Appendix A

Central Coast Water Supply Headworks Development Servicing Plan 2019

Central Coast Council

Development Servicing Plan -Water Headworks 2019

Version 1.0

Satpal Singh

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1. Introduction

The purpose of this Development Servicing Plan (DSP) is to determine the headworks component of development charges applicable to the proposed new developments within the North and South regions of the Central Coast Council.

This plan has been prepared in accordance with the requirements of the Water Management Act 2000, using the methodology and parameters determined by the Independent Pricing and Regulatory Tribunal's Determination in October 2018 for Central Coast Council for levying maximum developer charges.

2. Area of the Plan

All lands contained within the Central Coast Council Local Government areas serviced by Water Supply headworks may be subject to this DSP. Local area DSPs where applicable will refer to this DSP for headworks component of developer charges.

3. Population and Equivalent Water Tenement Projection

Council has engaged *.id consulting* for its demographics analysis based on latest available Australian Bureau of Statistics (ABS) Census data. *.id* has provided population forecast figures for central coast council's North (former Wyong Shire Council LGA) and South (former Gosford City Council LGA) regions. *.id* has provided population projection up to 2036 only.

Further population projection from 2037 to 2050 is based on previous studies done for sewerage master plan of both North and South regions. The 2036 population has been linearly extrapolated at 1.39% and o.4% annual growth rates respectively for the Northern and Southern Regions. A small fraction of population is not connected to council's water services therefore both North and South population have been suitably modified to calculate serviced population.

Tenement projection has been done based on 150KL/tenement average annual water demand as per directions from IPART. The water demand patterns of both North and South regions are slightly different to each other which may further depart in future because of higher scope of growth of BASIX (more water efficient) housing in the northern region than the south.

Table 1 below summarises serviced population projection for the North and South regions. The individually climate corrected demand of both regions (239.5 l/c/d for North and 230 l/c/d for South) has been used to forecast water demand for both regions which is further used for calculating total equivalent water tenements.

Table 1 Population and tenement Projection

Year	North Total Population	South Total Population	North Serviced Population	South Serviced Population	North Tenements	South Tenements	Total Tenement
30/6/2021	173,178	176,428	171,446	174,664	99,916	97,966	197,882
30/6/2026	187,806	180,345	185,928	178,542	108,356	100,141	208,497
30/6/2031	204,810	182,955	202,762	181,125	118,166	101,590	219,756
30/6/2036	221,707	186,176	219,490	184,314	127,915	103,379	231,294
30/6/2041	237,551	189,931	235,175	188,032	137,056	105,464	242,520
30/6/2046	254,526	193,761	251,981	191,823	146,850	107,590	254,440
30/6/2049	265,288	196,095	262,635	194,134	153,059	108,887	261,946
30/6/2050	268,976	196,879	266,286	194,910	155,187	109,322	264,509

4. Reference to Other Development Servicing Plans

The development charge for the headworks component determined by this DSP will be included in all applicable North and South region DSP charges.

5. Estimates of Capital and Operation Costs

The capital costs are taken as Gross Replacement Costs of each of the Joint Headworks Assets are as per: 12099 - JWS W&S Final Report 29.09.16 and Gosford-Wyong JWS Fair Value Estimates - Dams & Weirs Final Report 07.06.2016. Assets Costs are determined by using Modern Engineering Equivalent Replacement Asset (MEERA) approach. These costs are further indexed as per June 2019 Update - NSW Water Supply and Sewerage Construction Cost Indices of NSW Reference Rates Manual.

The annual value charges are calculated using 0% discount rate for pre-1996 assets and 4.9% discount rate (real pre-tax WACC as in the prevailing IPART price determination) for post-1996 assets as per IPART's final report on "*Maximum prices to connect, extend or upgrade a service for metropolitan water agencies October 2018*."

Operating costs are not relevant to this DSP and are detailed in each Local Area DSP.

6. System Demand

Council has used iSDP (Integrated Supply Demand Model) for demand forecast. The iSDP model was first developed by the Institute for Sustainable Futures (ISF), part of the University of Technology Sydney, for Sydney Water Corporation (SWC) in the late 1990s to enable SWC to conduct a detailed water planning exercise. This included both the development of a detailed demand forecast and development of a broad range of demand management and supply options. The model was subsequently modified by SWC and later released in 2003 as the Water Services Association of Australia (WSAA) end use model (EUM). The tool, now

known as the iSDP model, has been further developed by ISF and CSIRO, and applied to numerous cities across Australia. The model is currently used as a planning tool by various large water service providers. Hunter Water who is working closely with Central Coast Council for long term water resources planning is using iSDP model for water demand forecasting.
Council has used iSDP for water sales forecast for recent IPART Water Pricing submission/ determination. The model assumptions have been suitably updated to use it forecasting long term water demand forecasting. The forecast demand is provided in the table below.

Table 2 Projected Water Demand for Central Coast Council

Year	Annual Average Demand ML/year	Average Day Demand ML/day	Peak Day Demand ML/day
30/6/2021	31,397	86	193
30/6/2026	32,829	90	202
30/6/2031	34,443	94	212
30/6/2036	36,194	99	223
30/6/2041	37,978	104	234
30/6/2046	39,900	109	246
30/6/2050	41,534	114	256

7. System Yield

The System Yield of 46,000 ML/year was adopted for the DSP in 2014. Since then council has reworked its system yield with combined system modelling with Hunter Water Corporation which has drastically reduced to 35,400ML/year. Council has also updated its Rainfall Runoff Model for Central Coast water catchments with latest SILO (Scientific Information for Land Owners, owned by Queensland Government) climate data using eSource platform. The rainfall runoff modelling has resulted in lower steam flows than predicted by the previous studies.

Council is currently in the process of building a joint WATHNET model with Hunter Water for system yield analysis but in the meantime the most relevant estimate of system yield (including Hunter Water connection contribution) is 35,400ML/year. While the current agreement with Hunter Water for inter-regional water sharing expires in 2026, it assumed for the purpose of this DSP that the provision for inter-regional water transfers will continue beyond 2026.

The predicted demand exceeds the above described system yield in 2034. A provision of Nominal Yield increase of 7,000 ML/year is proposed in future infrastructure works, enhancing the System Yield to 42,400ML/year

Total existing water treatment and distribution capacity provided for in the DSP is 300 ML/day which is sufficient to meet the peak day demand up to 2050.

The following graphs provide details of annual demand versus yield over time and peak day demand versus treatment capacity over time.

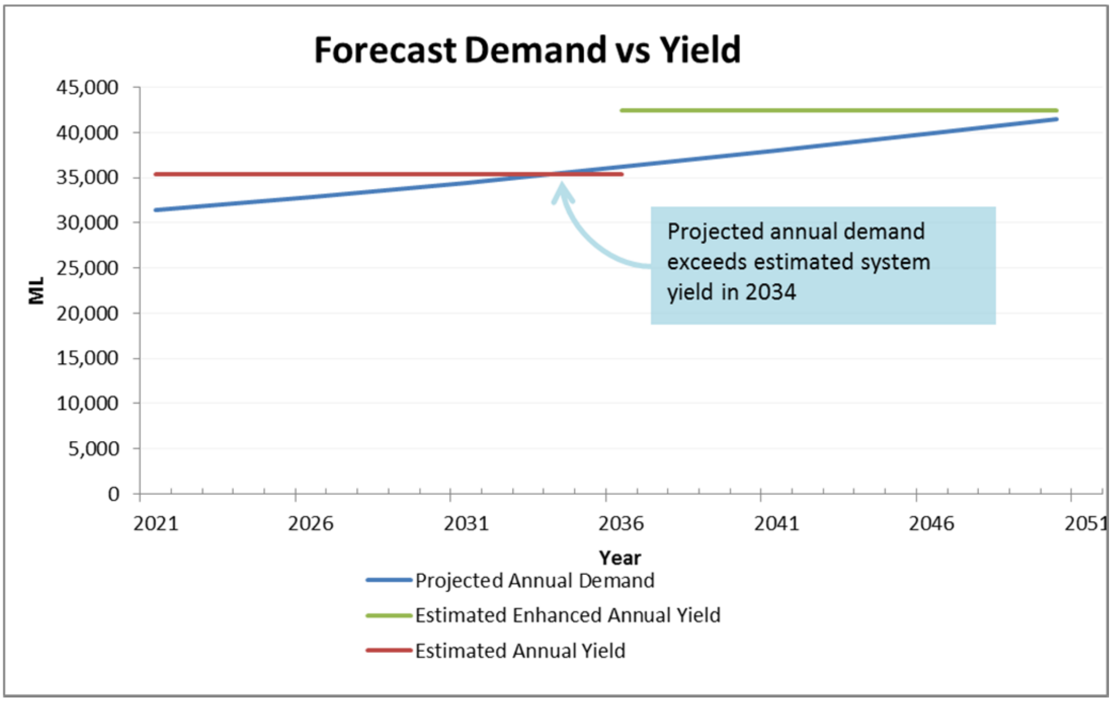

Figure 1 Forecast Demand versus System Yield

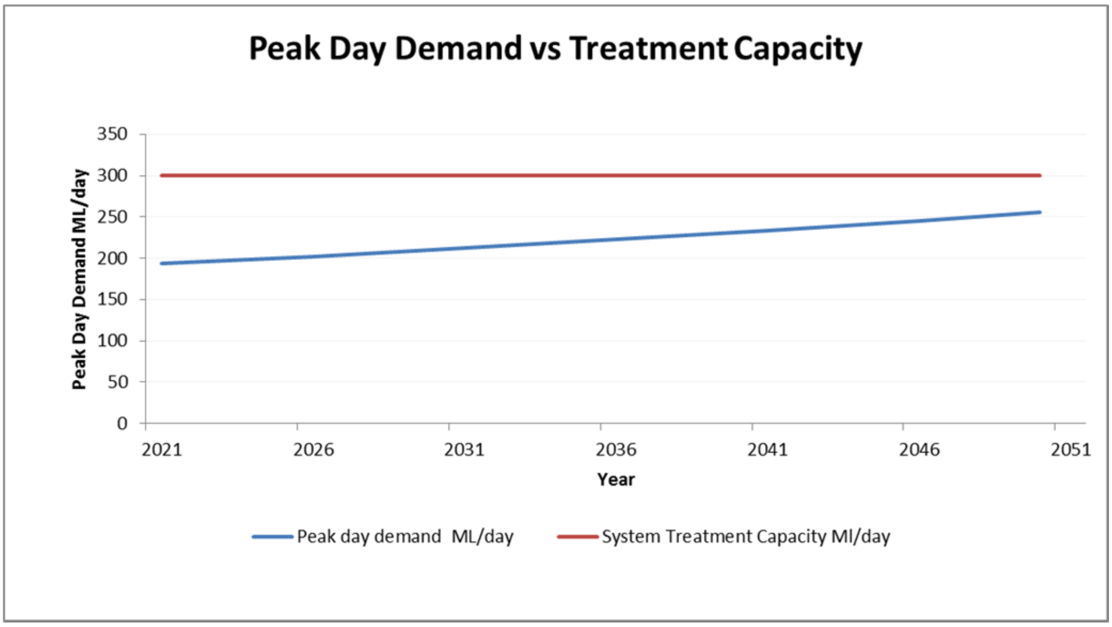

Figure 2 Theoretical Peak Day Demand versus Central Coast Water Treatment Capacity

8. Method of Reviewing/Updating Developer Charges

The Developer Charges determined in this DSP are incorporated in North and South Water DSPs developed by Central Coast Council. The value of charges payable under the Development Servicing Plan will be held constant in real terms for the life of the Plan by the adjustments specified within Local Area DSPs.

9. Calculation of Development Service Charges

The 2018 Calculation Template provided by IPART has been used to calculate maximum charges that can be levied for the headworks component of developer charges on new developments.

Headworks development service charges assessed on the basis of one equivalent tenement (ET) are determined as $3,933/ET.

10. References

The following Reports provide the basis upon which the need and capacity of capital works have been assessed:

i. PWD Report on Investigations for Water Supply to the Gosford – Wyong Region, January 1975.

ii. PWD Report on Investigations for Water Supply to the Gosford – Wyong Region, July 1985.

iii. WaterPlan 2050 with supporting documents

iv. DPWS Report on Mardi Dam Condition Assessment of Intake Tower and Outlet Pipe August 2000.

v. Gosford Wyong Water Supply Desalination Project Concept Design Report July 2005

vi. Mangrove-Enlarge-Options-Report-Draft-V2-130802-PlusAppendix July 2013

vii. Forecast.id Report on Central Coast Council Population and Household Forecasts December 2017

viii. Maximum prices for connecting, or upgrading a connection, to a water supply, sewerage, or drainage system- Sydney Water, Hunter Water and Central Coast Council October 2018

Central Coast Council Water Supply Headworks Development Servicing Plan

CALCULATION OF MAXIMUM PRICE

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Note: an input is required in F21 to incorporate the Headwork costs per ET into the maximum price.

Table 1: Calculation of maximum price ($, $2019-20)

Maximum price		Headworks costs per ET	Pre-1996 assets	Post-1996 commissioned assets	Post-1996 uncommissioned assets	Reduction for expected revenue and operation costs
	Costs to be recovered via DSP		257,145,045	125,963,168	25,234,269	0
	ETs		102,076	106,944	106,944	106,944
3,933	Value per ET		2,519	1,178	236	0

Table 2: Key variables used in maximum price calculation ($, $2019-20)

Sum of new ETs (not discounted)	Sum of PV of new ETs (discounted at pre-1996 asset discount rate)	Sum of PV of new ETs (discounted at post-1996 asset discount rate)	Sum of PV of new ETs (discounted at expected revenue and costs discount rate)	Sum of PV of Pre-1996 commissioned assets (discounted at pre-1996 asset discount rate)	Sum of PV of Post-1996 commissioned assets (discounted at post-1996 asset discount rate)	Sum of PV of Post-1996 uncommissioned assets (discounted at post-1996 asset discount rate)	Sum of PV of revenue for new customers (discounted at expected future revenue and costs discount rate)	Sum of PV of costs for new ETs (discounted at expected future revenue and costs discount rate)
102,076.149	102,076	106,944	106,944	257,145,045	125,963,168	25,234,269	0	0

PRE-1996 ASSETS WITH A NEXUS TO THE SERVICE FOR WHICH THE MAXIMUM PRICE IS BEING CALCULATED

Consideration must be given to the principles regarding asset exclusions presented on the 'Asset exclusions' worksheet before they are entered into the register
Hyperlink to the 'Asset exclusions' worksheet: Asset exclusions'!A1

Date range for assets

Start date	01 Jan 1970
End date	31 Dec 1995

Register of pre-1996 assets

General inputs | **Service potential inputs** | **Asset value inputs**

Identifier	Description	Date commissioned	Date check	DSP areas serviced by asset	Expected system-wide ETs to be serviced by this asset	Proportion of asset cost to be recovered via this DSP	Number of units or length of asset (A)	Unit of measure in (A)	MEERA value per unit/measure of length (B) ($ as at 1 July 2019)	Total MEERA value (A x B) ($, $2019-20)	MEERA value to be recovered via DSP ($, $2019-20)
Raw Water Yield			-			-				-	-
	Mangrove Dam	1 January 1982	Date check - OK		261,946	39.0%	1		156,157,726	156,157,726	60,852,158
	Mardi Dam	1 January 1970	Date check - OK		261,946	39.0%	1		23,714,516	23,714,516	9,241,166
	Mangrove Creek Weir	1 January 1975	Date check - OK		261,946	39.0%	1		4,038,323	4,038,323	1,573,670
	Lower Wyong River Weir -Structure Upgrade	1 January 1990	Date check - OK		261,946	39.0%	1		83,383	83,383	32,493
	Ourimbah Creek Upper Weir	1 January 1979	Date check - OK		261,946	39.0%	1		1,359,603	1,359,603	529,816
	Ourimbah Creek to Mardi Dam WMR	1 January 1979	Date check - OK		261,946	39.0%	1		10,060,172	10,060,172	3,920,287
	Boomerang Creek Tunnel	1 January 1989	Date check - OK		261,946	39.0%	1		140,872,727	140,872,727	54,895,839
	Ourimbah Ck Tunnel	1 January 1979	Date check - OK		261,946	39.0%	1		5,255,000	5,255,000	2,047,789
	Mangrove Creek Pumping Station	1 January 1975	Date check - OK		261,946	39.0%	1		19,612,139	19,612,139	7,642,536
	Mangrove Creek PS to Somersby BalanceTanks WMR	1 January 1975	Date check - OK		261,946	39.0%	1		45,941,312	45,941,312	17,902,591
	Ourimbah Creek Pumping Station (WPS11)	1 January 1979	Date check - OK		261,946	39.0%	1		3,466,198	3,466,198	1,350,722
			-			-				-	-
Treatment and Transfer			-			-				-	-
	Somersby WTP Stage 1	1 January 1971	Date check - OK		261,946	39.0%	1		32,561,814	32,561,814	12,688,816
	Somersby Balance Tank 2	1 January 1971	Date check - OK		261,946	39.0%	1		3,947,031	3,947,031	1,538,094
	Kariong Reservoir No 1(K1)	1 January 1973	Date check - OK		261,946	39.0%	1		5,014,111	5,014,111	1,953,918
	Balance Tanks to Somersby WTP WM Treated Upgrade	1 January 1975	Date check - OK		261,946	39.0%	1		10,797,449	10,797,449	4,207,592
	Coastal Connection	1 January 1977	Date check - OK		261,946	39.0%	1		6,938,702	6,938,702	2,703,901
	Somersby WTP to K2 TM- Upgrade	1 January 1978	Date check - OK		261,946	39.0%	1		10,040,729	10,040,729	3,912,711
	K2 to North Gosford TM- Upgrade	1 January 1979	Date check - OK		261,946	39.0%	1		8,854,675	8,854,675	3,450,525
	Mardi Dam to Mardi WTP WM Treated	1 January 1982	Date check - OK		261,946	39.0%	1		1,965,896	1,965,896	766,078
	Mardi WTP Stage I: 80 ML/d	1 January 1982	Date check - OK		261,946	39.0%	1		42,950,227	42,950,227	16,737,013
	Somersby WTP Stage 2	1 January 1986	Date check - OK		261,946	39.0%	1		29,997,508	29,997,508	11,689,547
	Gosford -Wyong (Tuggerah 2) TM	1 January 1986	Date check - OK		261,946	39.0%	1		45,167,566	45,167,566	17,601,075
	Mardi WTP to Tuggerah 2 TM	1 January 1986	Date check - OK		261,946	39.0%	1		5,877,192	5,877,192	2,290,247
	Kariong Reservoir No 2 (K2)	1 January 1986	Date check - OK		261,946	39.0%	1		19,910,144	19,910,144	7,758,663
	Tuggerah 2 Reservoir	1 January 1986	Date check - OK		261,946	39.0%	1		15,114,431	15,114,431	5,889,851
	Forresters Beach Pumping Station	1 January 1987	Date check - OK		261,946	39.0%	1		1,375,162	1,375,162	535,879
	Ourimbah Pumping Station (WPS17)	1 January 1987	Date check - OK		261,946	39.0%	1		217,347	217,347	84,697
	Mardi WTP Stage II: 80 ML/d	1 January 1994	Date check - OK		261,946	39.0%	1		8,589,967	8,589,967	3,347,372
			-			-				-	-
			-			-				-	-

