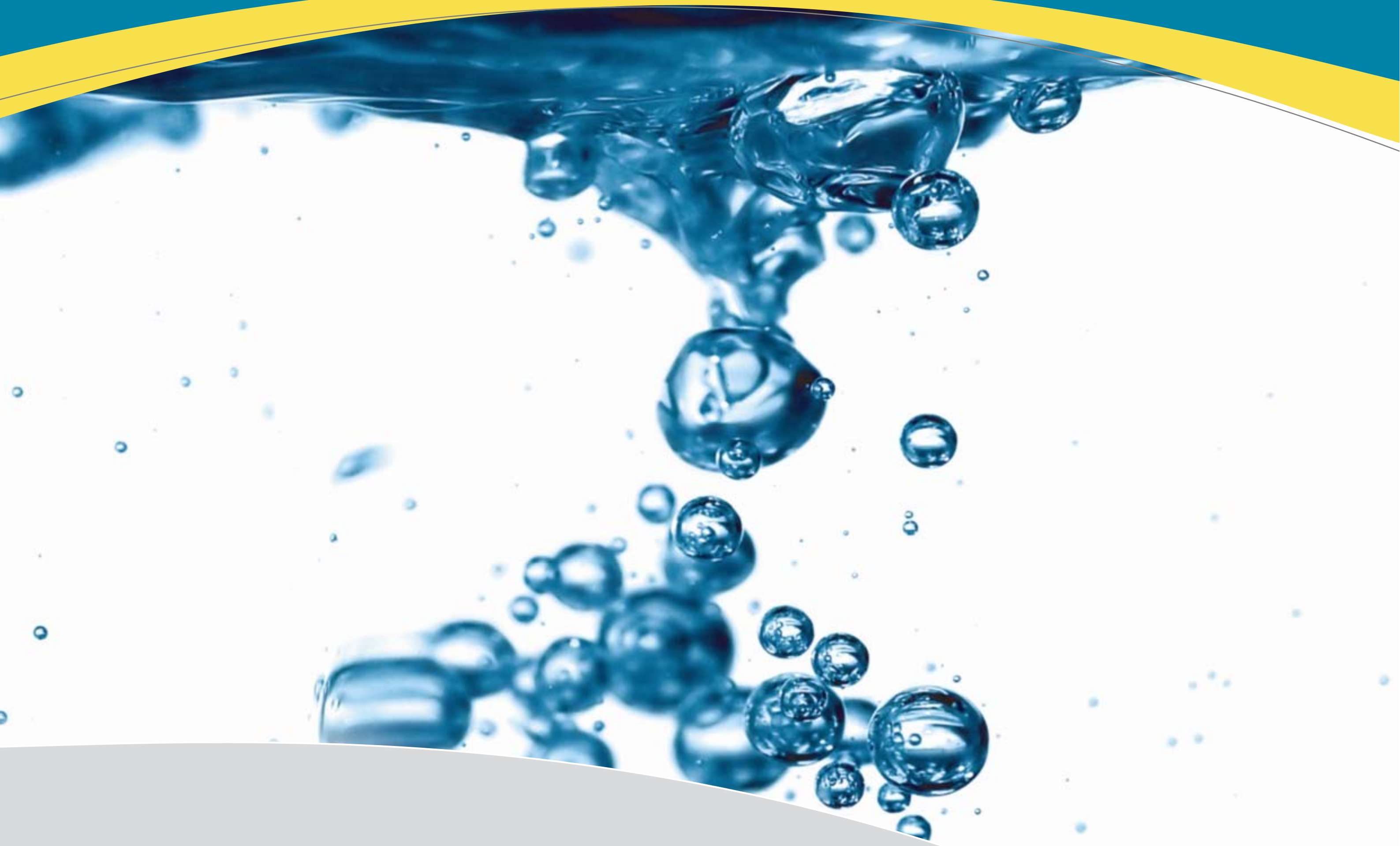

FINAL REPORT

Yarrabilba Precinct One Development Water Supply and Wastewater Network Planning Report

Prepared for Delfin Lend Lease

24 June 2011

Report

Yarrabilba Precinct One Development Water Supply and Wastewater Network Planning Report

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24/06/2011

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1	01/03/11	Draft to client	H. Lin	S. O'Brien	S. O'Brien	L. Lees
1	01/03/11	Final	H. Lin	S. O'Brien	S. O'Brien	L. Lees
2	22/06/11	Revised draft to client	H. Lin	S. O'Brien	S. O'Brien	S. Gillespie
2	24/06/11	Revised final	H. Lin	S. O'Brien	S. O'Brien	S. Gillespie

Delfin Lend Lease

Yarrabilba Precinct One Development Water Supply and Wastewater Network Planning Report

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APPENDICES

1 Introduction

1.1 Background

Delfin Lend Lease (DLL) engaged MWH to undertake the assessment of water and wastewater infrastructure for the Yarrabilba development to be sited south of the Logan Village. The extent of this development covers the full Yarrabilba site which is currently proposed for urban development via the Urban Land Development Authority.

MWH has undertaken previous conceptual planning works for the proposed development in 2004 and in 2010. For this revision of the master planning, the layouts of the future water supply and wastewater networks are proposed based on Logan Water Alliance Desired Standards of Service (LWA DSOS) and other strategies/assumptions provided by Logan Alliance. Information provided by Allconnex relating to long term strategy and capacity of existing assets has also been taken into account in this revision.

1.2 Scope of Work

The scope of this study is summarised below:

- Determine the extent and timing of infrastructure required for water supply and wastewater for Yarrabilba's ultimate development;
- Determine the requirements for providing water/wastewater services and the reuse of wastewater effluent to Precinct 1 of the development.

It is noted that the following assumptions and exclusions are applied in this study:

- Potable water is assumed to be sourced from the Travis Road reservoir as advised by Allconnex Water. Bulk supply issues will be managed by Allconnex Water;
- Costs of works upstream of the Travis Road reservoir are excluded;
- Wastewater is assumed to be treated at a temporary facility in the centre of the development before 2016. Allconnex advises that sewage from the development will be pumped to the proposed Cedar Grove wastewater treatment plant (WWTP) in the medium term dependent on an economic assessment of pumping versus local treatment. At this stage we have assumed that the transfer will occur at 2016;
- Treated effluent from the temporary facility will be used to irrigate the undeveloped land to the south of Precinct 1 boundary. Allconnex advises that the treated effluent from the future Cedar Grove WWTP will be used in a regional recycled water scheme.

2 Population Projection

2.1 Land Use Plan

The 'Yarrabilba Proposed Land Use Areas Plan' dated 25 August 2010 was provided by DLL for use in this study. This Land Use Plan outlines the extent of future commercial, industrial, open space and varying densities of residential development within the studied area. A spreadsheet named '100915-Yield-by-year.xlsx' provided by DLL tabulated the projected number of dwellings by year for each land use polygon. The two supplied documents formed the basis of long term population projection assessment. A Staging Plan, showing the likely timing of development for each land use polygon was also developed. Both the Land Use Plan and Staging Plan are included in Appendix A.

2.2 Precinct 1 Development Content

The content of Precinct 1 development was adopted from the provided the plan 'Precinct One – Reconfiguration of a Lot' dated 31 January 2011 (refer to Appendix B). This plan shows the proposed subdivisions, lot types, street layout and the areas of first three year development. The number of residential lots and the area of non-residential parcels were then counted. The Precinct 1 development covers 77% area of residential polygon 'R01b' in the Land Use Plan, and so the population projection of polygon 'R01b' was amended accordingly.

DLL advised that the first three years development is only within the Precinct 1 boundary. Hence the schedule of lots outside the Precinct 1 boundary was deferred when they were proposed to be developed in the first three years.

2.3 Population Assessment

To determine the total Equivalent Persons (EP) for the Yarrabilba development, separate approaches were applied for the residential and non-residential land use categories.

2.3.1 Residential Equivalent Population

The residential EP was determined by multiplying the occupancy rates with the projection for the number of dwellings to be developed within the land use polygons in each successive year of the development up to 28 years. The number of residential dwellings within the Precinct 1 development was counted from the provided plan. These rates were adopted or derived from the Planning Scheme Policy of Logan or Gold Coast City Councils. The occupation rates were approved by Allconnex Water and are summarised in Table 2-1. The total residential population was estimated to be 44,382 EP at ultimate development.

Table 2-1 : Occupation Rates for Future Residential Development

Product	Occupancy Rate (EP/dwelling)	Category
Sub-urban residential lot	3	Residential Detached
Urban lot	2	Residential Attached
Apartment at the major activities centre	2	Residential Attached
Retirement village	2	Residential Attached

2.3.2 Non-Residential Equivalent Population

To determine the non-residential EP, the development densities adopted for the Planning Scheme Policy of Logan or Gold Coast City Councils. DLL also provided the projection for the areas to be developed within the land use polygons in each successive year of the development up to 28 years. The areas of non-residential lots within in the Precinct 1 development were calculated based on the provided plan. The total non-residential water and wastewater EP of the ultimate Yarrabilba development were then calculated as 7,208 and 8,137 EP respectively. The adopted equivalent population densities are summarised in Table 2-2.

Table 2-2 : Adopted EP Density for Future Non-Residential Development

Land Use	Adopted Density (Water EP/ha)	Adopted Density (Wastewater EP/ha)
Village - Mixed Use Development	30	37
Local Retail	30	37
Education / Child Care	45	45
Mixed Industry and Business Area	30	37

2.3.3 Population Summary

Combining the residential and non-residential EP provides a total ultimate water EP for the Yarrabilba development of 51,591 EP. Equivalent populations at key development intervals are provided in Table 2-3.

Table 2-3 : Yarrabilba Population Projection

Precinct 1 Water EP at Development Year				
Year 1	Year 2	Year 3	Year 4	Year 5
133	416	628	1,549	2,165
Precinct 1 Wastewater EP at Development Year				
Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
136	430	642	1,589	2,233

Projected Water EP at Development Year				
Year 10	Year 15	Year 20	Year 25	Year 28
15,000	25,432	37,548	47,316	51,591
Projected Wastewater EP at Development Year				
Year 10	**Year 15**	**Year 20**	**Year 25**	**Year 28**
15,316	26,022	38,332	48,244	52,519

3 Desired Standards of Service

3.1 Water Supply Network

3.1.1 Unit Demand

In accordance with the report *Review of Desired Standards of Service* (Logan Water Alliance 2010, LWA DSOS), an average day potable water demand (AD) of 230 L/EP/day was adopted for various land uses in this study. The unaccounted for water allowance is 30 L/EP/day.

3.1.2 Peaking Factors

The water supply peaking factors adopted for this study are summarised in Table 3-1.

Table 3-1 : Potable Water Demand Peaking Factors

Peaking Factor	Residential Detached	Residential Attached	Commercial / Education	Industry
Maximum Day (MD)	1.7	1.6	1.3	1.3
Maximum Hour (MH)	3.8	3.1	2.0	1.7
Mean Day Maximum Month (MDMM)	1.4	1.3	1.2	1.2

3.1.3 Infrastructure Sizing Criteria and Modelling Parameters

The following standards and modelling parameters were adopted for sizing the water supply infrastructure:

- Hazen Williams pipeline roughness:
  - C = 100 when the pipe diameter ≤ 150 mm;
  - C = 110 when the pipe diameter > 150 mm and < 300 mm;
  - C = 120 when the pipe diameter ≥ 300 mm and ≤ 600 mm; and
  - C = 125 when the pipe diameter > 600 mm;
- Maximum velocity of pipeline at PH: 2.5 m/s;
- Minimum service pressure at PH: 22 m;
- Reservoir size: 3 x (MD-MDMM) + 4 hours of MDMM:
- Pump stations size: MDMM over 20 hours
- Reticulation was sized for PH flows; and
- Bulk supply infrastructure, such as pump stations and trunk water mains serving the reservoirs, were sized for catering the MDMM demand.

3.2 Wastewater Network

3.2.1 Unit Loading and Peaking Factors

The average dry weather flow (ADWF) of 200 L/EP/day is adopted in this study in accordance with LWA DSOS. As ‘Reduced Infiltration Gravity Sewers’ (RIGS) will be utilised in the proposed development, the peak weather flow (PWWF) was calculated based on 1,000 L/EP/day.

