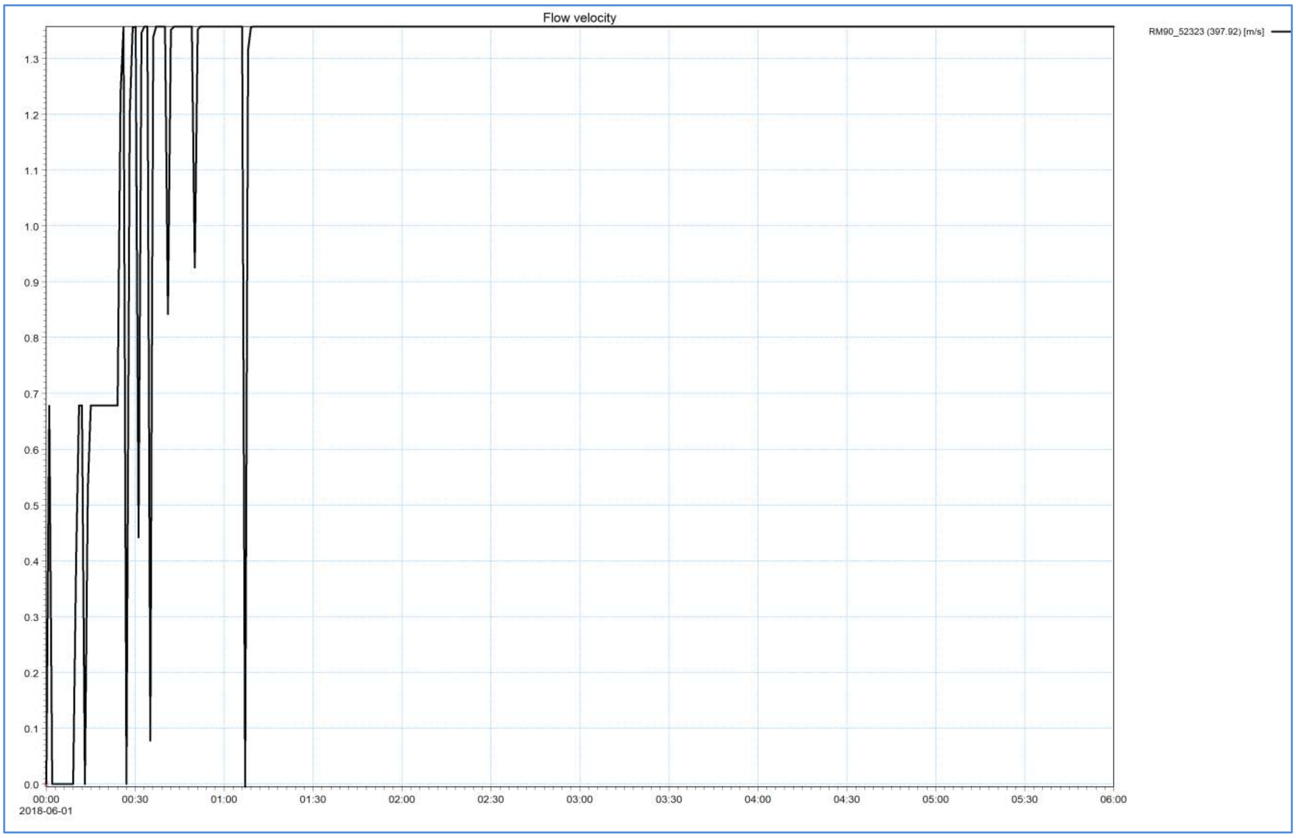

Discharge
RM90_52323 (397.92) [l/s]
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
00:00
2018-06-01
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00


Flow velocity
RM90_52323 (397.92) [m/s]
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
2018-06-01
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00

SPS 90, 2041 Post-develop. + DN225 RM Upgrade + Pump Renewal (53 L/s)






Flow velocity
RM90_52323 (397.92) [m/s]
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
2018-06-01
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00

Appendix 4. Wet well modelling results for Weinam Creek PDA

		2041 Post-develop.	
		SPS 90	SPS 132
Single Pump Capacity Required	Catchment EP	4,377.0	2,055.0
	Pump Arrangement	Duty/Assist	Duty/Assist
	C1	4.0	4.5
	ADWF (L/s)	10.6	5.0
	Q (L/s)	42.2	22.3
Operational Storage Capacity Required	Duty Flow (L/s)	42.2	22.3
	Duty Head (m)	-	-
	Pump Efficiency (%)	-	-
	Duty Power (kW)	<100	<100
	No. pump starts (n)	12.0	12.0
	OSCR (kL)	3.2	1.7
Operational Storage Capacity Available	Duty Start (m)	-3.2	-3.2
	Duty Stop (m)	-4.4	-3.7
	Duty Height (m)	1.16	0.5
	WW Diam. (m)	2.0	3.3
	OSCA (kL)	3.6	4.3
OUTCOME	**Difference (kL)**	**+0.5**	**+2.6**
	Pass / Fail	**PASS**	**PASS**

Note: Above calculations include the proposed duty start/stop level changes for SPS 90, i.e. duty start at 50 mm below invert of gravity main and duty stop at 400 mm above WW IL.

Appendix 5. Gravity main modelling results for Weinam Creek PDA

SPS 132 - 2041 PWWF Pre-develop.						
Name	**Diam. (mm)**	**Link Water Level**	**Link Discharge (L/s)**	**Link Velocity (m/s)**	**Link Depth (m)**	**d/D (%)**
56683	214	-2.676	1.629	0.347	0.034	15.7%
56684	214	-2.616	1.629	0.413	0.034	15.7%
56685	214	-2.356	1.629	0.413	0.034	15.7%
56686	214	-2.099	1.586	0.332	0.041	19.2%
56687	214	-1.862	1.169	0.403	0.028	13.3%
56688	214	-1.503	1.072	0.379	0.027	12.7%
56689	150	-1.171	0.563	0.448	0.019	12.4%
56690	150	-0.144	0.387	0.401	0.016	10.3%
56691	150	-1.207	0.308	0.223	0.023	15.5%
56692	150	-0.887	0.194	0.271	0.013	8.4%
56693	150	-0.584	0.050	0.209	0.006	4.0%
56694	150	-0.095	0.044	0.241	0.005	3.4%
56695	150	-0.602	0.087	0.260	0.008	5.0%
56696	150	0.058	0.087	0.224	0.008	5.5%
Inlet_132_1_56682	233	-3.205	1.580	0.037	1.295	555.9%

SPS 132 - 2041 PWWF Post-develop.						
Name	**Diam. (mm)**	**Link Water Level**	**Link Discharge (L/s)**	**Link Velocity (m/s)**	**Link Depth (m)**	**d/D (%)**
56683	214	-2.648	5.534	0.510	0.062	28.9%
56684	214	-2.576	5.534	0.517	0.074	34.4%
56685	214	-2.322	5.534	0.548	0.068	32.0%
56686	214	-2.054	4.796	0.392	0.086	40.4%
56687	214	-1.826	2.938	0.398	0.064	30.0%
56688	214	-1.487	2.599	0.484	0.043	20.1%
56689	150	-1.170	0.678	0.474	0.020	13.5%
56690	150	-0.145	0.339	0.385	0.015	9.7%
56691	150	-1.183	1.243	0.330	0.047	31.4%
56692	150	-0.874	0.904	0.430	0.026	17.7%
56693	150	-0.573	0.452	0.407	0.017	11.4%
56694	150	-0.087	0.339	0.445	0.013	8.8%
56695	150	-0.592	0.226	0.248	0.018	12.0%
56696	150	0.063	0.226	0.299	0.013	8.7%
Inlet_132_1_56682	233	-2.809	5.534	0.601	0.061	26.0%

SPS 90 - 2041 PWWF Pre-develop.						
Name	**Diam. (mm)**	**Link Water Level**	**Link Discharge (L/s)**	**Link Velocity (m/s)**	**Link Depth (m)**	**d/D (%)**
232863	150	4.078	0.488	0.164	0.048	31.9%
29531	214	-0.291	15.709	0.701	0.129	60.5%
29570	150	5.716	1.363	0.651	0.026	17.6%
29571	150	4.187	1.469	1.381	0.017	11.0%
29572	150	4.078	0.041	0.019	0.048	31.9%
29573	150	3.749	1.999	0.549	0.039	26.0%
29574	150	0.779	2.015	0.973	0.029	19.4%
29575	150	0.563	2.064	0.513	0.043	28.4%

29576	150	0.253	2.116	0.757	0.033	22.2%
29577	150	0.563	0.032	0.088	0.013	8.4%
29578	150	-0.625	2.118	0.593	0.045	30.1%
29579	150	-1.085	2.427	0.543	0.045	29.9%
29580	150	-0.625	0.299	0.328	0.015	10.1%
29581	150	7.091	1.238	0.809	0.021	14.2%
29582	150	7.930	0.207	0.383	0.010	7.0%
29583	150	8.137	0.083	0.277	0.007	4.6%
29584	150	6.379	0.156	0.367	0.009	5.9%
29585	150	5.471	0.284	0.486	0.011	7.3%
29586	150	4.826	0.416	0.404	0.016	10.8%
29587	150	4.920	0.219	0.410	0.010	6.9%
29588	150	5.268	0.157	0.421	0.008	5.4%
29589	150	4.009	0.647	0.503	0.019	12.6%
29590	150	2.094	0.659	0.759	0.014	9.6%
29591	150	1.801	0.659	0.443	0.021	13.9%
29592	219	-0.542	16.010	0.727	0.148	67.7%
29593	214	-0.810	20.942	0.670	0.180	84.0%
29594	150	0.850	0.138	0.254	0.010	7.0%
29595	150	1.015	0.041	0.204	0.005	3.6%
29596	150	1.155	0.043	0.211	0.005	3.6%
29597	150	-1.685	2.881	0.530	0.055	36.8%
29598	150	1.127	0.101	0.311	0.007	4.9%
29599	150	1.537	0.064	0.229	0.007	4.5%
29600	150	-1.855	3.726	0.524	0.055	37.0%
29601	150	-2.081	4.000	0.572	0.059	39.1%
29602	150	0.106	0.051	0.205	0.006	4.1%
29603	150	1.036	0.051	0.199	0.006	4.2%
29604	219	-1.261	21.650	0.805	0.149	68.0%
29605	150	0.064	0.032	0.257	0.004	2.6%
29606	219	-1.628	21.682	0.911	0.122	55.6%
29611	214	-1.968	23.140	0.834	0.152	71.1%
29612	214	-2.203	23.264	1.007	0.127	59.3%
29614	150	-2.185	4.000	0.563	0.065	43.0%
29615	150	-2.523	4.598	0.489	0.087	58.3%
29616	150	0.860	0.634	0.458	0.020	13.2%
29617	150	1.454	0.027	0.208	0.004	2.6%
29618	150	-2.761	5.480	0.514	0.099	66.1%
29619	150	-2.870	5.677	0.463	0.110	73.1%
Inlet_090_29613	214	-3.712	29.823	0.749	1.078	503.5%

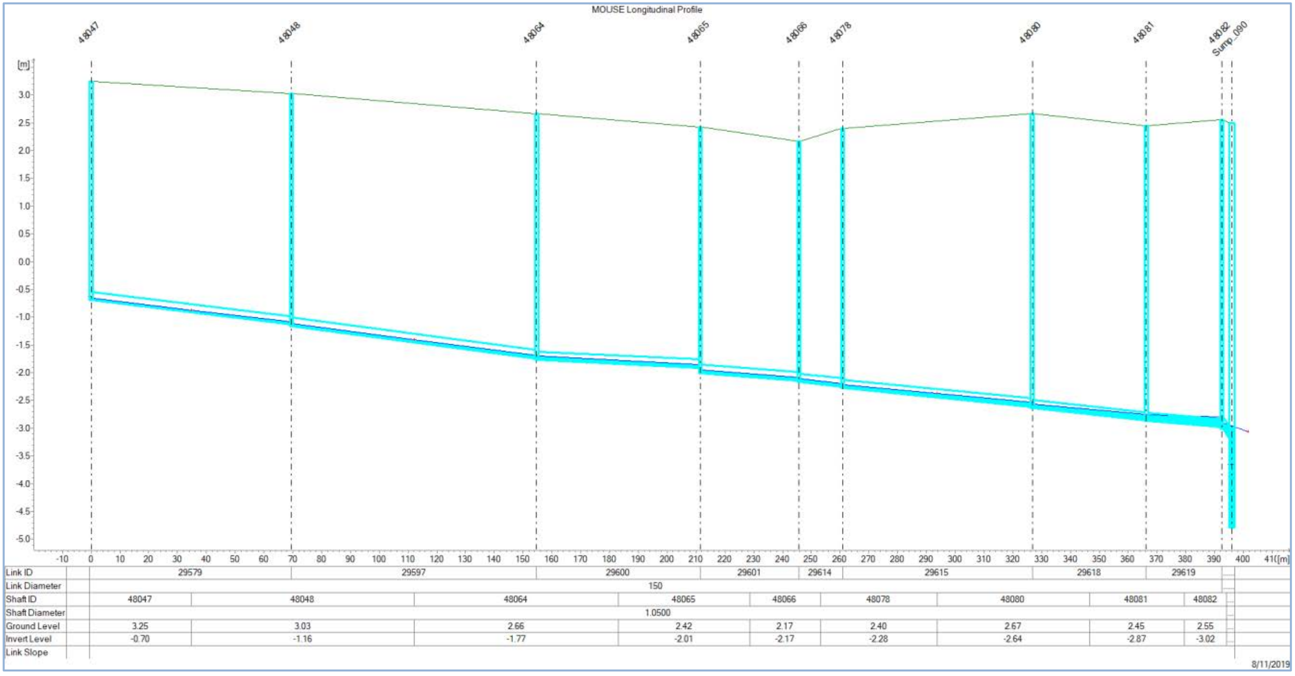
SPS 90 - 2041 PWWF Post-develop. + DN150/200/225 Duplication Main

Name	Diam. (mm)	Link Water Level	Link Discharge (L/s)	Link Velocity (m/s)	Link Depth (m)	d/D (%)
232863	150	4.2	2.7	0.2	0.131	87.3%
29531	214	-0.3	15.7	0.7	0.138	64.7%
29570	150	5.7	3.2	0.8	0.041	27.0%
29571	150	4.2	4.0	1.9	0.027	17.9%
29572	150	4.2	1.0	0.1	0.131	87.3%
29573	150	3.8	7.6	0.8	0.079	52.9%
29574	150	0.8	7.8	0.9	0.097	64.9%

29575	150	0.6	8.4	0.6	0.118	78.6%
29576	150	0.3	8.9	0.8	0.112	74.5%
29577	150	0.6	0.2	0.0	0.088	58.6%
29578	150	-0.6	9.7	0.9	0.105	70.1%
29579	150	-1.0	7.0	0.6	0.106	70.9%
29580	150	-0.6	3.7	0.5	0.075	50.1%
29581	150	7.1	1.5	0.9	0.023	15.6%
29582	150	7.9	0.9	0.6	0.022	14.4%
29583	150	8.2	0.4	0.3	0.023	15.4%
29584	150	6.4	0.8	0.6	0.019	12.5%
29585	150	5.5	1.3	0.8	0.023	15.3%
29586	150	4.8	1.3	0.6	0.028	18.9%
29587	150	4.9	0.8	0.6	0.019	12.5%
29588	150	5.3	0.6	0.6	0.015	10.0%
29589	150	4.0	2.3	0.7	0.035	23.3%
29590	150	2.1	2.5	0.8	0.040	26.5%
29591	150	1.8	2.5	0.7	0.040	26.6%
29592	219	-0.4	17.9	0.5	0.271	123.7%
29593	214	-0.7	22.8	0.6	0.303	141.7%
29594	150	0.9	2.2	0.6	0.040	26.8%
29595	150	1.1	0.4	0.1	0.050	33.5%
29596	150	1.2	0.9	0.5	0.023	15.1%
29597	150	-1.6	8.6	0.7	0.107	71.5%
29598	150	1.1	1.3	0.7	0.025	16.8%
29599	150	1.5	0.4	0.4	0.017	11.1%
29600	150	-1.8	8.1	0.7	0.082	54.7%
29601	150	-2.0	8.3	0.6	0.109	72.7%
29602	150	0.1	2.3	0.6	0.039	25.7%
29603	150	1.1	2.3	0.6	0.039	26.2%
29604	219	-1.1	26.6	0.7	0.327	149.5%
29605	150	0.1	2.0	0.9	0.027	18.3%
29606	219	-1.5	28.6	0.8	0.285	130.0%
29611	214	-1.9	31.5	0.9	0.204	95.4%
29612	214	-2.2	31.6	1.1	0.148	69.1%
29614	150	-2.1	8.8	0.7	0.110	73.4%
29615	150	-2.5	9.1	0.6	0.133	88.6%
29616	150	0.9	1.2	0.6	0.028	18.3%
29617	150	1.5	0.0	0.0	0.005	3.3%
29618	150	-2.6	8.7	0.5	0.229	153.0%
29619	150	-2.7	5.7	0.3	0.306	204.2%
Inlet_090_29613	214	-3.0	54.0	1.6	0.173	81.0%
Link_12	150	-1.0	6.7	0.6	0.106	70.9%
Link_13	150	-1.6	8.4	0.7	0.107	71.5%
Link_15	200	-1.8	11.3	0.7	0.090	44.9%
Link_16	200	-2.0	11.4	0.7	0.109	54.5%
Link_17	200	-2.1	11.3	0.7	0.110	55.1%
Link_18	200	-2.5	11.7	0.6	0.133	66.5%
Link_19	225	-2.6	13.7	0.4	0.229	102.0%
Link_20	225	-2.7	16.7	0.4	0.306	136.1%

Note: Link_19 and Link_20 show results that do not comply with SEQ Code 75% d/D flow depth, however this is due to erroneous results from Mike Urban, as the well HGL was above the invert level of this pipework, which could not be altered. Manual calculations showed that the DN150/DN225 duplication main should be sufficient to achieve 75% d/D. Further modelling will be required at the detailed design stage to confirm pipe sizing.

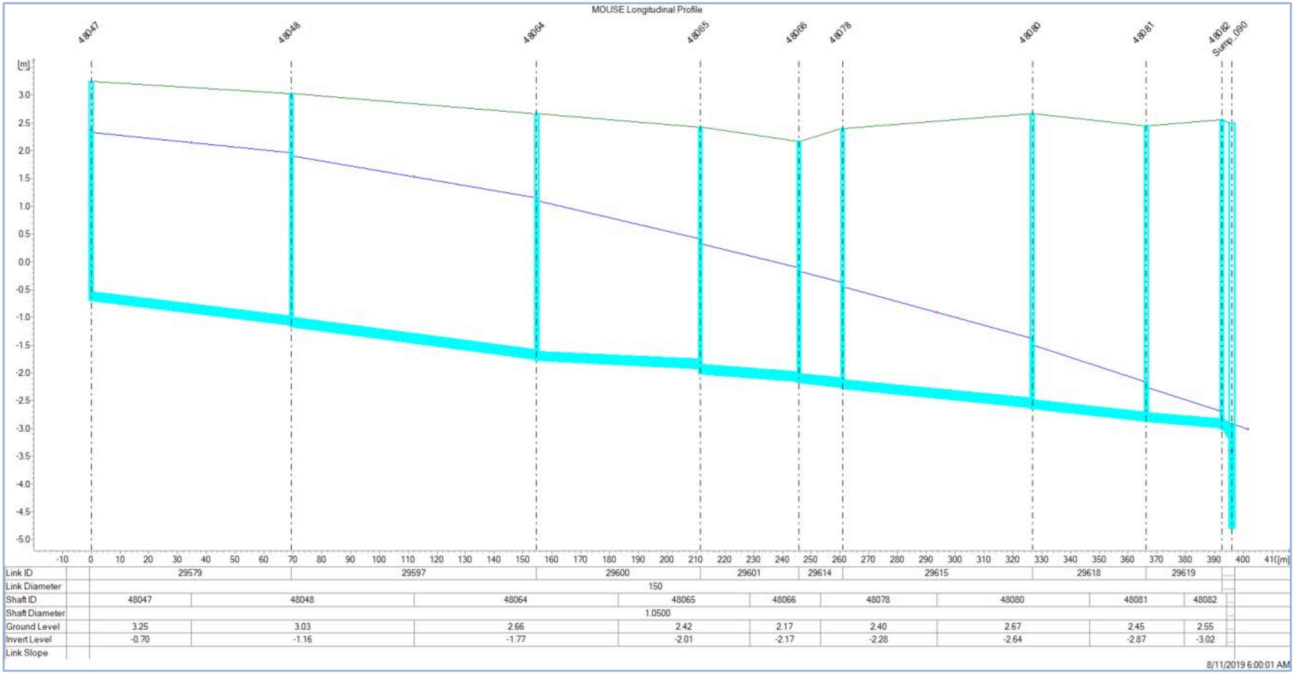
SPS 90 Gravity Mains, 2041 Pre-develop.



Link ID	29579	29597	29600	29601	29614	29615	29618	29619	
Link Diameter	150								
Shaft ID	48047	48048	48064	48065	48066	48078	48080	48081	48082
Shaft Diameter	1.0500								
Ground Level	3.25	3.03	2.66	2.42	2.17	2.40	2.67	2.45	2.55
Invert Level	-0.70	-1.16	-1.77	-2.01	-2.17	-2.28	-2.64	-2.87	-3.02
Link Slope									

8/11/2019

SPS 90 Gravity Mains, 2041 Post-develop.



Link ID	29579	29597	29600	29601	29614	29615	29618	29619	
Link Diameter	150								
Shaft ID	48047	48048	48064	48065	48066	48078	48080	48081	48082
Shaft Diameter	1.0500								
Ground Level	3.25	3.03	2.66	2.42	2.17	2.40	2.67	2.45	2.55
Invert Level	-0.70	-1.16	-1.77	-2.01	-2.17	-2.28	-2.64	-2.87	-3.02
Link Slope									

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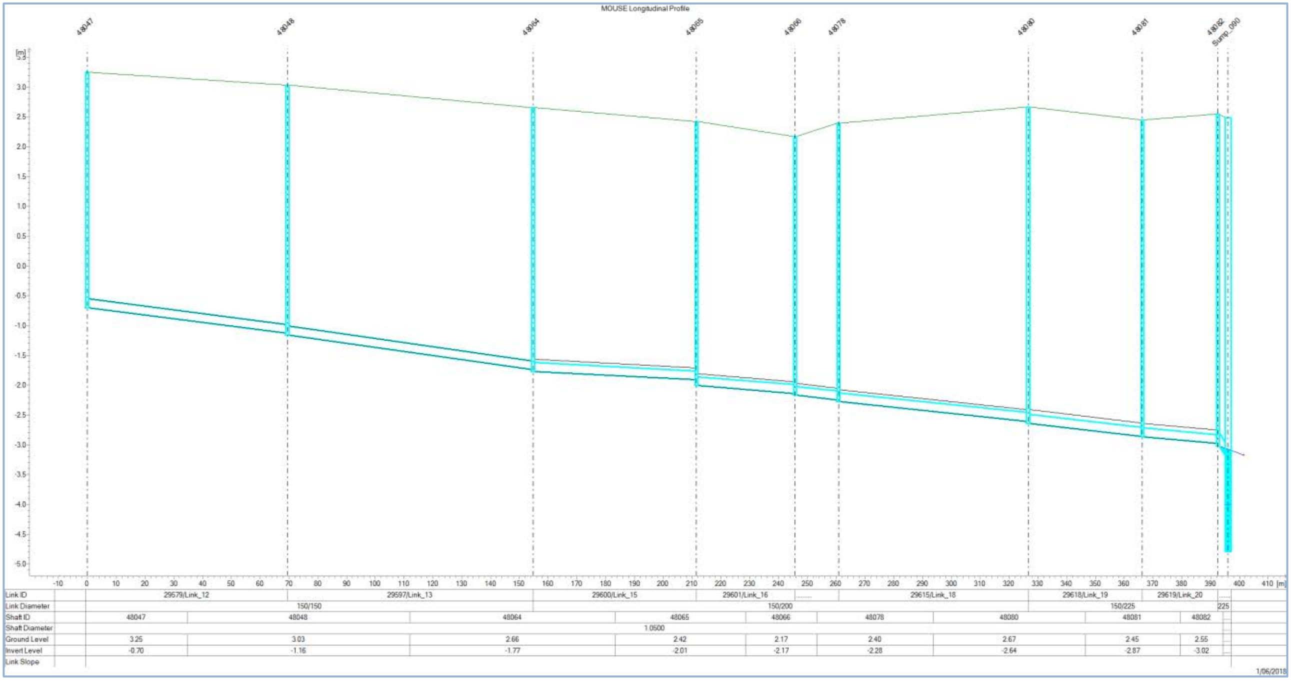
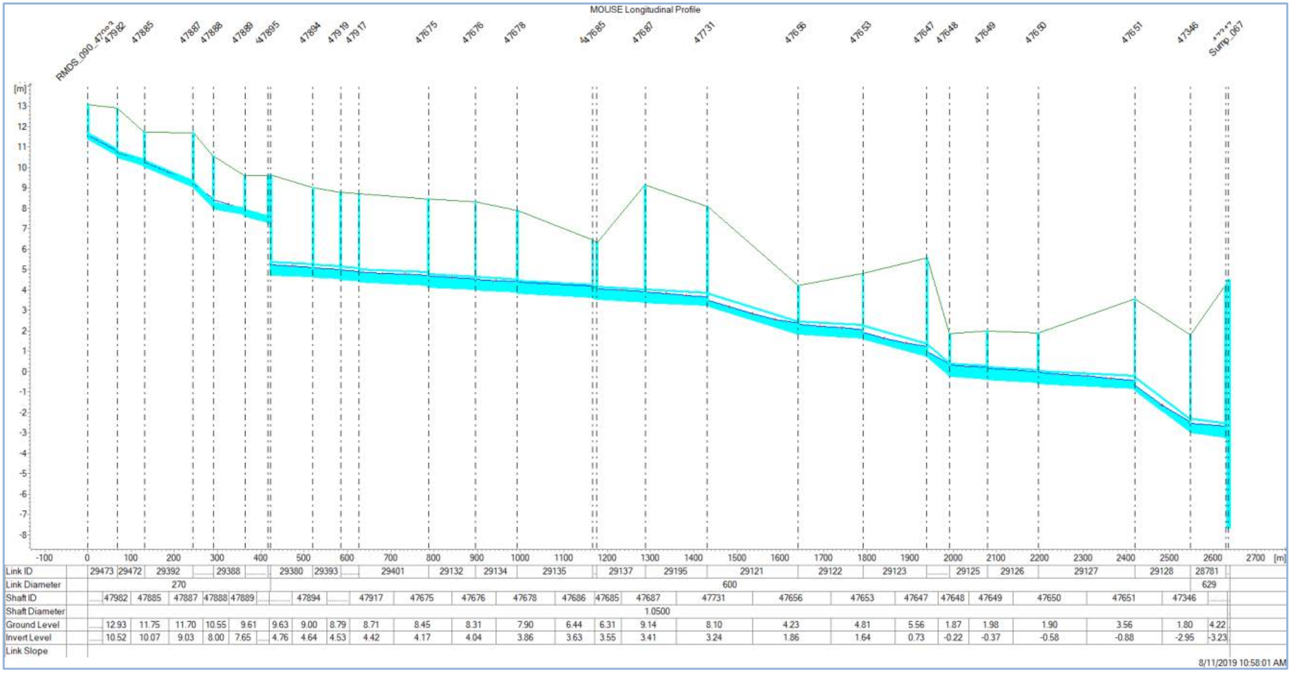
SPS 90 Gravity Mains, 2041 Post-develop. + DN150/200/225 Duplication Main



SPS 67 - 2041 PWWF Post-develop. + SPS 90 DN225 Rising Main Upgrade						
Name	**Diam. (mm)**	**Link Water Level**	**Link Discharge (L/s)**	**Link Velocity (m/s)**	**Link Depth (m)**	**d/D (%)**
28781	629	-2.679	235.647	0.968	0.501	79.6%
29121	600	2.394	209.356	0.945	0.534	89.0%
29122	600	2.066	209.288	1.048	0.386	64.4%
29123	600	1.227	209.288	1.086	0.447	74.4%
29124	600	0.373	239.074	1.210	0.543	90.4%
29125	600	0.205	238.220	0.889	0.535	89.2%
29126	600	-0.007	237.089	0.924	0.503	83.9%
29127	600	-0.428	235.972	1.156	0.382	63.7%
29128	600	-2.475	235.745	1.389	0.455	75.8%
29132	600	4.553	204.350	0.820	0.493	82.1%
29134	600	4.412	204.791	0.830	0.492	82.0%
29135	600	4.196	204.655	0.761	0.546	91.0%
29136	600	4.117	208.168	0.791	0.557	92.8%
29137	600	3.919	208.745	0.856	0.479	79.8%
29195	600	3.673	209.430	1.001	0.403	67.2%
29380	600	5.116	190.257	0.850	0.436	72.7%
29381	270	7.391	58.204	1.431	0.181	66.9%
29384	270	7.622	56.306	0.983	0.282	104.5%
29388	270	7.996	56.216	0.981	0.256	94.8%
29391	270	8.477	56.216	0.981	0.427	158.3%
29392	270	9.338	55.265	1.063	0.268	99.1%
29393	600	5.005	190.259	0.860	0.435	72.6%
29399	600	4.919	190.888	0.851	0.449	74.8%
29401	600	4.706	191.168	0.856	0.436	72.7%
29472	270	10.368	54.578	1.049	0.248	91.7%
Inlet_067_28784	629	-2.937	242.658	1.513	0.313	49.7%

SPS 67 Gravity Mains, 2041 Post-develop. + DN225 Rising Main Upgrade

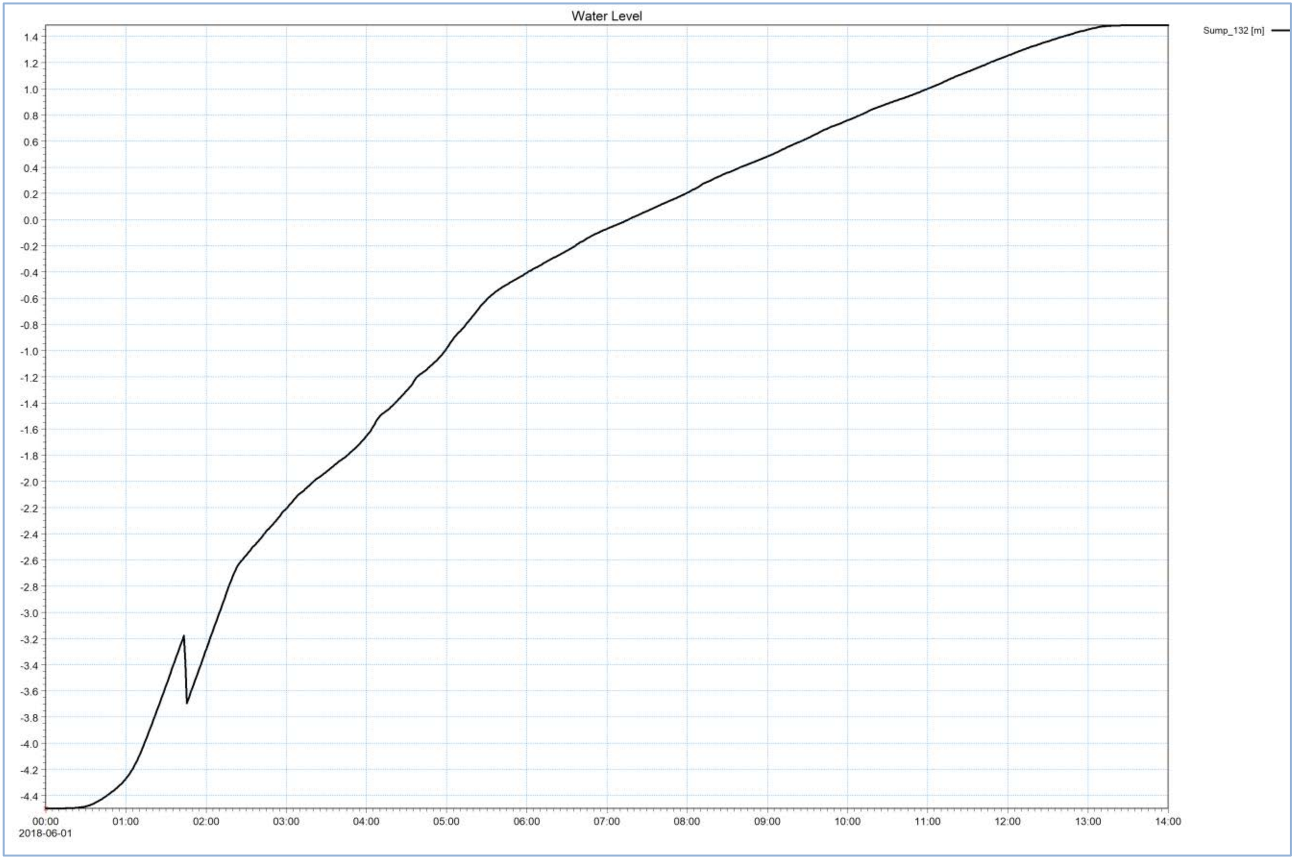


Link ID	29473	29472	29392	....	29388	....	29380	29393	....	29401	29132	29134	29135	29137	29195	29121	29122	29123	....	29125	29126	29127	29128	28781		
Link Diameter	270	600	629																							
Shaft ID	....	47982	47885	47887	47888	47889	....	....	47894	....	47917	47675	47676	47678	47686	47685	47687	47731	47656	47653	47647	47648	47649	47650	47651	47346	....
Shaft Diameter	1.0500																										
Ground Level	....	12.93	11.75	11.70	10.55	9.61		9.63	9.00	8.79	8.71	8.45	8.31	7.90	6.44	6.31	9.14	8.10	4.23	4.81	5.56	1.87	1.98	1.90	3.56	1.80	4.22
Invert Level	....	10.52	10.07	9.03	8.00	7.65	....	4.76	4.64	4.53	4.42	4.17	4.04	3.86	3.63	3.55	3.41	3.24	1.86	1.64	0.73	-0.22	-0.37	-0.58	-0.88	-2.95	-3.23
Link Slope																											

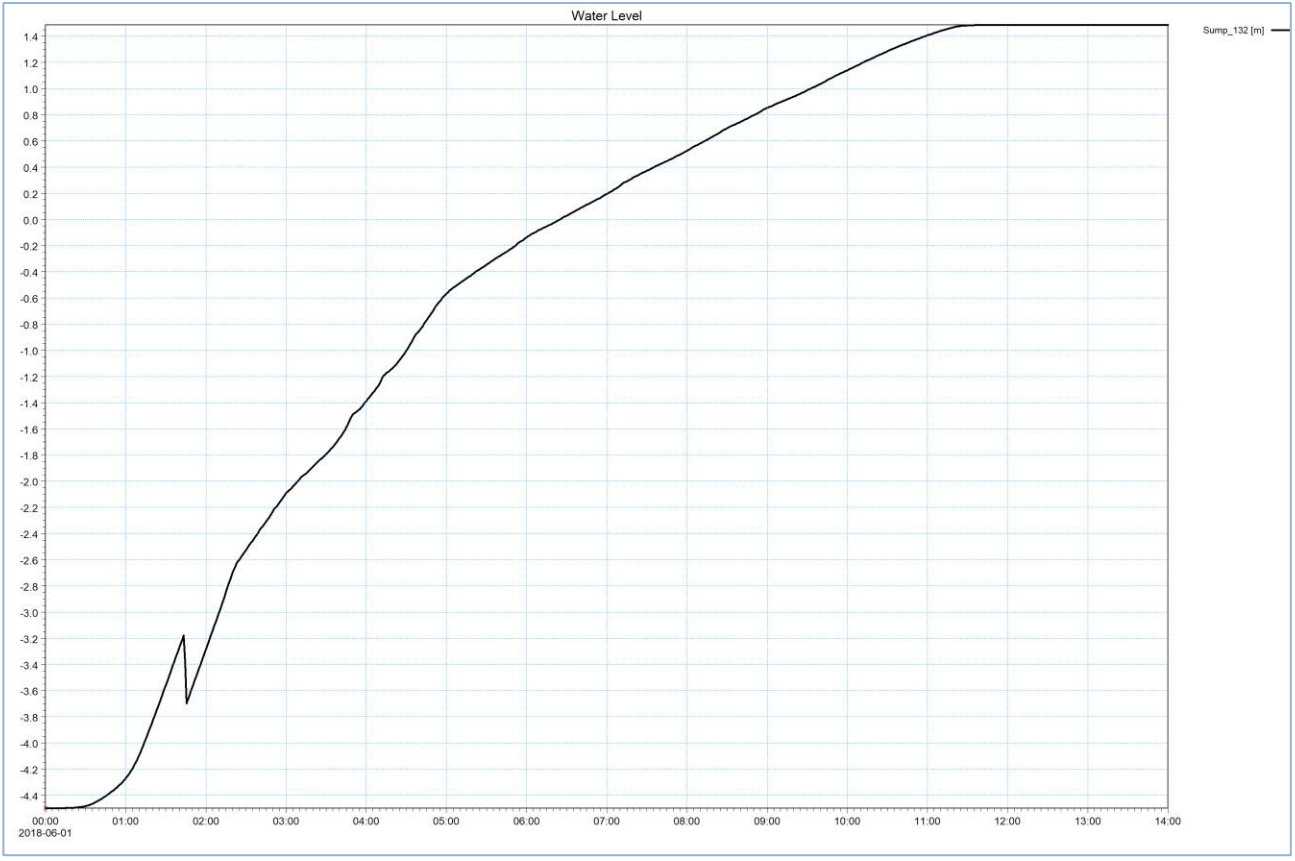
8/11/2019 10:58:01 AM

Appendix 6. Emergency storage modelling results for Weinam Creek PDA

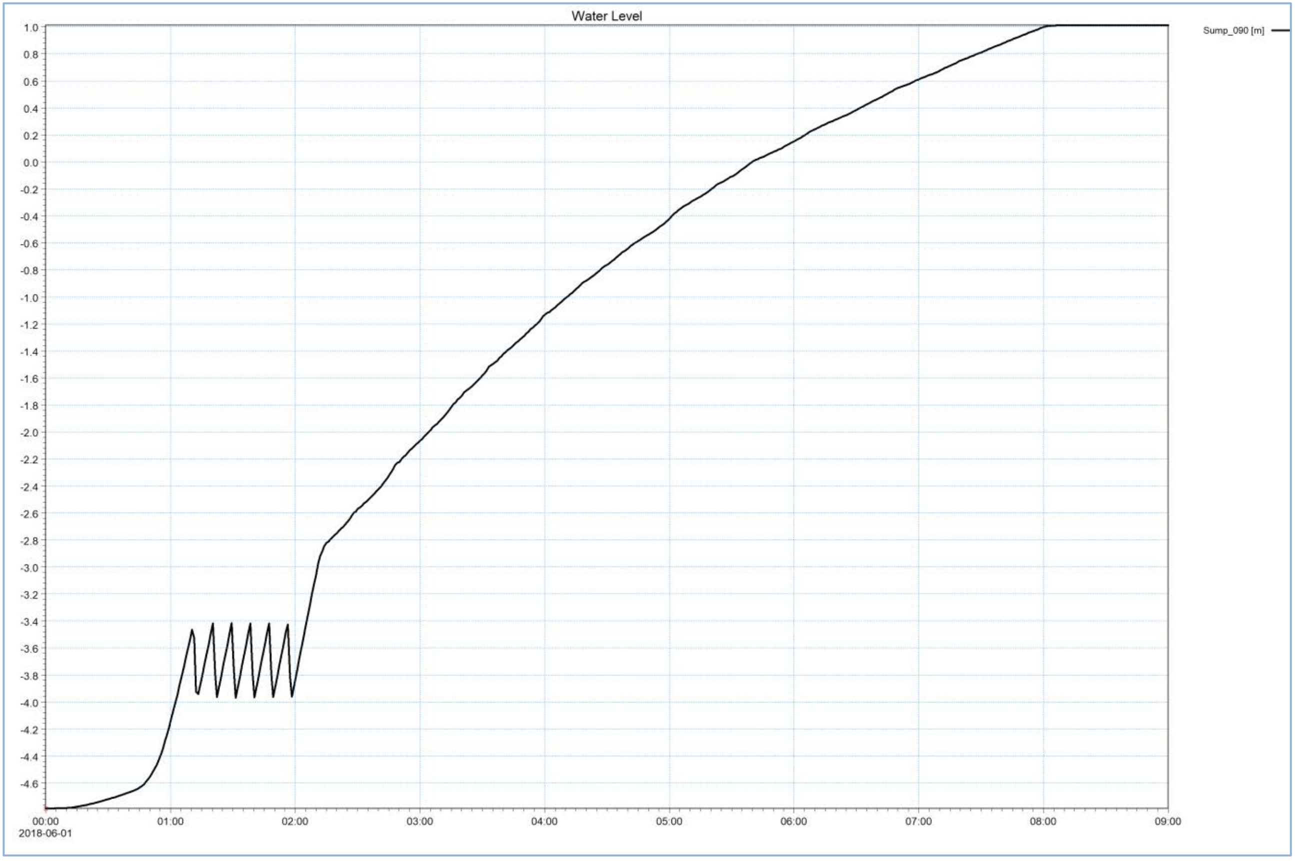
SPS 132, 2041 Pre-develop. (11H 2M)



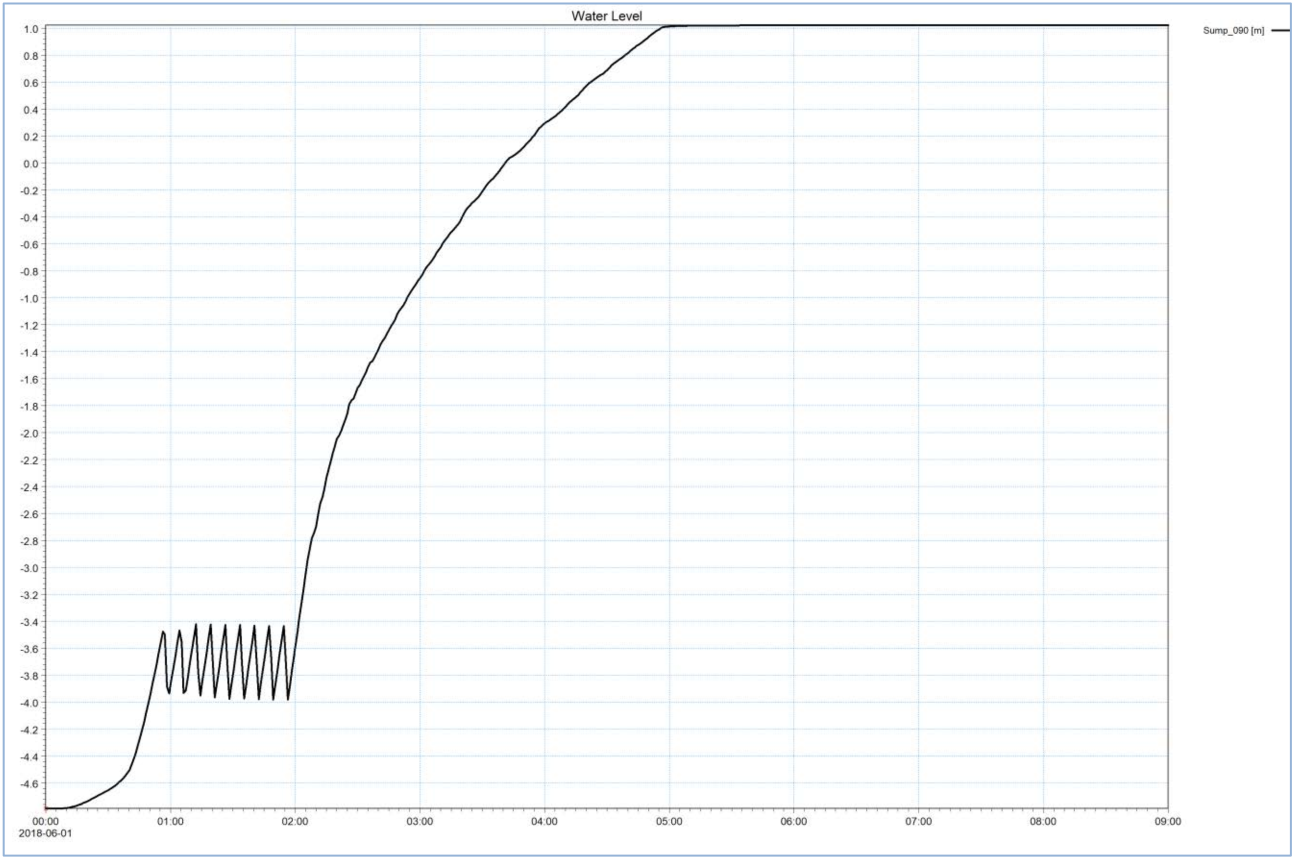
SPS 132, 2041 Post-develop. (9H 15M)



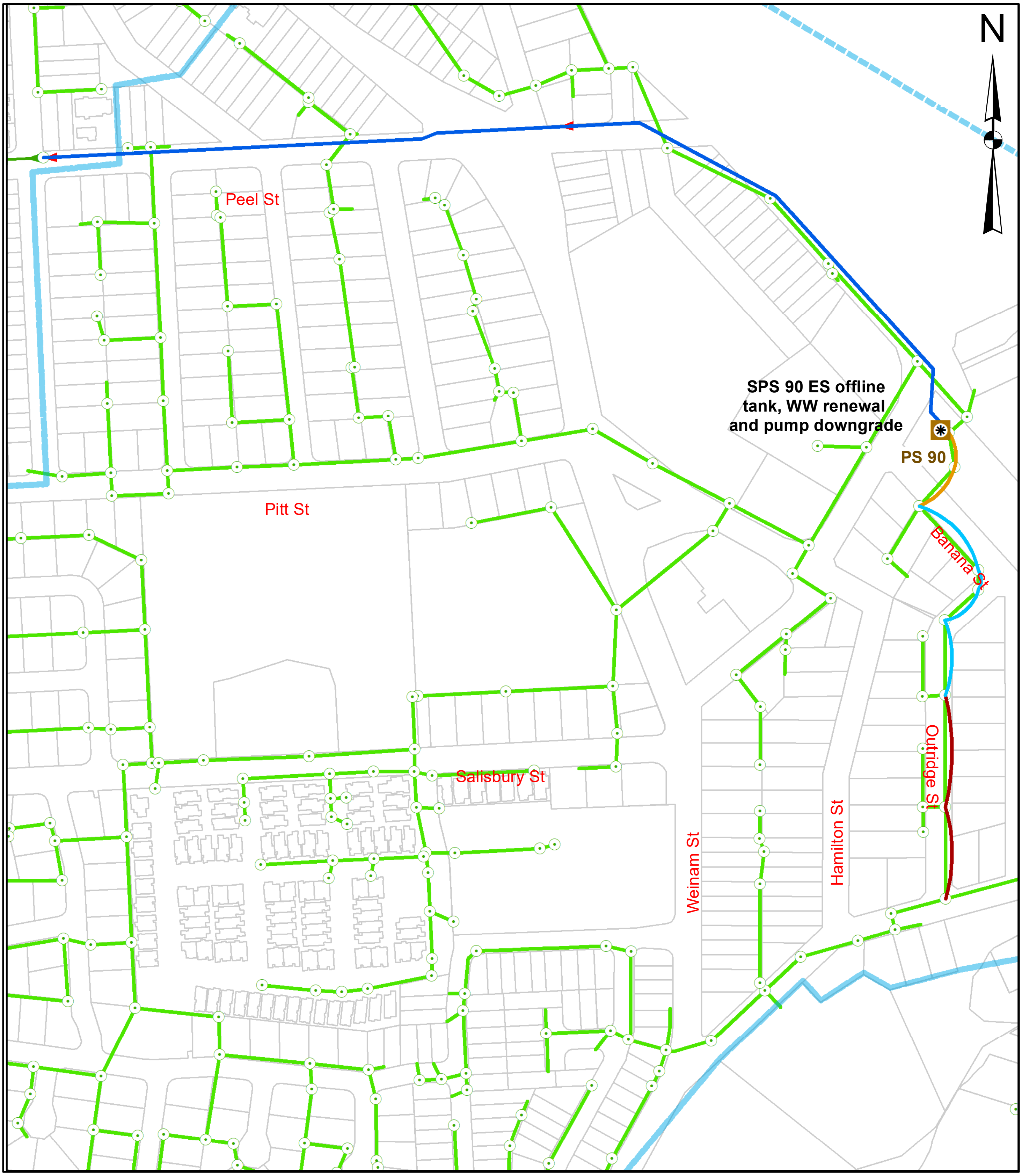
SPS 90, 2041 Pre-develop. (6H 0M)



SPS 90, 2041 Post-develop. (2H 56M)



Appendix 7. Proposed sewer infrastructure upgrades for the Weinam Creek PDA



Legend

- ☐ Current Land
- 🟪 Weinam Creek PDA
- ▭ WW Catchment

GM Duplication

- 🟥 150
- 🟦 200
- 🟧 225

RM Upgrade

- 🟦 225

WW Pressure Pipes

- ▶▶▶ Operating
- ▶▶▶ Out of Service
- – – · Decommissioned

WW Non-pressure Pipes

- ▶▶▶ Trunk Gravity
- 🟩 Reticulation
- ▶▶▶ Effluent Outflow
- ▶▶▶ Effluent Reuse

D1	3/04/2020	JM	MI	MI
Issue	Date	By	Chkd	Appd

Redland City Council

Redland Water
PO Box 21
Cleveland QLD 4163

Job Title **Weinam Creek PDA**

Drawing Title **Sewer catchments servicing PDA**

Scale at A3 **1:406,300** Drawing Status **Draft V1**

Coordinate System **GDA 1994 MGA Zone 56**

Date of Print **3/04/2020** Drawing No **001**

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Appendix 8. Detailed capital cost estimate calculations and assumptions

Catchment	Aug No.	Description	Size	Length (m)	Unit Base Rate	Adjustment Factor	Base Sub-total	Indexed Sub-total
SPS 90	1	Rising main upgrade	DN225	800	$ 326	1.20	$312,960	$352,239
	2	Duty/assist renewal	18 kW	NA	$500 / kW + $7k install	NA	$25,000	$25,000
	3	Well and internal pipework renewal	NA	NA	NA	NA	$500,000	$500,000
	4	Emergency storage tank	41 kL	NA	$ 3,676	NA	$150,716	$179,963
	5	Gravity mains	DN150	154	$ 385	1.37	$81,227	$ 91,422
	6		DN200	172	$ 471	1.37	$110,986	$124,916
	7		DN225	66	$ 516	1.37	$46,657	$52,513
							TOTAL	**$1,326,053**

Note 1: Assumed soft rock urban for all pipework

Note 2: Aug No. 2 was estimated based on RCC costs from recent works

Note 3: Aug No. 3 was a high level estimation based on RCC historical works

Note 4: Emergency storage tank cost estimation sourced from Cardno's CoGC 2014 wet well unit rates, indexed at 3% per annum for 6 years

Note 5: Gravity main cost estimation sourced from Cardno's RCC 2017 unit rates, indexed at 3% per annum for 4 years

Note 6: Rates include 20% overheads. No contingency adjustments have been applied.

Appendix H – Victoria Point Sewage Treatment Plant Upgrades for New Developments

Redland Water

Victoria Point Sewage Treatment Plant

Upgrades for New Developments
Phase 2 Report

Revision C:
Final with Appendices
July 2, 2020

Redland City Council

Redland Water

TYR Group
Treatment and Reuse

Redland Water
Victoria Point STP – Upgrades for New Developments
Phase 2 Report

This report has been prepared solely for the benefit of Redland Water for the Victoria Point STP – Upgrades for New Developments. No liability is accepted by Tyr Group or any employee or sub-consultant of Tyr Group with respect to its use by any other person or in relation to any other project.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval or to fulfil a legal requirement.

Revision	Date	Description	Prepared by	Reviewed by
A	May 12, 2020	Draft for Client Review	David Fligelman, Ian Fisher, Ryan Schwartz	David Fligelman
B	July 2, 2020	Final	David Fligelman, Ian Fisher, Ryan Schwartz	David Fligelman
C	July 2, 2020	Final	David Fligelman, Ian Fisher, Ryan Schwartz	David Fligelman

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TABLE OF CONTENTS

ABBREVIATIONS

AAL	Average Annual Load
ADWF	Average Dry Weather Flow
APT	Activated Primary Tank
BNR	Biological Nutrient Removal
BUA	Beneficial Use Approach
COD	Chemical Oxygen Demand
DES	Department of Environment and Science
DO	Dissolved Oxygen
EBPR	Excess Biological Phosphorus Removal
EP	Equivalent Population
EoW	End of Waste Code
IDM	Infrastructure Demand Model
MLSS	Mixed Liquor Suspended Solids
MML	Maximum Monthly Load
NPC	Net Present Cost
PDWF	Peak Dry Weather Flow
PST	Primary Sedimentation Tank
PWWF	Peak Wet Weather Flow
RAS	Return Activated Sludge
RBCOD	Readily Biodegradable COD
rDON	Dissolved Organic Nitrogen
SBCOD	Slowly Biodegradable COD
STP	Sewage Treatment Plant
SRT	Sludge Retention Time (Sludge Age)
SOUR	Specific Oxygen Uptake Rate
TP	Total Phosphorus
TSS	Total Suspended Solids
VFA	Volatile Fatty Acid
VS	Volatile Solids
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WRR	Waste Reduction and Recycling Act
WWTP	Wastewater Treatment Plant

1 EXECUTIVE SUMMARY

1.1 BACKGROUND AND OBJECTIVES

The 2003 upgrade to Victoria Point STP delivered a nominal design capacity of 34,000 EP, and the 2020 loading is estimated at approximately 96% of this value (32,496EP). Demand modelling for the catchment previously predicted a contributing population of 37,097 EP for 2041.

Council has received development applications that cover the majority of land in the SW Victoria Point local plan area. As a result, Council has needed to prioritise and bring forward detailed land use and infrastructure planning for the local plan area ahead of the City Plan and LGIP timeframe of post 2027. The projected load for 2041 would be increased to 44,312 EP by two proposed developments in the catchment – an increase of approximately 19% in the connected population over the baseline. The bulk of this additional load is predicted to be connected between 2022 and 2027. The existing Victoria Point STP operates under a very tight limit for nitrogen mass loads discharged, and the additional growth has significant implications for the nitrogen removal required to be achieved by the plant in the future.

The projected growth in loads requires the plant's previous upgrade strategy to be reassessed, including specific consideration of:

- The process and hydraulic capacity of the existing plant, and the scope, costs and timing of works required to ensure ongoing compliance with the Environmental Authority, including the Total Nitrogen Mass Load limit, under the:
    - The increase in load associated with the baseline 2041 projected load alone (37,097 EP), and,
    - The increase loads associated the additional developments in combination with the baseline projected load through to 2041 (44,312 EP).

1.2 BASIS OF PLANNING ADOPTED

The baseline growth in the catchment is expected to be increased supplemented by two developments – Weinam Creek (to an ultimate value of 3000 EP) and South West Victoria Point (to the ultimate connected population of 4215 EP). The majority of this additional growth is expected to occur between 2022 and 2027. The design horizon for planning has been adopted as 2041.

Based on high level visual inspection, the existing plant is generally in good condition. Items requiring renewal comprise:

- Removal (and replacement if required) of the acoustic covers on the oxidation ditch aerators;
- Refurbishment of structural steel and cladding of the dewatering building, and,
- Provision of a replacement sludge dewatering machines.

There have been major structural issues in the existing bioreactor. In the absence of other information, the analysis has assumed that the repairs to this structure undertaken in July 2017 will render it suitable for ongoing use throughout the design horizon.

Phase 1 of the upgrade planning study was completed prior to finalisation of the End of Waste (EoW) code for Biosolids by the Queensland Government The draft code issued for consultation at the time excluded the "barrier option" for vector attraction reduction. As a result, the Phase 1 study centred on options which met the requirements of the draft code, including specific infrastructure for biosolids stabilisation on-site. The ultimate inclusion of "barrier option" under the finalised EoW code has substantially reduced the scope of upgrade works required to manage the future loads.

The sewage loads and composition applied to the study were drawn from extensive analysis of 12 years of historical operational monitoring data, and intensive monitoring of the plant influent sewage composition and plant operations in

November and December 2019. This data was used to calibrate a dynamic process model of the existing plant for use in the estimation of the existing plant capacity, and the selection and concept design of the required upgrade works.

The current effluent quality criteria for the plant requires the mass load of total nitrogen to be maintained at less than 13.5 kg/d on an annual basis. Compliance with this limit requires the effluent total nitrogen concentration to be substantially reduced under the higher flows from the additional developments. Previous consultation with DES stretching back to 2002-03, has not been successful in amending this limit. Further analysis and modelling of the receiving waterway, Eprapah Creek, is currently underway to identify the potential to increase the mass of nitrogen which can be discharged from the plant. However, pending completion of this analysis, the 13.5 kgN/day limit has been applied to the upgrade planning.

1.3 KEY FINDINGS AND RECOMMENDATIONS

The prevailing capacity of Victoria Point STP is limited to 38,300 EP by the ability of the secondary clarifiers to treat 5 x ADWF. The existing plant's ability to maintain compliance with the Total Nitrogen Mass Load Limit will be compromised at a similar load (38,700 EP). While this capacity exceeds the projected baseline connected population at 2041 of 37,097 EP, a number of renewals and upgrades are required to maintain performance and compliance.

Upgrades to a further three process areas will be required to treat the additional 7215 EP load from the South West Victoria Point and Weinam Creek developments.

Concept designs were developed for each of the upgrade works proposed, and the associated capital costs estimated.

The scope, required timing and estimated capital costs of the required upgrades is summarised in Table 1-1.

Table 1-1: Summary of Required Plant Upgrades and Staging

Upgrade	Estimated Capital Cost	Required from	
RENEWALS AND PLANT UPGRADES REQUIRED TO SERVICE BASELINE GROWTH			
2 No. New Raw Sewage Pumps	Not included (in progress under separate project)	41,240 EP	Installation scheduled for August 2020
2 No. New Band Screens and 2 No. Screw Wash Presses	$0.910m Direct Job Cost	As soon as possible (for performance and redundancy)	
Removal of existing covers / installation of noise barriers to oxidation ditch aerators	$0.030m Direct Job Cost	As soon as possible (existing covers corroded)	
Control system change / minor works to facilitate duty/assist chlorinator operation	$0.026m Direct Job Cost	As soon as possible (estimated peak dose rate < demand)	
New dewatering trains / WAS pump station and poly storage and dosing	Not included (in progress under separate project)	As soon as possible (existing GDD/BFPs at end of serviceable life)	
Total Capital Cost	**Total Direct Job Cost (including Preliminaries): $0.987m** **Total Project Cost (including 30% Contingency): $2.200m**		
PLANT UPGRADES REQUIRED TO SERVICE ADDITIONAL DEVELOPMENTS			
Post-Anoxic / Re-Aeration Zone)	$1.289m Direct Job Cost	38,700 EP	2025
1 No. Additional Secondary Clarifier	$2.255m Direct Job Cost	38,300 EP	2024
1 No. Additional Chlorine Contact Tank	$0.296m Direct Job Cost	38,700 EP	2025
Total Capital Cost (+/- 30% Accuracy Target)	**Total Direct Job Cost (including Preliminaries, Commissioning and Handover): $4.033m** **Total Project Cost (including 30% Contingency): $8.512m**		

The additional operational costs required to treat the sewage load generated by the South West Victoria Point and Weinam Creek Developments were estimated in detail. The additional electricity consumption and biosolids haulage required to treat the load dominates the additional costs. In 2041 (the design horizon), the additional annual operating cost is $135,100 p.a. with additional sludge haulage at $65 /wet tonne, increasing to $160,400 p.a. if the rate for sludge haulage rises to $100 /wet tonne

The whole-of-life cost to treat the additional load from the South West Victoria Point and Weinam Creek Developments is **$10.31-10.68m over 40 years,** depending on the cost of biosolids management.

The renewals and upgrade works required for baseline growth are required to be completed as soon as possible. Given the limited scope of these works, completion of these upgrades could be completed as a single project, or as a suite of minor projects.

The works to treat sewage loads from the additional developments are required to be completed and in service by 2024-25. This suggests the upgrades should be undertaken under a single contract with procurement and design commencing in 2020-21.

2 BACKGROUND AND OBJECTIVES

The Victoria Point Sewage Treatment Plant (STP) was originally constructed in 1977, then upgraded to an oxidation ditch-based process in 2003. The sewage received by the plant is primarily residential in origin, with some light trade waste. The plant consistently achieves excellent nitrogen removal, with the annual median effluent total nitrogen ranging from 1.40 mg/L to 1.90 mg/L over the last five years of operation.

The existing Environmental Authority for the plant includes a stringent requirement for total nitrogen mass loads not to exceed 13.5 kgN/d on a long-term median basis. This requirement constrains the effluent total nitrogen limit to lower values as the flow to the plant increases, and there is a risk of non-compliance with this limit at the current sewage flows and effluent nitrogen performance. While issues in the initial calculation basis applied to this limit have been referred to the regulator on a number of occasions (including 2003 and 2010), Redland Water's case to raise the limit to 21.3 kgN/d has not been accepted to date.

The 2003 upgrade delivered a nominal design capacity of 34,000 EP, and the current estimated 2020 loading is estimated at approximately 96% of this value (32,496EP). Demand modelling for the catchment previously predicted a contributing population of 37,097 EP in 2041. However, the projected load for 2041 would be increased 44,312 EP (~20%) by two proposed developments in the catchment – *South West Victoria Point* and *Weinam Creek*. The bulk of this additional load is predicted to be connected between 2022 and 2027.

The loads from these additional developments will result in substantial exceedance of the existing plant's capacity in the near term, and prevent compliance with the existing effluent quality criteria.

Phase 1 of the *Victoria Point STP – Upgrades for New Developments* (Tyr Group, July 2019) considered the process and hydraulic capacity of the existing plant, the scope, cost and timing of upgraded to achieve compliance under future loads under a compressed timeframe. Phase 2 of the study, as described in this report, has refined the future planning for the plant through:

- An intensive monitoring program for the influent sewage and plant operations undertaken in November-December 2019;
- Development and calibration of a process model of the existing plant;
- Revised projections of connected population for one of the two proposed developments;
- Extension of the planning horizon for the upgrades from 2036 to 2041, and,
- The final End of Waste (EoW) code for Biosolids, which stipulates the options for biosolids processing requirements for biosolids reuse in Queensland from January 2020. The Phase 1 study was developed based on the draft EoW Code (October 19th, 2018), which omitted the "barrier option" for biosolids stabilisation included in the NSW Guidelines for Biosolids Reuse (which were previously applicable in Queensland). The exclusion of this option from the draft code, which has been utilised for management of the Victoria Point STP biosolids to date, resulted in additional infrastructure to further stabilise the biosolids generated within the plant under Phase 1. However, as detailed in Section 3.8, the inclusion of the barrier option (and allowance of operation at a shorter secondary treatment process sludge age) effectively means that no additional infrastructure is required for biosolids stabilisation in the current (Phase 2) study.

Based on the above, Redland Water requires the plant's previous upgrade strategy to be reassessed in detail, including specific consideration of:

- The hydraulic capacity of the existing plant;
- The process capacity of the existing plant (based on dynamic process modelling);

- The development of concept designs, cost estimates, and required timing for the upgrade works required to deliver to ensure ongoing compliance with the Environmental Authority, including the Total Nitrogen Mass Load limit, under the following two loading scenarios:
    - The increase in load associated with the baseline 2041 projected load alone (37,097 EP), and,
    - The increase loads associated the Weinam Creek and South West Victoria Point developments (in combination with the baseline projected load) through to 2041 (44,312 EP).

3 BASIS OF ASSESSMENT, PLANNING, AND DESIGN

3.1 CONTRIBUTING POPULATION

Redland City Council has received development applications that cover the majority of land in the SW Victoria Point local plan area. As a result, Council has needed to prioritise and bring forward detailed land use and infrastructure planning for the local plan area ahead of the City Plan and LGIP timeframe of post 2027.

The projected contributing population to Victoria Point STP catchment is shown in Table 3-1 and Figure 3-1 overleaf. The figures shown are based on the Infrastructure Demand Model (IDM) outputs provided by Redland Water, and were projected from a base contributing population of 28,730 EP at the 2011 Census.

The growth in the contributing population of the Weinam Creek development was originally provided to an ultimate value of 3377 EP. Based on advice from Redland Water, this project has assumed a linear growth rate through to a reduced ultimate load of 3000 EP in 2036.

In the absence of detailed projections for the South West Victoria Point development (formerly known as Clay Gully), the projection has been developed based on connections commencing in 2022-23, and linear growth over the subsequent five years. An ultimate connected population of 4215 EP has been applied for this development.

It is important to note that the “ultimate” connected population, as shown in Table 3-1, does not refer to a particular year. Rather, the ultimate refers to the connected population when the catchment is “fully developed”.

The projection indicates the two developments will increase the connected population as follows:

- 2026: 34,813 EP to 39,836 EP (+14%);
- 2031: 36,243 EP to 43,050 EP (+19%);
- 2036 36,642 EP to 43,897 EP (+20%);
- 2041 37,097 EP to 44,312 EP (+19%), and,
- Ultimate: 44,398 EP to 51,613 EP (+16%).

The planning horizon report has been set as 2041, with the existing plant capacity referencing the baseline load of 37,097 EP, and upgraded plant capacity of 44,312 EP, with the majority of this additional growth occurring between 2022 and 2030.

Table 3-1: Victoria Point STP - Projected Connected Population

Year	Baseline Projection (2015 IDM (2011 Base)	South West Victoria Point Development	Weinam Creek Development	Total (incl. Developments)
2011	**28,730 EP**			28,730 EP
2012	29,128 EP			29,128 EP
2013	29,526 EP			29,526 EP
2014	29,925 EP			29,925 EP
2015	30,323 EP			30,323 EP
2016	**30,721 EP**			30,721 EP
2017	31,165 EP			31,165 EP
2018	31,609 EP			31,609 EP
2019	32,052 EP			32,052 EP
2020	32,496 EP		**0 EP**	32,496 EP
2021	**32,940 EP**		434 EP	33,374 EP
2022	33,315 EP	0 EP	677 EP	33,992 EP
2023	33,689 EP	843 EP	921 EP	35,453 EP
2024	34,064 EP	1,686 EP	1,164 EP	36,914 EP
2025	34,438 EP	2,529 EP	1,408 EP	38,375 EP
2026	**34,813 EP**	3,372 EP	1651 EP	39,836 EP
2027	35,099 EP	4,215 EP	1,839 EP	41,153 EP
2028	35,385 EP	4,215 EP	2,027 EP	41,627 EP
2029	35,671 EP	4,215 EP	2,216 EP	42,102 EP
2030	35,957 EP	4,215 EP	2,404 EP	42,576 EP
2031	**36,243 EP**	4,215 EP	2592 EP	43,050 EP
2032	36,323 EP	4,215 EP	2,674 EP	43,211 EP
2033	36,403 EP	4,215 EP	2,755 EP	43,373 EP
2034	36,482 EP	4,215 EP	2,837 EP	43,534 EP
2035	36,562 EP	4,215 EP	2,918 EP	43,696 EP
2036	**36,642 EP**	4,215 EP	3000 EP	43,857 EP
2037	36,733 EP	4,215 EP	3000 EP	43,948 EP
2038	36,824 EP	4,215 EP	3000 EP	44,039 EP
2039	36,915 EP	4,215 EP	3000 EP	44,130 EP
2040	37,006 EP	4,215 EP	3000 EP	44,221 EP
2041	**37,097** EP	4,215 EP	3000 EP	44,312 EP
Ultimate	**44,398 EP**	4,215 EP	3000 EP	51,613 EP

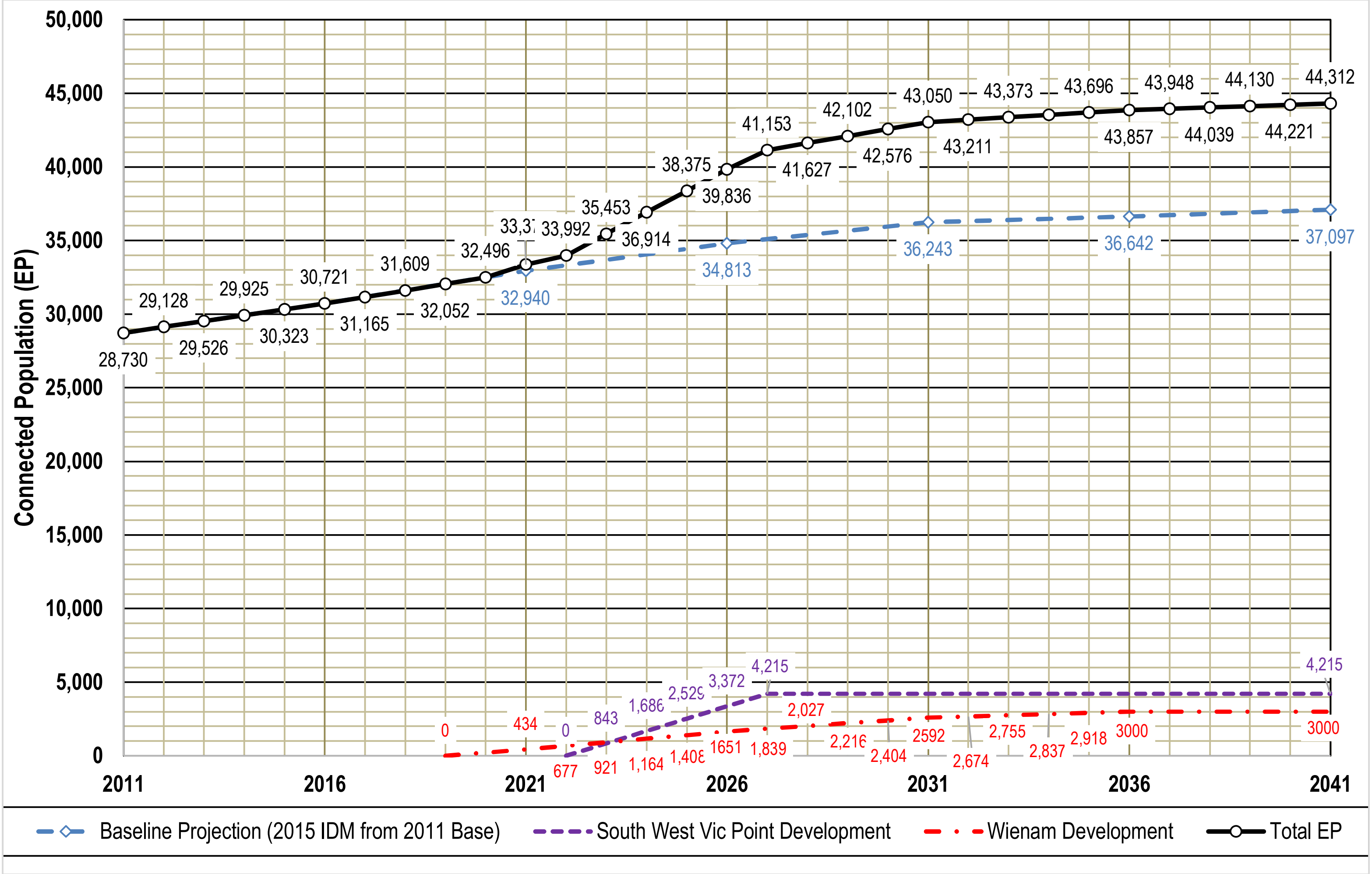

Figure 3-1: Victoria Point STP –Projected Contributing Population – Baseline and with Developments

3.2 INFLUENT SEWAGE FLOWS

The dry weather flows to the plant are critical to quantifying the plant loading, but additionally for Victoria Point STP, determine the maximum acceptable effluent total nitrogen (see Section 3.6.3).