POST-1996 COMMISSIONED ASSETS WITH A NEXUS TO THE SERVICE FOR WHICH THE MAXIMUM PRICE IS BEING CALCULATED

Consideration must be given to the principles regarding asset exclusions presented on the 'Asset exclusions' worksheet before they are entered into the register.
Hyperlink to the 'Asset exclusions' worksheet: Asset exclusions'!A1

Date range for assets

Start date	01 Jan 1996
End date	30 Jun 2019

Register of post-1996 commissioned assets

General inputs | **Service potential inputs** | **Asset value inputs**

Identifier	Description	Date commissioned	Financial year of commissioning		Expected system-wide ETs to be serviced by this asset	Proportion of asset cost to be recovered via this DSP	Number of units or length of asset (A)	Unit of measure in (A)	MEERA value per unit/measure of length (B) ($ as at 1 July 2019)	Total MEERA value (A x B) ($, $2019-20)	MEERA value to be recovered via DSP ($, $2019-20)
Raw Water Yield			-			-				-	-
	Mangrove Dam - Communications Upgrade	01 Jan 2010	2009-10		261,946	39.0%	1		395,416	395,416	154,087
	Mardi Dam Upgrades	01 Jan 2012	2011-12		261,946	39.0%	1		18,185,994	18,185,994	7,086,790
	Mooney Dam Upgrades-Instrumentation, Destratification and other minor works	01 Jan 2004	2003-04		261,946	39.0%	1		270,269	270,269	105,319
	Mangrove Creek Electrical Upgrades Works	01 Jan 2004	2003-04		261,946	39.0%	1		37,692	37,692	14,688
	Lower Wyong River Weir -Fishwayand other Upgrade	01 Jan 2010	2009-10		261,946	39.0%	1		1,429,042	1,429,042	556,875
	Ourimbah Creek Upper Weir- Fishway Upgrade	01 Jan 2007	2006-07		261,946	39.0%	1		637,781	637,781	248,533
	Lower Wyong PS to Mardi Dam WMR -Upgrade pipeline DN1000	01 Jan 2006	2005-06		261,946	39.0%	1		8,102,685	8,102,685	3,157,486
	Mardi Dam to Mangrove Dam WMR	01 Jan 2011	2010-11		261,946	39.0%	1		91,713,571	91,713,571	35,739,305
	Boomerang Creek Tunnel Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		234,533	234,533	91,394
	Mangrove Creek Pumping Station -Electrical Control Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		164,002	164,002	63,909
	Mooney Mooney Pumping Station- Electrical Control Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		158,701	158,701	61,843
	Mooney Pumpstation and Power upgrade	01 Jan 2016	2015-16		261,946	39.0%	1		3,397,358	3,397,358	1,323,896
	Mangrove Creek PS to Somersby BalanceTanks WMR-Upgrade	01 Jan 2007	2006-07		261,946	39.0%	1		426,706	426,706	166,280
	Wyong River WPS 1A	01 Jan 2012	2011-12		261,946	39.0%	1		11,311,913	11,311,913	4,408,071
	Ourimbah Creek Pumping Station (WPS11) Electrical Control Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		169,842	169,842	66,185
	Mardi Dam to Mangrove Creek Dam Pumping Station WPS24	01 Jan 2012	2011-12		261,946	39.0%	1		7,539,559	7,539,559	2,938,045
			-			-				-	-
Treatment and Transfer			-			-				-	-
	Somersby WTP Electrical Control Upgrade 1	01 Jan 2004	2003-04		261,946	39.0%	1		904,888	904,888	352,620
	Somersby WTP Electrical Control Upgrade 2	01 Jan 2004	2003-04		261,946	39.0%	1		2,020,896	2,020,896	787,511
	Mardi WTP-Elecrtical Control Upgrade 1	01 Jan 2004	2003-04		261,946	39.0%	1		1,920,427	1,920,427	748,360
	Mardi WTP-Elecrtical Control Upgrade 2	01 Jan 2004	2003-04		261,946	39.0%	1		486,884	486,884	189,731
	Somersby Balance Tank 1 Electrical Control Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		83,029	83,029	32,355
	Somersby Balance Tank 2 Electrical Control Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		142,936	142,936	55,700
	Kariong Reservoir No 1(K1) Electrical Power Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		156,599	156,599	61,024
	Kariong Reservoir No 2 (K2 -Electrical Power Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		192,333	192,333	74,949
	Tuggerah 2 Reservoir Electrical Power Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		126,120	126,120	49,147
	Forresters Beach Pumping Station Electrical Power Upgrade	01 Jan 2004	2003-04		261,946	39.0%	1		68,807	68,807	26,813
	Woy Woy WTP for Groundwater Bores	01 Jan 2007	2006-07		261,946	39.0%	1		9,735,059	9,735,059	3,793,596
	Hunter Connection	01 Jan 2007	2006-07		261,946	39.0%	1		21,297,039	21,297,039	8,299,114
	Somersby WTP Civil and Metal Upgrade	01 Jan 2008	2007-08		261,946	39.0%	1		1,099,601	1,099,601	428,497
	Mardi WTP- Civl/ Mech/Elec Upgrade	01 Jan 2008	2007-08		261,946	39.0%	1		1,592,590	1,592,590	620,607
	Mardi Dam to Mardi WTP Pumping Station WPS23	01 Jan 2010	2009-10		261,946	39.0%	1		5,037,338	5,037,338	1,962,970
	High Lift Pump Station WPS25	01 Jan 2011	2010-11		261,946	39.0%	1		9,936,469	9,936,469	3,872,082
	Ourimbah Pumping Station (WPS17) Electrical Power Upgrade	01 Jan 2013	2012-13		261,946	39.0%	1		1,197,930	1,197,930	466,814
			-			-				-	-

POST-1996 UNCOMMISSIONED ASSETS WITH A NEXUS TO THE SERVICE FOR WHICH THE MAXIMUM PRICE IS BEING CALCULATED

Consideration must be given to the principles regarding asset exclusions presented on the 'Asset exclusions' worksheet before they are entered into the register.
Hyperlink to the 'Asset exclusions' worksheet: Asset exclusions'!A1

Date range for assets
Start date 01 Jul 2019

Register of uncommissioned assets

General inputs				Service potential inputs			Asset value inputs				
Identifier	Description	Date commissioned	Financial year of commissioning	DSP areas serviced by asset	Expected system-wide ETs to be serviced by this asset	Proportion of asset cost to be recovered via this DSP	Number of units or length of asset (A)	Unit of measure in (A)	MEERA value per unit/measure of length (B) ($ as at 1 July 2019)	Total MEERA value (A x B) ($, $2019-20)	MEERA value to be recovered via DSP ($, $2019-20)
Future Yield Augmentation			-			-				-	-
	Mardi to Warnervale Pipeline (M2WPL)	30 Jun 2021	2020-21		261,946	39.0%	1		13,714,819	13,714,819	5,344,445
	Future Yield Augmentation (DESAL)	30 Jun 2034	2033-34		261,946	39.0%	1		100,970,000	100,970,000	39,346,387
			-			-				-	-
			-			-				-	-

Appendix B

Water Supply Capital Works Summary

Components	Diameter (mm)	Length (m)	Unit Cost ($/m)	Cost ($)	2007 Forecast Year	Equivalent Population	New Forecast Year (ID 2017 Data)	Total Cost
The Entrance Area								
Bellevue Rd - The Entrance Rd through proposed subdivision - 2014	200	625	328.94	$205,587.50	2014	174080	2020	$205,587.50
Bellevue Rd - The Entrance Rd through proposed subdivision - 2014	250	712	393.67	$280,293.04	2014	174080	2020	$280,293.04
Water main - Brogden Rd Nth Entrance 2015	200	150	328.94	$49,341.00	2015	176740	2021	$49,341.00
Water main - Warrigal / Benelong St 2015	200	220	328.94	$72,366.80	2015	176740	2021	$72,366.80
Water main - Narrawa Ave - 2015	200	210	328.94	$69,077.40	2015	176740	2021	$69,077.40
Water main - Fairport Ave - 2015	200	250	328.94	$82,235.00	2016	179400	2022	$82,235.00
Water main - Beenbah Ave - 2016	200	240	328.94	$78,945.60	2016	179400	2022	$78,945.60
Water main - Anzac Ave - 2016	200	120	328.94	$39,472.80	2016	179400	2022	$39,472.80
Water main - Archbold Rd - 2016	200	120	328.94	$39,472.80	2016	179400	2022	$39,472.80
Water main - Kitchener Rd - 2016	200	200	328.94	$65,788.00	2016	179400	2022	$65,788.00
Water main - Stella, Bay Rd & Pacific St -2016	200	740	328.94	$243,415.60	2016	179400	2022	$243,415.60
Water main - Yethonga St - 2015	200	120	328.94	$39,472.80	2015	176740	2021	$39,472.80
Water main - Oaks Ave - 2015	200	380	328.94	$124,997.20	2015	176740	2021	$124,997.20
Water main - Denning St, Bay Rd & Boondilla - 2009	200	770	328.94	$253,283.80	2015	176740	2021	$253,283.80
Northern System Distribution Upgrades								
Trunk Main Mardi-Warnervale	750	8900					2021	$47,601,162.79
Water Mains DN 200mm - 2011 Modelling Map	200	4315	328.94	$1,419,376.10	2016	179400	2022	$1,419,376.10
Water Mains DN 200mm - 2016 Modelling Map	200	4845	328.94	$1,593,714.30	2016	179400	2022	$1,593,714.30
Water Mains DN 375 WTC - 2016 Modelling Map	375	1390	540.22	$750,905.80	2016	179400	2022	$750,905.80
Water Mains DN 450mm Kiar Ridge Reservoir to M2W Pipeline - 2016 Map	450	4435	665.58	$2,951,847.30			2023	$2,951,847.30
Water Mains DN 200mm - 2021 Modelling Map	200	3110	328.94	$1,023,003.40	2021	193600	2026	$1,023,003.40
Water Mains DN 250mm - 2021 Modelling Map	250	1080	393.67	$425,163.60	2021	193600	2026	$425,163.60
Water Mains DN 375mm - 2021 Modelling Map	375	1910	540.22	$1,031,820.20	2021	193600	2026	$1,031,820.20
Water Mains DN 200mm - 2026 Modelling Map Incl 150mm duplications	200	6610	328.94	$2,174,293.40	2026	207800	2031	$2,174,293.40
Water Mains DN 600mm - Northern Link Main - 2026 Modelling Map	600	6240	927.69	$5,788,785.60	2026	207800	2031	$5,788,785.60
Water Mains DN 200mm - 2031 Modelling Map	200	990	328.94	$325,650.60	2031	220100	2034	$325,650.60
Water Mains DN 300mm - Nth Reticulation Ring Main -2031 Map	300	300	460.44	$138,132.00	2031	220100	2034	$138,132.00
Water Mains DN 200mm - 2041 Modelling Map - Incl Wyee to Link Road	200	4940	328.94	$1,624,963.60	2041	234540	2036	$1,624,963.60
Water Mains DN 200mm - 2046 Modelling Map	200	1470	328.94	$483,541.80	2046	236700	2041	$483,541.80
Water Mains DN 200mm Hakone Road Linkage	200	115	328.94	$37,828.10			2025	$37,828.10
Water Mains DN 200mm Louisiana Road to Minnesota Rd Linkage	200	435	328.94	$143,088.90			2021	$143,088.90
Water Mains DN 250mm Louisiana Road Rd Linkage	250	325	393.67	$127,942.75			2025	$127,942.75
Water Mains DN 250mm Georgia Drive to Pac Hwy Linkage	250	400	393.67	$157,468.00			2021	$157,468.00
Wadalba Area								
Water Mains - Murrawal Rd / Wahroonga Rd / Louisiana Rd Ring Main	200	1720	328.94	$565,776.80			2026	$565,776.80
Water Mains - Jensen Rd	200	1850	328.94	$608,539.00			2021	$608,539.00
Water Mains - Johns Rd to Jensen Rd	200	950	328.94	$312,493.00			2021	$312,493.00
Lake Munmorah								
Water Mains - Darkinjung - Chainvalley Bay Rd (West)	200	908	328.94	$298,677.52			2026	$298,677.52
Water Mains - Darkingjung - Chainvalley Bay Rd (East)	200	707	328.94	$232,560.58			2026	$232,560.58
Gwandalan								$0.00
Water Main - Cams Bvde (between Summerland Rd and Kanangra Dr)	200	770	328.94	$253,283.80			2021	$253,283.80
Water Main - Ring Main Precinct 20	200	1500	328.94	$493,410.00			2025	$493,410.00
Doyalson								
New subdivision - Between scenic Dr and Wentworth	200	1380	328.94	$453,937.20			2030	$453,937.20
New subdivision - North Doyalson RSL	200	1200	328.94	$394,728.00			2030	$394,728.00
Total								

Asset Name	Cap (ML)	Install Year PWD Report	Install Year iD 2014 Forecast	Install Year iD 2017 Forecast	Commissioning Date	GHD Estimate from Options Report ($2017)	2017 Rate Indexed to 2019/20
Kiar Ridge	15	2016	2023	2023	1/01/2023	$10,006,523	$10,376,764

Note: NSW Public Works Department of Commerce estimated the cost of the proposed Kiar Ridge Reservoir as part of their water modelling investigations completed in 2008.

The cost estimate was later updated as part of an investigation into intial options for the site by GHD which included geotechnical investigation.

Mardi to Warnervale Pipeline Funding

Total estimated cost from business case
$61,100,000

Previous proposals to fund a portion of the cost via a previously accumulated revenue variance and grant funding have not eventuated.

Total cost is now to be split between the Northern Distribution DSP and Central Coast Headworks DSP to represent the dual functionality of the pipeline.

Modelling investigations identified that the required diameter to service growth within the northern growth corridor was DN600mm. The upsize to allow inter-regional transfers as part of a yield augmentation is a DN750mm pipe. The upsize cost will be attributable to the Headworks DSP.

Table 1 - 2018 Reference rates manual

Reference Rates Tables

NSW Reference Rates Manual

Table 3 Water Mains - Steel

(See also Table 17 on page 35 for additional costs)

	Diameter (mm)	*Contract Rate ($/m) 2014*	*Reference Rate ($/m) 2014*
Trunk Mains Steel	***300***	400	440
	375	509	560
	450	591	650
	500	655	720
	600	782	860
	750	955	1 050
	900	1 180	1 300
	1 050	1 500	1 650
	1 200	1 770	1 950

	Reference Rate		
DN600mm	860 /m		
DN750mm	1050 /m		
Upsize cost %	22%		
			$2019/20
Northern Region Proportion	**78%**	**$47,601,163**	**$48,362,781**
Headworks Proportion	**22%**	**$13,498,837**	**$13,714,819**

Appendix C

Wyong Water Supply – Distribution System Review 2007

NSW Department of Commerce

NSW Water Solutions

WYONG WATER SUPPLY: DISTRIBUTION SYSTEM REVIEW

Prepared for:

WYONG SHIRE COUNCIL

NSW - WS Document No: DC07129
November 2007

Foreword

This report has been prepared for Wyong Shire Council by the Water Services unit of NSW Water Solutions Group, NSW Department of Commerce. Commerce acknowledges the input and assistance provided by Enn Karm and Daryl Mann of Wyong Shire Council.

This report presents a hydraulic review of development plans for Wyong Shire Council over the next 50 years.