3.2.2 Infrastructure Sizing Criteria

The following standards were extracted from LWA DSOS and adopted for sizing the wastewater infrastructure:

- Manning pipeline roughness: 0.013;
- Hazen Williams C value for rising main:

- C = 110 when the pipe diameter ≤ 300 mm;
- C = 130 when the pipe diameter > 300 mm;

- Design capacity of gravity sewer: 75 % of pipe depth at PWWF;
- Pipe depth of gravity sewer: at least 1 m cover and less than 4 m;
- Minimum grades:
  - 150 mm diameter : 1 in 150;
  - 225 mm diameter : 1 in 290;
  - 300 mm diameter : 1 in 400;
  - 375 mm diameter : 1 in 500;
  - 450 mm diameter : 1 in 600;
  - 525 mm diameter : 1 in 700;
  - 600 mm diameter : 1 in 850;
  - 675 mm diameter : 1 in 925;
  - 750 mm diameter : 1 in 1000;
- Design capacity of rising main and pumping station: PWWF;
- Maximum velocity of rising main: 2.5 m/s;
- Emergency storage volume at pumping station: 4 hours of ADWF (local gravity catchment only);
- Maximum number of pump starts
  - 12 per hour for pump motor ≤ 15 kW;
  - 8 per hour for pump motor between 15 and 200 kW.
  - 5 per hour for pump motor > 200 kW;

4 Network Layouts

4.1 Water Supply Network

4.1.1 Potable Water Demands

Projected potable water demands were calculated for each development polygon in the Yarrabilba Land Use Plan using the populations developed in Section 2 and the LWA DSOS. In accordance with the DSOS, trunk mains supplying a reservoir are to be designed to transfer MDMM demand over a 20 hour period. As the trunk network within Yarrabilba is a gravity network distributing water from the Travis Road reservoir, these mains are to be designed for MH demand.

A summary of the projected water demands and storage required for the Yarrabilba development is shown in Table 4-1.

Table 4-1 : Yarrabilba Development Potable Water Demand

Precinct 1 Demand	Development Year	
	3	5
MD Demand (ML/d)	0.4	0.9
MDMM Demand (ML/d)	0.3	0.8
4 hrs MDMM Demand (kL)	55.8	125.2
Storage Required (ML)	0.2	0.5

Yarrabilba Demand	Development Year				
	10	15	20	25	28
MD Demand (ML/d)	6.3	10.7	15.8	19.9	21.8
MDMM Demand (ML/d)	5.3	9.0	13.2	16.6	18.1
4 hrs MDMM Demand (ML)	0.9	1.5	2.2	2.8	3.0
Storage Required (ML)	4.0	6.8	10.0	12.7	14.0

4.1.2 Servicing Strategy

Allconnex advised that the proposed Yarrabilba development will form part of the Travis Road reservoir supply zone. Water will continue to be supplied to the Travis Road reservoir from the South Maclean WTP clear water reservoir.

The bottom water level of the existing 3 ML Travis Road reservoir is 104 m AHD. Allconnex advised that the minimum operation level (MOL) is 105 m AHD and that the remaining capacity is sufficient to serve the 2016 population including the 500 lots from the Yarrabilba Precinct 1 development.

New reservoir storage would be required to serve the development outside the Yarrabilba Precinct 1 boundary. Allconnex indicated that the two MOLs (95 m AHD and 105 m AHD) should be investigated for the future Travis Road reservoir. The final decision was not available at the time of writing this report. Hence this report reviews the areas that will not meet the DSOS requirement of 22 m of residual pressure at peak hour.

Allconnex also advised that the Yarrabilba Precinct 1 development can be served by the recently constructed 300 mm diameter water main along Camp Cable Road and Waterford Tamborine Road. A pressure reduce valve (PRV) is installed downstream of the proposed Yarrabilba connection and intended to protect downstream infrastructure in Logan Village. It is acknowledged that this 300 mm diameter main is sized for serving the population growth in Logan Village, not for the proposed development. Hence the

300 mm diameter main is assumed to be unavailable after the completion of the Precinct 1 development. Connections to the 300 mm diameter main would be removed, and dedicated trunk water main would be constructed from the reservoir to the Yarrabilba development.

4.1.3 Distribution Network

A trunk distribution network layout was developed for the Yarrabilba urban footprint using the proposed road layout and demand projections developed for each development polygon. The proposed potable water trunk network is shown in Figure 4-1.

Infrastructure was sized using a H_2OMap model of the proposed network, using a static simulation at maximum hour demand. Pipe sizes were selected to allow all areas of the development to receive a minimum of 22 m pressure during maximum hour demand. Assuming the MOL of 105 m AHD in the Travis Road reservoir, the minimum pressure expected to be experienced in the proposed network would be approximately 18 m at the maximum ground elevation in the development at 71 m AHD on the southern side. A local booster pump station is proposed to serve the area with elevations higher than 66 m AHD.

When the MOL of Travis Road reservoir is reduced to 95 m AHD, the servicing boundary of the booster pump station is extended to the 56 m AHD contour over an extensive area in the south of the development. It is noted further investigation is necessary to develop an optimised servicing option for the highlighted high level areas if the MOL of 95 m AHD is adopted by Allconnex. The option assessment will consider the capital costs, operation and maintenance costs, energy consumption and security of supply.

Infrastructure outside of the ultimate Yarrabilba development including the Travis Road reservoir, Camp Cable Road trunk main and pumps at South McLean WTP are not included in this assessment. Allconnex can supply this information based on work being undertaken by the Logan Water Alliance.

The Precinct 1 reticulation performance, including the fire fighting residual pressure assessment was undertaken by adopting the following conditions and criteria:

- MOL of existing Travis Road reservoir is at 105 m AHD;
- Top water level (TWL) of existing Travis Road reservoir is at 110 m AHD;
- No PRV is installed between the reservoir and Precinct 1;
- Existing 300 mm diameter main to Logan Village is utilised;
- Residential fire flow requires 15 L/s;
- Commercial and industrial fire flow requires 30 L/s; and
- Minimum residual pressure is 12 m at property boundary.

The proposed water supply reticulation within the Precinct 1 development meets the requirements of minimum operating pressure at MH, maximum operation pressure and fire fighting residual pressure. The nodal pressures at lower elevations (< 53 m AHD) are higher than the 55 m target pressure. The total number of lots within the Precinct 1 development is around 500 lots and less than ideal size (2,000 to 5,000 lots) for implementation of a district metering area (DMA). The proposed 600 mm diameter trunk main also runs through the middle of the Precinct 1 development resulting in less opportunity to implement DMAs. However this will be further assessed as the development proceeds.

The contours of Yarrabilba development are ranged between 30 m and 75 m AHD, and the MOL of future Travis Road reservoir is either 105 m AHD or 95 m AHD. Installing a PRV on the trunk water mains may cause pressure deficiencies in the areas with higher elevations. Hence it is recommended to create up to 4 DMAs in the areas with low elevations. Boundary valves would be installed on the first tier of branch mains off the trunk main loops.

The extent of the trunk water supply network for the ultimate Yarrabilba development and for Precinct 1 are shown in Figure 4-1. The network analysis outcomes are provided in Appendix C.

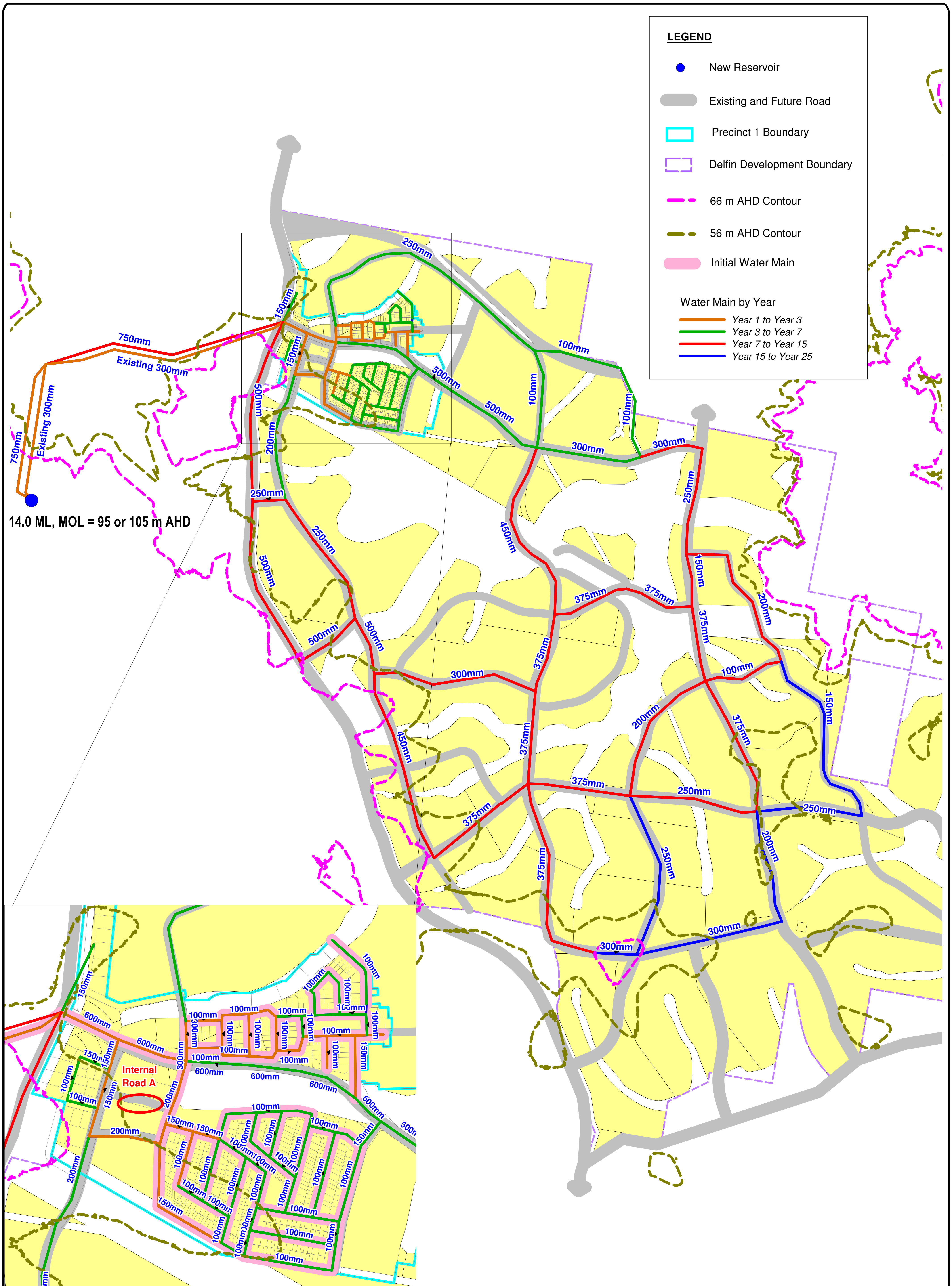

Figure 4-1
Ultimate Yarrabilba
Water Supply Network (Rev B)

MWH
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DATUM: MGA Zone 56 (GDA 94)

PROJECT No: A1251203

FILE REFERENCE: P:\Projects\A1251200 - Delfin LL Yarrabillba Master Plan \01 MWH Docs\02 Drawings - GIS \Yarrabilba Potable Water Networks March 2011\

SCALE: Not to Scale

Delfin Lend Lease
Level 3, 35 Boundary St South Brisbane, PO Box 3602, South Brisbane, QLD. 4101.

DATE: 22/03/2011

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4.2 Wastewater Network

4.2.1 Wastewater Design Flows

Projected wastewater design flows were calculated for each development parcel in the Yarrabilba Land Use Plan, using the populations developed in Section 2 in conjunction with the adopted DSOS. These loadings are expressed in terms of Average Dry Weather Flow (ADWF) and Peak Wet Weather Flow (PWWF). A summary of the design flows for the ultimate Yarrabilba development is given in Table 4-2.

Table 4-2 : Yarrabilba Development Sewage Design Flows

Design Flow	Development Year						
	3 - 4	5	10	15	20	25	28
ADWF (ML/d)	0.3	0.4	3.1	5.2	7.7	9.6	10.5
ADWF (L/s)	3.5	5.2	35.4	60.2	88.7	111.7	121.6
PWWF (L/s)	17.4	25.8	177.3	301.2	443.7	558.4	607.9

4.2.2 Servicing Strategy

The servicing strategy adopted by this study aligns with that proposed in the report *Part A: Logan South Wastewater Strategy* (Logan Water Alliance, March 2011). The strategy has been developed based on wastewater from the Yarrabilba development being collected and pumped to a regional WWTP located at Cedar Grove. The initial stage of the Cedar Grove WWTP is proposed for construction in 2016.