The influent flows to the plant have been analysed for the period January 2007 through June 2019, and estimated on a per capita basis (using the IDM population projection) for the last six years. The following two criteria were applied to exclude wet weather days from the dataset:

Criteria 1: Exclusion of days on which the recorded rainfall exceeded 4mm, or the rainfall in the preceding 4 days exceeded 10mm. This criterion is focussed on reducing the influence of even modest levels of sustained infiltration on the analysis by excluding days immediately following relatively minor rainfall.

Criteria 2: Exclusion of days on which the recorded rainfall exceeded 1mm, or the rainfall in the preceding 4 days exceeded 50mm. This criterion is identical to that used to define a “dry weather day” in the Environmental Authority for all Redland STPs. This criterion will exclude inflow to the sewerage system more than Criteria 1, but retain more days which are influenced by the sustained infiltration which occurs after heavy rainfall.

The results of this analysis are shown in Figure 3-2 and Figure 3-3, and indicate:

- The average flow tracks very strongly with total rainfall on a 365 day rolling average basis. This indicates the impact of sustained infiltration after wet weather events on the flows to the plant.
- There does not appear to have been any substantial increase in the baseline dry weather flow to the plant over the last 10 years. That is, for a given annual rainfall, the calculated dry weather average flows do not appear to have increased when considered on a 365 day average basis.
- There is a small discrepancy between influent sewage flows and the flows discharged from the plant. This is likely due to inaccuracies with the effluent flowmeter, which is calculated from the height of flow of a weir. The overall magnitude of this error is not significant.
- The per capita dry weather sewage flows over the last four years have averaged 180 L/EP/d (Influent, Criteria 1) to 191 L/EP/d (Effluent, Criteria 1), but all of these years were below the average annual rainfall.
- The maximum recorded flows per capita during the analysis period, calculated on an annual basis, were in 2011 (212 L/EP/d Influent, 1584mm) and 2012 (216 L/EP/d Influent, 1384mm). Since then, the maximum per capita flows, were 219 L/EP/d estimated for 2013 and 2015 under Criteria 2 for the effluent. Both of these years recorded comparable (or higher) rainfall than the 2011 and 2012 years. This suggests that a moderately wet year may see a per capita flow in the order of 220 L/EP/d (calculated under Criteria 2).
- The dry weather flow calculated for the characterisation period of November 29 – December 19, 2019 was 153 L/EP/d. As the characterisation period followed on from a prolonged period of low rainfall, this is likely to represent the minimum per capita flow at Victoria point.

Based on the analysis of the data, a maximum dry weather average per capita inflow of 220 L/EP/d has been carried forward as the basis of planning. For reference, it is worth noting that the 2003 plant upgrade was based on a per capita flow of 220 L/EP/d, but the Strategic Planning Review (2009) applied a per capita flow of 190 L/EP/d increasing to 230 L/EP/d by 2025.

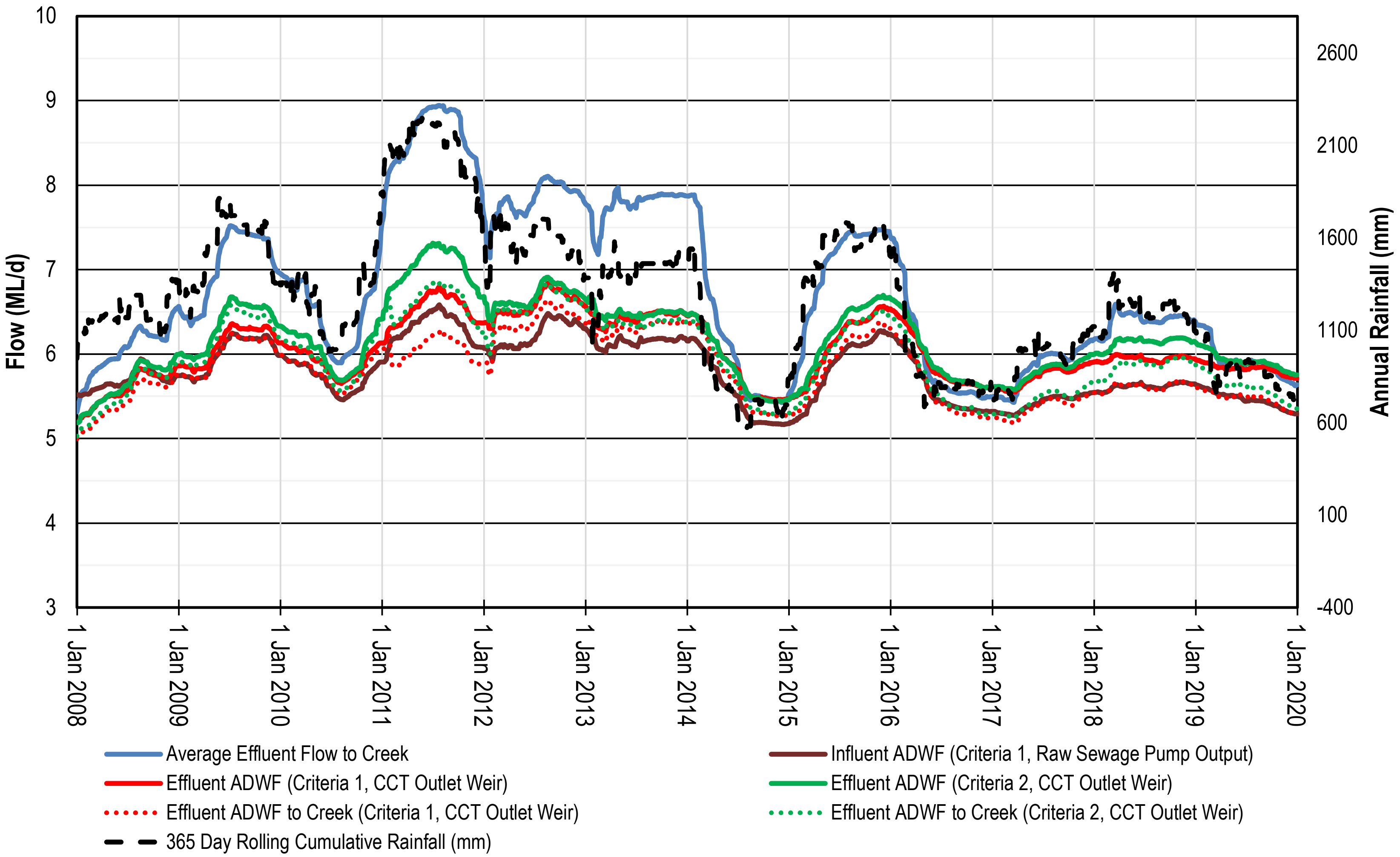

Figure 3-2: Victoria Point – 365-Day Rolling Dry Weather Average Flows, January 2007- December 2019

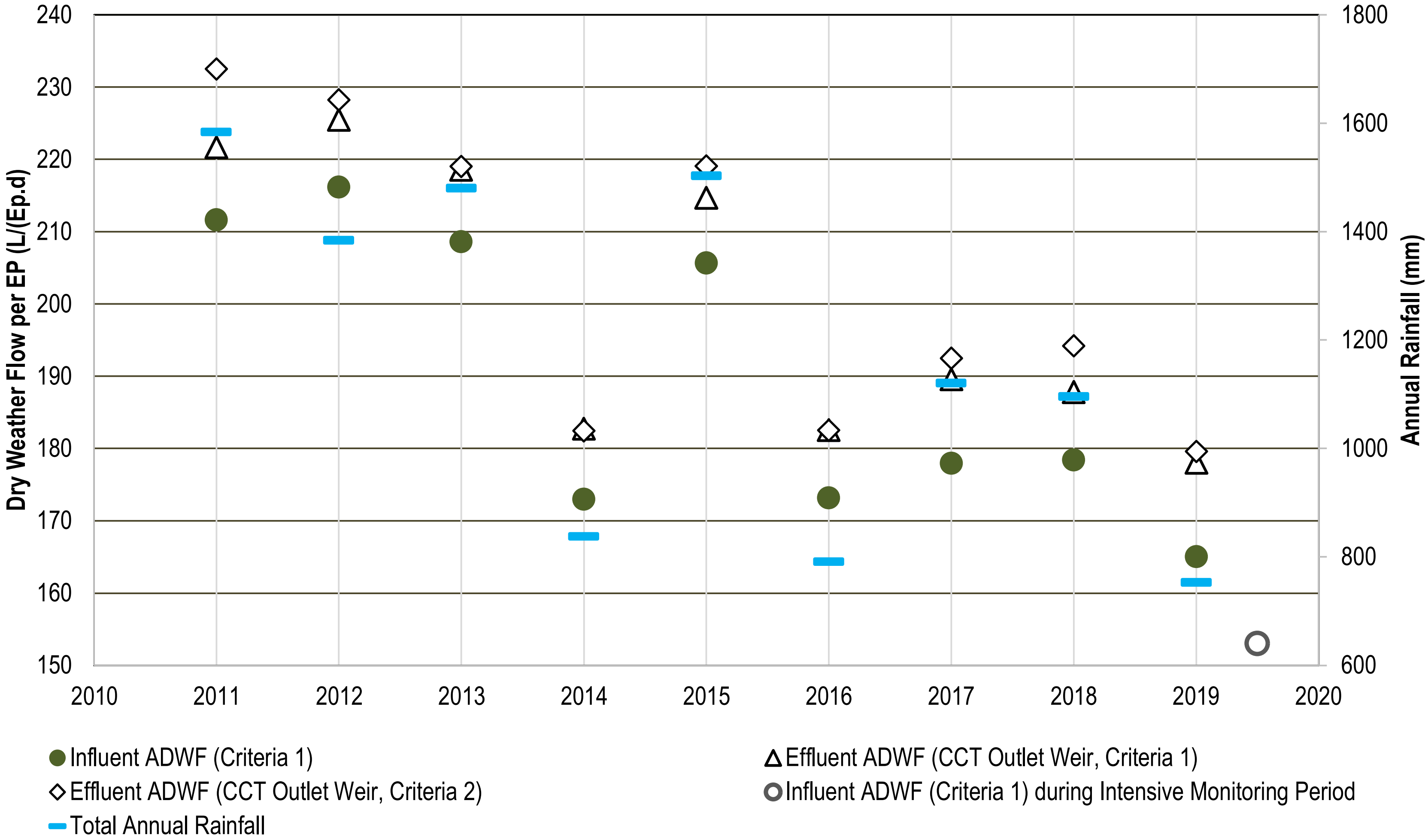

Figure 3-3: Victoria Point – Annual Dry Weather Average Per capita Flow, 2007- 2019

3.2.1 Dry Weather Diurnal Influent Sewage Flows

The typical dry weather diurnal sewage flow pattern was derived from 30-minute SCADA data drawn from the intensive monitoring period (November 27 through December 20, 2019). No filtering of this data for wet weather was required as the plant was operating under a sustained period of dry weather at this time.

Average diurnal flow patterns were derived from this data based on a 30-minute averaging are summarised in Figure 3-4. As the averaging of daily flow patterns serves to attenuate the diurnal profile (reducing the magnitude of the peaks and the troughs), a “typical” diurnal profile was derived from the SCADA data and adopted for analysis of the plant capacity. To this end, the profile from November 30, 2019, showing a diurnal peak of 1.95 x ADWF, was applied to the concept design.

The typical dry weather diurnal peaking factor recorded during the monitoring period was 1.8 x ADWF on weekdays, and 1.9 x ADWF on weekends. This ratio is typical for sewage catchments of this scale.

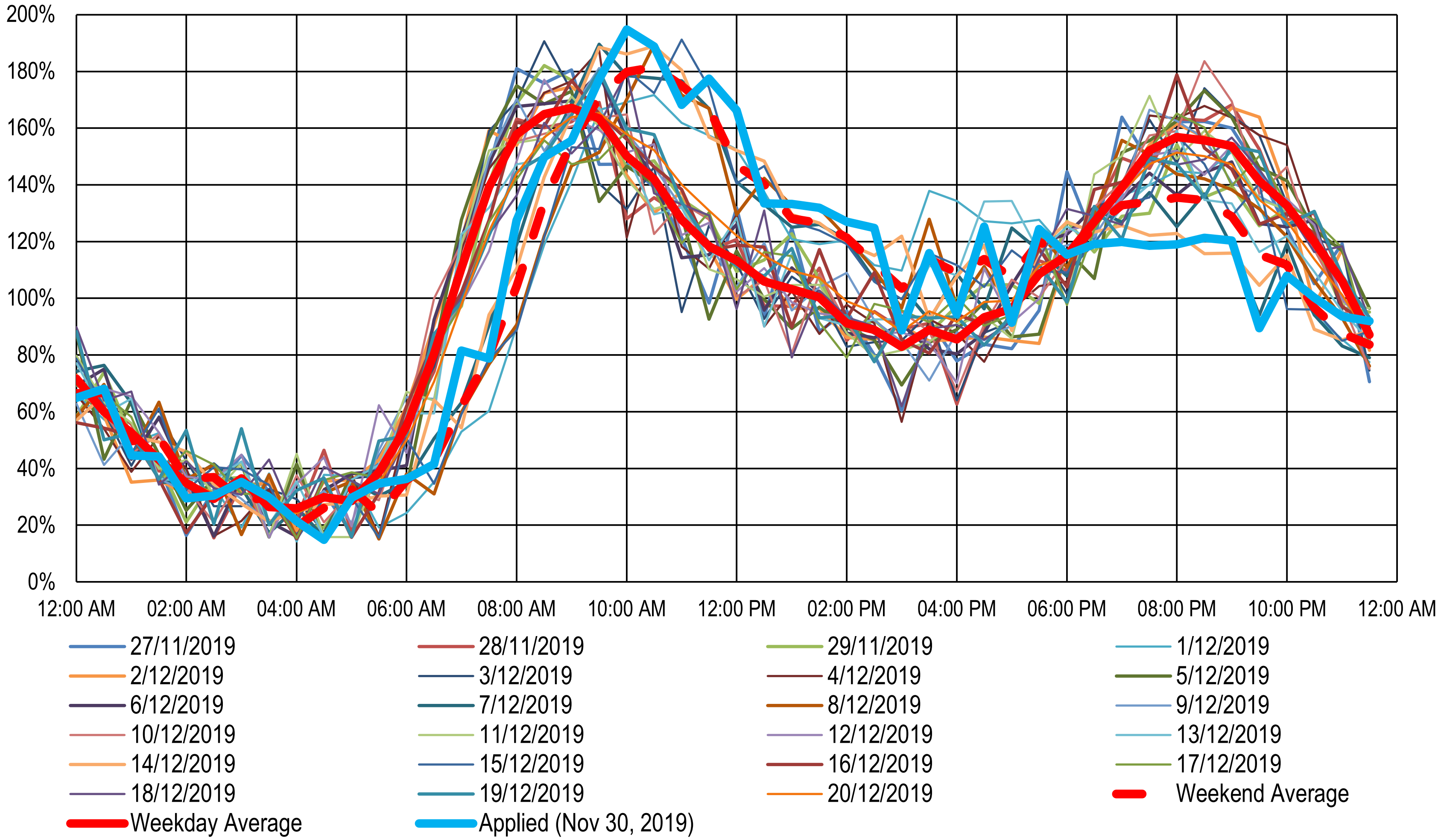

Figure 3-4: Diurnal Influent Flow Pattern – 30 Minute Average Flow, Nov 27-Dec 20, 2019, and Typical Pattern Applied to Planning

3.3 INFLUENT SEWAGE COMPOSITION

3.3.1 Available Influent Sewage Monitoring Data

The ongoing sampling and composition monitoring of Victoria Point STPs influent sewage was limited in recent years. Key limitations in the long-term influent characterisation data available include:

- **Limited valid sampling events for bulk pollutants (COD, BOD_5, TKN, Total Phosphorus, Suspended Solids):** There were a total of just 61 dry weather influent sampling events over the last 10 years – all since 2014. However, this data set is reduced further by inconsistencies and anomalies observed for almost all sampling events prior to October 2015. These issues, likely related to non-representative sampling, appear to have been resolved around this date, resulting in a total of 30 dry weather sampling results over the period from October 2015 through to May 2019. All but one of these 30 influent sampling events occurred in the 2015-2017 years. These results have been used to support estimates of average annual pollutant loads, but were not sufficient for estimation of the extent of variation around the average (e.g. Maximum Monthly Load, Maximum Weekly Load etc.).
- **Limited valid sampling result to support COD fractionation (e.g. sCOD, FFCOD, BOD_5, $sBOD_5$, TSS, VSS):** While there is substantial data to support estimation of the COD fractions for periods well prior to 2014, there was little or no valid data from the last five years. The limited monitoring through to May 2019 included BOD_5 results which were inconsistent with the remainder of the results. Further, there was only one sampling result with a direct measurement of inert suspended solids.

Due to these gaps in the influent sewage composition, intensive monitoring of the plant influent sewage and operational performance was undertaken from the 28th of November to the 18th of December 2019. This program included sampling to support estimation of the bulk pollutant load, COD fractionation, and diurnal pollutant variations. As outlined in the following sections, the intensive monitoring period provided suitable information for derivation of the influent sewage fractions, and calibration of a dynamic model of the plant's secondary treatment process. However, the results from both the long-term sampling and characterisation program are not sufficient to support accurate estimation of maximum monthly loads (relative to average annual loads). As such, the typically observed ratios of maximum monthly loads to average annual loads (MML/AAL) for Municipal STPs of comparable scale have been applied (1.18 for COD, and 1.15 for TKN, TP and ISS).

The influent parameters measured during the intensive monitoring period are summarised in Table 3-2.

Table 3-2: Intensive Monitoring Period (Nov 28-Dec 18, 2019) – Summary of Influent and Effluent Results

Date of Collection	Units	Range	Median	No. of Results
Influent Sewage – 24 Hour Composite Results				
Flow from Log (6am to 6am)	ML/d	4.7 - 5.4	5	21
pH - Field	pH units	7.33 - 8.15	7.56	8
Conductivity - Field	µS/cm	1170 - 1710	1410	8
Total Alkalinity	mg/L as CaCO$_3$	293 - 403	299	8
BOD 5 days @ 20^{o}C	mg/L	220 - 420	280	11
BOD$_5$ Mass Load	kg/d	1104 - 2192	1372	11
Soluble BOD (1.2um)	mg/L	59 - 130	85	11
sBOD/BOD	ratio	0.24 - 0.46	0.29	11
BOD-Uninhibited	mg/L	300 - 400	355	6
cBOD/Total BOD	ratio	0.8 - 1.05	0.95	6
COD	mg/L	610 - 1100	790	13
COD Mass Load	kg/d	3020 - 5126	3863	13
Soluble COD (1.2um)	mg/L	200 - 300	250	13
sCOD/COD	ratio	0.24 - 0.41	0.30	13
Flocculated Soluble COD	mg/L	140 - 180	165	6
F$_{bs}$ (at average effluent sCOD)	ratio	0.144 - 0.176	0.152	5
Total Oil & Grease	mg/L	47 - 100	65.5	4
Suspended Solids	mg/L	300 - 540	360	13
VSS/TSS	ratio	0.88 - 0.97	0.94	13
Inert Suspended Solids	mg/L	10 - 60	20	13
Calcium as Ca	mg/L	36 - 37	36.5	4
Magnesium as Mg	mg/L	17 - 21	17.5	4
Ammonia N	mg/L	49 - 80	51	13
Nitrate N (Calc)	mg/L	0.026 - 0.54	0.052	7
Nitrite+Nitrate as N	mg/L	0.026 - 0.54	0.042	8
Total Kjeldahl Nitrogen as N	mg/L	64 - 84	69	13
Total Nitrogen as N	mg/L	64 - 85	69	13
TN Mass Load	kg/d	308 - 414	334	13
Ammonia/TKN	ratio	0.66 - 0.80	0.74	12
Ortho Phosphorus as P	mg/L	4.2 - 8.1	4.6	13
Total Phosphorus as P	mg/L	6 - 11	8.6	13
TP Mass Load	kg/d	29.2 - 53.6	43.6	13

Table 3-2: Intensive Monitoring Period (Nov 28-Dec 18, 2019) – Summary of Influent and Effluent Results (continued)

Date of Collection	Units	Range	Median	No. of Results
Effluent – 24 Hour Composite Results				
pH - Field	pH unit	6.88 - 7.86	6.91	6
Total Alkalinity	mg/L as $CaCO_3$	114 - 115	115	2
BOD 5 days @ 20°C	mg/L	<5	<5	6
COD as O_2	mg/L	21 - 31	25.5	6
F_{us} (based on Effluent COD)		0.022- 0.040	0.027	6
Soluble COD (1.2um)	mg/L	14 - 28	20.5	6
F_{us} (based on Effluent sCOD)		0.018 - 0.032	0.023	6
Suspended Solids	mg/L	<5	<5	6
VSS	mg/L	<5	<5	6
Ammonia N	mg/L	0.02 - 0.37	0.044	6
Nitrate N (Calc)	mg/L	0.6 - 0.9	0.79	6
Nitrite+Nitrate as N	mg/L	0.61 - 0.9	0.8	6
Total Kjeldahl Nitrogen as N	mg/L	0.72 - 1.4	1.05	6
Total Nitrogen as N	mg/L	1.5 - 2.2	1.7	6
Ortho Phosphorus as P	mg/L	0.81 - 1.7	1.1	6
Total Phosphorus as P	mg/L	0.84 - 1.7	1.2	6

3.3.2 COD Fractionation

The fractions of influent COD which are biodegradable, non-biodegradable, particulate, and soluble are crucial to effective estimation of plant capacity and performance. The fractionation of the COD has been derived from the intensive monitoring period data, and where possible, validated against the available long term information.

3.3.2.1 Readily Biodegradable COD (RBCOD, F_{bs})

The readily biodegradable fraction of the COD determines the extent to which biological phosphorus removal can be achieved with a given influent sewage, and in some configurations has a bearing on the extent of denitrification. The intensive monitoring period data indicated that the readily biodegradable COD was consistently around 15% of the influent COD (range 14.4-17.5%). This gives an F_{bs} 0.15, which is around the midpoint of the typical range for municipal sewage in South East Queensland. As no long-term records of this parameter are available, data from the monitoring period has been applied to the analysis without modification.

3.3.2.2 Unbiodegradable-Soluble COD (F_{us})

The fraction of the influent COD which is unbiodegradable and soluble (F_{us}) has been directly estimated using the influent and effluent data from the monitoring period. The F_{us} was found to be in the range of 0.02 to 0.04, with an average value of 0.03. This value is lower than the 0.05 typically observed in Australian municipal sewage.

3.3.2.3 Unbiodegradable-Particulate COD (F_{up})

Given the importance of the unbiodegradable-particulate COD fraction in determining plant capacity based on solids settling, the unbiodegradable particulate fraction of the COD (F_{up}) has been estimated through calibration of a steady-state process model to the sludge production observed within the existing secondary treatment process. This analysis is summarised in Section 3.3.4.

Due to the significant data gaps in the long-term data to inform this calibration, the F_{up} derived from the intensive monitoring period is considered to be more reliable and representative. To this end, the unbiodegradable-particulate COD fraction (F_{up})

of 0.26 derived from the intensive monitoring period has been applied to the planning. This is marginally higher than the 0.20 to 0.25 typically observed in Australian municipal sewage

3.3.2.4 Slowly Biodegradable COD which is Particulate (F_{xsp})

Influent COD which is neither unbiodegradable (F_{up} or F_{us}) nor readily biodegradable (F_{bs}) is classified as slowly biodegradable. The slowly biodegradable fraction is important in driving denitrification, and also determines the benefits gleaned from pre-fermentation (which converts slowly biodegradable COD to readily biodegradable COD).

The colloidal (F_{xsc}) and particulate (F_{xsp}) slowly biodegradable COD is determined by balancing the COD fractions, and relies on measurement of soluble COD and soluble BOD. Based on the intensive monitoring period result, the F_{xsp} value derived from the data was 0.75, which is in line with the default value applied in the model.

3.3.3 Suspended Solids Load

The mass of inert suspended solids can vary substantially between catchments, and its accurate determination is vital to an accurate solids production estimate. Results for this parameter are limited in the historical influent monitoring results for the plant. However, even where influent monitoring results for inert suspended solids are available, accurate measurement often proves challenging due to:

1. Difficulties in obtaining a representative concentration of solids within sewage samples – particularly given the settling of solids in the inlet works and sewage mains in between pumping events and as a function of flow velocity.
2. The relatively low mass of inert suspended solids which are typically filtered from influent sewage in comparison to error imposed by the testing methodology (e.g. residual moisture or ash associated with filter papers). The typical reported uncertainty in measurements of total suspended solids (~5%) and volatile suspended solids (~15%) stems from these challenges.

To assist in generating the most accurate estimate of this parameter possible, the volatile and total suspended solids measured in the bioreactor have been used to calibrate the sludge production within the secondary treatment process, then compared with figures contained in the plant log.

The steady-state analysis is summarised in Section 3.3.4, and identified average inert suspended solids concentrations consistently in the range 32-35 mg/L through the periods of study. This is in the typical range for Australian municipal sewage.

3.3.4 Secondary Treatment Steady-State Model Calibration to Support Influent Characterisation

A steady-state process model for has been calibrated to 2018 and 2019 operating data for sludge production and composition, and separately for the intensive monitoring period of November-December 2019. The specific function of the calibration was to estimate the key sludge production parameters which cannot be adequately estimated from direct measurement of the influent sewage stream (e.g. Unbiodegradable-Particulate COD Fraction (F_{up}), and Inert Suspended Solids (ISS)).

The steady-state model calibration analysed operations for each quarter of 2018 and the calibration period, by drawing on:

- The extensive operations data in terms of sewage flow, waste sludge flow, mixed liquor solids concentration, alum dose rate, and effluent phosphorus concentrations.
- Biosolids haulage records (as an independent measure of sludge production and solids capture). Due to intrinsic uncertainties in biosolids haulage records (particularly due to variations in dry solids content of the dewatered biosolids cake), the application of these records have been limited to their use as a general check.
- Two filtrate sampling results from 2018 (Jan and Dec),which indicated solids capture of 87% in dewatering. This figure was applied to calculation of true sludge age from the model. This result was broadly in line with analysis of the biosolids haulage records over a 12 month timestep, and indicated a dewatering solids capture rate in the order of 90%. Note that the dewatering filtrate sampling data from the intensive monitoring period was highly variable,

with suspended solids results ranging between 12 and 1600 mg/L. This variability rendered the filtrate data largely unusable in the estimation of dewatering solids capture.

- Eight sampling results for mixed liquor VSS/TSS ratio from 2013-2019. These results, while few in number, indicated a VSS/TSS ratio consistently in the range of 79-80%.
- Three mixed VSS/TSS results measured in the intensive monitoring period, which ranged from 83.8 - 85.3% (average 84.5%).

Using this processed data, unbiodegradable-particulate COD and inert suspended solids in the influent were then estimated for each year of the analysis periods using the following methodology:

- Step 1: Estimate the mass of sludge in the secondary treatment process using the plant log data.
- Step 2: Estimate the sludge age by dividing the sludge inventory by the mass wasted each day.
- Step 3: Develop a steady state model of the process using the influent sewage load (COD, TKN, TP, F_{bs}, F_{us} etc.), the average sludge age (estimated in Step 2), and the average temperature for the relevant period.
- Step 4: Calibrate the model to balance the total sludge production and mixed liquor VSS/TSS ratio through adjustment of the unbiodegradable-particulate COD fraction (F_{up}) and inert suspended solids (ISS).

The results of this analysis are summarised in Table 3-3, and show an excellent fit to the available monitoring and operating data. Overall, while the intensive monitoring period was relatively short (and therefore may have indicated to shorter-term variations influent quality), the results from this period were more comprehensive and internally consistent. As a result, the results of the intensive monitoring period are considered to be more reliable and have been given greater weighting in the influent characterisation adopted for planning.

Table 3-3: Victoria Point STP – Steady-State Model Solids Production Calibration to 2018 and 2019 Operating Data

Parameter	Units	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Nov-Dec 2019 (intensive)
Input Operational Parameters (Measured or estimated from data)						
Influent ADWF	ML/d (L/EP/d)	5.80 (183)	6.10 (193)	5.7 (180)	5.95 (188)	4.91 (153)
Influent COD	g/EP/d	122.4	122.4	122.4	122.4	122.6
Mixed Liquor Temp	˚C	25.9	22.3	20.5	24.4	26.0
True SRT (87% solids capture)	days	20.2	19.7	18.8	20.0	
Effluent PO_4-P	mgP/L	0.45	0.40	0.31	0.40	1.22
Alum Dose	mg/L as alum powder	31	31	31	31	0
VSS/TSS in Mixed Liquor (calibration target)	%	79.5%				84.5%
VSS/TSS in Mixed Liquor (model output)	%	79.5%	79.3%	79.3%	79.5%	84.1%
Calibration Error – VSS/TSS	**% Error**	**0.0%**	**0.3%**	**0.3%**	**0.0%**	**0.5%**
MLSS (calibration target)	mg/L	3219	3255	3544	3556	3433
MLSS (model output)	mg/L	3222	3260	3211	3336	3377
Calibration Error – MLSS	**% Error**	**-0.1%**	**-0.2%**	**9.4%**	**6.2%**	**1.6%**
Average Haulage	*t/d*	*11.9*	*11.7*	*12.3*	*12.2*	*11.9*
Average Dryness (%)	*%*	*14.7*	*14.7*	*14.3*	*14.1*	*13.7*
Haulage Sludge Production (target)	*kg/d*	*1747*	*1719*	*1758*	*1728*	*1624*
Sludge Production (model output)	*kg/d*	*1515*	*1572*	*1622*	*1585*	*1483*
Calibration Error – Sludge Haulage	***% Error***	***13.3%***	***8.6%***	***7.7%***	***8.3%***	***8.7%***
Calibration Outputs						
Fup	**ratio**	**0.240**	**0.244**	**0.25**	**0.25**	**0.26**
Inert Suspended Solids	**mg/L**	**32**	**32**	**36**	**36**	**35**

3.3.5 Nutrient Loads

3.3.5.1 Total Nitrogen

The loads of influent nitrogen are generally on the lower end of those normally observed for Australian municipal sewage. An average value was selected based of 10.8 g/EP/d was adopted based on the intensive monitoring period result. This is 3% below the average estimated from the long term data. In the absence of long term nitrogen load data, the maximum monthly nitrogen load has been applied as 15% higher than the average annual result.

3.3.5.2 Total Phosphorus

The average Phosphorus load on the plant is slightly lower than value expected for typical Australian Municipal Sewage, at 1.4 g/EP/d. This result is consistent with the general reduction in influent total phosphorus observed across Australia over the last 8-10 years. Similarly to the nitrogen loads, due to the absence of long term phosphorus load data, the maximum monthly phosphorus load has been applied as 15% higher than the average annual result.

3.3.6 Diurnal Variations in Influent Sewage Composition

The Intensive Monitoring Period included three days of monitoring of diurnal variations in influent and effluent composition. The monitoring was based on 2-hourly composite samples, tested for the major pollutants such COD, suspended solids, nitrogen and phosphorus. The influent monitoring results are summarised in Figure 3-5 and Figure 3-6 overleaf. Note that these plots have been simplified to represent a continuous 12am to 12pm profile, but are based on stitching the 12am-8am results from the second day of each monitoring event to the 8am-12pm results from the first day of each monitoring event.

- Substantial variations in influent suspended solids within the diurnal pattern – particularly for the December 18-19 monitoring. This may be the result substantial settling of solids in the network upstream of the plant during periods of lower or average flow, and resuspension of the solids with the onset of the morning and evening peak flow periods.
- Relatively large diurnal variations in the influent concentrations of COD and Total Phosphorus, with the peak in concentration coinciding with the peak flow period. The peak in concentrations is higher than often observed in municipal sewage catchments, and may be due in part to the peak in suspended solids.
- The peak in influent nitrogen concentration commencing a little prior to the peaks in COD and TSS. This is frequently observed in municipal sewage catchments (due to a greater proportion of the influent nitrogen being soluble rather than particulate), and can have implications for denitrification performance in secondary treatment processes.

The average of the diurnal profiles from each of the three days of monitoring (as shown in Figure 3-6) were applied to the calibration and planning.

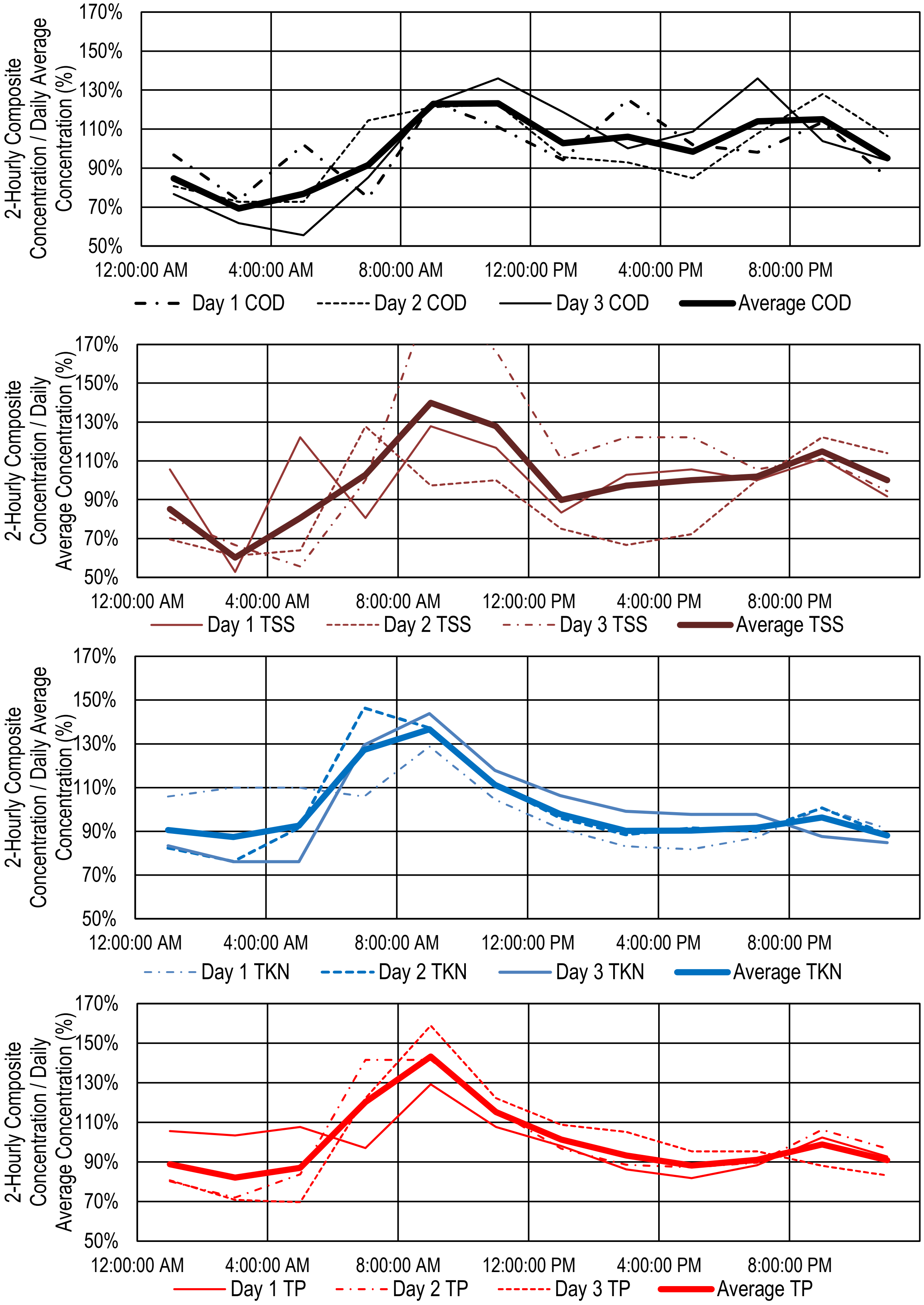

Figure 3-5: Diurnal Influent Pollutant Concentration Profiles (Nov 29-30, Dec 2-3, Dec 18-19, 2019)

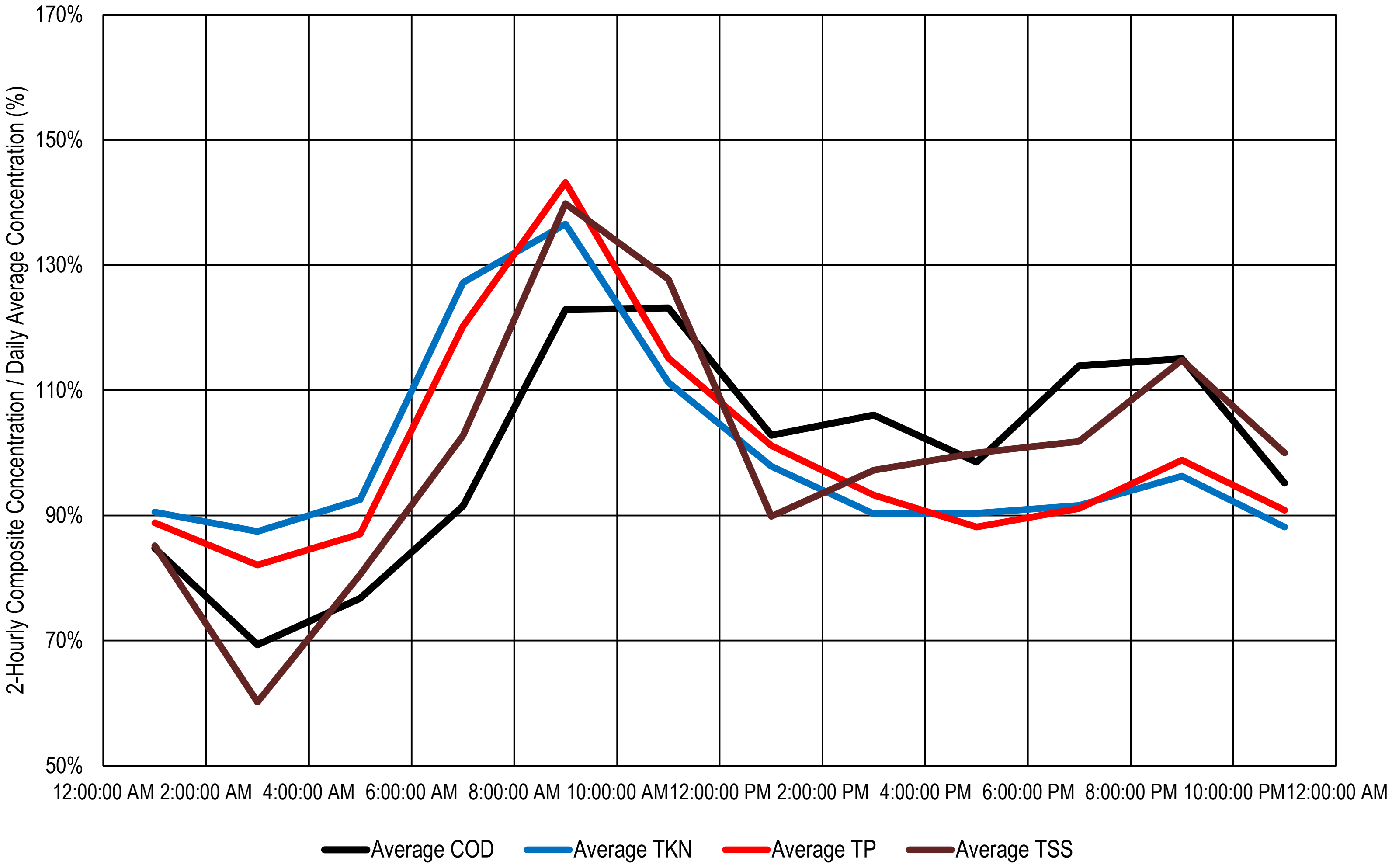

Figure 3-6: Average Diurnal Influent Pollutant Concentration Profiles (Nov 29-30, Dec 2-3, Dec 18-19, 2019)

3.4 INFLUENT LOADS ADOPTED FOR CAPACITY ASSESSMENT

The influent characteristics adopted for planning, as derived as described in the previous sections, are summarised in Table 3-4. As outlined in the preceding sections, a number of key assumptions have been applied to the generation of these estimates.

Table 3-4: Influent Per Capita Flows and Loads

Parameter	Original Design (2001-2002)	Strategic Planning Review (2009) ("Future Case Conservative")	Applied as Phase 1 Basis of Planning (from Long-Term Data)	November-December 2019 Intensive Monitoring Period	Applied
Flows and Loads					
Average Dry Weather Flow	220 L/EP/d	190 L/EP/d increasing to 230 L/EP/d by 2025	220 L/EP/d	153 L/EP/d	**220 L/EP/d (153 L/EP/d also considered)**
Peak Wet Weather Flow to Secondary Treatment Process	5 x ADWF		5 x ADWF		**5 x ADWF (1100 L/EP/d)**
COD	115 g/EP/d (MML 138 g/EP/d)	126.5 g/EP/d	122.4 g/EP/d at AAL (Ave Oct 2015- 2018)	122.6 g/EP/d	**122.6 g/EP/d at AAL 144.7 g/EP/d at MML**
Total N	11 g/EP/d	15 g/EP/d	11.1 g/EP/d at AAL (Ave Oct 2015- 2018)	10.8 g/EP/d	**10.8 g/EP/d at AAL 12.4 g/EP/d at MML**
Total P	2.5 g/EP/d	3.2 g/EP/d	1.7 g/EP/d at AAL (Ave Oct 2015- 2018)	1.4 g/EP/d	**1.4 g/EP/d at AAL 1.54 g/EP/d at MML**
Inert Suspended Solids	Back-calc from sludge production: 26 mg/L at AAL 30 mg/L at MML		36 mg/L at AAL (calibration) 41.4 mg/L at MML	35 mg/L	**35 mg/L at AAL 40 mg/L at MML**
COD Fractions					
Unbiodegradable Particulate (Fup)	Back-calc from sludge production: 0.21		0.25	0.26	**0.26**
Readily Biodegradable (F_{bs})	0.15		0.15	0.157	**0.157**
Unbiodegradable Soluble (F_{us})	Not stated		0.05	0.03	**0.03**

3.5 SLUDGE AGE, SLUDGE SETTLEABILITY AND CLARIFIER DESIGN PARAMETERS

The settleability of the mixed liquor generated within the secondary treatment process is critical to establishing the plant's existing capacity and upgrade requirements. The settleability of the plant sludge, measured as Dilute Sludge Volume Index (DSVI), has been routinely monitored during operations. Under the DSVI test methodology, the settling cylinder needs to have a sludge volume of 150-250 mL/L at the end of 30 minutes. As shown in Figure 3-7, many of the monitoring results exceeded this range – especially prior to 2013. Fortunately, there remain an average of more than 150 valid DSVI test results for the last 5 years, providing ample data for analysis.

The settleability is plotted with mixed liquor suspended solids and sludge age in Figure 3-7 and Figure 3-8 respectively. Within this data, it is worth noting that settleability is a complex function and not strongly correlated to recorded parameters. For example:

- The data suggests that higher mixed liquor concentrations tend to correlate a more favorable (lower) DSVI. However, the correlation appears to be minor, and may be an artefact of the test methodology rather than process conditions.
- There are anecdotal reports that alum dosing improves settleability. The results for Victoria Point STP are somewhat consistent with this observation. In 2013-14, the plant operated without alum dosing, and achieved an average settleability of 212 mL/g DSVI. From 2015 to early 2019, an alum dose of approximately 40 mg/L was applied, and a lower average DSVI of 182 mL/g achieved. However, as the average DSVI in 2018 was 217 mL/g with an alum dose of 43 mg/L, this improvement was not consistent enough to make a substantial material impact on the "unfavorable" settleability which should be adopted for planning.
- There does not appear to be any strong correlation between sludge age and settleability. The gradual decline in the plant's sludge age over the last 12 years of operation does not appear to have a marked impact on the settleability (or the range of settleabilities) observed.

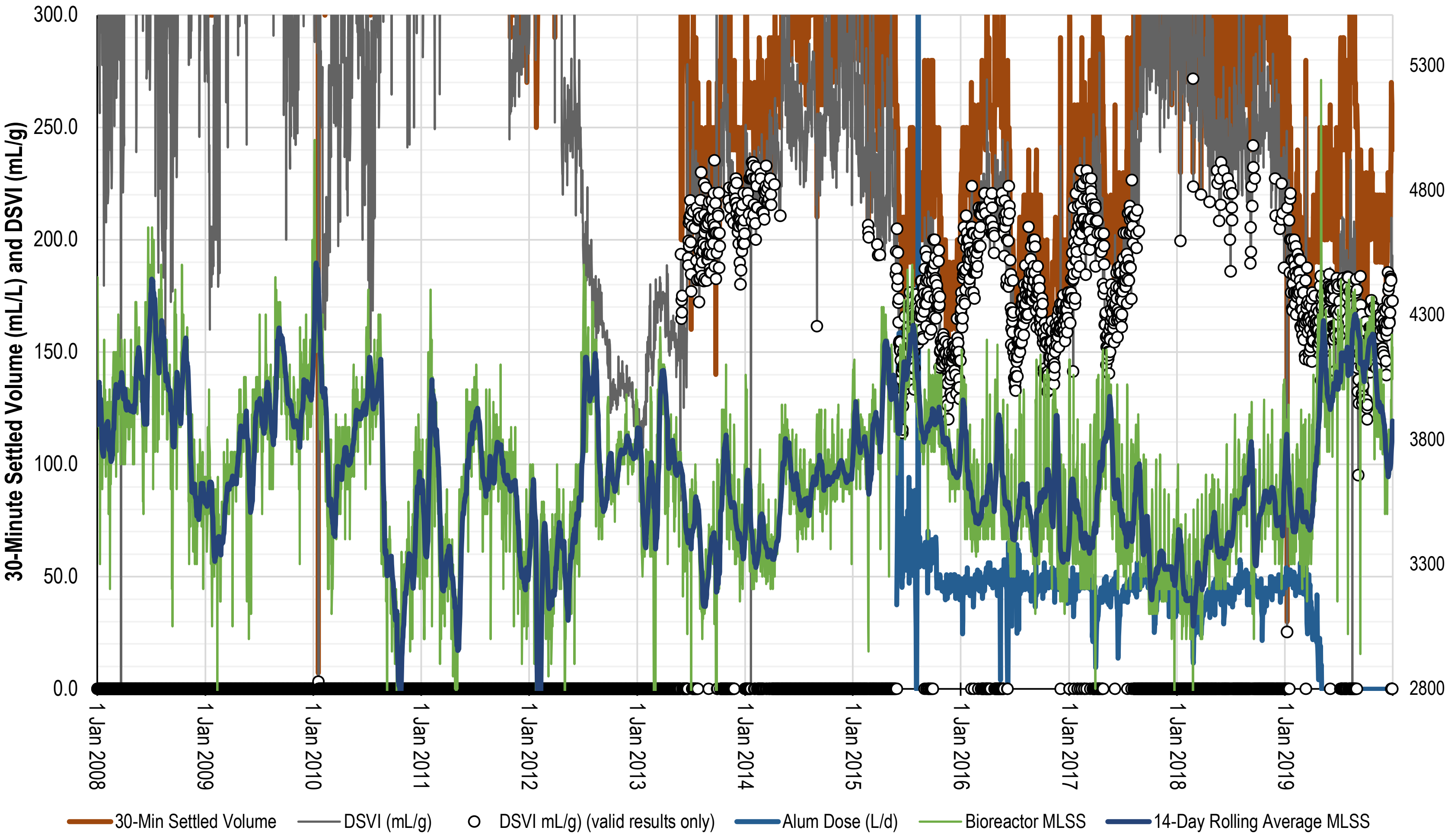

Figure 3-7: Victoria Point STP – Settleability, Alum Dose and Mixed Liquor Suspended Solids

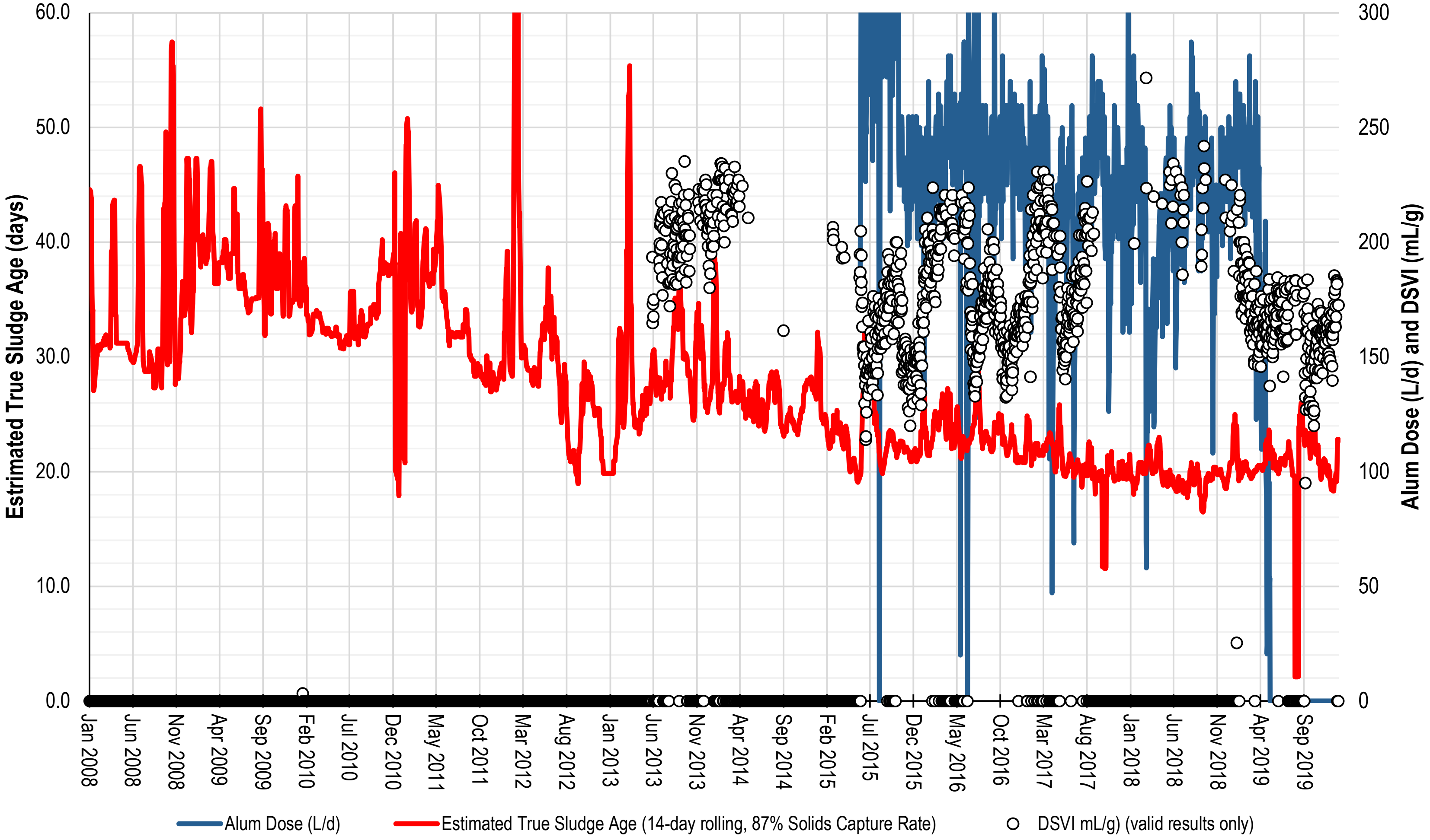

Figure 3-8: Victoria Point STP – Settleability, Alum Dose and Sludge Age

Table 3-5 summarises sludge age and settleability applied to the 2003 upgrade design, 2009 Strategic Planning Review, and adopted for upgrade planning.

Table 3-5: Clarifier Design Parameters for Previous Upgrades and Applied for Phase 1 Upgrade Planning

Parameter	Original Design (2001-2002)	Strategic Planning Review (2009) ("Future Case Conservative")	Applied as BoP Estimated from Monitoring, Solids Calibration and IDM (2018)
Sludge Age	25 days	25 days	15 days (see Section 3.8)
Mixed Liquor Solids	90th%ile MLSS = 1.2 x AAL (applied to design)	90th%ile MLSS = 1.2 x AAL (applied to design)	Maximum Monthly MLSS = 1.17 x AAL Based on: • MML/AAL peaking factors (1.18 for COD, 1.15 for solids and nutrients) • 20˚C Minimum Temperature
Settleability	185 mL/g DSVI (90th %ile) Vo: 5.81 m/h n: 0.34 m^3/kg FST Design Factor = 1.0		205 mL/g DSVI (80th %ile 2013-June 2019) Vo: 5.47 m/h n: 0.492 m^3/kg FST Design Factor = 0.8

The key clarifier design parameters differ markedly between the 2003 upgrade design and the values adopted for the upgrade planning. Key differences are as follows:

Sludge Age: The reduction in sludge age from 25 days to 15 days effectively increases clarifier capacity (by reducing mixed liquor solids concentration). The capability of the plant to achieve the effluent quality requirements at the reduced sludge age of 15 days has been verified by process modelling (see Section 5). Further, operating experience from other oxidation ditches in South East Queensland, and operation of Victoria Point STP at a true sludge age of less than 20 days over recent years, indicates that the lower sludge age represents a sound basis of planning.

Peak Mixed Liquor Solids: The peaking factor of 1.2 applied to the 2003 upgrade design is comparable to the peaking factor derived through application of the adopted maximum monthly sewage loads and the impact of minimum operating temperature (1.17).

Settleability: The settleability adopted for the upgrade planning is substantially inferior than that applied to the 2003 Upgrade Design in three key respects:

1. The settleability (as DSVI) measured on site is consistently inferior to that applied to the 2003 design. The 80th percentile DSVI has been applied to the upgrade planning as adoption of the 90th percentile is considered excessively conservative (given the other design factors applied).
2. Clarifier designs undertaken using the Vesilind Flux model rely on published correlations between settleability (e.g. DSVI) and the model parameters V_o and n. The n-value applied to the 2003 upgrade design (0.34) is much more favourable than that derived from the IAWQ correlation (0.47, (Ekama, et al., 1997)), and suggests a settling rate of approximately 1.21 m/h (compared to 0.66 m/h for the IAWQ correlation at the design maximum monthly mixed liquor concentration). In spite of this figure, the clarifiers appear to have been sized based on a settling rate of 0.90 m/h in the 2003 upgrade design. This is equivalent to a DSVI of 142 mL/g under the IAWQ correlation and the maximum solids concentration – a very favourable settleability compared to the measured 80th percentile of 205 mL/g DSVI.
3. It has become part of sound clarifier design practice to de-rate the peak flux and surface overflow rate for design by a factor of 0.8 to account for the typical non-idealities found when comparing the outputs of the Vesilind Flux theory with the results of stress tests on full scale clarifiers (Ekama, et al., 1997). This approach has been adopted for the upgrade planning.

Sludge Storage in Clarifiers: The upgrade planning has included provision for the storage of sludge in the clarifiers. Sludge storage in the clarifiers serves to increase the clarification capacity by reducing the mixed liquor solids concentration in the clarifier feed. The depth of sludge applied to the analyses comprised:

For Calibration: Up to a depth of 0.82m up the side wall - based on the measured sludge level in the existing plant, and,

For upgrade planning: Up to 0.3m (upgraded plant) up the side wall.

The TSS concentration in the clarifier blanket was assumed to the same as the concentration in the mixed liquor. It does not appear that any provision for clarifier sludge storage was included in the 2003 upgrade design.

Overall, the clarifier design parameters applied to the planning result in:

- A comparable maximum surface overflow rate of approximately 0.86-0.93 m/h for the current plant (cf. 0.9 m/h under 2003 design).
- A lower maximum surface overflow rate with addition of a further clarifier or additional reactor volume (primarily due to higher mixed liquor solids concentrations at higher loads).

3.6 ENVIRONMENTAL LICENCE LIMITS FOR DISCHARGE AND EXISTING PLANT EFFLUENT QUALITY

3.6.1 Effluent Quality Criteria

The effluent quality criteria required under the current Victoria Point STP Environmental Authority (EPPR00874613) are summarised in Table 3-6.

Table 3-6: Surface Water Release Limits from Victoria Point STP to Eprapah Creek (Release Point W1)

Parameter	Min	Long Term 50th %ile	Short Term 50th %ile	Long Term 80th %ile	Short Term 80th %ile	Max
Design ADWF (ML/d)						8.5 (98.4 L/s)
Max Inflow (ML/d)						42.5 (491 L/s)
BOD_5(mg/L)				10 mg/L	15 mg/L	30 mg/L
Suspended Solids (mg/L)				10 mg/L	15 mg/L	30 mg/L
pH	6.5					8.5
Dissolved Oxygen (mg/L)	2					
Total N (mgN/L) Note 1		3 (2 @ St 2)	5 (3@ St 2)			9 (6@ St 2)
	Mass Load must not exceed 13.5 kgN /d					
Total P(mgP/L)Note 1		5 (4@ St 2)	10 (6@ St 2)			15 (12@ St 2)
Free Cl (mg/L)						0.7
Faecal Coliforms	150 cfu/100ml (median of 5 samples), 600 cfu/100ml (4 out of 5 samples)					

Note 1: The existing Environmental Authority states "*Second stage Nitrogen limits shall come into effect when the long term 50th percentile Nitrogen load from the plant reaches 13.5 kgN/d. The long term 50th percentile total effluent Nitrogen load from the plant must not exceed 13.5 kgN/d. Second stage Phosphorus limits are based on blend of 6.9 mgP/L from the existing plant and 2 mgP/L from the new plant*". However, the plant is required to achieve better than the Stage 2 concentration limits to comply with the 13.5 kgN/d mass load limit (see Figure 3-10).

The 13.5 kgN/d limit for total nitrogen has been the subject of substantial consultation with the regulator, stretching back to 2002. The limit was derived as an estimate of the prevailing mass load of nitrogen discharged to the Eprapah Creek by the plant prior to the 2003 upgrade. Under analysis undertaken by GHD at the time of the upgrade (de Haas, 2003), it is understood that the mass load of 13.5 kg/d was estimated based on grab samples of effluent collected at approximately 8am each day. As the effluent total nitrogen concentration was much lower at 8am than at other times of day, the actual nitrogen mass load during this period was likely to be substantially higher, and was estimated to be 21.3 kgN/d. This figure was not reflected in the plant's Environmental Authority at the time. Subsequent efforts to have DES modify the limit to 21.3 kg/d (including in 2003, 2010, and 2017) have not been successful.

As background to future development of the plant, and discussions with DES, the assimilative capacity of Eprapah Creek is currently being modelled. To this end, specific areas of investigation within this project include:

- Ability to tolerate total nitrogen loads (for example, loads exceeding 13.5 kgN/day);
- Potential benefits (in terms of acceptable nitrogen loads) of relocation of the STP's discharge location closer to the mouth of Eprapah Creek;
- Potential benefits (in terms of acceptable nitrogen loads) of confining the STP's effluent discharge to ebb tide, and,
- The scope to deliver reduced nitrogen loads to Eprapah Creek through nutrient reductions from other sources (offsets).

Preliminary advice from the specialists undertaking the modelling suggests that nitrogen discharges will remain the key pollutant of concern for Eprapah Creek in the future. By contrast, the STP dry weather flow, and phosphorus loads are not expected to be the critical parameters impacting the creek's health.

The environmental modelling is scheduled for completion in July 2020. Pending completion of this analysis, the upgrade planning has assumed that the concentration and mass load limits within the current licence will be retained into the future – including the critical limit for the existing mass load limit of 13.5 kgN/day of total nitrogen.

The upgrade planning has been based on:

1. Maintaining effluent total nitrogen mass loads at less than 13.5 kgN/day under average annual loading conditions with temperature at or above the annual average of 23.9°C. Application of this criteria means the Stage 2 long-term median total nitrogen limit of 2 mg/L will be met.
2. Meeting the Stage 2 short term median total nitrogen concentration limit of 3 mg/L at the critical loading conditions of maximum monthly sewage loads and a minimum operating temperature of 19.5°C. While the wording of the existing Environmental Licence is ambiguous in relation to the transition from Stage 1 to Stage 2 limits, the Stage 2 nutrient limits have been applied as they appear to be most consistent with the planning applied to the original 2003 plant design. Additionally, within this second criteria, the predicted level of exceedance of the maximum TN mass load limit of 13.5 kg/d under these "worst case" operating conditions must be minor to be consistent with the need for median concentration limits to accommodate short-term process disruptions due to equipment outages or other issues.

3.6.2 Historical Effluent Total Nitrogen

The long term median effluent total nitrogen of the plant has been analysed on an annual basis for 2014 through 2018, and for the period of January through May of 2019. The results, as shown in Table 3-7, show a range of concentrations between 1.40 mg/L and 1.90 mg/L. The data also suggests no significant correlation between effluent TN concentration and annual rainfall.

Table 3-7: Victoria Point STP – Long Term (Annual) Median Effluent Total Nitrogen and Annual Rainfall

Year	Annual Rainfall (mm)	Annual Median Effluent Total Nitrogen (mg/L)
2011	1584	
2012	1384	
2013	1480	
2014	838	1.40
2015	1503	1.60
2016	791	1.90
2017	1121	1.40
2018	1096	1.40
2019 (January to May)	456	1.90

Note: Time weighted composite effluent samples.

The mass load limit of 13.5 kgN/d effectively reduces the acceptable long-term median effluent total nitrogen concentration which can be discharged from the plant. As the mass of effluent nitrogen is also a function of flow, the prevailing annual per capita flow (which in turn is strongly influenced by annual rainfall) is also critical.

As shown in Figure 3-9, the compliance of the plant with the total nitrogen mass load limit has been robust over the last 5½ years. This has been the result of:

- Low annual rainfall (and Dry weather per capita flows of less than 220 L/EP/d) for all years except 2015.
- Long term median effluent total nitrogen of substantially less than 1.90 mg/L in 2014 (1.40 mg/L), 2015 (1.60 mg/L), 2017 (1.40 mg/L) and 2018 (1.40 mg/L).
- Some effluent reuse at the Redland Bay Golf Club (2.4-5.3% of average flow)

3.6.3 Effective Total Nitrogen Limit

Figure 3-10 shows the maximum effluent total nitrogen concentration based on the projected connected populations and per capita flows. This analysis effectively assumes that wet weather flow results are excluded from the data set under the wet weather criteria applied in the Cleveland STP licence (see Criteria 2 under Section 3.2). The chart additionally shows the required nitrogen concentrations at the average per capital flow under Criteria 1 for the last four years (191 L/EP/d), which represents an upper bound which would be acceptable in years of lower rainfall. Alternative calculation methodologies which directly consider wet weather flows would require lower effluent total nitrogen to be achieved.

The horizontal blue line on Figure 3-10 the shows the upper end of the range of annual median effluent total nitrogen limits achieved in the last 5½ years of operation (1.90 mg/L). As shown on Figure 3-10, the existing plant would be at risk of exceeding its mass load limit for total nitrogen where:

- The long-term median effluent total nitrogen concentration is at the upper end of the range achieved by the plant over the last 5 years;
- The per capita flow is at 220 L/EP/d or more. Analysis of flows over the last 6½ years suggests that the current catchment is likely to deliver per capital flows at or above this value in years where the total rainfall is approximately 1500mm. Long term rainfall records for Redland Bay (41 years) and Mt Cotton (86 years) indicate that annual rainfall is at or above this level for one out of every three years, **AND,**
- Effluent reuse is negligible or not substantially increased from that achieved in recent operations. The Redland Bay Golf Club reuse flows have historically ranged between 2.4% and 5.3% of the average effluent flows over the last 5 ½ years, with the lowest usage of recycled water coinciding with wet years.

However, subsequent analysis (Section 5.2.2) indicates that the high effluent total nitrogen occurs only at low per capita flows, the risk of exceedance of the nitrogen mass load limit is relatively low through to 2041 without developments, or from2025 with the South West Victoria Point and Weinam Creek developments underway.