The core Department of Commerce project team members involved in the preparation of this document were:

- Vu Dao
- Allan Young

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List of Abbreviations

AAD	- Average Annual Demand
ADD	- Average Daily Demand
CWT	- Clear Water Tank
GWCWA	- Gosford Wyong Councils Water Authority
HLPS	- High Lift Pumping Station
HWC	- Hunter Water Corporation
JWSS	- Joint Water Supply Scheme
LGA	- Local Government Area
ML	- Mega Litres
ML/d	- Mega Litres per day
MV	- Motorised Valve
m, mm	- metre, millimetre
PDD	- Peak Day Demand
PRV	- Pressure Reducing Valve
PS	- Pumping Station
WAE	- Works As Executed
WS	- Water Supply
WSC	- Wyong Shire Council
WTP	- Water Treatment Plant

1 INTRODUCTION

1.1 WYONG DISTRIBUTION SYSTEM

The Wyong Distribution System comprises of a network of water supply infrastructure owned and operated by Wyong Shire Council (WSC), situated on the Central Coast of New South Wales. This Local Government Area (LGA) is expecting significant population growth over the next few decades, along with a corresponding projected doubling of the current unrestricted Peak Day Demand (PDD) of approximately 70 ML/d, by 2051. Increased demand of this scale has necessitated an evaluation of the capacity of existing infrastructure to be performed, along with the development of a viable plan for future augmentation in line with these forecasts.

1.2 EXISTING WATER SUPPLY INFRASTRUCTURE

At present, water supply in the Central Coast incorporates functions of the following constituent entities:

- Wyong Distribution System;
- Gosford Distribution System, owned and operated by Gosford City Council; and
- Joint headworks owned and controlled by Gosford City and Wyong Shire Councils. This is known as the Joint Water Supply Scheme (JWSS) and is responsible for the delivery of potable water to the independent distribution systems through the provision of source water and subsequent treatment and transfer processes.

Each council is responsible for the management of its own distribution system, while the Gosford Wyong Councils Water Authority (GWCWA) controls the JWSS. Consequently, this report is primarily concerned with the Wyong Distribution System, whilst recognising the presence of links between the Wyong, Gosford and Hunter Water Corporation (HWC) systems. These links facilitate water transfers to the adjacent LGAs of Gosford and Lake Macquarie, which is served by the HWC, to suit operational requirements in various situations.

In accordance with the brief, this report will focus upon infrastructure located within Wyong Shire downstream of the Mardi Water Treatment Plan (WTP) Clear Water Tank. This asset base consists of 20 reservoirs, 17 pump stations, pipelines (including approximately 205 km of mains, ranging between 250 mm and 1050 mm in diameter) along with corresponding valving. Furthermore, it is specified that existing pipelines of a diameter greater than or equal to 250 mm are to be considered, with a 200 mm threshold for proposed future works. WSC maintains an asset register linked to its GIS, with an installed capability for controlling and monitoring operations and recording data such as reservoir levels, pumping station operations and flow meter readings at 15 minute intervals.

Transfers from the JWSS to the Wyong Distribution System are typically delivered through the WTP Clear Water Tank at Mardi. Links to the Gosford Distribution System consist of a coastal connection delivering up to 20 ML/d each way through a 10 km long, 450 mm diameter transfer main and pump station. Alternatively, 80 ML/d may be transferred from Gosford to Wyong via a 17 km long, 750-1050 mm transfer main by utilising the booster pump station at Ourimbah, with a reciprocal exchange possible upon the completion of the Mardi High Lift Pump Station (HLPS). The existing link with the HWC system at Mannering Park/Vales Point provides an additional 7 ML/d supply when required.

1.3 Current Development Plans

Some parts of the LGA are experiencing urban infill, along with a degree of redevelopment, and it is envisaged that elevated levels of higher density development may take place in the vicinity of The Entrance. There are also plans for green-field development to occur around Warnervale, in the northern part of WSC. Conscious of this probable, extensive future development within the shire, augmentation of the water distribution system was already investigated between 1985 and 1990, although many of the proposed upgrades were never implemented. In the past, WSC has been able to mitigate supply requirements through a variety of demand management activities and this is one factor which led to some of these works not being realised. It is, however, now deemed vital that a review of, and the preparation of a future development plan for, the Wyong Distribution System is undertaken.

A number of projects are already being developed for the JWSS headworks and Wyong Distribution System in order to increase supply capacity. These include:

- Expansion of Mardi Dam outlet works (raising capacity from 100 ML/d to 160 ML/d in order to utilise Mardi WTP to full potential);
- Completion of Mardi HLPS (160 ML/d upgradeable to 240 ML/d);
- Northern Connection Main (750 mm, connecting from Mardi HLPS to Warnervale); and
- Construction of a 30 ML/d link to HWC, along with a reservoir.

It is envisaged that the realisation of Mardi HLPS, the Northern Connection Main and the additional link to the HWC will enable bulk water transfer to take place between Mardi WTP and the HWC. Furthermore, the completion of a pipeline to Wyong will allow transfers from the HWC to the northern part of WSC.

1.4 Objectives

Three basic objectives are outlined by the brief as being essential components to be addressed within this report;

- Establishment of development and demand forecasts, to be approved by WSC, at intervals of 5 years based on current, planned and potential zonings and in consideration of population forecasts, along with the evaluation of ADD, PDD and AAD figures in line with these findings;
- Creation of a calibrated, upgradeable hydraulic model using Infoworks WS software reflecting the layout of the Wyong Distribution System, both for use in devising a future capital works program based on forecasted demands and by WSC itself, with appropriate training; and
- Determining the operational scenarios and capital works schemes, including transfers, that may be implemented to enable the Wyong Distribution System to achieve its required capacity by 2051. This includes identifying and evaluating options, and presenting a plan estimating the costs and delivery timeframe of proposed works.

1.5 Existing System

The current Wyong water supply network is primarily fed under gravity from the Mardi WTP CWT. From the Mardi CWT the treated water is fed into two systems: a northern system and the southern system, which are separated geographically by Wyong Creek.

The northern system is fed from the CWT under gravity which is then boosted north by No.4 Pumping Station. This pumping station supplies water primarily to the Kanwal and Wyong Reservoirs. Supply to the Kanwal reservoirs are regulated by the Kanwal Motorised Valve (MV). The Doyalson and Halekulani reservoirs are in turn serviced from the head of the Kanwal reservoirs. The remaining reservoirs, Kanangra and Treelands, are supplied by local booster pumping stations, No. 10 and No.13 PS respectively.

The southern system is fed under gravity from the CWT and boosted by No.2 pumping station towards the Entrance and Southern Lakes. Wyrrabalong is the major reservoir in the southern system supported by the smaller local reservoirs such as The Entrance, Bateau Bay and Tuggerah 1 reservoirs, most of which are supplied by local booster pumping stations.

Under the current operating regimes Tuggerah 2 is only used to supplement water levels in the Kanwal reservoirs if they drop below critical levels. This is accomplished by opening a valve allowing the head of Tuggerah 2 reservoir to drive additional flow to Kanwal reservoirs in lieu of the lower Mardi CWT head.

The nodal diagram of the current Wyong water supply network and the layout of the network on a GIS layer including locations of pumping stations, reservoirs and pipelines are shown in Figure 1-1 and Figure 1-2 respectively.

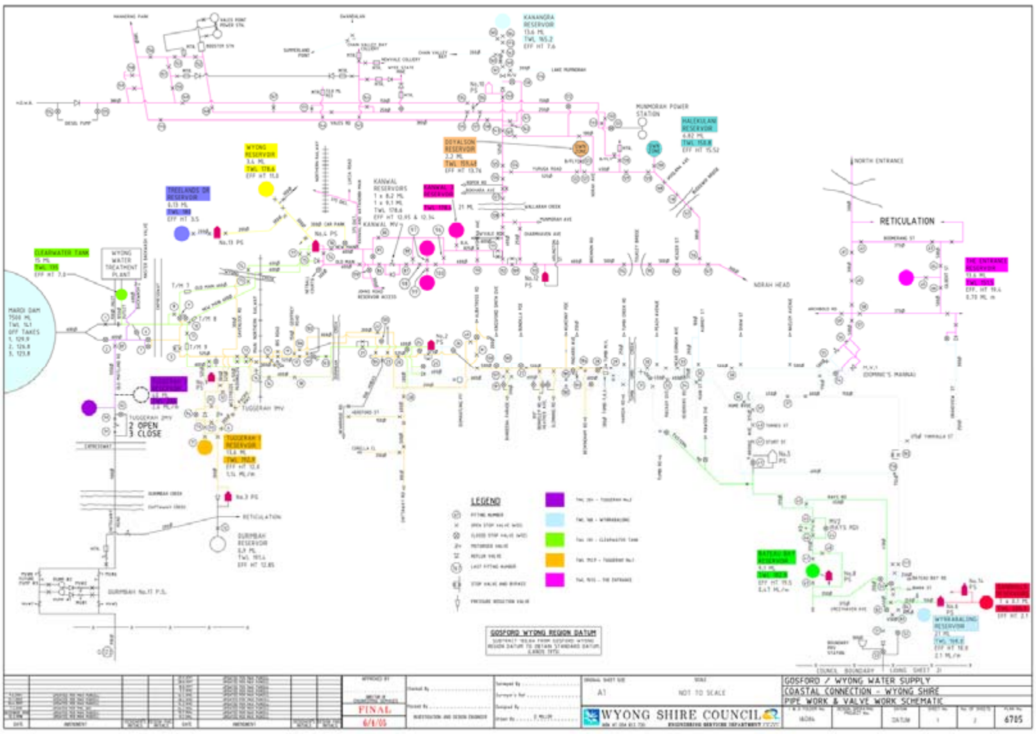


Figure 1-1: WSC Network Nodal Diagram of Wyong Network

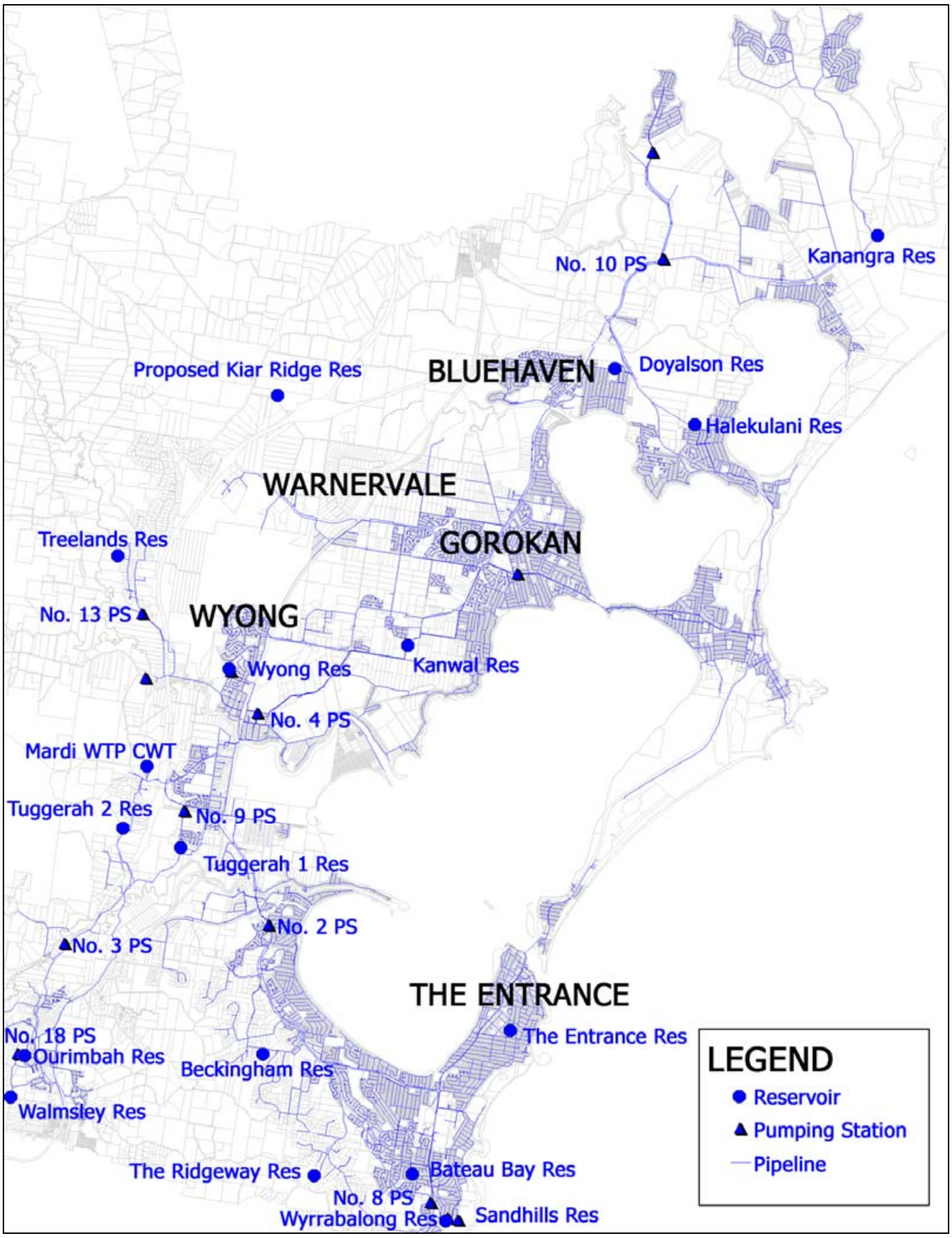


Figure 1-2: Layout of Existing Wyong Water Supply Network

2 HYDRAULIC MODELLING

2.1 HYDRAULIC MODEL DEVELOPMENT

The following processes were carried out in order to develop a functional hydraulic model of the Wyong Distribution System:

- Network model development. Creating the pipes, reservoirs and other infrastructure pertaining to the system in order to accurately reflect the assets present within the existing Wyong network;
- System Operation development. Generating the rules and operating regimes governing the system. This had to be reflected in the "controls" assigned to reservoirs, pumping stations etc;
- Importing system demands. Analysing consumption patterns, zoning and development plans in order to estimate current and future levels of demand;
- Model Calibration. To demonstrate the accuracy of the model. Calibrated to existing peak day demand; and
- Hydraulic runs for the 5 year demand increments up to 2051 to determine necessary system augmentations at each increment.

2.1.1 Network Development

A model of the Wyong Distribution System was developed using InfoWorks WS (Water Supply) software package by Wallingford Software. The basis of this model was formed directly from Council GIS data and network nodal diagrams, along with extensive consultation with Council personnel. These discussions were consolidated in a subsequent phase through the review of assumptions and other possible sources of error with WSC, along with thorough examination of available Work as Executed (WAE) drawings in order to more accurately represent the actual system layout. To some extent, inaccuracies within the Council GIS data initially compromised progress and resulted in considerable difficulty arising in the formation phase.

The hydraulic components of the Wyong Distribution System were modelled with the aid of the Infoworks WS software. This application effectively allowed the GIS data used in establishing the physical location of the network to be directly imported into the model, thereby avoiding the possibility of further undermining the fidelity of these values. When a suitable network layout was achieved, node heights were adjusted and details of pipes and other infrastructure were checked to ensure that the data had been converted correctly in the importation process. Finally, demand data for the various zones, as described below, was incorporated into the ultimate InfoWorks WS model in order to facilitate the performing of hydraulic simulations.

2.1.2 Methodology of Importing GIS Data

During the importation of the GIS data into the model it was evident that there were errors in the original GIS data that were impacting on producing a hydraulic model that would accurately reflect the reality of the water supply network. These errors include incorrect pipe sizes read from the Works as Executed drawings (WAE), typos resulting in incorrect pipe sizes, pipelines not being fully connected or drawn "close enough" to the visual eye but not close enough for Infoworks WS to interpret a connection of the pipelines, missing data etc. To overcome these issues a comprehensive review of the GIS data was undertaken to identify these errors. This was achieved by re-examining original WAE drawings, examining the model against known performance, discussions with WSC operating staff etc. When errors were identified a data entry “flag” was added in the Infoworks WS model. These flags identified areas where data was missing and **added**, where data was missing and needed to be **inferred** from surrounding data, or where data was **modified** from what was imported from the GIS due to incorrect data (listed within the data entry flags as AD, IN, or MO respectively). Examples of uses of these data entry flags are provided below:

- Where pipeline diameter sizes were missing but could be inferred from surrounding pipework (ie a blank section of pipe located in between two sections of DN100 pipe is likely to be a DN100 pipe) and assessed as such within the Inference tool within Infoworks WS a data flag of IN was added to the pipeline.

- If a section of pipeline could not be inferred (eg a blank pipe surrounded by a DN100 pipe and a section of DN200 pipe) the data was added based upon a best guess (erring on the side of conservatism) or additional information the data flag of AD was added to the data field. Another example is if a section of pipeline did not exist in the model and had to be added independent of GIS data.

- Under the situation where a pipeline size was shown found to be incorrect or if a pipeline needed to be broken into two separate pieces and thereby altering the asset numbering, the data flag of MO would be used.