The initial Yarrabilba (Precinct 1) development is scheduled to commence by 2012. It is proposed that wastewater from the development will be treated on site at a temporary WWTP, until the first stage of the ultimate WWTP is constructed in 2016. The notional location of the temporary treatment plant is shown in Figure 4-2.

It is proposed that the temporary WWTP will be designed to treat sewage to a standard sufficient for use in open space irrigation. This is considered a requirement, as early discussion with Department of Environment and Resource Management (DERM), indicates that a discharge licence for the WWTW to the Logan River would be unlikely to be approved.

4.2.3 Trunk Collection System

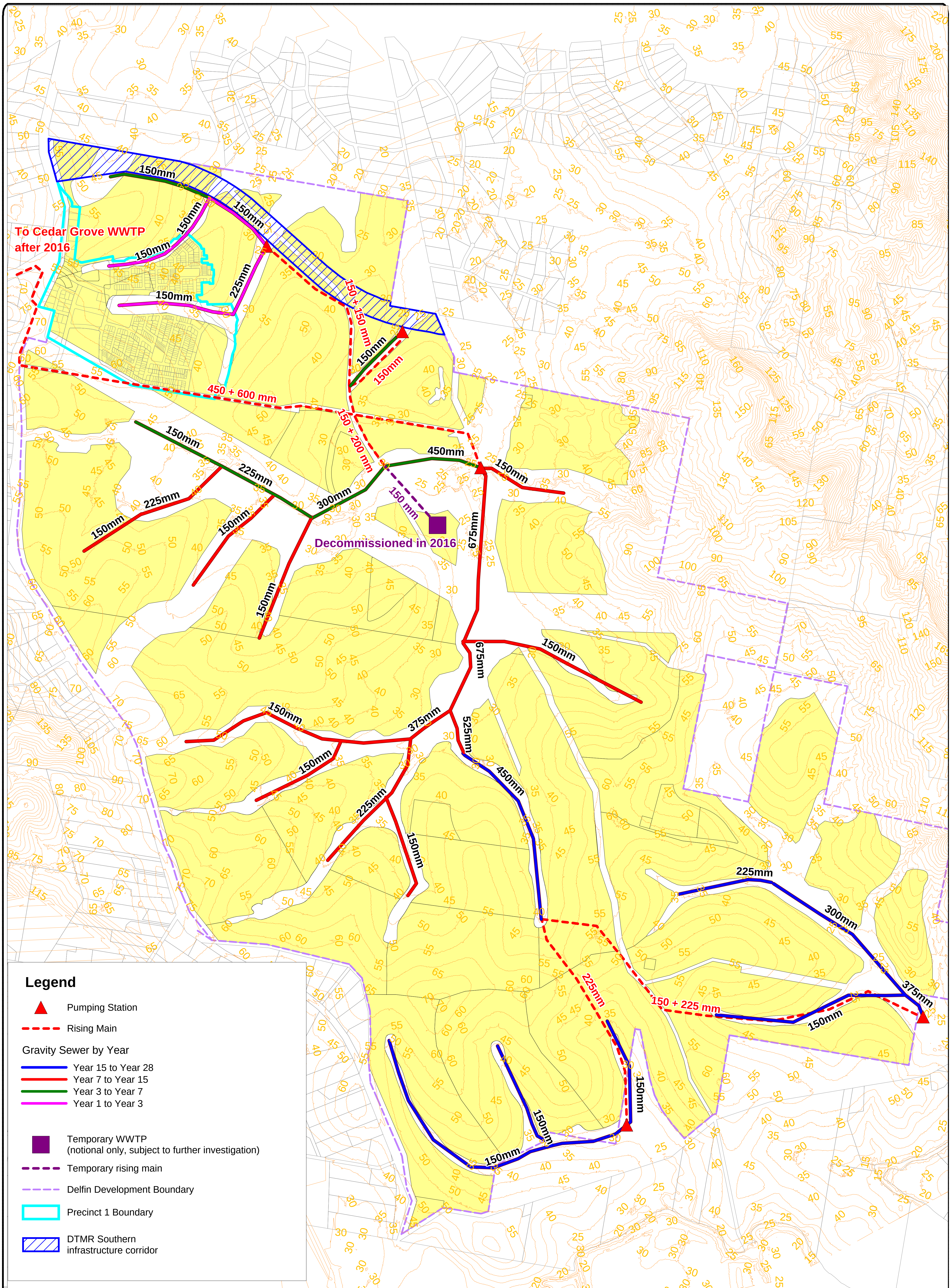
The extent and timing of the wastewater collection network for the ultimate Yarrabilba development is provided in Figure 4-2. Based on the development/ growth plan, location of treatment facilities and the undulating topography of the proposed development, five wastewater pumping stations are required to service the development area. The construction and operation of these pumping stations are staged to correspond with the growth across the catchment.

During the first three years of development (Precinct 1), it is planned to develop the urban footprint area in the north west of the site. Precinct 1 will comprise of predominately residential properties and minor commercial services. It is proposed that a temporary treatment facility be constructed approximately 1.5 km to the south east of Precinct 1, which will receive flows via a 150 mm diameter rising main from a proposed pumping station to the north east of the precinct. This temporary treatment plant is proposed to service the Yarrabilba development for the initial 3 to 4 years of development. After this time, sewage will be pumped to the Cedar Grove WWTP via a new purpose built pumping station and rising main.

A notional site for the temporary WWTP has been identified in the central area of the development. As this site is remote from the proposed Precinct 1 development and existing rural properties on the northern boundary of the Yarrabilba development, a minimum 500 m buffer can be established around the temporary WWTP to reduce the noise and odour impacts.

The sizing of the proposed trunk infrastructure has been undertaken in accordance with Logan Water Alliance DSOS. It should be noted that it has been assumed that the Yarrabilba sewage collection system will be constructed using RIGS. It is DLL's intention to monitor wet weather performance to assess the compliance with the design flows. Where the performance is found to be superior to that outlined in the DSOS, DLL may request a change to the design criteria.

The staging of trunk wastewater infrastructure and calculated pipe sizing (as per DSOS) are shown in Figure 4-2.



MWH

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Figure 4-2
Ultimate Yarrabilba
Wastewater Network

DATUM: MGA Zone 56 (GDA 94)

PROJECT No: A1251203

FILE REFERENCE:
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SCALE: Not to Scale

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DATE: 22/06/2011

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5 Wastewater Treatment

5.1 Strategy for Treatment and Reuse

The strategy for treatment and reuse of wastewater is based on the recommendation in the report *Part A: Logan South Wastewater Strategy* (Logan Water Alliance, March 2011). Logan South covers the existing Jimboomba Township, Logan Village, existing Flagstone Township and Yarrabilba urban development areas (UDA) and Flagstone UDA. The preferred option proposes a centralised WWTP at Cedar Grove with wastewater from the townships and UDAs pumped to the WWTP after commissioning in 2016.

The wastewater treatment strategy for Yarrabilba will be as follows:

1. Construct a temporary WWTP to service the development for the first 4 years until the Cedar Grove WWTP is constructed. This will require a maximum treatment capacity of 0.6 ML/d to service a connected population of 3,000 EP. This would be constructed in two stages of 1,500 EP.
2. Sewage will be pumped to the Cedar Grove WWTP after 2016.

The temporary WWTP will utilise water recycling to open space and agricultural end uses. The water quality to be produced by the WWTP will depend on the final end uses. At this stage it is assumed that a Class A recycled water will be produced, although this may be revised to Class B for agricultural reuse.

After the raw wastewater from the Yarrabilba development is transferred to the Cedar Grove WWTP in 2016, the treated effluent will be transferred to a regional reuse scheme to be implemented in the lower Logan area. Water will be used for agriculture and industrial uses.

Allconnex also advised that the preferred Logan South wastewater strategy was further revised in March 2011. The major change was to transfer wastewater from Logan Village to the exiting Loganholme WWTP when the Logan Village WWTP is decommissioned in 2016.

5.2 Temporary Treatment Plant

5.2.1 Capacity Required

As discussed above, the temporary WWTP will be sized to service the first four to five years of the development. The maximum connected population for this period is estimated to be 3,000 EP and assuming 200 L/EP/d for the dry weather flow, a total of 0.6 ML/d capacity will be required. The facility will be a staged package plant (2 x 1,500 EP stages) located within to the north east of the first stage of the development. It is proposed to provide a minimum buffer of 500 m to the boundary of the existing development to the north and to the proposed Yarrabilba development.

5.2.2 Technologies Assessed

Several packaged wastewater treatment technologies are currently available on the market. Quotes were sought from treatment technology providers including Innoflow, Rotating Disc Systems, Ovivo Water, CST Wastewater Solutions, Aquacell, EPCO, and Clearwater. The detailed assessment of the options reviewed including the raw sewage characteristics and treated effluent guidelines provided to suppliers are detailed in Appendix D.

It is noted that all options will require seasonal storage to be provided for recycled water. A recycled water pumping station will also be provided to transfer water to the agreed end uses. Access for water tankers will be provided to utilise water for construction purposes.

5.2.3 Comparison of Treatment Options

Based on the cost assessment and the key criteria outlined in Table D2 of Appendix D, it is recommended that further consideration is given to the RBC system by Rotating Disc Systems and the MBR system by Ovivo. These systems have the lowest capital cost and minimum operating costs.

The SAF system by Ovivo does not meet the water quality requirements, while the MBR system by CST Wastewater is 60% more expensive than the MBR by Ovivo. The Innoflow system is significantly more expensive than all other systems and accordingly no further consideration should be given.

While the RBC system has a larger footprint than the MBR system by Ovivo, it will most likely be simpler to operate. Both systems meet the requirements of being packaged units, portable, with the ability to increase capacity as required and therefore, further study into these two systems should be made during the concept design phase to select the preferred technology.

5.3 Treated Effluent Reuse

It is proposed that all effluent produced by the development will be reused. As advised by Allconnex, the long term strategy for treated effluent in this area is to transport water to the southern areas around the Albert River Valley. Water would be reused for agricultural purposes and for industrial reuse at the Bromelton Industrial Precinct. Based on the latest advice this scheme would be operational around 2016 to 2025. As part of the scheme, wastewater would be treated at the centralised Cedar Grove WWTP, and transferred to the storage near the WWTP.

Prior to 2016, a local reuse strategy will be implemented. A zero discharge strategy will be pursued with end uses for effluent being a combination of irrigation of local open space and broad hectare agricultural reuse. It is estimated, based on preliminary MEDLI modelling that a minimum of 45 ha would be required to dispose of the effluent produced by the estimated 3,000 EP in the area. The final location and extent of the disposal area will be determined based on soil assessment and crop selection. For the first stage of 1,500 EP, a disposal area of approximately 22 ha will be required. Potential crops are lucerne hay and turf. Further assessment of the water balance including the suitability and capacity of actual soils and topography will be undertaken as part of the approvals process for the temporary WWTP.

Before the wastewater is transferred to Cedar Grove WWTP, it is proposed to utilise all recycled water produced by the temporary WWTP (up to 0.6 ML/d) for construction purposes and irrigation of a dedicated area for agricultural reuse. The potential agricultural reuse area is proposed to the south of electricity easement. Seasonal storage during this period will be provided closed to the site of WWTP.

Water quality to be supplied for the reuse scheme will be dependent on the end use of the water. It is anticipated that where open space irrigation is undertaken within the urban areas, the quality will be Class A, with Class B quality being delivered to the agricultural reuse areas. Again the final decision on water quality will be made as part of the development of the Recycled Water Management Plan.