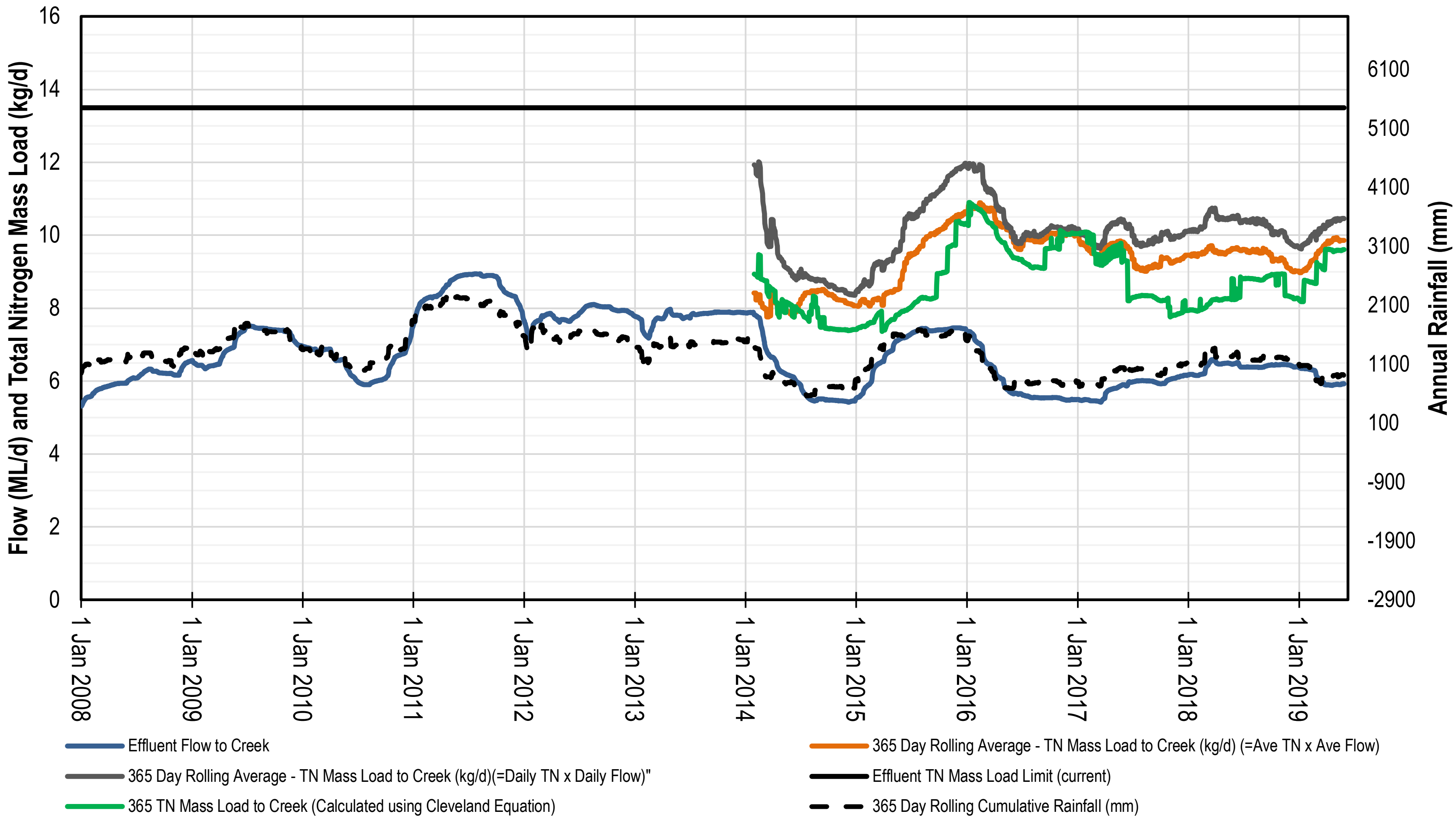

Figure 3-9: Victoria Point STP – Historical Performance Against Total Nitrogen Mass Load Limit

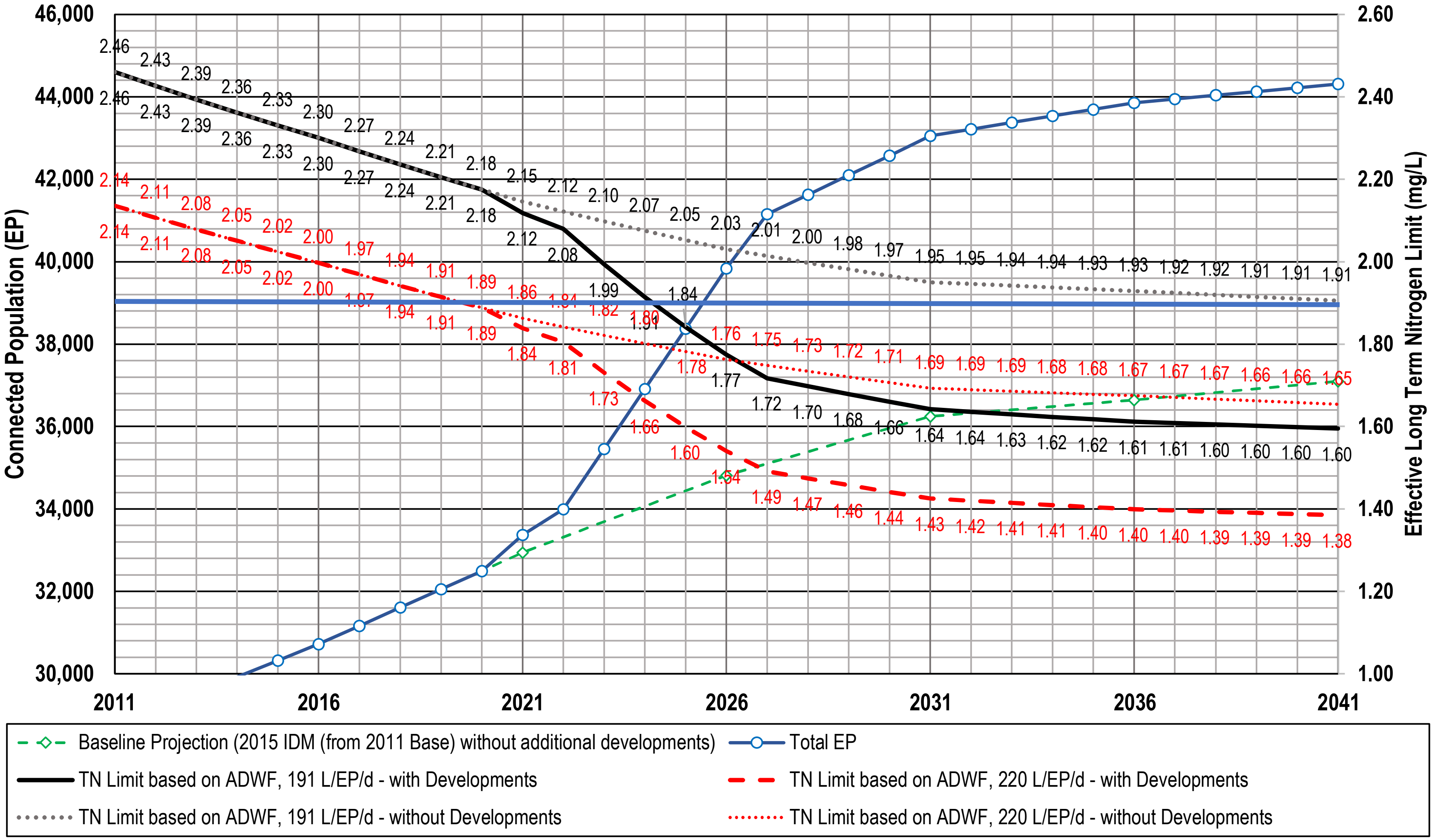

Figure 3-10: Victoria Point STP – Projected Maximum Effluent Total Nitrogen Concentration required for Mass Load Limit Compliance

3.6.4 Effluent Nitrogen Components and Refractory Dissolved Organic Nitrogen

Refractory Dissolved Organic Nitrogen (known as rDON, F_{nus} or TKN_{us}) passes directly through conventional biological treatment processes without modification, and is also generated in activated sludge. As rDON emerges in the plant effluent, its concentration has a direct bearing on the maximum inorganic nitrogen which can be permitted in the plant effluent without exceeding the licence limits. This is critical for establishing the ability of the plant to achieve lower effluent total nitrogen concentrations using conventional biological processes in the future.

The rDON in the effluent, as estimated from the effluent TKN, ammonia and suspended solids results, is listed in Table 3-8. Based on this analysis, a maximum median rDON of just under 0.7 mg/L was applied to the Phase 1 upgrade planning. This value is at the lower end of the long-term median values typically observed in South East Queensland.

However, the average rDON estimated from 24-hour effluent composite samples during the intensive monitoring period was substantially higher at 0.91 mg/L (range 0.68-1.04). While it is important to note that the low per capita flows (153 L/EP/d) during the intensive monitoring period may have contributed to the higher rDON recorded during this period, the potential impacts of a higher rDON concentration of 0.91 mg/L has been considered in the upgrade planning.

Table 3-8: Victoria Point STP – Long Term (Annual) Median Effluent Nitrogen by Species

Period	Ammonia (as N) (mg/L)	Oxidised N (mg/L)	Total Nitrogen (mg/L)	Estimated rDON (assuming nil solids)
2014	0.032	0.78	1.4	0.63
2015	0.02	1.10	1.60	0.54
2016	0.018	1.2	1.9	0.7
2017	0.013	0.76	1.4	0.68
2018	0.021	0.71	1.4	0.68
2019 (to May)	0.018	1.1	1.9	0.69
2014-May 2019	**0.02**	**0.85**	**1.50**	**0.67**
Intensive Monitoring Period	0.097	**0.77**	**1.78**	**0.91**

Note: Flow weighted composite effluent samples.

Importantly, the oxidised nitrogen concentrations shown in Table 3-8 indicate that the effluent ammonia concentrations are very low on average, but that there is substantial scope to reduce the effluent Total Nitrogen achieved by enhancing denitrification in the secondary treatment process.

3.6.5 Ammonia Removal through Breakpoint Chlorination

The presence of chlorine in a substantial excess to ammonia (Cl:N ratio of ~9 to 1), which may be occurring for substantial periods of time in the chlorine contact tanks of Victoria point, can result in further ammonia oxidation through 'breakpoint chlorination". In an effort to understand the likely extent of ammonia removal via this mechanism in the existing plant operations, grab samples of filtered effluent were collected during the intensive monitoring period, and compared to the final effluent (post chlorination). The results of this analysis are summarised in Table 3-9. While the sampling results are not conclusive, they suggest that breakpoint chlorination may be having a minor impact on the effluent ammonia concentrations.

Table 3-9: Filtered and Final Effluent Ammonia Sampling Results – Nov-Dec 2019.

Ammonia Nitrogen Result	Units	Nov 29 ~9am	Dec 4 8:35am	Dec 9 ~9am	Dec 11 9:05am	Dec 13 9:00am	Dec 16 9:00am
Filtered Effluent Grab	mg/L	0.038	0.027	0.150	0.026	0.034	0.41
Final Effluent 24h Composite	mg/L	0.034	0.054	0.076	0.020	0.027	0.037
Final Effluent 2h Composite	mg/L	0.027	0.25 (8-10am, Dec 2.)		0.067 (8-10am, Dec 18)		

3.6.6 Maximum Effluent Flow

The existing Environmental Licence for Victoria Point STP states that *"Inflows must not exceed the peak design capacity of 5 times the Design Average Dry Weather Flow (DADWF) of 42.5 ML/d (DADWF = 8.5 ML/d)"* (Condition No. G4-1). Considered in isolation, the wording of this condition is somewhat ambiguous in relation to:

- Whether the average dry weather flow to the plant must not exceed 8.5 ML/d, or,
- Whether it is acceptable to treat peak flows less than 5 times the average dry weather flow - particularly where the average dry weather flow exceeds 8.5 ML/d.

A conservative interpretation of the existing licence would mean that new licence would potentially be required:

1. Once the average dry weather flow to the plant exceeds 8.5 ML/d, or,
2. To augment the plant capacity to more than 8.5 ML/d ADWF capacity.

Under this interpretation, a per capita flow of 220 L/EP/day may require a new discharge consent from DES once the connected population exceeds approximately 38,600 EP. While this population is not projected to be exceeded until after 2041 on the 2015 IDM, the projected growth associated with the South West Victoria Point and Weinam Creek developments would see this limit exceeded in 2025.

Counter to this interpretation, DES may consider the view that no new licence will be required as the proposed upgrades are not intended to increase the plant's capacity above the range of the current Environmentally Relevant Activity (63-1(e) Sewage Treatment 10,000-50,000 EP). This would also be in line with preliminary expectation that increases in effluent flows to Eprapah Creek (in the absence of additional pollutant loads) are not expected to have an adverse impact on the health of the waterway (Pers. Comm., T. McAllister, December 2019).

In the absence of specific information on what new conditions might be applied, the upgrade planning has considered that the current effluent quality and mass load limits in the existing Environmental Authority would continue to apply under a new approval.

3.6.7 Peak Wet Weather Flow to Treatment

In line with the design basis applied to the 2003 upgrade, the upgrade planning has been based on transfer and full treatment of all flows up to five times the average dry weather flow (at 220 L/EP/d).

3.7 RECYCLED WATER QUALITY

In the absence of details of the existing effluent reuse to the Redland Bay Golf Club, the design has assumed that no further treatment of the effluent is required to meet the requirements of the Recycled Water Management Plan.

3.8 END OF WASTE CODE

The End of Waste (EoW) code for Biosolids was issued by the Queensland Government under the *Waste Reduction and Recycling Act 2011*(WRR Act), and became effective on January 1, 2020 (Department of Environment and Science, 1 Jan 2020). The code defines the requirements and conditions under which biosolids can be beneficially used as a resource in urban and rural land applications. Biosolids which do not meet the requirements of the code will need to be managed as a waste stream (which would generally be an inferior environmental outcome and attract much higher costs).

There was substantial concern within the industry that the EoW code would omit key options for achieving Grade B biosolids stability – namely the "Barrier options" (for Grade B only) where:

- Biosolids are injected below the surface of the land, or,
- Biosolids applied to the land surface are incorporated within six hours of application on the land.

These stabilisation options are included in the USEPA and NSW Guidelines for Biosolids Reuse, and are directly relevant to the planning of Victoria Point STP's upgrades. These options were omitted from the draft EOW waste code, issued for consultation on October 19th, 2018, and resulted in the consideration of an aerobic digester option and extended aeration option under Phase 1 of upgrade planning.

Critically, the final EoW code makes the "barrier option" available for biosolids generated in secondary treatment processes with sludge ages as short as 12 days - provided the solids do not represent an "undue risk" associated with high pathogen concentrations or excessive unstabilised solids. The code identifies undue risk to be processes which are achieving less than 1-log pathogen reduction compared to primary sewage for the relevant indicator organisms. This means the aerobic digestion and extended aeration applied in Phase 1 of the upgrade planning are no longer required. Rather, by handling biosolids via the "barrier option", the upgraded plant will not be required:

1. To operate at a sludge age of 20 days or longer, or,
2. Include additional facilities for sludge stabilisation (such as aerobic digestion, anaerobic digestion or lime treatment).

This change in requirements for biosolids management substantially reduces the scope of work for the upgrades.

3.9 REDUNDANCY

3.9.1 General

Redland Water applies Duty/Assist redundancy as a general approach to all mechanical equipment. This principal has been applied to the development of the plant, under the interpretation that the capacity to treat or pass the peak loading of any process unit is met with all parallel elements in service.

The redundancy of the oxidation ditch aerators is based on a duty/duty/standby configuration (as per the current operations). As the positions of the three installed aerators are fixed, Aerator No.1 and Aerator No. 2 are normally operated, with Aerator No. 3 only operating at times when one of Aerator No.1 or No. 2 are out of service. An alternative feed location is provided for periods when Aerator No. 1 is out of service.

In relation to secondary clarification, the redundancy criteria applied has been expanded to consider:

- Treatment of peak wet weather flows up to 5 x ADWF (see Section 3.6.7) with all clarifiers in service, and,
- Treatment of peak dry weather flows with one clarifier out of service.

The new blowers for the Re-Aeration Zone have been configured in a duty/standby arrangement. This approach has been adopted as the failure of a single blower under a duty/assist configuration would not have sufficient capacity to treat the peak diurnal load at the design horizon.

3.9.2 Bioreactor Redundancy

The upgrade planning has been based on retention of a single bioreactor (as per the existing plant). As an additional reactor is not required to achieve the projected process capacity, provision of a second reactor unit would add substantial costs. This means that the existing reactor will not be able to be taken out of service for repairs or maintenance through to the planning horizon (at least). Given the known structural issues in the oxidation ditch structure, this represents a risk to Redland Water.

A high level cost estimate has been developed for duplication of the existing Victoria Point STP oxidation ditch. Based on the key unit rates, mark-ups, and contingency applied in this investigation (see Section 8.1), the estimated cost to duplicate the existing oxidation ditch has been estimated as $18.7m. As the reactor volume in the existing plant does not directly constrain the plant capacity, this considered to be a high cost for resolution of the issues in the existing structure.

Previous investigations by Redland Water considered use of the existing, disused 'old plant' to provide treatment while the Oxidation Ditch is taken out of service for repairs. While the studies indicated that effluent TN levels <10mg/L may be achievable, extensive additional analysis would be required to verify the viability of this option. Use of the existing disused plant structures (either as temporary liquid stream treatment, or permanently for aerobic digestion of the sludge stream), will require a detailed structural assessment in order to ascertain viability and the scope and costs of required refurbishment measures.

3.10 CONDITION OF EXISTING PLANT INFRASTRUCTURE

The initial existing plant visual condition review (which was limited in scope to general condition observation without detailed or invasive inspection) noted the following elements of concern:

- Oxidation Ditch – Visual evidence of concrete deterioration and limited cover to reinforcement. Cracking resulting in loss of containment, which was under repair during the site visit of June 2019. In the absence of additional information, the study has assumed that the repaired oxidation ditch will be suitable for ongoing use through to the planning horizon. As noted in the previous section, the cost to duplicate the existing reactor is very high compared to the likely repair costs.
- Oxidation Ditch Aerator Covers – Severely corroded, require removal and/or replacement (depending on noise).
- Dewatering Building – Extensive corrosion to both structural steel and cladding. Repair and/or replacement of key elements required.
- Existing Gravity Drainage Decks / Belt Filter Presses – The existing TEMA GDD/BFP appears to be in reasonable condition, but is at risk of becoming obsolete within the next 5 years. The existing AJM belt press is in poor condition, and is largely obsolete (creating difficulties in maintenance). Both machines require extensive maintenance to remain operational. They also perform relatively poorly, achieving a relatively poor dry solids concentration in the dewatered biosolids product of only 12-14%. Due to the condition of the existing dewatering system, the options for upgrading the dewatering system are currently under investigation as a part of the separate project.

In general, metalwork within the existing disused plant's bioreactors and clarifiers is in very poor condition. The concrete structures, however, appear to be generally intact, and potentially suitable for ongoing service with refurbishment.

4 DYNAMIC PROCESS MODEL DEVELOPMENT AND CALIBRATION

In order to accurately assess the capacity of the existing secondary treatment process and inform the concept design of the upgrades, a dynamic BioWIN model of the existing plant was developed and calibrated. Given the very low effluent total nitrogen currently achieved by the plant, and the need to further enhance nitrogen removal in the future, the process model calibration pursued a high degree of accuracy. To generate the most accurate model possible, the following approach was applied:

- Whenever possible, actual plant operating data was used to calibrate the plant model, including:
    - Flow rates for Influent Sewage, RAS, and WAS.
    - Aerator speeds.

  For each of these parameters, 30-minute average values were derived from the SCADA historian.
- The 19-day period of December 1st to 19th, 2019 was selected for the calibration as it coincided with the characterisation program, providing the most accurate influent and operating data on which to base the model.
- The average sewage characteristics and diurnal influent sewage pollutant concentration patterns for COD, TKN, and TP derived from the characterisation period were applied. Diurnal changes in the influent total suspended solids were not applied, as this has been consistently shown to not be required to achieve a dynamic model calibration.
- As discussed in Section 3.3.4, the available samples for the solids concentration in the dewatering filtrate were highly variable. On this basis, the capture in the belt press during the calibration period was estimated using the limited historical filtrate monitoring data (which gave an estimated solids capture of 87%), as validated using the sludge haulage records and the steady-state process model calibration.
- The oxidation ditch was modelled as a series of thirty bioreactor cells to represent the plug flow nature of the Victoria Point reactor configuration (see Figure 4-1). This configuration also allows for relatively accurate comparison of key parameters, such as dissolved oxygen) at specific points in the bioreactor. A ditch velocity of 0.20 m/s, which is at the lower end of typical values was applied based visual observation of the surface flow within the bioreactor during site visits.
- Two model clarifiers were used, each with dimensions to represent the units installed at Victoria Point. While model clarifiers increase the overall complexity of the model (compared to “ideal” clarifiers), experience from a number of sites indicates the importance of modelling the biological processes in the clarifier sludge blankets to accurately assess phosphorus removal. As a part of this approach, the total volume of sludge in the model clarifier was compared to values reported onsite to ensure that it was an accurate representation of the plant for the period of study.
- On-site measurements of aerator power and current draw as a function of speed were collected for each aerator. This data was used to establish the relationship between power input and aerator speed in the model. Table 4-1 summarises the collected data from site and applied to the modelling of aeration.

Table 4-1: Victoria Point STP Aerator Power Consumption, Recorded March 17, 2020

Aerator	Speed (Hz)	Speed (%)	Power Consumed ((kW)
No. 1	30	60	27
	40	80	54
	50	100	103
No. 2	30	60	27
	40	80	59
	50	100	100

- Two bioreactors were added to represent the additional aeration from the bioreactor weir outlet and the RAS screen.
- As no alum dosing was undertaken during the period selected for calibration, it was not included in the model.

Calibration Method

- The calibration was performed to achieve the best match possible to the monitoring results for suspended solids, total nitrogen, ammonia, nitrate, total phosphorus, and phosphate both in the bioreactor and final effluent.
- In the first instance, the efficiency of the surface aerators was adjusted in the model to provide a match to the measured dissolved oxygen concentration. Unfortunately, the configuration of the aerators and dissolved oxygen instruments leads to an unstable model configuration where very small changes in the aerator efficiency resulting in large changes DO (i.e. from 0 to 5 mg/L), or the model outputs are unstable (and unrepeatable). To overcome this limitation, control logic was developed in the BioWin Controller add-on to accurately mimic the aerator speed control in the plant.
- Even with the actual measured DO accurately met by the model, the fit of ammonia, nitrate, and nitrite was initially relatively poor, with results suggesting insufficient nitrification and excess denitrification compared to the observed plant performance. On this basis, a review of the DO profile within the oxidation ditch was carried out by Redland operations personnel using a handheld instrument. While not conclusive, the monitoring confirmed that is substantial variation in the DO concentration achieved at various locations both along the path length of ditch, and across the channel. On this basis the measured DO reported from the site data was increased to achieve the observed performance. The total fit to the observed aeration input power remained excellent even with this change.
- The calibration philosophy was based on minimising the number of kinetic and stoichiometric parameters modified from the BioWIN default values. Despite some known divergences between the BioWIN model and BNR microbiological processes, it is our experience that making a large number of poorly or partially supported changes reduces the applicability and confidence in the final model. For this calibration, the plant operating conditions, coupled with the high degree of accuracy demanded by the stringent licence requirements, a relatively large number of changes to default parameters was required. These were:
    - AOB Substrate Half Saturation reduced to 0.3 mg/L (from 0.7 mg/L) to provide the low level of Ammonia observed in the final effluent. Modification to substrate half saturations are not typically required.
    - PAO Anoxic Growth Factor reduced to 0 from 0.33 to eliminate anoxic P uptake – to better match the level of denitrification and effluent phosphate. Modification of the anoxic growth factors is infrequently required, but was necessary to reduce the extent of phosphorus removal reported by the model in this case.
    - NOB Max Specific Growth rate increased to 1.5 /d from 0.7 /d and Substrate Half Saturation increased to 0.05 from 0.1 to reduce the nitrite and increase the nitrate in the final effluent as reported by the model. More recent model calibrations have sometimes required amendment of this parameter to prevent nitrite levels in the effluent far exceeding those observed in practice.
    - AOB DO Half Saturation and NOB DO Half Saturation decreased to 0.05 mg/L from 0.25 and 0.5 respectively. Modifications to these parameters are typical for processes where the dissolved oxygen is not uniformly maintained outside the concentration where simultaneous nitrification and denitrification is known to occur, such as oxidation ditches or intermittent processes.

Calibration Results

Given the available information, the fit of the model to the observed plant performance is considered reasonably good as shown in Figure 4-2 through Figure 4-14. More specifically:

- The model's fit with respect to effluent ammonia, nitrate and total nitrogen is considered excellent (see Figure 4-5 through Figure 4-7, and Figure 4-10 through Figure 4-11). The accuracy for these parameters far exceeds the recommended thresholds for this type of modelling, but was vigorously pursued due to the very low levels of nitrogen required at Victoria Point.

- The fit with respect to effluent phosphate and total phosphorus (see Figure 4-8, Figure 4-9, and Figure 4-12) is not as good the nitrogen species, but is still considered acceptable. Previous projects have demonstrated that BioWin may overpredict excess biological phosphorus removal under low or transient DO conditions (such as those which occur at Victoria Point). Given that the phosphorus removal requirements are relatively lenient compared to the nitrogen removal requirements, and that additional phosphorus removal can be readily achieved with chemical dosing, this is not considered a significant limitation.
- The average solids inventory predicted by the model was within 2% of the results of the characterisation period (see Figure 4-4), and 8% of the values reported in the plant log. Both of these figures are well within the recommended 10% error range (Rieger, et al., 2013).

Table 4-2: Dynamic Process Model Calibration Evaluation

Parameter	Mean of Residuals	Absolute Mean of Residuals	Root Mean Square Error	Target Value
Effluent Ammonia	0.05	0.07	0.12	1.0 mg/L Note 1
Effluent Nitrate	-0.07	0.12	0.16	1.0 mg/L Note 1
Effluent TN	0.10	0.18	0.19	1.0 mg/L Note 1
Effluent Phosphate	0.82	0.82	0.90	N/A
Effluent TP	0.85	0.85	0.91	N/A

Note 1: Recommended target for assessing plant capacity for nitrogen removal using dynamic modelling. Monthly or annual average (Rieger, et al., 2013)

Note 2: No recommended target for assessing phosphorus removal using dynamic modelling (Rieger, et al., 2013)

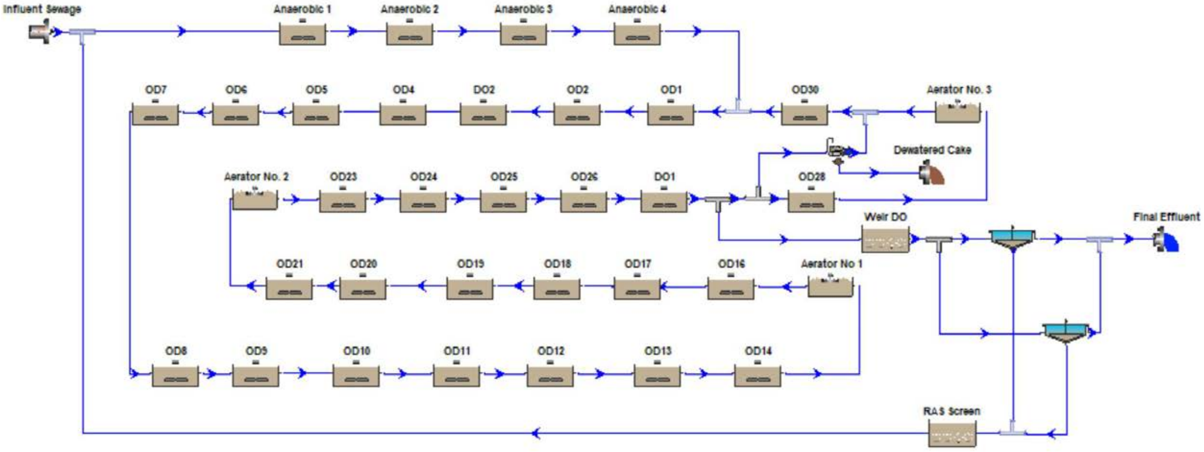

Figure 4-1: BioWIN Process Model Configuration – Existing Victoria Point STP

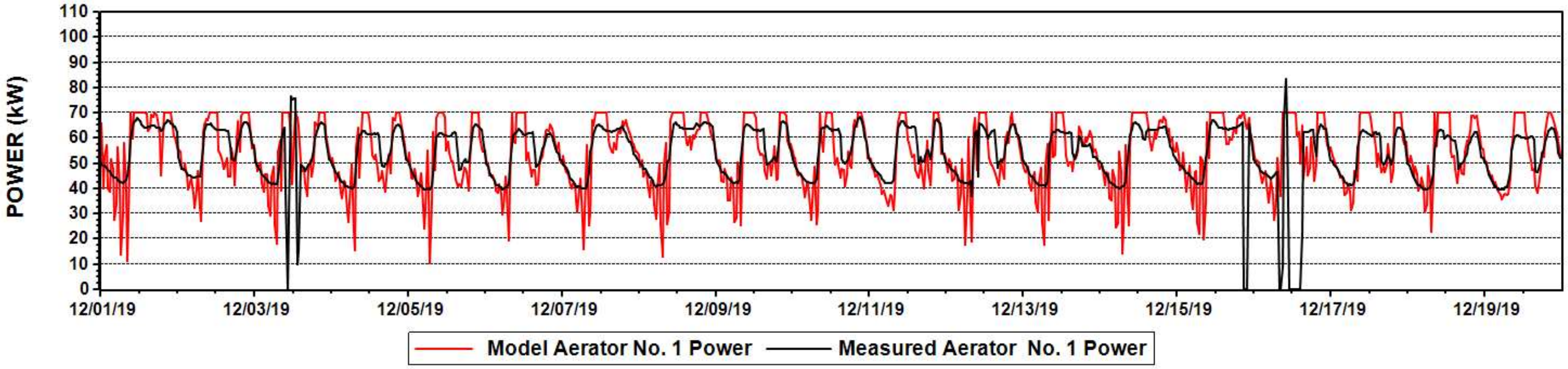

Figure 4-2: Victoria Point STP Dynamic Model Calibration - Aerator No.1 Power

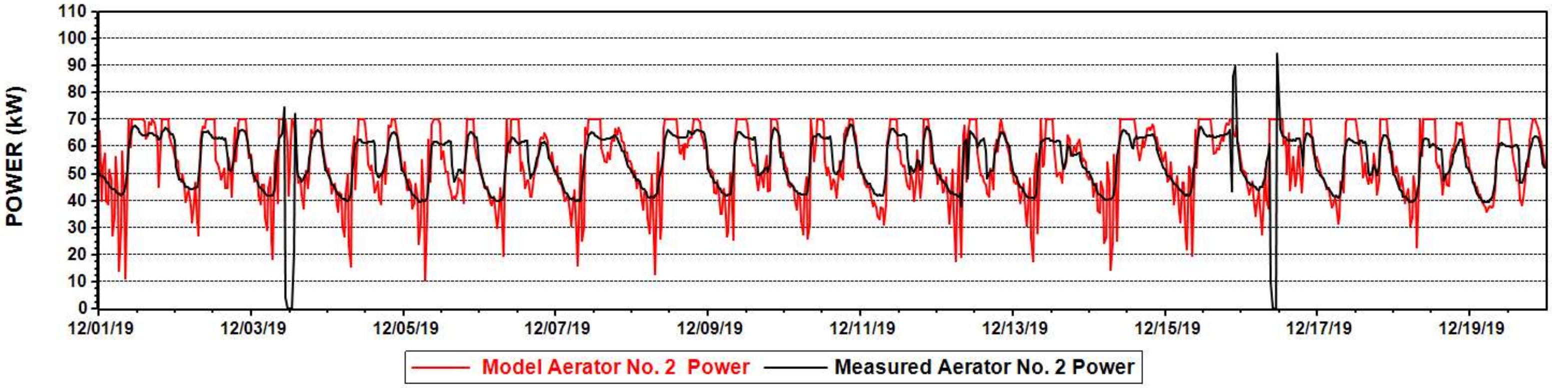

Figure 4-3: Victoria Point STP Dynamic Model Calibration - Aerator No. 2 Power

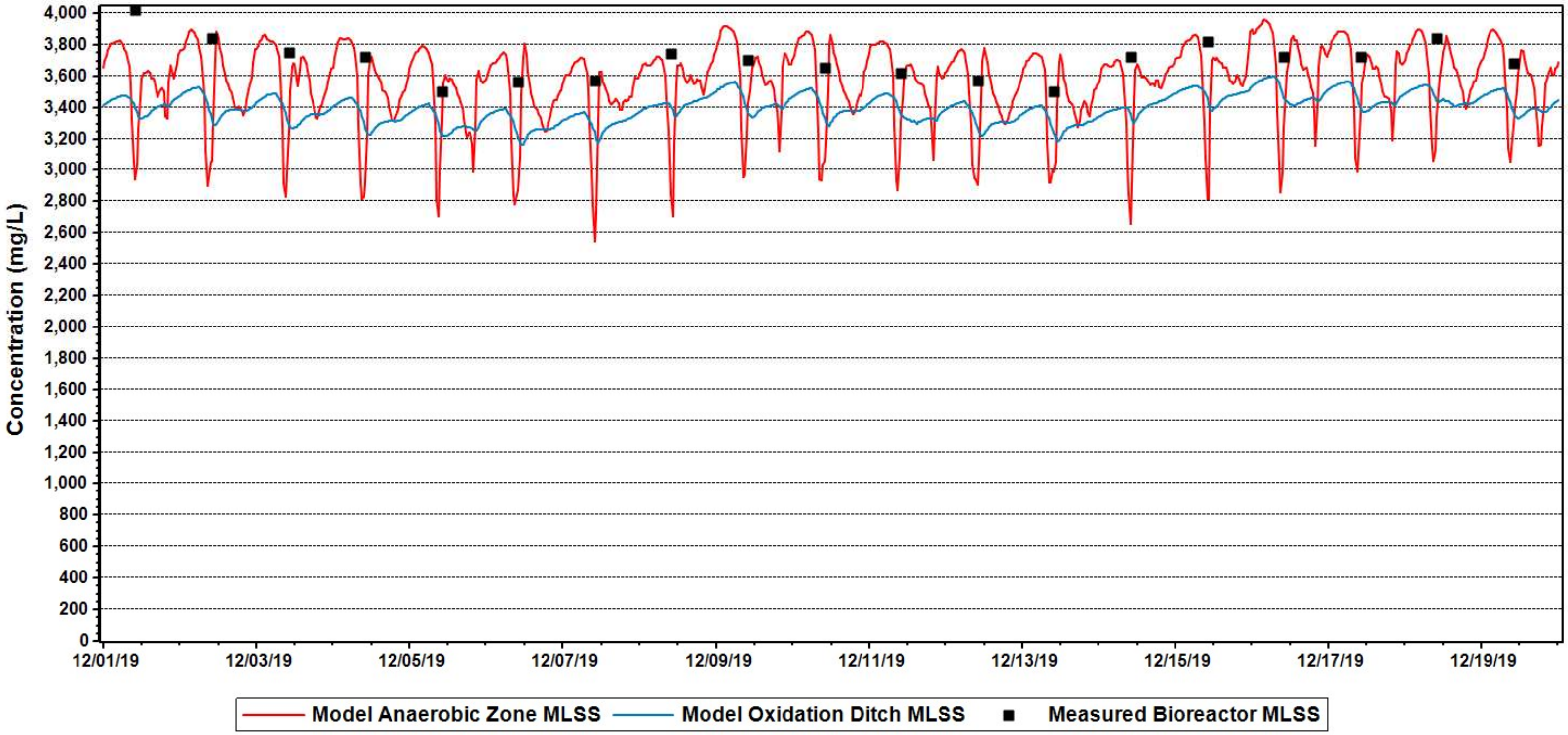

Figure 4-4: Victoria Point STP Dynamic Model Calibration - Bioreactor Mixed Liquor Suspended Solids

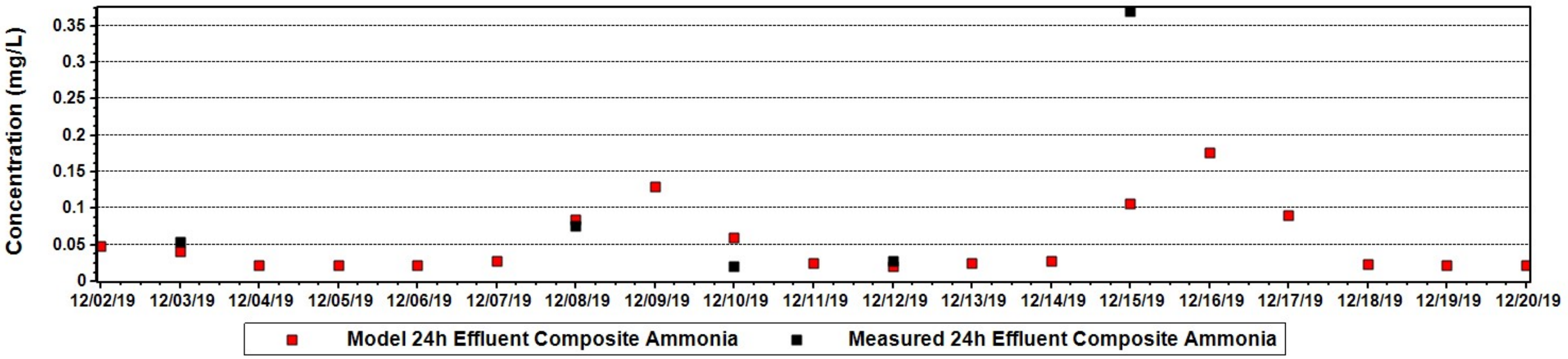

Figure 4-5: Victoria Point STP Dynamic Model Calibration - Effluent Ammonia (as N)

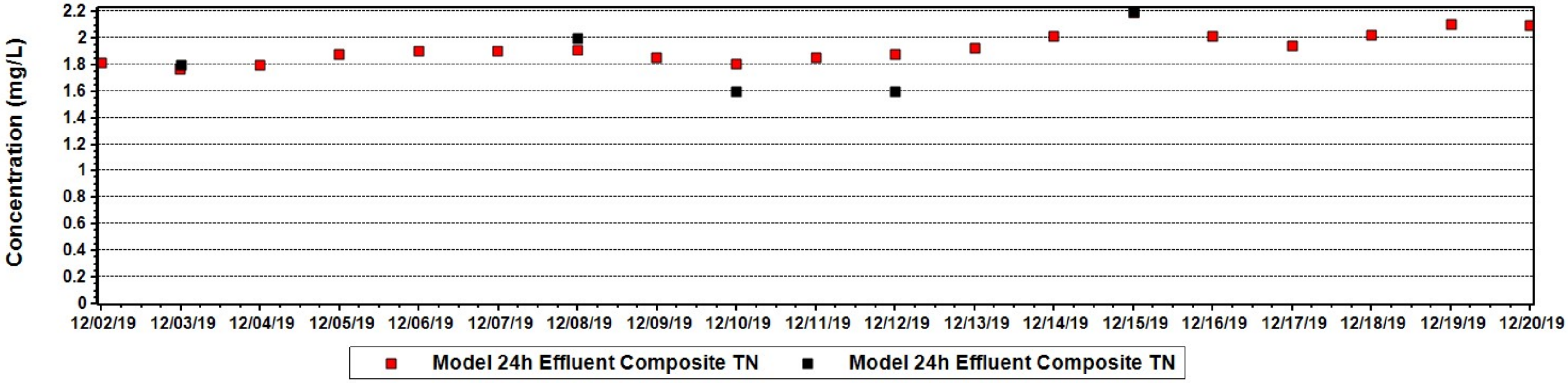

Figure 4-6: Victoria Point STP Dynamic Model Calibration - Effluent Total Nitrogen

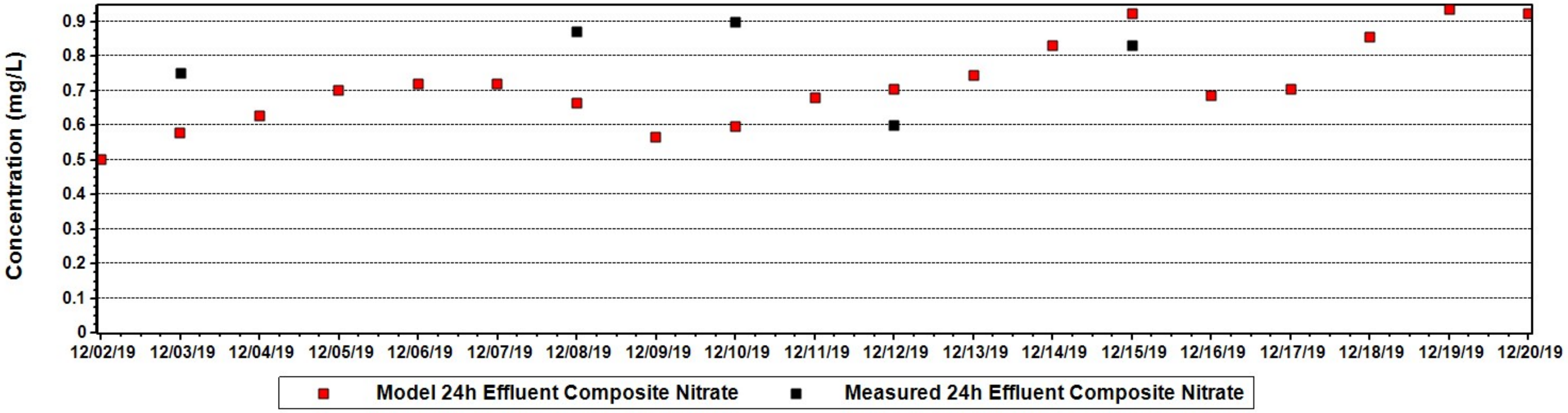

Figure 4-7: Victoria Point STP Dynamic Model Calibration - Effluent Nitrate (as N)

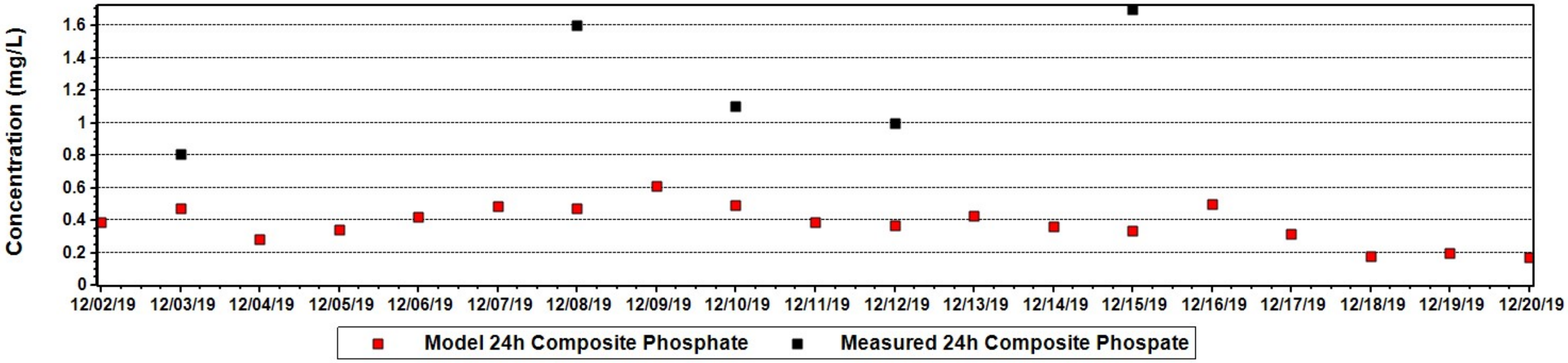

Figure 4-8: Victoria Point STP Dynamic Model Calibration - Effluent Phosphate (as P)

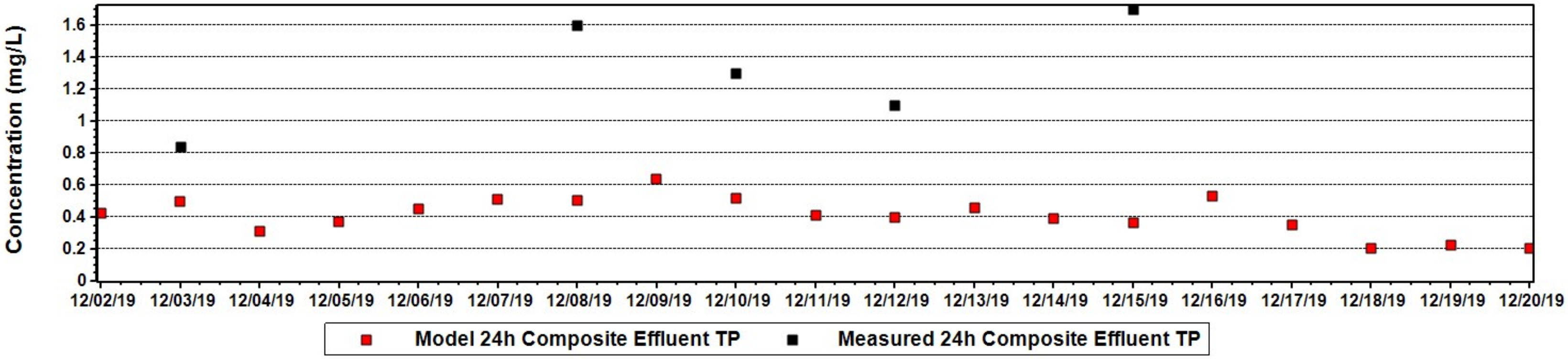

Figure 4-9: Victoria Point STP Dynamic Model Calibration - Effluent Total Phosphorus

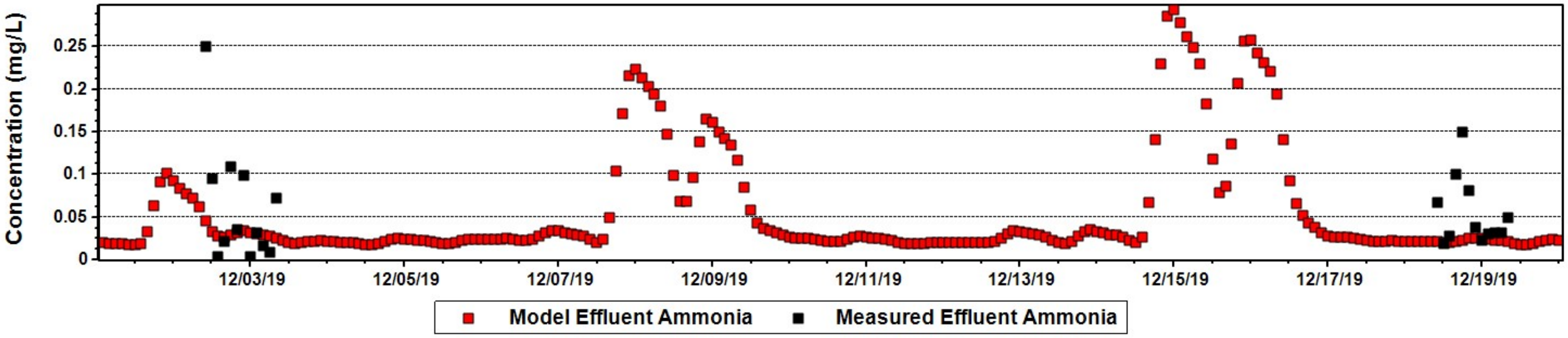

Figure 4-10: Victoria Point STP Dynamic Model Calibration - Diurnal Effluent Ammonia (as N)

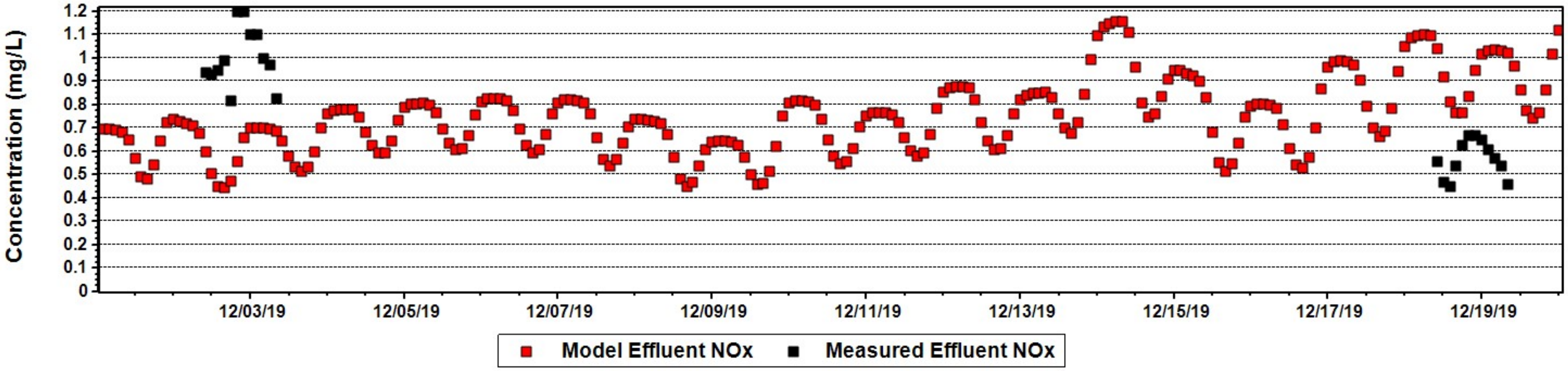

Figure 4-11: Victoria Point STP Dynamic Model Calibration - Diurnal Effluent Oxidised Nitrogen (as N)

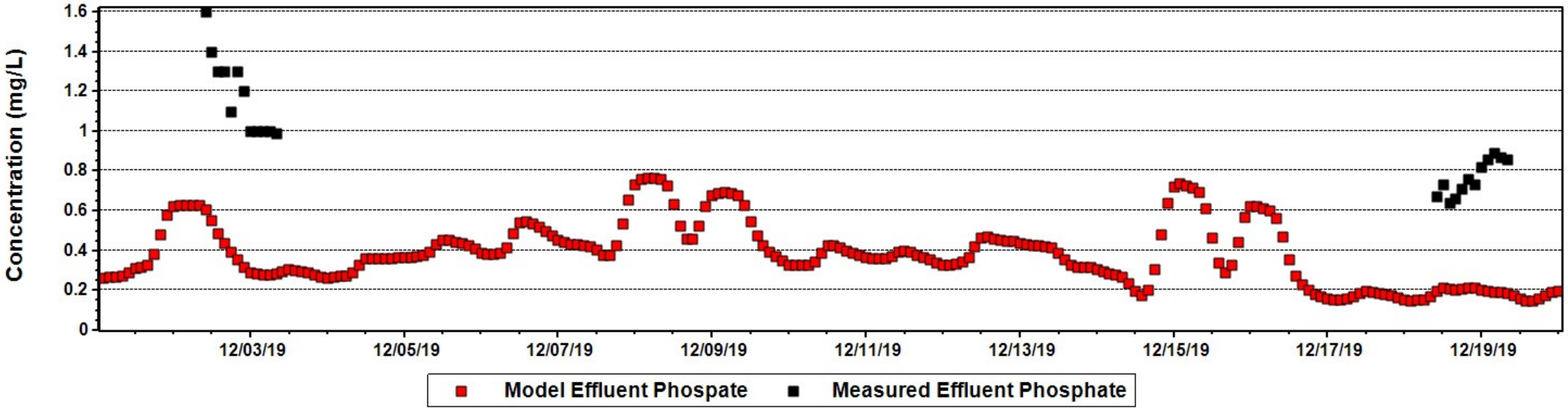

Figure 4-12: Victoria Point STP Dynamic Model Calibration - Diurnal Effluent Phosphate (as P)

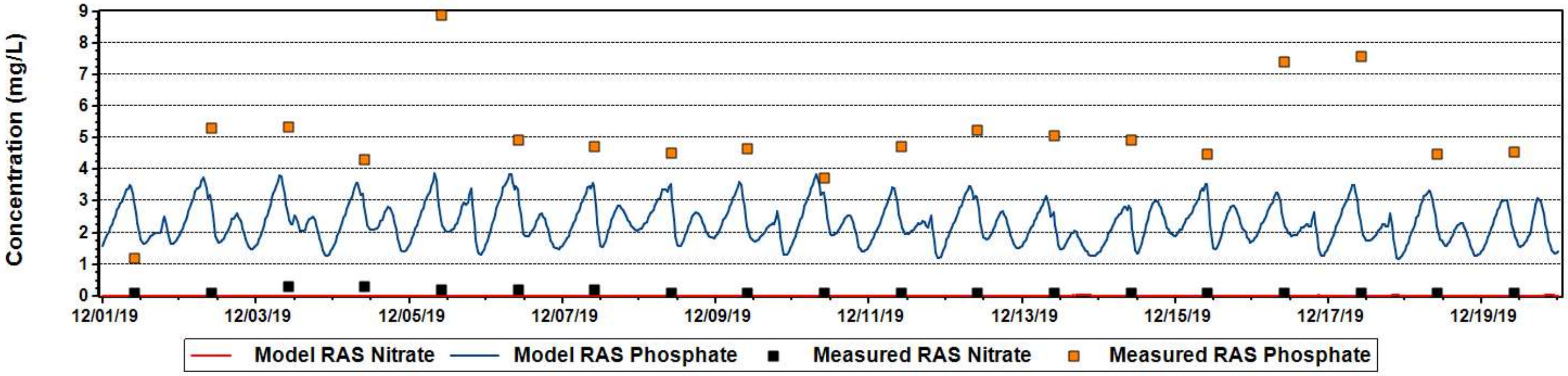

Figure 4-13: Victoria Point STP Dynamic Model Calibration – RAS Stream Nutrients

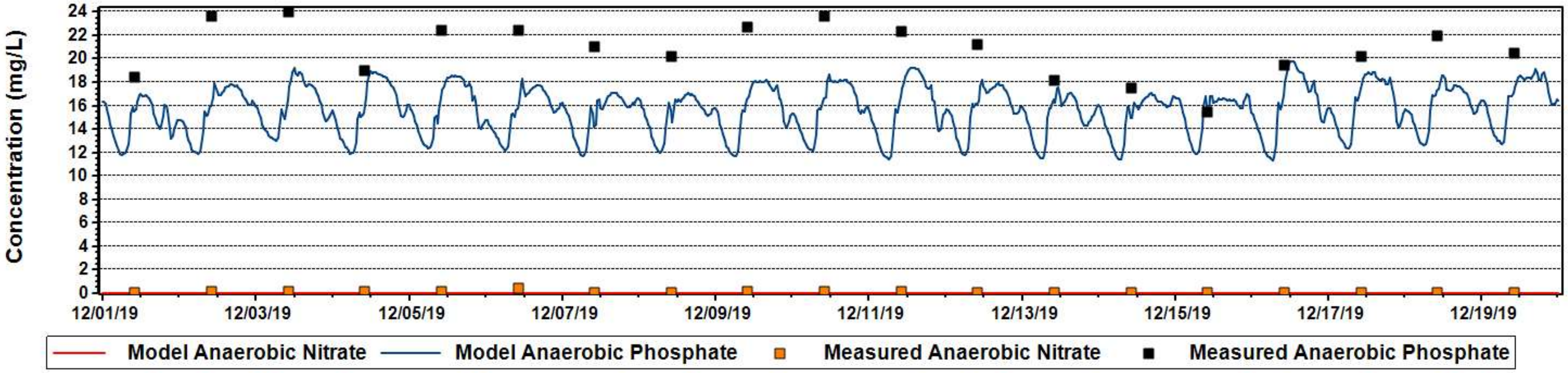

Figure 4-14: Victoria Point STP Dynamic Model Calibration - Anaerobic Zone Nutrients

5 EXISTING PLANT CAPACITY

5.1 HYDRAULIC CAPACITY

The existing plant has been modelled to identify the hydraulic capacity of the installed infrastructure. A report summarising the inputs, outputs, assumptions and limitations of the hydraulic analysis is provided in Appendix A.

The assessment was based on the requirement of the Plant to pass 565 L/s (plus an additional 400L/s RAS in the relevant units), based on the following key assumptions:

- Per capita flow of 220 L/EP/d
- Design connected population of 44,398 EP representing the ultimate connected population in the absence of the Weinam Creek and South West Victoria Point Developments. Note that this approximately equal to the 44,312 EP projected for 2041 should these two developments proceed.
- Peak wet weather flow condition of 5xADWF
- Minimum freeboard of 300mm

Note that minimum freeboard of 500mm is routinely applied as the hydraulic design criteria for aerated vessels, but the 2003 design of the oxidation ditch (which features enclosed aerators) applied a minimum freeboard of 300mm which has been carried forward to this analysis.

Limitations on the system to meet the above requirements, as listed in the hydraulic report are:

- **Inlet pumps** - The existing pumps operating in a duty/assist configuration have an estimated peak capacity of 525 L/s. This is substantially less than the 565 L/s required to meet the design criteria adopted for upgrade planning. Additionally, it is anticipated that the existing pumps will suffer from cavitation under this operating condition.

  However, two new pumps have been ordered for the Victoria Point WWTP inlet pump stations, and are expected to be delivered and installed in August 2020[1]. The new pumps have been sized to deliver 300 L/s with a single duty unit, and 550 L/s with both units operating at the nominated top water level in the pump stations.

  However, RCC have advised that the selected inlet pumps will theoretically deliver the 565 L/s required once the water level in the well increases to 0.5m above the normal top water level. This level would still be 1.0m below surcharge. At 1.5m above the normal top water level (i.e. the level at which surcharge commences), the pumps are expected to deliver a combined flow of approximately 590 L/s. As such, the upgraded pumps will be sufficient to deliver 5 x ADWF at 220 L/EP/d under the projected 2041 load without additional developments, and will be sufficient for the projected 2031 load if the South West Victoria Point and Weinam Creek developments proceed.
- **Inlet channel** – The limited availability of information concerning the losses through the step screen, grit screw and grit trap, has prevented verification of their capacity in the hydraulic model. However, experience during extreme wet weather events indicates the inlet works has sufficient capacity for the peak influent sewage flow delivered by the existing raw sewage pumps (~525 L/s). Further, the change in raw sewage screens identified under this project (see Section 6.2) will provide scope in increase hydraulic capacity through inlet screening channels.
- **Filter feed pumps** – The performance data from the existing pumps provided does not match the analysis for single pump duty. Due to continuous and variable rate of discharge of flows to the filter feed tank, and the lack of flow measurement on the filter inflow or outflow, it has not been feasible to independently verify the actual flow delivered by the filter feed pumps in operation, or their capacity.
- **Filters** – The existing filters may not be sufficient to meet the entire 3xADWF capacity applied to the 2003 upgrade design. However, it is noted that filtration of flows to 3 x ADWF is not specifically required for licence compliance,

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[1] The new pumps are Wilo 55 kW 6 pole FA25.93T pumps with FK34.1-6/33 motors.

and acceptance of a lesser peak throughput is anticipated to be sufficient for this process unit based on the licence requirements and frequency of wet weather events (see Section 6.4).

Subsequent to the hydraulic analysis, the RAS flow achieved by the existing pump stations was measured on-site. With two of the three pumps in each pump station operating simultaneously at 100% speed (4 pumps in total), RAS pump station 1 delivered 190 L/s, and RAS Pump Station 2 delivered 193 L/s, giving a total RAS flow of 383 L/s. The RAS channel and screen adjacent to the anaerobic zone managed this flow without issue or exceedance of freeboard limits.

Table 5-1: Victoria Point STP – Summary of Existing Process Unit Hydraulic Capacity

Unit	Hydraulic Assessment Flow Capacity of unit at minimum freeboard (L/s)
Raw Sewage Pump Capacity	525 (Existing Pumps), 550 L/s (from August 2020)
Inlet channel to Anaerobic Reactor pipe	727 L/s
Pipe oxidation ditch to Mixed Liquor Distributor	1460 L/s
Mixed Liquor Distributor Weir	1400 L/s
Mixed Liquor Distributor to Clarifier	Including RAS: 517 L/s (per clarifier) Total required: 489 L/s (per clarifier)
Pipe from Clarifier to Filter Feed Tank	754 L/s
Filter Feed Tank to Filters	Unable to be confirmed.
Filter Hydraulic Capacity (estimation)	442 L/s
Filtered Water holding tank to chlorine contact tank inlet	1012 L/s
Chlorine contact tank outlet weirs	1610 L/s
RAS Pump Capacity	188 L/s (per pump station in original design) From Site Measurements: RAS Pump Station 1 155 L/s (one pump at 100% speed) 193 L/s (two pumps at 100% speed) RAS Pump Station 2: 120 L/s (one pump at 100% speed) 190 L/s (two pumps at 100% speed)
WAS Pump	1-8.3 L/s (depending on stator condition)
Dewatering filtrate return	73 L/s (Derived from SCADA Data for Pump Station)

5.2 SECONDARY TREATMENT PROCESS CAPACITY

5.2.1 Capacity Based on Sludge Production / Clarification

The nominal clarification capacity of the existing secondary treatment process was initially quantified using steady state process modelling and the Vesilind 1-D flux model. The following criteria and conditions were applied to the analysis:

1. **Pollutant loads at Maximum Monthly Load (see Sections 3.3 and 3.4)**
   As the maximum monthly influent load will correspond to the maximum sludge inventory within the system, this loading condition has been applied to the analysis. This is in line with typical process design practice.

2. **Sludge age of 15 days (see Section 3.5)**
   To maximise the capacity of the system while maintaining adequate nitrification and denitrification, an operating sludge age of 15 days has been applied. This sludge age was determined based on analysis of the performance of the existing plant and confirmed with the calibrated dynamic process model. This sludge age exceeds the minimum required for application of the "barrier option" under the end of waste code.

3. **Mixed liquor temperature of 19.5°C (see Section 3.6.1)**
   The maximum sludge inventory corresponds to the minimum mixed liquor temperature. This figure was drawn directly from the plant log, and represents the typical sustained minimum value during the winter months.

4. **Settleability at 80th percentile of Valid Monitoring Results (see Section 3.5)**
   The 80th percentile of the valid settleability monitoring results measured on-site from 2013-19, 205 mL/g DSVI, has been applied to the capacity assessment.

5. **De-rating of Clarifier Peak Surface Overflow Rate to account for non-idealities in full scale clarifiers**
   The peak surface overflow rate has been de-rated by 20% to account for typical impact of non-idealities in the Vesilind Flux theory compared to full-scale stress test results (Ekama G. A., et al., 1997).

6. **Sludge Storage in Secondary Clarifiers**
   The steady state modelling included provision for the storage of sludge in the clarifiers up to a depth of 0.3m to the side wall. This depth of sludge blanket is somewhat less than measured under recent operations, but is considered a suitably conservative basis for analysis. Sludge storage in the clarifiers serves to increase the clarification capacity by reducing the mixed liquor solids concentration in the clarifier feed. The solids concentration in the clarifier blanket was assumed to the same as the concentration in the mixed liquor.

7. **Treatment of Flows up to 5 x ADWF (see Section 3.6.7)**
   In line with the design basis applied to the 2003 upgrade, the upgrade planning has been based on transfer and full treatment of all flows up to five times the average dry weather flow (at 220 L/EP/d).

8. **Peak Capita Flows at 220 L/EP/d (see Sections 3.2 and 3.4).**
   In line with the design basis applied to the 2003 upgrade, the upgrade planning has been based on transfer and full treatment of all flows up to five times the average dry weather flow (at 220 L/EP/d).

The solids removal capacity of the existing Victoria Point secondary treatment process based on these conditions is summarised in Table 5-2.

Table 5-2: Secondary Treatment Process Capacity based on Solids Clarification

Parameter	Units	AAL	MML
Capacity	ML/d ADWF	9.42	8.43
	L/s PWWF	545	488
	EP	42,800	38,300
Maximum Surface Overflow Rate (including derating for non-idealities)	kL/m²/h	1.080	0.969
Minimum RAS Ratio from Vesilind Flux Model	Ratio	0.54	0.61
Minimum RAS Flow Required	L/s	295	298
RAS Flow Available in Existing Plant (2 No. RAS Pump at 100% Speed in each RAS Pump Station)	L/s	383	

5.2.2 Ability of Existing Plant to Meet Effluent Total Nitrogen Mass Load Limit

The calibrated dynamic process model has been used to assess the ability of the existing plant to achieve the nitrogen removal requirements at the design horizon. The results of this analysis are summarised in Table 5-3.

In considering the results (and validating against actual plant performance), it is important to note that the maximum per capita flow is effectively the most stringent assessment criteria for annual compliance (as it results in the lowest effluent total nitrogen requirements). By contrast, the compliance with the less-stringent short-term concentration limit has been assessed at both the minimum and maximum per capita flows.

Table 5-3: Existing Secondary Treatment Process Nitrogen Removal Performance Limits

Loading Condition	Connected Population (EP)	Per Capita Flow (L/EP/d)	Temperature (°C)	Ammonia as N (mg/L)	NO_3 as N (mg/L)	rDON (mg/L)	Total (mg/L)	Required TN (mg/L)
AAL	37,097	220	23.9	0.34	0.33	0.67	1.34	1.65 Note 1
AAL	44,312	220	23.9	0.36	0.40	0.67	1.43	1.38 Note 1
MML	37,097	220	19.5	0.49	0.59	0.91	1.99	3 mg/L (Short term median @St.2) Note 2
MML	44,312	220	19.5	0.46	0.70	0.91	2.07	
MML	37,097	153	19.5	0.52	0.53	0.91	1.96	
MML	44,312	153	19.5	0.45	0.69	0.91	2.05	

Note 1: See Figure 3-10 in Section 3.6.3.
Note 2: See Section 3.6.1 for additional discussion of the exceedance of the mass load limit for periods much less than 12 months.

Key conclusions of this analysis include:

- The modelling indicates that the plant can meet the effluent quality requirements through to the design horizon (2041) in the absence of the South West Victoria Point and Weinam Creek developments - provided operations are optimised throughout the year. However, there is effectively no margin of error. In a year with higher rDON, instrumentation issues, or where sustained or periodic process upsets or equipment outages occur, licence compliance with the mass load limits will be challenging. This is indicated by the historical performance of the plant (see Section 3.6.4), which shows that the plant is capable of delivering this level of performance at the current load, but has not done so in all years under recent operations.
- With the sewage load increased by the South West Victoria Point and Weinam Creek developments, the modelling predicts an increase of just 0.09 mg/L in effluent total nitrogen under AAL conditions. However, due to increased flows, the reduction in the effective total nitrogen limit to stay under 13.5 kgN/day pushes the plant into non-compliance. Effectively, the additional load imposed by the South West Victoria and Weinam Creek developments are very likely to result in the plant exceeding its mass load discharge limit for Total Nitrogen.

- The per capita influent sewage flows have only a marginal impact on the predicted effluent quality under the MML loading scenario. The existing plant is capable of meeting the short-term concretion limits for total nitrogen under these critical loading conditions.
- As rDON represents a significant portion of the effluent TN limit, any sustained increase in the rDON concentration represents a risk to licence compliance under every operating scenario.

While the modelling suggests that the capacity of the plant is sufficient for the 2041 design horizon under the low population growth scenario (i.e. no development), analysis of the existing plant operations suggests that higher median effluent TN concentrations have occurred under recent operations - especially particularly in years with reduced rainfall. It is important to consider that the model effectively represents an "ideal" operating scenario, without the real-world practicalities associated with operating a municipal STP under an ever-changing set of loading and operating conditions. Median effluent nitrogen of up to 1.9 mg/L has been observed under recent operations, however it is important to note that operations under dry conditions effectively increases the permissible effluent nitrogen concentration. In wet years the observed effluent nitrogen concentration decreases to 1.5 mg/L or less, but the discharge requirements become more stringent due to the increased flow and mass load licence.

Based on the analysis undertaken in Section 3.6.3, the highest 365-day average mass load discharged by the plant under recent operations was 10.7 kg/d, which occurred in January 2016. Based on this figure and the estimated connected population in 2016, it is anticipated that the "real-world" nitrogen removal capacity of the plant is approximately 38,700 EP, which is broadly consistent with the overall conclusions of the dynamic process model.

5.2.3 Capacity Based on Aeration

The aeration system must provide sufficient dissolved oxygen to oxidise the influent COD and TKN, and maintain the dissolved oxygen concentrations required for proliferation of the organisms which undertake these processes. An analysis of the modelling undertaken for Section 5.2.2 was undertaken to establish the likely capacity of the existing aeration system. To consider the aeration limitations within the dynamic process model, the maximum power for each aerator was directly specified as a part of the model development.

In assessing the aeration capacity of the secondary treatment process, it is important to differentiate between the total installed aerator capacity, and that which can be used while meeting overall nitrogen removal requirements. At Victoria Point the Dissolved Oxygen concentration near the end of the aerobic zone must be relatively low to enable adequate denitrification performance – both in terms of denitrification within that portion of the bioreactor itself, and in reducing the oxygen discharged to the anoxic zone portion of the ditch.

Key conclusions of this analysis included:

- At a load of 37,097 EP, as projected for 2041 without additional developments, the target dissolved oxygen concentration within the oxidation ditch can be maintained at maximum monthly load (MML) with Aerators No.1 and 2 operating below their maximum output. If a high (i.e. >1.0mg/L) DO setpoint is applied, the aerators operate just below their maximum period during the peak flow period. On this basis, the plant has adequate aeration capacity for this load.
- At a load of 44,312 EP (and MML), as projected for 2041 the South West Victoria Point and Weinam Creek developments, the target dissolved oxygen concentration within the oxidation ditch is not maintained throughout the day, with Aerators No. 1 and 2 operating at the maximum output for most of the daytime period. Under this scenario the total effluent nitrogen increases, but the model predicts it will remain compliant with the Short-Term median total nitrogen concentration limit of 3 mg/L on a 24-hour composite basis at MML. This suggests that at this load, the plant is essentially operating at (or marginally above) its aeration capacity, with absolutely no reserve.
- Subsequent model runs demonstrated that nitrogen removal performance could be maintained by operating the third aerator at very low output for a portion of the day. This operating strategy relies on simultaneous nitrification-denitrification throughout the bulk of the ditch to meet the nutrient removal requirements, which is likely to be difficult to robustly replicate under real-world operating conditions. Further, operational regimes which rely on operation of all three aerators would not necessarily provide a suitable operating risk given criticality of aeration to effluent quality.

5.3 SUMMARY OF EXISTING PLANT CAPACITY

The overall process capacity of the Victoria Point STP, as compiled from the analyses in Sections 5.1, 5.2 and 6 is summarised in Table 5-4. As noted in the table, the prevailing plant capacity, pending the upcoming upgrade of the raw sewage pumps and dewatering system, is limited to 38,300 EP by the ability of the secondary clarifiers to treat 5 x ADWF. The ability of the process to maintain compliance with the Total Nitrogen Mass Load Limit will be compromised at a similar load (38,700 EP).

Table 5-4: Victoria Point STP – Summary of Capacity by Process Unit

Process Unit	Value	Notes
Loading Scenario	Maximum Monthly Load	
Per Capita Flow	220 L/EP/d	Nominal maximum of range in Basis of Planning
PWWF / ADWF	5.0 x ADWF	As defined in plant licence for entire plant liquid stream.
Inlet Works - Overall		**41,240 EP, 9.07 ML/d ADWF**
Existing Raw Sewage Pumps	*41,240 EP*	Capacity based on existing combined pump capacity of 525 L/s (Duty/Assist) (see Sections 5.1, 6.1)
New Raw Sewage Pumps	43,200 EP	Capacity based on new pumps of 550 L/s (Duty/Assist) to be installed in August 2020 (see Sections 5.1, 6.1)
Influent Sewage Screening	43,910 EP	559 L/s, to be upgraded due to redundancy and performance (see Section 6.2)
Grit Removal	69,120 EP *36,520 EP*	880 L/s based on manufacturer rating 465 L/s based on 1.5 m/minute rise rate (conservative)
Secondary Treatment - Overall		**38,300 EP, 8.43 ML/d ADWF**
Clarification	38,300 EP	At 15 days sludge age, MML loading conditions
Nitrogen Removal	38,700 EP	Based on Total Nitrogen Mass Load Limit of 13.5 kg/d
Aeration	~44,300 EP	Based on nitrogen removal capacity with two aerators operating at 100%.
Hydraulic Capacity		
Effluent Disinfection and Discharge- Overall		**38,300 EP, 7.48 ML/d ADWF**
Tertiary Filters	*35,350 EP to 3.0 x ADWF* *37,100 EP at 2.8 x ADWF* *44,310 EP at 2.4 x ADWF*	270 L/s Capacity. Filtration of all flows not required for licence compliance with the retention of chlorination.
Effluent Disinfection	38,700 EP	Required for Residual Chlorine <0.7mg/L when secondary effluent ammonia must be reduced to maintain compliance with effluent Total Nitrogen Mass Load Limit (see Section 6.5).
Biosolids Handling - Overall		**44,300EP, ML/d ADWF**
Existing GDD/BFPs	*>44,300 EP*	Duty/Assist, 5 hours/day, 6 days/week
New Dewatering Machines (upgrade planning in progress)	44,300 EP	Duty/Standby, 11.2 hours/day, 5 days/week (Duty Only)
Baseline Overall Plant Capacity		**38,300 EP, 7.48 ML/d ADWF**
Overall Existing Plant Capacity	**38,300 EP**	Limited by secondary treatment clarifier capacity, noting that nitrogen removal capacity (and chlorine contact tank capacity by corollary) is only marginally higher.