An image illustrating the use of data entry flags is shown below in

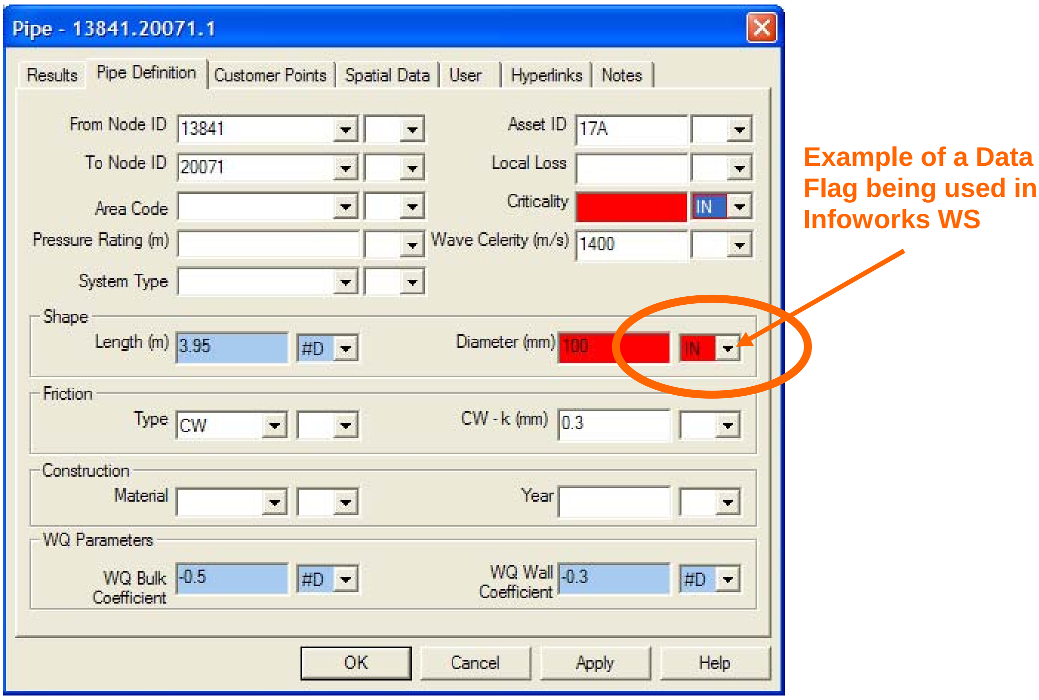


Figure 2-1: Infoworks WS Data Entry Flags

2.1.3 System Operation

Consultation was undertaken with WSC in order to attain a level of understanding of the Wyong Distribution System conducive to the creation of a model which reflected the system and its operations as accurately as possible. To this end, operating rules were established through discussions with council, as well as from previous hydraulic studies completed by the Department. The items determined in conjunction with WSC protocol include control philosophies for pumping stations, stop/start levels, reservoir float valve open/close levels and open close values for key motorised valves.

2.1.4 Importing of Demand Data

Projected future levels of demand within the Wyong Distribution System have been analysed previously by the Department of Commerce and presented in the Document *"Long Term Demand Projections"*. This study considered factors such as current and projected demand and zoning data along with addressing several population growth and development scenarios which would have an impact on future water usage levels. In particular, the Whelan Report was commissioned to prepare population, tenement, commercial area and industrial area projections from the present through to 2051 for potential development precincts as indicated by WSC. This study also included locations of future subdivisions, timing for demands and specific consumption data for individual meters over 5 year increments throughout the duration of the period in question.

User categories were stipulated in accordance with the Local Environment Plan, with ADD values estimated by utilising the total recorded demand data collected by meters over a five and a half year period commencing in 2001. PDD figures were calculated for each combination of Small Area and Local Environment zoning, and for all users. These PDD figures are contingent upon factors related to the size, arrangement, location and occupancy of tenement, as well as location parameters such as soil moisture storage, average rainfall, and surface evaporation rates. ADD and PDD values were subsequently used as a basis for analysing future demands, in conjunction with the findings of the Whelan Report which identified projected dwelling numbers and population according to estimates of available land supply and urban releases until 2051.

In turn, the allocation of pre-defined demand allowances across these projected figures enabled comparisons with demand projections in the GWCWA March 2002 review to be made. Additional projections have also been derived as part of an Investigation Report completed in 2003 and the Whelan Report. These cases, illustrating scenarios featuring variations in parameters such as water efficiency and population, were also addressed as part of the comprehensive treatment of this matter within the aforementioned Department of Commerce document. WSC have reviewed and accepted the suggested demand values which underpin the water supply network model.

A methodology outlining how the demands produced from the demand model were imported into the Infoworks hydraulic models is provided in **Appendix B**

2.1.5 Model Calibration

Part of the validation process integral to the development of a viable, accurate model was the requirement for a calibration run to be performed. This step represents an opportunity to assess the capacity of the model to replicate observed events, whilst simultaneously offering the possibility of refining the parameters in use within it. Assessment of the successfulness of the calibrated model was based on known low pressure areas, reservoir zonings, as well as recorded pumping station and reservoir performance over the course of the nominated PDD. A live run of the calibrated model was presented to council and signed off to enable work on future runs to commence.

Descriptions of some of the characteristics that the model was calibrated against are summarised below:

Low Pressure Zones

WSC identified the regions of Central East Gorokan and Bluehaven as low pressure problem areas. Both these zones draw water from Kanwal reservoirs and due to their high ground levels suffer low residual pressures when Kanwal reservoirs drop.

The calibrated model duplicated these findings and is represented in the minimum residual pressures as simulated in the calibrated model shown below in Figure 2-2

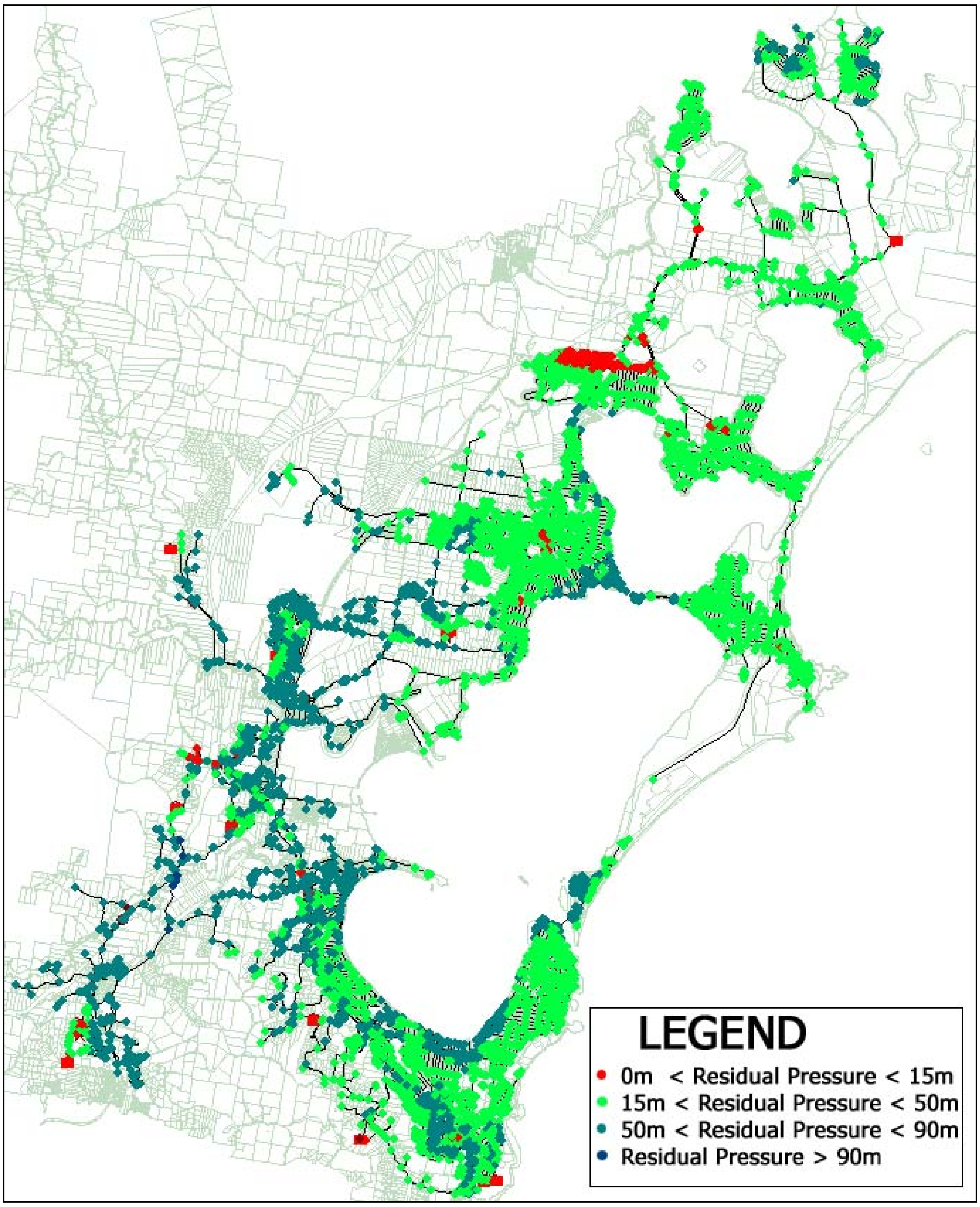


Figure 2-2: Node Minimum Residual Pressures during Calibration Run

2.2 FUTURE MODEL SIMULATIONS

2.2.1 General

The future hydraulic simulations were assessed under the demand scenarios derived in the "Long Term Demand Projections Report" prepared by Commerce. The hydraulic modelling philosophy and methodology to derive the future distribution systems are summarised below.

2.2.2 Methodology

In order to optimise the staging of works it was decided to model the system for 2051 then model backwards towards the current system arrangement. The purpose of this methodology was to ensure that the staged works were orientated and timed in accordance with progressively increasing demands, introductions of new development areas and were all focused towards a final optimised distribution system in 2051. Each staging of the network had to ensure that the following primary requirements were met:

- Minimum nodal pressure of 15m at the nodes
- Sufficient reservoir refilling over the peak day demand (PDD)
- Maintain integrity of the system operating philosophy
- Provide a supply source to match each of the new subdivisions introduced into the system.

In addition to these basic hydraulic requirements staging of the works was assessed with respect to the following key criteria:

- Examine how long could the northern system be supplied from Tuggerah 2/Mardi HLPS without the need of Kiar Ridge Reservoir;
- Analyse the need to upgrade Tuggerah 2 reservoir;
- Assess the stress on Kanwal reservoirs under the increased demands predominately in the northern precinct of the Wyong System.

2.2.3 Proposed System Operating Philosophy

The introduction of the Mardi HLPS into the system requires that the system now be exposed to the head of Tuggerah 2 reservoir or the head of the Mardi HLPS on a permanent basis as opposed to only when required for emergency top ups of Kanwal Reservoirs. Therefore the future model runs have been assessed with No.4 PS and No.2 PS deactivated and valving modified so that the all water delivered from the CWT is exposed to the head of Tuggerah 2 reservoir or the head of the Mardi HLPS pumps.

2.2.4 Expansion of the Northern Water Supply System

The majority of the future capital works relate to proposed infill and future expansion of development areas within the Warnervale region and northern regions of the shire. This is a reflection of the demands produced in the previous *"Long Term Demand Projections".* To cater for this expansion new distribution and reticulation works have been proposed to supply these development areas and staged. The location and alignments of these new works in the northern development areas have been based on a proposed water supply reticulation plan for the northern precincts of the shire provided by WSC. It should be noted that this plan has been used as a guide only and modified to suit the results of the hydraulic analysis. A copy of the reticulation development plan mentioned is provided below in Figure 2-3

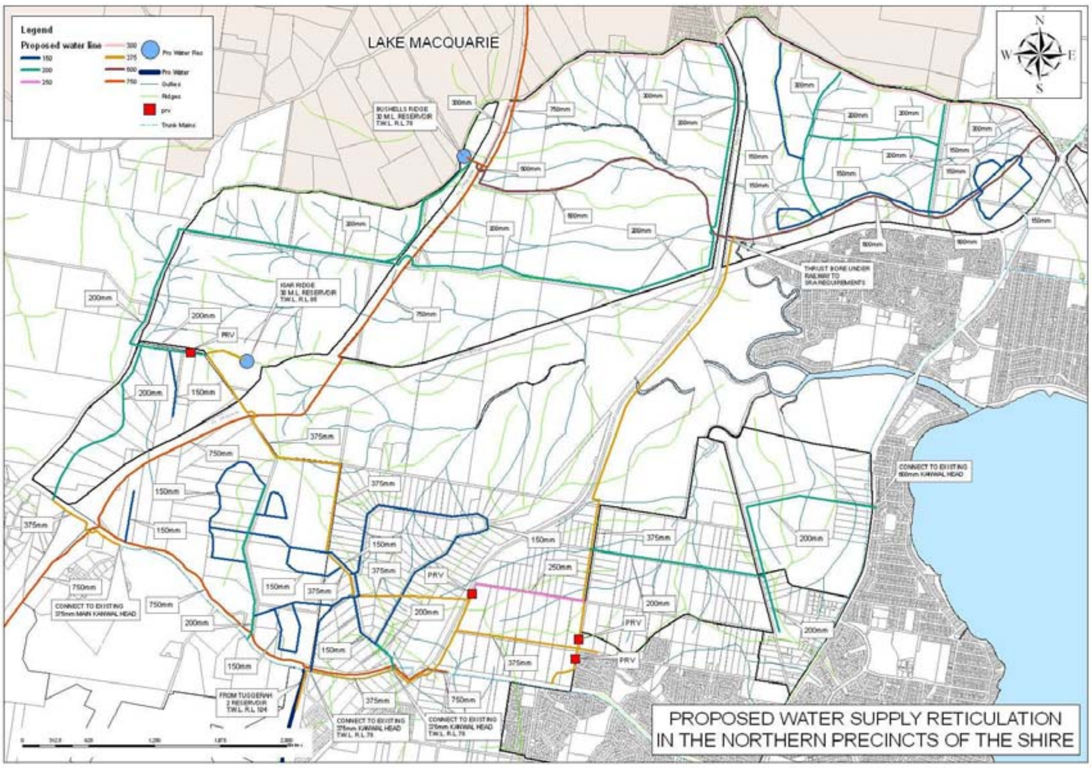


Figure 2-3: Proposed Reticulation Plan of Northern Precincts by WSC

Future small diameter reticulation pipelines(less than 200mm), for the most part, have not been modelled except where shown on the aforementioned reticulation plan. This is due to the uncertainty on the arrangement of the future subdivisions and road alignments. Without these details it is impossible to accurately assess the amount, size and layout the of reticulation network required for each subdivision.

2.2.5 Results Files

The results of the hydraulic simulations including overviews of reservoir zonings, minimum residual pressures and hydraulic grade lines for the various options are provided in **Appendix A.**

3 DISTRIBUTION SYSTEM DEVELOPMENT PLAN

3.1 STAGING OF WORKS

Based on the results of the future 5 year increment simulations within Infoworks WS a distribution system development plan was created with the aim of optimising the staging of the delivery of capital works required. A summary of the development plan is outlined in Figure 3-1 and Table 3-1 below.

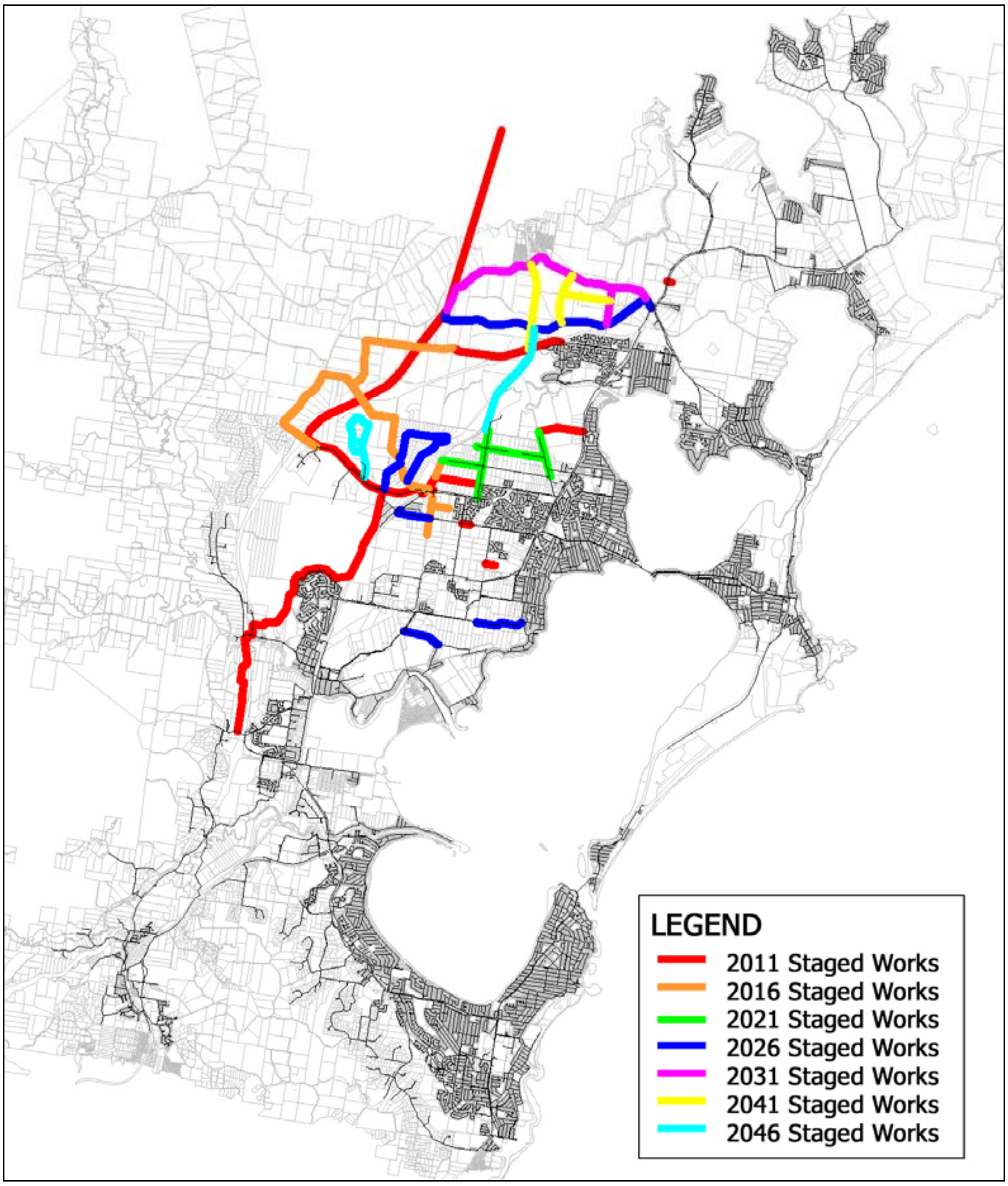


Figure 3-1: Overview of Distribution System Development Plan

Table 3-1: Summary of Staged Capital Works

Component	2011	2016	2021	2026	2031	2036	2041	2046	2051	Total
	DEVELOPMENT PLAN STAGE Quantities (m)									
DN100 Pipe	239			1011						1250
DN150 Pipe		465		3160				600		4225
DN200 Pipe	4313	4844	3105	3451	988		4940	1467		23108
DN250 Pipe			1077							1077
DN300 Pipe					300					300
DN375 Pipe	1964	1388	1907					3112		8371
DN450 Pipe		4434								4434
DN600 Pipe				6236						6236
Kiar Ridge Reservoir		15ML								

Details of the 5 yearly increment development plan stages are expanded in the following sections with descriptions of works required and the reason for their proposed timing of their implementation.