6 Conclusions and Recommendations

6.1 Conclusions

The following can be concluded from this study:

1. The total residential population was estimated to be 44,382 EP at ultimate development;
2. The total non-residential water and wastewater EP of the ultimate Yarrabilba development were calculated as 7,208 and 8,137 EP respectively.
3. The population projection for the proposed development is tabulated as below (not including wastewater from Logan Village):

Precinct 1 Water EP at Development Year				
Year 1	Year 2	Year 3	Year 4	Year 5
133	416	628	1,549	2,165
Precinct 1 Wastewater EP at Development Year				
Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
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Year 10	Year 15	Year 20	Year 25	Year 28
15,000	25,432	37,548	47,316	51,591
Projected Wastewater EP at Development Year				
Year 10	**Year 15**	**Year 20**	**Year 25**	**Year 28**
15,316	26,022	38,332	48,244	52,519

4. A total reservoir capacity of 14.0 ML is required to serve the ultimate Yarrabilba development;
5. The revised network layouts for the ultimate Yarrabilba development are shown in Figure 4-1 and Figure 4-2;
6. The strategy for the treatment of wastewater will have the following staging:
   a. A temporary WWTP to be constructed to service the development for the first 4 years until the Cedar Grove WWTP is constructed. This will require a maximum treatment capacity of 0.6 ML/d to service a maximum connected population of 3,000 EP. This plant will be constructed in two 1,500 EP stages.
   b. Sewage from the proposed development will be pumped to the Cedar Grove WWTP after 2016.
7. Effluent from the temporary WWTP will be used for agricultural reuse area within the Yarrabilba development as well as for construction.
8. Initial treatment process assessment shows the RBC system by Rotating Disc Systems and the MBR system by Ovivo have the lowest capital cost and minimum operating costs and they also meet the requirements of being packaged units, portable, with the ability to increase capacity as required;
9. The treated effluent reuse strategy is described below:
   a. Before the wastewater is transferred to Cedar Grove WWTP, it is proposed to utilise all recycled water produced by the temporary WWTP (up to 0.6 ML/d) for construction purposes and irrigation of a dedicated area for agricultural reuse;

   b. The long term strategy for treated effluent in this area is to transport water to the southern areas around the Logan River Valley for agricultural purposes and for industrial reuse at the Bromelton Industrial Precinct.

6.2 Recommendations

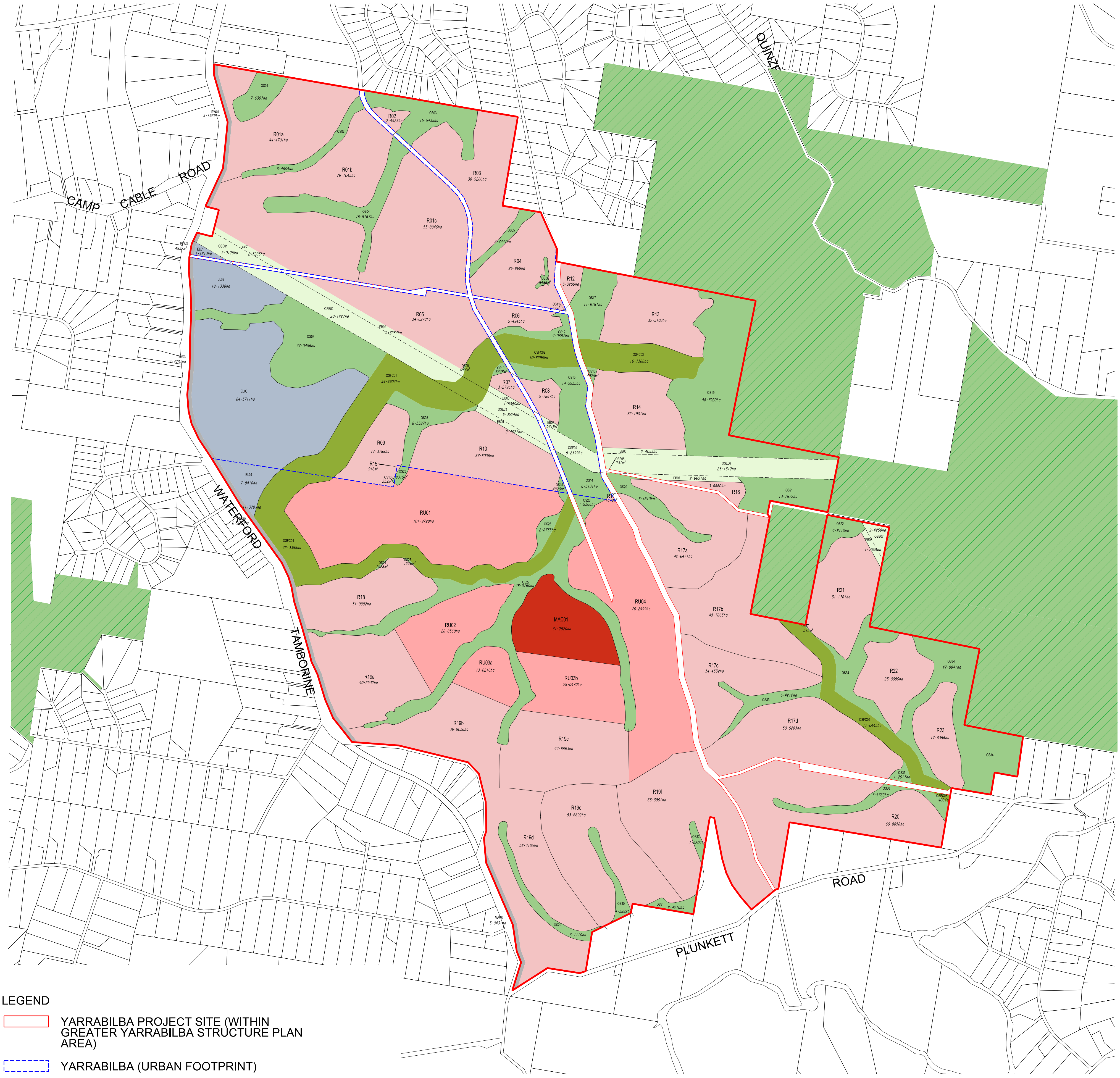
The following is recommended from this study:

1. A detailed water balance should be undertaken in the future to revise:
   a. open space irrigation demands;
   b. size of seasonal storages; and
   c. area of irrigation required;
2. A further investigation is necessary to develop an optimised option of serving the highlighted high level areas if the MOL of 95 m AHD is adopted by Allconnex;
3. To create up to 4 water supply DMAs in the areas with low elevations and the locations of boundary valves or PRV should be installed on the first tier of branch mains off the trunk main loops;
4. To monitor wet weather performance to assess the compliance with the design flows. Where the performance is found to be superior to that outlined in the DSOS, DLL may request a change to the design criteria.

Appendix A Proposed Land Use Areas Plan and Development Rollout Plan

FOR INTERNAL USE ONLY
NOT FOR DISTRIBUTION

Yarrabilba
A COMPLETE TOWN, A BETTER OUTCOME



LEGEND

- YARRABILBA PROJECT SITE (WITHIN GREATER YARRABILBA STRUCTURE PLAN AREA)
- YARRABILBA (URBAN FOOTPRINT)
- ROAD INFRASTRUCTURE INVESTIGATION ZONE
- MAJOR ACTIVITY CENTRE (MAC) / TOWN CENTRE
- MAC TOWN FRAME - EMPLOYMENT, BULKY GOODS
- LOCAL ACTIVITY CENTRE (LAC)
- NEIGHBOURHOOD ACTIVITY CENTRE (NAC)
- URBAN RESIDENTIAL ZONE
- SUBURBAN RESIDENTIAL ZONE
- MIBA / ENTERPRISE ZONE
- OPEN SPACE 2nd ORDER FAUNA CORRIDOR
- PRIMARY SECURED UNINTERRUPTED KOALA CORRIDOR (200m wide)
- OPEN SPACE
- ELECTRICITY EASEMENT AND BUFFER
- EXTERNAL ADJOINING CONSERVATION AREAS AND OPEN SPACE
- PRIMARY MOVEMENT NETWORK
- SECONDARY ROAD NETWORK

FUNCTIONAL INTERFACES

- INTERFACE RESIDENTIAL TO SECONDARY CORRIDORS AND RETAINED CREEK VEGETATION INCLUDES EDGE INTERFACE TO PROTECT VEGETATION
- INTERFACE RESIDENTIAL TO KOALA CORRIDOR, MEASURES TO PROTECT INTEGRITY OF THE KOALA CORRIDOR
- BUSHFIRE APZ, EMERGENCY ACCESS AND EFFECTIVE MEASURES TO AVOID IMPACT ON ADJACENT FLORISTIC
- BUSHFIRE APZ AND EMERGENCY ACCESS INTERFACE WITHIN REVEGETATION AREAS TO 'OF LEAST CONCERN' VEGETATION

THE CONTENTS OF THIS PLAN ARE CONCEPTUAL ONLY, FOR DISCUSSION PURPOSES. ALL AREAS AND DIMENSIONS ARE APPROXIMATE ONLY SUBJECT TO RELEVANT STUDIES, SURVEY, ENGINEERING AND COUNCIL APPROVAL AND DOES NOT FORM PART OF THE YARRABILBA DEVELOPMENT APPLICATION.

DRAFT

Delfin
Lend Lease

YARRABILBA

PROPOSED LAND USE AREAS PLAN

0 200 400 600 800 1000 metres

Scale 1:30000 AT A3

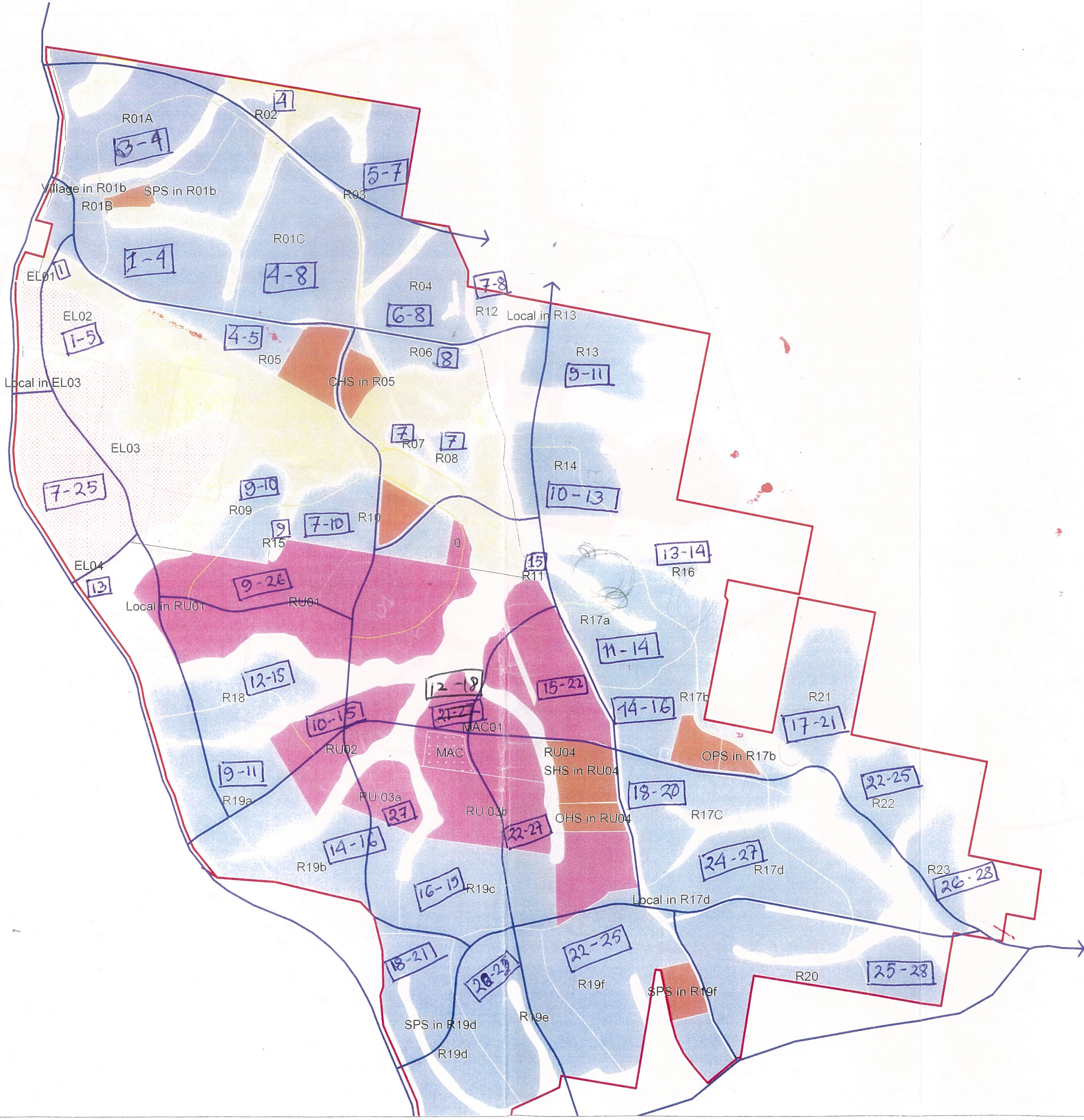
N

File No. F 1.4

Drawing No.YB-LUCP-100825

25 AUG 2010

2012-2038



R01A
3-4
R02
4
5-7
Village in R01b
SPS in R01b
R01B
R03
R01C
1-4
4-8
EL01
1
R04
6-8
7-8
R12
Local in R13
EL02
1-5
4-5
R05
R06
8
R13
9-11
Local in EL03
CHS in R05
7
R07
7
R08
EL03
R14
10-13
7-25
9-10
R09
7-10
R10
9
R15
15
R11
13-14
R16
EL04
13
9-26
RU01
Local in RU01
R17a
11-14
12-15
R18
12-18
15-22
21-22
R17b
14-16
R21
17-21
10-15
MAC01
RU02
MAC
RU04
SHS in RU04
OPS in R17b
9-11
R19a
RU 03a
27
RU 03b
22-27
OHS in RU04
18-20
R17C
22-25
R22
14-16
24-27
R17d
R19b
16-19
R19c
Local in R17d
R23
26-28
18-21
20-23
22-25
R19f
SPS in R19f
R20
25-28
R19e
SPS in R19d
R19d