Note 1: Italicised figures are not considered to limit overall plant capacity.

5.4 SUMMARY OF REQUIRED UPGRADE WORKS

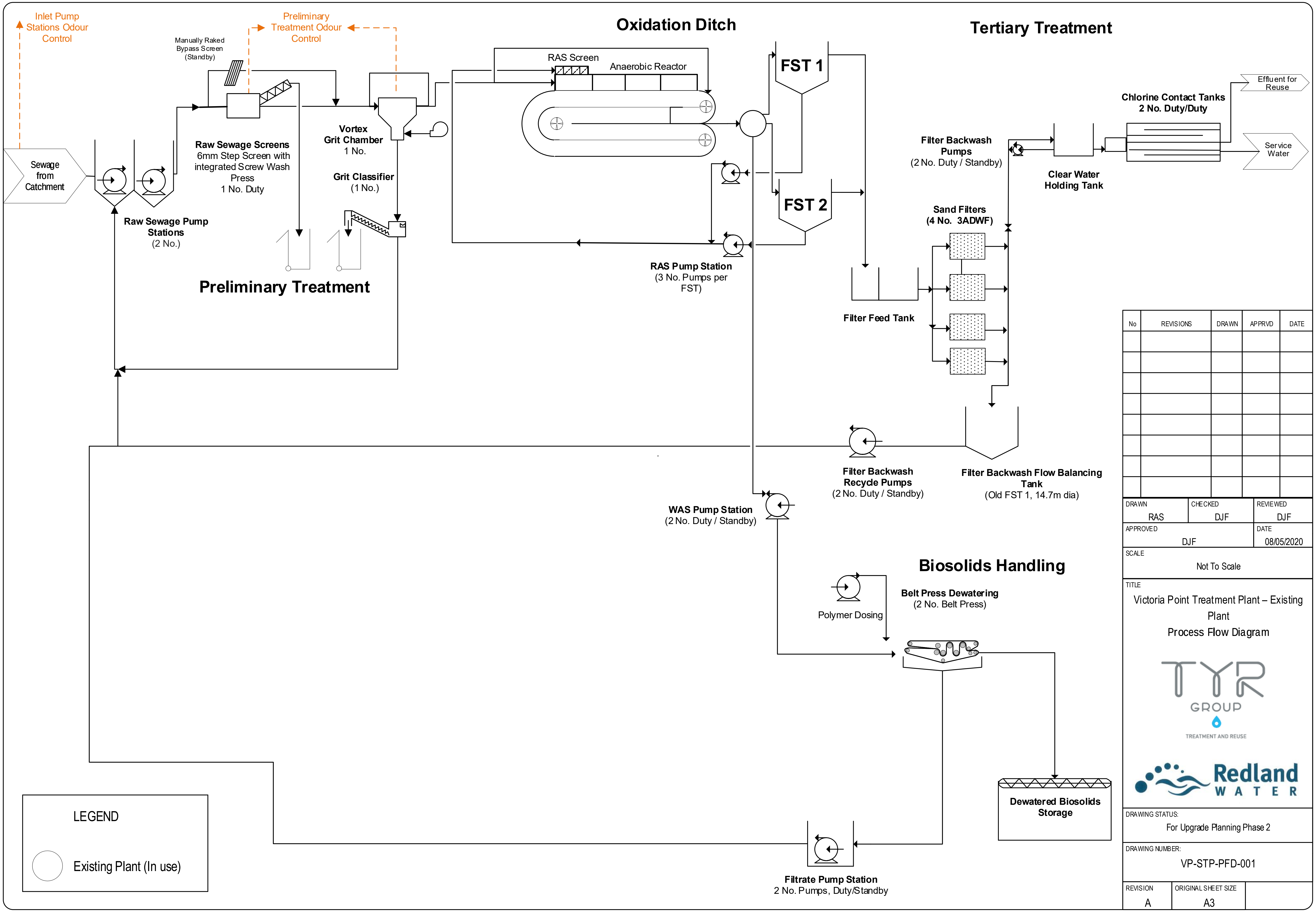
The planning investigations and concept design have identified a suite of renewals and upgrade works required to meet the baseline growth in loads projected through to 2041 (37,097 EP), and additional works required to manage the additional loads associated with the South West Victoria Point and Weinam Creek development (44,312 EP). The works required in each of these phases, and the associated staging of works, are summarised in Table 5-5 and Figure 5-2 overleaf.

Table 5-5: Summary of Required Plant Upgrades and Staging

Upgrade	Infrastructure	Required from	
Renewals and Plant Upgrades Required to Service Baseline Growth			
Raw Sewage Pumps	2 No. New Raw Sewage Pumps (in progress under separate project)	41,240 EP	Installation scheduled for August 2020
Raw Sewage Screens	2 No. New Band Screens and 2 No. Screw Wash Presses	As soon as possible (for performance and redundancy)	
Aerator Covers / Noise Control	Removal of existing covers / installation of noise barriers	As soon as possible (existing covers corroded)	
Increased Peak Chlorine Dose Rate	Control system change / minor works to facilitate duty/assist chlorinator operation	As soon as possible (estimated peak dose rate < demand)	
Biosolids Handling	New dewatering trains / WAS pump station and poly storage and dosing (in progress under separate project)	As soon as possible (existing GDD/BFPs at end of serviceable life)	
Plant Upgrades Required to Service Additional Developments			
Increased Nitrogen Removal	Post-Anoxic / Re-Aeration Zone)	38,700 EP	2025
Additional Solids Settling Capacity	1 No. Additional Secondary Clarifier	38,300 EP	2024
Additional Disinfection Capacity	1 No. Additional Chlorine Contact Tank	38,700 EP	2025

The renewals and upgrade works required for baseline growth are required to be completed as soon as possible. Given the limited scope of these upgrade works within the plant, completion of these upgrades could be completed as a single project, or as a suite of minor projects.

Completion of the works to service additional developments is required to be completed and in service by 2024-25. This suggest the works should be undertaken as a single stage and under a single contract with procurement and design commencing in 2020-21.



No	REVISIONS	DRAWN	APPRVD	DATE

DRAWN	CHECKED	REVIEWED
RAS	DJF	DJF

APPROVED DJF

DATE 08/05/2020

SCALE Not To Scale

TITLE
Victoria Point Treatment Plant – Existing Plant
Process Flow Diagram

TYR GROUP
TREATMENT AND REUSE

Redland WATER

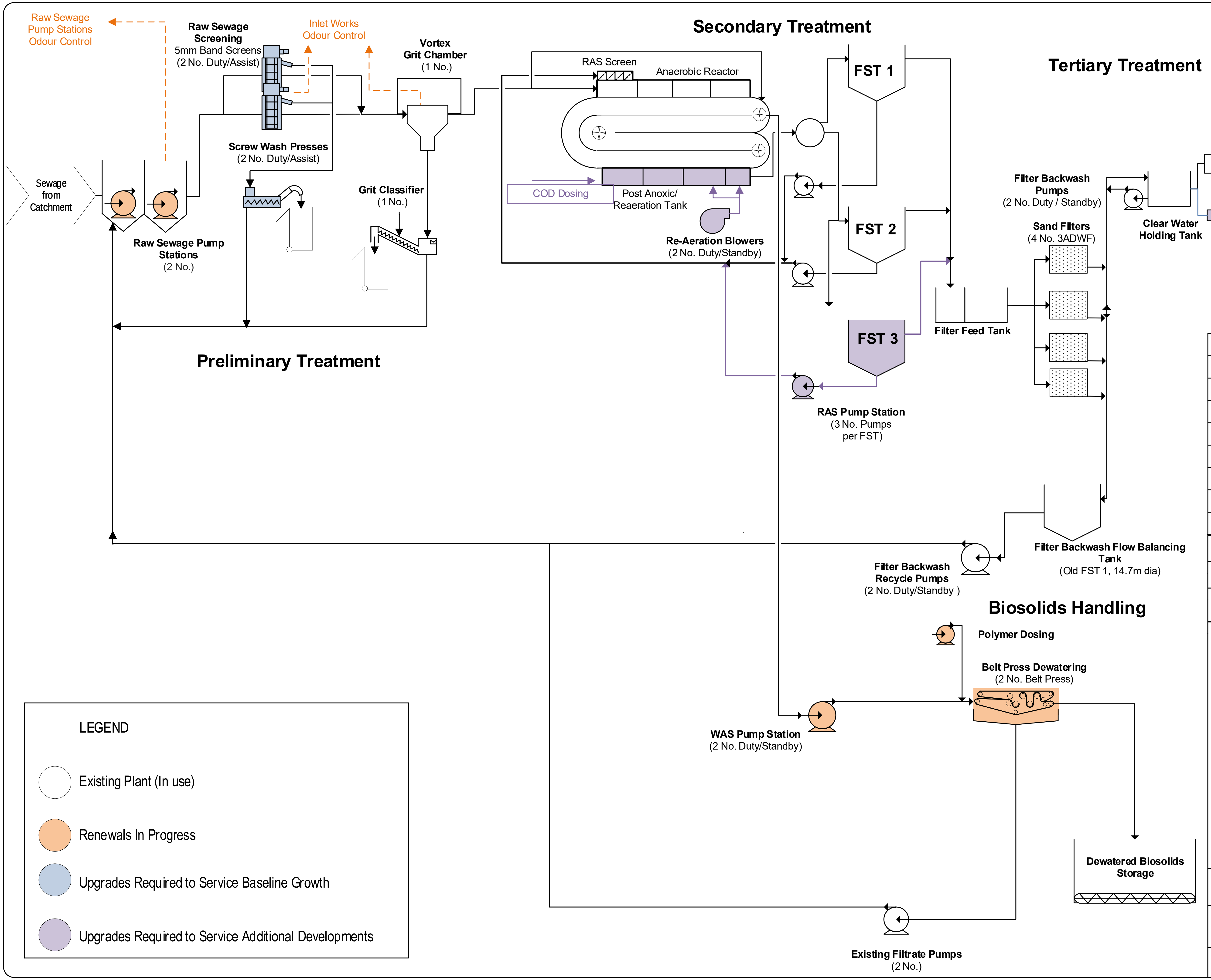
DRAWING STATUS:
For Upgrade Planning Phase 2

DRAWING NUMBER:
VP-STP-PFD-001

REVISION A

ORIGINAL SHEET SIZE A3

HTTPS://TYRGROUP.SHAREPOINT.COM/SITES/PROJECTS/SHARED DOCUMENTS/J1904 - VICTORIA POINT UPGRADES/DRAWINGS/VICTORIA POINT STP - PROCESS FLOW DIAGRAM - REV A - EXISTING PLANT - FOR PHASE 2 REPORT.VSD



LEGEND

○ Existing Plant (In use)

● Renewals In Progress

● Upgrades Required to Service Baseline Growth

● Upgrades Required to Service Additional Developments

No	REVISIONS	DRAWN	APPRVD	DATE

DRAWN	CHECKED	REVIEWED
RAS	DJF	DJF

APPROVED DJF

DATE 08/05/2020

SCALE Not To Scale

TITLE

Victoria Point Treatment Plant –
Option 2, 20 day Sludge Age, Additional
Clarification
Process Flow Diagram

TYR GROUP
TREATMENT AND REUSE

Redland WATER

DRAWING STATUS: For Upgrade Planning Phase 2

DRAWING NUMBER: VP-STP-PFD-002

REVISION	ORIGINAL SHEET SIZE
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6 RENEWALS AND PLANT UPGRADES REQUIRED TO SERVICE BASELINE GROWTH

The process selection and concept design of the upgrades required to rectify issues, renew key process systems, and service the baseline growth in the catchment are summarised in the following sections.

6.1 RAW SEWAGE PUMPS

As noted in Section 5.1, two new pumps have been ordered for the Victoria Point WWTP inlet pump station, and are expected to be delivered and installed in August 2020[2]. The new pumps are projected to deliver 550 L/s with both units operating. This is equivalent to 43,200 EP capacity under the adopted basis of planning. This is substantially above the requirement for the projected 2041 load without additional developments, but is marginally (2.5%) less than that required for the projected 2041 load if the South West Victoria Point and Weinam Creek developments proceed. If these developments proceed, delivery of 5 x ADWF to the plant without bypass will require upgrade to the pumps in 2031.

The anticipated scope of upgrade works to the Raw Sewage Pumps in 2031 would comprise two new larger pumps (565 L/s at 18-20m head). Due to the marginal increase in flow required at this time, it has been assumed that the 2031 pump upgrade can proceed without removal and replacement of the existing 400mm DN MSCL pipework (with the existing influent sewage flowmeter) with a larger (500mm DN) pipe and new (larger) flowmeter to reduce headlosses, or substantial electrical works. There may also be potential that pumps to be installed in August 2020 may achieve the required 2041 flow without upgrade (e.g. through lower screen losses, or minor overspeed).

6.2 RAW SEWAGE SCREENS

The existing single duty step screen is considered to be in a suitable condition for ongoing use. However, given the reliance of Victoria Point STP on a single bioreactor which cannot be taken out of service, the upgrade of the inlet screen system has been identified as required to improve the proportion of screenings captured to minimise accumulations in the downstream process units, and reduce the risk of blockages and damage in the mechanical systems.

Testing undertaken in the United Kingdom indicated that step screens, operated well, generally achieve a screenings capture ratio in the order of 30-35%. By contrast, alternative technologies such as band, drum, or spiral screens can achieve capture ratios of up to 85%. The selection of 5 or 6 mm 2-dimensional screens is generally accepted as optimum for conventional wastewater treatment plants (i.e. non-membrane bioreactor process trains). This aperture size provides effective removal of screenings – particularly if the screens are controlled such that a mat of screenings builds up on the front face to provide finer screening of the wastewater.

The concept design of the screening upgrade has been based on band screens based on:

- Ability to be readily retrofitted to the existing inlet works structure;
- Sufficient capacity for Duty/Standby operation (if required) within the existing channels;
- Best available screenings capture performance (due to 2-D screen profile, and flow configuration);
- High degree of industry acceptance and application;
- Relatively low turbulence in operation (particularly compared to drum screen alternatives), and,
- Robust reliability and performance – provided suitable care is taken in equipment selection and proper maintenance is undertaken.

The preliminary configuration is based on fitting two parallel band screens to the existing inlet works – one in place of the existing step screen, and the second in the existing bypass channel. The concept design is based on sizing of the screens to operate in a duty/assist configuration for flows up to 5 x ADWF. It is important to note that the channels can readily accommodate screens sized for duty/standby operation at a small cost premium.

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[2] The new pumps are Wilo 55 kW 6 pole FA25.93T pumps with FK34.1-6/33 motors.

The key attributes of the raw sewage screens selected for concept design are summarised in Table 6-2.

Table 6-1: Upgraded Raw Sewage Screens Design Summary

Parameter	Value	Comments
Screen Type	Band Screen, Hydro-Dyne Great White Centre Flow, Model CF-26-24-135-5-P [Note 1]	5mm UHMWPE Perforated panels
Number of Screens	2 No.	Duty/Assist
Peak Capacity per Screen	283 L/s peak design flow	
Design Loading per screen (1 screen on-line)	ADWF: 113 L/s	ADWF at design horizon
	PDWF: 220 L/s	1.95 x ADWF at design horizon
	Peak Instantaneous: 283 L/s	
Design Loading per screen (2 screens on-line)	ADWF: 56 L/s	ADWF at design horizon
	PDWF: 134 L/s	2.2 x ADWF at design horizon
	Peak Instantaneous: 283 L/s	Duty/Standby Peak Instantaneous: 564 L/s
Wash water	3 L/s per band screen	In operation only, 4 bar minimum pressure
Screen Material of Construction	316SS with UHMWPE screen panels	
Maintenance	Upstream and downstream isolation provided by stopboards. Individual panels can be removed and replaced with unit in place.	

Note 1: As an alternative, Duty/Standby screening capacity can be provided by Hydrodyne Model CF-28-36-141-5-P, giving 565 L/s capacity per screen. Concept design confirms that this model can be accommodated in the existing screenings channels without additional works.

The transfer of screenings from the band screens to the screenings handling system will be achieved by a dedicated sluicing launder for each screen. The deluge wash service water flow applied during screen clearing is sufficient to effectively convey the screenings through the sluicing launders. This makes the selection of a sluicing launder, which has no moving parts, more suitable than a screw or belt conveyor in this application.

Fine screens can be expected to remove significant quantities of biodegradable organic (i.e. faecal) material with the screenings. To manage this material, the collected screenings will be washed and dewatered with a view to achieving the following aims:

- Improve the quality of the dewatered screenings product;
- Reduce the volume of screenings requiring storage and off-site disposal;
- Control odour, and,
- To ensure that the full organic load is made available to the secondary treatment process for biological nitrogen removal.

Washpactors and screw wash presses are the most commonly used technologies for screenings washing and dewatering. Both types of screenings handling systems are generally completely enclosed to contain odour. While washpactors provide more effective screenings washing and organics recovery, they have greater demands for service water, power and capital cost compared with screw wash presses. Further, in spite of the superior quality of the screenings product produced by washpactors, the screenings products of both washpactors and screw wash presses require disposal at secure landfill. On this basis, the concept design has been based on two screw wash presses with the screenings collected by each screen normally directed to a single washpactor.

The key attributes of the screenings washing and dewatering system selected for concept design are summarised in Table 6-2.

Table 6-2: Screenings Washing and Dewatering Summary

Parameter	Value	Comments
Screenings Conveyor Type	Sluicing Launder, Kuhn KLS-280	
Service Water	2 L/s	Intermittent only
Screening Washing Type	Screw Wash Presses, Kuhn KWP-P 250/1200	
Number of Units	2 No.	Duty/Assist 1 No. per band screen
Estimated Screenings Production	ADWF: 1.05 m^3/d PWWF: 5.3 m^3/d	Based on 12% Dryness
Solids Handling Capacity Per Unit	2.8 m^3/h of raw screenings	
Material of Construction	316SS	

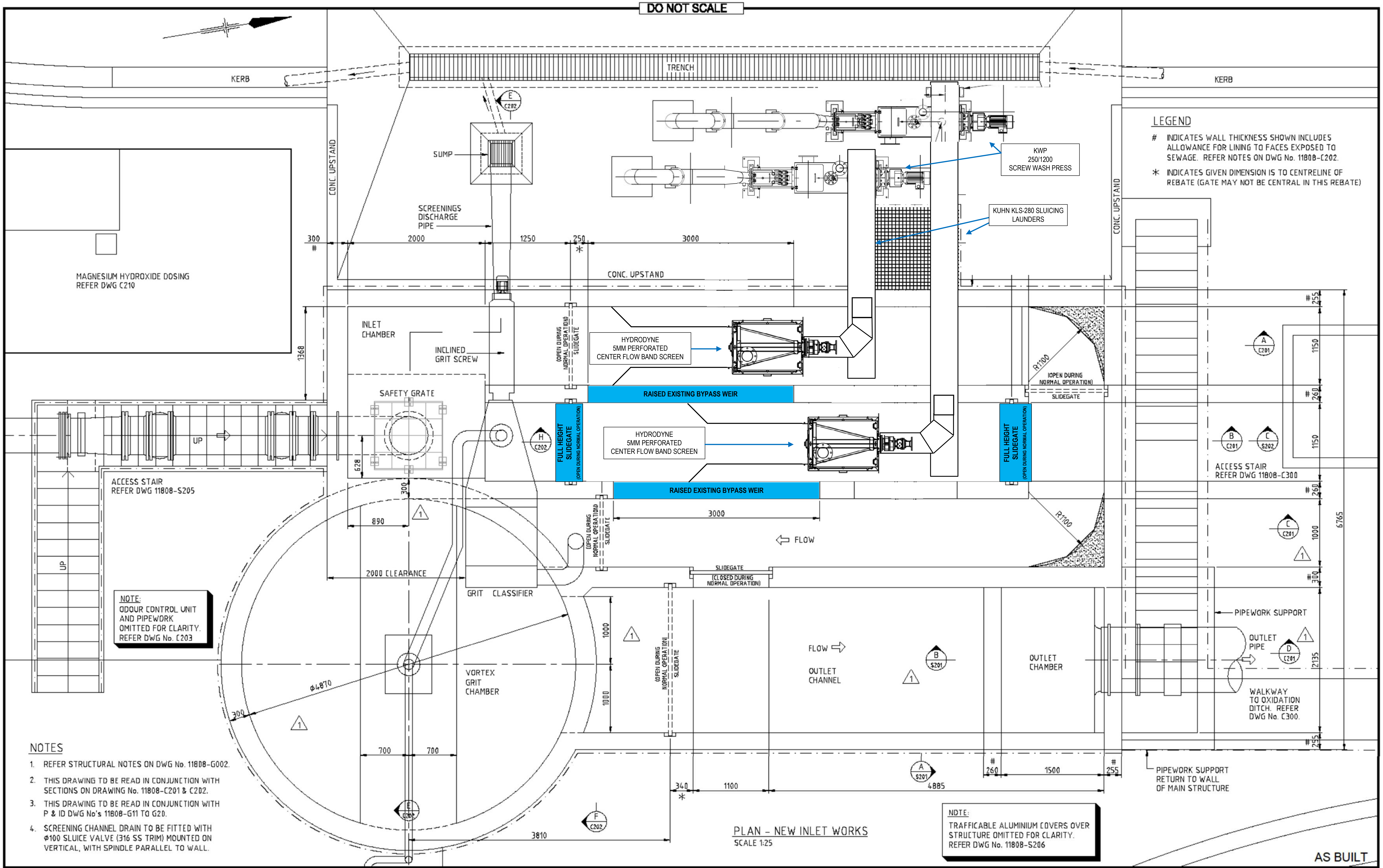
The concept design has been based on each screen, sluicing launder, and screw wash press being configured as a distinct train to avoid all single points of failure in the system and simplify installation. The outline scope of works for installation of the new screening and screenings handling system will comprise:

- Filling of the existing bypass weirs between channels with plates or concrete. Screen bypass weirs for the new screening system will be provided by configuring the baffle plates upstream of the band screens to overtop in the event of excessive depth of flow (due to screen failure).
- Removal of the existing false floor from the bypass channel by concrete cut and repair to provide the full channel depth for the new screen.
- Installation of two new stopboards in the modified channel to facilitate upstream and downstream isolation of the new screen. The existing stopboards in this channel are of insufficient height for the modified configuration.
- Installation of one new band screen in the modified bypass channel, and its associated sluicing launder and screw wash press to provide a complete train. The new train will be used to screen the full plant inflow (at flows <2.5 x ADWF) on commissioning, enabling the existing step screen and screw wash press to be removed.
- The second band screen will be installed in the existing step screen channel, and its associated sluicing launder and screw wash press installed adjacent to the new unit.

It is not anticipated that substantial changes to the odour control system will be required as a part of upgrade to the screenings system. Additionally, a high level review of the existing service water system indicates that it has sufficient capacity to provide the ~12 L/s of peak service water demand required for simultaneous operation of the screens and screw wash presses.

The concept design of the upgraded raw sewage screening and screenings handling system is provided in Figure 6-1 and Figure 6-2 overleaf.

DO NOT SCALE



LEGEND

\# INDICATES WALL THICKNESS SHOWN INCLUDES ALLOWANCE FOR LINING TO FACES EXPOSED TO SEWAGE. REFER NOTES ON DWG No. 11808-C202.

* INDICATES GIVEN DIMENSION IS TO CENTRELINE OF REBATE (GATE MAY NOT BE CENTRAL IN THIS REBATE)

NOTES

1. REFER STRUCTURAL NOTES ON DWG No. 11808-G002.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH SECTIONS ON DRAWING No. 11808-C201 & C202.
3. THIS DRAWING TO BE READ IN CONJUNCTION WITH P & ID DWG No's 11808-G11 TO G20.
4. SCREENING CHANNEL DRAIN TO BE FITTED WITH φ100 SLUICE VALVE (316 SS TRIM) MOUNTED ON VERTICAL, WITH SPINDLE PARALLEL TO WALL.

PLAN – NEW INLET WORKS
SCALE 1:25

NOTE:
TRAFFICABLE ALUMINIUM COVERS OVER STRUCTURE OMITTED FOR CLARITY. REFER DWG No. 11808-S206

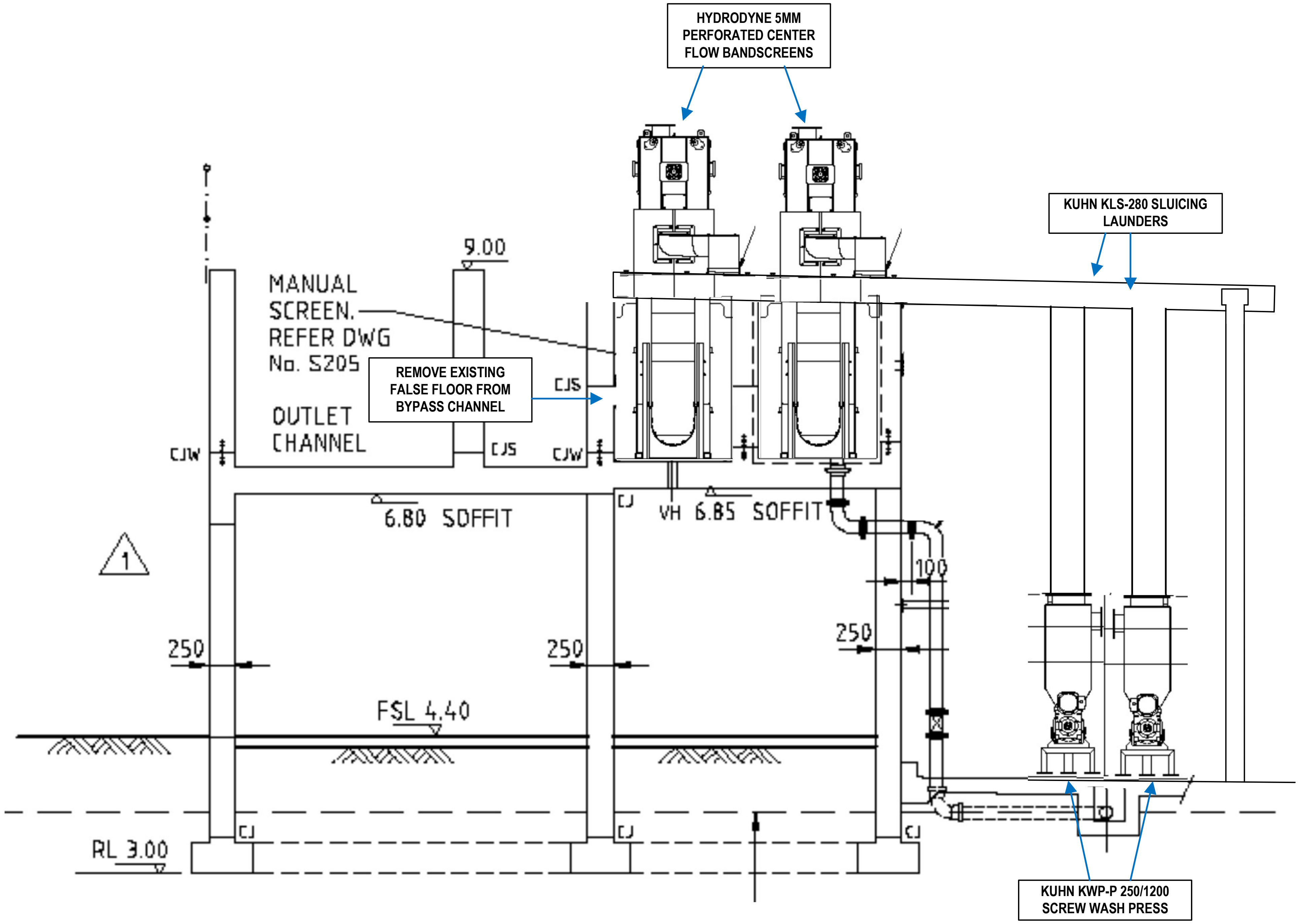
AS BUILT

No.	REVISIONS	DRAWN	APPROVED	DATE
A	For Estimation	RAS	DJF	06/05/2020

DRAWN BY
NAME RYAN SCHWARTZ
CHECKED BY
NAME DAVID FLIGELMAN
APPROVED BY
NAME DAVID FLIGELMAN
DATE
06/05/2020

TITLE
Victoria Point Treatment Plant -
Inlet Works Duty/Standby Bandscreens
Plan View

DRAWING STATUS
For Phase 2 Planning
SCALE
1:25 at A3
DRAWING NUMBER
J1904-1-1
REVISION
A
SHEET SIZE
A3



No.	REVISIONS	DRAWN	APPROVED	DATE
A	For Estimation	RAS	DJF	06/05/2020

DRAWN BY
NAME RYAN SCHWARTZ
CHECKED BY
NAME DAVID FLIGELMAN
APPROVED BY
NAME DAVID FLIGELMAN
DATE
06/05/2020

TITLE
Victoria Point Treatment Plant -
Inlet Works Duty/Standby Bandscreens
Plan View

DRAWING STATUS
For Phase 2 Planning
SCALE
1:25 at A3
DRAWING NUMBER
J1904-1-2
REVISION A
SHEET SIZE A3

6.3 AERATOR COVERS / NOISE CONTROL

As noted in Section 3.10, the acoustic covers on the aerators are substantially corroded. These covers should be removed as a priority. Depending on noise nuisance from the units, options include:

a. Removal of the covers without replacement, and coating of drive, gearbox and appurtenances are required to protect the units.

b. As per a., but including noise barriers local to each unit to avoid any nuisance, or,

c. Replacement of the acoustic covers with covers with suitable corrosion protection.

Based on consultation with Redland City Council stakeholders, the concept design has been based on removal of the covers, coating of the aerator drives, gearbox and appurtenances, and installation of noise barriers to limit noise emissions. Provision has been made for installation of noise barriers to the north, east and south of the three aerators to limit noise emissions to the nearest anticipated noise-sensitive locations, including residences, Victoria Point State School, and Cameron Court Park.

6.4 TERTIARY FILTERS

The existing deep bed media filters are sized to treat flows up to 3.0xADWF at a connected population of 35,350 EP. In the absence of upgrade, the capacity of the filters (as a function of ADWF) would reduce from 3.0 x ADWF to 2.8 x ADWF at the 2041 projected capacity in the absence of additional developments, and 2.4 x ADWF if the South West Victoria Point and Weinam Creek developments proceed.

Provision of additional filtration capacity has not been considered as warranted, as:

- The capacity of the existing filters is large enough to manage the expected peak dry weather flow through to the design horizon.
- Given that the clarifiers are sized for 5 x ADWF, and the quality of the secondary effluent generally achieved by the secondary treatment process, the effluent quality at flows exceeding 2.4 x ADWF is expected to be suitable for direct discharge to chlorination, and well within the maximum license limit of 30 mg/L total suspended solids.
- While filtration is critical to ensure the performance of UV disinfection systems, the upgraded plant design is based on retention of chlorine disinfection. This reduces the potential impact of secondary effluent flows bypassing the filters on disinfection performance.

Overall, additional filter capacity is not considered to be required to meet the current effluent quality requirements.

6.5 DISINFECTION

6.5.1 Chlorine Contact Tanks

Full details of the chlorine contact tank capacity and requirements for upgrade are provided in Section 7.3. The nominal capacity of the existing chlorine contact tanks is effectively pegged to the existing plant's nitrogen removal capacity at 38,300 EP. On this basis, no additional chlorine contact volume will be required until after 2041 under the baseline population projection.

Augmentation of the chlorine contact system is required in the event that the South West Victoria Point and Weinam Creek developments proceed. The basis and concept design of this upgrade element is described in Section 7.3.

IMPORTANT: There is potential for changes to the prevailing operating practices, as may be required for other aspects of plant operation, to threaten compliance with the maximum free chlorine limit at loads less than 38,300 EP. For example, off-lining of CCTs for maintenance outside of low flow periods, increased aeration to reduce effluent total nitrogen, or changes to the practices in chlorine dosing control could all result in exceedance of the maximum free chlorine limit. To this end, it is recommended that the chlorine disinfection performance be routinely reviewed as flows increase to ensure robust and consistent compliance observed in operations to date is being maintained.

6.5.2 Chlorine Storage and Dosing

The existing chlorine storage comprises two 920 kg chlorine drums coupled to two De Nora chlorinators. The two drums currently operate in a duty/standby arrangement.

Based on a minimum temperature of chlorine within the drums of 20°C, the maximum sustained chlorine withdrawal rate from each drum is approximately 10 kg/h - though higher withdrawal rates may be possible for short periods.

The capacity of the existing chlorinators is not known, but is estimated to be 10 kg/h based on the tubing size installed. However, these units can operate at up to 60 kg/h with suitable tube sizes and flowmeters.

The capacity assessment and concept design of upgrades to the chlorine storage and dosing are summarised in Table 6-3. While the reported performance of the existing disinfection system is sound, process modelling suggests that the existing chlorine dosing configuration may not be able to deliver the peak dose required during wet weather events. This has not been an issue under plant operations to date. Based on the available information, it appears that modification of the two chlorine storage and dosing trains to operate on a duty/assist (rather than a duty/standby basis) will be sufficient to enable the required peak chlorine dose to be delivered. While a full review of the system's capability by a specialist supplier would be required to confirm this, this change appears to be achievable through minor modification of the control system.

Additionally, as flows on the plant increase, the storage of additional drums may be preferred by operations personnel to reduce the frequency of deliveries. As the existing room includes space to store an additional two drums if required, the provision for storage of two additional drums may require additional pipework and fittings connections, and review and updates to the chlorine manifest, emergency response plans and other safety requirements.

Table 6-3: Chlorine Storage and Dosing Capacity and Upgrade Requirements

Loading Scenario	2020 (existing)	2041 without developments	2041 with developments	Notes
Chlorine Contact Tank Volume	2 No. Tanks (400 kL)	2 No. Tanks (400 kL)	3 No. Tanks (600 kL)	See Section 7.3 for additional CCT.
Chlorine Storage (920 kg drums)	2 No. connected	2 No. connected 2 No. Unconnected	2 No. connected 2 No. Unconnected	Space in existing building for up to 2 No, Unconnected Drums
Operating Configuration	Duty/Standby	Duty/Assist	Duty/Assist	Minor modification of controls required to meet peak chlorine dose rate
Storage per 920 kg drum at average consumption	27 days	23 days	20 days	
Chlorine Dosing				
Average Chlorine Dose	5.6 mg/L Note 1	5.9 mg/L	5.5 mg/L	Estimated peak dose unable to be met in existing chlorine system
	1.44 kg/h Note 1	1.67 kg/h	1.93 kg/h	
Peak Chlorine Dose	11.3 mg/L	11.9 mg/L	11.0 mg/L	
	14.5 kg/h	18.0 kg/h	19.9 kg/h	
Maximum nominal withdrawal rate	10 kg/h/drum			
Estimated Chlorinator Capacity	10 kg/h/chlorinator, upgradable to 60 kg/h (existing)			

Note 1: From Plant log, 2015-2020

6.6 BIOSOLIDS HANDLING

The existing dewatering system at Victoria Point WWTP includes two (2) gravity-drainage-deck-plus-belt-filter-press combination units (GDD-BFP's) to dewater mixed liquor and scum. The existing machines are reaching the end of their operating life, and require extensive maintenance to remain operational. They also perform relatively poorly, achieving a relatively poor dry solids concentration in the dewatered biosolids product of only 12-14%.

Due to the condition of the existing dewatering system, the options for upgrading the dewatering system are currently under investigation as a part of the separate project. On determining the preferred upgrade solution, upgrade to the system is expected to be procured in the 2020-21 financial year. On this basis, and given the minimal impact of the upgrade planning on the dewatering system requirements under the finalised End-of-Waste code, the biosolids dewatering upgrade is not considered within this investigation.

7 PLANT UPGRADES REQUIRED TO SERVICE ADDITIONAL DEVELOPMENTS

The process selection and concept design of the upgrades required to meet the growth in the catchment as a result of additional developments are summarised in the following sections.

7.1 INCREASED NITROGEN REMOVAL

7.1.1 Options Identification and Short-Listing

The concept design includes augmentation to reduce effluent total nitrogen concentrations to meet the mass load limit at loads in excess of 38,700 EP. Should both the South West Victoria Point and Weinam Creek development proceed, these works are projected to be completed by the end of 2025.

The options to enhance the nitrogen removal process within the existing plant were the subject of an identification and short-listing process to identify the preferred solutions to be carried forward for more detailed analysis. As detailed in Section 3.6.4, the ammonia, oxidised nitrogen, and refractory nitrogen fractions of the total nitrogen in the plant effluent indicate that there is substantial potential for the nitrogen concentrations to be reduced further using conventional processes. The long-list of options considered is summarised in Table 5-3.

In addition to the treatment options, it is important to note that compliance with the licence could also be achieved through a number of alternative options which accommodate higher effluent total nitrogen concentrations. As discussed in Section 3.6.1 the assimilative capacity of Eprapah Creek is currently being modelled as a background to the future development of the plant. Depending on the results of the modelling, and subsequent negotiations with the DES, potential solutions include:

- Renegotiation of the Stage 2 Nitrogen Mass Load Limit based on the impacts of nitrogen loads (see Section 3.6.1);
- Increased effluent reuse to reduce the volume of flow discharged to Eprapah Creek;
- Relocation of the effluent discharge point closer to the mouth of Eprapah Creek (where dilution with tidal flow is increased);
- Installing effluent storage to enable effluent discharge to be limited to the ebb-tide periods (during dry weather).

The viability of these options depends on the results of the environmental assessments, and have the potential to deliver greater value if viable. They remain outside the scope of the upgrade investigations. It is recommended that the development and assessment of these alternative options be pursued if viable upon conclusion of the current environmental investigations.

Table 7-1: Summary of Options Identification and Short-Listing for Enhancing Nitrogen Removal

Option	Advantages	Disadvantages	Carried Forward
Treatment Plant Options			
Dry Weather Flow and Load Attenuation (Influent Balance Tank)	• Proven, well understood technology applied at multiple STPs in SEQ to target very low effluent total nitrogen. • Provides opportunity to optimise operations through reducing plant dynamics and shifting power demand from peak to off-peak periods.	• Plant already achieves very low effluent ammonia • Does not provide additional wet weather treatment capacity • High Capex due to large tankage (2.5 to 3 ML) and odour control (15,000-24,000 m^3/h) required • Not likely to be as effective as other solutions within Victoria Point STP's existing configuration.	✗
Post-Anoxic / Re-Aeration Tank	• Proven, well understood technology. Reliably provides supplemental nitrification and denitrification. • Existing oxidation ditch has been configured specifically to enable post-anoxic tankage to be readily added. • Denitrification performance can be efficiently supplemented with chemical substrate (e.g. sugar), eliminating the risk in influent characteristics • Provides a minor increase in solids removal capacity through increasing bioreactor volume • Enables structural issues in one section of the existing oxidation wall to be resolved.	• Additional access road required for maintenance of new equipment in post-anoxic / reaeration zone.	✓
Ozone and BAC	• Well developed, mature technology • Robust additional nitrogen removal • Small footprint	• High energy and materials consumption • Significant additional process complexity compared to alternatives and existing STP.	✗
Reverse Osmosis	• Well developed, mature technology • Can robustly achieve the required levels of nitrogen removal • Small footprint	• No sink available for the nitrogen removed with the RO system and brine stream • High energy consumption	✗

The two options which were considered in detail are discussed further in the following.

Post-Anoxic/Re-Aeration Tank

This option would comprise addition of further bioreactor tankage at the downstream end of the oxidation ditch to provide:

1. A post-anoxic zone, where oxidised nitrogen can be denitrified under anoxic conditions. The substrate to drive this additional denitrification is generated through the death and lysis of organisms within the biomass, and if required, augmented by dosing of additional substrate to drive rapid denitrification.
2. A re-aeration zone, to oxidise any ammonia released through death/lysis of organisms in the post-anoxic zone, drive additional biological P uptake as required, and deliver the mixed liquor to the clarifiers with sufficient dissolved oxygen.

Based on experience in the design of comparable systems, the optimal post-anoxic zone generally comprises a mass fraction of 6-9%, and the optimum re-aeration zone approximately 2-3% mass fraction.

Influent Sewage Dry Weather Balance Tank

The effluent of conventional biological nitrogen removal processes suffer from a peak in effluent ammonia associated with diurnal peak flow period. As nitrifying organisms are very slow growing, they are unable to respond to large scale increases in nitrogen load above the average. As a result, normal dry weather flows generally see the effluent ammonia increase for a few hours during and after the peak loading period. Additionally, effluent nitrate generally increases for many hours after the peak in effluent ammonia due to the nitrification of the excess ammonia in the absence of the substrate required to denitrify it. The balancing of influent sewage flows during dry weather enables the peaks in both effluent ammonia and effluent oxidised nitrogen to be avoided, reducing effluent total nitrogen (on a 24-hour basis).

Dry weather influent sewage flow balancing is used at a number of sewage treatment plants in South East Queensland, including Murrumba Downs, Cooroy, and Pimpama. These facilities demonstrate the capability of load balancing to deliver very low effluent ammonia and nitrate.

A dry weather balancing tank at Victoria Point would need to be approximately 2.5-3 ML in working volume, and would seek to attenuate dry weather flows between approximately 80% and 120% of the average flow. In wet weather, the balance tank would generally fill, and flow attenuation would cease. Flow would be pumped from the tank to the inlet works / secondary treatment process by relatively low head pumps. Due to the configuration of the existing raw sewage pump stations at Victoria Point, a balance tank is likely to be most cost effectively delivered as an additional (very large) wet well for these pump stations.

Due to the odours associated with storage of sewage, it is anticipated that a balance tank at Victoria Point STP would need to be fully enclosed and maintained at a negative pressure by an odour control facility. Due to the large volume of air within the balance tank, and its potential rate of filling, the odour control system required to ensure licence compliance would be of substantial scale. Mixing of the balance tank would also be required to ensure that it balances load (rather than just flow).

A Post Anoxic/Re-Aeration Tank has been adopted as preferred upgrade for Victoria Point as:

- The need for and potential benefits of an influent dry weather sewage balance tank are limited by the very low effluent ammonia already achieved by the plant. A balance tank can also be used to deliver lower effluent nitrate (as required to reduce overall effluent total nitrogen), but not as efficiently or robustly as a Post Anoxic Zone / Re-Aeration zone (with substrate dosing if required).
- The capital and operating costs associated with a balance tank will be larger due to the need for:
  - An odour control system of substantial capacity;
  - Construction of a 2.5-3.0 ML tank (compared to a 0.85-0.90 ML post-anoxic / reaeration tank), including corrosion protection, and,
  - Additional scope in pipework and existing asset modifications.

- The additional wet weather treatment capacity provided by the post-anoxic /reaeration tank (which is not provided by the balance tank option).
- The potential to use the new post-anoxic / re-aeration tank to provide additional cover over the reinforcement in the eastern side of the existing oxidation ditch wall.

7.1.2 Post-Anoxic / Re-Aeration Tank Concept Design

The Post Anoxic zone will comprise three cells, complete with sugar dosing to the first zone if required. Each cell will contain a high-speed compact mixer to maintain the solids in suspension. The Re-Aeration cell will be located downstream of the oxidation ditch and will be serviced by two blowers, diffused aeration and one DO meter. Additionally, the third post-anoxic cell will be fitted with aeration to enable it to operate under anoxic or aerobic conditions as process requirements vary.

The outlet pipework from the existing oxidation ditch outlet has been specifically configured to enable the future addition of a post-anoxic/re-aeration tank on the eastern side of the existing structure. This tank may be cast against the existing reactor to provide some additional cover to the reinforcement of the oxidation ditch, which is showing surface cracking.

Key considerations in the design of the of the Post-Anoxic / Re-Aeration Tank included:

- A post-anoxic zone that is large enough (and compartmentalised) to deliver efficient substrate utilisation in denitrification, but not so large that all nitrate is exhausted well prior to the end of the zone (which can compromise biological phosphorus removal performance).
- Sufficient aeration capacity to fully oxidise any residual substrate and ammonia in the re-aeration zone.
- The provision to aerate the third Post-Anoxic cell under reduced loading conditions to prevent anaerobic conditions (and associated loss of biological phosphorus removal performance).
- Provision of an overall increase in bioreactor volume to deliver increase in wet weather treatment capacity.

Both the dynamic and steady-state process models have been used to support the development of the design for the Post-Anoxic / Re-Aeration Tank. The revised configuration of the model is shown in Figure 7-1.

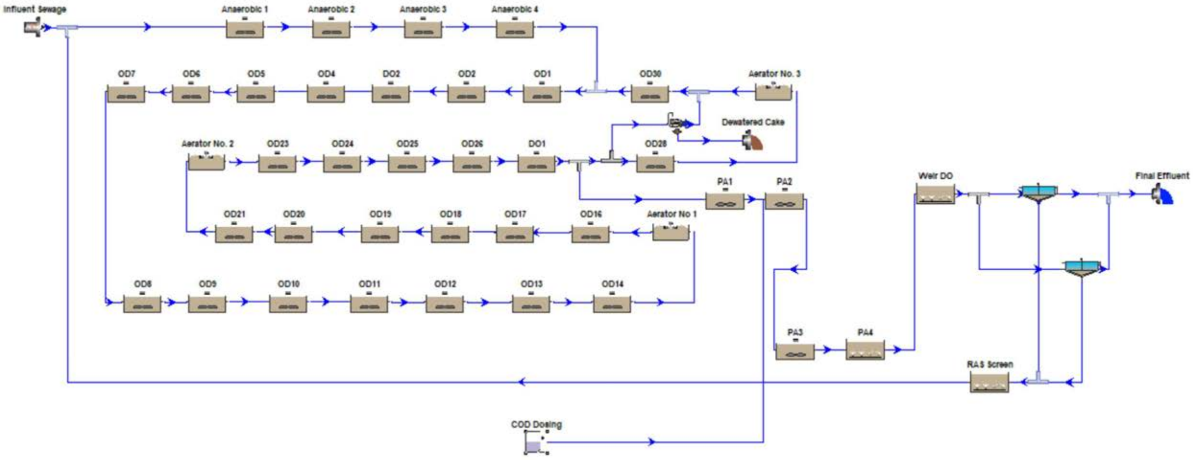


Figure 7-1: Dynamic Process Model including Post Anoxic Zone

The nitrogen removal performance and aeration requirements of the post anoxic zone are summarised in Table 7-2.

The modelling did not include the dosing of additional substrate, and indicated that no additional substrate will be required to achieve compliance with the effluent total nitrogen mass load limits. As a result, no facilities for substrate storage and dosing have been included in the concept design. Should substrate dosing be required in practice to manage operations, changed loading conditions, or drive to lower effluent total nitrogen, the existing Molasses Storage and Dosing Facility could be readily reconfigured for this purpose.

Table 7-2: Victoria Point STP – Post-Anoxic Zone Design - Dynamic Modelling Results

Loading Condition	EP	Temp (°C)	Effluent NH_3-N[1] (mg/L)	Effluent NO_3-N[1] (mg/L)	Effluent TN[1] (mg/L)	Mass Load (kg/d)	Ditch Setpoint (mg/L)	Re-Aeration Setpoint (mg/L)	Peak AOTR (kgO_2/hr)	Peak SOTR (kgO_2/hr)
AAL	37,097	23.9	0.05	0.27	**0.99**	8.1	0.6	2.0	8.6	26.2
AAL	44,397	23.9	0.08	0.28	**1.03**	10.1	0.6	2.0	10.6	32.2
MML	37,097	19.5	0.15	0.37	**1.43**	11.7	1.2	2.0	8.3	25.0
MML	44,397	19.5	0.41	0.39	**1.71**	16.7	1.2	2.0	10.7	32.3
MML	37,097	28.0	0.00	0.10	**1.01**	8.2	0.4	1.2	7.4	22.6
MML	44,397	28.0	0.05	0.30	**1.26**	12.3	0.4	1.2	12.0	32.5

Note 1: Based on 220 L/EP/d, 0.67 mg/L rDON at AAL, 0.91 mg/L rDON at MML

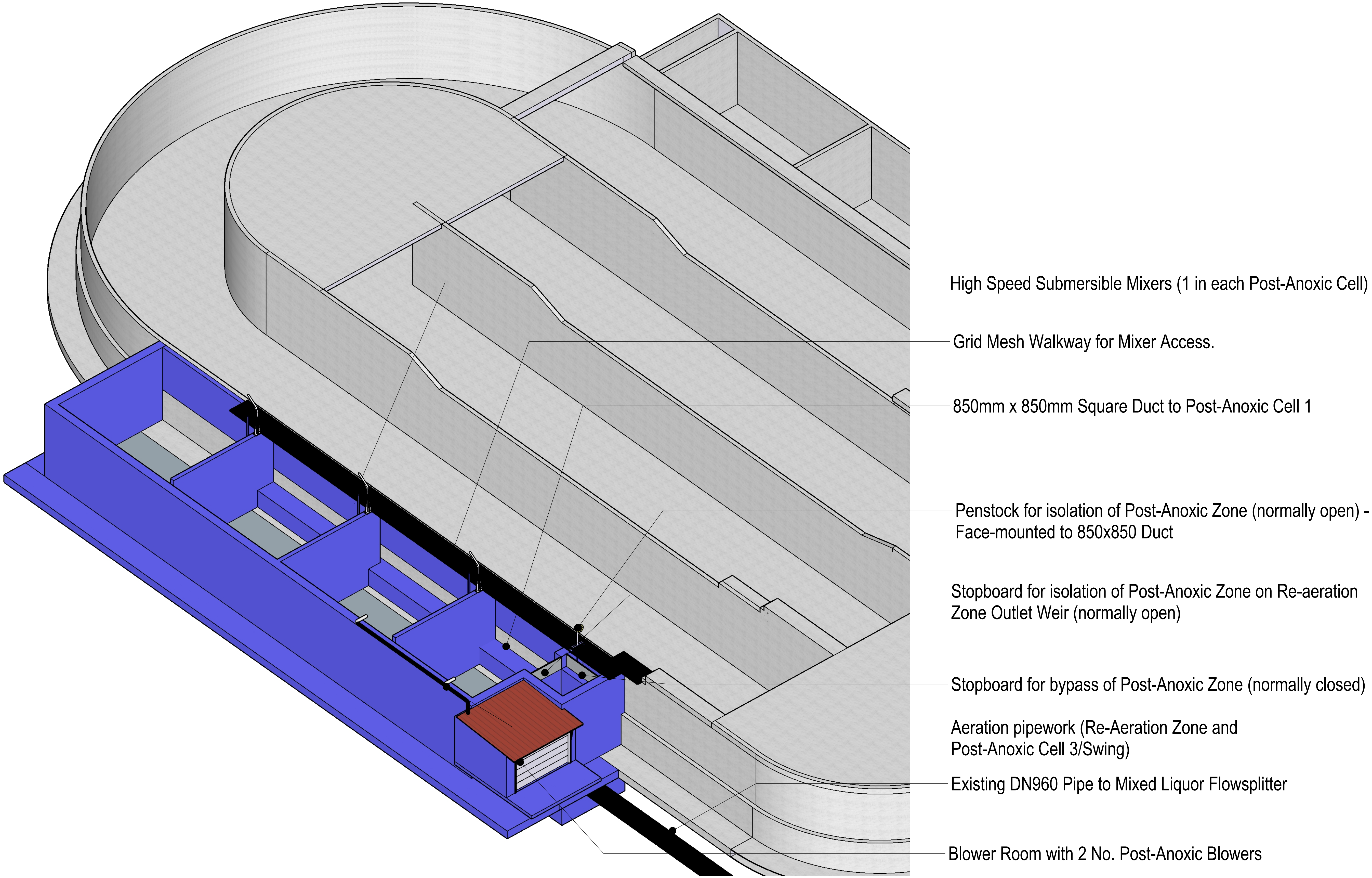
The concept design of the Post-Anoxic / Re-Aeration Tank is outlined in Table 7-3 and shown in Figure 7-2 through .

Table 7-3: Schedule of Capital Works – Augment Reactor with Post–Anoxic/Re-Aeration Tank

Item	Works required
Civil Structure	• Mixed liquor transfer chamber and re-aeration zone outlet chamber • 3 No. Post Anoxic Cells ○ 2.6% mass fraction (250 kL) each cell ○ Internal dimensions 8.46m length x 7.20m width x ~4.1m water depth ○ Serpentine flow between cells • 1 No. Re-Aeration cell ○ 2% mass fraction (187 kL) ○ Internal dimensions 6.37m length x 7.20m width x ~4.1m water depth • Western wall of new tank formed against existing oxidation ditch wall • 500mm external wall thickness, 500mm floor thickness with 1.5m toe. • 250mm baffle wall thickness
Mechanical	• Aeration fitted to Post-Anoxic Cell 3 and Re-Aeration Zone ○ Fixed-to-floor fine pore membrane diffuser systems ○ Positive displacement blowers (2 No., Duty Standby, 500 Nm³/h per blower), fitted in dedicated room at corner of outlet chamber for noise control. Roller-door access for maintenance. ○ DN150mm spiral wound stainless steel aeration pipework ○ 1 No. actuated butterfly valve for control of air flow to Post-Anoxic Cell 3. • 1 No. high speed compact mixer in each post anoxic zone cell (3.7 kW each)
Instrumentation	• 1 No. DO meter (Re-aeration zone)
Pipework modification	• Modify mixed liquor pipework (chamber attached to ditch or pipework) • 1 No. Penstock / 2 No. Stopboards to bypass new tank as required for maintenance • Submerged duct in tank for mixed liquor transfer to Cell 1
Ancillaries	• New walkway on tank wall for access • Relocation of scum harvester to north of existing location required. • New access road to blower room and apron included in scope.

Key attributes of the design include:

- Construction of a new Mixed Liquor Transfer Chamber and Re-Aeration Zone Outlet Chamber directly over the existing DN960 mixed liquor pipe to the between the oxidation ditch and mixed liquor flowsplitter. The chambers extend to below the floor slab level of the existing bioreactor and enable the pipe to be encapsulated into walls of the new chambers around the existing 90-degree bend. Following completion of construction and wet commissioning of the Post-anoxic / Re-aeration tank, process commissioning of the system can be undertaken through:
    1. Isolation of influent sewage and RAS flow from the oxidation ditch;
    2. Raising of the existing outlet weir of the oxidation ditch;
    3. Emptying the existing DN960 mixed liquor pipe (through closing the penstocks and temporary pumping from the mixed liquor distribution chamber);
    4. Cutting the existing bend at the inlet and outlet of the new transfer chamber;
    5. Returning penstocks and weirs to their normal positions, and re-establishing normal flows to the oxidation ditch.
- A submerged square duct (constructed in concrete) is used to transfer mixed liquor from the transfer chamber to Post Anoxic Cell 1 (through the Re-Aeration Zone, and Post-Anoxic Cells 3 and 2). On discharge to the anoxic zone,
- The inlet to the duct is fitted with a normally-open penstock within the transfer chamber. Isolation and drainage of the Post-Anoxic / Re-aeration tank can be facilitated by closing this penstock, and opening a normally closed stopboard at the top of the transfer chamber to direct mixed liquor from the oxidation ditch direction to the outlet chamber of the new tankage. The design also includes a stopboard on the outlet weir of the Re-Aeration Zone to prevent backflow to the Re-Aeration Zone under this maintenance condition.



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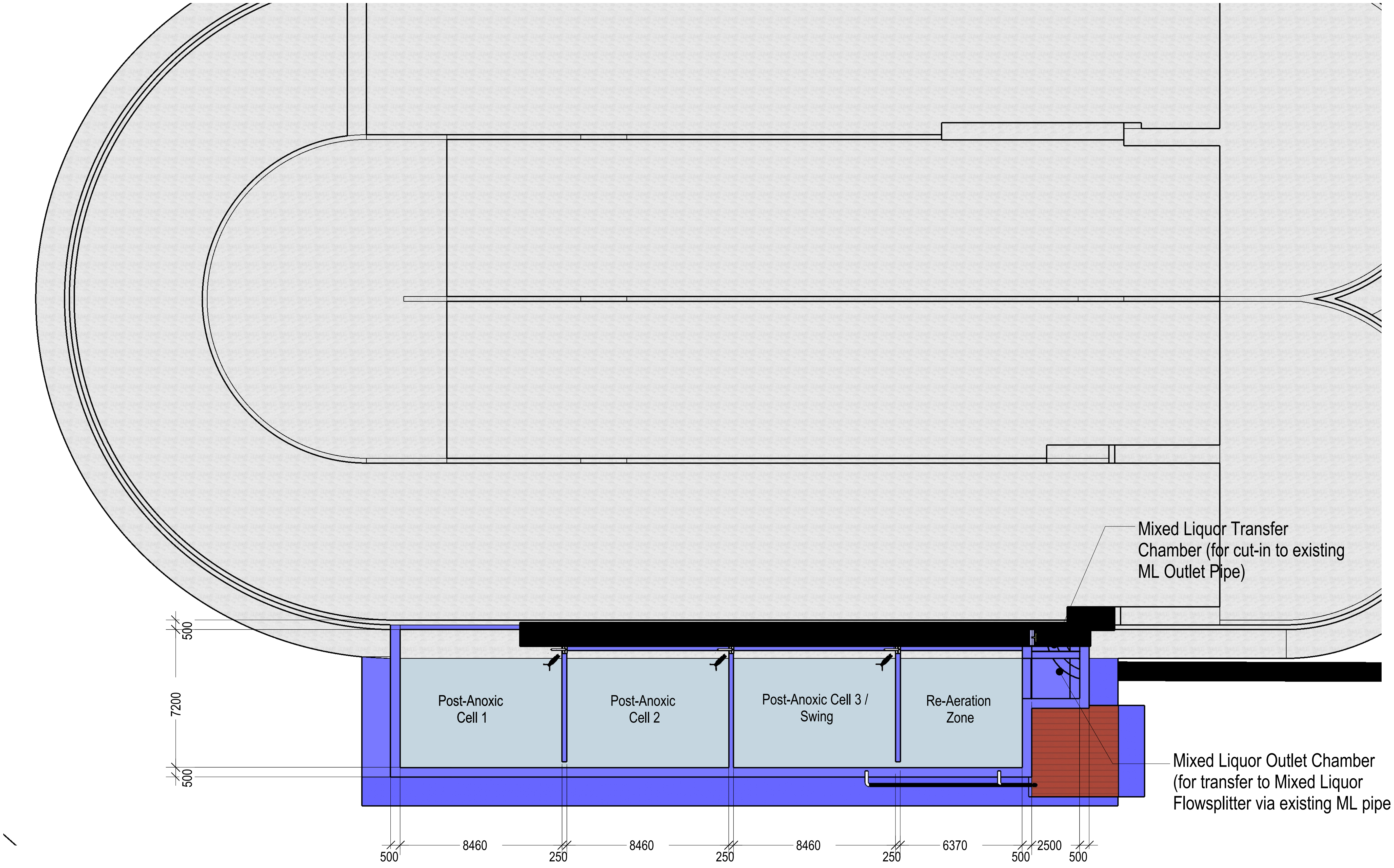
REVIEWED: IAF
APPROVED: DJF
DATE: 25/6/2020
SCALE: 1:200 at A3

TITLE
Victoria Point STP Upgrade Planning
Post-Anoxic Zone
General Arrangement - Isometric

REVISION: B
ORIGINAL SHEET SIZE: A3
DRAWING NUMBER: J1904-01



Mixed Liquor Transfer Chamber (for cut-in to existing ML Outlet Pipe)

Mixed Liquor Outlet Chamber (for transfer to Mixed Liquor Flowsplitter via existing ML pipe

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TITLE
Victoria Point STP Upgrade Planning
Post-Anoxic Zone
General Arrangement - Plan, Walkway Level

REVISION	ORIGINAL SHEET SIZE	DRAWING NUMBER
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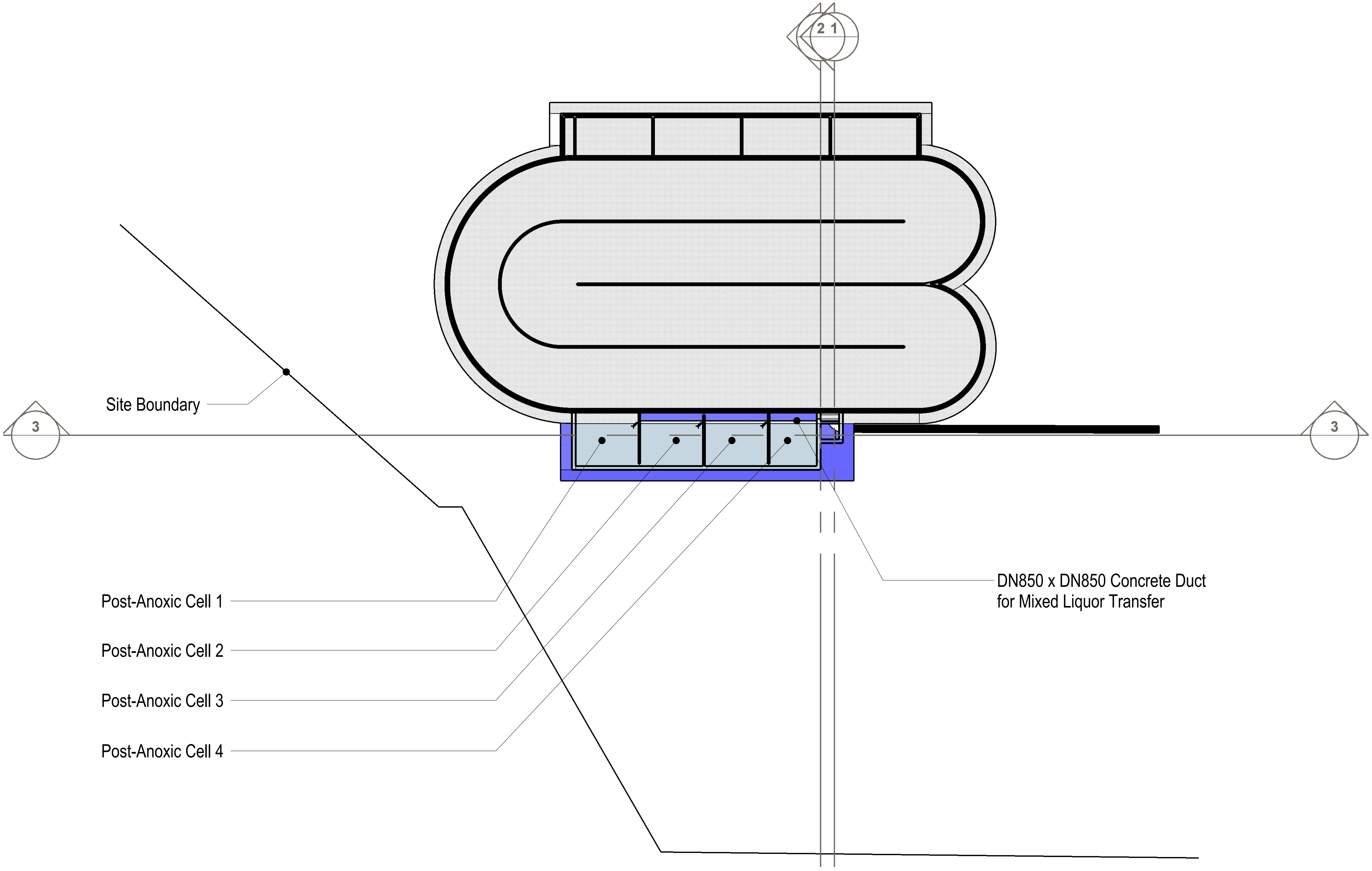

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DJF	IAF	IAF

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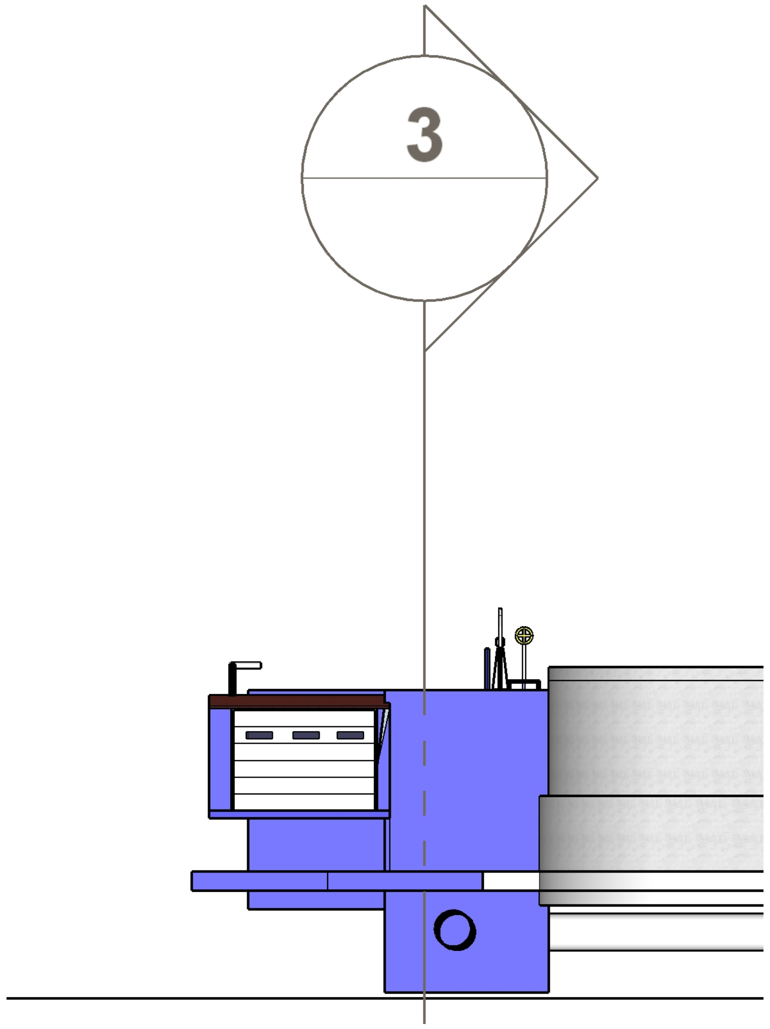
SCALE: 1:500 at A3

TITLE
Victoria Point STP Upgrade Planning
Post-Anoxic Zone
General Arrangement - Plan, Floor Slab Level

REVISION	ORIGINAL SHEET SIZE	DRAWING NUMBER
B	A3	J1904-03



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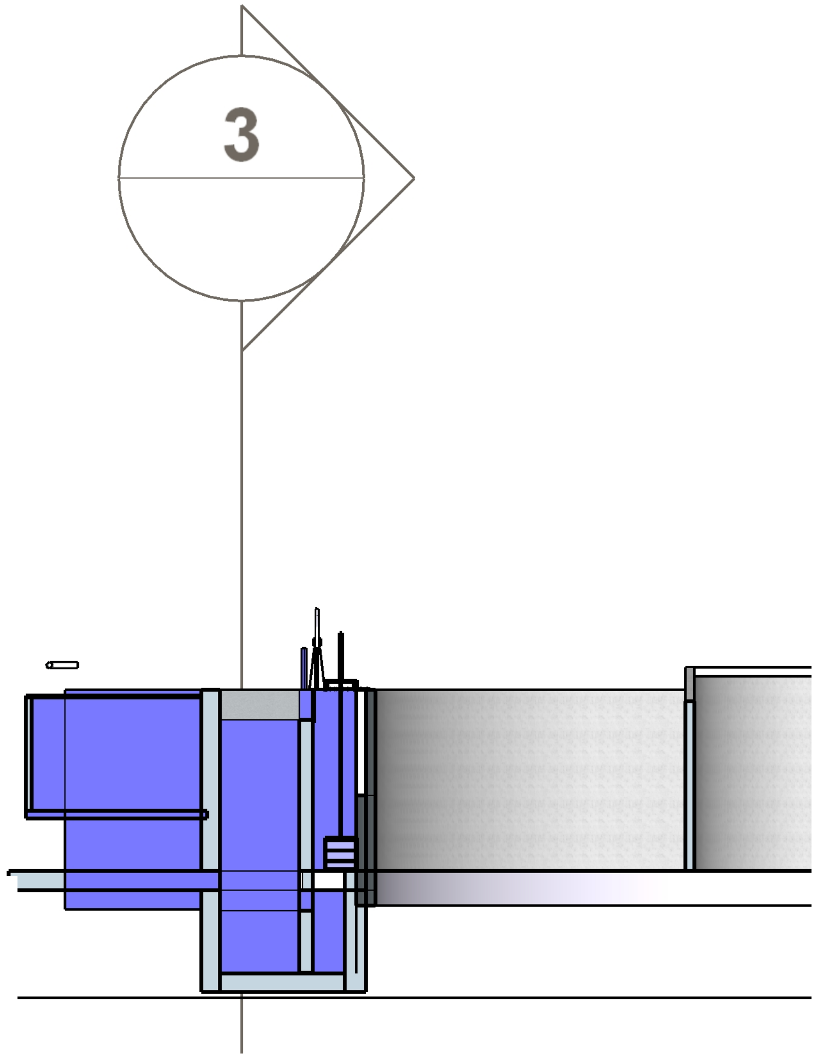

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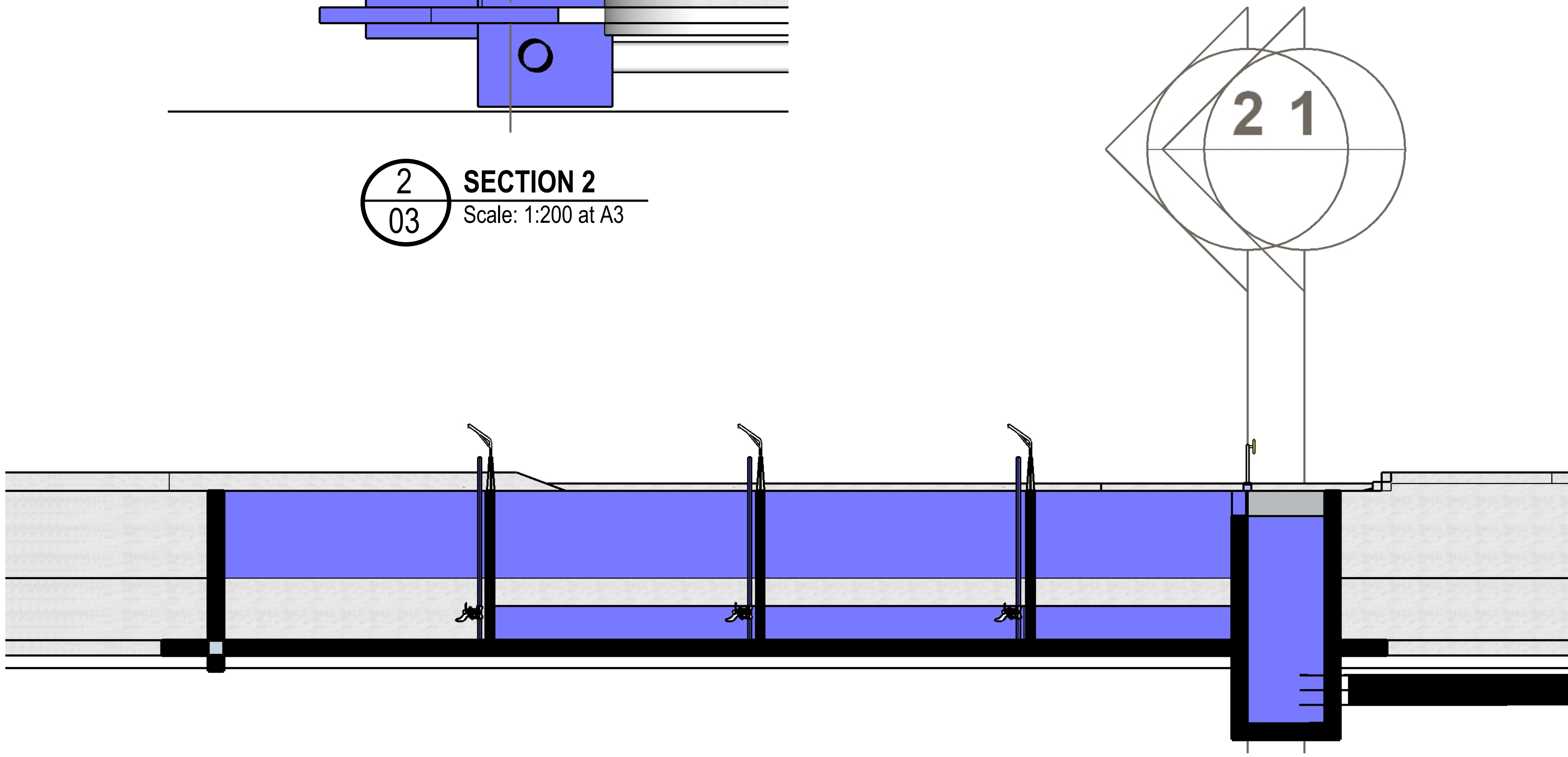

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DJF

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TITLE
Victoria Point STP Upgrade Planning
Post-Anoxic Zone
Sections

REVISION	ORIGINAL SHEET SIZE	DRAWING NUMBER
B	A3	J1904-04

7.2 ADDITIONAL SOLIDS SETTLING CAPACITY

7.2.1 Description and Requirements

The concept design includes provision of an additional secondary clarifier to meet the additional wet weather treatment capacity required at loads in excess of 38,300 EP. Should both the South West Victoria Point and Weinam Creek development proceed, these works are projected to be completed by the start of 2024.