3.1.1 2011

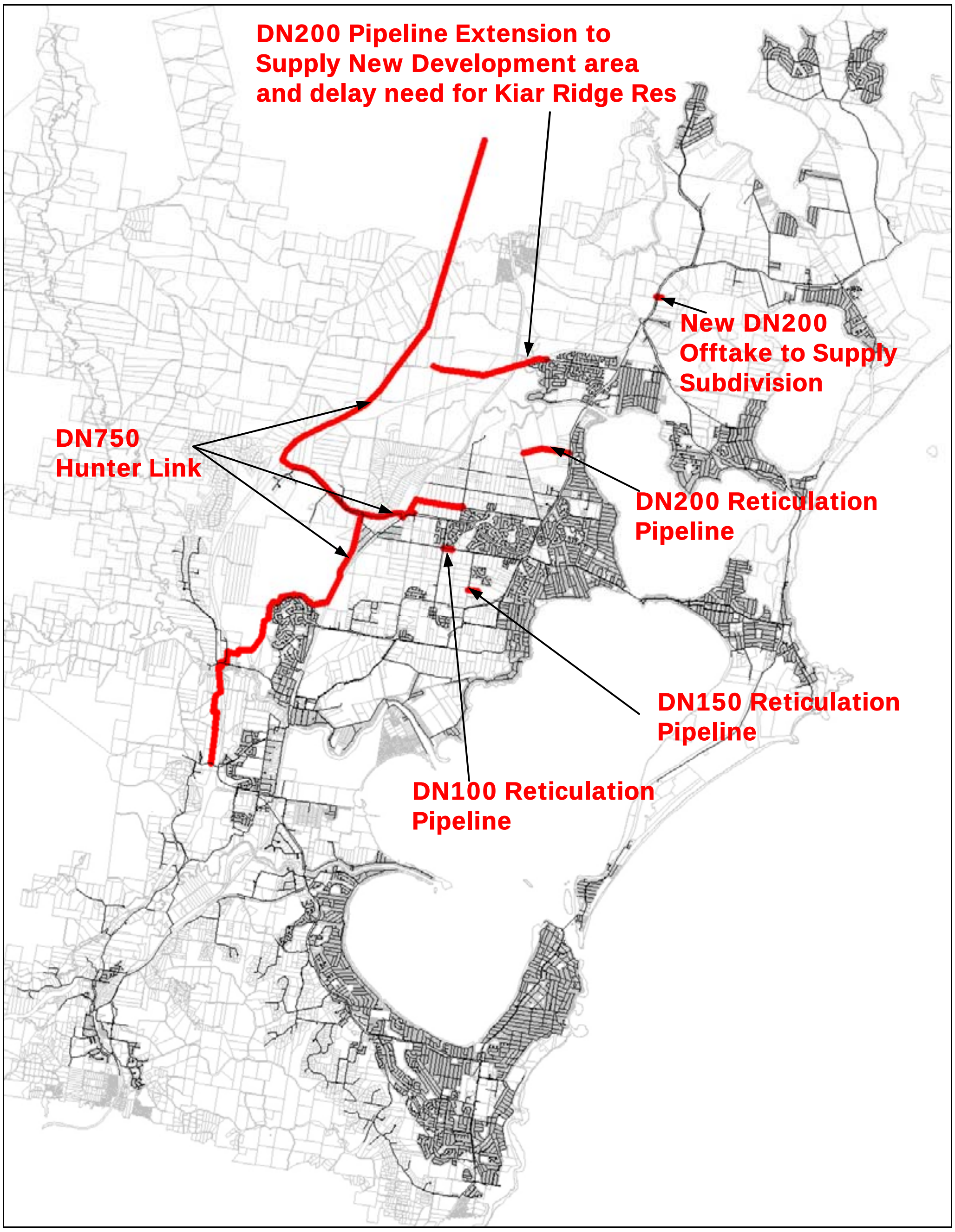


Figure 3-2: Staged Capital Works for 2011

As assessed under the projected peak day demand the results of the hydraulic simulations indicated that with the introduction of the Mardi HLPS, the DN750 Hunter link and connection with the Mardi transfer pipelines and several other minor augmentations, the requirement for Kiar Ridge reservoir could be postponed until 2016. These works would ensure that Kanwal reservoirs could maintain sufficient head at known low pressure areas and delay the need for Kiar Ridge reservoir.

The Hunter link has been included in this staging of the works as it is required to be operating prior to 2011 to delay the need for Kiar Ridge reservoirs til 2016. Without this link supply to the north to supplement and relieve system stresses on Kanwal reservoirs would not be possible.

3.1.2 2016

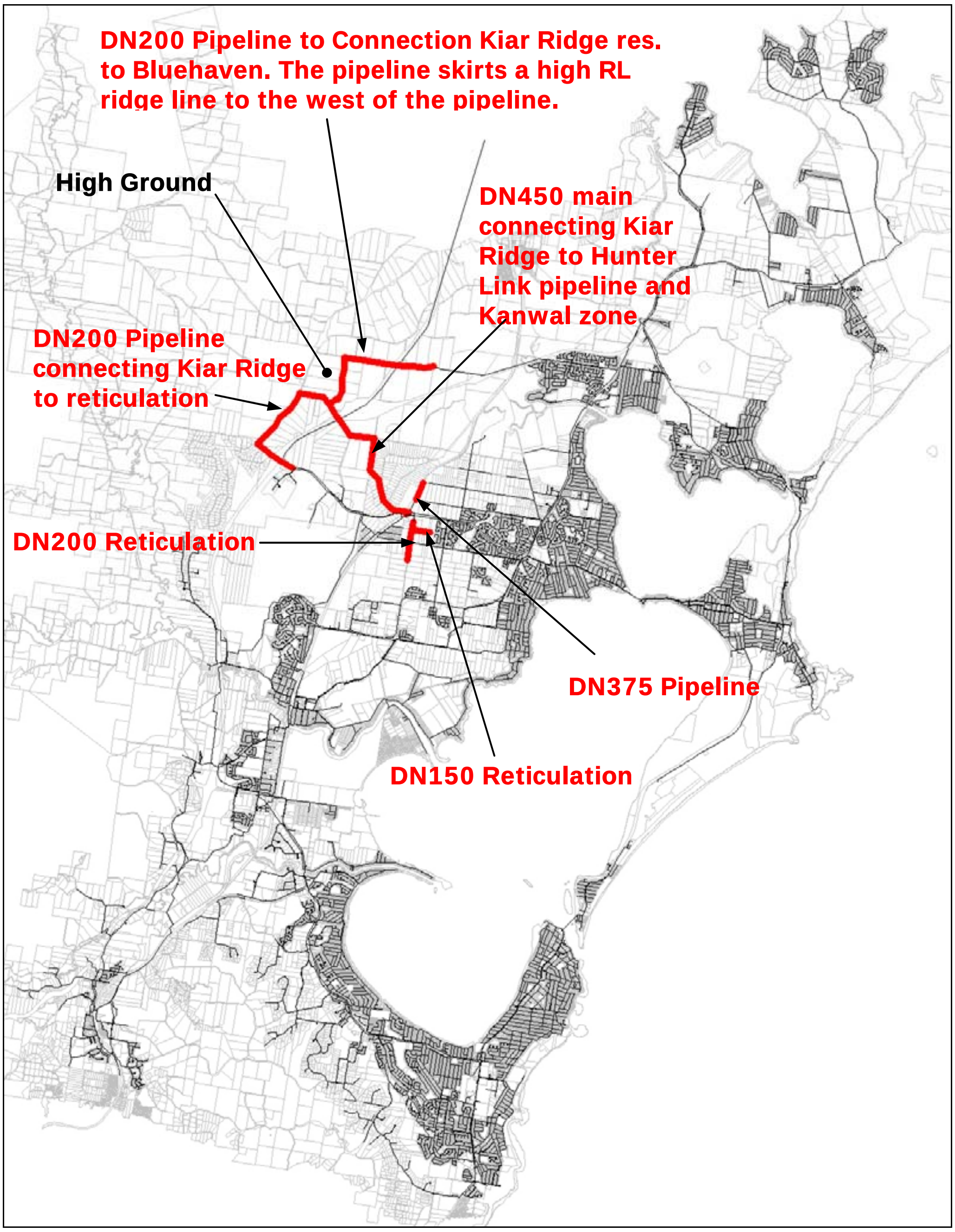


Figure 3-3: Staged Capital Works for 2016

With the increased 2016 PDD the network was found to be no longer able to supply known critical low pressure areas from Kanwal reservoir and as such required the implementation of the Kiar Ridge reservoir to supplement supply to these areas. The suburb of Bluehaven especially was found to be continually suffering low pressures as its location and elevation were found to make it sensitive to changes in levels at Kanwal reservoirs. This situation would only become more of an issue as system demands increase and would stress Kanwal's ability to supply these demands further. It is therefore recommended that the suburb of Bluehaven be linked to the Kiar Ridge reservoir which would remedy the low pressure issues at Bluehaven and in turn reduce the demand on Kanwal reservoirs.

With the introduction of the Kiar ridge reservoirs to service the additional demands and new development areas in the northern system, the majority of the pipeline capital works nominated in this stage are required to provide distribution and reticulation supply connections to and from Kiar Ridge reservoir. The alignment of one of these supply connections (the DN200 pipeline running north then east and connects up with Bluehaven) was forced to skirt a high level ridgeline that runs north of Kiar Ridge and as such could not follow the alignment proposed in the WSC Proposed WS Reticulation in the Northern Precincts Plan.

3.1.3 2021

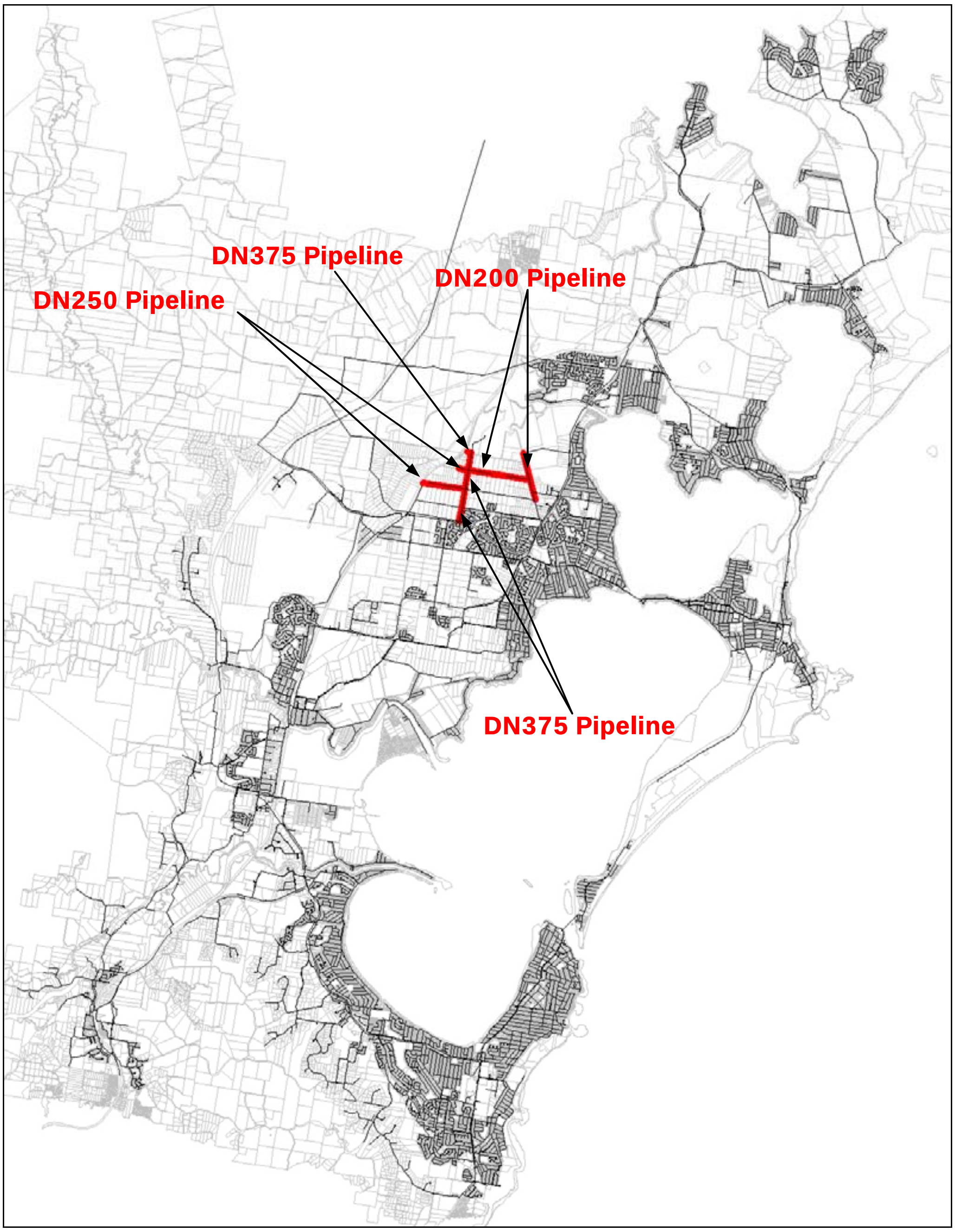


Figure 3-4: Staged Capital Works for 2021

With Kiar ridge now supplementing supply in the north, capital works staged for 2021 were nominated to provide additional reticulation capacity in West Gorokan. These works were directly related to increased consumers and demands from new development areas and infilling of West Gorokan staged for 2021.

3.1.4 2026

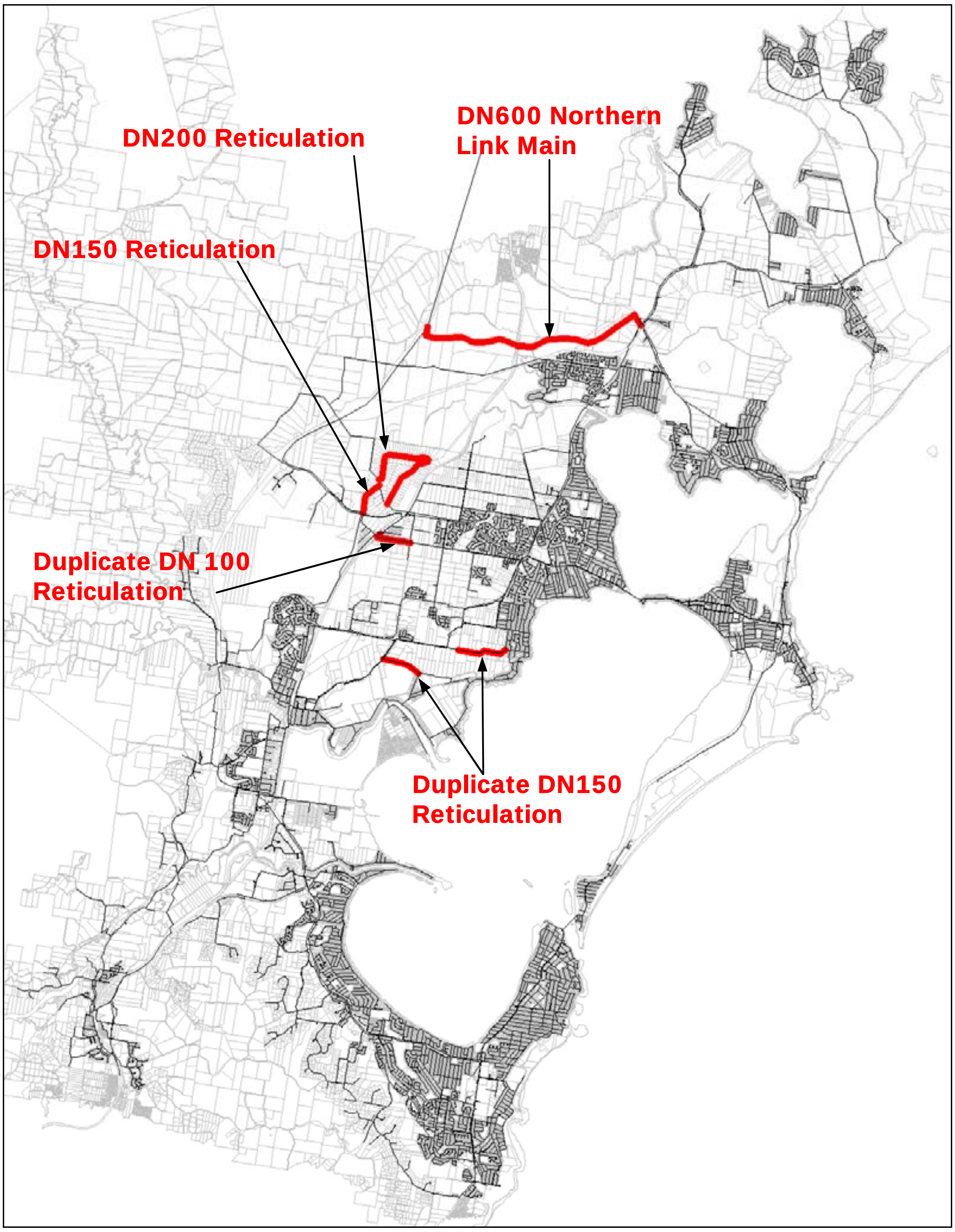


Figure 3-5: Staged Capital Works for 2026

Under this peak day demand capital works were limited to a new DN600mm main linking the Hunter link near Bushells Ridge to north of Bluehaven and local reticulation upgrades around Warnervale. The DN600 main provides sufficient capacity to supply demands in the north of the shire while also allowing for future expansion in this area. In addition it also provides a larger link to provide greater capacity and flow to the north-eastern areas of the shire including Mannering Park, Vales Point and Gwandalan.