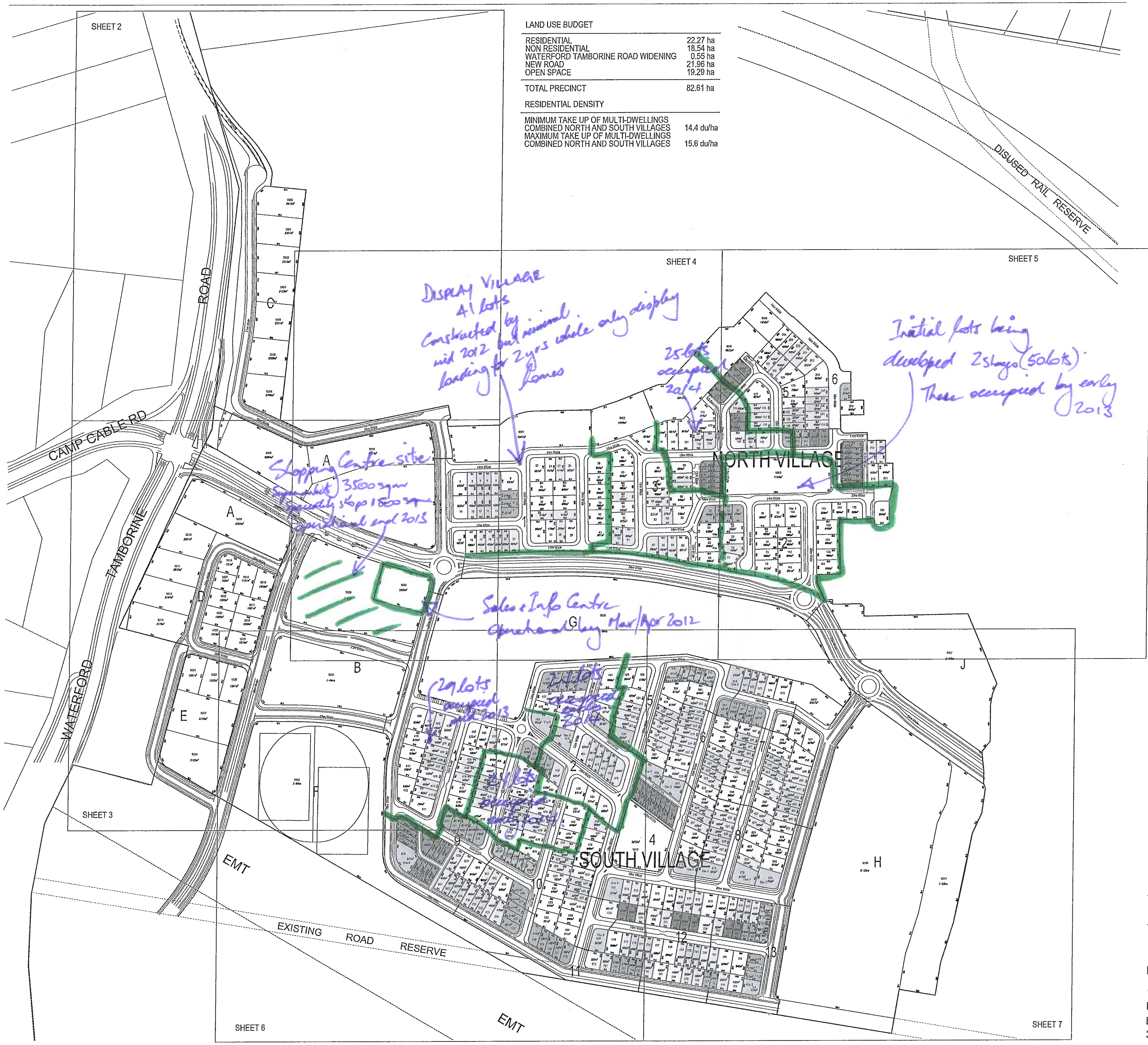
Appendix B Precinct 1 Development Content

LAND USE BUDGET

RESIDENTIAL	22.27 ha
NON RESIDENTIAL	18.54 ha
WATERFORD TAMBORINE ROAD WIDENING	0.55 ha
NEW ROAD	21.96 ha
OPEN SPACE	19.29 ha
TOTAL PRECINCT	82.61 ha

RESIDENTIAL DENSITY

MINIMUM TAKE UP OF MULTI-DWELLINGS COMBINED NORTH AND SOUTH VILLAGES	14.4 du/ha
MAXIMUM TAKE UP OF MULTI-DWELLINGS COMBINED NORTH AND SOUTH VILLAGES	15.6 du/ha



Yarrabilba

A COMPLETE TOWN, A BETTER OUTCOME

LEGEND

- YARRABILBA SITE BOUNDARY
- PRECINCT ONE BOUNDARY
- ELECTRICAL TRANSMISSION EASEMENT (EMT)
- INDICATIVE SOUTHERN INFRASTRUCTURE CORRIDOR
- RESIDENTIAL VILLAGE BOUNDARY
- PROPOSED STAGE BOUNDARY

RESIDENTIAL NORTH VILLAGE

LOT YIELD		LOT AREA (sqm)			Lots	Dwellings	
Lot Type	% Total Lots	Average Size	% of Total Area	Area	No	Min No	Max No
P	5.56%	840	9.99%	7565	9	9	9
T	18.52%	657	26.02%	19711	30	30	30
C	17.90%	499	19.11%	14477	29	29	29
PV	19.75%	405	17.13%	12975	32	32	32
V	6.79%	320	4.65%	3520	11	11	11
TT	5.56%	530	6.30%	4770	9	9	9
TCY	4.94%	390	4.12%	3123	8	8	8
TC	6.79%	318	4.63%	3508	11	11	11
TCE	8.64%	235	4.35%	3293	14	14	
TPV	5.56%	311	3.70%	2803	9	9	9
Total Number of Lots					162	162	176

Min Residential Density = 12.6 ha = 162 du = 12.9 du/ha

Max Residential Density = 12.6 ha = 176 du = 14.0 du/ha

RESIDENTIAL SOUTH VILLAGE

LOT YIELD		LOT AREA			Lots	Dwellings	
Lot Type	% Total Lots	Average Size	% of Total Area	Area	No	Min No	Max No
T	14.67%	660	22.40%	32361	49	49	49
C	12.28%	503	14.29%	20643	41	41	41
PV	19.46%	411	18.53%	26765	65	65	65
V	15.27%	329	11.62%	16779	51	51	51
TT	5.09%	577	6.80%	9822	17	17	17
TCY	2.69%	370	2.31%	3334	9	9	9
TC	10.18%	338	7.96%	11503	34	34	34
TV	1.80%	240	1.00%	1440	6	6	6
TCE	5.99%	255	3.54%	5119	20	20	40
TPV	2.10%	300	1.45%	2100	7	7	7
MFF	5.99%	194	2.70%	3898	20	20	20
MFS	4.49%	712	7.39%	10680	15	30	37
Total Number of Lots					334	349	376

Min Residential Density = 21.86 ha = 349 du = 15.9 du/ha

Max Residential Density = 21.86 ha = 376 du = 17.2 du/ha

NOTE:

MINIMUM DWELLINGS is based on the development of one dwelling on each single family lot, two dwellings on each multi family strata (MFS) lot, and one dwelling on each multi family freehold (MFF).

MAXIMUM DWELLINGS for terrace (TCE) and multi family strata (MFS) lots is based on fonzi flats on rear loaded terraces and the development of the maximum number of dwellings on MFS lots.

DENSITY calculations include the area of residential lots, local roads and local parks.

The boundaries, roads and pathways shown hereon are subject to detailed engineering design, final survey and approval of subsequent development applications by the relevant authorities.

Delfin Lend Lease

PRECINCT ONE

RECONFIGURATION OF A LOT

0 50 100 150 200 250 metres

N

Scale 1:2500 AT A1

File No. YB-P01

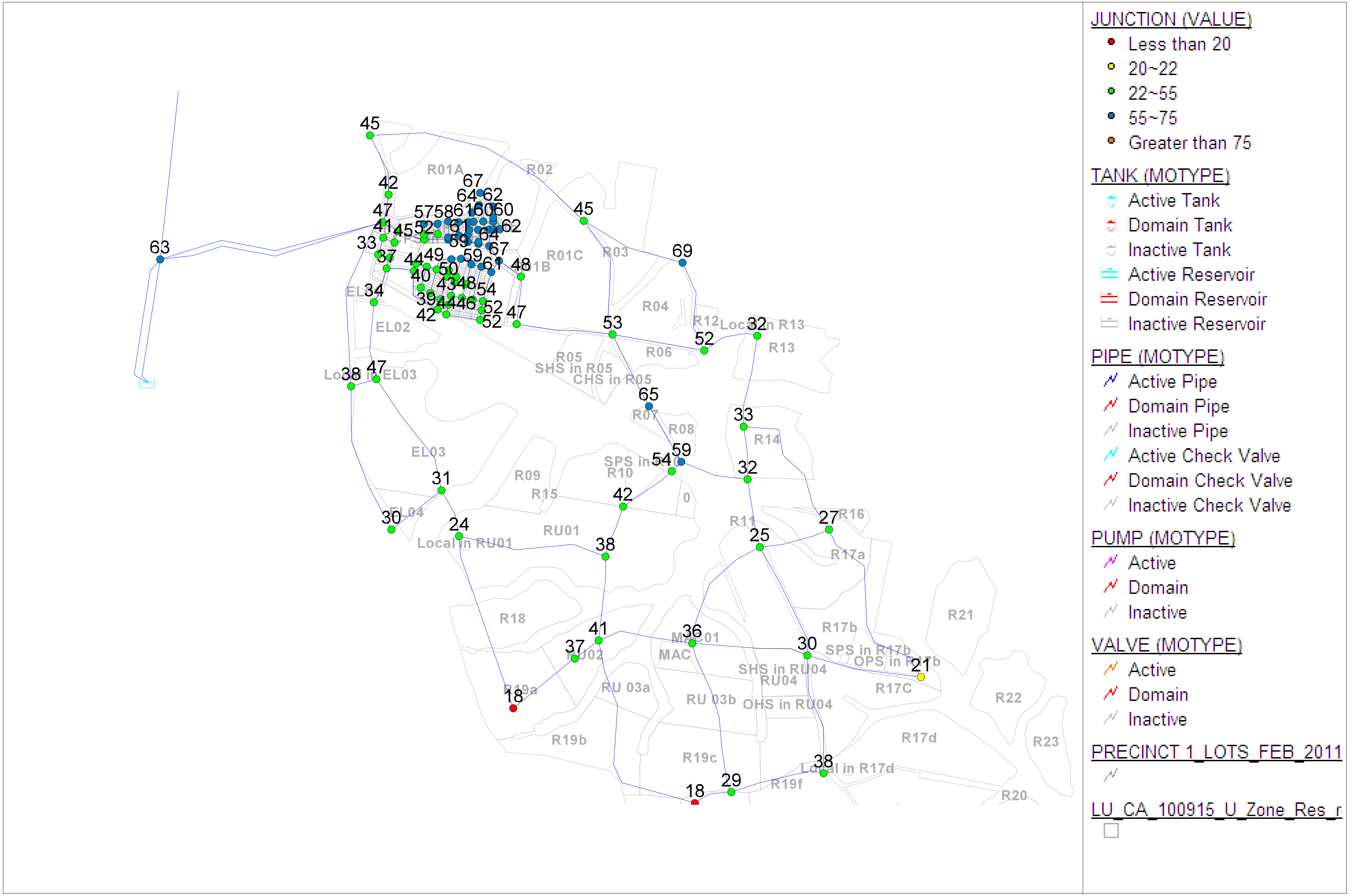
Drawing No. YB-P01-ROL101118A SHEET 1 OF 7