While the Phase 1 upgrade planning study identified up to two additional clarifiers may be required under some scenarios, the reduced operating sludge age made possible by the final End-of Waste Code (see Section 3.8) has resulted in a single additional clarifier being sufficient.

7.2.2 Additional Clarifier Concept Design

The additional secondary clarifier diameter has been set at a nominal 34.5m to match the existing final clarifiers and provide ease of operation. At this sizing, the secondary treatment process capacity based on solids settling is 49,100 EP through addition of the third clarifier.

The concept design has located the clarifier immediately to the north of the existing units (in line with the master plan provided within the 2001 upgrade). This location leaves insufficient space for an access road to pass around the northern end of the new unit, or for the provision of additional berms to provide visual screening and noise abatement to the adjacent parkland. It is recommended that adjustment of the site boundary be considered to accommodate both of these elements during design development.

Based on the GIS overlays, it is not anticipated that the additional clarifier will require removal of any koala trees in the proposed location. The clarified effluent and RAS pipework alignment has been specifically defined to avoid removal of any of the koala significant trees located to the north-east of the existing clarifiers.

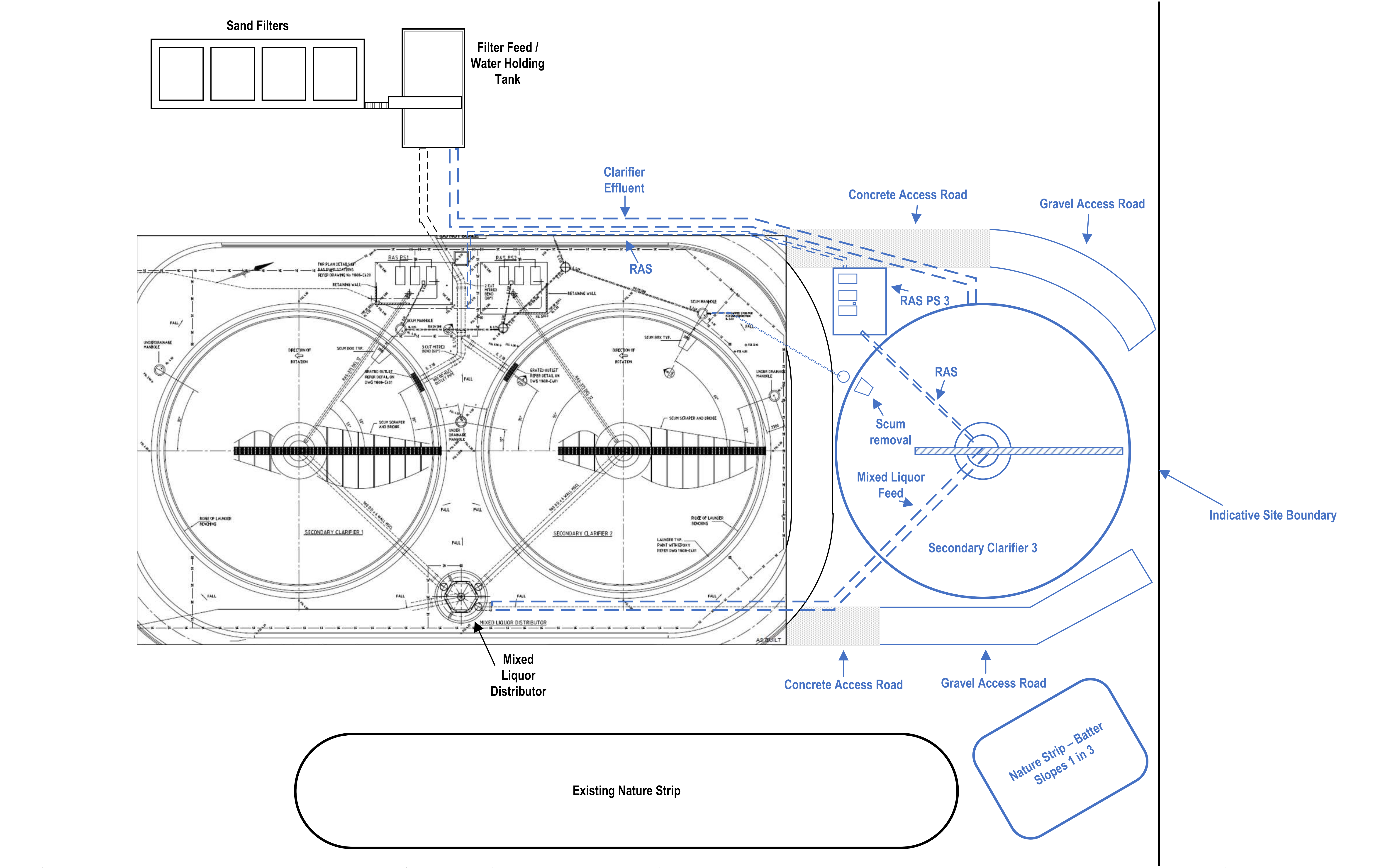
The clarifier will be provided with a log-spiral scraper, rotating bridge and scum beaches. In keeping with the installed infrastructure, the new clarifier will be serviced by a dedicated RAS pump station comprising three pumps configured as duty/duty/standby. The clarifier will have a 1 in 12 floor slope, and a side water depth of 4.0m. The concept design has adopted a marginally deeper clarifier design due to the benefits it provides to both wet and dry weather solids capture.

Modifications to the mixed liquor flowsplitter are required to install each new clarifier, including modification of the internal division in the flowsplitter's annular section and the addition of a new isolation penstock. New RAS pumps and pipework, scum pipework (to the existing scum system), and civil works for the RAS pump station have also been included within the assessment.

Table 7-4 outlines the schedule of works required for additional secondary clarifier.

Table 7-4: Schedule of Capital Works – Additional Clarifier

Item	Works required
Modifications to Mixed Liquor Flowsplitter	• New DN960 Mixed Liquor pipe from Mixed Liquor Distributor • Modify internal division in Mixed Liquor Distributor outer annulus • 2 No new penstocks
Additional Final Clarifier	• Nominal 34.5m diameter, 4m side wall depth clarifier • Clarifier mechanism (including bridge, scraper, flocculation skirt, energy dissipating inlet, centre column, weirs, scum beaches, scum pump)
RAS Pump Station	• New RAS pipework, fittings and civil works for additional RAS pump station • 3 no 11 kW RAS pumps sized for 190 L/s with two pumps at 100%



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NAME RYAN SCHWARTZ
CHECKED BY
NAME DAVID FLIGELMAN
APPROVED BY RPEQ
NAME DAVID FLIGELMAN
DATE
22/04/2020

TITLE
Victoria Point Treatment Plant -
Additional Secondary Clarifier
Site Layout

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SCALE
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DRAWING NUMBER
J1904-4-01

REVISION	SHEET SIZE
A	A3

7.3 DISINFECTION

7.3.1 Options Identification and Short-Listing

Under the criterion applied to sizing of chlorine contact tanks in the original plant design (60- minutes HRT at ADWF), the existing two chlorine contact tanks have sufficient volume for up to 9.60 ML/d ADWF or 43,640 EP. Such a capacity would be sufficient for the 2041 design horizon with the additional developments (44,312 EP) while two tanks are in service. However, while the required faecal coliform kill will be readily achievable in the existing disinfection system through to the design horizon, there are a number of factors which are likely to make compliance with the maximum free chlorine residual limit of 0.7 mg/L much more challenging as loads increase. The key factors include:

1. ***Reduced secondary effluent ammonia concentrations*** – lower secondary effluent ammonia levels will be required to maintain compliance with the nitrogen mass load limit as the connected population exceeds approximately 38,700 EP. As noted in Section 7.1.2, the addition of a post-anoxic / re-aeration zone to meet the nitrogen removal requirements will reduce secondary effluent ammonia levels to near zero for much of the day. Lower secondary effluent ammonia will reduce the formation of chloramines (which support disinfection, but do not contribute to free chlorine residual).

   It should be noted that the historical performance of the plant has seen robust disinfection performance with measured Free Chlorine levels, as recorded on daily grab samples, well below 0.7 mg/L (2015-2019 annual average 0.12-0.24 mg/L, annual maximum 0.67-0.69 mg/L). This excellent performance at low free chlorine residuals is considered likely to be partially due to chloramine disinfection in addition to free chlorine, but will be less feasible due to the lower effluent ammonia required as flows increase.

2. ***Reduced Chlorine Contact Time*** – The increase in flows will reduce chlorine contact time in the existing tanks (from 81 minutes at the current maximum ADWF to 59 minutes at the projected 2041 ADWF with additional developments). Modelling of the disinfection process indicates that this change will increase the free chlorine residual required to achieve the specified effluent Faecal Coliforms by 0.15 mg/L at ADWF, and 0.26 mg/L at peak dry weather flow, and 0.69 mg/L at PWWF.
3. ***Chlorine Contact Tank Off-lining for Maintenance*** – In the existing plant, the chlorine contact time is effectively halved during the routine cleaning of chlorine contact tanks. At current flows, process modelling indicates that the required free chlorine residual is approximately 0.7 mg/L at ADWF with one tank out of service (in the absence of chloramination). However, the estimated required free chlorine residual with one tank out of service increases to 0.87 mg/L at the 2041 projected ADWF without the additional developments, and to over 1 mg/L with the additional developments. At flows in excess of ADWF, the predicted residual required is expected to be higher.

Based on the above, it is anticipated that compliance with the maximum free chlorine residual limit of 0.7 mg/L is likely to become substantially more challenging as flows increase. However, given the excellent current performance in terms of both disinfection and chlorine residual achieved in plant operations to date, there appears to substantial scope to maintain compliance until the effluent ammonia needs to be reduced (to comply with the effluent total nitrogen mass load). At this point, the existing system is expected to become inoperable as the chlorine dose required for disinfection will consistently exceed the maximum free chlorine. As a result, the nominal capacity of the existing disinfection system is effectively pegged to the existing plant's nitrogen removal capacity at 38,700 EP.

IMPORTANT: There is potential for changes to the prevailing operating practices, as may be required for other aspects of plant operation, to threaten compliance with the maximum free chlorine limit at loads less than 38,700 EP. For example, off-lining of CCTs for maintenance outside of low flow periods, increased aeration to reduce effluent total nitrogen, or changes to the practices in chlorine dosing control could all result in exceedance of the maximum free chlorine limit. To this end, it is recommended that the chlorine disinfection performance be routinely reviewed as flows increase to ensure robust and consistent compliance observed in operations to date is being maintained.

Once the capacity of the existing chlorine contact tanks is exceeded, there are two key options for augmentation:

Option 1: Installation of additional chlorine contact tank volume to reduce the free chlorine residual required to achieve disinfection, or,

Option 2: Dechlorination at the end of the chlorine contact tank through dosing of sodium bi-sulphite (SBS) or sodium meta bi-sulphite (SMBS).

Redland City Council operates a dechlorination facility at Cleveland STP, and has encountered significant difficulties in operation of the system. Issues have included:

- The on-line chlorine residual meters require high levels of ongoing maintenance to remain accurate. As the dosing of SBS is controlled under feedback from these instruments, the system is unable to operate reliably without accurate readings. RCC outsourced the maintenance of these instruments under contract due to the excessive demand they imposed on Operator resources. However, even with this maintenance outsourced, the accuracy of dosing control remains a significant issue.
- Variations in the ammonia concentration in the Cleveland STP effluent have a very strong bearing on the SBS dose required, and has resulted in very high SBS consumption over short periods. Maintaining a suitable supply of SBS on site has been at issue as a result.

While not a specific issue noted at Cleveland STP, overdosing of SBS consumes dissolved oxygen in the effluent stream, and has the potential to push the DO concentration below the minimum of 2 mg/L in the Environmental Approval. DO monitoring in the SBS mixing chamber at Cleveland indicates that this is not an issue at this site.

Based on the difficulties encountered in dechlorination at Cleveland, the provision of additional disinfection capacity has been based on Option 1.

7.3.2 Additional Chlorine Contact Tank Concept Design

The additional chlorine contact tank will be identical in design to the two existing tanks, and located immediately to the north of the existing units. This additional chlorine contact tank will not be required until after 2041 under the baseline population projection, but will be required from 2025 should the additional developments proceed.

The concept design of the additional chlorine contact tank is summarised in Table 7-5, and shown in Figure 7-7 and Figure 7-8.

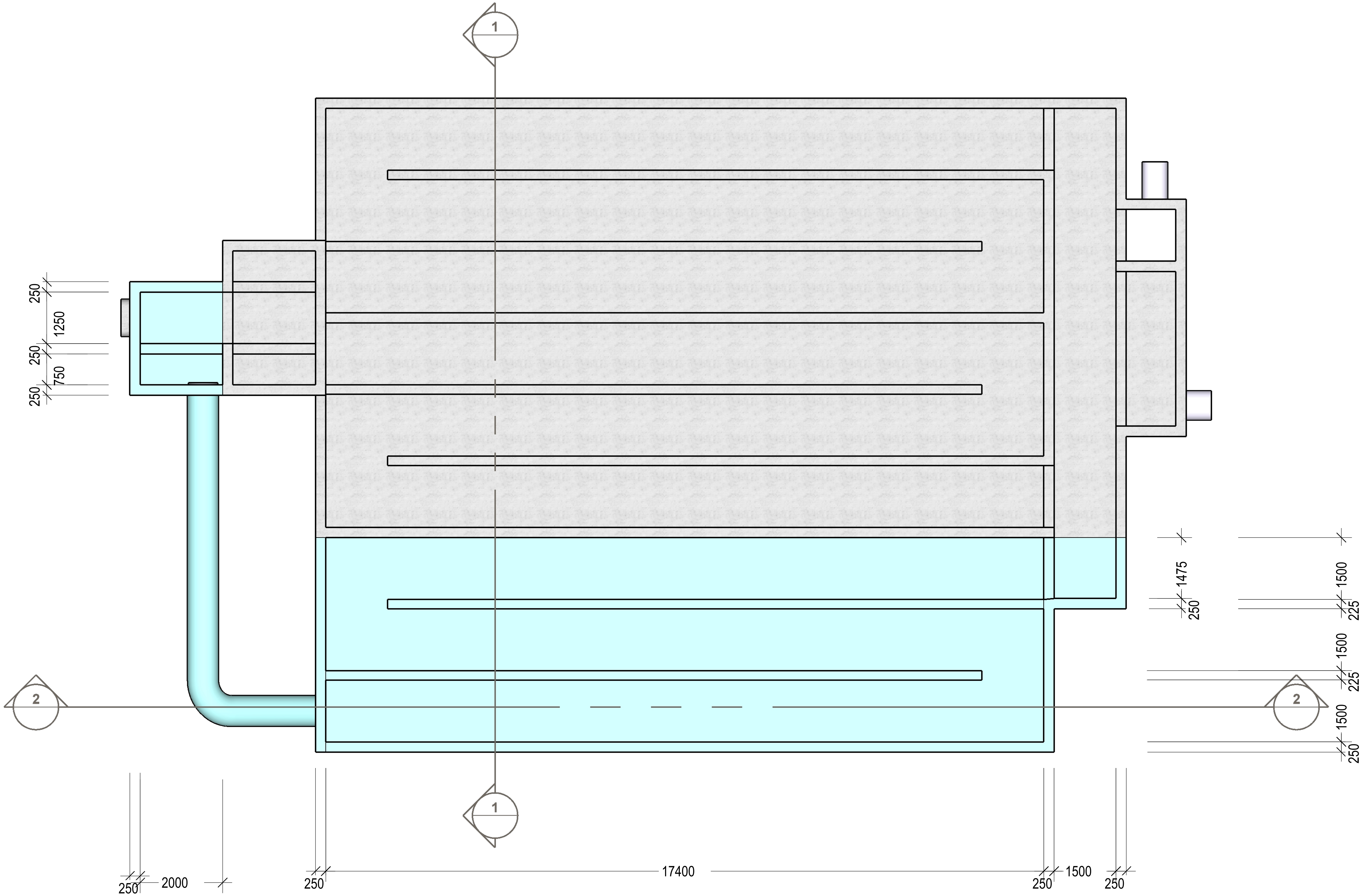
Table 7-5: Schedule of Capital Works – Additional Chlorine Contact Tank

Item	Works required

Additional Chlorine Contact Tank	• 1 No. new 3-pass Chlorine Contact Tank
	• Nominal volume 200 kL
	  ○ Internal dimensions 17.4 length x 1.5m width per pass x 2.61m water depth to TWL
	  ○ Serpentine flow between passes
	• Extension to existing inlet chamber, including new 1.5m weir to initial leg in 7.5m x 1.5m x 2.61m water depth concrete chamber.
	• Extension to outlet chamber, 1.5m long extension to existing outlet chamber.

Chlorination	• Modification to chlorinator discharges to inlet pipe to inlet chamber.

Given the works required to manage baseline growth through to 2041 (see Section 6.5.2), no substantial modification to the chlorine storage and dosing system is expected to be required to accommodate the additional upgrades.



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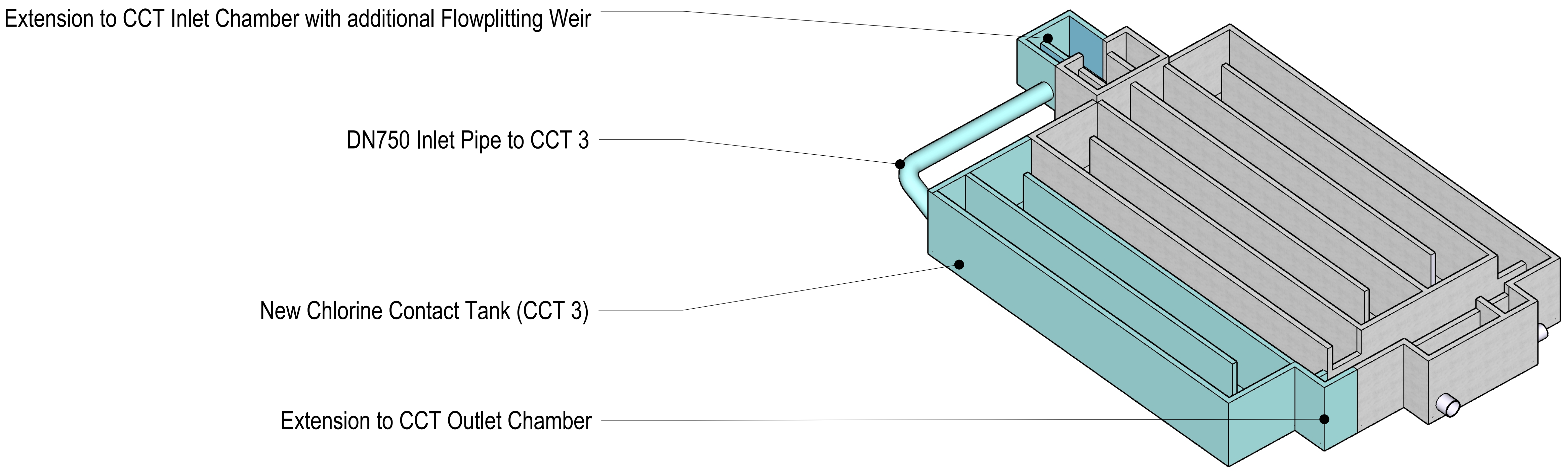
TITLE
Victoria Point STP Upgrade Planning
Additional Chlorine Contact Tank
General Arrangement - Plan

REVISION	ORIGINAL SHEET SIZE	DRAWING NUMBER
A	A3	J1904-05



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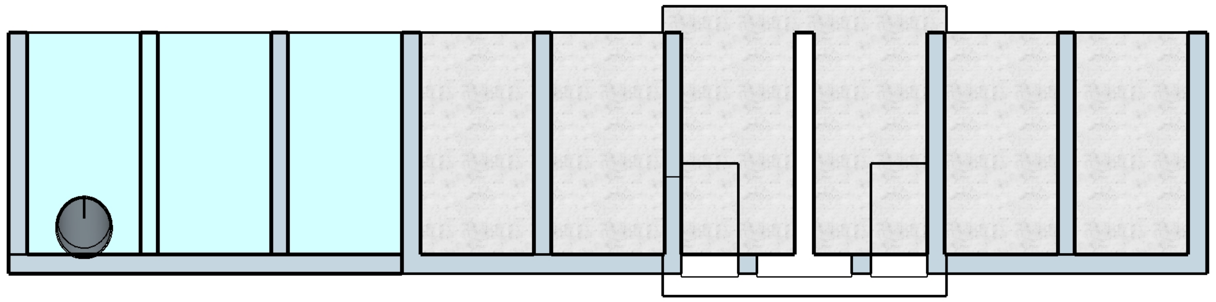

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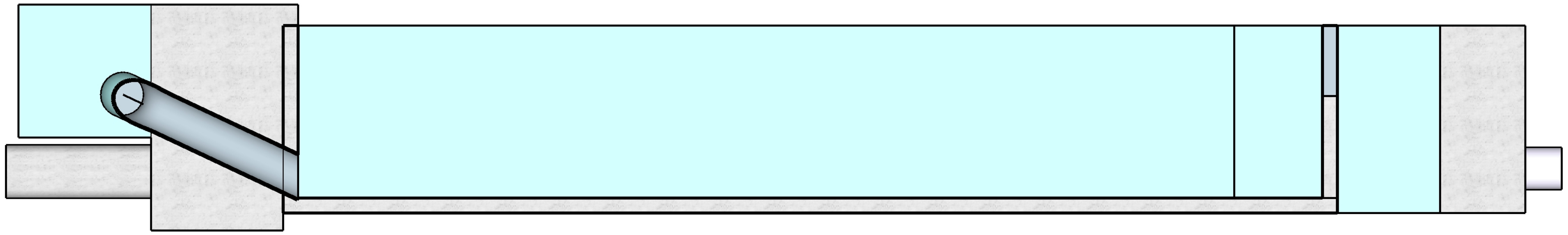

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TITLE
Victoria Point STP Upgrade Planning
Additional Chlorine Contact Tank
Isometric And Sections

REVISION A
ORIGINAL SHEET SIZE A3
DRAWING NUMBER J1904-06

8 ESTIMATED COSTS

8.1 CAPITAL COSTS

The capital costs for the upgrades have been estimated assuming delivery of the required works under one contract for the renewals and upgrades required to service baseline growth, and a separate contract for the upgrades to service additional developments. Due to the nature of the scope of works under each of these categories, the difference in cost anticipated for delivery of both of these packages of work under a single combined contract are expected to be minor.

Key assumptions applied to the capital cost estimates include:

- Cost estimates have not considered geotechnical information. No piling or decontamination of land has been allocated within the cost estimate. Should acid sulphate soils, contaminated land or geotechnical issues arise, costs would increase. This level of detail would be expected to be assessed during subsequent design phases through geotechnical analysis of the proposed site.
- No structural design has been undertaken. As a result, the extent of concrete works has been drawn from the existing structures on site, and typical slab and wall thickness applied in the detailed design of comparable water retaining structure.
- The costs for supply of major equipment items (and installation where appropriate) are based on budget quotations from equipment suppliers based on the concept design. This includes raw sewage screening and screenings handling equipment, blowers, and clarifier mechanical equipment.
- The costs for procurement of minor mechanical equipment items (blowers, pumps, mixers, valves, penstocks, and stopboards) have been based on actual supply costs in relevant previous sewage treatment plant upgrade projects. Similarly, the cost rates for earthworks, yard pipework, concrete cutting and other general civil construction have been drawn from advice from construction engineers on comparable sewage treatment plant projects.
- Costs have been escalated using the Non-residential construction cost index or CPI as applicable.
- The cost rates for concrete works are derived from construction of similar scaled water retaining structures in water and sewage treatment plants over the last 12 months. The rates are drawn from Tier 2 contractors.
- Delivery of the upgrades under a design-and-construct delivery model has been assumed. Other delivery modes may be selected at the discretion of the Principal, and carry different overheads for the Contractor and Redland City Council, and different margins.
- A 30% contingency was applied to capital cost estimations, which is considered appropriate for the level of study conducted.
- Foreign exchange risk was applied to key elements sources from overseas. Contractor margins are shown in Table 8-1.

Overall, within the assumptions listed above, the cost estimates have pursued an accuracy of +/- 30%.

Table 8-1 Indirect Costs, Overhead and Margin included in the Capital Cost Estimate

Item	Value
Indirect costs (including bid costs, mobilisation, bonds, insurance, legal, administration, inclement weather, site establishment, office staff costs)	25% of DJC
Design and Engineering	11-14% of DJC
Foreign Exchange Risk	10% of Imported Equipment
Design Growth	3% of DJC
Contractor Fees and Margin	11% of Net Capital Cost
Client Costs	5% of Total Contract Cost
Contingency	30% of Total Project Cost

Table 8-2 outlines the costs associated with the renewals and plant upgrades required to service baseline growth as described in Section 6.

Table 8-2: Estimated Capital Costs- Renewals and Upgrades to Service Baseline Growth ($AUD, 2020)

Item	Inclusions	Direct Job Cost	
Preliminaries	Site Establishment	$15,000	$21,444
	Site Survey	$6,144	
Raw Sewage Pumps	Existing independent project (pumps to be installed in August 2020)	-	-
Raw Sewage Screens Upgrade	Existing bypass channel modifications comprising: • Removal of false floor (concrete cut and repair) • Removal of chute to existing screw wash press. • Filling of existing bypass weirs • Removal of existing manual screen • Replacement of inlet and outlet slidegates with full height units • Coating for corrosion protection	$48,128	$909,797
	Existing step screen channel modifications comprising: • Removal of existing step screen. • Minor concrete coating repair.	$3,857	
	Supply and install new band screens (duty/assist) • 2 No. 5mm aperture Perforated Center Flow Bandscreen, Hydrodyne CF26-24-135-5-P • 4 No. Inlet baffle plates, including bypass weirs • Minor service water pipework modifications	$451,987	
	Supply and install new screenings handling (duty/assist) • 2 No. KWP 250/1200 Screw Wash Press and Kuhn KLS 280 • Minor modifications to bin discharge chutes.	$242,060	
	Electrical and Control at 18% of DJC for Screening System Replacement	$163,763	
Aerator Cover Removal /. Noise Emission Control	Replacement of existing acoustic covers, comprising: • Removal of existing corroded covers to 3 No. aerators • S&I acoustic barriers to aerators (east, north and south) • Additional coating / protection of aerator drives and gearboxes	$29,595	$29,595
Tertiary Filters	No upgrade required.		
Chlorine Storage and Dosing	Modifications to chlorine storage and dosing to accommodate additional drum storage and duty/assist operation, comprising: • Minor pipework and drum cradle modifications • Control system modifications to D/A chlorinator operation • Revision of documentation, including manifest, safety plans etc.	$26,000	$26,000
Biosolids Dewatering Upgrade	Existing independent project (concept design and documentation in progress for D&C in 2021 FY)	-	-
	TOTAL DIRECT JOB COST	**$986,536**	
Indirect Costs	25% of DJC	$246,634	
Other Costs	Design (14%), Foreign Exchange Risk (10% of screening equipment cost), Design Growth (3%)	$218,745	
Contractor Fees and Margin	11% of DJC + Indirect and Other Costs	$159,711	
	TOTAL CONTRACT COST	**$1,611,626**	
Client Costs	5% of Total Contract Cost	$80,581	
	TOTAL PROJECT COST	**$1,692,207**	
	CONTINGENCY AT 30% OF TOTAL PROJECT COST	$507,662	
	TOTAL PROJECT COST INCLUDING CONTINGENCY	**$2.200m**	

Table 8-3 outlines the costs associated with the plant upgrades required to service additional developments as described in Section 7.

Table 8-3 Estimated Capital Costs- Upgrades to Service Additional Developments ($AUD, 2020)

Item	Inclusions	Direct Job Cost	
Preliminaries	Site Establishment	$32,000	$72,560
	Site Survey	$15,360	
	Service Location	$3,200	
	Geotechnical Investigations	$12,000	
	Environmental Controls	$10,000	
Post-Anoxic / Re-Aeration Tank	Civil works comprising: • Excavation (with fill to new berm) • Slab (including toe) and walls of Post-Anoxic / Reaeration Tank, Transfer and Outflow chambers • Mixed liquor pipe modification (block-outs cuts) • Concrete duct from transfer chamber to Post-Anoxic Cell 1 • Slab and apron for access to blower room • Concrete cut to existing toe of oxidation ditch • Blower building, including louvres and door • Walkway and access stairs to access post-anoxic /re-aeration cells and mixers (grid mesh) • Access road (sealed, with kerb and gutter) to blower building.	$837,796	$1,289,451
	Supply and install 3 No. post-anoxic cell mixers for (3.7 kW each)	$37,905	
	Supply and install new diffused aeration system, comprising: • Fixed-to-floor fine pore membrane diffusers in Post-Anoxic Cell 3 and Re-Aeration Zone • 2 No. Aeration Blowers (Atlas-Copco ZL2 VSD) • DN150 Spiral wound stainless aeration pipework • DO meter for Re-Aeration Zone • Actuated butterfly valve for Post-Anoxic Cell 3 aeration control	$190,959	
	Miscellaneous additional mechanical comprising: • Extension to existing service water network • Relocation of scum harvester • Stopboards (2 No.) and penstock (1 No.) for isolation and bypassing of Post-Anoxic / Re-Aeration Tank	$55,163	
	Electrical and Control at 13% of DJC for Post-Anoxic Zone	$167,629	

Table 8-3 Estimated Capital Costs- Upgrades to Service Additional Developments ($AUD, 2020) (continued)

Item	Inclusions	Direct Job Cost	
Additional Secondary Clarifier	Civil works comprising: • Clear and Grub of area • Excavation of clarifier (with fill to new berms) • Completion of new berms for visual/noise screening, including landscaping • Modification / removal of wall in ML distributor annular section • New Mixed liquor pipework (ML distributor to Clarifier) • New RAS pipework (clarifier to pump station, pump station to main) • Secondary effluent pipework (clarifier to filter feed tank) • Concrete works to clarifier (floor, walls, toe, path, launder) • Epoxy coating of clarifier launder • Groundwater drainage pipework and manhole • Connection of scum beach to existing scum system • New RAS pump station base slab • Sealed roadway (including kerb and channel) to RAS pump station and clarifier • Gravel roadway to clarifier circumference • Repairs to existing roads at pipe crossings	$1,106,684	$2,254,960
	Supply and install clarifier mechanism comprising: • Log-spiral scraper (1 1/3 radius) • Peripheral scum baffle and weirs • Scum skimmer • 1 No. scum beach • Centre column, energy dissipating inlet, flocculation skirt • Slipring • Access bridge and walkway	$715,000	
	RAS Pump Station, comprising: • Pipework and valves within RAS pump station • 3 No. RAS pumps (11 kW) • RAS flowmeter and associated isolation valves	$178,549	
	Miscellaneous additional mechanical comprising: • New aluminium slidegate to ML Distribution Chamber for clarifier isolation • Extension to service water network and hose point	$29,230	
	Electrical and Control at 10% of DJC for Secondary Clarifier /RAS PS	$225,496	

Table 8-3 Estimated Capital Costs- Upgrades to Service Additional Developments ($AUD, 2020) (continued)

Item	Inclusions	Direct Job Cost	
Additional Chlorine Contact Tank	Civil works comprising: • Excavation of new CCT • Concrete works to: ○ New CCT inlet distribution chamber ○ New chlorine contact tank (~200 kL) ○ New drainage sump ○ Extension to CCT outlet chamber to receive flow from new CCT • New pipework to drainage	$260,347	$295,565
	Miscellaneous mechanical works comprising: • Inlet isolation penstock to new CCT • Weirs and isolation stopboard • New inlet pipework cut-in	$35,218	
Testing, Commissioning and Handover	3% of DJC	$121,006	
	Total Direct Job Cost	**$4,033,542**	
Indirect Costs	25% of DJC	$1,008,386	
Other Costs	Design (11%), Foreign Exchange Risk (10% of pump, mixers, instruments and blowers cost), design growth (3%)	$576,156	
Contractor Fees and Margin	11% of DJC + Indirect and Other Costs	$617,989	
	Total Contract Cost	**$6,236,0731**	
Client Costs	5% of Total Contract Cost	$311,804	
	Total Project Cost	**$6,547,877**	
	Contingency at 30% of Total Project Cost	$1,964,363	
	TOTAL PROJECT COST INCLUDING CONTINGENCY (+/- 30% Accuracy Target)	**$8.512m**	

8.2 Operational Costs

With the exception of the biosolids dewatering upgrade (which is being developed under a separate project), the operating costs associated with the renewals and plant upgrades required to service baseline growth will not have a significant or readily quantifiable impact on the plant's operating cost. For example:

- For the new raw sewage screening facility, the overall impacts on operating costs are expected to be negligible as the increased capture of additional screenings (and therefore increase screenings haulage required) can be expected to be offset by:
  - The superior screening and dewatering achieved in the new screw wash presses, achieving improved dryness in the screenings product;
  - Improved scope to completely fill the screenings bins prior to removal from site;
  - The additional power consumption in the new screenings system will also be negligible (less than $3000 p.a.).
  - The reduced frequency of downstream blockages in mechanical equipment due to screenings.

- The replacement of the acoustic covers on the aerators with acoustic barriers will not have a material impact on operations or maintenance costs.
- The modifications to the chlorine dosing system will not have a material impact on chlorine consumption.

Due to the small impact, the operational costs changes imposed by the renewal and upgrades required to service baseline capacity have not been estimated.

By contrast, treatment of the load associated with the additional developments will have a material impact on the operating costs of the plant, and have been estimated using the operational costs under baseline growth alone as a datum.

Key assumptions applied to the operational cost estimates include:

- Power and haulage cost rates have been based on rates provided by Redlands Water. These are shown in Table 8-4.

Table 8-4: Adopted Values – Operational Cost Estimates

Parameter	Value	Source
Electricity cost	$0.11 /kWh $156 p.a. for each additional kW of peak demand	Redlands Water, 2020
Polyelectrolyte	$4.95/kg	Redlands Water, 2019
Biosolids haulage cost	$65 /Wet Tonne (lower bound) $100 /Wet Tonne (upper bound)	Redlands Water, 2020
Chlorine	$2.94/kg	Redlands Water, 2019

- Substrate dosing has not been included within the cost analysis as the modelling suggests that it will not be routinely required.
- Excess biological phosphorus removal performance is not expected to be significantly impacted by the additional developments (and associated upgrades). Further, given the limited requirement for phosphorus removal (TP 4 as long term median), alum dosing is expected to be negligible for both options.
- The cost analysis has considered unit operating costs relevant to each option on a comparative basis. Existing plant elements which are not subject to change (or of minimal impact) across the options have not been included in the assessment (for example existing pump stations). Elements included in the operating cost analyses include:
  - Electrical Fixed: Drives for additional operating items under "upgrades for additional developments", principally mixers, scrapers.
  - Electrical Variable: Drives for treatment of additional load, principally aeration, RAS pumps, and filter feed pumps. Assumes 2 months per year with peak wet weather events.
  - Maintenance – for comparative plant components only. Maintenance on key items such as diffusers, Final Settling Tanks, pumps.
  - Biosolids Haulage – Total additional haulage, assuming 18% dryness based on anticipated sustainable performance of upgraded dewatering system.
  - Polyelectrolyte – 11 kg/dry tonne poly consumption as per typical requirement for screw presses
  - Chlorine – Additional secondary effluent flow off-set by reduced average dose due to additional CCT.

Table 8-5 summarises the compiled operating costs associated with the upgrades and additional loads associated with the Weinam Creek and South West Victoria Point developments, as estimated for the design horizon (2041).

Table 8-5: Estimated Annual Additional Operating Costs at 2041 due to Additional Developments ($AUD, 2020)

Upgrade	Electrical - Fixed	Electrical – Variable	Chemical - Variable	Maintenance - Fixed	Total Operating Costs
Plant Upgrades Required to Service Additional Developments					
Post-Anoxic / Re-Aeration Zone	$9942 p.a.	$9999 p.a.	Nil	$6440 p.a.	**$26,384 p.a.**
Key elements	Mixers	Blowers		Diffuser replacement / mechanical	
Additional Secondary Clarifier	$2558 p.a.	$1212 p.a.	Nil	$18,625 p.a.	**$22,395 p.a.**
Key elements	Bridge, Scum pump	RAS pumps		Mechanical	
Additional Chlorine Contact Tank	Nil	Nil	$8133 p.a.	Nil	**$8133 p.a.**
Key elements			Chlorine		
Other Additional OPEX					
Power Consumption – Oxidation Ditch Aeration	Nil	$20,412 p.a.			**$20,412 p.a.**
Power Consumption – Additional Pumping (Filter Feed, miscellaneous)		$3704 p.a.			**$3704 p.a.**
Polyelectrolyte Consumption			$7083 p.a.		
SUB-TOTALS	**$12,500 p.a.**	**$35,300 p.a.**	**$15,200 p.a.**	**$25,100 p.a.**	**$88,110 p.a.**
Biosolids Haulage	$47,000 p.a. additional sludge haulage at $65 /wet tonne $72,300 p.a. additional sludge haulage at $100 /wet tonne				
TOTAL ADDITIONAL OPEX	**$135,100 p.a.** with additional sludge haulage at $65 /wet tonne **$160,400 p.a.** with additional sludge haulage at $100 /wet tonne				

Note 1: Variable and total additional operating costs shown for operations at the 2041 design load

8.3 WHOLE OF LIFE COSTS

The following assumptions have been applied to the cost analysis of the options:

- The analysis of options has been based on net present cost (or NPC) over a period of 40 years using the factors supplied by Redland Water.
- It has been assumed that construction will commence in the 2022-23 financial year, and take approximately 2 years to complete. The analysis has assumed that 50% of the capital cost of the works is spent in each year of construction.
- The additional variable operational costs associated with the additional load are applied to the analysis based on the projected additional population from 2020-21. The additional fixed operating costs are only applied from completion of the works in 2023-2024.

Cost escalation factors as supplied by Redland Water were used to account for increases to electricity, labour, maintenance and other costs, and costs of capital as summarised in Table 8-6.

.

Table 8-6: Discount Rate and Escalation Factors applied to Whole-of-Life Cost Analysis

Parameter	Factor
Discount Rate (Weighted Average Cost of Capital)	7.00 % p.a.
Capital Escalation	1.07% FY2021 1.43% FY21-22 1.79% FY22-23 2.16% FY23-24
Electricity Escalation	2.50 % p.a.
Maintenance and Other Items Escalation (including biosolids haulage)	2.50 % p.a.
Chemicals and other Operating Costs Escalation	2.50 % p.a.

- The variable operational costs (e.g. chemical consumption, electrical power consumption and biosolids haulage) have been escalated through the NPC analysis in line with the applicable population projections.

The additional whole-of-life cost for the additional development are summarised in Table 8-7 below. Note 15-year NPC values have been given in addition to the prescribed 40-year NPCs, for information.

Table 8-7 Additional Whole of Life Costs to Service Additional Developments ($AUD, 2020)

Options	Total Whole of Life Cost (7% discount rate)	
Duration	**15 years**	**40 years**
Additional Costs with Biosolids Management at $65 / wet tonne (AUD, 2020)	$9.24m	$10.31m
Additional Costs with Biosolids Management at $100 / wet tonne (AUD, 2020)	$9.42m	$10.68m

The estimated costs to treat the additional load from the South West Victoria Point and Weinam Creek Developments is $10.31-10.68m over 40 years, depending on the cost of biosolids management applied.

As the whole-of-life cost includes $8.512m in capital (AUD 2020), the capital cost comprises the majority of the servicing costs. The low contribution of operational costs is the result in the delay to the completion of the upgrade (2023-2024), and the low contributing population from the additional developments in the initial years.

9 CONCLUSION AND RECOMMENDATIONS

The prevailing capacity of Victoria Point STP, pending the upcoming upgrade of the raw sewage pumps and dewatering system, is limited to 38,300 EP by the ability of the secondary clarifiers to treat 5 x ADWF. The ability of the process to maintain compliance with the Total Nitrogen Mass Load Limit will be compromised at a similar load (38,700 EP). While this capacity exceeds the projected baseline connected population at 2041 of 37,097EP, a number of renewals and upgrades are required to maintain performance and compliance.

Upgrades to a further three process areas will be required to treat the additional 7215 EP load from the South West Victoria Point and Weinam Creek developments.

Concept designs were developed for each of the upgrade works proposed, and the associated capital costs estimated.

The scope, required timing and estimated capital costs of the required upgrades is summarised in Table 9-1.

Table 9-1: Summary of Required Plant Upgrades and Staging

Upgrade	Estimated Capital Cost	Required from	
RENEWALS AND PLANT UPGRADES REQUIRED TO SERVICE BASELINE GROWTH			
2 No. New Raw Sewage Pumps	Not included (in progress under separate project)	41,240 EP	Installation scheduled for August 2020
2 No. New Band Screens and 2 No. Screw Wash Presses	$0.910m Direct Job Cost	As soon as possible (for performance and redundancy)	
Removal of existing covers / installation of noise barriers to oxidation ditch aerators	$0.030m Direct Job Cost	As soon as possible (existing covers corroded)	
Control system change / minor works to facilitate duty/assist chlorinator operation	$0.026m Direct Job Cost	As soon as possible (estimated peak dose rate < demand)	
New dewatering trains / WAS pump station and poly storage and dosing	Not included (in progress under separate project)	As soon as possible (existing GDD/BFPs at end of serviceable life)	
Total Capital Cost	**Total Direct Job Cost (including Preliminaries): $0.987m** **Total Project Cost (including 30% Contingency): $2.200m**		
PLANT UPGRADES REQUIRED TO SERVICE ADDITIONAL DEVELOPMENTS			
Post-Anoxic / Re-Aeration Zone)	$1.289m Direct Job Cost	38,700 EP	2025
1 No. Additional Secondary Clarifier	$2.255m Direct Job Cost	38,300 EP	2024
1 No. Additional Chlorine Contact Tank	$0.296m Direct Job Cost	38,700 EP	2025
Total Capital Cost **(+/- 30% Accuracy Target)**	**Total Direct Job Cost (including Preliminaries, Commissioning and Handover): $4.033m** **Total Project Cost (including 30% Contingency): $8.512m**		

The additional operational costs required to treat the sewage load generated by the South West Victoria Point and Weinam Creek Developments were estimated in detail. The additional electricity consumption and biosolids haulage required to treat the load dominates the additional costs. In 2041 (the design horizon), the additional annual operating cost is $135,100 p.a. with additional sludge haulage at $65 /wet tonne, increasing to $160,400 p.a. if the rate for sludge haulage rises to $100 /wet tonne

The whole-of-life cost to treat the additional load from the South West Victoria Point and Weinam Creek Developments is **$10.31-10.68m over 40 years** depending on the cost of biosolids management.

The renewals and upgrade works required for baseline growth are required to be completed as soon as possible. Given the limited scope of these works within the plant, completion of these upgrades could be completed as a single project, or as a suite of minor projects.

The works to treat sewage loads from the additional developments are required to be completed and in service by 2024-25. This suggests the upgrades should be undertaken under a single contract with procurement and design commencing in 2020-21.

10 REFERENCES

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APPENDIX A: VICTORIA POINT WWTP – HYDRAULIC ANALYSIS

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19/06/2019

Our ref: TYR-190531

Tyr Group
PO Box 315
Bangalow NSW 2479

Attn: David Fligelman

Dear David,

Victoria Point WWTP - Hydraulic Analysis

1 Introduction

Tyr Group have commissioned CMP Consulting Group a hydraulic analysis of the Victoria Point WWTP. The nominated cases assessed were

- 500 L/s influent + 345 L/s RAS
- 404 L/s influent + 279 L/s RAS
- 577 L/s influent and 400 L/s RAS

We have also looked at the flows that match the hydraulic profile provided.

There are some areas where we are missing information. This is either because of unclear or missing pump data or information that we are unable to determine from the drawings.

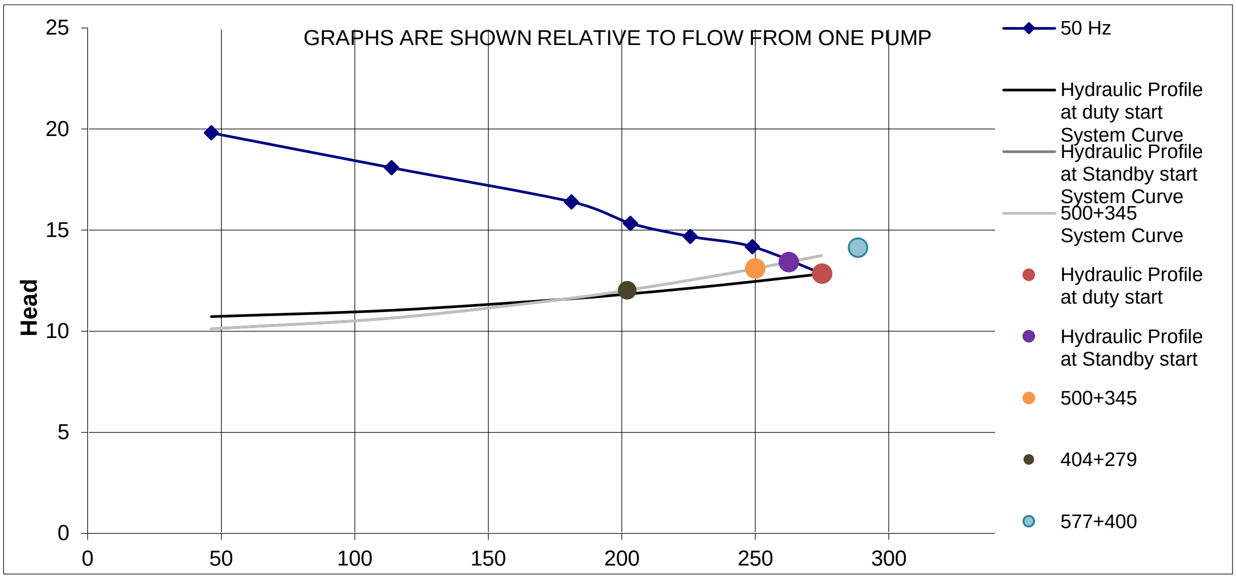
We have not looked at any of the chemical dosing.

The following is a summary of our findings.

2 Results

2.1 Inlet Pump Station

Depending upon operating level in the well and the level in the inlet works (modelled at the nominated figures of 8.36m) as well as which pumps are running, pump 1 should produce approximately 275 L/s of flow (red dot on the following graph). This matches the SCADA data provided. Both pumps running should produce around 525 L/s. This is right on the end of the pump curve and will operate with cavitation assuming that the full pump curve has been shown in the data provided. We have not been able to find other published data for this pump.



The nominated cases where the inlet flow is 500 L/s (250 L/s per pump – dark grey dot) and 404 L/s (202 L/s per pump - yellow dot) are achievable. The one where the inlet flow is 577 L/s (288.5 L/s per pump – blue dot) is not achievable without replacing the pumps.

2.2 Inlet Channel

Hydraulic losses along the channel are only 2mm + whatever losses occur as a result of the grit screw, the step screen and the vortex grit trap. There is no flow vs pressure loss information in VoR's documentation for these.

2.3 Pipe from Inlet Channel to Anaerobic Reactor

Losses are 54 mm at 500 L/s, 35 mm at 404 L/s and 71 mm at 577 L/s. The hydraulic profile shows a drop of 110 mm. This would match a flow of around 727 L/s.

2.4 Anaerobic Reactor and Oxidation Ditch

The flooded weir entering the Anaerobic Reactor can take larger flows than any of the nominated cases without exceeding the hydraulic profile levels.

2.5 Weir Outlet form Oxidation Ditch

The tilting weir on the outlet of the oxidation ditch provides enough freeboard (at least 300mm) in the oxidation ditch for all three nominated flows.

2.6 Pipe from Oxidation Ditch to Mixed Liquor Distributor

Losses are in the order of 27mm at a flow of 180 L/s, 108mm at a flow of 360 L/s and to match the hydraulic profile, the flow through this pipe is in the order of 1460 L/s.

2.7 Across Weir in Mixed Liquor Distributor

We have assessed the flow going to each clarifier on the basis of matching the hydraulic profile and also how much could be achieved if you only allowed for 300mm freeboard in the central chamber.

Matching the hydraulic profile, the flow is 340 L/s for each clarifier or 680 L/s total. The maximum flow allowing for minimum freeboard is over 1400 L/s combined.

2.8 Pipe from Mixed Liquor Distributor to Clarifier

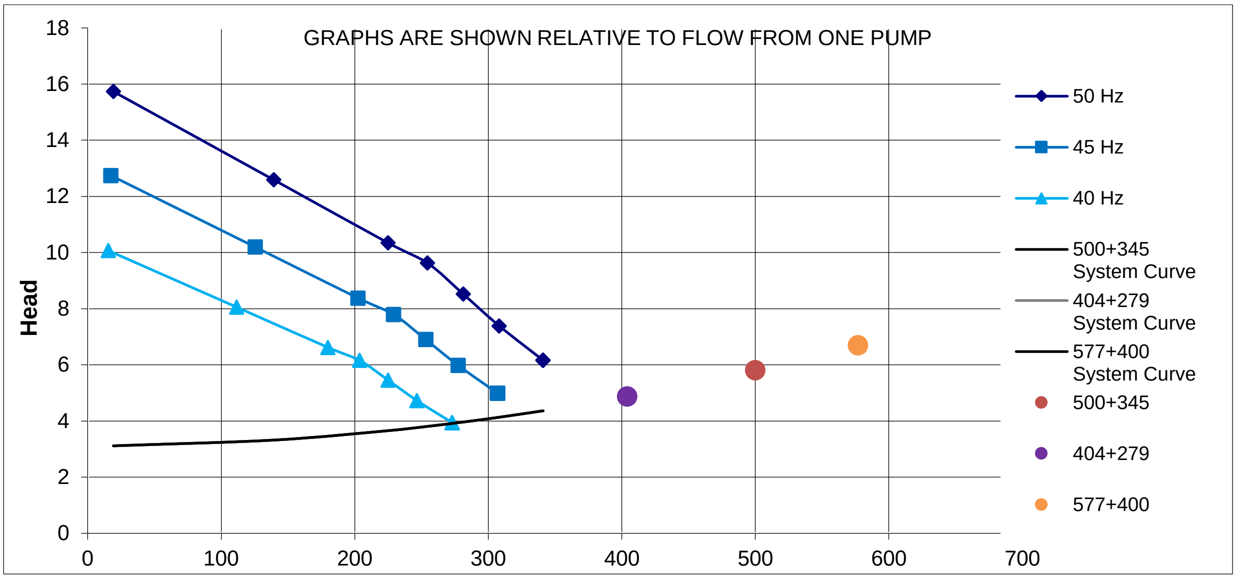
Losses are 229 mm for 500+345 L/s, 157 mm for 404+279 L/s, 306 for 577+400 L/s. To match the hydraulic profile, the flow through the pipe is in the order of 517 L/s. This is per clarifier. Flow capacity is above the nominal figures.

2.9 Pipe from Clarifier to Filter Feed Tank

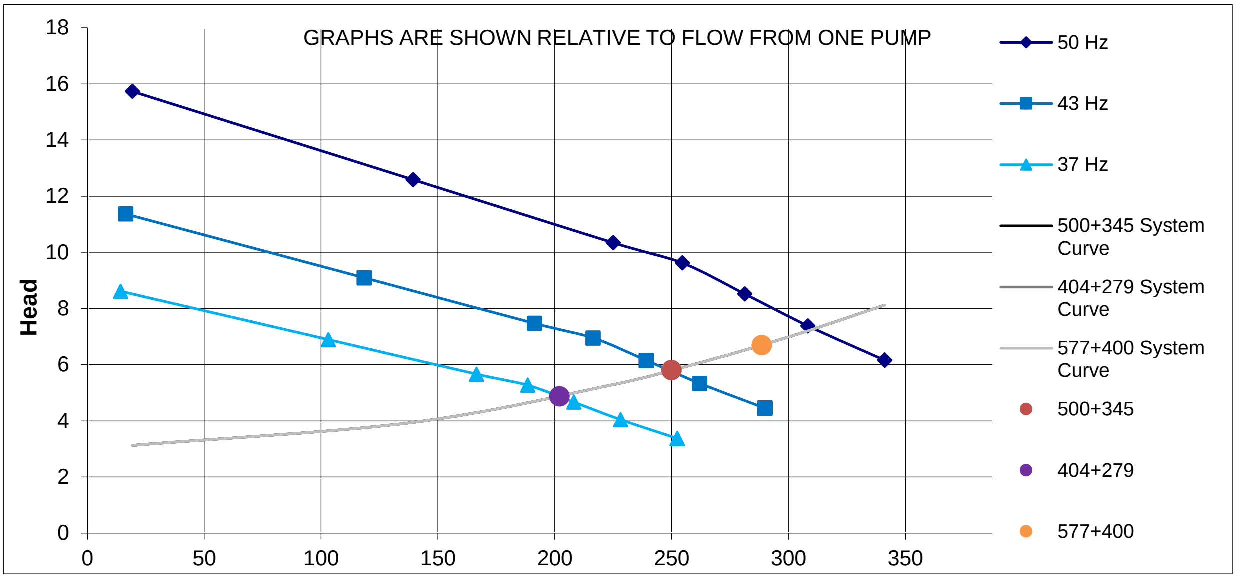
Losses are 11mm for 180 L/s, 43 mm for 360 L/s and to match the hydraulic profile, the flow through the pipe is in the order of 754 L/s. This is a combined flow. The flow out of each of the clarifiers will be half of these.

2.10 Filter Feed Tank to Filters

This is a pumped system and while the calculation has been set up, the information on the pumps doesn't make much sense for single pump duty. The figures show the pumps running way off the end of the curve. With one pump running, this should not work at any flow rate.



If two pumps are put into service, the increased back pressure puts the system curve into a position where the pumps are operable at all of the nominated flow rates. For changes to the existing system, the actual flow rate required by these pumps will need to be checked once the PFD has been fully developed and there would be no standby.



2.11 Filters

Hydraulic gradient through clean media is $h = \frac{6\,(1-e)V^2}{d\,e^3 g}$x (5 Re^-1 + 0.4 Re^-0.1)

- e = media voidage
- d = hydraulic size of media
- V = Filtration rate
- Re = Reynolds number in media

In practical analysis, this cannot be worked out without a lot more information. The most effective way to address the hydraulic capacity of the filters is to look at the headlosses against outlet control valves and then extrapolate from there. If you are able to provide operational information on the range of valve positions against dp, we could potentially do an estimate of the maximum possible flow rate.

A possible approximation would be to base the flow rate on 10 m/hr through the filters. This gives a flow of 442 L/s which is less than two of the three nominated conditions.

2.12 Filtered Water Holding Tank to Chlorine Contact Tank Inlet

Losses are 88 mm for 500 L/s, 58 mm for 404 L/s and 117 mm for 577 L/s. To match the hydraulic profile, the flow through the pipe is in the order of 1012 L/s.

2.13 Chlorine Contact Tank Outlet Weirs

To match the figures on the hydraulic Profile, the flow over the weir to the old secondary clarifiers is in the order of 1610 L/s. The flow over the weir to the outfall is 4835 L/s.

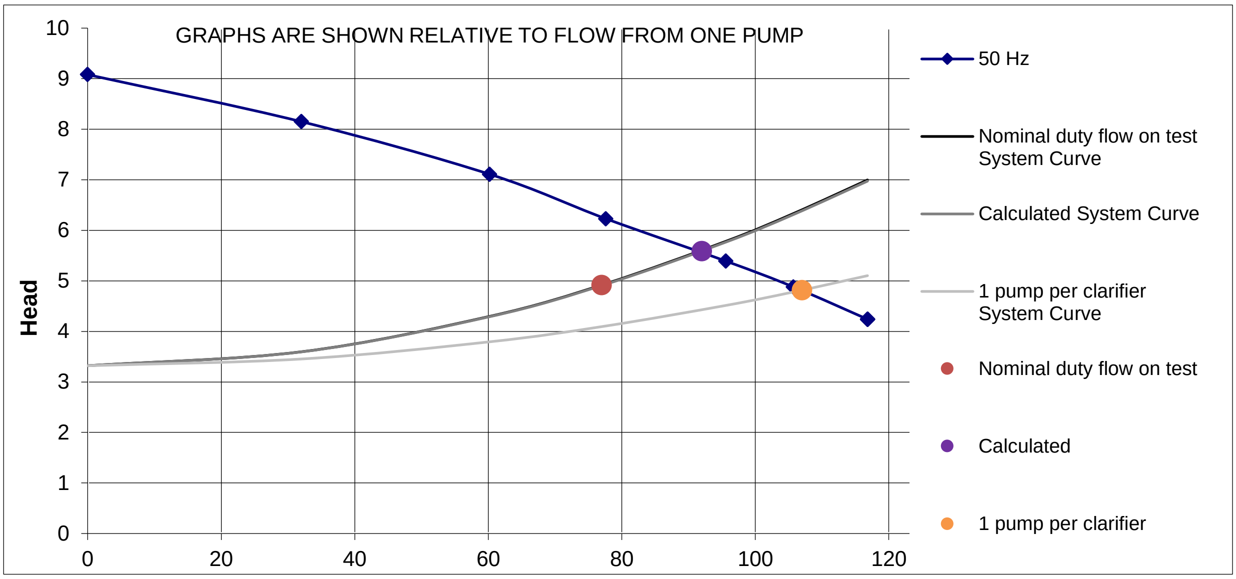
There is hydraulic data for a final manhole, but the location of this manhole is not shown on the drawings, so we are unable to model this.

2.14 Waste Activated Sludge Pumps

These pumps are progressive cavity rated at 8.3 L/s with a very steep curve. The actual flow rate will depend upon the pump condition, particularly of the stator. If the pump is in good condition, then the flow rate of 1 L/s should be a reasonable assumption.

2.15 Return Activated Sludge Pumps

The nominated duty point per pumps on the test data is 77 L/s. The nominated duty in the Summary of unit sizing is 94 L/s. Assuming consistency of water, the plant should be able achieve over 90 L/s per pump. Thicker sludge will drop that value.



The nominated RAS flows of 345 L/s (86.25 L/s per pump) and 279 L/s (69.75 L/s per pump) are achievable. The flow of 400 L/s is not achievable without replacing the pumps.

2.16 Foul Water Return Pumps

We need clarification on pump performance data. Foul water pumps and belt press filtrate pumps have been filed together without labelling.

2.17 Conclusion

The limitations on the system are

- Inlet Pumps – The existing pumps are not capable of achieving the 577 L/s between them.
- Filter Feed Pumps – The performance data from the existing pumps provided does not match the analysis for single pump duty. The curves for these pumps need to be confirmed.
- Filters – The existing filters are likely to be insufficient. More filter area is required.
- RAS Pumps – The highest of the three RAS flows assessed is not achievable.