3.1.5 2031

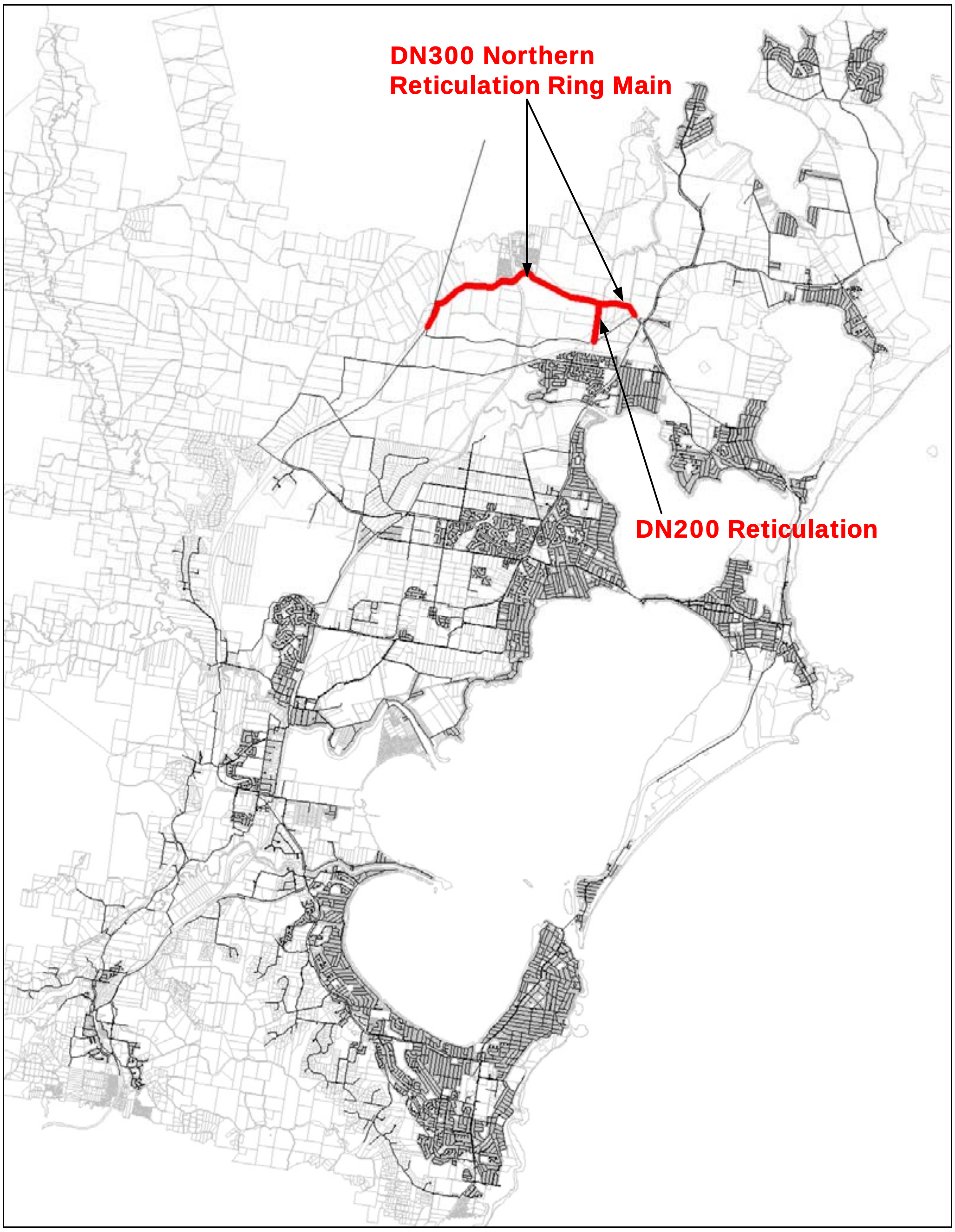


Figure 3-6: Staged Capital Works for 2031

Under this phase a DN300 ring main north of the DN600 northern link has been implemented to provide a reticulation source to development areas in the north of the shire.

3.1.6 2036

No new capital works were required for this development stage.

3.1.7 2041

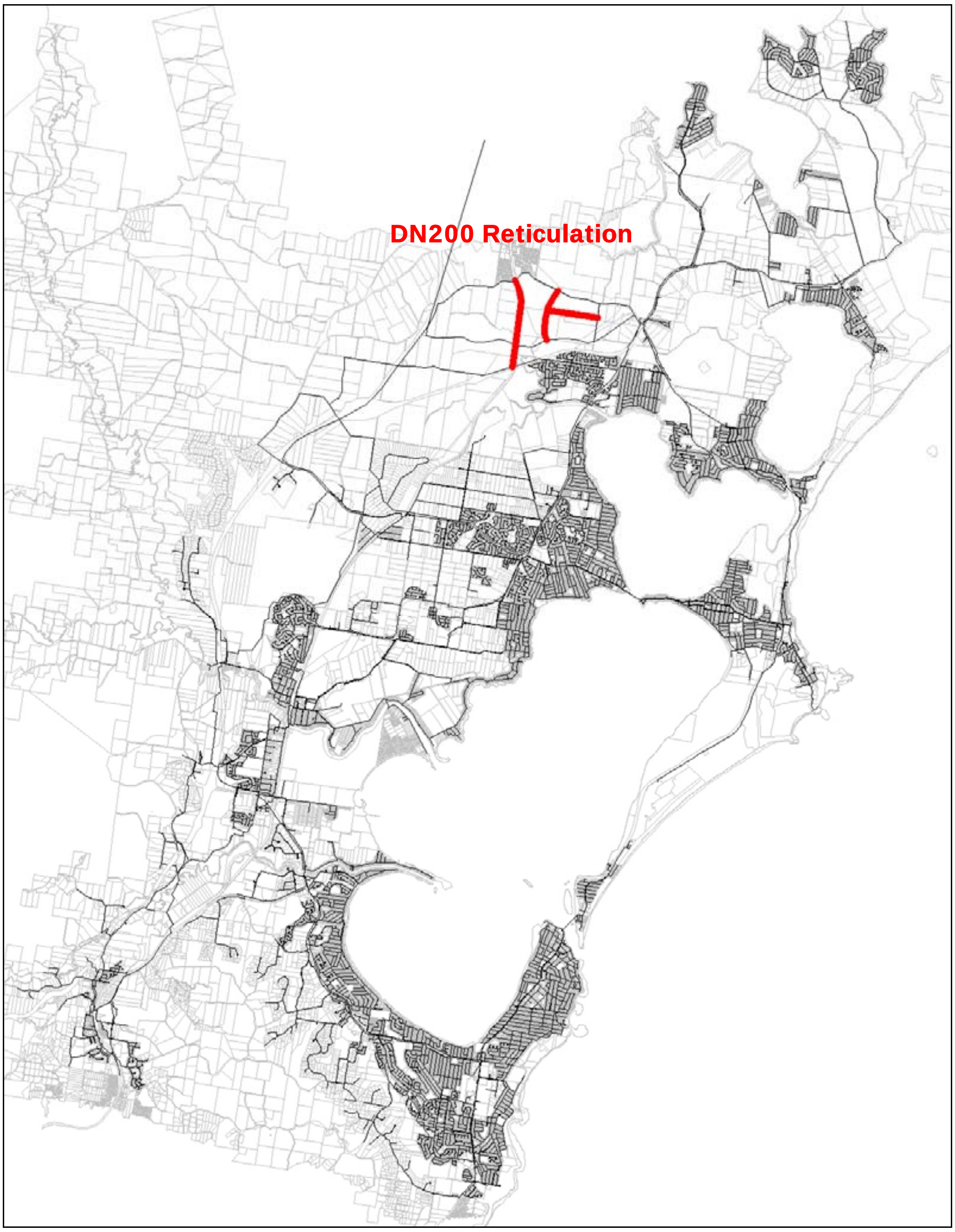


Figure 3-7: Staged Capital Works for 2041

Additional reticulation lines were added under this staging of the works in the northern areas to supply infilling of development areas in the northern most precincts of the shire.

3.1.8 2046

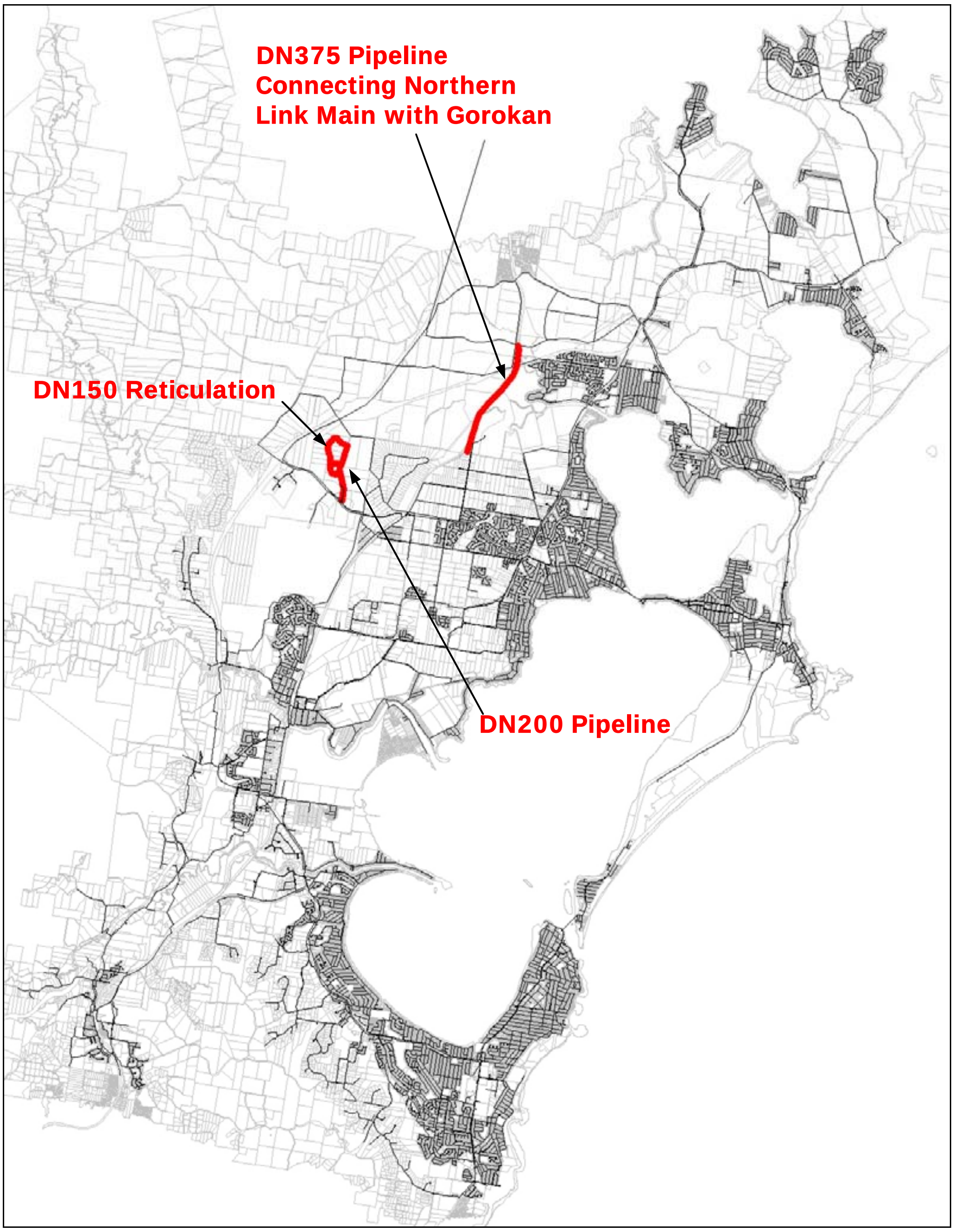


Figure 3-8: Staged Capital Works for 2046

3.1.9 2051

No new capital works were required for this development stage.

3.2 DISCUSSION OF KEY WORKS

3.2.1 Kiar Ridge Reservoir

Kiar Ridge has been selected as the preferred site for the northern precincts new reservoir as opposed to Bushells Ridge as there is insufficient head at Bushells ridge to supply high development areas in Warnervale. In addition the extra head and closer proximity of Kiar Ridge to the Warnervale area allows it to more effectively supplement Kanwal reservoirs. This is of critical importance when assessed with the stresses and demands on Kanwal under the new PDD events.

Under the Peak Day Demand Kanwal is required to supply all of the northern regions with only 40ML of total capacity. This is insufficient with areas such as Bluehaven and central East Gorokan sensitive to level changes in Kanwal reservoirs. To reduce the impact of low levels in Kanwal it is recommended that Kiar Ridge be connected to the reservoir zone of Kanwal and allow the head of both reservoirs to supply the northern precinct.

A 15ML reservoir was found to be sufficient to provide the additional supply required for the northern precincts. Kiar Ridge at 15ML capacity would, when combined with the existing reservoirs, just exceed the 2051 PDD supply requirements for the Wyong system. In addition during 2051 PDD it was found that the reservoir did not empty and would refill during the course of the Peak Day.

3.2.2 Tuggerah 3 Reservoir

Under the demand scenarios modelled there is no need to implement Tuggerah 3 reservoir prior to 2051. The addition of Kiar Ridge reservoir in the northern system brings reservoir supply capacity in the north to approximately 70ML while the southern system can rely on approximately on 55ML of storage capacity. Tuggerah 2 adds an additional 40ML of capacity to the system. The total storage capacity of the system exceeds the 2051 PDD.

Under the peak day demand hydraulic simulation for 2051 the Mardi HLPS is capable of ensuring that Tuggerah 2 refills during the day and does not turn off and on frequently during the course of the PDD.

3.2.3 Pressure Relief Valves in Northern Precinct Development Areas

The northern precincts reticulation development plan previously recommended several PRVs throughout the northern system to reduce the maximum residual pressures from Kiar Ridge reservoir on low lying reticulation zones. This, however, would impact on the ability of Kiar Ridge to supplement supply to areas such as East Gorokan and North East towards Gwandalan when Kanwal is no longer able to provide sufficient head to supply these areas. It is therefore recommended that the use of PRVs in this area be avoided.

3.2.4 Transfer In/Out of the Wyong Network

Transfers out of the Wyong system were examined under non-PDD events. For the purposes of the study 50% of the PDD was nominated as the cut-off point for system transfers to the Hunter and Gosford. Under this condition the Hunter link, the Tuggerah 2 to Gosford Link and the Coastal link have the hydraulic capacity to deliver the nominated flow rates of 30ML/d, 80ML/d and 8ML/d respectively.

Details of the hydraulic grade lines for these scenarios can be found in **Appendix B**.

4 COSTINGS

The costs involved in implementing the proposed works identified in the Distribution System Development Plan were estimated based on known supply rates and recent tender prices. This was achieved by first calculating the cost of the pipelines for each of the staged options before assessing these costings in a Net Present Value (NPV) analysis. The results of these costings are tabulated below.