31 JAN 2011

PW No A1000PDU1003

Appendix C Water Network Performance Analysis Outcomes

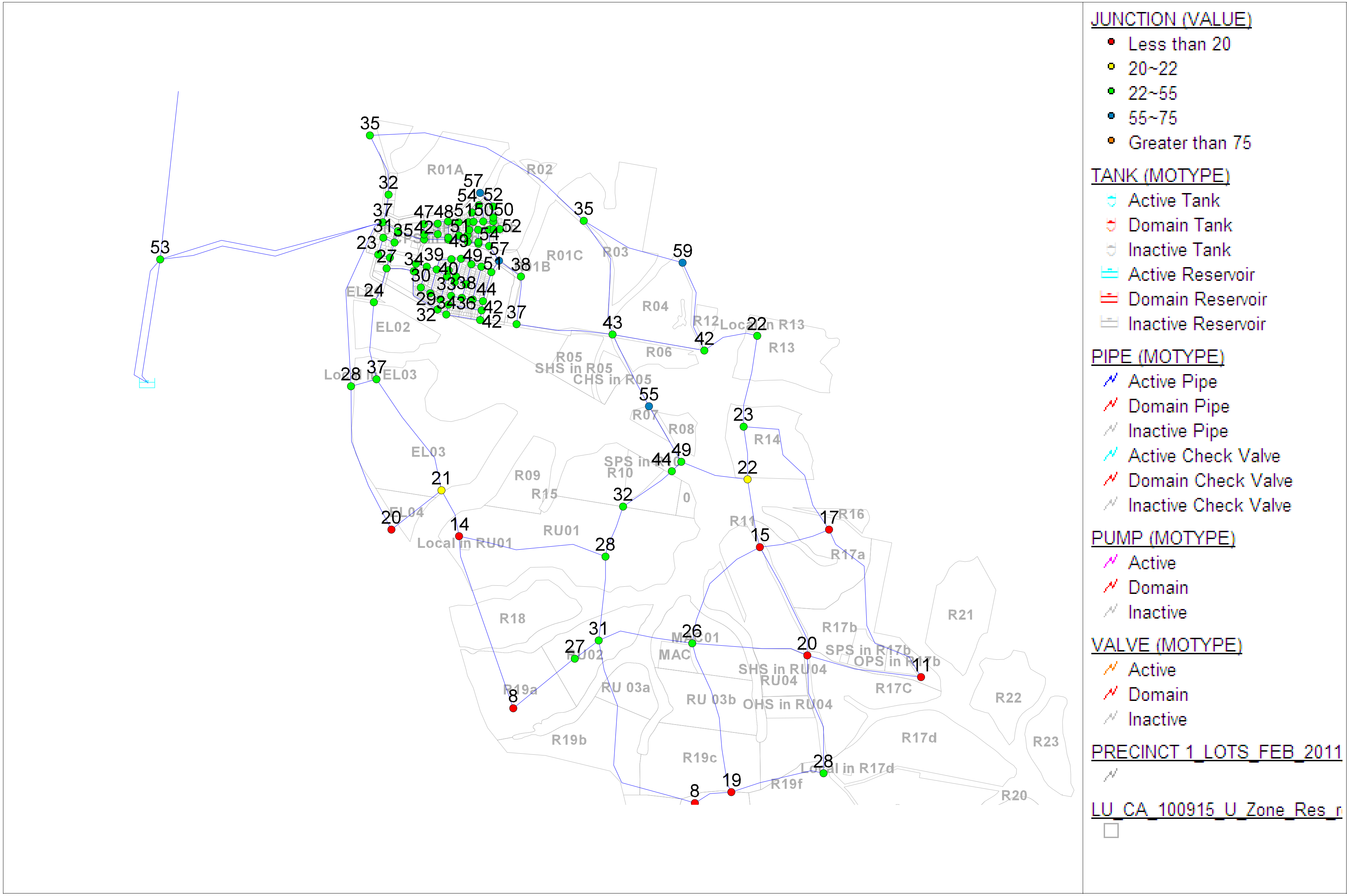
Yarrabilba Ultimate Network Performance - MH
Travis Rd Res. MOL = 105 m AHD



Prepared By: Henry Lin

Date: Tuesday, March 01, 2011

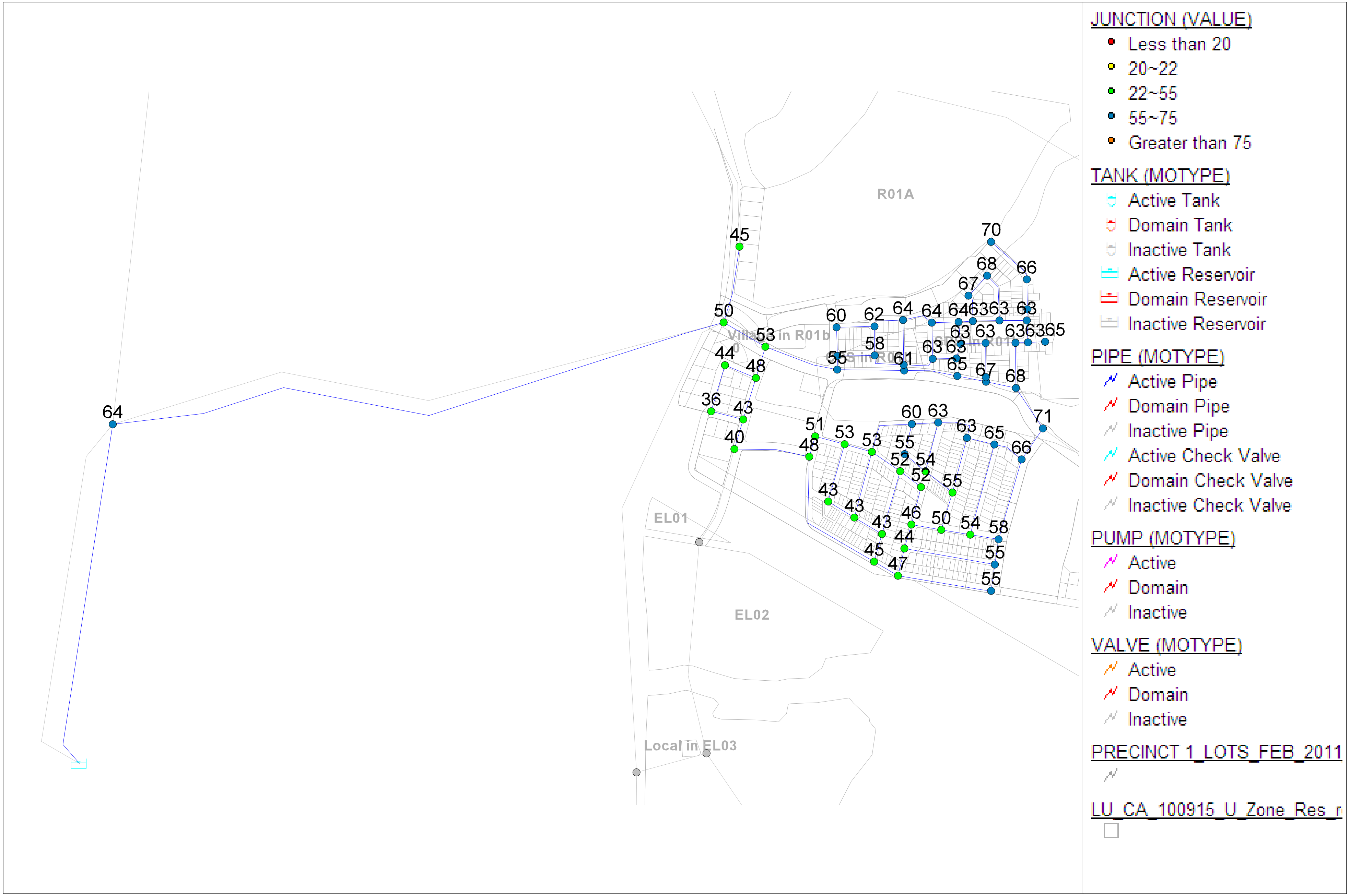
Yarrabilba Ultimate Network Performance - MH
Travis Rd Res. MOL = 95 m AHD



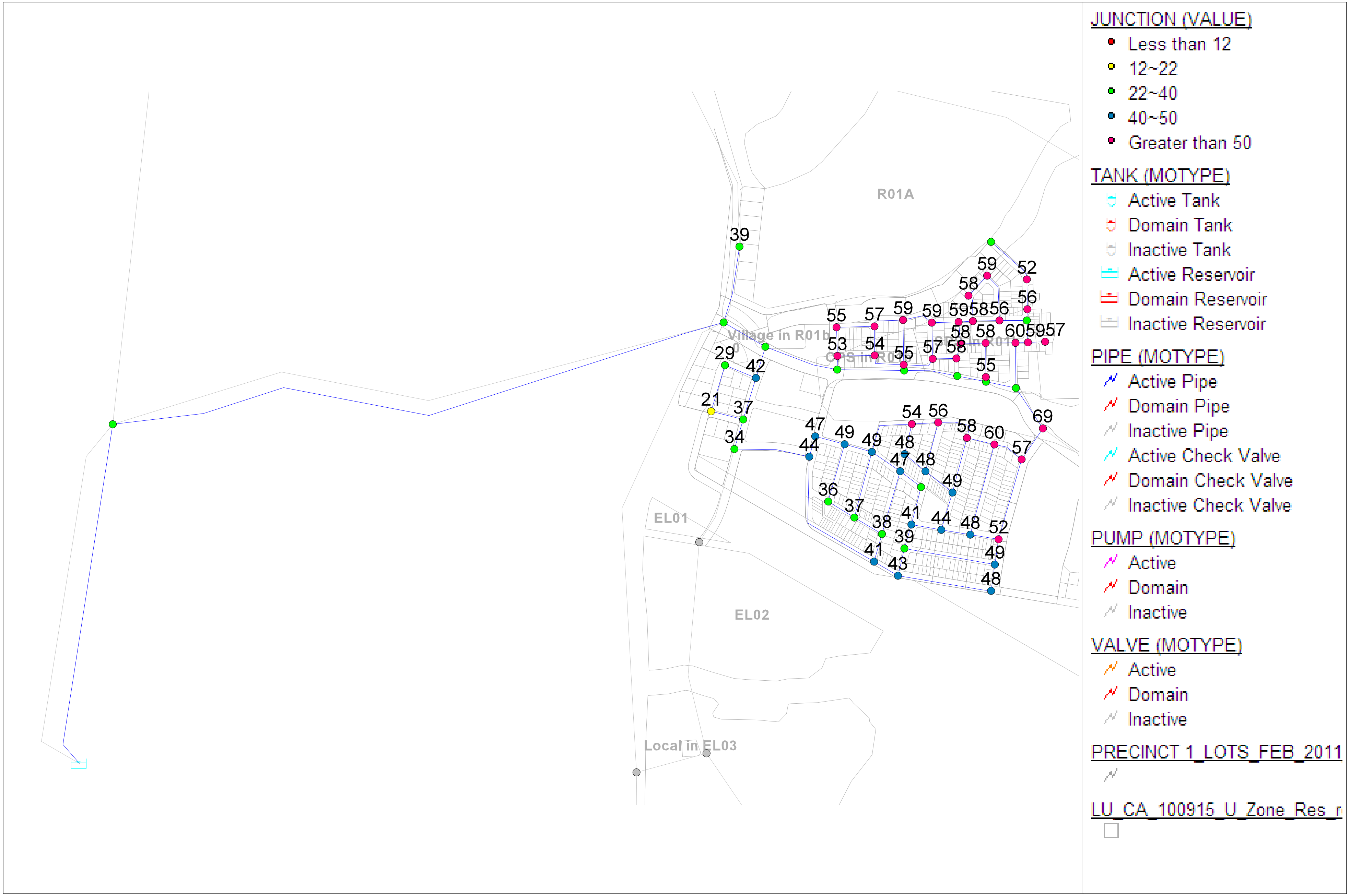
Prepared By: Henry Lin

Date: Tuesday, March 01, 2011

Yarrabilba Precinct Network Performance - MH
Travis Rd Res. MOL = 105 m AHD



Yarrabilba Precinct Network Performance - Fire flow Residual Pressure at MH
Travis Rd Res. MOL = 105 m AHD



Prepared By: Henry Lin

Date: Tuesday, March 01, 2011

Appendix D Preliminary Assessment of Treatment Technologies

Several packaged wastewater treatment technologies are currently available on the market. Quotes were sought from treatment technology providers including Innoflow, Rotating Disc Systems, Ovivo Water, CST Wastewater Solutions, Aquacell, EPCO, and Clearwater. The raw sewage characteristics and treated effluent guidelines provided to suppliers are detailed in **Table B1**. A base design average dry weather flow (ADWF) of 0.3 ML/d was used to facilitate comparison between the treatment technologies.