Yours faithfully

Lachlan Douglas

Calculation

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Client:

Tyr Group

Description:

Plant Hydraulic Analysis

Project:

Victoria Pt WWTP Analysis

Doc No:

TYR-190531 CAL 01

Rev:

3

Revision	Issued for:	Prepared	Date	Checked	Date	Approved	Date
1	Preliminary Issue	LD	17/06/2019				
2	Issued for Review	LD	19/06/2019	Still to be checked			
3	Final	LD	19/06/2019	GC	19/06/2019		

INLET PUMP STATION

1. Design Input

				Case 1	Case 2	Case 3	Case 4	Case 5	
Different cases for different flows and/or elevations but same piping system				Hydraulic Profile at duty start	Hydraulic Profile at Standby start	500+345	404+279	577+400	
Pump Type	Submersible								
No of duty pumps		*PN =*		1	2	2	2	2	
			Graphs on the System Curve worksheet will be displayed in the units selected below.						
Total flow		*Q =*	Choose units from drop down	275	525	500	404	577	L/s
		Qt =		990.000	1890.000	1800.000	1454.400	2077.200	m^3/hr
		qt =	*Qt / 3.6*	275.000	525.000	500.000	404.000	577.000	L/s
				0.275	0.525	0.500	0.404	0.577	m^3/s
				23.760	45.360	43.200	34.906	49.853	ML/d
Flow per pump				275	262.5	250	202	288.5	L/s
		Qp =	*Qt / PN*	990.000	945.000	900.000	727.200	1038.600	m^3/hr
		qp =	*Qp / 3.6*	275.000	262.500	250.000	202.000	288.500	L/s
Pumped liquid:	water								
Density of pumped liquid		*Dens =*		1000	1000	1000	1000	1000	kg/m^3
Density of water		$Dens_{H2O}$ =		1000	1000	1000	1000	1000	kg/m^3
Kinematic Viscosity of liquid		*KV =*	25 C	8.910E-07	8.910E-07	8.910E-07	8.910E-07	8.910E-07	m^2/s
		KVcst =	*KV x 1E6*	0.891	0.891	0.891	0.891	0.891	cSt

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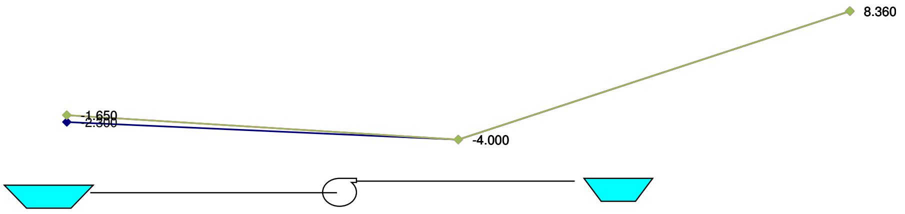
2. Static Conditions



			Case 1	Case 2	Case 3	Case 4	Case 5	
2.1 Pump			Hydraulic Profile at duty start	Hydraulic Profile at Standby start	500+345	404+279	577+400	
Elevation of pump	*ELp =*		-4.000	-4.000	-4.000	-4.000	-4.000	m EL
2.2 Suction								
Elevation liquid level	*ELsl =*		-2.300	-1.650	-1.650	-1.650	-1.650	m EL
Liquid pressure at pump	*SPl =*	*ELsl - ELp*	1.700	2.350	2.350	2.350	2.350	m liq
Air or gas pressure	*SPg =*	e.g. pumping from pressurised system						kPag
Equivalent liquid head due to air pressure	*SPm =*	*SPg / Dens / g x 1E3*	0.000	0.000	0.000	0.000	0.000	m liq
Static suction head	*SHs =*	*SPl + SPm*	1.700	2.350	2.350	2.350	2.350	m liq
2.3 Discharge								
Elevation liquid level	*ELdl =*		8.360	8.360	8.360	8.360	8.360	m EL
Liquid pressure at pump	*DPl =*	*ELdl - Elp*	12.360	12.360	12.360	12.360	12.360	m liq
Air or gas pressure	*DPg =*	e.g. pumping to pressurised system						kPag
Equivalent liquid head due to air pressure	*DPm =*	*DPg / Dens / g x 1E5*	0.000	0.000	0.000	0.000	0.000	m liq
Static discharge head	*DHs =*	*DPl + DPm*	12.360	12.360	12.360	12.360	12.360	m liq
2.4 Static Head								
Static differential head	*Hs =*	*DHs - SHs*	10.660	10.010	10.010	10.010	10.010	m liq

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3. Dynamic Conditions

3.1 Suction

				Case 1	Case 2	Case 3	Case 4	Case 5	
Pipe Section 1	**Not used**			Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe Section 2	**Not used**			Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe Section 3	**Not Used**			Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe Section 4	**Not Used**			Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	

3.2 Discharge

				Case 1	Case 2	Case 3	Case 4	Case 5	
Pipe Section 5	**Pump Discharge**			Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe size	DICL?			DN375	DN375	DN375	DN375	DN375	mm
Inside Diameter		d_5 =	Use accurate internal diameter from tables	406	406	406	406	406	mm
		D_5 =	d_5 / 1000	0.406	0.406	0.406	0.406	0.406	m
Area		A_5 =	Π / 4 x D_5^2	0.129	0.129	0.129	0.129	0.129	m^2 area

Number of streams for total flow	S_5 =	Default from Design Inputs	1	2	2	2	2	
Flow for this pump station		Default from previous section	990	945	900	727.2	1038.6	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc						m3/hr
Total flow for this pipe section	Q_5 =		990.000	945.000	900.000	727.200	1038.600	m³/h
	q_5 =	$Q_5 / 3.6$	275.000	262.500	250.000	202.000	288.500	L/s
Velocity	V_5 =	$\underline{Q}_5$	2.124	2.028	1.931	1.560	2.228	m/sec
		A_5 x 3600						
Pipe Wall Roughness	k_5 =		3	3	3	3	3	mm
			0.003	0.003	0.003	0.003	0.003	m
Reynolds number	Re_5 =	$\underline{V}_5$ x D_5	967919	923923	879926	710981	1015435	
		KV						
Reynolds number is above 2500, therefore flow may be considered turbulent								
Friction factor	f_5 =	*0.25*	0.034	0.034	0.034	0.034	0.034	
(Swamee & Jain modified CW equ.)		*(log (k5 / 3.7 / D5 + 5.74 / Re5^0.9))²*						
Hydraulic gradient	HG_5 =	$\underline{f}_5$ x 100 x V_5^2	1.950	1.777	1.612	1.054	2.146	m/100 m
		D_5 x 2 x g						
Quantity	k value							
15 m of Pipe length		x HG_5 / 100	0.293	0.267	0.242	0.158	0.322	m liq
2 x Elbow Short Radius 90	1	per fitting x V_5^2 / 2 / g	0.460	0.419	0.380	0.248	0.506	m liq
1 x Valve - Check conventional	2.4	per fitting x V_5^2 / 2 / g	0.552	0.503	0.456	0.298	0.607	m liq
1 x Valve - Gate	0.2	per fitting x V_5^2 / 2 / g	0.046	0.042	0.038	0.025	0.051	m liq
1 x Expander 4:5	0.15	per fitting x V_5^2 / 2 / g	0.034	0.031	0.029	0.019	0.038	m liq
Sub total	dP_5 =	*Sum of friction losses*	1.385	1.262	1.145	0.747	1.524	m liq

Pipe Section 6	**Pump station header**		Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe size	DICL		DN500	DN500	DN500	DN500	DN500	mm
Inside Diameter	d_6 =	Use accurate internal diameter from tables	472	472	472	472	472	mm
	D_6 =	d_6 / 1000	0.472	0.472	0.472	0.472	0.472	m
Area	A_6 =	Π / 4 x D_6^2	0.175	0.175	0.175	0.175	0.175	m² area
Number of streams for total flow	S_6 =	Default from Design Inputs	1	2	2	2	2	
Flow for this pump station		Default from previous section	990.000	945.000	900.000	727.200	1038.600	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc						m3/hr
Total flow for this pipe section	Q_6 =		990.000	945.000	900.000	727.200	1038.600	m³/h
	q_6 =	$Q_6 / 3.6$	275.000	262.500	250.000	202.000	288.500	L/s
Velocity	V_6 =	$\underline{Q}_6$	1.572	1.500	1.429	1.154	1.649	m/sec
		A_6 x 3600						
Pipe Wall Roughness	k_6 =	See attached worksheet	3	3	3	3	3	mm
			0.003	0.003	0.003	0.003	0.003	m
Reynolds number	Re_6 =	$\underline{V}_6$ x D_6	832575	794730	756886	611564	873446	
		KV						
Reynolds number is above 2500, therefore flow may be considered turbulent								
Friction factor	f_6 =	*0.25*	0.033	0.033	0.033	0.033	0.033	
(Swamee & Jain modified CW equ.)		*(log (k6 / 3.7 / D6 + 5.74 / Re6^0.9))²*						
Hydraulic gradient	HG_6 =	$\underline{f}_6$ x 100 x V_6^2	0.876	0.799	0.725	0.474	0.964	m/100 m
		D_6 x 2 x g						
Quantity	k value							
6 m of Pipe length		x HG_6 / 100	0.053	0.048	0.043	0.028	0.058	m liq
1 x Tee - in line	0.6	per fitting x V_6^2 / 2 / g	0.076	0.069	0.062	0.041	0.083	m liq
1 x Elbow Short Radius 45	0.4	per fitting x V_6^2 / 2 / g	0.050	0.046	0.042	0.027	0.055	m liq
1 x Reducer 5:4	0.15	per fitting x V_6^2 / 2 / g	0.019	0.017	0.016	0.010	0.021	m liq
Sub total	dP_6 =	*Sum of friction losses*	0.197	0.180	0.163	0.107	0.217	m liq

Pipe Section 7	**Flowmeter**		Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe size			DN400	DN400	DN400	DN400	DN400	mm
Inside Diameter	d_7 =	Use accurate internal diameter from tables	372	372	372	372	372	mm
	D_7 =	d_7 / 1000	0.372	0.372	0.372	0.372	0.372	m
Area	A_7 =	Π / 4 x D_7^2	0.109	0.109	0.109	0.109	0.109	m² area
Number of streams for total flow	S_7 =	Default from Design Inputs	1	1	1	1	1	
Flow for this pump station		Default from previous section	990.000	1890.000	1800.000	1454.400	2077.200	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc						m3/hr
Total flow for this pipe section	Q_7 =		990.000	1890.000	1800.000	1454.400	2077.200	m³/h
	q_7 =	$Q_7 / 3.6$	275.000	525.000	500.000	404.000	577.000	L/s
Velocity	V_7 =	$\underline{Q}_7$	2.530	4.830	4.600	3.717	5.309	m/sec
		A_7 x 3600						
Pipe Wall Roughness	k_7 =	See attached worksheet	3	3	3	3	3	mm
			0.003	0.003	0.003	0.003	0.003	m
Reynolds number	Re_7 =	$\underline{V}_7$ x D_7	1056385	2016735	1920700	1551925	2216488	

		KV						
Reynolds number is above 2500, therefore flow may be considered turbulent								
Friction factor	f_7 =	0.25	0.035	0.035	0.035	0.035	0.035	
(Swamee & Jain modified CW equ.)		(log (k7 / 3.7 / D7 + 5.74 / Re7^0.9))²						
Hydraulic gradient	HG_7 =	f_7 x 100 x V_7^2	3.105	11.302	10.252	6.696	13.650	m/100 m
		D_7 x 2 x g						
Quantity	k value							
4.5 m of Pipe length		x HG_7 / 100	0.140	0.509	0.461	0.301	0.614	m liq
1 x Expander 4:5	0.15	per fitting x V_7^2 / 2 / g	0.049	0.178	0.162	0.106	0.215	m liq
1 x Bend Long Radius 90	0.4	per fitting x V_7^2 / 2 / g	0.131	0.476	0.431	0.282	0.575	m liq
Sub total	dP_7 =	Sum of friction losses	0.319	1.163	1.055	0.689	1.404	m liq

Pipe Section 8			Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe size			DN500	DN500	DN500	DN500	DN500	
Inside Diameter	d_8 =	Use accurate internal diameter from tables	538	538	538	538	538	mm
	D_8 =	d_8 / 1000	0.538	0.538	0.538	0.538	0.538	m
Area	A_8 =	Π / 4 x D_8^2	0.227	0.227	0.227	0.227	0.227	m² area
Number of streams for total flow	S_8 =	Default from Design Inputs	1	1	1	1	1	
Flow for this pump station		Default from previous section	990.000	1890.000	1800.000	1454.400	2077.200	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc						m3/hr
Total flow for this pipe section	Q_8 =		990.000	1890.000	1800.000	1454.400	2077.200	m³/h
	q_8 =	Q_8 / 3.6	275.000	525.000	500.000	404.000	577.000	L/s
Velocity	V_8 =	$\underline{Q_8}$	1.210	2.309	2.199	1.777	2.538	m/sec
		A_8 x 3600						
Pipe Wall Roughness	k_8 =	See attached worksheet	3	3	3	3	3	mm
			0.003	0.003	0.003	0.003	0.003	m
Reynolds number	Re_8 =	$\underline{V_8}$ x D_8	730437	1394471	1328067	1073079	1532590	
		KV						
Reynolds number is above 2500, therefore flow may be considered turbulent								
Friction factor	f_8 =	0.25	0.032	0.032	0.032	0.032	0.031	
(Swamee & Jain modified CW equ.)		(log (k8 / 3.7 / D8 + 5.74 / Re8^0.9))²						
Hydraulic gradient	HG_8 =	f_8 x 100 x V_8^2	0.438	1.592	1.444	0.943	1.922	m/100 m
		D_8 x 2 x g						
Quantity	k value							
6 m of Pipe length		x HG_8 / 100	0.026	0.096	0.087	0.057	0.115	m liq
1 x Elbow Short Radius 90	1	per fitting x V_8^2 / 2 / g	0.075	0.272	0.247	0.161	0.328	m liq
1 x Enlargement Sudden	1	per fitting x V_8^2 / 2 / g	0.075	0.272	0.247	0.161	0.328	m liq
Sub total	dP_8 =	Sum of friction losses	0.175	0.639	0.580	0.379	0.772	m liq

Pipe Section 9	**Not Used**	Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Pipe Section 10	**Not Used**	Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	
Control Valve Sizing	**Not Used**	Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400	

4. Total Dynamic Losses

				Hydraulic Profile at duty start	Hydraulic Profile at Standby start	500+345	404+279	577+400	
Friction loss in suction pipework									
Pipe Section 1	Not used	dP_1 =		0.000	0.000	0.000	0.000	0.000	m liq
Pipe Section 2	Not used	dP_2 =		0.000	0.000	0.000	0.000	0.000	m liq
Pipe Section 3	Not Used	dP_3 =		0.000	0.000	0.000	0.000	0.000	m liq
Pipe Section 4	Not Used	dP_4 =		0.000	0.000	0.000	0.000	0.000	m liq
Total		SHd =	$dP_1 + dP_2 + dP_3 + dP_4$	0.000	0.000	0.000	0.000	0.000	m liq
Friction loss in discharge pipework									
Pipe Section 5	Pump Discharge	dP_5 =		1.385	1.262	1.145	0.747	1.524	m liq
Pipe Section 6	Pump station header	dP_6 =		0.197	0.180	0.163	0.107	0.217	m liq
Pipe Section 7	Flowmeter	dP_7 =		0.319	1.163	1.055	0.689	1.404	m liq
Pipe Section 8	0	dP_8 =		0.175	0.639	0.580	0.379	0.772	m liq
Pipe Section 9	Not Used	dP_9 =		0.000	0.000	0.000	0.000	0.000	m liq
Pipe Section 10	Not Used	dP_{10} =		0.000	0.000	0.000	0.000	0.000	m liq
Control Valve	Not Used	dpV =		0.000	0.000	0.000	0.000	0.000	m liq
Total		DHd =	$dP_5 + dP_6 + dP_7 + dP_8 + dP_9 + dP_{10}$	2.077	3.244	2.942	1.921	3.918	m liq

5. Summary

			Hydraulic Profile at duty start	Hydraulic Profile at Standby start	500+345	404+279	577+400	
Safety margin on dynamic losses	dP% =		5.00%	5.00%	5.00%	5.00%	5.00%	
Suction dynamic losses	SHd% =	(1 + dp%) x SHd	0.000	0.000	0.000	0.000	0.000	m liq
Discharge dynamic losses	DHd% =	(1 + dp%) x DHd	2.181	3.406	3.089	2.017	4.114	m liq
Total dynamic losses	Hd% =	SHd% + Dhd%	2.181	3.406	3.089	2.017	4.114	m liq
Total suction head	TSHg =	SHs - SHd%	1.700	2.350	2.350	2.350	2.350	m liq g
Total required discharge head	TDHg =	DHs + DHd%	14.541	15.766	15.449	14.377	16.474	m liq g
Calculated Differential Head Requirements	DHr =	TDHg - TSHg	**12.841**	**13.416**	**13.099**	**12.027**	**14.124**	m liq
	=	DHr x Dens / $Dens_{H2O}$	**12.841**	**13.416**	**13.099**	**12.027**	**14.124**	m H_2O

Hydraulic Profile	Hydraulic Profile	500+345	404+279	577+400

6. NPSH Available

(Assuming elevation & velocity head negligible)

			at duty start	at Standby start				
NPSHA Available	*NPSHa =*	*101.3/Densx1000/9.81+TSHg*	12.026	12.676	12.676	12.676	12.676	m liq

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7. Estimated Power Required

Assumed efficiency	*Peff =*		70.00%	70.00%	70.00%	70.00%	70.00%	
Estimated absorbed pump power	*Pabs =*	$\frac{qp \times DHr \times Dens \times g}{Peff}$	49.49	49.35	45.89	34.05	57.10	kW

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8. Notes

Calculation
Pump Station Head

CMP Consulting Group Pty Ltd
Office 2, Level 1, 700 Springvale Road,
Mulgrave VIC 3170
Phone (03) 9002 0710
www.cmpgroup.com.au

INLET PUMP STATION

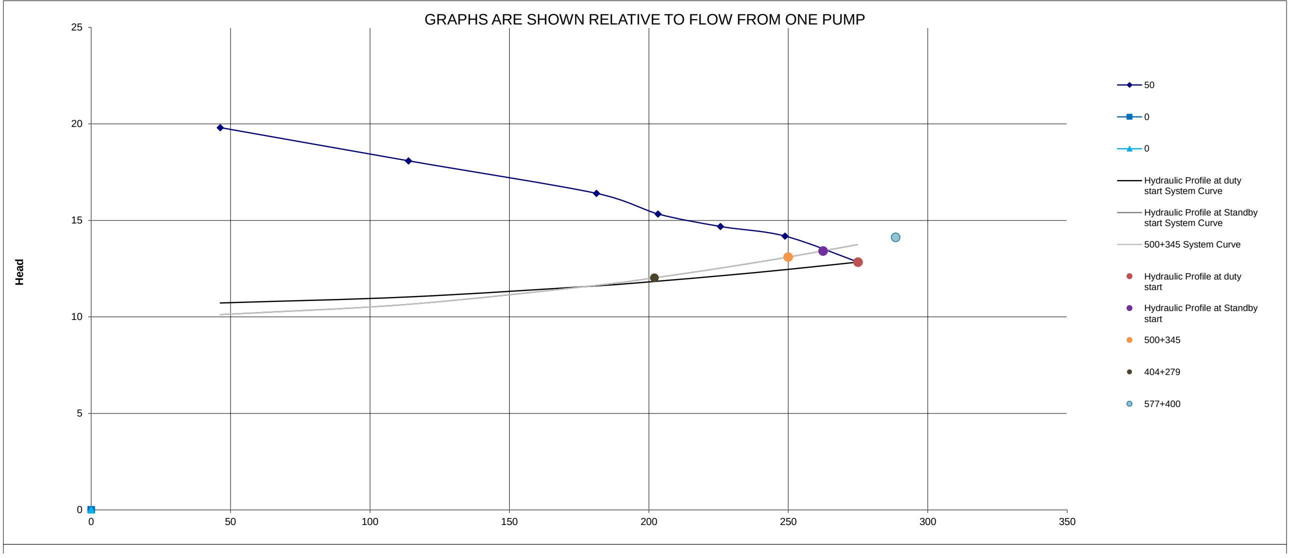
Performance Curves Resulting from VSD Speeds

	Existing N1	N2	N3
Speed	50	0	0
Flow multiplier	*N2/N1*	0	0
Head Multiplier	*$(N2/N1)^2$*	0	0
Power Multimplier	*$(N2/N1)^3$*	0	0

System Curve (Default figures from Pump Sizing spreadsht)

Static head [m H2O]	10.66	10.01	10.01	10.01	10.01
Duty flow [L/s]	275	262.5	250	202	288.5
Duty head [m H2O]	12.84083222	13.41584342	13.09930874	12.0272465	14.1236755
Coefficient	2.88375E-05	4.94272E-05	4.94289E-05	4.9437E-05	4.9424E-05

Flow at 50 [L/s]	Head at 50 [m H2O]	Power at 50 [kW]	Eff at 50 [%]	Flow at 0 [L/s]	Head at 0 [m H2O]	Power at 0 [kW]	Eff at #REF! [%]	Flow at 0 [L/s]	Head at 0 [m H2O]	Power at 0 [kW]	Eff at 0 [%]	Hydraulic Profile at duty start System	Hydraulic Profile at Standby start	500+345 System Curve	404+279 (Default figures from	577+400
46.31	19.808	1	899.88%	0.00	0.00	0.00	899.88%	0	0.00	0.00	899.88%	10.72	10.12	10.12	10.12	10.12
113.82	18.086	1	2019.44%	0.00	0.00	0.00	2019.44%	0	0.00	0.00	2019.44%	11.03	10.65	10.65	10.65	10.65
181.22	16.4	1	2915.54%	0.00	0.00	0.00	2915.54%	0	0.00	0.00	2915.54%	11.61	11.63	11.63	11.63	11.63
203.28	15.334	1	3057.87%	0.00	0.00	0.00	3057.87%	0	0.00	0.00	3057.87%	11.85	12.05	12.05	12.05	12.05
225.69	14.684	1	3251.07%	0.00	0.00	0.00	3251.07%	0	0.00	0.00	3251.07%	12.13	12.53	12.53	12.53	12.53
248.87	14.185	1	3463.15%	0.00	0.00	0.00	3463.15%	0	0.00	0.00	3463.15%	12.45	13.07	13.07	13.07	13.07
274.78	12.851	1	3464.11%	0.00	0.00	0.00	3464.11%	0	0.00	0.00	3464.11%	12.84	13.74	13.74	13.74	13.74
274.78	12.851	1	3464.11%	0.00	0.00	0.00	3464.11%	0	0.00	0.00	3464.11%	12.84	13.74	13.74	13.74	13.74
274.78	12.851	1	3464.11%	0.00	0.00	0.00	3464.11%	0	0.00	0.00	3464.11%	12.84	13.74	13.74	13.74	13.74
274.78	12.851	1	3464.11%	0.00	0.00	0.00	3464.11%	0	0.00	0.00	3464.11%	12.84	13.74	13.74	13.74	13.74



PIPE FROM INLET WORKS TO ANAEROBIC REACTOR

1. Design Input

			Case 1	Case 2	Case 3	Case 3	
Different cases for different flows and/or elevations but same piping system			500+345	404+279	577+400	Hydraulic profile	
Total flow	Q =	Choose units from drop down	500	404	577	718	L/s
	Qt =		1800.000	1454.400	2077.200	2584.800	m³/hr
	qt =	$Qt / 3.6$	500.000	404.000	577.000	718.000	L/s
			0.500	0.404	0.577	0.718	m³/s
			43.200	34.906	49.853	62.035	ML/d
Liquid: ?							
Density of pumped liquid	$Dens$ =		1000	1000	1000	1000	kg/m³
Density of water	$Dens_{H2O}$ =		1000	1000	1000	1000	kg/m³
Kinematic Viscosity of liquid	KV =	25 C	8.910E-07	8.910E-07	8.910E-07	8.910E-07	m²/s
	$KVcst$ =	$KV \times 1E6$	0.891	0.891	0.891	0.891	cSt

2. Dynamic Conditions

Pipe Section 1	**Outlet from inlet works**		500+345	404+279	577+400	Hydraulic profile	
Pipe size	960 OD MSCL		DN960	DN960	DN960	DN960	mm
Inside Diameter	d_1 =	Use accurate internal diameter from tables	912	912	912	912	mm
	D_1 =	$d_1 / 1000$	0.912	0.912	0.912	0.912	m
Area	A_1 =	$\Pi / 4 \times D_1{}^2$	0.653	0.653	0.653	0.653	m²
Number of streams for total flow	S_1 =	Default from Design Inputs	1	1	1	1	
Flow for this pipe section		Default from Design Inputs	1800.000	1454.400	2077.200	2584.800	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc					m3/hr
Total flow for this pipe section	Q_1 =		1800.000	1454.400	2077.200	2584.800	m³/h
	q_1 =	$Q_1 / 3.6$	500.000	404.000	577.000	718.000	L/s
Velocity	V_1 =	$\dfrac{Q_1}{A_1 \times 3600}$	0.765	0.618	0.883	1.099	m/sec
Pipe Wall Roughness	k_1 =	See attached worksheet	3	3	3	3	mm
			0.003	0.003	0.003	0.003	m
Reynolds number	Re_1 =	$\dfrac{V_1 \times D_1}{KV}$	783443	633022	904094	1125025	

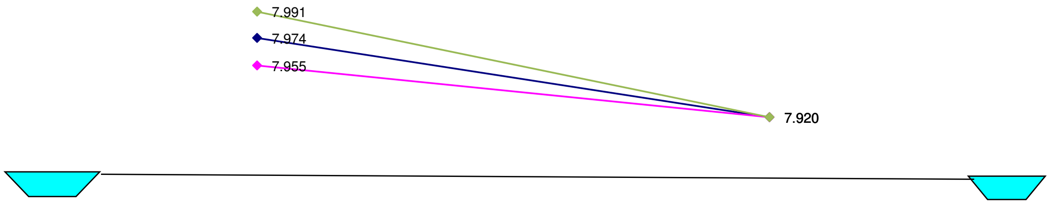
Reynolds number is above 2500, therefore flow may be considered turbulent

Friction factor (Swamee & Jain modified CW equ.)	f_1 =	$\dfrac{0.25}{(\log (k1 / 3.7 / D1 + 5.74 / Re1\hat{}0.9))^2}$	0.027	0.027	0.027	0.027	
Hydraulic gradient	HG_1 =	$\dfrac{f_1 \times 100 \times V_1{}^2}{D_1 \times 2 \times g}$	0.089	0.058	0.118	0.182	m/100 m
Qty	k value						
7 m of pipe length		$\times HG_1 / 100$	0.006	0.004	0.008	0.013	m liq
1 x Inlet Sharp Edged	0.5	per fitting $\times V_1{}^2 / 2 / g$	0.015	0.010	0.020	0.031	m liq
1 x Enlargement Sudden	1	per fitting $\times V_1{}^2 / 2 / g$	0.030	0.019	0.040	0.062	m liq
Sub total	dP_1 =	Sum of friction losses	0.051	0.033	0.068	0.105	m liq

3. Total Dynamic Losses

			500+345	404+279	577+400	Hydraulic profile	
Friction loss in pipework							
Pipe Section 1 Outlet from inlet works	dP_1 =		0.051	0.033	0.068	0.105	m liq
Total	DHd =	$dP1 + dP2 + dP3 + dP4 + dP_5 + dP_6 + dP_7 + dP_8 + dP_9 + dP_{10}$	0.051	0.033	0.068	0.105	m liq
Safety margin on dynamic losses	$dP\%$ =		5.00%	5.00%	5.00%	5.00%	
Dynamic losses	$Hd\%$ =	$(1 + dp\%) \times DHd$	0.054	0.035	0.071	0.110	m liq

4. Elevations



	500+345	404+279	577+400	Hydraulic profile	
$Hd\%$ =	0.054	0.035	0.071	0.110	m

Inlet elevation liquid level	*ELi =*	*ELo + HD%*	7.974	7.955	7.991	8.030	m EL
Outlet elevation liquid level	*ELo =*	Top Water Level Downstream	7.920	7.920	7.920	7.920	m EL

ANAEROBIC REACTOR INLET WEIR

1. Design Input

			Case 1	Case 2	Case 3	Case 4	
Different cases			500+345	404+279	577+400	Hydraulic profile	
Flow per clarifier	*Q =*		500	404	577	780	L/s
	Qt =		1800.000	1454.400	2077.200	2808.000	m³/hr
	qt =	*Qt / 3.6*	500.000	404.000	577.000	780.000	L/s
	qts =	*qt / 1000*	0.500	0.404	0.577	0.780	m³/s
			43.200	34.906	49.853	67.392	ML/d

Hydraulic drop 80mm

2. Dynamic Conditions

Weir width	**Flooded weir - CMP Flooded Weir Calculator used**	900	900	900	900	mm
Downstream TWL		7.840	7.840	7.840	7.840	m
Upstream TWL		7.870	7.860	7.880	7.920	m
		30	20	40	80	mm

OXIDATION DITCH OUTLET WEIR

1. Design Input

			Case 1	Case 2	Case 3	Case 4	
Different cases			Matching hydraulic drop in drawings	500+345	404+279	577+400	
Flow per clarifier	*Q =*		340	845	683	977	L/s
	Qt =		1224.000	3042.000	2458.800	3517.200	m³/hr
	qt =	*Qt / 3.6*	340.000	845.000	683.000	977.000	L/s
	qts =	*qt / 1000*	0.340	0.845	0.683	0.977	m³/s
			29.376	73.008	59.011	84.413	ML/d

2. Dynamic Conditions

Weir width			5084	5084	5084	5084	mm
	b =		5.084	5.084	5.084	5.084	m
Height over weir is	*h =*	$(\frac{qts}{0.595 \times 2/3 \times \sqrt{2g} \times (b-0.003)})^{2/3}+0.001$	0.114	0.209	0.181	0.230	m
			114	209	181	230	mm
TWL in Oxidation Ditch			7.560	7.560	7.560	7.560	m
Weir in down position			7.080	7.080	7.080	7.080	m
			480	480	480	480	mm

PIPE FROM OXIDATION DITCH TO MIXED LIQUOR DISTRIBUTOR

1. Design Input

			Case 1	Case 2	Case 3	Case 3	
Different cases for different flows and/or elevations but same piping system			500+345	404+279	577+400	Hydraulic profile	
Total flow	*Q =*	Choose units from drop down	845	683	977	1460	L/s
	Qt =		3042.000	2458.800	3517.200	5256.000	m³/hr
	qt =	*Qt / 3.6*	845.000	683.000	977.000	1460.000	L/s
			0.845	0.683	0.977	1.460	m³/s
			73.008	59.011	84.413	126.144	ML/d

Liquid: ?							
Density of pumped liquid	*Dens =*		1000	1000	1000	1000	kg/m³
Density of water	*Dens* $_{H2O}$ *=*		1000	1000	1000	1000	kg/m³
Kinematic Viscosity of liquid	*KV =*	20 C	8.910E-07	8.910E-07	8.910E-07	8.910E-07	m²/s
	KVcst =	*KV x 1E6*	0.891	0.891	0.891	0.891	cSt

2. Dynamic Conditions

Pipe Section 1			500+345	404+279	577+400	Hydraulic profile	
Pipe size	mscl		DN960	DN960	DN960	DN960	mm
Inside Diameter	d_1 =	Use accurate internal diameter from tables	912	912	912	912	mm
	D_1 =	d_1 / 1000	0.912	0.912	0.912	0.912	m
Area	A_1 =	Π / 4 x $D_1{}^2$	0.653	0.653	0.653	0.653	m²
Number of streams for total flow	S_1 =	Default from Design Inputs	1	1	1	1	
Flow for this pipe section		Default from Design Inputs	3042.000	2458.800	3517.200	5256.000	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc					m3/hr
Total flow for this pipe section	Q_1 =		3042.000	2458.800	3517.200	5256.000	m³/h

	q_1 =	$Q_1 / 3.6$	845.000	683.000	977.000	1460.000	L/s
Velocity	V_1 =	$\frac{Q_1}{A_1 \times 3600}$	1.294	1.046	1.496	2.235	m/sec
Pipe Wall Roughness	k_1 =	See attached worksheet	3	3	3	3	mm
			0.003	0.003	0.003	0.003	m
Reynolds number	Re_1 =	$\frac{V_1 \times D_1}{KV}$	1324019	1070184	1530848	2287654	

Reynolds number is above 2500, therefore flow may be considered turbulent

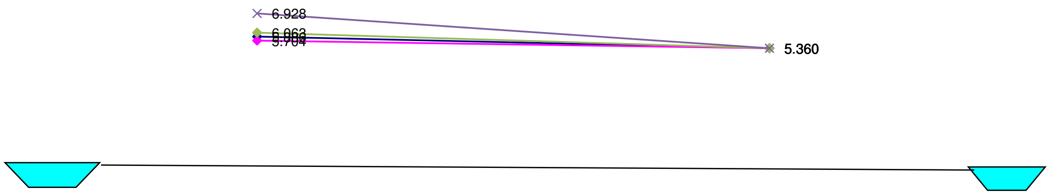
Friction factor	f_1 =	$\frac{0.25}{(\log(k1 / 3.7 / D1 + 5.74 / Re1^{0.9}))^2}$	0.027	0.027	0.027	0.027	
(Swamee & Jain modified CW equ.)							
Hydraulic gradient	HG_1 =	$\frac{f_1 \times 100 \times V_1^2}{D_1 \times 2 \times g}$	0.253	0.165	0.337	0.752	m/100 m

Qty		k value						
102	m of pipe length		$\times HG_1 / 100$	0.258	0.168	0.344	0.767	m liq
2	x Elbow Mitre 90 4 piece	0.3	per fitting $\times V_1^2 / 2 / g$	0.051	0.033	0.068	0.153	m liq
1	x Bend Medium Radius 90	0.75	per fitting $\times V_1^2 / 2 / g$	0.064	0.042	0.086	0.191	m liq
1	x Inlet Sharp Edged	0.5	per fitting $\times V_1^2 / 2 / g$	0.043	0.028	0.057	0.127	m liq
1	x Enlargement Sudden	1	per fitting $\times V_1^2 / 2 / g$	0.085	0.056	0.114	0.255	m liq
Sub total		dP_1 =	Sum of friction losses	0.501	0.327	0.669	1.493	m liq

3. Total Dynamic Losses

				500+345	404+279	577+400	Hydraulic profile	
Friction loss in pipework								
Pipe Section 1	0	dP_1 =		0.501	0.327	0.669	1.493	m liq
Total		DHd =	$dP1 + dP2 + dP3 + dP4 + dP_5 + dP_6 + dP_7 + dP_8 + dP_9 + dP_{10}$	0.501	0.327	0.669	1.493	m liq
Safety margin on dynamic losses		dP% =		5.00%	5.00%	5.00%	5.00%	
Dynamic losses		Hd% =	(1 + dp%) x DHd	0.526	0.344	0.703	1.568	m liq

4. Elevations



			500+345	404+279	577+400	Hydraulic profile	
	Hd% =		0.526	0.344	0.703	1.568	mm
Inlet elevation liquid level	ELi =	ELo + HD%	5.886	5.704	6.063	6.928	m EL
Outlet elevation liquid level	ELo =	Top Water Level Downstream	5.360	5.360	5.360	5.360	m EL

MIXED LIQUOR DISTRIBUTOR

1. Design Input

			Case 1	Case 2	Case 3	Case 4	Case 5
Different cases			Matching hydraulic drop in drawings	500+345	404+279	577+400	If only leave 300mm freeboard
Flow per clarifier	Q =		340	422.5	350.5	488.5	727
	Qt =		1224.000	1521.000	1261.800	1758.600	2617.200
	qt =	Qt / 3.6	340.000	422.500	350.500	488.500	727.000
	qts =	qt / 1000	0.340	0.423	0.351	0.489	0.727
			29.376	36.504	30.283	42.206	62.813

Hydaulic drop in drawngs is 290mm.

2. Dynamic Conditions

Weir width	Each of the two weirs in the flow splitter is	1250	1250	1250	1250	1250
	b =	1.25	1.25	1.25	1.25	1.25
Height over weir is	$h = \left(\frac{qts}{0.595 \times 2/3 \times \sqrt{2g} \times (b - 0.003)}\right)^{2/3} + 0.001$	0.290	0.335	0.296	0.369	0.480
		290	335	296	369	480

PIPE FROM MIXED LIQUOR DISTRIIBUTOR TO CLARIFIER

1. Design Input Case 1 Case 2 Case 3 Case 4

Different cases for different flows and/or elevations but same piping system

			Matching hydraulic drop in drawings	500+345	404+279	577+400	
Total flow	Q =	Choose units from drop down	1034	845	701	977	L/s
	Qt =		3722.400	3042.000	2523.600	3517.200	m^3/hr
	qt =	Qt / 3.6	1034.000	845.000	701.000	977.000	L/s
			1.034	0.845	0.701	0.977	m^3/s
			89.338	73.008	60.566	84.413	ML/d
Liquid: ?							
Density of pumped liquid	Dens =		1000	1000	1000	1000	kg/m^3
Density of water	$Dens_{H2O}$ =		1000	1000	1000	1000	kg/m^3
Kinematic Viscosity of liquid	KV =		8.910E-07	8.910E-07	8.910E-07	8.910E-07	m^2/s
	KVcst =	KV x 1E6	0.891	0.891	0.891	0.891	cSt

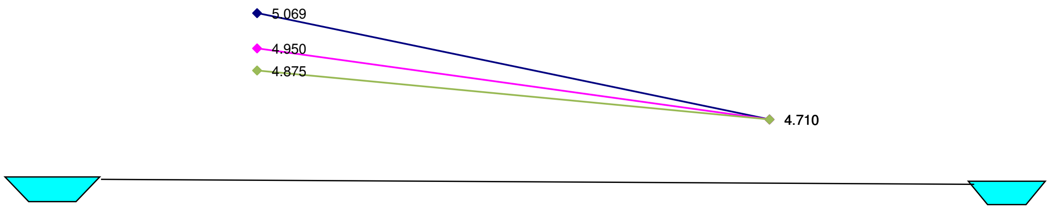
2. Dynamic Conditions

			Case 1	Case 2	Case 3	Case 4	
Pipe Section 1	**Mixed Liquor Distributor to Clarifer**						
Pipe size	MSCL		DN960	DN960	DN960	DN960	mm
Inside Diameter	d_1 =	Use accurate internal diameter from tables	912	912	912	912	mm
	D_1 =	d_1 / 1000	0.912	0.912	0.912	0.912	m
Area	A_1 =	$\Pi / 4 \times D_1^2$	0.653	0.653	0.653	0.653	m^2
Number of streams for total flow	S_1 =	Default from Design Inputs	2	2	2	2	
Flow for this pipe section		Default from Design Inputs	1861.200	1521.000	1261.800	1758.600	m^3/hr
Additional flows from another source		Use for multiple stations, dosing points etc					m3/hr
Total flow for this pipe section	Q_1 =		1861.200	1521.000	1261.800	1758.600	m^3/h
	q_1 =	$Q_1 / 3.6$	517.000	422.500	350.500	488.500	L/s
Velocity	V_1 =	$\frac{Q_1}{A_1 \times 3600}$	0.791	0.647	0.537	0.748	m/sec
Pipe Wall Roughness	k_1 =	See attached worksheet	3	3	3	3	mm
			0.003	0.003	0.003	0.003	m
Reynolds number	Re_1 =	$\frac{V_1 \times D_1}{KV}$	810080	662010	549194	765424	
Reynolds number is above 2500, therefore flow may be considered turbulent							
Friction factor	f_1 =	$\frac{0.25}{(\log (k1 / 3.7 / D1 + 5.74 / Re1^{0.9}))^2}$	0.027	0.027	0.027	0.027	
(Swamee & Jain modified CW equ.)							
Hydraulic gradient	HG_1 =	$\frac{f_1 \times 100 \times V_1^2}{D_1 \times 2 \times g}$	0.095	0.063	0.044	0.085	m/100 m
Qty	k value						
35.5 m of pipe length		$\times HG_1 / 100$	0.034	0.023	0.016	0.030	m liq
1 x Inlet Sharp Edged	0.5	per fitting $\times V_1^2 / 2 / g$	0.016	0.011	0.007	0.014	m liq
2 x Elbow Mitre 90 4 piece	0.3	per fitting $\times V_1^2 / 2 / g$	0.019	0.013	0.009	0.017	m liq
0 Assumed losses through clarifier entry slots		Q=0.62 A Sqrt(2gh)	0.273	0.183	0.126	0.244	m liq
Sub total	dP_1 =	Sum of friction losses	0.342	0.229	0.157	0.306	m liq

3. Total Dynamic Losses

Friction loss in pipework							
Pipe Section 1	Mixed Liquor Distributor to Cl dP_1 =		0.342	0.229	0.157	0.306	m liq
Total	DHd =	$dP1 + dP2 + dP3 + dP4 + dP_5 + dP_6 + dP_7 + dP_8 + dP_9 + dP_{10}$	0.342	0.229	0.157	0.306	m liq
Safety margin on dynamic losses	dP% =		5.00%	5.00%	5.00%	5.00%	
Dynamic losses	Hd% =	(1 + dp%) x DHd	0.359	0.240	0.165	0.321	m liq

4. Elevations



	Hd% =		0.359	0.240	0.165	0.321	mm
Inlet elevation liquid level	ELi =	ELo + HD%	5.069	4.950	4.875	5.031	m EL
Outlet elevation liquid level	ELo =	Top Water Level Downstream	4.710	4.710	4.710	4.710	m EL

PIPE FROM CLARIFIER OUTLETS TO FILTER FEED TANK

1. Design Input

			Case 1	Case 2	Case 3	Case 3	
Different cases for different flows and/or elevations but same piping system			Matching hydraulic drop in drawings	500+345	404+279	577+400	
Total flow	Q =	Choose units from drop down	754	500	404	577	L/s
	Qt =		2714.400	1800.000	1454.400	2077.200	m³/hr
	qt =	$Qt / 3.6$	754.000	500.000	404.000	577.000	L/s
			0.754	0.500	0.404	0.577	m³/s
			65.146	43.200	34.906	49.853	ML/d
Liquid:	?						
Density of pumped liquid	$Dens$ =		1000	1000	1000	1000	kg/m³
Density of water	$Dens_{H2O}$ =		1000	1000	1000	1000	kg/m³
Kinematic Viscosity of liquid	KV =		8.910E-07	8.910E-07	8.910E-07	8.910E-07	m²/s
	$KVcst$ =	$KV \times 1E6$	0.891	0.891	0.891	0.891	cSt

2. Dynamic Conditions

Pipe Section 1	**Clarifier to tee**		Matching hydraulic drop in	500+345	404+279	577+400	
Pipe size			DN960	DN960	DN960	DN960	mm
Inside Diameter	d_1 =	Use accurate internal diameter from tables	912	912	912	912	mm
	D_1 =	$d_1 / 1000$	0.912	0.912	0.912	0.912	m
Area	A_1 =	$\Pi / 4 \times D_1^2$	0.653	0.653	0.653	0.653	m²
Number of streams for total flow	S_1 =	Default from Design Inputs	2	2	2	2	
Flow for this pipe section		Default from Design Inputs	1357.200	900.000	727.200	1038.600	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc					m3/hr
Total flow for this pipe section	Q_1 =		1357.200	900.000	727.200	1038.600	m³/h
	q_1 =	$Q_1 / 3.6$	377.000	250.000	202.000	288.500	L/s
Velocity	V_1 =	$\frac{Q_1}{A_1 \times 3600}$	0.577	0.383	0.309	0.442	m/sec
Pipe Wall Roughness	k_1 =	See attached worksheet	3	3	3	3	mm
			0.003	0.003	0.003	0.003	m
Reynolds number	Re_1 =	$\frac{V_1 \times D_1}{KV}$	590716	391722	316511	452047	
Reynolds number is above 2500, therefore flow may be considered turbulent							
Friction factor	f_1 =	$\frac{0.25}{(\log(k1 / 3.7 / D1 + 5.74 / Re1^{0.9}))^2}$	0.027	0.027	0.027	0.027	
(Swamee & Jain modified CW equ.)							
Hydraulic gradient	HG_1 =	$\frac{f_1 \times 100 \times V_1^2}{D_1 \times 2 \times g}$	0.051	0.022	0.015	0.030	m/100 m
Qty	k value						
8 m of pipe length		$\times HG_1 / 100$	0.004	0.002	0.001	0.002	m liq
1 x Inlet Sharp Edged	0.5	per fitting $\times V_1^2 / 2 / g$	0.008	0.004	0.002	0.005	m liq
1 x Bend Medium Radius 90	0.75	per fitting $\times V_1^2 / 2 / g$	0.013	0.006	0.004	0.007	m liq
1 x Elbow Mitre 45	0.3	per fitting $\times V_1^2 / 2 / g$	0.005	0.002	0.001	0.003	m liq
1 x Tee - in line	0.6	per fitting $\times V_1^2 / 2 / g$	0.010	0.004	0.003	0.006	m liq
Sub total	dP_1 =	Sum of friction losses	0.041	0.018	0.012	0.024	m liq

Pipe Section 2	**Tee to Filter Water Tank**		Matching hydraulic drop in drawings	500+345	404+279	577+400	
Pipe size	Pipe size and material		DN960	DN960	DN960	DN960	
Inside Diameter	d_2 =	Use accurate internal diameter from tables	912	912	912	912	mm
	D_2 =	$d_2 / 1000$	0.912	0.912	0.912	0.912	m
Area	A_2 =	$\Pi / 4 \times D_2^2$	0.653	0.653	0.653	0.653	m²
Number of streams for total flow	S_2 =	Default from Design Inputs	1	1	1	1	
Flow for this pump station		Default from previous section	2714.400	1800.000	1454.400	2077.200	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc					m3/hr
Total flow for this pipe section	Q_2 =		2714.400	1800.000	1454.400	2077.200	m³/h
	q_2 =	$Q_2 / 3.6$	754.000	500.000	404.000	577.000	L/s
Velocity	V_2 =	$\frac{Q_2}{A_2 \times 3600}$	1.154	0.765	0.618	0.883	m/sec
Pipe Wall Roughness	k_2 =	See attached worksheet	3	3	3	3	mm
			0.003	0.003	0.003	0.003	m

Reynolds number	Re_2 =	$\frac{V_2 \times D_2}{KV}$	1181433	783443	633022	904094	

Reynolds number is above 2500, therefore flow may be considered turbulent

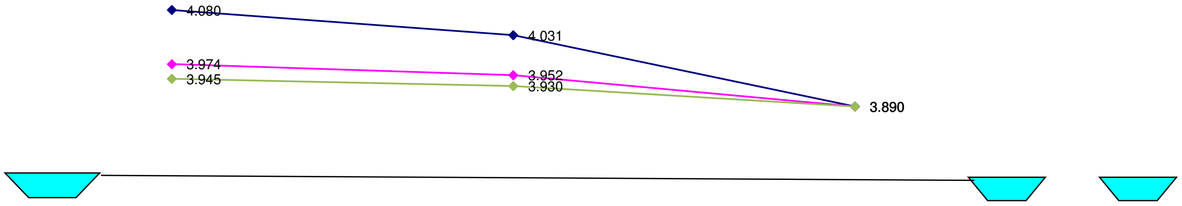
Friction factor	f_2 =	0.25	0.027	0.027	0.027	0.027	
(Swamee & Jain modified CW equ.)		(log (k2 / 3.7 / D2 + 5.74 / Re2^0.9))²					
Hydraulic gradient	HG_2 =	$\frac{f_2 \times 100 \times V_2^2}{D_2 \times 2 \times g}$	0.201	0.089	0.058	0.118	m/100 m
Quantity	k value						
26 m of Pipe length		x HG_2 / 100	0.052	0.023	0.015	0.031	m liq
2 x Elbow Mitre 22.5	0.15	per fitting x V_2^2 / 2 / g	0.020	0.009	0.006	0.012	m liq
1 x Enlargement Sudden	1	per fitting x V_2^2 / 2 / g	0.068	0.030	0.019	0.040	m liq
Sub total	dP_2 =	Sum of friction losses	0.141	0.062	0.040	0.082	m liq

3. Total Dynamic Losses

Friction loss in pipework

Pipe Section 1	Clarifier to tee	dP_1 =		0.041	0.018	0.012	0.024	m liq
Pipe Section 2	Tee to Filter Water Tank	dP_2 =		0.141	0.062	0.040	0.082	m liq
Total		DHd =	$dP1 + dP2 + dP3 + dP4 + dP_5 + dP_6 + dP_7 + dP_8 + dP_9 + dP_{10}$	0.181	0.080	0.052	0.106	m liq
Safety margin on dynamic losses		dP% =		5.00%	5.00%	5.00%	5.00%	
Dynamic losses		Hd% =	(1 + dp%) x DHd	0.190	0.084	0.055	0.111	m liq

4. Elevations



			Matching hydraulic drop	500+345	404+279	577+400	
	Hd% =		0.190	0.084	0.055	0.111	mm
Inlet elevation liquid level	ELi =	ELo + HD%	4.080	3.974	3.945	4.001	m EL
Before Pipe Section 2	Tee to Filter Water Tank		4.031	3.952	3.930	3.972	m EL
Outlet elevation liquid level	ELo =	Top Water Level Downstream	3.890	3.890	3.890	3.890	m EL

FILTERS

Hydraulic gradient through clean media is

$$h = \frac{6\,(1-e)V^2}{d\,e^3 g} \text{x (5 Re^-1 + 0.4 Re^-0.1)}$$

e = media voidage
d = hydraulic size of media
V = Filtration rate
Re = Reynolds number in media

In practical analysis, this cannot be worked out without a lot more information. The most effective way to address the hydraulic capacity of the filters is to look at the headlosses against outlet control valves and then extrapolate from there. If you are able to provide operatoinal information on the range of valve positions aginst dp, we could potentially do an estimate of the maximum possible flow rate.

A reasonable approximation would be to base the flow rate on 10 m/hr through the filters. This gives a flow of 442 L/s which is less than two of the three nominated conditions.

FILTERED WATER HOLDING TANK TO CHLORINE CONTACT TANK

1. Design Input

			Case 1	Case 2	Case 3	Case 3	
Different cases for different flows and/or elevations but same piping system			Matching hydraulic drop in drawings	500+345	404+279	577+400	
Total flow	Q =	Choose units from drop down	1012	500	404	577	L/s
	Qt =		3643.200	1800.000	1454.400	2077.200	m³/hr
	qt =	Qt / 3.6	1012.000	500.000	404.000	577.000	L/s
			1.012	0.500	0.404	0.577	m³/s
			87.437	43.200	34.906	49.853	ML/d
Liquid:	?						
Density of pumped liquid	Dens =		1000	1000	1000	1000	kg/m³
Density of water	$Dens_{H2O}$ =		1000	1000	1000	1000	kg/m³
Kinematic Viscosity of liquid	KV =		8.910E-07	8.910E-07	8.910E-07	8.910E-07	m²/s
	KVcst =	KV x 1E6	0.891	0.891	0.891	0.891	cSt

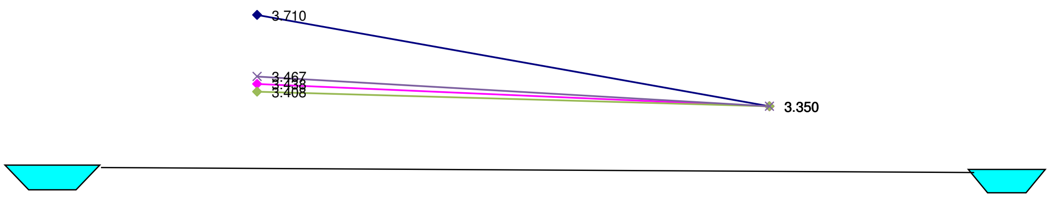
2. Dynamic Conditions

Pipe Section 1	?			Matching hydraulic drop in drawings	500+345	404+279	577+400	
Pipe size	Pipe size and material			DN960	DN960	DN960	DN960	mm
Inside Diameter		d_1 =	Use accurate internal diameter from tables	912	912	912	912	mm
		D_1 =	$d_1 / 1000$	0.912	0.912	0.912	0.912	m
Area		A_1 =	$\Pi / 4 \times D_1^2$	0.653	0.653	0.653	0.653	m²
Number of streams for total flow		S_1 =	Default from Design Inputs	1	1	1	1	
Flow for this pipe section			Default from Design Inputs	3643.200	1800.000	1454.400	2077.200	m³/hr
Additional flows from another source			Use for multiple stations, dosing points etc					m3/hr
Total flow for this pipe section		Q_1 =		3643.200	1800.000	1454.400	2077.200	m³/h
		q_1 =	$Q_1 / 3.6$	1012.000	500.000	404.000	577.000	L/s
Velocity		V_1 =	$\frac{Q_1}{A_1 \times 3600}$	1.549	0.765	0.618	0.883	m/sec
Pipe Wall Roughness		k_1 =	See attached worksheet	3	3	3	3	mm
				0.003	0.003	0.003	0.003	m
Reynolds number		Re_1 =	$\frac{V_1 \times D_1}{KV}$	1585689	783443	633022	904094	
Reynolds number is above 2500, therefore flow may be considered turbulent								
Friction factor		f_1 =	0.25	0.027	0.027	0.027	0.027	
(Swamee & Jain modified CW equ.)			$(\log (k1 / 3.7 / D1 + 5.74 / Re1^{0.9}))^2$					
Hydraulic gradient		HG_1 =	$\frac{f_1 \times 100 \times V_1^2}{D_1 \times 2 \times g}$	0.362	0.089	0.058	0.118	m/100 m
Qty		k value						
44	m of pipe length		x $HG_1 / 100$	0.159	0.039	0.026	0.052	m liq
1	x Inlet Sharp Edged	0.5	per fitting x $V_1^2 / 2 / g$	0.061	0.015	0.010	0.020	m liq
1	x Enlargement Sudden	1	per fitting x $V_1^2 / 2 / g$	0.122	0.030	0.019	0.040	m liq
Sub total		dP_1 =	Sum of friction losses	0.343	0.084	0.055	0.112	m liq

3. Total Dynamic Losses

				Matching hydraulic drop in	500+345	404+279	577+400	
Friction loss in pipework								
Pipe Section 1	?	dP_1 =		0.343	0.084	0.055	0.112	m liq
Total		DHd =	$dP1 + dP2 + dP3 + dP4 + dP_5 + dP_6 + dP_7 + dP_8 + dP_9 + dP_{10}$	0.343	0.084	0.055	0.112	m liq
Safety margin on dynamic losses		dP% =		5.00%	5.00%	5.00%	5.00%	
Dynamic losses		Hd% =	(1 + dp%) x DHd	0.360	0.088	0.058	0.117	m liq

4. Elevations



			Matching hydraulic drop	500+345	404+279	577+400	
	Hd% =		0.360	0.088	0.058	0.117	mm
Inlet elevation liquid level	ELi =	ELo + HD%	3.710	3.438	3.408	3.467	m EL
Outlet elevation liquid level	ELo =	Top Water Level Downstream	3.350	3.350	3.350	3.350	m EL

CHLORINE CONTACT TANK OUTLET WEIRS

1. Design Input

			Case 1	Case 2	Case 3	Case 3	
Different cases			To existing secondary clarifier	To outfall	?	?	
Total flow	Q =		1610	4835			L/s
	Qt =		5796.000	17406.000	0.000	0.000	m³/hr
	qt =	Qt / 3.6	1610.000	4835.000	0.000	0.000	L/s

qts =	*qt / 1000*	1.610	4.835	0.000	0.000	m^3/s
		139.104	417.744	0.000	0.000	ML/d

Hydaulic drop in drawngs is 815mm.

2. Dynamic Conditions

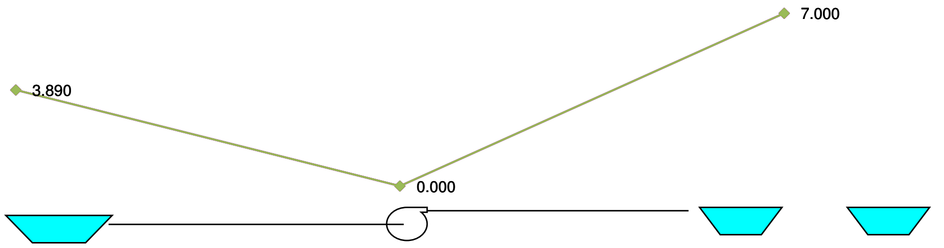
Weir width	**Weir width is**		1250	3750			mm
		b =	1.25	3.75	0	0	m
Height over weir is		*h =* $\left(\frac{qts}{0.595 \times 2/3 \times \sqrt{2g} \times (b - 0.003)}\right)^{2/3}+0.001$	0.815	0.815	0.001	0.001	m
			815	815	1	1	mm

FILTER FEED PUMPS

1. Design Input

			Case 1	Case 2	Case 3	
Different cases for different flows and/or elevations but same piping system			40	45	50	
Pump Type	Submersible					
No of duty pumps	PN =		1	1	1	
		Graphs on the System Curve worksheet will be displayed in the units selected below.				
Total flow	Q =	Choose units from drop down	500	404	577	L/s
	Qt =		1800.000	1454.400	2077.200	m^3/hr
	qt =	Qt / 3.6	500.000	404.000	577.000	L/s
			0.500	0.404	0.577	m^3/s
			43.200	34.906	49.853	ML/d
Flow per pump			500	404	577	L/s
	Qp =	Qt / PN	1800.000	1454.400	2077.200	m^3/hr
	qp =	Qp / 3.6	500.000	404.000	577.000	L/s
Pumped liquid:	water					
Density of pumped liquid	Dens =		1000	1000	1000	kg/m^3
Density of water	Dens $_{H2O}$ =		1000	1000	1000	kg/m^3
Kinematic Viscosity of liquid	KV =		1.137E-06	8.910E-07	8.910E-07	m^2/s
	KVcst =	KV x 1E6	1.137	0.891	0.891	cSt

2. Static Conditions



			40	45	50	
2.1 Pump						
Elevation of pump	ELp =		0.000	0.000	0.000	m EL
2.2 Suction						
Elevation liquid level	ELsl =		3.890	3.890	3.890	m EL
Liquid pressure at pump	SPl =	ELsl - ELp	3.890	3.890	3.890	m liq
Air or gas pressure	SPg =	e.g. pumping from pressurised system				kPag
Equivalent liquid head due to air pressure	SPm =	SPg / Dens / g x 1E3	0.000	0.000	0.000	m liq
Static suction head	SHs =	SPl + SPm	3.890	3.890	3.890	m liq
2.3 Discharge						
Elevation liquid level	ELdl =		7.000	7.000	7.000	m EL
Liquid pressure at pump	DPl =	ELdl - Elp	7.000	7.000	7.000	m liq
Air or gas pressure	DPg =	e.g. pumping to pressurised system				kPag
Equivalent liquid head due to air pressure	DPm =	DPg / Dens / g x 1E5	0.000	0.000	0.000	m liq
Static discharge head	DHs =	DPl + DPm	7.000	7.000	7.000	m liq
2.4 Static Head						
Static differential head	Hs =	DHs - SHs	3.110	3.110	3.110	m liq

3. Dynamic Conditions

3.1 Suction

Pipe Section 1	**Not used**			40	45	50	
Pipe Section 2	**Not used**			40	45	50	
Pipe Section 3	**Not Used**			40	45	50	
Pipe Section 4	**Not Used**			40	45	50	

3.2 Discharge

Pipe Section 5	**Pump Discharge**			40	45	50	
Pipe size	St Stl			DN500	DN500	DN500	mm
Inside Diameter		$d_5 =$	Use accurate internal diameter from tables	495.3	495.3	495.3	mm
		$D_5 =$	$d_5 / 1000$	0.4953	0.4953	0.4953	m
Area		$A_5 =$	$\Pi / 4 \times D_5^2$	0.193	0.193	0.193	m² area
Number of streams for total flow		$S_5 =$	Default from Design Inputs	1	1	1	
Flow for this pump station			Default from previous section	1800	1454.4	2077.2	m³/hr
Additional flows from another source			Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section		$Q_5 =$		1800.000	1454.400	2077.200	m³/h
		$q_5 =$	$Q_5 / 3.6$	500.000	404.000	577.000	L/s
Velocity		$V_5 =$	$\frac{Q_5}{A_5 \times 3600}$	2.595	2.097	2.995	m/sec
Pipe Wall Roughness		$k_5 =$		3	3	3	mm
				0.003	0.003	0.003	m
Reynolds number		$Re_5 =$	$\frac{V_5 \times D_5}{KV}$	1130450	1165589	1664715	
Reynolds number is above 2500, therefore flow may be considered turbulent							
Friction factor (Swamee & Jain modified CW equ.)		$f_5 =$	$\frac{0.25}{(\log (k5 / 3.7 / D5 + 5.74 / Re5^{0.9}))^2}$	0.032	0.032	0.032	
Hydraulic gradient		$HG_5 =$	$\frac{f_5 \times 100 \times V_5^2}{D_5 \times 2 \times g}$	2.241	1.463	2.981	m/100 m
Quantity		k value					
13	m of Pipe length		$\times HG_5 / 100$	0.291	0.190	0.387	m liq
1	x Valve - Check wafer	3	per fitting $\times V_5^2 / 2 / g$	1.030	0.672	1.371	m liq
1	x Valve - Butterfly full bore	0.4	per fitting $\times V_5^2 / 2 / g$	0.137	0.090	0.183	m liq
1	x Tee Sharp Edge - branch	1.2	per fitting $\times V_5^2 / 2 / g$	0.412	0.269	0.549	m liq
Sub total		$dP_5 =$	*Sum of friction losses*	1.870	1.221	2.490	m liq

Pipe Section 6	**afte 1 st offtake**			40	45	50	
Pipe size	st stl			DN500	DN500	DN500	mm
Inside Diameter		$d_6 =$	Use accurate internal diameter from tables	495.3	495.3	495.3	mm
		$D_6 =$	$d_6 / 1000$	0.4953	0.4953	0.4953	m
Area		$A_6 =$	$\Pi / 4 \times D_6^2$	0.193	0.193	0.193	m² area
Number of streams for total flow		$S_6 =$	Default from Design Inputs	1.33333	1.33333	1.33333	
Flow for this pump station			Default from previous section	1350.003	1090.803	1557.904	m³/hr
Additional flows from another source			Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section		$Q_6 =$		1350.003	1090.803	1557.904	m³/h
		$q_6 =$	$Q_6 / 3.6$	375.001	303.001	432.751	L/s
Velocity		$V_6 =$	$\frac{Q_6}{A_6 \times 3600}$	1.946	1.573	2.246	m/sec
Pipe Wall Roughness		$k_6 =$	See attached worksheet	3	3	3	mm
				0.003	0.003	0.003	m
Reynolds number		$Re_6 =$	$\frac{V_6 \times D_6}{KV}$	847840	874194	1248539	
Reynolds number is above 2500, therefore flow may be considered turbulent							
Friction factor (Swamee & Jain modified CW equ.)		$f_6 =$	$\frac{0.25}{(\log (k6 / 3.7 / D6 + 5.74 / Re6^{0.9}))^2}$	0.032	0.032	0.032	
Hydraulic gradient		$HG_6 =$	$\frac{f_6 \times 100 \times V_6^2}{D_6 \times 2 \times g}$	1.262	0.824	1.678	m/100 m
Quantity		k value					

6 m of Pipe length		$x\ HG_6 / 100$	0.076	0.049	0.101	m liq
1 x Tee - in line	0.6	per fitting $x\ V_6^2 / 2 / g$	0.116	0.076	0.154	m liq
Sub total	$dP_6 =$	*Sum of friction losses*	0.192	0.125	0.255	m liq

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Pipe Section 7	**After 2nd offtake**		40	45	50	
Pipe size	st stl		DN500	DN500	DN500	mm
Inside Diameter	$d_7 =$	Use accurate internal diameter from tables	495.3	495.3	495.3	mm
	$D_7 =$	$d_7 / 1000$	0.4953	0.4953	0.4953	m
Area	$A_7 =$	$\Pi / 4 \times D_7^2$	0.193	0.193	0.193	m² area
Number of streams for total flow	$S_7 =$	Default from Design Inputs	2	2	2	
Flow for this pump station		Default from previous section	900.000	727.200	1038.600	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section	$Q_7 =$		900.000	727.200	1038.600	m³/h
	$q_7 =$	$Q_7 / 3.6$	250.000	202.000	288.500	L/s
Velocity	$V_7 =$	$\frac{Q_7}{A_7 \times 3600}$	1.298	1.048	1.497	m/sec
Pipe Wall Roughness	$k_7 =$	See attached worksheet	3	3	3	mm
			0.003	0.003	0.003	m
Reynolds number	$Re_7 =$	$\frac{V_7 \times D_7}{KV}$	565225	582795	832358	
Reynolds number is above 2500, therefore flow may be considered turbulent						
Friction factor (Swamee & Jain modified CW equ.)	$f_7 =$	$\frac{0.25}{(\log (k7 / 3.7 / D7 + 5.74 / Re7^{0.9}))^2}$	0.032	0.032	0.032	
Hydraulic gradient	$HG_7 =$	$\frac{f_7 \times 100 \times V_7^2}{D_7 \times 2 \times g}$	0.562	0.367	0.747	m/100 m
Quantity	k value					
6 m of Pipe length		$x\ HG_7 / 100$	0.034	0.022	0.045	m liq
1 x Tee - in line	0.6	per fitting $x\ V_7^2 / 2 / g$	0.051	0.034	0.069	m liq
Sub total	$dP_7 =$	*Sum of friction losses*	0.085	0.056	0.113	m liq

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Pipe Section 8	**After 3rd offtake**		40	45	50	
Pipe size	st stl		DN500	DN500	DN500	
Inside Diameter	$d_8 =$	Use accurate internal diameter from tables	495.3	495.3	495.3	mm
	$D_8 =$	$d_8 / 1000$	0.4953	0.4953	0.4953	m
Area	$A_8 =$	$\Pi / 4 \times D_8^2$	0.193	0.193	0.193	m² area
Number of streams for total flow	$S_8 =$	Default from Design Inputs	4	4	4	
Flow for this pump station		Default from previous section	450.000	363.600	519.300	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section	$Q_8 =$		450.000	363.600	519.300	m³/h
	$q_8 =$	$Q_8 / 3.6$	125.000	101.000	144.250	L/s
Velocity	$V_8 =$	$\frac{Q_8}{A_8 \times 3600}$	0.649	0.524	0.749	m/sec
Pipe Wall Roughness	$k_8 =$	See attached worksheet	3	3	3	mm
			0.003	0.003	0.003	m
Reynolds number	$Re_8 =$	$\frac{V_8 \times D_8}{KV}$	282612	291397	416179	
Reynolds number is above 2500, therefore flow may be considered turbulent						
Friction factor (Swamee & Jain modified CW equ.)	$f_8 =$	$\frac{0.25}{(\log (k8 / 3.7 / D8 + 5.74 / Re8^{0.9}))^2}$	0.033	0.033	0.033	
Hydraulic gradient	$HG_8 =$	$\frac{f_8 \times 100 \times V_8^2}{D_8 \times 2 \times g}$	0.141	0.092	0.188	m/100 m
Quantity	k value					
6 m of Pipe length		$x\ HG_8 / 100$	0.008	0.006	0.011	m liq
1 x Tee Sharp Edge - branch	1.2	per fitting $x\ V_8^2 / 2 / g$	0.026	0.017	0.034	m liq
1 x Reducer 5:3	0.27	per fitting $x\ V_8^2 / 2 / g$	0.006	0.004	0.008	m liq
Sub total	$dP_8 =$	*Sum of friction losses*	0.040	0.026	0.053	m liq

Pipe Section 9	**Entrance to filter**			40	45	50	
Pipe size	st stl			DN300	DN300	DN300	
Inside Diameter		d_9 =	Use accurate internal diameter from tables	304.84	304.84	304.84	mm
		D_9 =	d_9 / 1000	0.30484	0.30484	0.30484	m
Area		A_9 =	$\pi / 4 \times D_9^2$	0.073	0.073	0.073	m² area
Number of streams for total flow		S_9 =	Default from Design Inputs	4	4	4	
Flow for this pump station			Default from previous section	450.000	363.600	519.300	m³/hr
Additional flows from another source			Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section		Q_9 =		450.000	363.600	519.300	m³/h
		q_9 =	Q_9 / 3.6	125.000	101.000	144.250	L/s
Velocity		V_9 =	$\frac{Q_9}{A_9 \times 3600}$	1.713	1.384	1.976	m/sec
Pipe Wall Roughness		k_9 =	See attached worksheet	3	3	3	mm
				0.003	0.003	0.003	m
Reynolds number		Re_9 =	$\frac{V_9 \times D_9}{KV}$	459185	473458	676202	
Reynolds number is above 2500, therefore flow may be considered turbulent							
Friction factor (Swamee & Jain modified CW equ.)		f_9 =	$\frac{0.25}{(\log(k9 / 3.7 / D9 + 5.74 / Re9^{0.9}))^2}$	0.038	0.038	0.038	
Hydraulic gradient		HG_9 =	$\frac{f_9 \times 100 \times V_9^2}{D_9 \times 2 \times g}$	1.860	1.214	2.472	m/100 m
Quantity		k value					
1 m of Pipe length			x HG_9 / 100	0.019	0.012	0.025	m liq
1 x Elbow Short Radius 90		1	per fitting x $V_9^2 / 2 / g$	0.150	0.098	0.199	m liq
1 x Enlargement Sudden		1	per fitting x $V_9^2 / 2 / g$	0.150	0.098	0.199	m liq
1 x Valve - Butterfly full bore		0.4	per fitting x $V_9^2 / 2 / g$	0.060	0.039	0.080	m liq
Sub total		dP_9 =	Sum of friction losses	0.377	0.246	0.503	m liq

4. Total Dynamic Losses

				40	45	50	
Friction loss in suction pipework							
Pipe Section 1	Not used	dP_1 =		0.000	0.000	0.000	m liq
Pipe Section 2	Not used	dP_2 =		0.000	0.000	0.000	m liq
Pipe Section 3	Not Used	dP_3 =		0.000	0.000	0.000	m liq
Pipe Section 4	Not Used	dP_4 =		0.000	0.000	0.000	m liq
Total		SHd =	$dP_1 + dP_2 + dP_3 + dP_4$	0.000	0.000	0.000	m liq
Friction loss in discharge pipework							
Pipe Section 5	Pump Discharge	dP_5 =		1.870	1.221	2.490	m liq
Pipe Section 6	afte 1 st offtake	dP_6 =		0.192	0.125	0.255	m liq
Pipe Section 7	After 2nd offtake	dP_7 =		0.085	0.056	0.113	m liq
Pipe Section 8	After 3rd offtake	dP_8 =		0.040	0.026	0.053	m liq
Pipe Section 9	Entrance to filter	dP_9 =		0.377	0.246	0.503	m liq
Total		DHd =	$dP_5 + dP_6 + dP_7 + dP_8 + dP_9 +$	2.564	1.674	3.414	m liq

5. Summary

			40	45	50	
Safety margin on dynamic losses	dP% =		5.00%	5.00%	5.00%	
Suction dynamic losses	SHd% =	(1 + dp%) x SHd	0.000	0.000	0.000	m liq
Discharge dynamic losses	DHd% =	(1 + dp%) x DHd	2.693	1.758	3.585	m liq
Total dynamic losses	Hd% =	SHd% + Dhd%	2.693	1.758	3.585	m liq
Total suction head	TSHg =	SHs - SHd%	3.890	3.890	3.890	m liq g
Total required discharge head	TDHg =	DHs + DHd%	9.693	8.758	10.585	m liq g
Calculated Differential Head Requirements	DHr =	TDHg - TSHg	**5.803**	**4.868**	**6.695**	m liq
		= DHr x Dens / $Dens_{H2O}$	**5.803**	**4.868**	**6.695**	m H_2O

6. NPSH Available (Assuming elevation & velocity head negligible)

			40	45	50	
NPSHA Available	NPSHa =	101.3/Densx1000/9.81+TSHg	14.216	14.216	14.216	m liq

7. Estimated Power Required

Assumed efficiency	P_{eff} =		70.00%	70.00%	70.00%	
Estimated absorbed pump power	P_{abs} =	$\frac{qp \times DHr \times Dens \times g}{Peff}$	40.66	27.56	54.14	kW

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8. Notes

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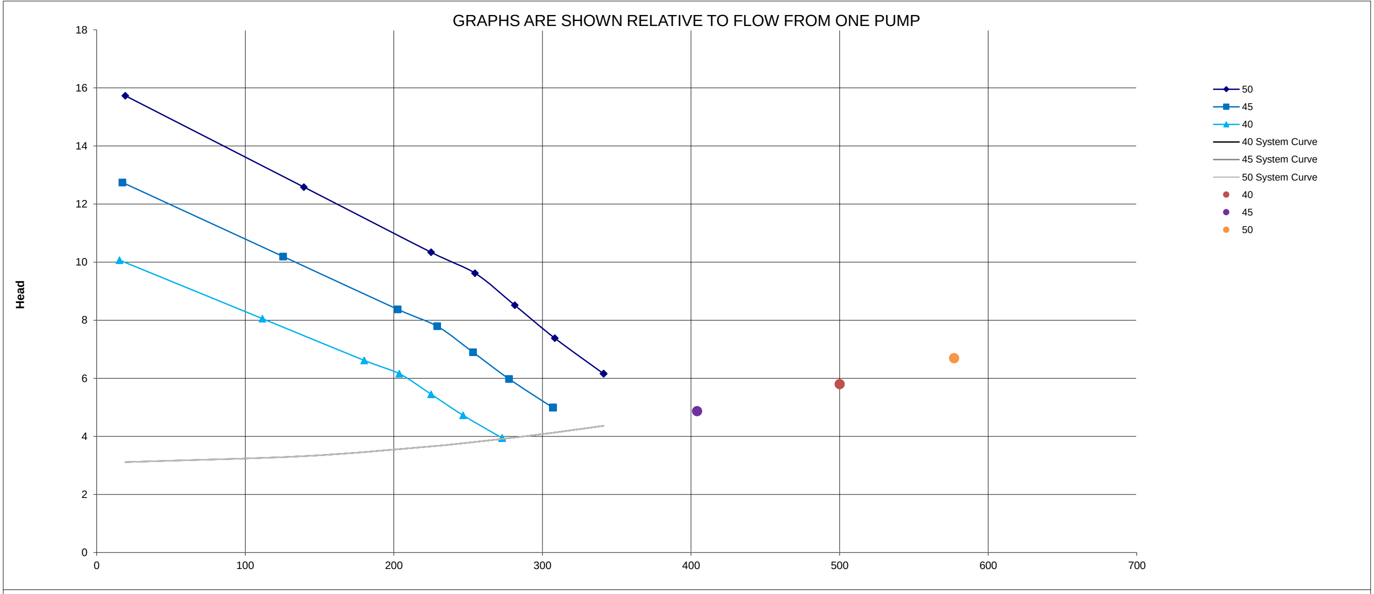
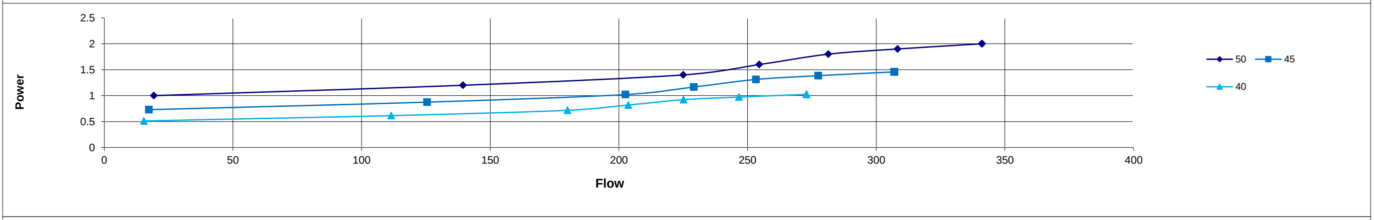
FILTER FEED PUMPS