Table 4-1: Pipeline Cost Estimates Based on Pipeline Lengths for Each Stage

STAGE	PIPELINE SIZE	QUANTITY (m)	RATE /m	COST
2011	375	1964	$516	$1,012,617
	200	4313	$244	$1,054,091
	100	239	$131	$31,407
				$2,098,114
2016	450	4434	$648	$2,871,494
	375	1388	$516	$715,638
	200	4844	$244	$1,183,866
	150	465	$194	$90,295
				$4,861,293
2021	375	1907	$516	$983,228
	250	1077	$305	$328,797
	200	3105	$244	$758,857
				$2,070,883
2026	600	6236	$997	$6,218,954
	200	3451	$244	$843,419
	150	3160	$194	$613,620
	100	1011	$131	$132,853
				$7,808,846
2031	300	6304	$368	$2,320,818
	200	988	$244	$241,466
				$2,562,283
2041	200	4940	$244	$1,207,329
				$1,207,329
2046	200	1467	$244	$358,533
	150	600	$194	$116,510
	375	3112	$516	$1,604,513
				$2,079,556

Table 4-2: NPV Analysis of Distribution System Development Plan

Staged Works

Item	Description	Quantity	Unit	Rate	AMT $k	Present Worth 4%	Present Worth 7%	Present Worth 10%
1.0	**Capital Cost**							
1.1	**Pipeline**							
1.1.1	Stage 2011 Pipeline Works		Allow		$2,098,114	$1,793,477	$1,600,641	$1,433,040
1.1.2	Stage 2016 Pipeline Works		Allow		$4,861,293	$3,415,480	$2,644,221	$2,061,663
1.1.3	Stage 2021 Pipeline Works		Allow		$2,070,883	$1,195,883	$803,124	$545,328
1.1.4	Stage 2026 Pipeline Works		Allow		$7,808,846	$3,706,410	$2,159,211	$1,276,809
1.1.5	Stage 2031 Pipeline Works		Allow		$2,562,283	$999,602	$505,145	$260,137
1.1.6	Stage 2041 Pipeline Works		Allow		$1,207,329	$318,194	$120,998	$47,258
1.1.7	Stage 2046 Pipeline Works		Allow		$2,079,556	$450,475	$148,595	$50,542
1.2	**Reservoirs**							
1.2.1	Kiar Ridge Reservoir	1	Allow		$7,200,000	$5,058,624	$3,916,323	$3,053,503
1.3	**Prime Cost**				$29,888,304	$16,938,145	$11,898,258	$8,728,280
1.4	**General contingencies**	(prime cost)		25%	$7,472,076	$4,234,536	$2,974,565	$2,182,070
1.5	**Contractors on-costs**	(prime cost)		10%	$2,988,830	$1,516,987	$1,189,826	$872,828
1.6	**Direct Cost**				$40,349,210	$22,689,668	$16,062,649	$11,783,179
1.7	**Pre-construction activities**	(direct cost)		10%	$4,034,921	$2,286,650	$1,606,265	$1,178,318
1.8	**Supervision**	(direct cost)		5%	$2,017,461	$1,143,325	$803,132	$589,159
1.9	**Total Capital Cost**				$46,401,592	$26,119,642	$18,472,046	$13,550,655
2.0	**Operation and Maintenance Costs**							
2.1	**Maintenance Costs**							
2.1.1	Civil (0.5% of capital costs)	Item	Allow		$2,606,939	$2,385,837	$1,242,935	$710,273
	Total O & M				$2,606,939	$2,385,837	$1,242,935	$710,273
	Total NPV				$49,008,531	$28,505,479	$19,714,982	$14,260,929

Year (2007–2026)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1.0																				
1.1																				
1.1.1	$0	$0	$0	$0	$2,098,114	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4,861,293	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,070,883	$0	$0	$0	$0	$0
1.1.4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$7,808,846
1.1.5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.2																				
1.2.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$7,200,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.3	$0	$0	$0	$0	$2,098,114	$0	$0	$0	$0	$12,061,293	$0	$0	$0	$0	$2,070,883	$0	$0	$0	$0	$7,808,846
1.4	$0	$0	$0	$0	$524,529	$0	$0	$0	$0	$3,015,323	$0	$0	$0	$0	$517,721	$0	$0	$0	$0	$1,952,212
1.5	$0	$0	$0	$0	$209,811	$0	$0	$0	$0	$1,206,129	$0	$0	$0	$0	$207,088	$0	$0	$0	$0	$780,885
1.6	$0	$0	$0	$0	$2,832,454	$0	$0	$0	$0	$16,282,746	$0	$0	$0	$0	$2,795,692	$0	$0	$0	$0	$10,541,943
1.7	$0	$0	$0	$0	$283,245	$0	$0	$0	$0	$1,628,275	$0	$0	$0	$0	$279,569	$0	$0	$0	$0	$1,054,194
1.8	$0	$0	$0	$0	$141,623	$0	$0	$0	$0	$814,137	$0	$0	$0	$0	$139,785	$0	$0	$0	$0	$527,097
1.9	$0	$0	$0	$0	$3,257,322	$0	$0	$0	$0	$18,725,157	$0	$0	$0	$0	$3,215,046	$0	$0	$0	$0	$12,123,234
2.0																				
2.1																				
2.1.1	$0	$0	$0	$0	$16,287	$16,287	$16,287	$16,287	$16,287	$109,912	$109,912	$109,912	$109,912	$109,912	$125,988	$125,988	$125,988	$125,988	$125,988	$186,604
Total O & M																				
Total NPV																				

Year (2027–2051)

Item	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
1.0																									
1.1																									
1.1.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.5	$0	$0	$0	$0	$2,562,283	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,207,329	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.1.7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,079,556	$0	$0	$0	$0	$0
1.2																									
1.2.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1.3	$0	$0	$0	$0	$2,562,283	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,207,329	$0	$0	$0	$0	$2,079,556	$0	$0	$0	$0	$0
1.4	$0	$0	$0	$0	$640,571	$0	$0	$0	$0	$0	$0	$0	$0	$0	$301,832	$0	$0	$0	$0	$519,889	$0	$0	$0	$0	$0
1.5	$0	$0	$0	$0	$256,228	$0	$0	$0	$0	$0	$0	$0	$0	$0	$120,733	$0	$0	$0	$0	$207,956	$0	$0	$0	$0	$0
1.6	$0	$0	$0	$0	$3,459,082	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,629,894	$0	$0	$0	$0	$2,807,400	$0	$0	$0	$0	$0
1.7	$0	$0	$0	$0	$345,908	$0	$0	$0	$0	$0	$0	$0	$0	$0	$162,989	$0	$0	$0	$0	$280,740	$0	$0	$0	$0	$0
1.8	$0	$0	$0	$0	$172,954	$0	$0	$0	$0	$0	$0	$0	$0	$0	$81,495	$0	$0	$0	$0	$140,370	$0	$0	$0	$0	$0
1.9	$0	$0	$0	$0	$3,977,945	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,874,378	$0	$0	$0	$0	$3,228,510	$0	$0	$0	$0	$0
2.0																									
2.1																									
2.1.1	$186,604	$186,604	$186,604	$186,604	$206,494	$206,494	$206,494	$206,494	$206,494	$206,494	$206,494	$206,494	$206,494	$206,494	$215,865	$215,865	$215,865	$215,865	$215,865	$232,008	$232,008	$232,008	$232,008	$232,008	$232,008
Total O & M																									
Total NPV																									

APPENDIX A –SIMULATION RESULTS & HGLS

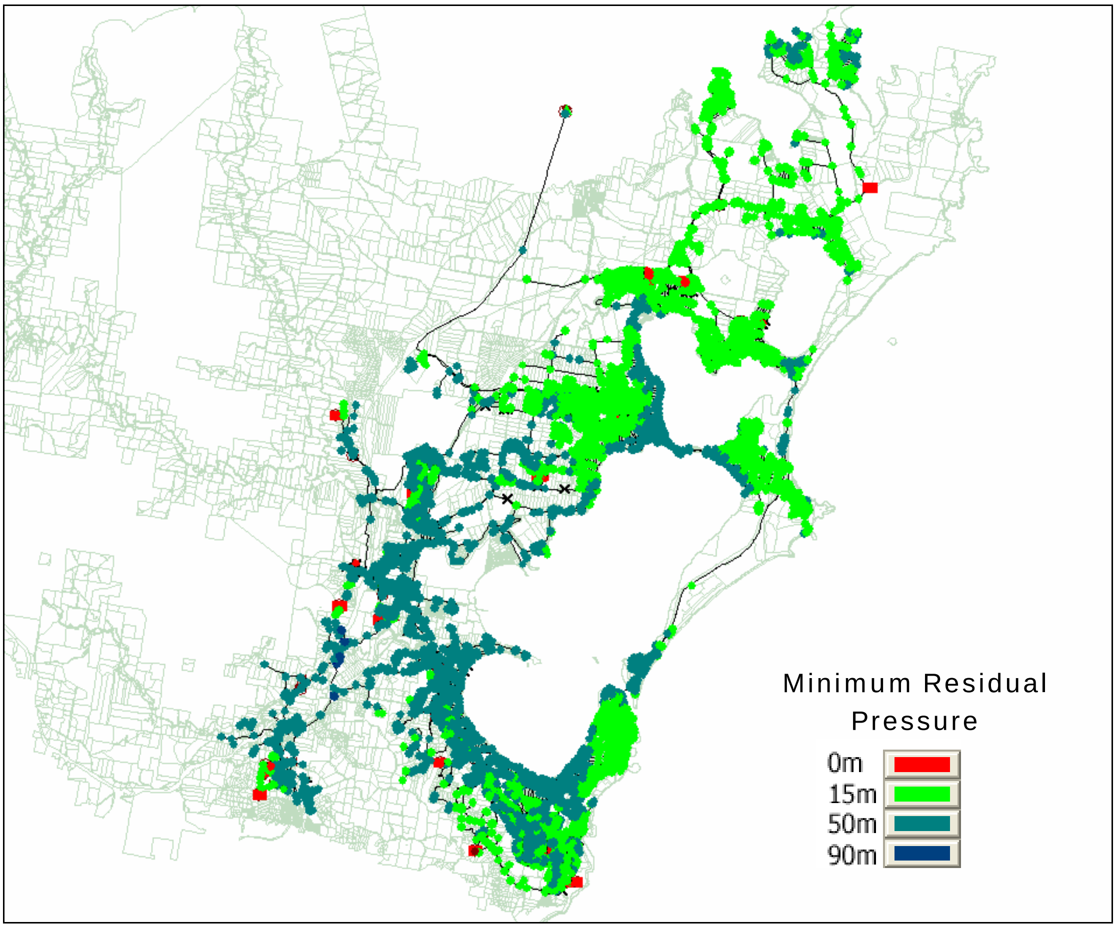
SIMULATION RESULTS AND HGLS

Result files generated for each of the future runs are provided below.

2011 SIMULATION RESULTS

The following are a compilation of charts, figures and schematics as produced from the simulation results files for the 2011 staged hydraulic model.

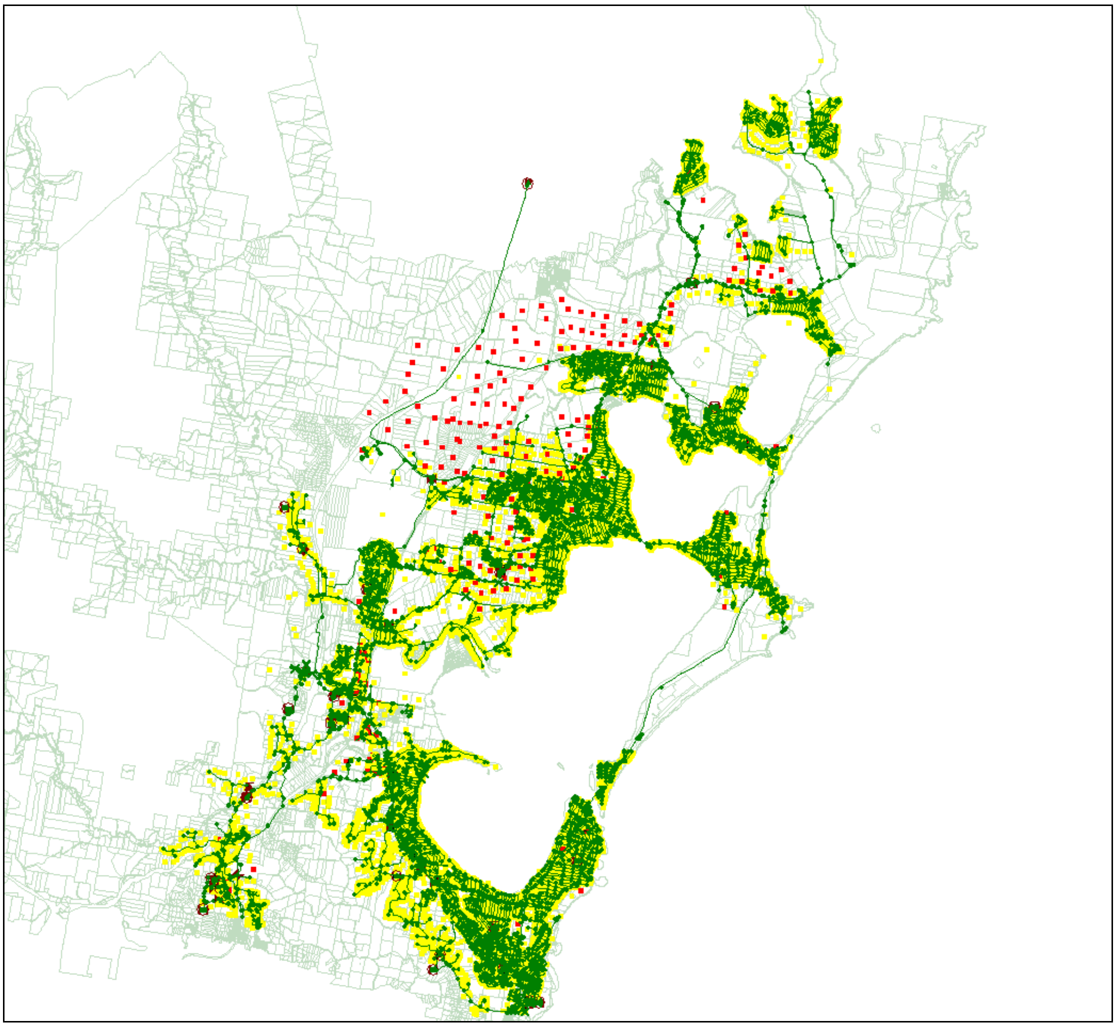
Minimum Residual Pressures



The above figure illustrates the minimum residual pressures experienced at each node during the course of the 24hr PDD simulation.

Red nodes represent locations where residual pressures of less than 15m are experienced. Light green for those above 15m and less than 50m. Dark green for those above 50m and less than 90m. Dark blue for those above 90m.

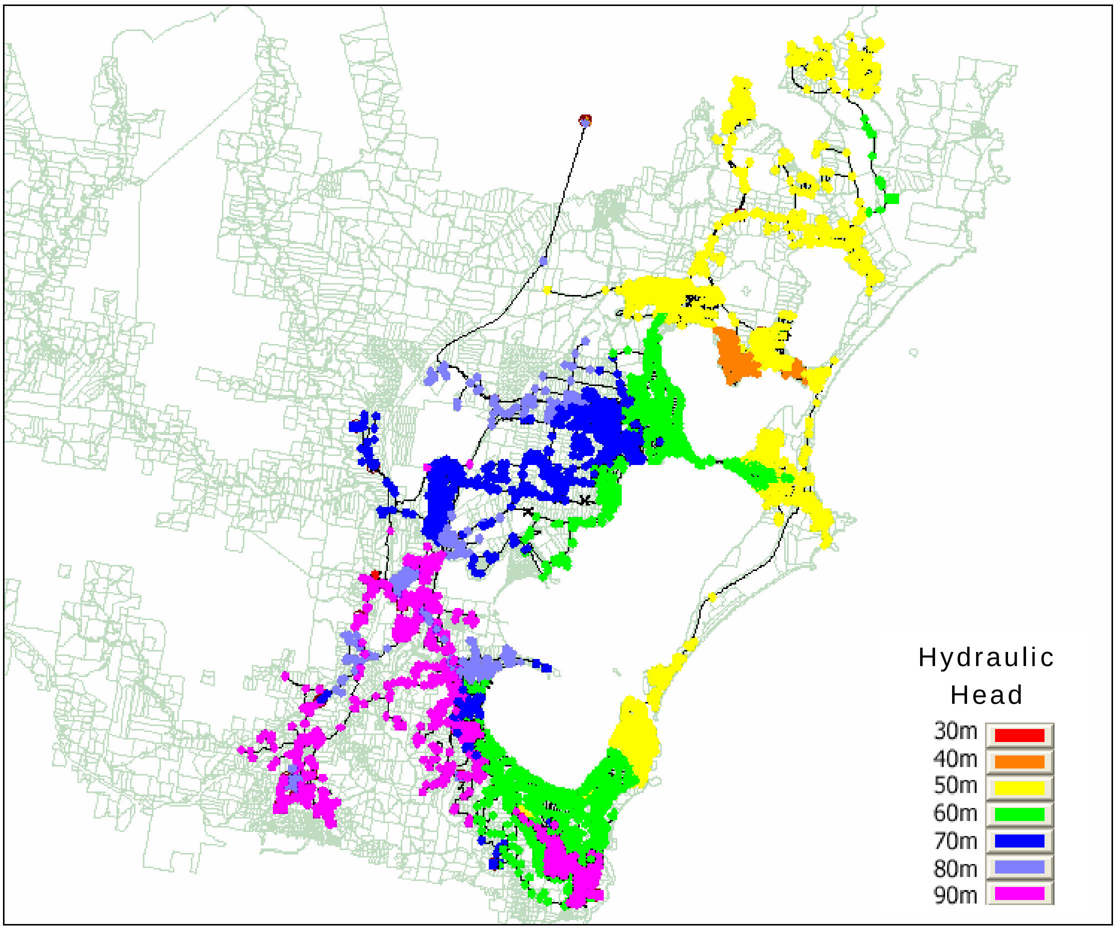
Customer Points



This figure identifies locations of development areas examined as part of the Long Term Demand Projection study and those that have been allocated a demand due to the current level of staging. Those that do not have demands allocated are shown in red. Those customers points that do have an allocated demand (pre-existing or current staged development zones) are shown in yellow.