Table B1: Typical Raw Sewage and Treated Effluent Parameter Values

PARAMETERS	UNITS	VALUES
Raw sewage$^{(1)}$		
ADWF	ML/d	0.3
Ammonia	mgN/L	42
Total Nitrogen (TN)	mgN/L	60
Total Phosphorous (TP)	mgP/L	18
Chemical Oxygen Demand (COD)	mg COD/L	750
Inert suspended solids	mg/L	50
COD:BOD_5 ¥	-	2.1
Readily biodegradable COD fraction (f_{bs})	-	0.18
Unbiodegradable soluble COD fraction (f_{us})	-	0.05
Alkalinity	mg/L as $CaCO_3$	315
pH	-	6.5-8.5
Min and Max temperature	^{o}C	24 and 33
Treated effluent $^{(2)}$		
TN	mgN/L	<10*
TP	mgP/L	<5*
Suspended solids	mg/L	5*
Total dissolved solids	mg/L	1000*
BOD_5 $^{(3)}$	mg/L	20*
Turbidity	NTU	2#
E.coli	cfu/100mL	10*
pH	-	6.5-8.5*

Notes

(1) Typical Queensland sewage type based on previous MWH conducted studies like Murrumba Downs & Pimpama STPs

(2) Based on Queensland EPA and FAO guidelines

(3) Five day Biochemical oxygen demand:

* Median

\# At 95%ile

^ at the nearest sensor location (outside the buffer zone)

Responses were received from the following treatment suppliers:

- Innoflow;
- Ovivo Water;
- Rotating Disc Systems; and

- CST Wastewater Solutions;

The suitability of these technologies for the Yarrabilba development was assessed and comparisons made of the individual technologies with each other.

Innoflow

Innoflow is a New Zealand based company specializing in decentralized wastewater management. The crux of their technology is passive anaerobic digestion with biological nutrient removal using a textile packed bed reactor (attached growth), named Orenco AdvanTex MAX®. This technology for decentralised small treatment plants consists of the following components:

- Inlet lift station;
- Solids screening and primary clarification;
- Secondary treatment via textile media bed (attached growth);
- Enhanced configuration for optiumum nitrogen and phosphorous removal;
- UV disinfection; and
- Remote telemetry controls.

This technology has been applied to the following sites:

- The Eco village at Currumbin (0.06 ML/d, Gold Coast, Australia); and
- Jacks Point (0.7 ML/d, Queenstown, New Zealand).

Modularity and Portability
The Innoflow Orenco AdvanTex MAX system is a packaged unit, contained within an insulated fibreglass tank. These tanks can be shipped by truck rail, cargo or container, and installed above or below ground. This will allow the sewage treatment plant (STP) to be removed or relocated as required.

Performance and Effluent Quality
Innoflow has indicated they would be able to meet the effluent quality required for the influent specifications as provided (refer to Table 1-1). Innoflow states they would provide the unit in the enhanced configuration for optimum nitrogen and phosphorous removal, however there is no indication on whether this would be via chemical treatment or enhanced biological treatment means

Site Issues (Footprint, biosolids, etc)
Innoflow have indicated that a footprint of approximately 1000 m^2 will be required for the proposed treatment technology.

Energy and Maintenance Requirements
MWH have worked out the operating costs for the Ovenco AdvanTex MAX system based on information supplied by Innoflow on the power costs, maintenance, parts replacement and solids removal requirements for such a system.

Rotating Disc Systems

Rotating Disc Systems is a Queensland based company specialising in rotating biological contactors for wastewater treatment. The treatment process train for which Rotating Disc Systems has offered for this project includes the following:

- Primary anaerobic settling tank;
- Rotating biological contactors (aerobic treatment, attached growth);
- Humus clarification tanks;
- Common sand filtration; and
- Common disinfection – chlorine contact tank.

This technology has been applied to the following sites:

- Small town in QLD (0.180 ML/d, Queensland);
- Mount Isa (0.030 ML/d, Queensland);
- Mining Client (0.030 ML/d, Western Australia); and
- Mining Client (0.180 ML/d, Papua New Guinea).

Modularity and Portability

The system provided by Rotating Disc Systems as a whole is not a self contained single module, though the rotating biological contactor (RBC) unit is a module. The system components are portable, with the ability to add/remove additional RBC trains as required to increase or decrease the capacity of the plant.
Rotating Disc Systems has even indicated the possibility of purchasing back the units at the end of the three years if required.

Performance and Effluent Quality

Rotating Disc Systems has indicated that the RBC process with sand filtration and disinfection will achieve Class A water and meet the effluent requirements as listed earlier. The RBC process is a proven attached growth technology which is commonly used as an alternative to suspended growth processes such as activated sludge. Carbon and Nitrogen reduction occurs biologically by the RBC, while phosphorous reduction is achieved chemically by dosing of aluminium sulphate into the primary anaerobic settling tanks.

Tertiary filtration is provided by the sand filters, while disinfection is achieved by dosing sodium hypochlorite into the chlorine contact tank.

Site Issues (Footprint, biosolids, etc)

The system provided by Rotating Disc Systems has the largest footprint of the treatment process quoted on, with a footprint of 1316 m^2. This includes all process units as well as clearance allowance around each unit.
Screens and biosolids will settle in the primary anaerobic tank. This will need to be desludged every year. As all solids produced on site will be fed into the primary anaerobic tank, no sludge handling unit or continuous disposal is required.

Energy and Maintenance Requirements

Rotating Disc Systems has indicated that the proposed RBC STP process would require a power supply of 40A, 415V as a minimum, and would consume approximately 275 kWh per day.
Maintenance costs have been estimate by Rotating Disc Systems to include yearly de-sludging at approximately $12,000 a year, and replacement mechanical parts required every 2-3 years at a cost of $4000. Replacement of filter pumps may cost $1000 per year.

CST Wastewater Solutions

CST Wastewater Solutions is an Australian based company specialising in the supply of screens for wastewater treatment. They also supply equipment including clarifiers, dewatering units, and packaged treatment plants. CST Wastewater Solutions have proposed a Membrane Bioreactor (MBR) based packaged treatment plant consisting of the following units:

- Common inlet screen and grit removal;
- 2x TITAN MBR trains (in parallel) for secondary and tertiary treatment;
- UV Disinfection unit
- Sludge dewatering skid

Modularity and Portability

The system provided by CST Wastewater Solutions as a whole is not a self contained single module; however the key treatment component, the TITAN MBR is a modular unit. The system components are portable, with the ability to add/remove additional MBR trains as required to increase or decrease the capacity of the plant.

Performance and Effluent Quality
The system provided by CST Wastewater Solutions has the necessary process units to consistently meet the desired effluent quality. It uses a membrane bioreactor for secondary wastewater treatment. The activated sludge component performs biological nitrogen and phosphorus removal, and the hollow fibre membranes act as a physical barrier to the mixed liquor suspended solids, dissolved solids, microorganisms and turbidity.

Site Issues (Footprint, biosolids, etc)
The site footprint required for the system provided by CST Wastewater Solutions has been estimated to be 215 m^2 by MWH. This has been based on the drawings provided of the TITAN MBR unit, and an estimate of the dewatering skid and sludge holding tank.
Sludge from the biological treatment will be stored in a sludge tank and thickened by a sludge belt press, with dewatered sludge disposed offsite.

Energy and Maintenance Requirements
CST Wastewater Solutions have not provided an estimate of the power requirements for the TITAN MBR system; however it would be reasonable to assume that the power requirements will be simlar to other MBR system types. Therefore, MWH have assumed power requirements would be ~1100 kWh/d.

MWH have assumed that total maintenance cost per annum would be at 5% of the capital cost.

Ovivo Systems

Ovivo proposed two different wastewater treatment technologies that could used at the site. This includes a Submerged Aerated Filter (SAF) system and a Membrane Bioreactor (MBR) system.

(i) Submerged Aerated Filter (SAF) System

The SAF system consists of:
- Primary settling tanks;
- SAF units;
- Final settling tank; and
- Sludge dewatering unit

Modularity and Portability
The SAF system provided by Ovivo is a packaged unit and is portable. It has the ability to add/removal additional SAF trains as required to increase or decrease the capacity of the plant.

Performance and Effluent Quality
The SAF system provided by Ovivo will not meet the effluent quality required by the project. It will only achieve Class B water quality. Additional filtration and disinfection units would be required to meet the project effluent discharge requirements.

Site Issues (Footprint, biosolids, etc)
The site footprint for the SAF system inclusive of balance and sludge tanks would need to be 215m^2. Solids from the process would be dewatered using a Amston Filter Press. Dewatered sludge cake would be stored in a 10m^3 storage tank for disposal offsite.

Energy and Maintenance Requirements
Ovivo have indicated that the power requirements for the entire SAF system would be 180A, with energy consumption being 1800 kWh/d. They also estimated that the total maintenance cost per annum would be at 5% of the capital cost.

(ii) Membrane Bioreactor (MBR) System

The MBR system consists of:

- Inlet screen
- Flow balance tank
- MBR Unit (Secondary and Tertiary treatment)
- Disinfection using hypochlorite in a chlorine contact tank
- Sludge holding tank
- Sludge filter press

Modularity and Portability

The MBR system provided by Ovivo is a packaged unit and is portable. It has the ability to add/removal additional MBR trains as required to increase or decrease the capacity of the plant.

Performance and Effluent Quality

The MBR system provided by Ovivo could exceed the effluent quality requirements by producing Class A+ water. It uses a membrane bioreactor for secondary wastewater treatment. The activated sludge component performs biological nitrogen and phosphorus removal, and the membranes act as a physical barrier to the mixed liquor suspended solids, dissolved solids, microorganisms and turbidity. Alum is dosed into the sludge tank feed to precipitate phosphorous.

Site Issues (Footprint, biosolids, etc)

The site footprint for the MBR system inclusive of balance and sludge tanks would need to be 215m^2. Solids from the process would be dewatered using a Amston Filter Press. Dewatered sludge cake would be stored in a 10m^3 storage tank for disposal offsite.

Energy and Maintenance Requirements

Ovivo indicated that the power requirements for the entire MBR STP system would be 100A, with energy consumption being 1100 kWh/d. They have estimated that the total maintenance cost per annum would be at 5% of the capital cost.

Comparison of Options

A comparison of the costs and other relevant evaluation criteria for the 5 different treatment plant options as supplied by the four suppliers is summarised in **Table B2**.