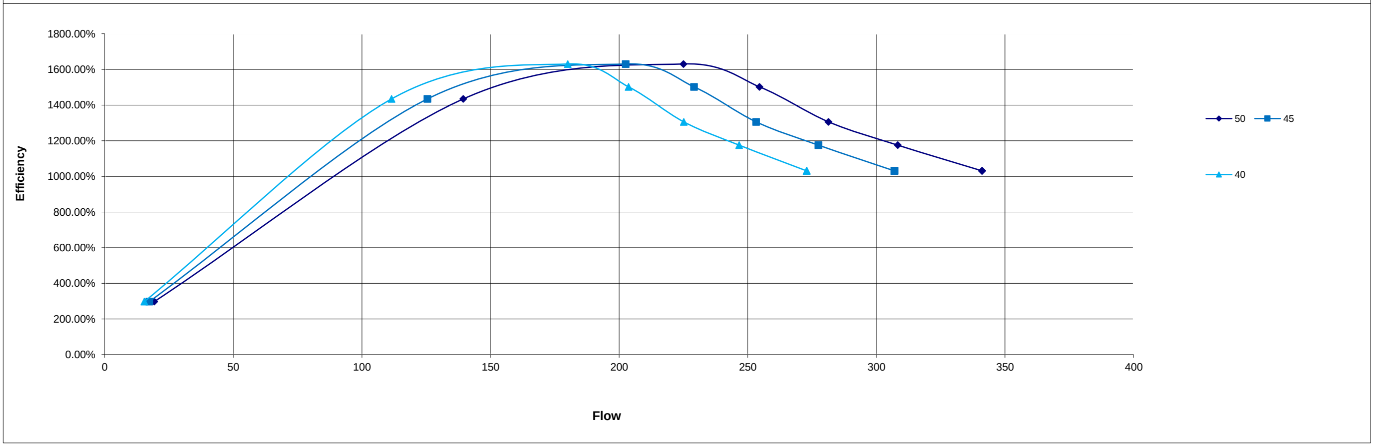
Performance Curves Resulting from VSD Speeds	**Existing N1**	**N2**	**N3**
Speed	50	45	40
Flow multiplier	*N2/N1*	0.9	0.8
Head Multiplier	*(N2/N1)* ^{2}	0.81	0.64
Power Multimplier	*(N2/N1)* ^{3}	0.729	0.512

System Curve	(Default figures from Pump Sizing spreadsht)		
Static head [m H2O]	3.11	3.11	3.11
Duty flow [L/s]	500	404	577
Duty head [m H2O]	5.802571477	4.867846484	6.694933674
Coefficient	1.07703E-05	1.07701E-05	1.07679E-05

Flow at 50 [L/s]	Head at 50 [m H2O]	Power at 50 [kW]	Eff at 50 [%]	Flow at 45 [L/s]	Head at 45 [m H2O]	Power at 45 [kW]	Eff at #REF! [%]	Flow at 40 [L/s]	Head at 40 [m H2O]	Power at 40 [kW]	Eff at 40 [%]	40 System Curve	45 System Curve	50 System Curve
19.25	15.732	1	297.09%	17.33	12.74	0.73	297.09%	15	10.07	0.51	297.09%	3.11	3.11	3.11
139.39	12.587	1.2	1434.31%	125.45	10.20	0.87	1434.31%	112	8.06	0.61	1434.31%	3.32	3.32	3.32
225.01	10.341	1.4	1630.44%	202.51	8.38	1.02	1630.44%	180	6.62	0.72	1630.44%	3.66	3.66	3.66
254.56	9.623	1.6	1501.93%	229.10	7.79	1.17	1501.93%	204	6.16	0.82	1501.93%	3.81	3.81	3.81
281.36	8.516	1.8	1305.85%	253.22	6.90	1.31	1305.85%	225	5.45	0.92	1305.85%	3.96	3.96	3.96
308.29	7.382	1.9	1175.03%	277.46	5.98	1.39	1175.03%	247	4.72	0.97	1175.03%	4.13	4.13	4.13
341.11	6.16	2	1030.66%	307.00	4.99	1.46	1030.66%	273	3.94	1.02	1030.66%	4.36	4.36	4.36
341.11	6.16	2	1030.66%	307.00	4.99	1.46	1030.66%	273	3.94	1.02	1030.66%	4.36	4.36	4.36
341.11	6.16	2	1030.66%	307.00	4.99	1.46	1030.66%	273	3.94	1.02	1030.66%	4.36	4.36	4.36
341.11	6.16	2	1030.66%	307.00	4.99	1.46	1030.66%	273	3.94	1.02	1030.66%	4.36	4.36	4.36







RAS PUMPS

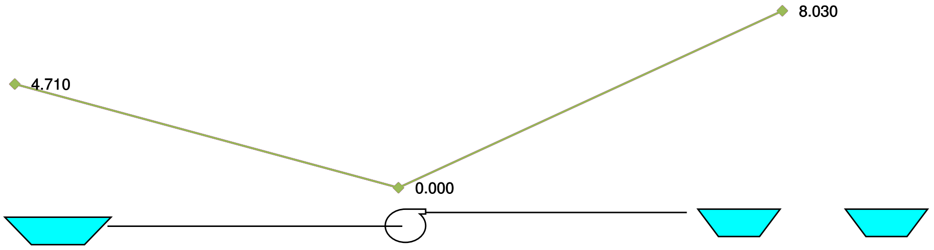
1. Design Input

Case 1

Different cases for different flows and/or elevations but same piping system

			Nominal duty flow on test	Calculated	1 pump per clarifier	
Pump Type						
No of duty pumps	*PN =*		4	4	2	
		Graphs on the System Curve worksheet will be displayed in the units selected below.				
Total flow	*Q =*	Choose units from drop down	308	368	214	L/s
	Qt =		1108.800	1324.800	770.400	m^3/hr
	qt =	*Qt / 3.6*	308.000	368.000	214.000	L/s
			0.308	0.368	0.214	m^3/s
			26.611	31.795	18.490	ML/d
Flow per pump			77	92	107	L/s
	Qp =	*Qt / PN*	277.200	331.200	385.200	m^3/hr
	qp =	*Qp / 3.6*	77.000	92.000	107.000	L/s
Pumped liquid:	water					
Density of pumped liquid	*Dens =*		1000	1000	1000	kg/m^3
Density of water	$Dens_{H2O}$ =		1000	1000	1000	kg/m^3
Kinematic Viscosity of liquid	*KV =*		1.137E-06	1.137E-06	1.137E-06	m^2/s
	KVcst =	*KV x 1E6*	1.137	1.137	1.137	cSt

2. Static Conditions



2.1 Pump

			Nominal duty flow on test	Calculated	1 pump per clarifier	
Elevation of pump	*ELp =*		0.000	0.000	0.000	m EL

2.2 Suction

Elevation liquid level	*ELsl =*		4.710	4.710	4.710	m EL
Liquid pressure at pump	*SPl =*	*ELsl - ELp*	4.710	4.710	4.710	m liq
Air or gas pressure	*SPg =*	e.g. pumping from pressurised system				kPag
Equivalent liquid head due to air pressure	*SPm =*	*SPg / Dens / g x 1E3*	0.000	0.000	0.000	m liq
Static suction head	*SHs =*	*SPl + SPm*	4.710	4.710	4.710	m liq

2.3 Discharge

Elevation liquid level	*ELdl =*		8.030	8.030	8.030	m EL
Liquid pressure at pump	*DPl =*	*ELdl - Elp*	8.030	8.030	8.030	m liq
Air or gas pressure	*DPg =*	e.g. pumping to pressurised system				kPag
Equivalent liquid head due to air pressure	*DPm =*	*DPg / Dens / g x 1E5*	0.000	0.000	0.000	m liq
Static discharge head	*DHs =*	*DPl + DPm*	8.030	8.030	8.030	m liq

2.4 Static Head

Static differential head	*Hs =*	*DHs - SHs*	3.320	3.320	3.320	m liq

3. Dynamic Conditions

3.1 Suction

			Nominal duty flow	Calculated	1 pump per	
Pipe Section 1	**Not used**					
Pipe size	375 dicl		DN375	DN375	DN375	mm
Inside Diameter	d_1 =	Use accurate internal diameter from tables	406	406	406	mm

	$D_1 =$	$d_1 / 1000$	0.406	0.406	0.406	m
Area	$A_1 =$	$\Pi / 4 \times D_1^2$	0.129	0.129	0.129	m²
Number of streams for total flow	$S_1 =$	Default from Design Inputs	2	2	2	
Flow for this pipe section		Default from Design Inputs	554.4	662.4	385.2	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section	$Q_1 =$		554.400	662.400	385.200	m³/h
	$q_1 =$	$Q_1 / 3.6$	154.000	184.000	107.000	L/s
Velocity	$V_1 =$	$\frac{Q_1}{A_1 \times 3600}$	1.190	1.421	0.826	m/sec
Pipe Wall Roughness	$k_1 =$	See attached worksheet	3	3	3	mm
			0.003	0.003	0.003	m
Reynolds number	$Re_1 =$	$\frac{V_1 \times D_1}{KV}$	424761	507506	295126	
Reynolds number is above 2500, therefore flow may be considered turbulent						
Friction factor	$f_1 =$	0.25	0.035	0.035	0.035	
(Swamee & Jain modified CW equ.)		(log (k1 / 3.7 / D1 + 5.74 / Re1^0.9))²				
Hydraulic gradient	$HG_1 =$	$\frac{f_1 \times 100 \times V_1^2}{D_1 \times 2 \times g}$	0.614	0.876	0.297	m/100 m
Qty	k value					
24 m of pipe length		$\times HG_1 / 100$	0.147	0.210	0.071	m liq
1 x Inlet Sharp Edged	0.5	per fitting $\times V_1^2 / 2 / g$	0.036	0.051	0.017	m liq
2 x Elbow Mitre 45	0.3	per fitting $\times V_1^2 / 2 / g$	0.043	0.062	0.021	m liq
1 x Tee Sharp Edge - branch	1.2	per fitting $\times V_1^2 / 2 / g$	0.087	0.124	0.042	m liq
0 Select	0	per fitting $\times V_1^2 / 2 / g$	0.000	0.000	0.000	m liq
0 Select	0	per fitting $\times V_1^2 / 2 / g$	0.000	0.000	0.000	m liq
0 Select	0	per fitting $\times V_1^2 / 2 / g$	0.000	0.000	0.000	m liq
0 Select	0	per fitting $\times V_1^2 / 2 / g$	0.000	0.000	0.000	m liq
0 Select	0	per fitting $\times V_1^2 / 2 / g$	0.000	0.000	0.000	m liq
0 Other			0.000	0.000	0.000	m liq
Sub total	$dP_1 =$	Sum of friction losses	0.313	0.447	0.151	m liq

Pipe Section 2			Nominal duty flow	Calculated	1 pump per	
Pipe size			DN300	DN300	DN300	
Inside Diameter	$d_2 =$	Use accurate internal diameter from tables	325	325	325	mm
	$D_2 =$	$d_2 / 1000$	0.325	0.325	0.325	m
Area	$A_2 =$	$\Pi / 4 \times D_2^2$	0.083	0.083	0.083	m²
Number of streams for total flow	$S_2 =$	Default from Design Inputs	2	2	2	
Flow for this pump station		Default from previous section	554.400	662.400	385.200	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section	$Q_2 =$		554.400	662.400	385.200	m³/h
	$q_2 =$	$Q_2 / 3.6$	154.000	184.000	107.000	L/s
Velocity	$V_2 =$	$\frac{Q_2}{A_2 \times 3600}$	1.856	2.218	1.290	m/sec
Pipe Wall Roughness	$k_2 =$	See attached worksheet	0	0	0	mm
			0	0	0	m
Reynolds number	$Re_2 =$	$\frac{V_2 \times D_2}{KV}$	530624	633992	368680	
Reynolds number is above 2500, therefore flow may be considered turbulent						
Friction factor	$f_2 =$	0.25	0.013	0.013	0.014	
(Swamee & Jain modified CW equ.)		(log (k2 / 3.7 / D2 + 5.74 / Re2^0.9))²				
Hydraulic gradient	$HG_2 =$	$\frac{f_2 \times 100 \times V_2^2}{D_2 \times 2 \times g}$	0.700	0.968	0.361	m/100 m
Quantity	k value					
4 m of Pipe length		$\times HG_2 / 100$	0.028	0.039	0.014	m liq
1 x Tee - in line	0.6	per fitting $\times V_2^2 / 2 / g$	0.105	0.150	0.051	m liq
1 x Valve - Gate	0.2	per fitting $\times V_2^2 / 2 / g$	0.035	0.050	0.017	m liq
1 x Elbow Short Radius 90	1	per fitting $\times V_2^2 / 2 / g$	0.176	0.251	0.085	m liq

Sub total	dP_2 =	*Sum of friction losses*	0.344	0.490	0.167	m liq

3.2 Discharge

Pipe Section 5		**Pump Discharge**	Nominal duty flow	Calculated	1 pump per	
Pipe size		DICL?	DN250	DN250	DN250	mm
Inside Diameter	d_5 =	Use accurate internal diameter from tables	266	266	266	mm
	D_5 =	$d_5 / 1000$	0.266	0.266	0.266	m
Area	A_5 =	$\Pi / 4 \times D_5^2$	0.056	0.056	0.056	m² area
Number of streams for total flow	S_5 =	Default from Design Inputs	4	4	2	
Flow for this pump station		Default from previous section	277.200	331.200	385.200	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section	Q_5 =		277.200	331.200	385.200	m³/h
	q_5 =	$Q_5 / 3.6$	77.000	92.000	107.000	L/s
Velocity	V_5 =	$\frac{Q_5}{A_5 \times 3600}$	1.386	1.656	1.925	m/sec
Pipe Wall Roughness	k_5 =		3	3	3	mm
			0.003	0.003	0.003	m
Reynolds number	Re_5 =	$\frac{V_5 \times D_5}{KV}$	324159	387307	450455	
Reynolds number is above 2500, therefore flow may be considered turbulent						
Friction factor	f_5 =	$\frac{0.25}{(\log (k5 / 3.7 / D5 + 5.74 / Re5^{0.9}))^2}$	0.040	0.040	0.040	
(Swamee & Jain modified CW equ.)						
Hydraulic gradient	HG_5 =	$\frac{f_5 \times 100 \times V_5^2}{D_5 \times 2 \times g}$	1.463	2.087	2.820	m/100 m

Quantity		k value					
4	m of Pipe length		$\times HG_5 / 100$	0.059	0.083	0.113	m liq
1	x Valve - Check conventional	2.4	per fitting $\times V_5^2 / 2 / g$	0.235	0.335	0.453	m liq
1	x Valve - Gate	0.2	per fitting $\times V_5^2 / 2 / g$	0.020	0.028	0.038	m liq
1	x Elbow Short Radius 90	1	per fitting $\times V_5^2 / 2 / g$	0.098	0.140	0.189	m liq
1	x Tee - in line	0.6	per fitting $\times V_5^2 / 2 / g$	0.059	0.084	0.113	m liq
Sub total		dP_5 =	*Sum of friction losses*	0.470	0.670	0.906	m liq

Pipe Section 6		**Pump station header**	Nominal duty flow	Calculated	1 pump per	
Pipe size		DICL?	DN300	DN300	DN300	mm
Inside Diameter	d_6 =	Use accurate internal diameter from tables	325	325	325	mm
	D_6 =	$d_6 / 1000$	0.325	0.325	0.325	m
Area	A_6 =	$\Pi / 4 \times D_6^2$	0.083	0.083	0.083	m² area
Number of streams for total flow	S_6 =	Default from Design Inputs	2	2	2	
Flow for this pump station		Default from previous section	554.400	662.400	385.200	m³/hr
Additional flows from another source		Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section	Q_6 =		554.400	662.400	385.200	m³/h
	q_6 =	$Q_6 / 3.6$	154.000	184.000	107.000	L/s
Velocity	V_6 =	$\frac{Q_6}{A_6 \times 3600}$	1.856	2.218	1.290	m/sec
Pipe Wall Roughness	k_6 =	See attached worksheet	0	0	0	mm
			0	0	0	m
Reynolds number	Re_6 =	$\frac{V_6 \times D_6}{KV}$	530624	633992	368680	
Reynolds number is above 2500, therefore flow may be considered turbulent						
Friction factor	f_6 =	$\frac{0.25}{(\log (k6 / 3.7 / D6 + 5.74 / Re6^{0.9}))^2}$	0.013	0.013	0.014	
(Swamee & Jain modified CW equ.)						
Hydraulic gradient	HG_6 =	$\frac{f_6 \times 100 \times V_6^2}{D_6 \times 2 \times g}$	0.700	0.968	0.361	m/100 m

Quantity		k value					
4	m of Pipe length		$\times HG_6 / 100$	0.028	0.039	0.014	m liq

Sub total		dP_6 =	*Sum of friction losses*	0.028	0.039	0.014	m liq
Pipe Section 7	**Rising Main**			Nominal duty flow	Calculated	1 pump per	
Pipe size	poly			DN630	DN630	DN630	mm
Inside Diameter		d_7 =	Use accurate internal diameter from tables	512.6	512.6	512.6	mm
		D_7 =	d_7 / 1000	0.5126	0.5126	0.5126	m
Area		A_7 =	$\Pi / 4 \times D_7^2$	0.206	0.206	0.206	m^2 area
Number of streams for total flow		S_7 =	Default from Design Inputs	1	1	1	
Flow for this pump station			Default from previous section	1108.800	1324.800	770.400	m^3/hr
Additional flows from another source			Use for multiple stations, dosing points etc				m3/hr
Total flow for this pipe section		Q_7 =		1108.800	1324.800	770.400	m^3/h
		q_7 =	Q_7 / 3.6	308.000	368.000	214.000	L/s
Velocity		V_7 =	$\frac{Q_7}{A_7 \times 3600}$	1.492	1.783	1.037	m/sec
Pipe Wall Roughness		k_7 =	See attached worksheet	0	0	0	mm
				0	0	0	m
Reynolds number		Re_7 =	$\frac{V_7 \times D_7}{KV}$	672855	803931	467503	
Reynolds number is above 2500, therefore flow may be considered turbulent							
Friction factor		f_7 =	$\frac{0.25}{(\log (k7 / 3.7 / D7 + 5.74 / Re7\hat{}0.9))^2}$	0.012	0.012	0.013	
(Swamee & Jain modified CW equ.)							
Hydraulic gradient		HG_7 =	$\frac{f_7 \times 100 \times V_7^2}{D_7 \times 2 \times g}$	0.275	0.381	0.142	m/100 m
Quantity		k value					
92 m of Pipe length			$\times HG_7 / 100$	0.253	0.350	0.130	m liq
1 x Enlargement Sudden		1	per fitting $\times V_7^2 / 2 / g$	0.114	0.162	0.055	m liq
Sub total		dP_7 =	*Sum of friction losses*	0.367	0.512	0.185	m liq

4. Total Dynamic Losses

				Nominal duty flow on test	Calculated	1 pump per clarifier	
Friction loss in suction pipework							
Pipe Section 1	Not used	dP_1 =		0.313	0.447	0.151	m liq
Pipe Section 2	0	dP_2 =		0.344	0.490	0.167	m liq
Total		SHd =	$dP_1 + dP_2 + dP_3 + dP_4$	0.657	0.937	0.319	m liq
Friction loss in discharge pipework							
Pipe Section 5	Pump Discharge	dP_5 =		0.470	0.670	0.906	m liq
Pipe Section 6	Pump station header	dP_6 =		0.028	0.039	0.014	m liq
Pipe Section 7	Rising Main	dP_7 =		0.367	0.512	0.185	m liq
Total		DHd =	$dP_5 + dP_6 + dP_7 + dP_8 + dP_9 +$	0.864	1.221	1.106	m liq

5. Summary

			Nominal duty flow on test	Calculated	1 pump per clarifier	
Safety margin on dynamic losses	$dP\%$ =		5.00%	5.00%	5.00%	
Suction dynamic losses	$SHd\%$ =	$(1 + dp\%) \times SHd$	0.690	0.984	0.334	m liq
Discharge dynamic losses	$DHd\%$ =	$(1 + dp\%) \times DHd$	0.907	1.282	1.161	m liq
Total dynamic losses	$Hd\%$ =	$SHd\% + Dhd\%$	1.598	2.266	1.496	m liq
Total suction head	$TSHg$ =	$SHs - SHd\%$	4.020	3.726	4.376	m liq g
Total required discharge head	$TDHg$ =	$DHs + DHd\%$	8.937	9.312	9.191	m liq g
Calculated Differential Head Requirements	DHr =	$TDHg - TSHg$	**4.918**	**5.586**	**4.816**	m liq
	=	$DHr \times Dens / Dens_{H2O}$	**4.918**	**5.586**	**4.816**	m H_2O

6. NPSH Available

(Assuming elevation & velocity head negligible)

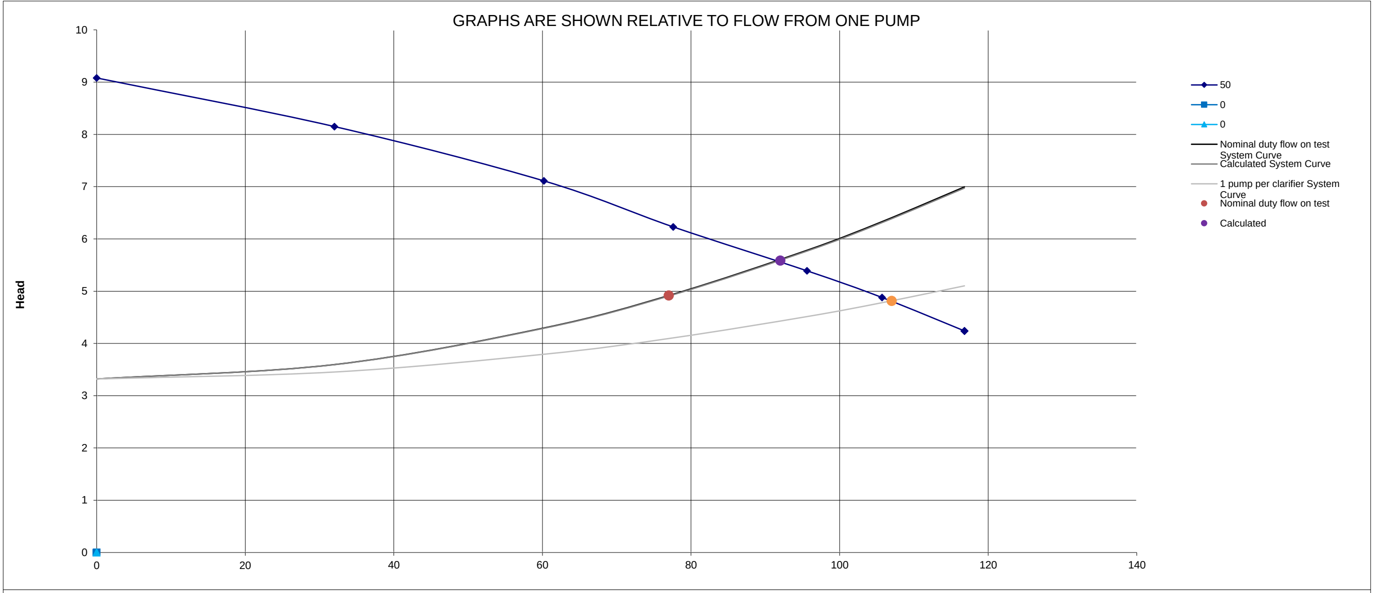
			Nominal duty flow on test	Calculated	1 pump per clarifier	
NPSHA Available	$NPSHa$ =	$101.3/Densx1000/9.81+TSHg$	14.346	14.052	14.702	m liq

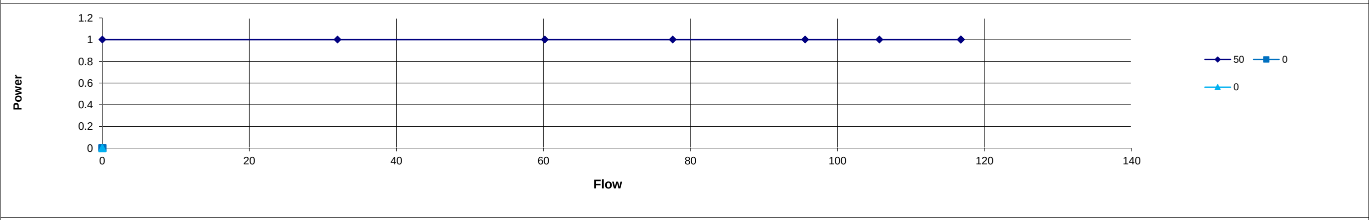
RAS PUMPS

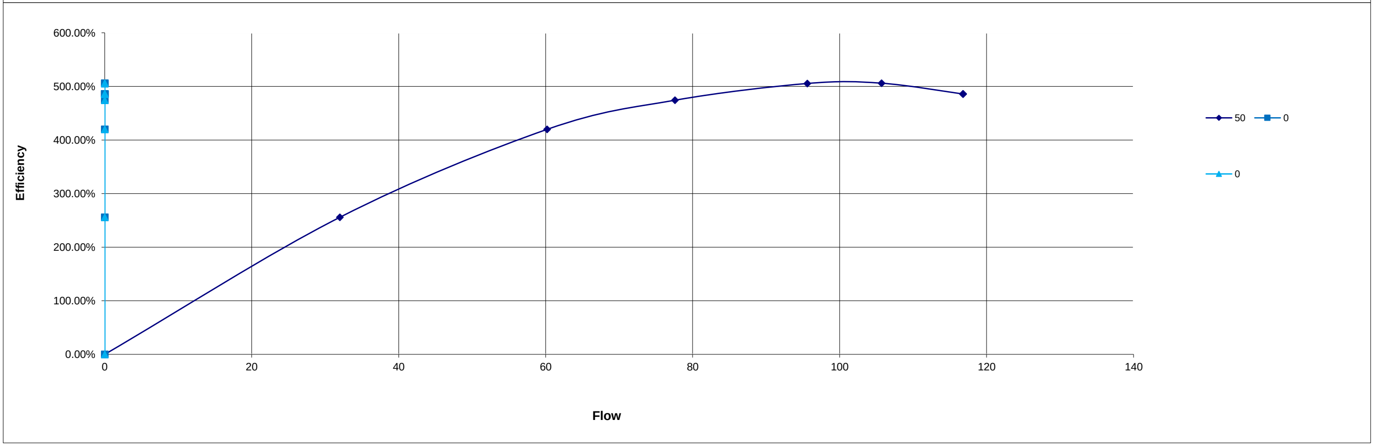
Performance Curves Resulting from VSD Speeds	**Existing N1**	**N2**	**N3**
Speed	50	0	0
Flow multiplier	*N2/N1*	0	0
Head Multiplier	*(N2/N1)* ^{2}	0	0
Power Multimplier	*(N2/N1)* ^{3}	0	0

System Curve	(Default figures from Pump Sizing spreadsht)		
Static head [m H2O]	3.32	3.32	3.32
Duty flow [L/s]	77	92	107
Duty head [m H2O]	4.917656153	5.586308398	4.815739357
Coefficient	0.000269465	0.000267759	0.000130644

Flow at 50 [L/s]	Head at 50 [m H2O]	Power at 50 [kW]	Eff at 50 [%]	Flow at 0 [L/s]	Head at 0 [m H2O]	Power at 0 [kW]	Eff at #REF! [%]	Flow at 0 [L/s]	Head at 0 [m H2O]	Power at 0 [kW]	Eff at 0 [%]	Nominal duty flow on test System Curve	Calculated System Curve	1 pump per clarifier System Curve
0	9.08	1	0.00%	0.00	0.00	0.00	0.00%	0	0.00	0.00	0.00%	3.32	3.32	3.32
32	8.15	1	255.84%	0.00	0.00	0.00	255.84%	0	0.00	0.00	255.84%	3.60	3.59	3.45
60.2	7.11	1	419.89%	0.00	0.00	0.00	419.89%	0	0.00	0.00	419.89%	4.30	4.29	3.79
77.6	6.23	1	474.26%	0.00	0.00	0.00	474.26%	0	0.00	0.00	474.26%	4.94	4.93	4.11
95.6	5.39	1	505.49%	0.00	0.00	0.00	505.49%	0	0.00	0.00	505.49%	5.78	5.77	4.51
105.7	4.88	1	506.02%	0.00	0.00	0.00	506.02%	0	0.00	0.00	506.02%	6.33	6.31	4.78
116.8	4.24	1	485.82%	0.00	0.00	0.00	485.82%	0	0.00	0.00	485.82%	7.00	6.97	5.10
116.8	4.24	1	485.82%	0.00	0.00	0.00	485.82%	0	0.00	0.00	485.82%	7.00	6.97	5.10
116.8	4.24	1	485.82%	0.00	0.00	0.00	485.82%	0	0.00	0.00	485.82%	7.00	6.97	5.10
116.8	4.24	1	485.82%	0.00	0.00	0.00	485.82%	0	0.00	0.00	485.82%	7.00	6.97	5.10







APPENDIX B: VICTORIA POINT WWTP – NET PRESENT COST ANALYSIS INPUT SHEETS

NPC Analysis Tool

40 Year NPV = $10313377
15 Year NPV = $9249373

Project Number	J1904
Project Name	Victoria Point STP Upgrades - Phase 2
Calculation Number	1
Calculation Name	Whole-of-Life Cost of Additional Developments

Current Financial Year	20/21	**Note: Defines start year for project (Year Zero) on Financial Year Basis (eg. 04/05)**
Discount Rate	7.00%	
Income Tax Rate	0%	**Note: Positive cash flows indicate revenue. Negative cash flows indicate expenditure.**

Capital Expenditure			**Depreciation (Linear)**	
Item	**Cost**	**Year of Project**	**Years**	**Escalation**
Post-Anoxic /reaeration Tank, Additional Clarifier and Additional CCT	$4,256,000	2	0	
	$4,256,000	3	0	

Fixed Operating Expenditure				
Item	**Cost**	**Start Year**	**End Year**	**Escalation**
Maintenance	$25,068	3	40	2.50%
Electrical	$12,500	3	40	2.50%

Note: Start Year is year of first cash flow. End Year is last year of cash flow.

Variable Operating Expenditure				
Item	**$/ML**	**Start Year**	**End Year**	**Escalation**
Electrical Variable	$70.24	3	40	2.50%
Chemical Variable	$30.25	3	40	2.50%
Haulage Variable	$93.39	3	40	2.50%

Projected Production			
		191	**L/EP/d**
Year	**Year No.**	**Additional Population**	**Flow (ML/d)**
20/21	0	-	0.00
21/22	1	434	0.08
22/23	2	677	0.13
23/24	3	1,764	0.34
24/25	4	2,850	0.54
25/26	5	3,937	0.75
26/27	6	5,023	0.96
27/28	7	6,054	1.16
28/29	8	6,242	1.19
29/30	9	6,431	1.23
30/31	10	6,619	1.26
31/32	11	6,807	1.30
32/33	12	6,888	1.32
33/34	13	6,970	1.33
34/35	14	7,052	1.35
35/36	15	7,134	1.36
36/37	16	7,215	1.38
37/38	17	7,215	1.38
38/39	18	7,215	1.3781
39/40	19	7,215	1.38
40/41	20	7,215	1.38
41/42	21	7,215	1.38
42/43	22	7,215	1.38
43/44	23	7,215	1.38
44/45	24	7,215	1.38
45/46	25	7,215	1.38
46/47	26	7,215	1.38
47/48	27	7,215	1.38
48/49	28	7,215	1.38
49/50	29	7,215	1.38
50/51	30	7,215	1.38
51/52	31	7,215	1.38
52/53	32	7,215	1.38
53/54	33	7,215	1.38
54/55	34	7,215	1.38
55/56	35	7,215	1.38
56/57	36	7,215	1.38
57/58	37	7,215	1.38
58/59	38	7,215	1.38

NPC Analysis Tool

40 Year NPV = $10682963
15 Year NPV = $9419684

Project Number	J1904
Project Name	Victoria Point STP Upgrades - Phase 2
Calculation Number	1
Calculation Name	Whole-of-Life Cost of Additional Developments

Current Financial Year	20/21	**Note: Defines start year for project (Year Zero) on Financial Year Basis (eg. 04/05)**
Discount Rate	7.00%	
Income Tax Rate	0%	**Note: Positive cash flows indicate revenue. Negative cash flows indicate expenditure.**

Capital Expenditure			**Depreciation (Linear)**	
Item	**Cost**	**Year of Project**	**Years**	**Escalation**
Post-Anoxic /reaeration Tank, Additional Clarifier and Additional CCT	$4,256,000	2	0	
	$4,256,000	3	0	

Fixed Operating Expenditure				
Item	**Cost**	**Start Year**	**End Year**	**Escalation**
Maintenance	$25,068	3	40	2.50%
Electrical	$12,500	3	40	2.50%

Note: Start Year is year of first cash flow. End Year is last year of cash flow.

Variable Operating Expenditure				
Item	**$/ML**	**Start Year**	**End Year**	**Escalation**
Electrical Variable	$70.24	3	40	2.50%
Chemical Variable	$30.25	3	40	2.50%
Haulage Variable	$143.68	3	40	2.50%

Projected Production			
		191	**L/EP/d**
Year	**Year No.**	**Additional Population**	**Flow (ML/d)**
20/21	0	-	0.00
21/22	1	434	0.08
22/23	2	677	0.13
23/24	3	1,764	0.34
24/25	4	2,850	0.54
25/26	5	3,937	0.75
26/27	6	5,023	0.96
27/28	7	6,054	1.16
28/29	8	6,242	1.19
29/30	9	6,431	1.23
30/31	10	6,619	1.26
31/32	11	6,807	1.30
32/33	12	6,888	1.32
33/34	13	6,970	1.33
34/35	14	7,052	1.35
35/36	15	7,134	1.36
36/37	16	7,215	1.38
37/38	17	7,215	1.38
38/39	18	7,215	1.3781
39/40	19	7,215	1.38
40/41	20	7,215	1.38
41/42	21	7,215	1.38
42/43	22	7,215	1.38
43/44	23	7,215	1.38
44/45	24	7,215	1.38
45/46	25	7,215	1.38
46/47	26	7,215	1.38
47/48	27	7,215	1.38
48/49	28	7,215	1.38
49/50	29	7,215	1.38
50/51	30	7,215	1.38
51/52	31	7,215	1.38
52/53	32	7,215	1.38
53/54	33	7,215	1.38
54/55	34	7,215	1.38
55/56	35	7,215	1.38
56/57	36	7,215	1.38
57/58	37	7,215	1.38
58/59	38	7,215	1.38

APPENDIX C: VICTORIA POINT WWTP – COST ESTIMATES

Victoria Point Upgrades - Phase 2 - Capital Cost Estimates for Renewals and Upgrades to Service Baseline Growth

Rev C, July 02, 2020

Item	Description	Dimensions			Qty /	Units	Rate	DJC Purchase	Installation	DJC Incl. Install	
Preliminaries											
Service location						hr	$ 200.00	$ -		$ -	
Site establishment					1	ls	$ 15,000.00	$ 15,000.00		$ 15,000.00	
Site survey	site set out only				48	hr	$ 128.00	$ 6,144.00		$ 6,144.00	
Environmental controls						ls	$ 80,000.00	$ -		$ -	
Geotechnical investigations						ls	$ 70,000.00	$ -		$ -	$ 21,144.00
Replacement of Existing Raw Sewage Screening System										$ -	
Bypass Chamber Redesign										$ -	
Concrete Cutting and making good.	Remove void 15.7 m, 200 mm thick with a 100 mm "topping"	15.7			15.7	m	$ 400.00	$ 6,280.00		$ 6,280.00	
Removal of existing inlet slidegate and outlet slidegate					1	ea	$ 1,000.00	$ 1,000.00		$ 1,000.00	
Full height inlet slidegate		1.6	1.2		1	ea	$ 11,558.35	$ 11,558.35	$ 3,467.51	$ 15,025.86	
Full height outlet slidegate		1.6	1.2		1	ea	$ 11,558.35	$ 11,558.35	$ 3,467.51	$ 15,025.86	
Raised Bypass Weir	Screen Channel to Bypass Channel - 3m	3	0.26	0.55	0.429	m3	$ 4,000.00	$ 1,716.00		$ 1,716.00	
Raised Bypass Weir	Bypass Channel to Outlet Channel - 3m	3	0.26	0.55	0.429	m3	$ 4,000.00	$ 1,716.00		$ 1,716.00	
Manually Raked Bar Screen Removal	Includes small crane				1	ea	$ 350.00	$ 350.00		$ 350.00	
Bypass channel Polyurea Coating	Supply and Install	7	5.45		38	m2	$ 183.88	$ 7,015.08		$ 7,015.08	$ 48,128.80
Bandscreen and Screw Wash Press Installation											
Step Screen Removal	Includes small crane				1	ea	$ 350.00	$ 350.00		$ 350.00	
Bypass channel Polyurea Coating	Supply and Install	3.5	5.45		19	m2	$ 183.88	$ 3,507.54		$ 3,507.54	$ 3,857.54
Mechanical Equipment											
Bandscreens	S&I 5 mm Perforated Center Flow Bandscreen - CF26-24-135-5-P (Duty/Assist) (Install assumed 30%) (incl. Professional fees, delivery etc.)				2	ea	$164,544	$ 329,088.00	$ 108,599.04	$ 437,687.04	
Bandscreen inlet weir plates	316SS				4	ea	$2,500	$ 10,000.00	$ 3,300.00	$ 13,300.00	
Service water system modifications at inlet works					1	ea	$1,000	$ 1,000.00		$ 1,000.00	$ 451,987.04
Sluicing Launders and Screw Wash Presses	S&I KWP 250/1200 Screw Wash Press and Kuhn KLS 280 Sluice Supply (Install assumed 30%) (incl. Professional fees, delivery etc.)				2	ea	$90,624	$ 181,248.00	$ 59,811.84	$ 241,059.84	
Bin outlet modifications					1	ea	$1,000	$ 1,000.00		$ 1,000.00	$ 242,059.84
New Screening System Electrical Works	18% of DJC				18%		$ 909,796.61	$ 163,763.39		$ 163,763.39	$ 163,763.39
							$ -				
Aerator Cover Removal / Noise Barriers											
Remove existing acoustic covers					3	ea	$ 1,500.00	$ 4,500.00		$ 4,500.00	
Additional coating / corrosion protection of aerator motors and gearboxes					3	ea	$ 2,500.00	$ 7,500.00		$ 7,500.00	
Acoustic barriers to north, east and west of aerators		4.9	3		14.7	m	$ 900.00	$ 13,230.00	$ 4,365.90	$ 17,595.90	$ 29,595.90
Chlorine Storage and Dosing											
Minor pipework and drum cradle modifications					1	ea	$ 6,000.00	$ 6,000.00		$ 6,000.00	
Control system modifications to facilitate D/A chlorinator operation					1	ea	$ 8,000.00	$ 8,000.00		$ 8,000.00	
Revision of documentation, including manifest, safety plans etc.					1	ea	$ 15,000.00	$ 12,000.00		$ 12,000.00	$ 26,000.00
TOTAL A =										**$ 986,537**	
B. INDIRECTS / MOBILISATION COSTS											
Indirects	% OF DJC			25.0%	Item	$ 986,537	$ 246,634				
Site Mobilisation	% OF DJC			0.0%	Item	$ 986,537	$ -				
TOTAL B =										**$ 246,634**	
C. OTHER COSTS											
Design works	% OF DJC			14.00%	Item	$ 986,537	$ 138,115				
Foreign exchange risk	% of imported equip.			10%	%	$ 510,336	$ 51,034				
Design Growth	% OF DJC			3.00%	Item	$ 986,537	$ 29,596				
TOTAL C =										**$ 218,745**	
D. FEES & MARGIN						A+B+C					
Margin @ 11%	% of A + B + C			11.00%	Item	$ 1,451,915	$ 159,711				
TOTAL D =										**$ 159,711**	
Total Contract Cost (A+B+C+D) =							**$ 1,611,626**			**$ 1,611,626**	
Client Costs	% of A+B+C+D			5%		$ 1,611,626	$ 80,581			$ 80,581	
TOTAL PROJECT COST										**$ 1,692,207**	
Contingency	**% of PROJECT COST**			30%	Item		$ 1,692,207			$ 507,662	

TOTAL PROJECT COST WITH CONTINGENCY = $ 2,199,870

Victoria Point Upgrades - Phase 2 - Capital Cost Estimates for Upgrades to Service Additional Developments - Post-Anoxic / Re-Aeration Zone

Rev B, June 24, 2020

Item	Description	Anticipated Size	Dimensions			Qty /	Units	Rate	DJC Purchase	Installation	DJC Incl. Install
Post Anoxic/Reaeration Slab					**624**	**9360**					$ -
Excavation	3 Personnel ($250/day), 1 Excavator ($2500/day), 1 Dump Truck ($1500/day)	1 machine 3 days				3	days	$ 4,750.00	$ 14,250.00		$ 14,250.00
Slab Concrete	Post Anoxic and Reaeration Zone - Excluding Mixed Liquor Transfer Chamber (including toe)		39.5	7.7	0.5	144	m3	$ 1,074.15	$ 155,174.39		$ 155,174.39
Slab and apron for access blower room			0.25	4.79	6.05	7	m3	$ 1,074.15	$ 7,782.08		$ 7,782.08
Post Anoxic Zone Mixers									$ -		$ -
Cell no. 1 Mixer	249.6 kL @ 14.2 watts/m3	KSB 3.5 kW				1	ea	$ 9,500.00	$ 9,500.00	$ 3,135.00	$ 12,635.00
Cell no. 2 Mixer	249.6 kL @ 14.2 watts/m3	KSB 3.5 kW				1	ea	$ 9,500.00	$ 9,500.00	$ 3,135.00	$ 12,635.00
Cell no. 3 Mixer	249.6 kL @ 14.2 watts/m3	KSB 3.5 kW				1	ea	$ 9,500.00	$ 9,500.00	$ 3,135.00	$ 12,635.00
Post Anoxic/reaeration Exterior Walls											
Exterior Wall Concrete			44	4.8	0.5	105.48	m3	$3,000.00	$ 316,440.00		$ 316,440.00
Bioreactor Wall			32.5	2.8	0.25	22.75	m3	$ 3,000.00	$ 68,250.00		$ 68,250.00
Mixed Liquor Transfer Chamber											
Toe Cut Out	5 m cut, 0.5m thickness		5			5	m	$ 400.00	$ 2,000.00	$ 660.00	$ 2,660.00
Penstock	Manually operated.		0.88	0.88		1	ea	$10,409.44	$ 10,409.44	$ 3,435.11	$ 13,844.55
Floor Slab			4.35	3.5	0.5	7.6125	m3	$ 1,074.15	$ 8,176.97		$ 8,176.97
Exterior Walls			10.7	7.5	0.5	40.125	m3	$ 3,261.00	$ 130,847.63		$ 130,847.63
Interior Wall			2.5	6.7	0.3	5.025	m3	$ 3,261.00	$ 16,386.53		$ 16,386.53
Mixed Liquor Duct			24	1.45	0.25	8.7	m3	$ 2,000.00	$ 17,400.00		$ 17,400.00
Reaeration Cell and Swing Zone											
Aeration Pipework		DN150 Spiral Wound SS				15	m	$ 680.00	$ 10,200.00	$ 3,366.00	$ 13,566
Control Valves	Supply and Install	DN150 butterfly with actuator				1	ea	$15,000.00	$ 15,000.00		$ 15,000
Diffusers	~126 fine pore membrane disk diffusers, fixed to floor					1	ea	$82,000	$ 82,000.00	$27,060.00	$ 109,060
Blowers	500 Nm3/h Atlas Copco ZL2VSD 15 kW					2	ea	$17,550.00	$ 35,100.00	$11,583.00	$ 46,683
Blower building, including louvres						30	m2	$ 2,200.00	$ 66,000.00		$ 66,000
DO meter	Probe, mounting hardware, controller box					1	ea	$ 5,000.00	$ 5,000.00	$ 1,650.00	$ 6,650
Mixed Liquor pipework modification	Two blockouts					2	#	$ 2,500.00	$ 5,000.00		$ 5,000
Two stopboards for weir isolation.	2100 x 800, 2500 x 800					2		$ 8,991.81	$ 17,983.63	$ 5,934.60	$ 23,918
Walkway			28	1.2		33.6	m2	$ 290.00	$ 9,744.00	$ 3,215.52	$ 12,960
Stairway						1	ea	$ 3,000.00	$ 3,000.00	$ 990.00	$ 3,990
Relocate scum harvester						1	ea	$15,000.00	$ 15,000.00		$ 15,000
Roadways											
Sealed Roadway	Supply and Install	30 m x 5 m				150	m2	$ 65.04	$ 9,756.20		$ 9,756
Kerbing	Supply and Install	60 m				60	m	$ 45.38	$ 2,722.66		$ 2,723
									$ -		$ -
Service Water System Augmentation						30	m	$ 80.00	$ 2,400.00		$ 2,400
Electrical at 13% of DJC for PA/RA Tank					13%		$ 1,289,451	$ 167,629			$ 167,629

NEW WORKS = $ 1,289,451

Victoria Point Upgrades - Phase 2 - Capital Cost Estimates for Upgrades to Service Additional Developments - Additional Clarifier

Rev B, June 24, 2020

Item	Description	Anticipated Size	Dimensions			Qty /	Units	Rate	DJC Purchase	Installation	DJC Incl. Install
Clear & grub			72	63		4536	m2	$ 6.00	$ 27,216.00		$ 27,216.00
Mods to ML flow split									$ -		$ -
Pipe to new clarifier		960 OD DICL				68	m	$ 1,004.89	$ 68,332.45	$ 22,549.71	$ 90,882.16
Bends in pipe to new clarifier		960 DICL				2	ea	$ 6,062.31	$ 12,124.62	$ 4,001.12	$ 16,125.74
Modify division in flowsplitter annulus, Removal of aluminium mixed liquor flow distribution chamber cap	Concrete cut, live cut-in					1	ea		$ 11,000.00		$ 11,000.00
Aluminium Slidegate	Supply and Install Aluminium Slidegate with spindle (clear opening sides and bottom)		1500	2200		1	ea	$ 20,173.33	$ 20,173.33	$ 6,657.20	$ 26,830.53
Extension to service water network and hose points						1	ea	$ 2,400.00	$ 2,400.00		$ 2,400.00
New Clarifier											$ -
Concrete Walls	Supply and Install	109.17m x 4.42m x 0.25 m	109.17	4.42	0.25	120.6	m3	$ 3,000.00	$ 361,800.00		$ 361,800.00
Concrete Wall Toe	Supply and Install	109.17 m x 1.7 m x 0.4 m	109.17	1.7	0.4	74.2	m3	$ 1,074.15	$ 79,701.93		$ 79,701.93
Concrete Floor	Supply and Install	977.24 m2 x 0.15 m	977.24	0.15		146.6	m3	$ 1,074.15	$ 157,470.39		$ 157,470.39
Concrete Path	Supply and Install	111.21 m x 0.9 m x 0.075 m	111.21	0.9	0.1	7.5	m3	$ 1,074.15	$ 8,056.13		$ 8,056.13
Sludge Cone Floor	Supply and Install	15.90 m2 x 0.35 m	15.9	0.35		5.6	m3	$ 3,261.00	$ 18,261.60		$ 18,261.60
Launder Concrete	Supply and Install	(111.2 m x 0.75 m x 0.25 m) + (108.865 m x 0.5 m x 0.15 m)				29	m3	$ 3,261.00	$ 94,569.00		$ 94,569.00
Launder Epoxy Coating	Supply and Install	(113.1 x 1.245)+(108.865 x 0.5)+(111.2 x 0.6)+(108.856 x 0.15)+(108.38 x 300)				311	m2	$ 183.88	$ 57,151.20		$ 57,151.20
S&I clarifier mechanism - weirs scrapers etc	Supply and Install					1	ea	$ 715,000.00	$ 715,000.00		$ 715,000.00
Secondary effluent pipework (to main filter feed tank)		960 DICL				67	m	$ 1,004.89	$ 67,327.56		$ 67,327.56
Excavation, including placement and overburden to new batters for sound and visual screening	3 Personnel ($250/day), 1 Excavator ($2500/day), 1 Dump Truck ($1500/day)	1 machine 4 days	1017.87602	5		6	days	$ 4,750.00	$ 28,500.00		$ 28,500.00
Groundwater Collection Manhole				#REF!							
Floor	Supply and Install		2.27		0.3	0.681	m3	$ 1,074.15	$ 731.50		$ 731.50
Walls - precast	Supply and Install	6m depth				3	ea	$ 1,850.00	$ 5,550.00		$ 5,550.00
Grounwater drainage pipework	Supply and Install					104	m	$ 70.11	$ 7,291.29		$ 7,291.29
RAS Pump Station											
RAS pipework for RAS pump station		375 DICL				85.5	m	$ 573.33	$ 49,019.89	$ 14,705.97	$ 63,725.85
Concrete slab	Supply and Install	6.4 m x 8.3 m x 0.4 m				21.25	m3	$ 1,074.15	$ 22,825.69		$ 22,825.69
RAS Pumps	190 L/s Duty/Assist/Standby					3	ea	$ 12,500.00	$ 37,500.00	$ 9,375.00	$ 46,875.00
NRV		DN300				3	ea	$ 5,986.61	$ 17,959.84	$ 4,489.96	$ 22,449.80
Isolation Valves Suction		DN300				3	ea	$ 2,975.13	$ 8,925.38	$ 2,231.34	$ 11,156.72
Isolation Valves Discharge		DN250				3	ea	$ 2,644.56	$ 7,933.67	$ 1,983.42	$ 9,917.09
RAS Flowmeter	Magflow	DN250				1	ea	$ 8,500.00	$ 8,500.00	$ 2,125.00	$ 10,625.00
Pre and Post Flowmeter Isolation Valve	Knifegate	DN375				2	ea	$ 5,520.00	$ 11,040.00	$ 2,760.00	$ 13,800.00
Scum Pump Station Cut In											
Pipework		150 DN DICL				20	m	$ 59.93	$ 1,198.60	$ 299.65	$ 1,498.25
Roadways											
Sealed Roadway	Supply and Install	15 m x 5 m				75	m2	$ 65.04	$ 4,878.10		$ 4,878.10
Kerbing	Supply and Install	30 m				30	m	$ 45.38	$ 1,361.33		$ 1,361.33
Gravel Roadway	Supply and Install	110 m x 5 m				550	m2	$ 30.25	$ 16,638.49		$ 16,638.49
Landscaped Nature Strips											
East Nature Strip											
Fill		45 m x 13.5 m (1:3 batter slope)	45	6.75	4.5	1367	m3	$ -	$ -		$ -
Coverage - Native trees, shrubs and hedges, mulched		45 m x 13.5 m	45	6.75		607.5	m2	$ 10.00	$ 6,075.00		$ 6,075.00
North Nature Strip									$ -		$ -
Fill		59 m x 13.5 m (1:3 batter slope)	59	6.75	4.5	1792	m3	$ -	$ -		$ -
Coverage - Native trees, shrubs and hedges, mulched		59 m x 13.5 m	59	13.5		796.5	m2	$ 10.00	$ 7,965.00		$ 7,965.00
SUNDRY MECH / ELECT / CIVIL WORKS											
Road repairs	Road restoration for pipe trench road crossings	22	1.5		m2	33	m2	$ 192.00	$ 6,336.00		$ 6,336.00
Landscaping	Includes restoration for entire work area with grass seed & topsoil.					934	m2	$ 8.00	$ 7,472.00		$ 7,472.00
Electrical for new clarifier	12% of DJC				10%		$ 2,254,960	$ 225,496			$ 225,496

NEW WORKS = $ 2,254,960

Victoria Point Upgrades - Phase 2 - Capital Cost Estimates for Upgrades to Service Additional Developments - Additional Chlorine Contact Tank

Rev B, June 24, 2020

Item	Description	Anticipated Size	Dimensions			Qty /	Units	Rate	DJC Purchase	Installation	DJC Incl. Install
Excavation	3 Personnel ($250/day), 1 Excavator ($2500/day), 1 Dump Truck ($1500/day)	1 machine 1.5 days				1.5	days	$ 4,750.00	$ 7,125.00		$ 7,125.00
New inlet chamber to CCT									$ -		$ -
Floor Slab			2	2	0.25	1	m3	$ 1,074.15	$ 1,074.15		$ 1,074.15
Exterior Walls			6	3.1	0.25	4.65	m3	$ 3,000.00	$ 13,950.00		$ 13,950.00
Interior Walls			2	3	0.225	1.35	m3	$ 3,000.00	$ 4,050.00		$ 4,050.00
New inlet pipework cut-in						1	ea	$ 4,000.00	$ 4,000.00		$ 4,000.00
New Chlorine Contact Tank											
Floor Slab			23.5	5.45	0.25	32.01875	m3	$ 1,074.15	$ 34,392.94		$ 34,392.94
Exterior Walls			57	3.1	0.25	44.175	m3	$ 3,000.00	$ 132,525.00		$ 132,525.00
Interior Walls			33.2	3	0.225	22.41	m3	$ 3,000.00	$ 67,230.00		$ 67,230.00
Penstock	DN900					1	ea	$ 12,491.33	$ 12,491.33		$ 12,491.33
Stopboard						1	ea	$ 8,327.55	$ 8,327.55		$ 8,327.55
Weir plates						1	ea	$ 2,400.00	$ 2,400.00		$ 2,400.00
Walkway, stairway and service water						1	ea	$ 8,000.00	$ 8,000.00		$ 8,000.00
						0					$ 295,566

Victoria Point Upgrades - Phase 2 - Capital Cost Estimates for Upgrades to Service Additional Developments - Compiled with General Items

Rev B, June 24, 2020

Item	Description	% Rate	Qty /	Units	Rate	DJC Purchase and Installation	DJC Incl. Install
Preliminaries							
Service location			16	hr	$ 200	$ 3,200	$ 3,200
Site Establishment			1	ls	$ 32,000	$ 32,000	$ 32,000
Site survey			120	hr	$ 128	$ 15,360	$ 15,360
Environmental controls			1	ls	$ 10,000	$ 10,000	$ 10,000
Geotechnical investigations			1	ls	$ 12,000	$ 12,000	$ 12,000
Post-Anoxic / Re-Aeration Tank							$1,289,451
Additional Secondary Clarifier							$2,254,960
Additional Chlorine Contact Tank							$295,565
Commissioning and Handover		3%	of DJC		$ 4,033,542	$ 121,006	$ 121,006
TOTAL A =							**$ 4,033,542**
B. INDIRECTS / MOBILISATION COSTS							
Indirects	% OF DJC	25.0%	Item	$ 4,033,542	$ 1,008,386		
Site Mobilisation	% OF DJC	0.0%	Item	$ 4,033,542	$ -		
TOTAL B =							**$ 1,008,386**
C. OTHER COSTS							
Design works	% OF DJC	11.00%	Item	$ 4,033,542	$ 443,690		
Foreign exchange risk	% of imported equip.	10%	%	$ 114,600	$ 11,460		
Design Growth	% OF DJC	3.00%	Item	$ 4,033,542	$ 121,006		
TOTAL C =							**$ 576,156**
D. FEES & MARGIN				A+B+C			
Margin @ 11%	% of A + B + C	11.00%	Item	$ 5,618,084	$ 617,989		
TOTAL D =							**$ 617,989**
Total Contract COST (A+B+C+D) =					**$ 6,236,073**		**$ 6,236,073**
Client Costs	% of A+B+C+D	5%		$ 6,236,073	$ 311,804		$ 311,804
TOTAL PROJECT COST							**$ 6,547,877**
Contingency	**% of PROJECT COST**	30%	Item		$ 6,547,877		$ 1,964,363

TOTAL PROJECT COST WITH CONTINGENCY = $ 8,512,240

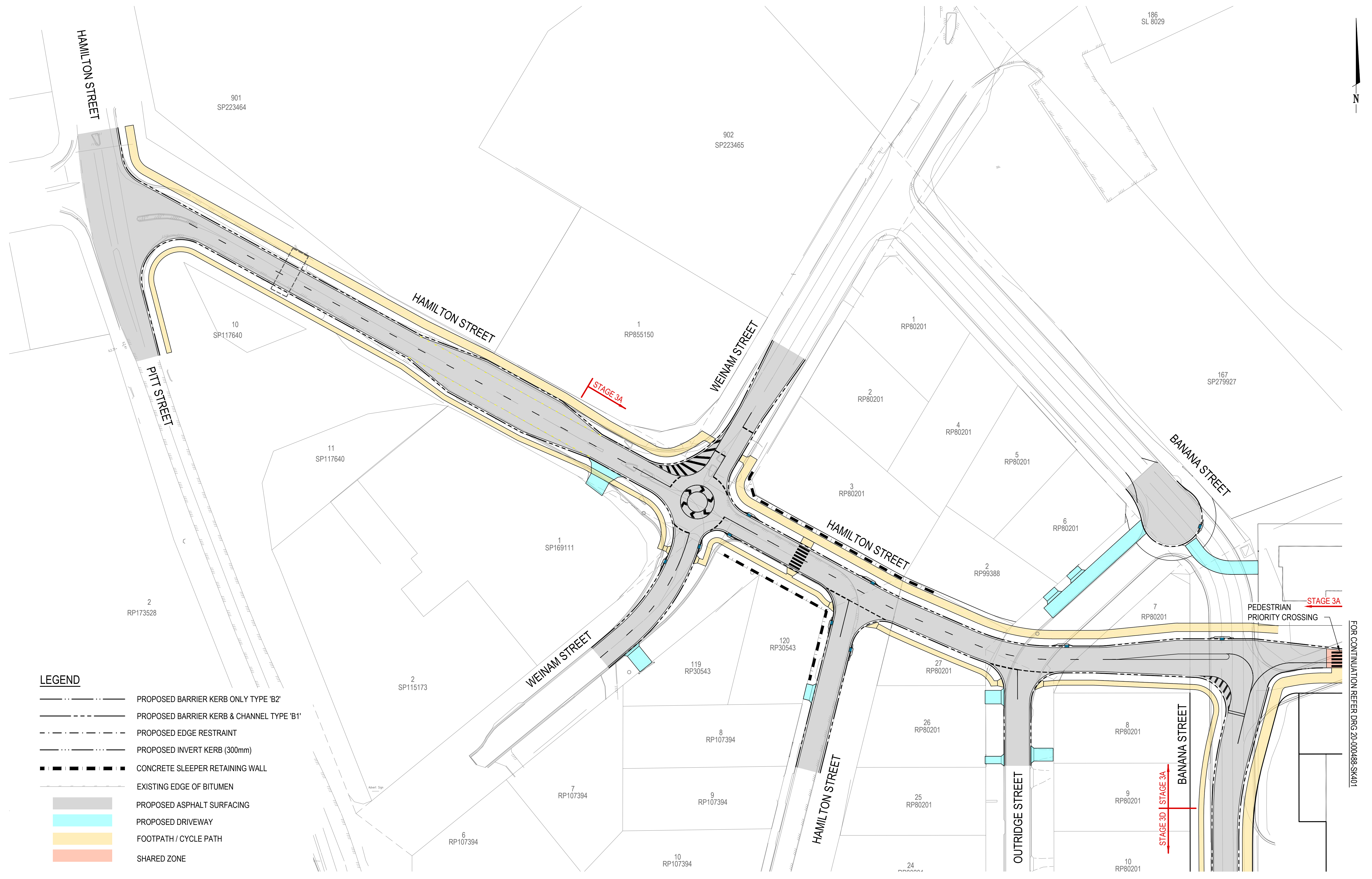
Victoria Point Upgrades - Phase 2 - Operational Cost Estimates for Treatment of Loads from Additional Developments

Rev A, May 12, 2020

Population Projection		Baseline	Additional Developments	Additional Load	
Connected EP (2041)		37097	44312	7215	EP
Flow per EP		191	191	0	L/EP/d
ADWF		7086	8464	1378	kL/d
Unit Rates					
Electrical Power Consumption		$0.11	/kWh		
Electrical Power Peak Demand Charge		156	/kW peak demand p.a.		
Chlorine (920 kg Drum Supply)		$2.94	per kg Chlorine		
Biosolids Haulage Rate - Minimum		$65	/wet tonne		
Biosolids Haulage Rate - Maximum		$100	/wet tonne		
Polyelectrolyte		$4.95	/kg poly (active)		

Operating Cost	Cost Type	Baseline (2041)	Average with Addition Developments (2041)	Peak with Addition Developments (2041)	Units	Annual Cost with Additional Developments (2041)		Notes
Post-Anoxic/Reaeration Zone								
Mixers	Electrical - Fixed	Nil	8.88	8.88	kW	$9,942		
Re-Aeration Blowers	Electrical - Variable	Nil	8.19	13.51	kW	$9,999	$26,384	
Diffuser replacement	Maintenance	Nil				$6,443		
Additional Clarifier								
Clarifier Drive	Electrical - Fixed	Nil	2.285	2.285	kW	$2,558		
RAS Pumps (5m head)	Electical - Variable	Nil	1.08	6.50	kW	$1,212	$22,395	Assumes 2 months per year with 5 x ADWF events
	Maintenance					$18,625		
Additional Chlorine Contact Tank		Baseline	Average with Addition Developments	Additional Chlorine Consumption with Additional Developments	Units	Annual Cost with Additional Developments		Notes
Chlorine	Chemical - Variable	15259	16991	2766	kg p.a.	$8,133		
Other Power Consumption		Baseline (2041)	Average with Addition Developments (2041)	Peak with Addition Developments (2041)	Units	Annual Cost with Additional Developments		Notes
Oxidation Ditch Aerators	Actual OTR	118.3	141.6	23.3	kg O2/h			1.9 kgO2/kWh SOTR
	Standard OTR	169.3	202.6	33.3	kg O2/h			17.5 kW additional
	Electrical - Variable		17.5	22.75	kW	$20,412		
Filter Feed Pumps	Electrical - Variable		1.34	6.7	kW	$1,466		Assumes 2 months per year with 5 x ADWF events
Other	Electrical - Variable		2	2	kW	$2,239		
Other - Poly Consumption	Chemical - Variable	19.9	23.8	3.92	kg/day	$7,083	$150,442	
Biosolids Production	Dry Solids Production	1811	2167	356	kg DS/day			Assumes 11 kg poly/dry tonne solids (upgraded dewatering system)
	Biosolids - Variable at Min of Range			1.98	wet tonnes per day	$46,974		Assumes 18% Dry Solids Cake (upgraded dewatering system
	Biosolids - Variable at Max of Range			1.98	wet tonnes per day	$72,268		Assumes 18% Dry Solids Cake (upgraded dewatering system
Total	Electrical - Fixed					$12,500		
	Electrical - Variable					$35,328		$70.24 per ML treated
	Chemical - Variable					$15,216		$30.25 per ML treated
	Maintenance - Fixed					$25,068		
	Biosolids - Variable at Minimum of Range					$46,974		$93.39 per ML treated
	Biosolids - Variable at Maximum of Range					$72,268		$143.68 per ML treated
Total Excl. Biosolids						$88,113		
Total with Biosolids at Min of Range						$135,087		
Total with Biosolids at Max of Range						$160,381		

Appendix I – Weinam Creek General Approved Overall Layout Plans



REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	27.10.21	ISSUED FOR INFORMATION	CH	CH
2	04.11.21	ISSUED FOR INFORMATION	CH	CH
3	03.12.21	ISSUED FOR INFORMATION	CH	CH

DRAWN

DESIGN

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
1:500 10 5 0 10 20m A1
1:1000 A3

CLIENT
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PROJECT
WEINAM CREEK
GENERAL

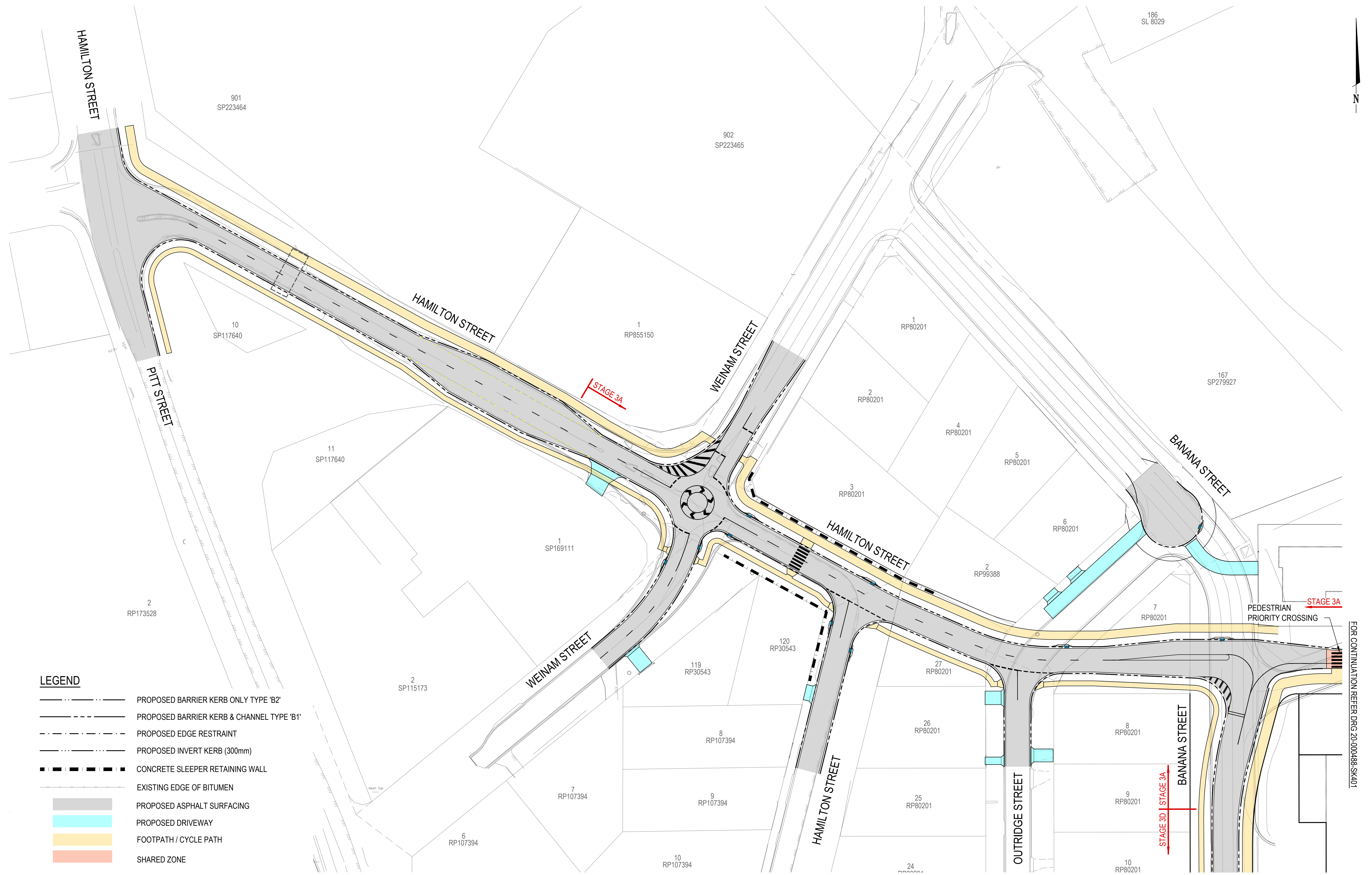
DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE
OVERALL
LAYOUT PLAN
SHEET 1 OF 3

PROJECT No.
20-000488

DRAWING No.
SK400

REVISION
3



LEGEND

- PROPOSED BARRIER KERB ONLY TYPE 'B2'
- PROPOSED BARRIER KERB & CHANNEL TYPE 'B1'
- PROPOSED EDGE RESTRAINT
- PROPOSED INVERT KERB (300mm)
- CONCRETE SLEEPER RETAINING WALL
- EXISTING EDGE OF BITUMEN
- ▨ PROPOSED ASPHALT SURFACING
- ▨ PROPOSED DRIVEWAY
- ▨ FOOTPATH / CYCLE PATH
- ▨ SHARED ZONE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	27.10.21	ISSUED FOR INFORMATION	CH	CH
2	04.11.21	ISSUED FOR INFORMATION	CH	CH
3	03.12.21	ISSUED FOR INFORMATION	CH	CH

DRAWN

DESIGN

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
1:500 A1
1:1000 A3
10 5 0 10 20m

CLIENT
REDLAND INVESTMENT CORPORATION

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PROJECT
WEINAM CREEK GENERAL

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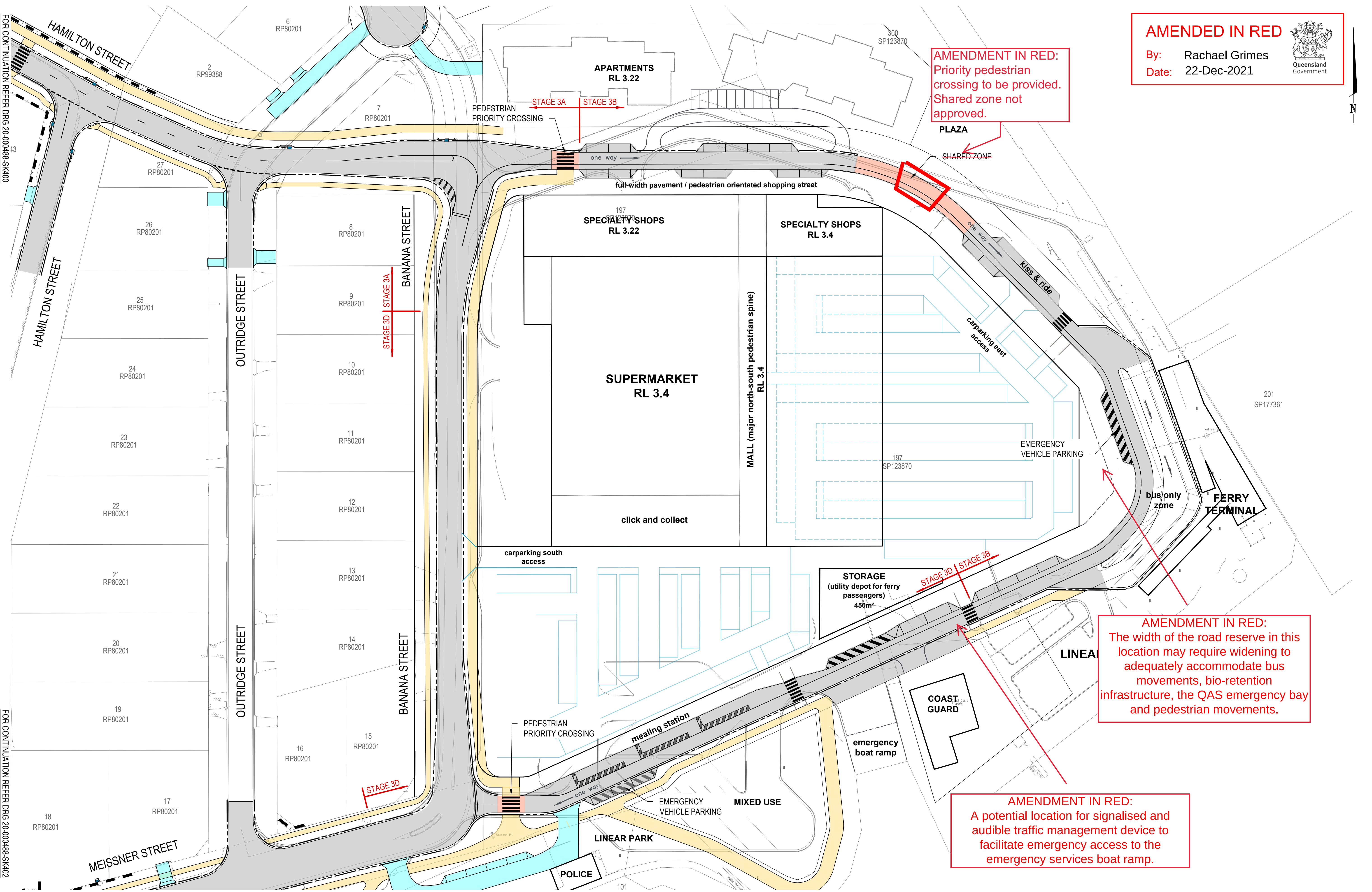
DRAWING TITLE
OVERALL
LAYOUT PLAN
SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
20-000488	SK400	3

AMENDED IN RED
By: Rachael Grimes
Date: 22-Dec-2021
Queensland Government



AMENDMENT IN RED:
Priority pedestrian crossing to be provided. Shared zone not approved.