Table 1-2: Comparison of the relevant evaluation criteria for the 5 different treatment plant options submitted by four suppliers

TREATMENT TECHNOLOGY		**Rotating Disc Systems Class A**	**CST Wastewater Class A**	**Ovivo Class B**	**Ovivo Class A+**	**Innoflow Class A**
		RBC	S&L Titan MBR	Submerged Aerated Filter	MBR	Orenco AX-Max
Footprint	m^2	1316	272	215	135	1000
CAPITAL COSTS						
Inlet Screening		not required	$ 125,000	included	included	included
Biological Treatment		included	$ 1,100,000	included	included	included
Tertiary Treatment		included	included	included	included	included
Disinfection		included	$ 30,000	included	included	included
Sludge Dewatering		included	$ 150,000	$ 114,300	$ 114,300	TBC
Civil Works (slab, covers, etc)		slab not required, just ground	$ 150,000	$ 53,750	$ 33,750	TBC
Sludge Holding Tank		not required	$ 20,000	included	included	TBC
Sludge Cake Holding Tank		not required	$ 16,000	$ 16,000	$ 16,000	TBC
TOTAL MECHANICAL COSTS		**$ 895,454**	**$ 1,591,000**	$ 1,574,550	$ 998,450	$ 4,550,000
Electrical, instrumentation and control @ 30% of Civil/Mechanical	Assumed to be included in package units	$ -	$ -	$ -	$ -	$ -
Electrical Supply to site	Not considered	$ -	$ -	$ -	$ -	$ -
SUB-TOTAL - DIRECT CONSTRUCTION COSTS (DCC) - ALL UPGRADE WORKS		***$ 895,454***	$ 1,591,000	$ 1,574,550	$ 998,450	$ 4,550,000
Plant Design and Drawings		included	not included	included	included	included
Manufacture		included	not included	included	included	included
Transport and Installation		included	not included	included	included	included
Commissioning and Testing	1.6% of DCC	included	$ 25,456	included	included	included
O&M Manuals	0.6% of DCC	included	$ 9,546	included	included	$ 27,300
Training	0.3% of DCC	included	$ 4,773	included	included	$ 13,650
Operations Support	0.2% of DCC	$ 1,791	$ 3,182	$ 3,149	$ 1,997	$ 9,100
Design, Project Management and Construction Supervision	30% of DCC	$ 268,636	$ 477,300	$ 472,365	$ 299,535	$ 1,365,000
Facilitation	0.5% of DCC	$ 4,477	$ 7,955	$ 7,873	$ 4,992	$ 22,750
Community Relations	0.2% of DCC	$ 1,791	$ 3,182	$ 3,149	$ 1,997	$ 9,100
DIRECT JOB COST (DJC)		***$ 1,172,149***	***$ 2,122,394***	***$ 2,061,086***	***$ 1,306,971***	***$ 5,996,900***
Indirect Costs	19% of DJC	$ -	$ -	$ -	$ -	$ -
Contractor Overhead and Margin	15% of DJC	$ -	$ -	$ -	$ -	$ -
TOTAL COST (EXCL. CONTINGENCY)		***$ 1,172,149***	***$ 2,122,394***	***$ 2,061,086***	***$ 1,306,971***	***$ 5,996,900***
Contingency	30% of Total Cost	$ 351,645	$ 636,718	$ 618,326	$ 392,091	$ 1,799,070
TOTAL ESTIMATED STP CAPITAL COST		***$ 1,523,794***	***$ 2,759,112***	***$ 2,679,412***	***$ 1,699,062***	***$ 7,795,970***
TREATED WATER STORAGE ESTIMATED CAPITAL COST (based on a 5 day storage capacity)	***1.5 ML***	***$ 1,248,000***	***$ 1,248,000***	***$ 1,248,000***	***$ 1,248,000***	***$ 1,248,000***
OPERATING COSTS						
Power Cost (@ 0.26 $/kWh)	$/year	$ 26,098	$ 104,390	$ 170,820	$ 104,390	included
Operator Cost (@75/h) (assumed 2 hr per day, 365 days/yr)	$/year	$ 54,600	$ 54,600	$ 54,600	$ 54,600	$ 54,600
Maintenance Cost (maintenance repairs/ incl desludging)	$/year	$ 15,000	$ 79,550	$ 78,728	$ 49,923	included
TOTAL OPERATING COSTS	***$/year***	***$ 95,698***	***$ 238,540***	***$ 304,148***	***$ 208,913***	***$ 313,500***

Appendix E Adopted Desired Standards of Service

Appendix E Recommended Desired Standards of Service (Water)

WATER NETWORK DSS			
Parameter	**Criteria**		
Water Demand			
Average Day demand	On demand areas - 260 L/EP/d. Based on 230 L/EP/d + allowance for leakage/losses (30 L/EP/d).		
	Constant flow areas - 180 L/EP/d. Based on 130 L/EP/d + allowance for leakage/losses (50 L/EP/d).		
Peaking factors	**MDMM/AD**	**MD/AD**	**MH/AD**
Residential detached	1.4	1.7	3.8
Residential attached	1.3	1.6	3.1
Rural residential	1.4	1.7	CF services 70 L/hr/ET
Commercial	1.2	1.3	2.0
Industry	1.2	1.3	1.7
Parks / Open Space	1.2	1.3	1.7
System planning			
Bulk supply and reticulation	3 days of MDMM. Reservoirs to have a net positive inflow and capable of continuous operation and not fall below the emergency level. 3 days of MD. Reservoirs should not fall below the emergency level. 5 days of AD. Reservoirs should fill from empty to full		
Minimum service pressure			
Minimum operating pressure at MH	On demand areas – 22m at the property boundary based on reservoir at minimum operating level (MOL). MOL defined as 15% of storage height or top of emergency storage		
	Constant flow areas – 10m at the property boundary based on reservoir at minimum operating level (MOL) MOL defined as 15% of storage height or top of emergency storage.		
Maximum operating pressure	80 m at the boundary based on the reservoir at TWL		
Target pressure	55 m at the property boundary based on the reservoir level at TWL		
Fire fighting			
System pressure	On demand areas – 12 m minimum at property boundary		
	Constant flow areas – no fire service provided		
Fire flow	Residential – 15l/s for 2 hrs Commercial & Industrial – 30 l/s for 4 hrs Special risk / hazard to be advised by Allconnex Water		
Background demand	2/3 MH (as per DERM requirements)		
Reservoir level	MOL		
Number of fires	<5000 EP – single fire for residential or industrial / commercial >5000 EP – simultaneous single residential fire plus single commercial / industrial fire for sizing trunk mains		

Reservoir storage	
Ground level storage capacity	3 (MD - MDMM) + (Greater of emergency storage/fire fighting storage) Emergency Storage = the greater of 4 hr MDMM demand in zone or 0.5 ML whichever is greater. *Where Fire Fighting Reserve is:* ***> 4800EP:*** • CF services for rural residential 72 kL (2 x 5 L/s x 2hrs); • for industry, business 540 kL (i.e. 30 L/s x 4hrs + 15 L/s x 2hrs) otherwise 210 kL (2 x 15L/s x 2hrs). **< 4800 EP:** • CF services 36 kL (15L/s x 2 hrs); for business & industry 432 kL (30L/s for 4 hrs); otherwise 150kL (= 15 L/s for > 2hrs).
Elevated storage capacity	6(MH - 1/12 MDMM) + minimum fire fighting reserve. *Where fire fighting reserve is:* > **4800EP**: • CF services for rural residential 72 kL (2 x 5 L/s x 2hrs); • for industry, business 540 kL (i.e. 30 L/s x 4hrs + 15 L/s x 2hrs) • otherwise 210 kL (2 x 15L/s x 2hrs). < **4800 EP**: • CF services 36 kL (15L/s x 2 hrs); • for business & industry 432 kL (30L/s for 4 hrs); • otherwise 150kL (= 15 L/s for > 2hrs).
Pumping capacity	
Pump supplying a ground level reservoir	MDMM over 20 hr
Pump supplying an elevated reservoir	(6MH – operating volume) / (6 x 3600)
Standby pump capacity	To match duty, except where more than one duty pump or as determined by risk assessment
Reticulation booster pumps/pumped system	MH + fire flow
Pipeline design	
Main capacity	Raw water mains & trunk feeding ground level reservoir : MDMM for a gravity supply and MDMM over 20hrs for a pumped supply Trunk Mains feeding elevated reservoir: capacity of pumps Reticulation Mains: MH + fire flow
Mains size	Constant flow areas - where mains terminate in short runs such as cul de sacs minimum sizes that may be acceptable are: DN 63 up to 150 m from main DN 80 up to 350 m from main
	On demand areas - minimum reticulation main 100mm in residential areas and 150mm in commercial and industrial areas
Friction default value	Hazen Williams Distribution: <300mm, C=110 300mm – 600mm, C=120 >600mm, C=125 Reticulation: <= 150mm, C=100 200mm - 300mm, C=110 >300mm, C=120
Maximum velocity	2.5 m/s
Water quality	
Drinking water quality	Drinking water to comply with the NHMRC Australian Drinking Water Guidelines – 2004.

Appendix 6 Recommended Desired Standards of Service (Wastewater)

WASTEWATER NETWORK DSS		
Parameter	**Criteria**	
Sewage load		
ADWF	200L/EP/day	
PDWF	2 x ADWF	
PWWF	Residential 1300 L/EP/d For CED PWWF = 660 L/EP/d	
	Commercial 1300 L/EP/d	
	Light Industrial 1000 L/EP/d	
	Heavy Industrial 840 L/EP/d	
Gravity sewer design		
Flow equation	Manning's 'n' or Colebrook White can be used. For modelling Colebrook - White is preferred.	
Pipe roughness general	Manning's 'n' =0.013 or Colebrook White k = 1.5mm	
Minimum velocity @ PDWF	0.35m/s	
Maximum velocity @ PWWF	3 m/s	
Depth of flow @ PWWF - Existing	Up to 1m below MH surface level and no spillage through overflow structures	
Depth of flow @ PWWF - Proposed	75% of pipe depth	
Minimum grades	**Diameter**	**Grades (mm, 1 in X)**
	150	150 (80 in last section between last manholes or to an end)
	225	290
	300	400
	375	500
	450	600
	525	700
	600	850
	675	925
	750	1000
	825	1000

	900	1090
	1050	1270
	1200	1450
Sewerage pump stations		
Wet well operating requirements	V (m^3) = 0.9 x pump rate (L/s) / N Where N is the acceptable number of starts per hour Pump Rate (L/s) = capacity of the largest duty pump N = 12 for motors <= 15 kW N = 8 for motors 15kW - 200 kW N = 5 for motors > 200 kW Control levels shall be based on Table 5.1 of WSA04-2005. The minimum depth between duty start and duty off is 100mm and ideally should be 300mm or greater.	
Emergency storage	4 hours of ADWF (local gravity catchment only) Except where otherwise specified to meet the requirements of the overflow risk assessment If there is an overflow pipe - storage in the system is measured between the alarm level and overflow pipe invert level. If there is no overflow pipe - storage is measured between the alarm level and 300mm below the lowest upstream manhole or top of wet well.	
Pump capacity	If PWWF <20L/s, then 2 pumps (duty/standby arrangement) shall be provided, with each pump being capable of delivering PWWF. If PWWF >20L/s and <200L/s, then 2 pumps (duty/duty assist arrangement) shall be provided, with each pump being sized such that the two pumps running in parallel are capable of delivering PWWF. It is desirable that a single pump be sized on C_1 if appropriate. i.e. From QDNRM. C_1 = 15 x $EP^{-0.1587}$ minimum 3.5, maximum 6.5. If PWWF >200L/s, then minimum of 3 pumps (duty/duty assist/standby arrangement) shall be provided. Duty/duty assist pumps being capable of delivering PWWF with each pump being sized in consultation with Allconnex Water.	
Pump operation	VSD shall only be used, subject to special approval from Allconnex Water. If approved by Allconnex Water, the VSD operating regime shall be selected to ensure sufficient self-cleansing velocities, and shall meet the pump supplier's requirements.	
NPSH	***Refer Clause 6.4 of WSA04-2005***	
Rising mains		
Flow equation	Hazen Williams or Colebrook-White. For modelling Colebrook - White is preferred	
Friction mains	100mm – 300mm diameter, C =110 > 300mm diameter, C =130 Colebrook-White to follow method in **WSA04**. The pump curve shall include the minimum static head with C=140 to confirm that the pump operates over the full range (i.e. to the overflow level) in the wet well.	
Minimum velocity	Minimum velocity shall be not less than 0.9m/s, but preferred minimum is 1.5m/s. ***Refer Clause 10.3.5 of WSA04-2005***	
Maximum velocity	2.5 m/s proposed systems	
Max detention time	Maximum time of detention in pressure main and SPS wet well is 6 hours [2 hours in wet well and 4 hours in rising main] (based on daily average flows) to minimise potential for odour / hydrogen sulphide generation. Where high retention times are likely to occur, odour / sulphide control measures will be required to the satisfaction of Allconnex Water. ***(Refer WSA 07-2007-1.1 section 3.15)***	
Reduced infiltration gravity sewers (RIGS)		
As per gravity sewers except	Not permitted without Allconnex Water approval	

PWWF	1000L/EP/d
Single Pump Capacity	Standard: C_1 x ADWF
	C_1 = 9.322 x $EP^{-0.1249}$ minimum 3.0, maximum 4.
Total PS Capacity	1000L/EP/d
Low pressure sewers / vacuum pumps	
Low pressure sewers / vacuum pumps	Are not preferred and will only be allowed subject to approval from Allconnex Water.
Private pump stations and rising mains	
	Private pump stations and rising mains are permitted for single users only and no connection or sharing will be permitted without approval from Allconnex Water
Common effluent discharge	
Common effluent discharge (CED)	Not permitted without approval from Allconnex Water.