AMENDMENT IN RED:
The width of the road reserve in this location may require widening to adequately accommodate bus movements, bio-retention infrastructure, the QAS emergency bay and pedestrian movements.

AMENDMENT IN RED:
A potential location for signalised and audible traffic management device to facilitate emergency access to the emergency services boat ramp.

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	27.10.21	ISSUED FOR INFORMATION	CH	CH
2	04.11.21	ISSUED FOR INFORMATION	CH	CH
3	03.12.21	ISSUED FOR INFORMATION	CH	CH

DRAWN

DESIGN

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
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1:1000 A3

CLIENT
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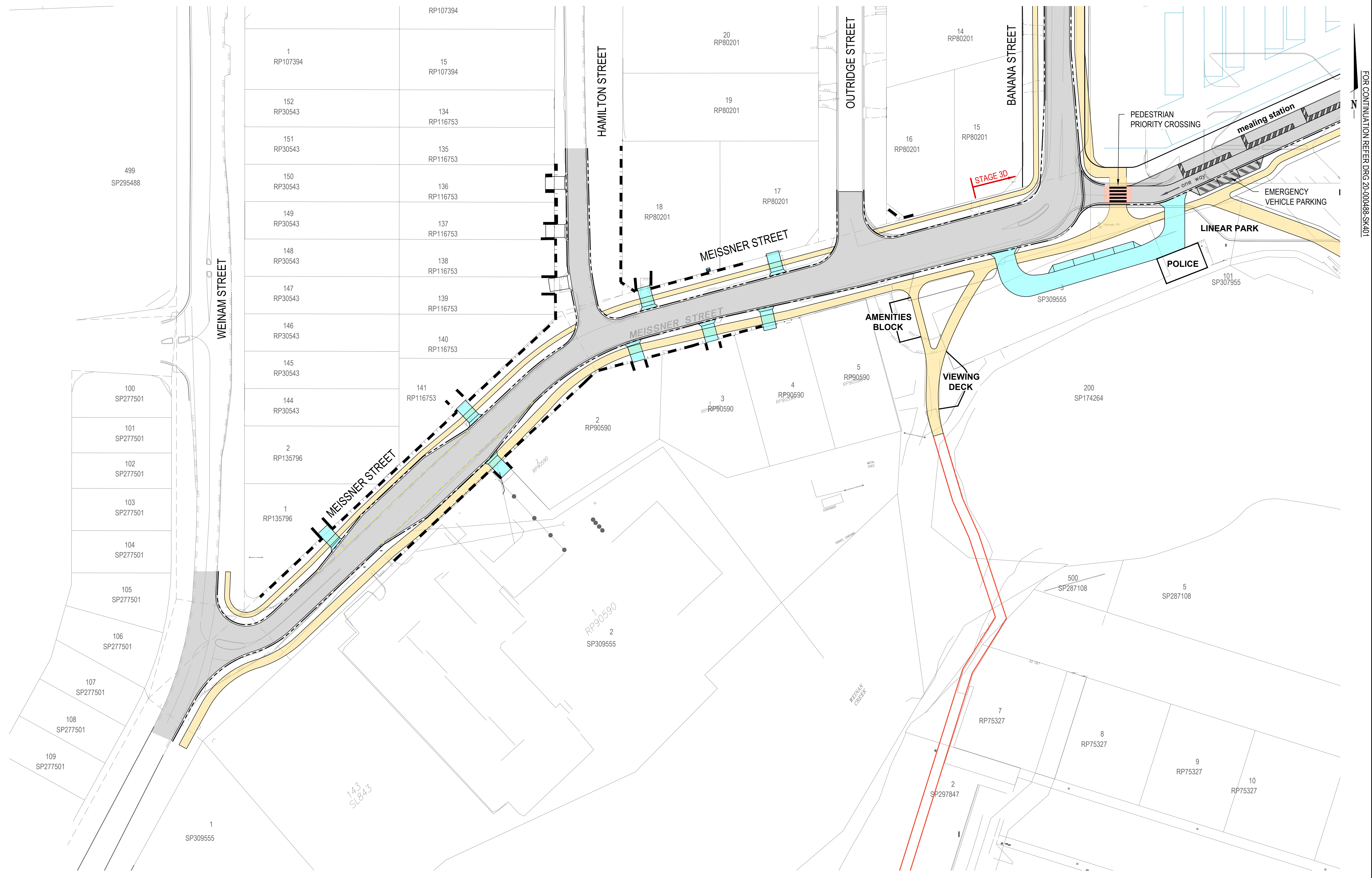
PROJECT
WEINAM CREEK GENERAL

DRAWING TITLE
OVERALL
LAYOUT PLAN
SHEET 2 OF 3

PROJECT No. 20-000488
DRAWING No. SK401
REVISION 3



REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
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2	04.11.21	ISSUED FOR INFORMATION	CH	CH
3	03.12.21	ISSUED FOR INFORMATION	CH	CH

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DESIGN

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE

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1:1000 A3

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GENERAL

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DRAWING TITLE

OVERALL
LAYOUT PLAN
SHEET 3 OF 3

PROJECT No.	DRAWING No.	REVISION
20-000488	SK402	3

Appendix J – Intersection Upgrade Hamilton Street and Pitt Street Drawings

PAVEMENT MARKING DIMENSIONS

TRANSVERSE LINES		WIDTH (mm)	LABEL
Give Way Line	600 600	200	GL
LONGITUDINAL LINES			
Lane Lines			
(a) Broken	9m 3m 9m	80	BLL
(b) Unbroken		80	ULL
Edge Line		100	EL

LEGEND

D	EXISTING DRAINAGE LINE
T	EXISTING TELSTRA LINE
S	EXISTING GRAVITY SEWER MAIN
E/OH PP	EXISTING OVER HEAD ELECTRICITY LINE & POWER POLE
LP	EXISTING LIGHTPOLE
	EXISTING & PROPOSED BACK OF KERB
▨	PROPOSED CONCRETE ISLAND INFILL
🟧	PROPOSED CONCRETE FOOTPATH

REVISION: 0
17/07/2023

Job No.
FC-22-014

DWG No.
Z-051

INTERSECTION UPGRADE HAMILTON STREET & PITT STREET
WEINAM CREEK PRIORITY DEVELOPMENT AREA
FOR REDLAND INVESTMENT CORPORATION

0 5 10 15
SCALE 1:500 (m)
DO NOT SCALE FROM PLAN

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W: www.engineeringsolutionsqld.com.au
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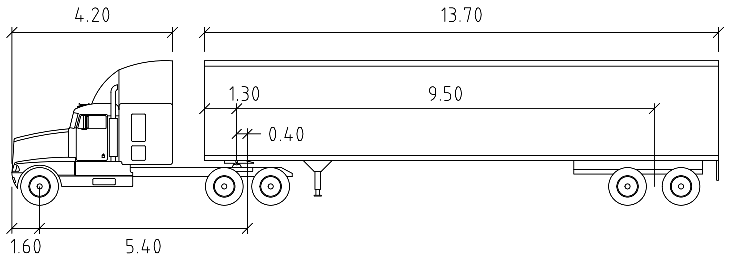
LEGEND

—D—	EXISTING DRAINAGE LINE
—	EXISTING & PROPOSED BACK OF KERB
▨	PROPOSED CONCRETE ISLAND INFILL
🟧	PROPOSED CONCRETE FOOTPATH

DESIGN VEHICLES



SEM1

meters

Tractor Width	: 2.50	Lock to Lock Time	: 6.0
Trailer Width	: 2.50	Steering Angle	: 28.4
Tractor Track	: 2.50	Articulating Angle	: 70.0
Trailer Track	: 2.50		

REVISION: 0
17/07/2023

Job No.
FC-22-014

DWG No.
Z-052

INTERSECTION UPGRADE (TURN PATH) HAMILTON STREET & PITT STREET
WEINAM CREEK PRIORITY DEVELOPMENT AREA
FOR REDLAND INVESTMENT CORPORATION

0 5 10 15
SCALE 1:500 (m)
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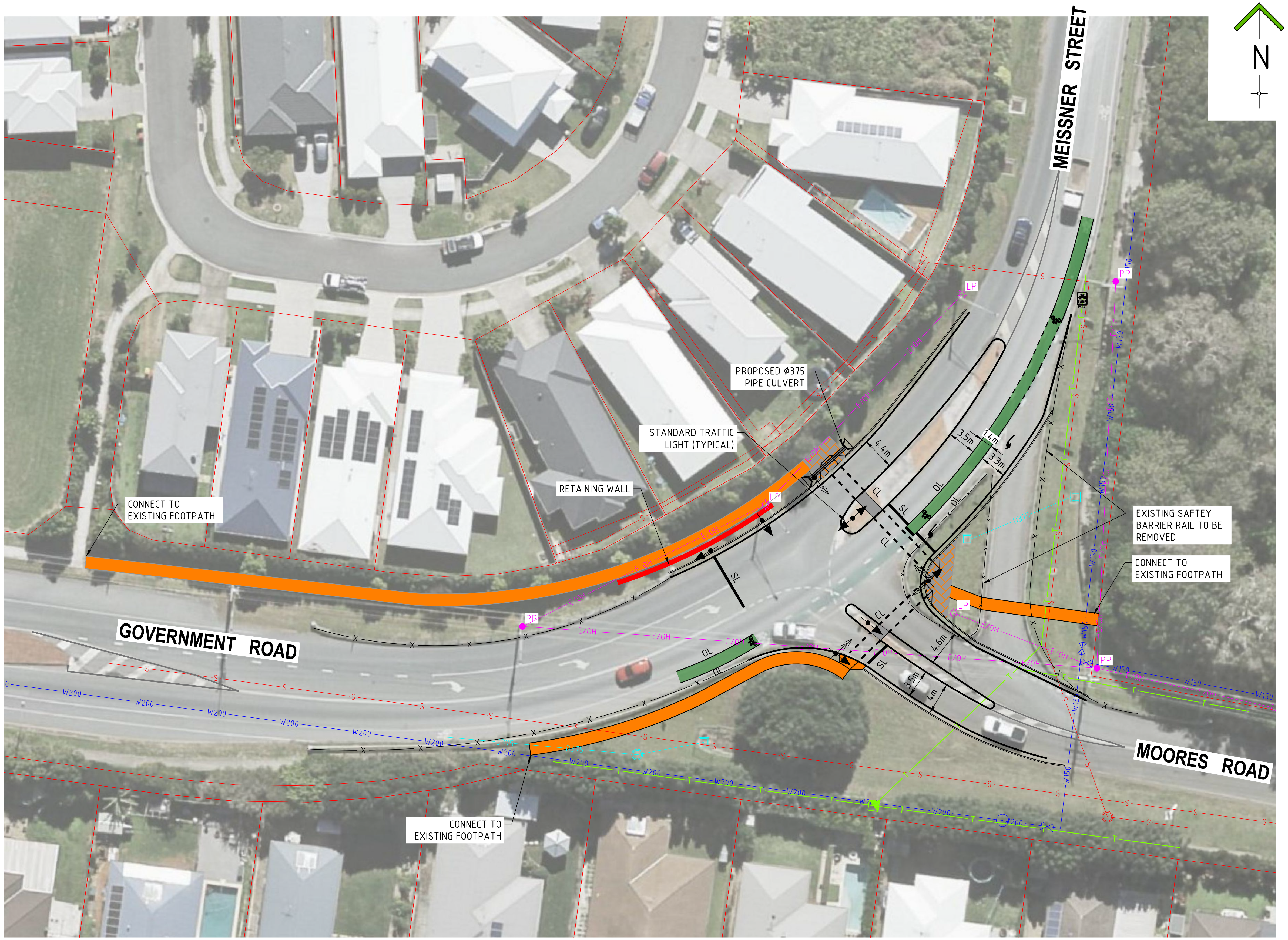
Appendix K – Intersection Upgrade Meissner Street and Moores Road Drawings

PAVEMENT MARKING DIMENSIONS

TRANSVERSE LINES		WIDTH (mm)	LABEL
Stop Line	▬	300	SL
LONGITUDINAL LINES			
Lane Lines			
Continuity Line	▬ 3m ▬ 1m ▬ 3m	200	CL
Outline Markings	—	100	OL

LEGEND

—X—	EXISTING GUARD RAIL FENCE
—0375—	EXISTING 375Ø DRAINAGE PIPE
☐	EXISTING DRAINAGE STRUCTURE
—T—	EXISTING TELSTRA LINE
—S—	EXISTING GRAVITY SEWER MAIN
—W150—	EXISTING 150Ø WATERMAIN
—W200—	EXISTING 200Ø WATERMAIN
—E/OH— ● PP	EXISTING OVER HEAD ELECTRICITY LINE & POWER POLE
☼ LP	EXISTING LIGHTPOLE
▽	PROPOSED DRAINAGE OUTLET
◄	PROPOSED STANDARD TRAFFIC LIGHT (TYPICAL)
▬D▬	PROPOSED DRAINAGE LINE
🟥	PROPOSED BLOCK RETAINING WALL
═	PROPOSED KERB
▨	PROPOSED CONCRETE ISLAND INFILL
🟧	PROPOSED CONCRETE FOOTPATH



REVISION: 1
17/07/2023

Job No.
FC-22-014

DWG No.
Z-049

INTERSECTION UPGRADE MEISSNER STREET & MOORES ROAD
WEINAM CREEK PRIORITY DEVELOPMENT AREA
FOR REDLAND INVESTMENT CORPORATION

0 5 10 15
SCALE 1:500 (m)
DO NOT SCALE FROM PLAN

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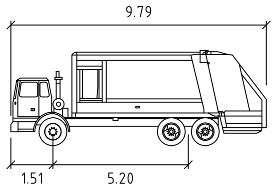
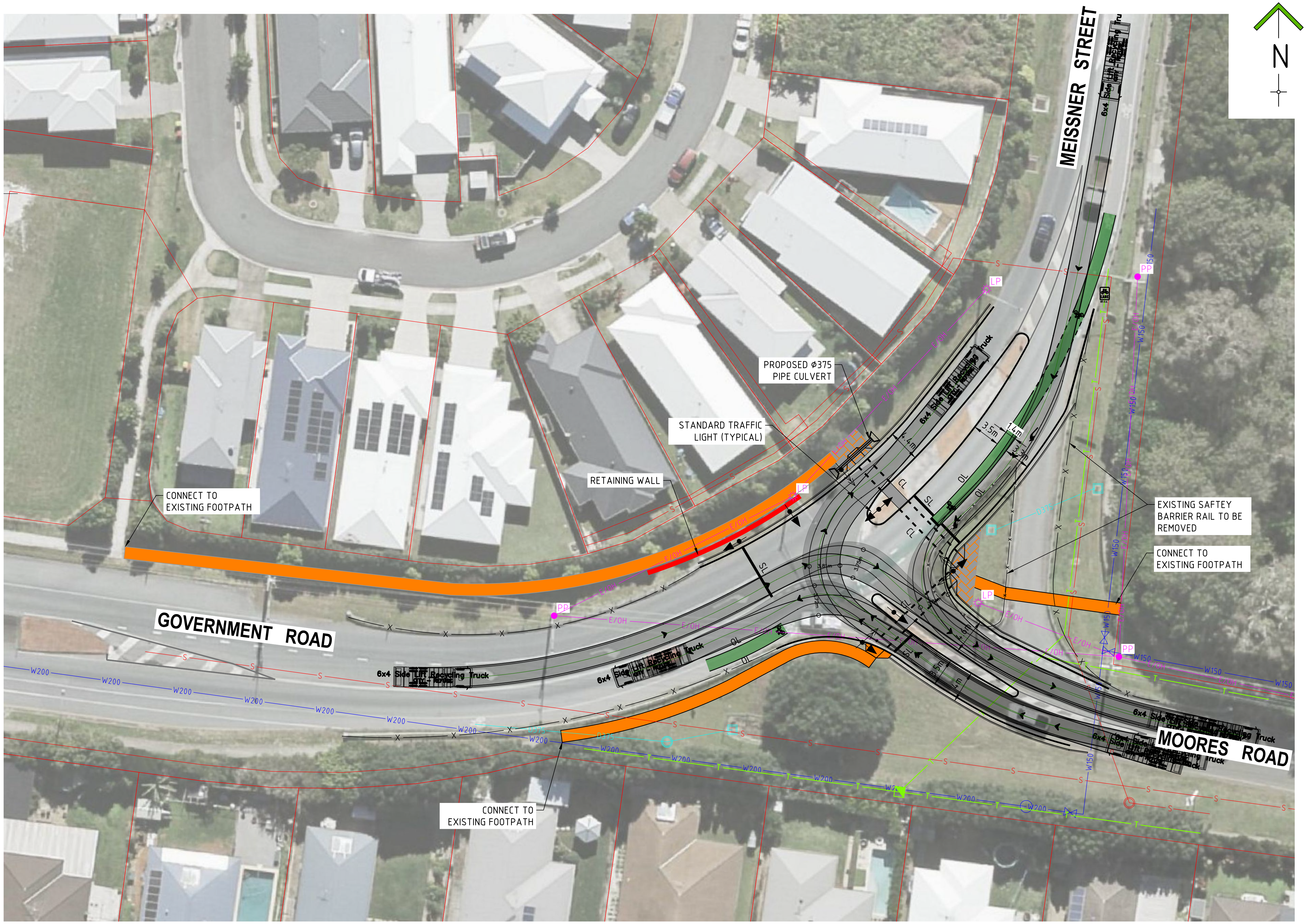
LEGEND

X	EXISTING GUARD RAIL FENCE
D375	EXISTING 375⌀ DRAINAGE PIPE
▢	EXISTING DRAINAGE STRUCTURE
T	EXISTING TELSTRA LINE
S	EXISTING GRAVITY SEWER MAIN
W150	EXISTING 150⌀ WATERMAIN
W200	EXISTING 200⌀ WATERMAIN
E/OH ● PP	EXISTING OVER HEAD ELECTRICITY LINE & POWER POLE
☼ LP	EXISTING LIGHTPOLE
▽	PROPOSED DRAINAGE OUTLET
◄	PROPOSED STANDARD TRAFFIC LIGHT (TYPICAL)
D	PROPOSED DRAINAGE LINE
🟥	PROPOSED BLOCK RETAINING WALL
═	PROPOSED KERB
▨	PROPOSED CONCRETE ISLAND INFILL
🟧	PROPOSED CONCRETE FOOTPATH



6x4 Side Lift Recycling Truck

	meters
Width	: 2.49
Track	: 2.44
Lock to Lock Time	: 6.0
Steering Angle	: 33.2



REVISION: 1
17/07/2023

Job No.
FC-22-014

DWG No.
Z-049

INTERSECTION UPGRADE (TURN PATH) MEISSNER STREET & MOORES ROAD
WEINAM CREEK PRIORITY DEVELOPMENT AREA
FOR REDLAND INVESTMENT CORPORATION

0 5 10 15
SCALE 1:500 (m)
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Appendix L – Landscape Masterplan Design Report – Weinam Creek Priority Development Area

02LA

WEINAM CREEK PRIORITY DEVELOPMENT AREA

LANDSCAPE MASTERPLAN DESIGN REPORT

FURTHER ISSUES RESPONSE

Client
Redland Investment Corporation

Project Address
Weinam Creek PDA
Redland Bay, QLD

Contact
02 Landscape Architecture
(07) 3831 0681

Document Number
358 SD_LR002_G
Date: 14/07/2021
Further Issues Response

Acknowledgments
This document presents work from 02 Landscape Architecture in association with Calibre, Ellivo Architects and RPS.

Contents

Introduction

Background

This landscape masterplan has been commissioned as part of the ongoing work in the Weinam Creek PDA.

The Weinam Creek PDA is in Redland Bay on the Moreton Bay foreshore within the Redland City Council Local Government Area.

The total area of the PDA is approximately 42 hectares, including 36 hectares over land and nearly 6 hectares over water within the Moreton Bay Marine Park. The PDA is bounded by Weinam Street to the west and Moreton Bay to the east, Peel Street in the north and Moores Road to the south.

Weinam Creek serves as the main point of departure and arrival for vehicular ferry and passenger ferry services between the mainland and the Southern Moreton Bay Islands. The area incorporates marine activity, residential development and open space areas.

The PDA incorporates the Weinam Creek Marina located at the intersection of Banana Street and Meissner Street.

Vision

> *The landscape masterplan re-imagines the site as a community hub, centered around the new urban foreshore and ferry terminal. It embraces and takes advantage of the scenic amenity of the waterfront allowing residents and visitors alike to enjoy the foreshore and Moreton Bay.*

The masterplan creates a variety of integrated open space opportunities that focus on:

Public Realm

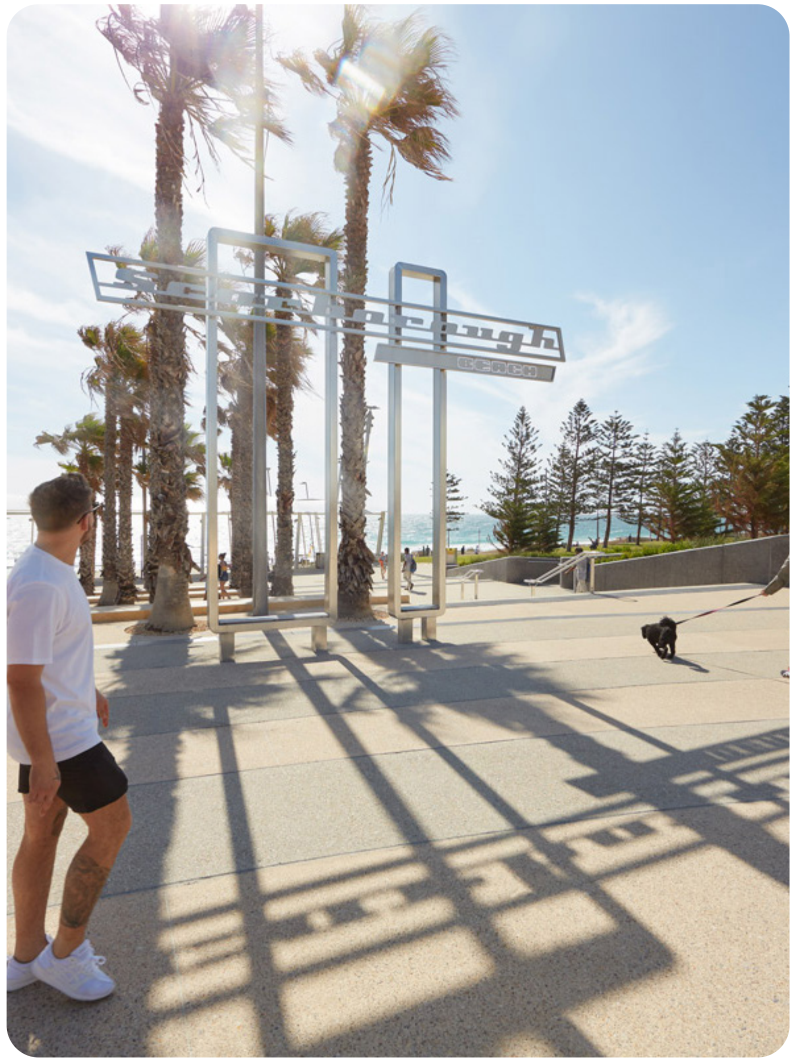
- Envisages a vibrant, urban public realm precinct on the heart of the foreshore that celebrates community based activities in both daytime and night time;
- Takes advantage of and embraces 1.5km of continuous foreshore experiences;
- Maximises and promotes views from the Foreshore to the Bay;
- Connects people to the water by designing flexible spaces that allow them to engage physically and visually with its natural assets;
- Maximises safety through design principles whilst ensuring no net loss of public open space;
- Incorporates outdoor dining and picnicking opportunities with waterfront experiences for all visitors; and
- Reflects the distinctive foreshore zones and proposes uses appropriate to these zones.

Connectivity

- Prioritises pedestrians and cyclists by providing safe and efficient movement options which connect with public transport, the waterfront and community focal points;
- Provides a sequence of multi-use spaces of varying scales that include recreational, sporting and ecological functions;
- Maximises safety through design principles whilst ensuring no net loss of public open space; and
- Improves open space network connections by establishing linear movement corridors.

Respects Existing Features

- Conserves and leverages local site characteristics, settings, places of heritage significance, landmarks, breezes and views;
- Respects and values marine and land based ecology and seeks to protect matters of ecological significance; and
- Re-inforces existing vegetation character and utilises native and endemic plant species.

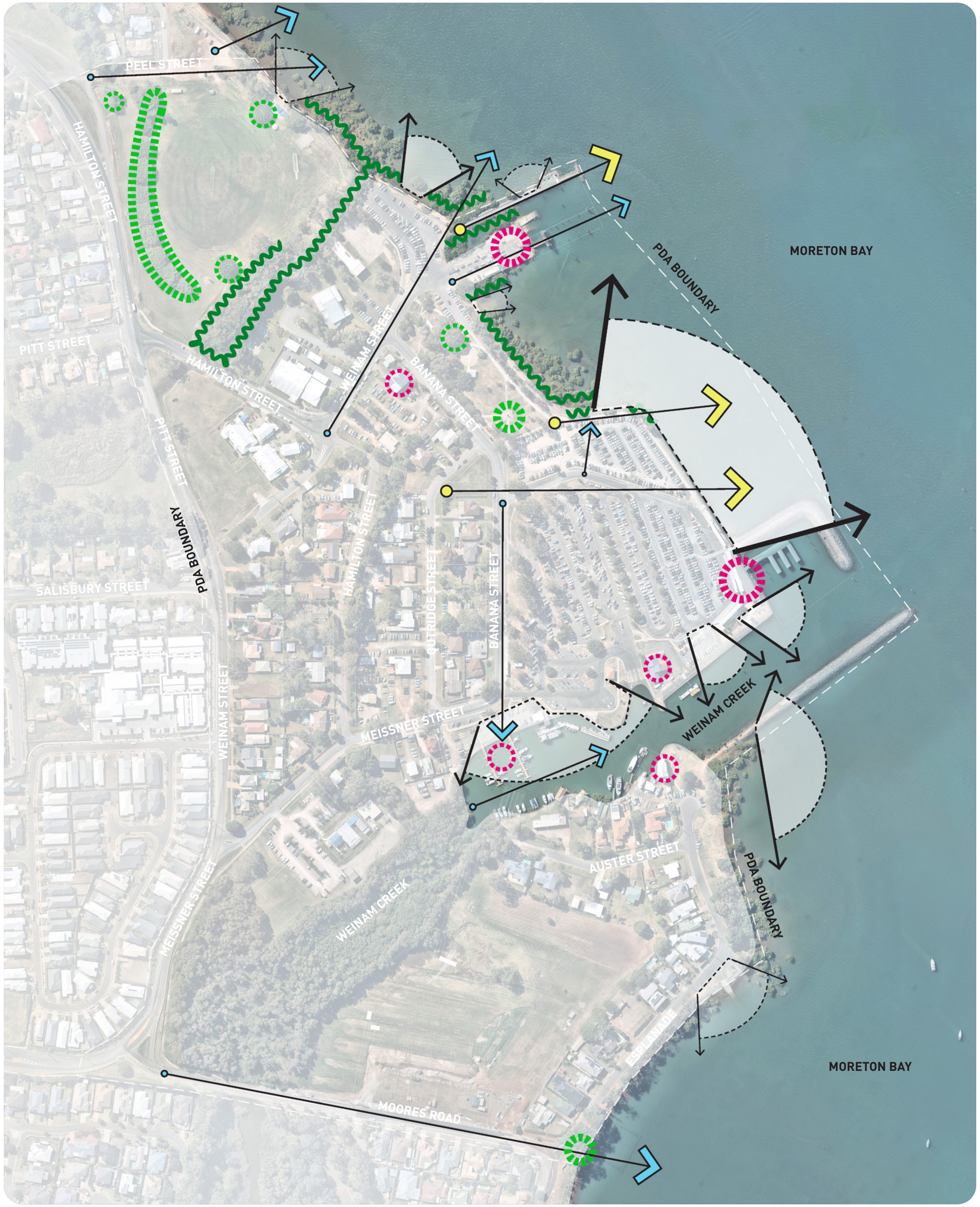


Conceptual Process

Analysis Diagram:
Site Features, Views & Vistas

LEGEND

- Site Boundary
- Landmarks
- Site Features
- Existing Views & Viewsheds
- Existing Vistas
- Edges



1:4000 - A3

0 20 40 80 200 300m

Circulation

Pedestrian and Cycleway Heirarchy Plan

LEGEND

- Site Boundary
- Moreton Bay Cycleway
Off-Road Shared Path (3m wide min.)
- Moreton Bay Cycleway
On-Road Bike Lanes as per LGIP
- Major Pedestrian paths - Civic Promenade - minimum 5m wide
- Major Pedestrian paths - Full width pavement - minimum 4.25m
- Major Pedestrian paths - minimum 3m wide
- Major Pedestrian paths - minimum 2.5m wide
- Minor Pedestrian paths - minimum 2.5m wide
- Minor Pedestrian paths - minimum 2.0m wide
- Minor Pedestrian paths - minimum 1.5m wide

1:4000 - A3 0 20 40 80 200 300m

Masterplan

Plan

LEGEND

A	Sel Outridge Park
B	Public Jetty
C	Vehicle Ferry Barge
D	Neville Stafford Park
E	Passenger Ferry Terminal (Redland Bay Marina)
F	Coast Guard
G	Boat ramp - emergency access only
H	Water Police
I	Public boat jetty
J	Tom's Park
K	Pedestrian connection through apartments
L	High Density Residential
M	Medium Density Residential
N	Storage Facility
O	Civic Prominade
P	Mixed Use Plaza (Town Centre)
Q	Boat Ramp
R	Retail/commercial
S	Residential/Retail
T	Pedestrian & Cycle connection
U	Vehicle and Boat carpark (servicing passenger ferry & boat ramp)

1:4000 - A3
0 20 40 80 200 300m

Sel Outridge Park and Surrounds

Design Intent

The parklands to the north and their surrounds encompasses the existing Sel Outridge Park, the existing skatepark and a new pocket park north of the Barge entry zone.

The existing character of these parkland areas is distinguished by:

+ Views to the bay;
+ Curvilinear pathways that hug the shoreline;
+ Wide open expanses of lawn and large feature/landmark trees;
+ Coastal and riparian vegetation;
+ Places for residents and visitors to barbecue and picnic.

The masterplan endeavours to build upon the existing qualities through:

+ Formalising an entry arrival plaza to Sel Outridge park;
+ Creating an architecturally designed equitable access, multipurpose amentity block located out of the flood zone;
+ Revegetation in key locations;
+ Enhancing views to the bay and bay islands;
+ Providing opportunities for visitors to access the water for water based play;
+ Improving existing playgrounds and making provision for All Abilities play opportunities;
+ Providing for small kickabout spaces for younger children and exercise zones for Seniors;
+ Creating a high intensity fitness work out zone that allows for basketball, netball and boot camp activities; and
+ Widening pedestrian and cyle pathways to improve ease of movement throughout the site and reinforce the importance of connectivity to the foreshore.

The following assets are proposed for the parklands:

+ All Abilities play spaces (directly North of the PDA zone);
+ Physical activity zones incl. AFL overflow oval, Senior fitness zone, Bootcamp zones, ball courts;
+ A variety of circulation spaces including pedestrian and cycleways;
+ Kickabout spaces, skate/ramp park & amphitheatre;
+ Amenities building with architectural form that promotes a distinctive 'foreshore' character;
+ Beach access zones;
+ Pedestrian bridge connections across creek;
+ Picnic facilities including shelters, barbecues, bins, water points and seating;
+ Carparking infrastructure; and
+ Flexible space that allows for pop up commercial facilities.

Sel Outridge Park and Surrounds

Plan

LEGEND

① Senior exercise zone - fenced and signed. Can be used in a 'senior safe' way by residents with or without trainers/ physiotherapists

② Parking including shade trees and amenity planting

③ Foreshore beach paddling zone/sand play and kayak/canoe launch area

④ All abilities playground, including seating, shade trees & fencing. This zone to be designed for maximum inclusion

⑤ Arrival/Entry Plaza - flexible design allows for uses including pop up shop, markets and community run events. Includes: water points, bins, seats, signage

⑥ Foreshore entry open space - connection to water, swimming/paddling zone, picnic facilities

⑦ Amphitheatre zone incl. picnic facilities, embankment playground & mixed ages play ground

⑧ Multi-purpose zone uses include: playground, seating, shade, market spill out zone

⑨ Informal seating mound

⑩ AFL overflow oval incl. lighting and goal posts and proprietary seating surrounding the oval

⑪ New fully accessible amenities facility incl. parents room, showers and toilets

⑫ Picnic including including: lawns, picnic facilities, seating, shade and capacity for marquees.

⑬ Sports zone incl. netball court, basketball half court, bootcamp zone, yoga and tai chi zone

⑭ Relocated cricket nets

⑮ Pedestrian connection

⑯ Riparian corridor - additional restoration work

⑰ Nature trail - low grade bush trail for walking and environmental activities

⑱ New pedestrian bridge - minimum 5m wide bridge (boardwalk style) to allow for increased Moreton Bay Cycleway traffic. Existing vegetation to be reduced around the site of the bridge to open views from north to south

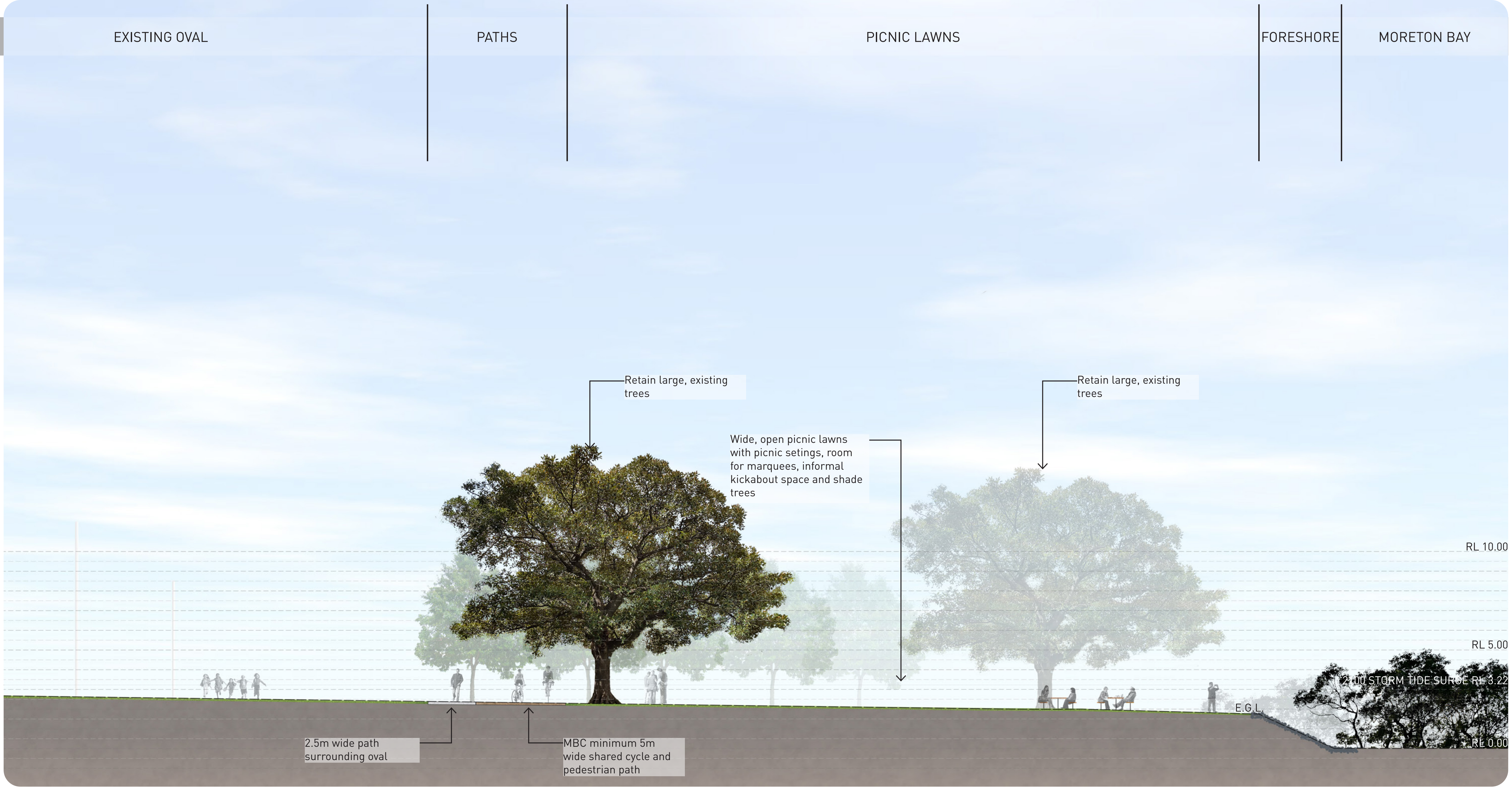
⑲ Moreton Bay Cycleway (MBC) shared pedestrian and cycle path

⬚ Not part of this application
The concepts shown to the north of the PDA zone are coneept only. Co-ordination with Council has begun in this area to ensure a co-hesive design approach.

1:1000 - A3 0 5 10 20 50 75m

Sel Outridge Park and Surrounds

Section A-A: Sel Outridge Park



Retain large, existing trees

Wide, open picnic lawns with picnic setings, room for marquees, informal kickabout space and shade trees

Retain large, existing trees

2.5m wide path surrounding oval

MBC minimum 5m wide shared cycle and pedestrian path

1:200 - A3 0 1 2 4 10 15m

Neville Stafford Park and Foreshore

Design Intent

The parklands encompass the existing Neville Stafford Park, the Civic promenade north and east of the proposed apartment buildings reaching to the Redlands Marina.

The existing character of these parkland areas is distinguished by:

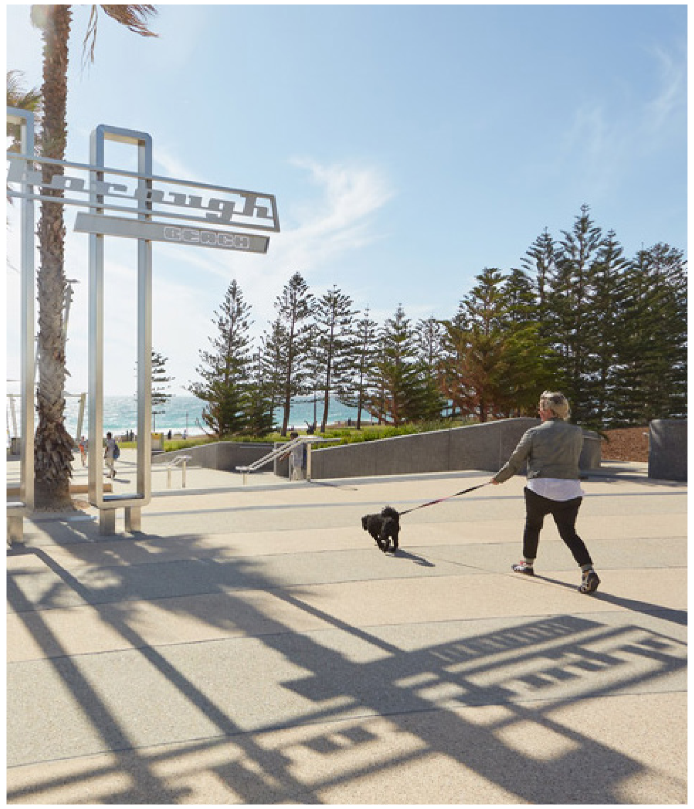
- Filtered and wide open panoramic views to the bay;
- Curvilinear pathways that transit across and through the parklands;
- Kickabout spaces;
- Coastal and Riparian vegetation;
- Monument - civic space; and
- Places for residents and visitors to barbecue and picnic.

The masterplan endeavours to build upon the existing qualities by:

- Celebrating and enhancing a strong linear connection along the foreshore and integration with the mixed use development;
- The addition of 2 x linear parks that closely hug the shoreline/revetment wall;
- Enhancing views to the bay and bay islands by opening up vistas and creating opportunities for small decks/pods that protrude beyond the existing revetment walls;
- Increasing active transport links through the addition of new or extended wide pedestrian and cyle pathways; and
- Providing breakout opportunities for visitors to access the water easily and to enjoy water based recreation.

The following assets are proposed for the Linear Parklands:

- Full width pathway along the entire foreshore;
- An urban civic forehore and Town Centre that focuses on:
  - An activated edge along the mixed use development, allowing opportunities for spill-out activities and passive surveillance;
  - Increased circulation and gathering spaces for pedestrians
  - High amenity pavements, seating, shelters and decking pods; and a
  - Feature sculpture/art intervention.
- A foreshore parkland that focuses on:
  - Uninteruppted panoramic views to the ocean;
  - Decking pods for seating and viewing and terraced lawns that drop down to the water;
  - A plaza and path that draw visitors from the retail centre to the water; and
  - Picnic facilities including shelters, barbecues, bins, water points and seating.
- Upgrade to Neville Stafford Park that includes;
  - Widening of new pathways and re-alignment of pathways to accommodate shared cycleways;
  - Kickabout spaces and new playground; and
  - Upgraded amenity block.



Neville Stafford Park and Foreshore

Plan

LEGEND

① Combined shared path road crossing incl. road threshold treatment to increase safety of cyclists and pedestrians moving north-south

② New amenities block and service zone co-located near existing carpark and barge entry/exit

③ New playground and toddler zone incl. new shelters

④ Upgraded shared path including Moreton Bay Cycleway

⑤ Terraced lawn access to pebble beach

⑥ Plaza extension path through parkland terminating in steps to water

⑦ Large deck and seats - extending beyond revetment wall

⑧ Priority crossing- combines Moreton Bay cycleway and NEW ROAD pedestrian link

⑨ Plaza with wide pedestrian connections from New Road to cafes and retail to the north of apartment buildings

⑩ Pod deck - extending beyond revetment wall incl. railings and telescopes

⑪ Civic foreshore promenade incl. high amenity pavements, feature sculpture, garden beds, pockets of lawn, seats, water points, signage and picnic facilities

⑫ Steps down to existing beach

⑬ Mixed Use Plaza (Town Centre) incl. gathering spaces, night/day time uses, space enough for markets, concerts, movies, outdoor dining & people watching, strong connection to mixed use node, shade, structural elements, public art, water features, bio-filtration, lighting, & seating.

⑭ Ferry Terminal (Redland Bay Marina)

⑮ Existing memorial

⑯ Retail precint

⑰ Multistorey carpark and open air carpark

⑱ Main Street - full width pavements inclucing shade trees and high amenity garden beds, bus stops, taxi and ride-share, car-share, kiss n ride and disability parking, street lighting, street furniture, flexible spaces for retail uses.

⑲ Covered connection - structural element (east-west) through carpark to Promenade and Ferry Terminal

⑳ Covered connection (north-south) through carpark from Southern New Road to Northern New Road (through supermarket frontage).

㉑ Pocket park - forming open space connection to Banana Street

㉒ MBC & Shared path

㉓ Pedestrian crossings/connections

1:1000 - A3
0 5 10 20 50 75m

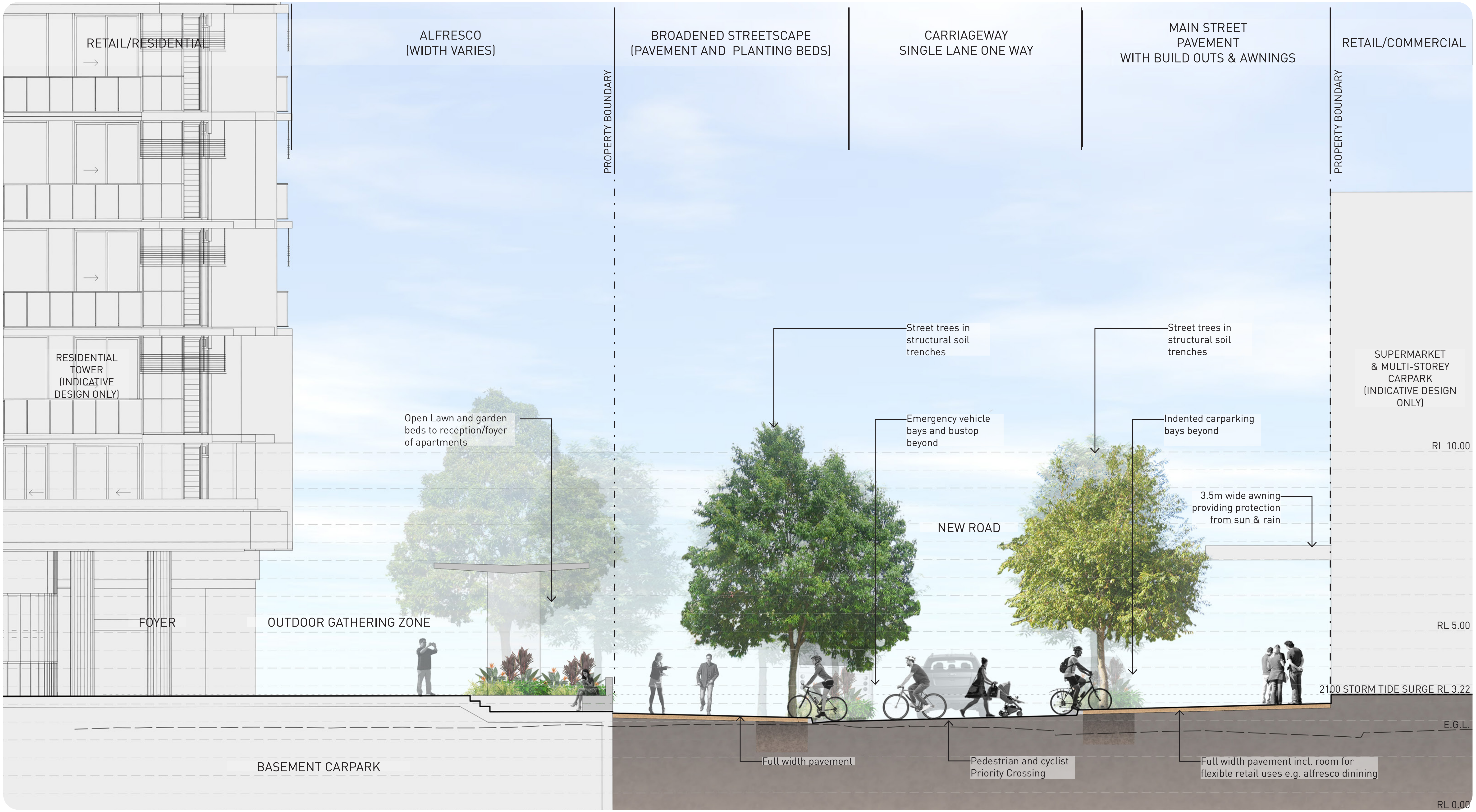
Neville Stafford Park and Foreshore

Section B-B: Neville Stafford Park

1:100 - A3 0 0.5 1 2 5 7.5m

Neville Stafford Park and Foreshore

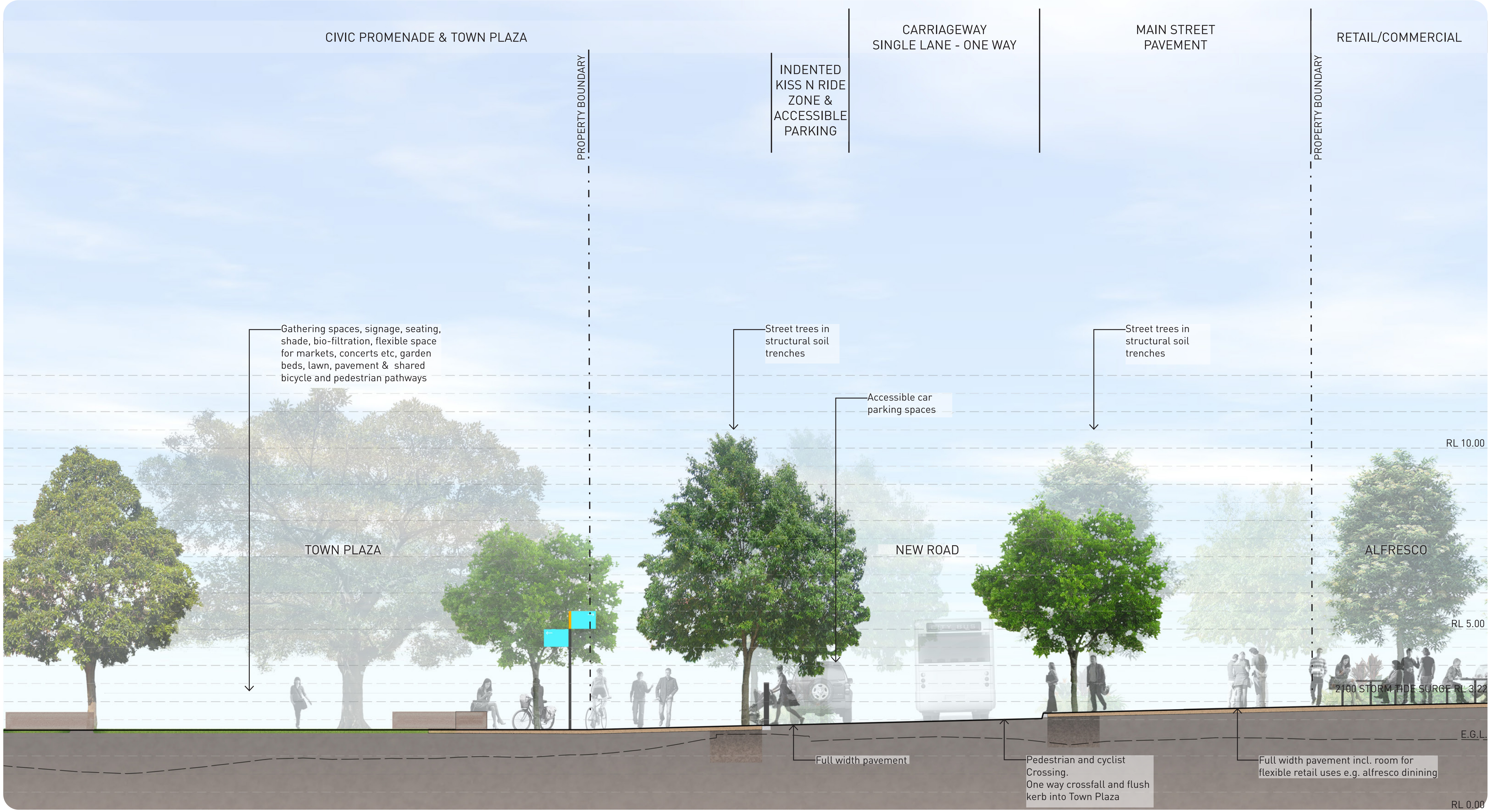
Section C-C: New Road Main Street



1:100 - A3 0 0.5 1 2 5 7.5m

Neville Stafford Park and Foreshore

Section D-D: New Road and Civic Promenade



Gathering spaces, signage, seating, shade, bio-filtration, flexible space for markets, concerts etc, garden beds, lawn, pavement & shared bicycle and pedestrian pathways

Street trees in structural soil trenches

Accessible car parking spaces

Street trees in structural soil trenches

Full width pavement

Pedestrian and cyclist Crossing.
One way crossfall and flush kerb into Town Plaza

Full width pavement incl. room for flexible retail uses e.g. alfresco dinining

1:100 - A3 0 0.5 1 2 5 7.5m

Weinam Creek Foreshore

Design Intent

The Weinam Creek Foreshore encompass the existing zone around the Ferry terminal and the new creek foreshore parks west of the Ferry terminal.

Currently there is very little parkland in this zone along Weinam creek.

The existing character of the small area of open space is distinguised by:

+ Open views to the bay and the creek;
+ Curvilinar pathways that transit across and through the parklands;
+ Views to marine activities;
+ Places for residents and visitors to walk and sit.

The masterplan endeavours to build upon the existing qualities through:

+ Providing a strong linear consolidated 'lower order and intimate' connection alonge the foreshore of the creek and at the roads edge; and
+ Increasing active transport links that connect to the new pedestrian bridge crossing Weinam Creek.

The following assets are proposed for the Southern Parklands:

+ Pathways along the entire foreshore and at the road level;
+ Bespoke architectural form amenity facilities;
+ Small open plaza with decking pod protruding into Weinam creek; and
+ Picnic facilities incl. shelters, BBQs, bins, water points and seating that reflect the character of Weinam foreshore.

Tom's Park and Rustler Reserve'D'

Tom's Park is an existing linear parkland that faces Moreton Bay.

The existing character of the park is distinguised by:

+ Kayak and High tide boat ramp;
+ Scar Tree;
+ Open and filtered views to the bay and the creek;
+ Clusters of native and coastal vegetation;
+ Views to marine activities; and
+ Gentle slopes to the water.

The masterplan endeavours to build upon the existing qualities through:

+ Formalising 'lower order' pedestrian connections; and
+ Providing place for visitors and residents to gather and/or rest.

The following assets are proposed for the Southern Parklands:

+ Pathways along the entire foreshore (subject to discussions with residents); and
+ Picnic facilities incl. shelters, barbeques, bins, water points and seating.

Weinam Creek Foreshore

Plan

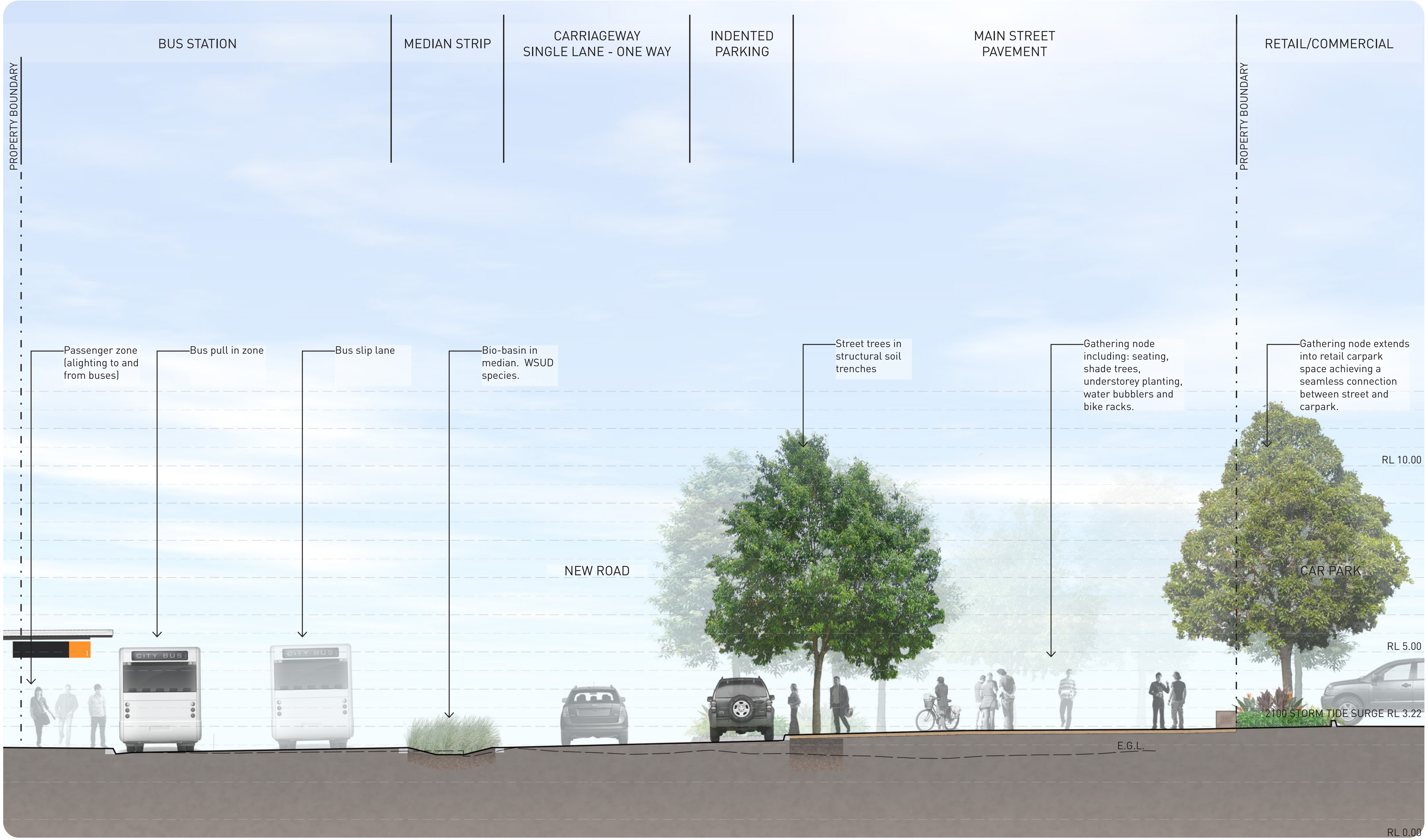
LEGEND

- ① Ferry Terminal
- ② Storage facility
- ③ Linear creek parkland incl. seating, shade trees, picnic facilities & water points
- ④ Coast Guard
- ⑤ Boat ramp - emergency access only
- ⑥ Linear creek parkland incl. seating & shade trees
- ⑦ Priority crossing- combines Moreteon Bay cycleway and NEW ROAD pedestrian link
- ⑧ Pedestrian and cyclist node incl. crossing point to Banana street, lawn, water point, seating and pod deck to water
- ⑨ Amenities block and service zone
- ⑩ Pedestrian bridge to boat/car parking
- ⑪ Boat ramp
- ⑫ Covered connection (north-south) through carpark from Southern New Road to Northern New Road (through supermarket frontage).
- ⑬ MBC and Shared path
- ⑭ Vehicle connection to jetty (Police access only)
- ⑮ Bus Mealing Station
- ⑯ Retail/Commercial
- ⑰ Shelters, seating, shade trees
- ⑱ Covered connection - structural element (east-west) through carpark to Promenade and Ferry Terminal
- ⑱ Full width concrete verge (4.25m) with gardens in buildouts, street trees and connections to Mixed Use Node, Supermarket, Storage Facility and Civic Promenade

1:1000 - A3 0 5 10 20 50 75m

Neville Stafford Park and Foreshore

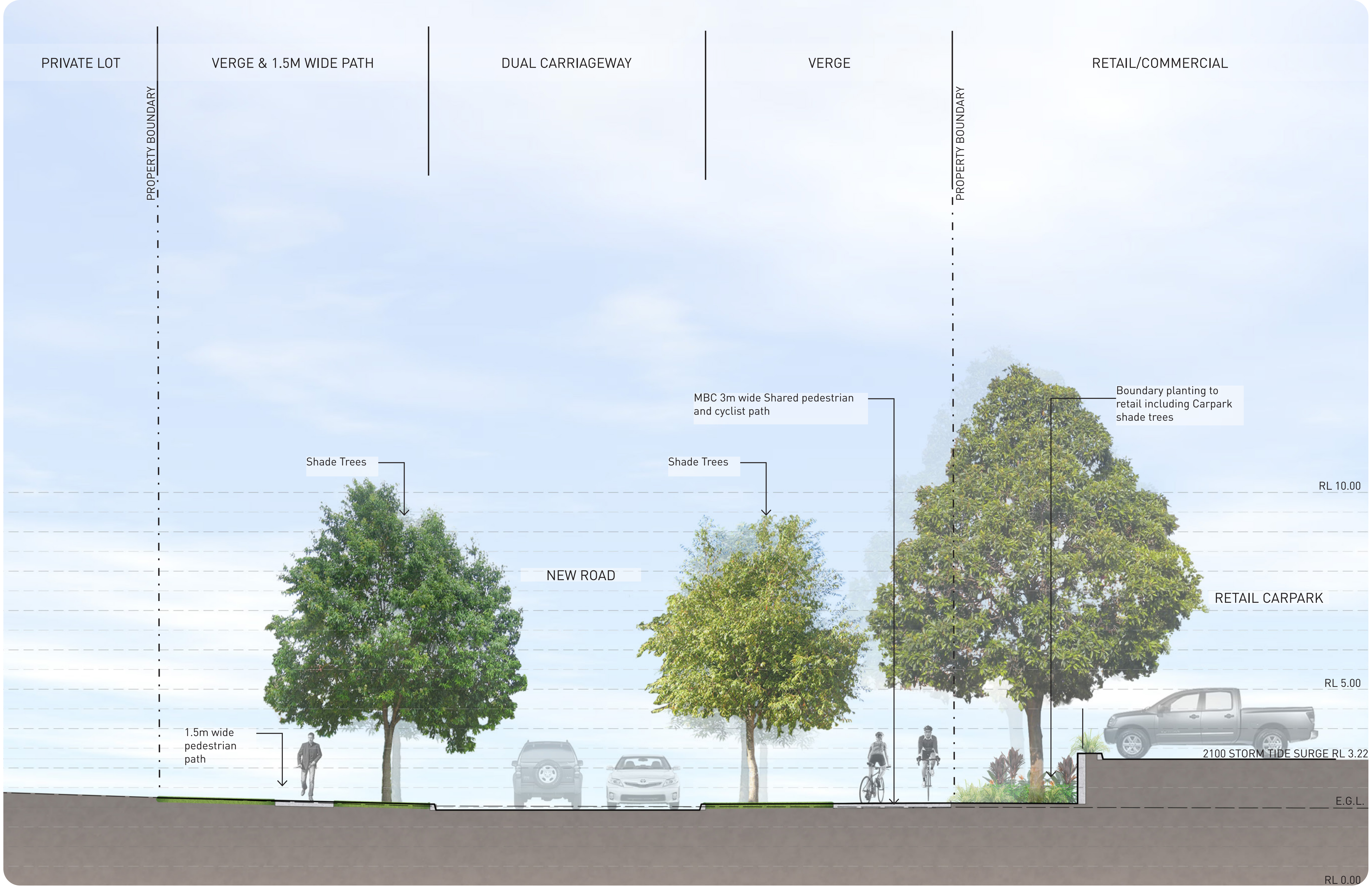
Section E-E: New Road Marina Terminal



1:100 - A3

Weinam Creek Foreshore

Section F-F: Banana Street South



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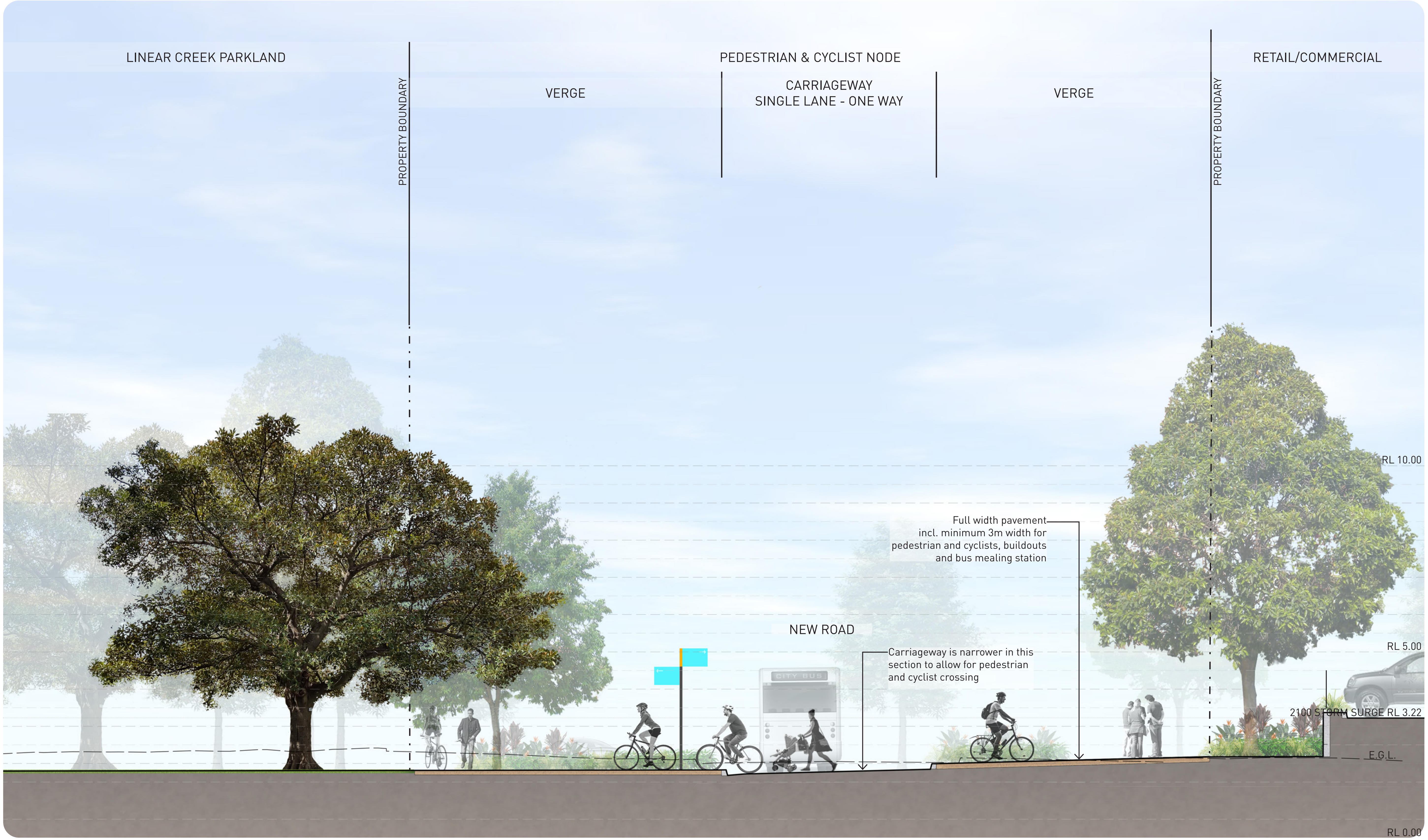
Weinam Creek Foreshore

Section G-G: New Road Southern End



Full width pavement incl. minimum 3m width for pedestrian and cyclists, buildouts and bus mealing station

Carriageway is narrower in this section to allow for pedestrian and cyclist crossing

1:100 - A3 0 0.5 1 2 5 7.5m

Tom's Park, Rustler Reserve Parks & Restoration Zone

Plan

LEGEND

① Boat ramp
② Restoration zone
③ Car and boat parking
④ Moreton Bay Cycleway
⑤ Existing amenities block, small boat ramp & CTV parking
⑥ Pedestrian path (proposed, consultation with local residents to be considered)
⑦ Shelters, seating, shade trees
⑧ Connection to the Moreton Bay Cycleway
⑨ Scar Tree
⑩ Pedestrian bridge to boat/car parking

1:2000 - A3 0 10 20 40 100 150m

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