With the progression of the staged works a number of the previously red nodes will turn yellow indicating infilling of that particular subdivision/development area during that particular staging of the works. It should be noted that the capital works programs is essentially driven by the timing of the expansion of these zones, nominated in the previous demand study.

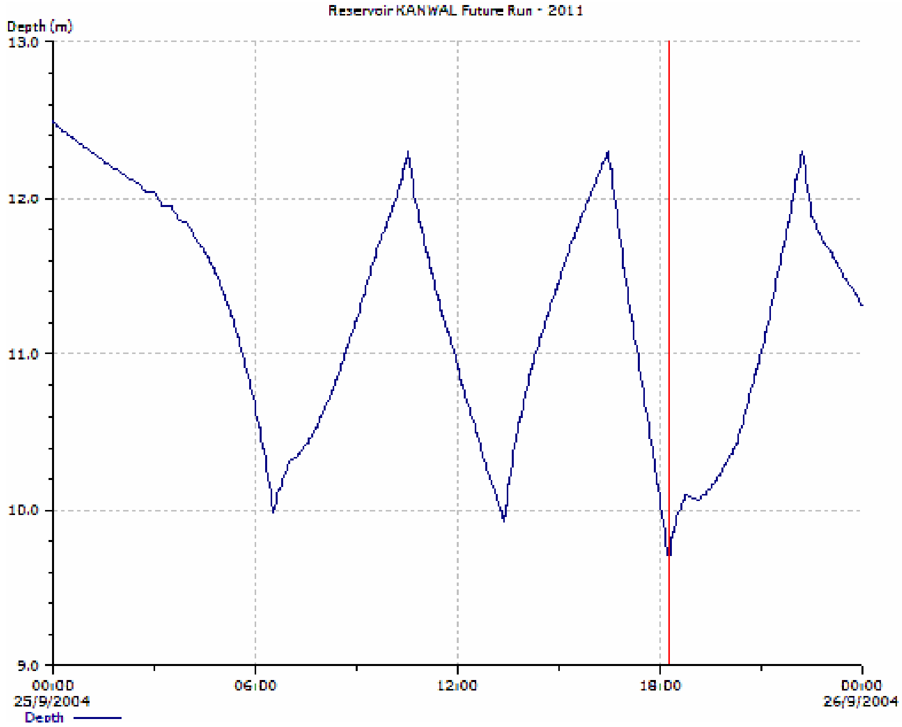
Simulated Head Conditions

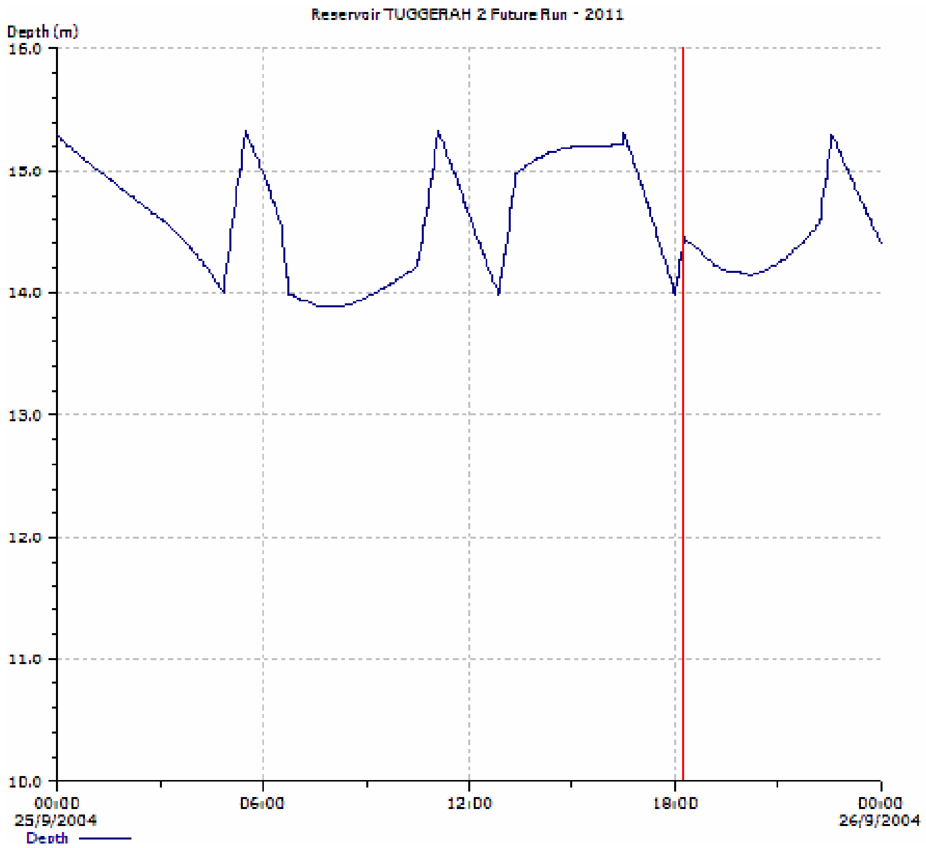


The above figure is a graphical representation of the head conditions experienced at one given time. For the purposes of this study the time step chosen to illustrate system head conditions corresponds to the time step when the Kanwal reservoirs are at their lowest levels. This criterion was chosen as Kanwal reservoirs play a significant role in the delivery of water to the northern system, which is where the majority of future expansion is predicted to occur.

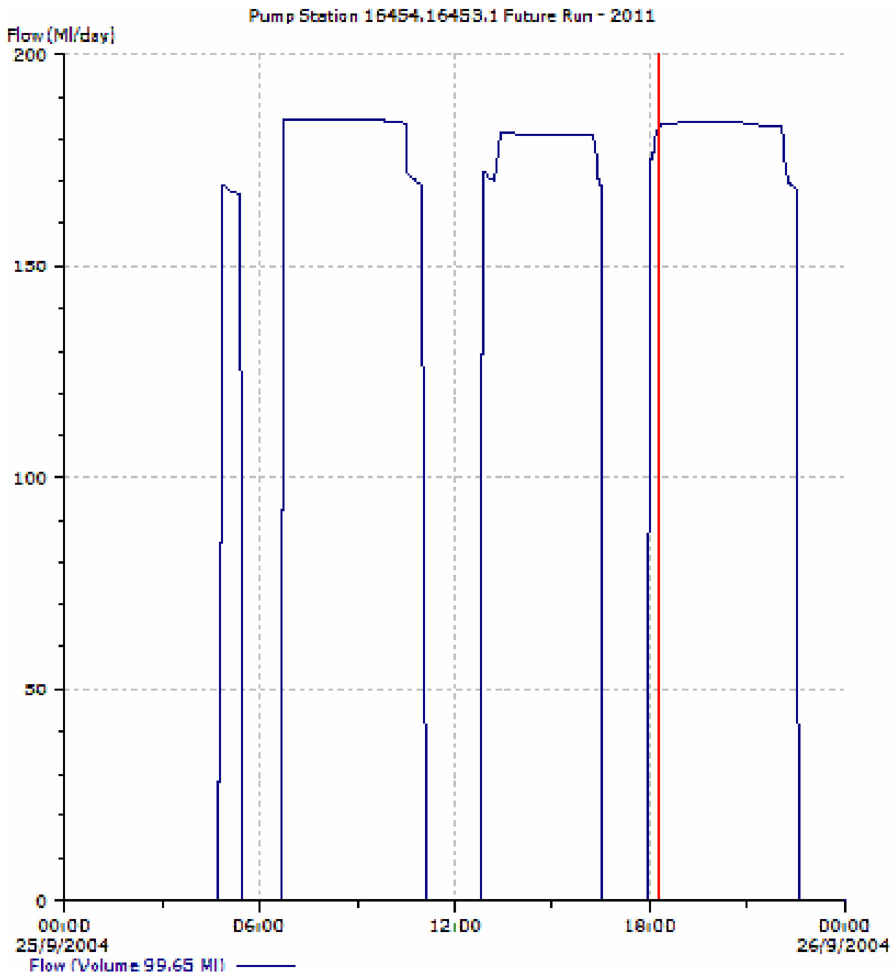
Reservoir Levels & MHLPS Performance

The following figures illustrate the performance of the MHLPS and a series of key reservoirs during the course of the simulation PDD. The figures are identified at the top of the charts except for the Mardi HLPS which has been given the following Infoworks WS computer generated identifier - 16454.16453.1



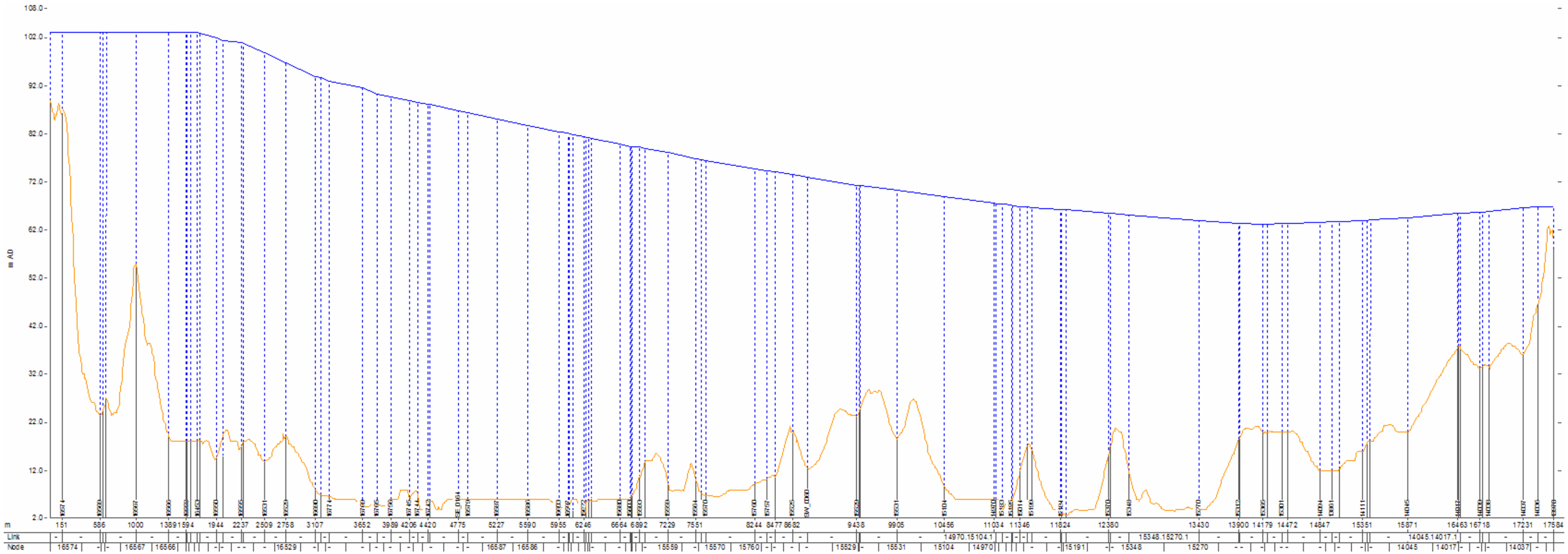


Reservoir TUGGERAH 2 Future Run - 2011
Depth (m)
16.0
15.0
14.0
13.0
12.0
11.0
10.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth

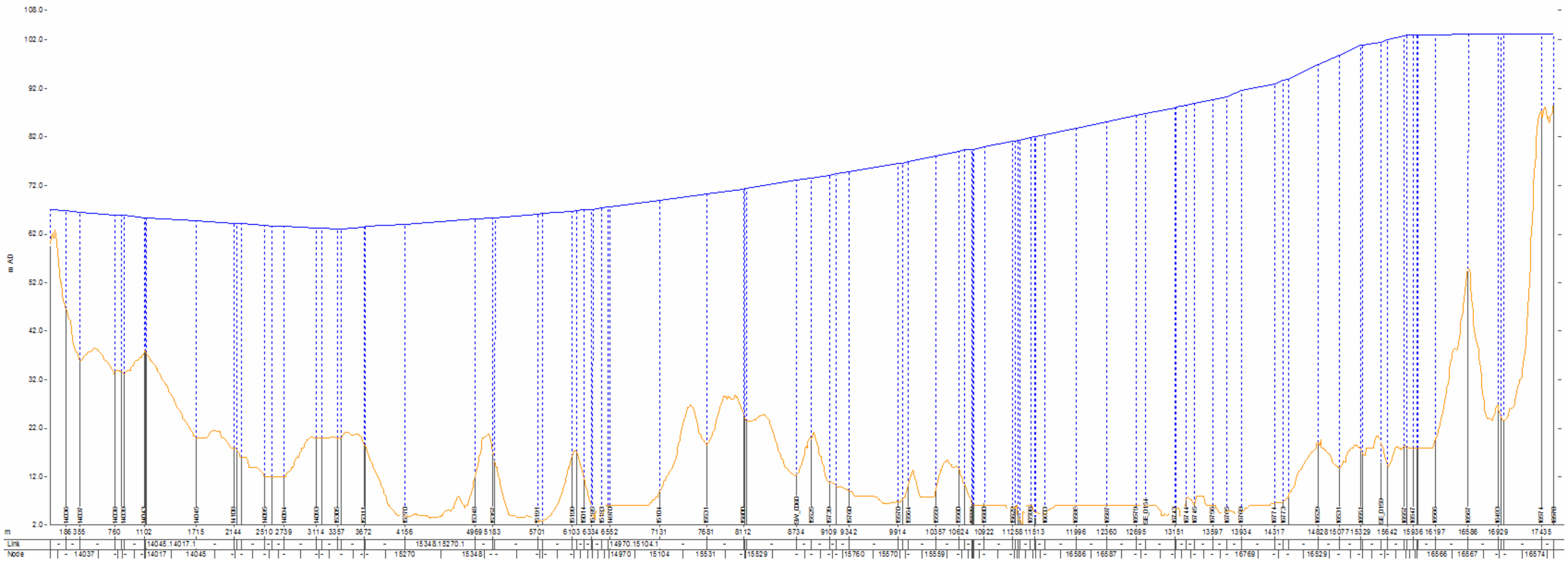

Pump Station 16454.16453.1 Future Run - 2011
Flow (Ml/day)
200
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 99.65 Ml)

System Hydraulic Grade Lines (HGLs)

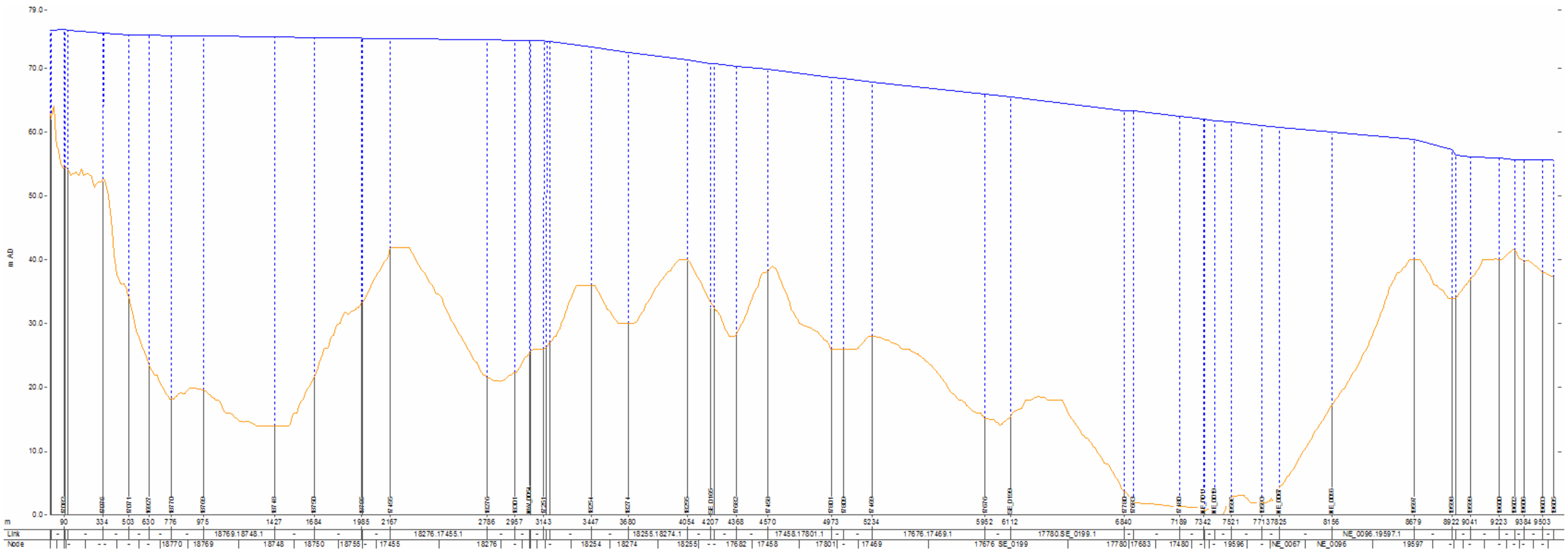
As with the previous simulation result charts and figures the HGLs have all been generated at the time step corresponding to the lowest water levels in Kanwal reservoir during the course of that particular hydraulic simulation.



Tuggerah 2 Reservoir to Kanwal Reservoir



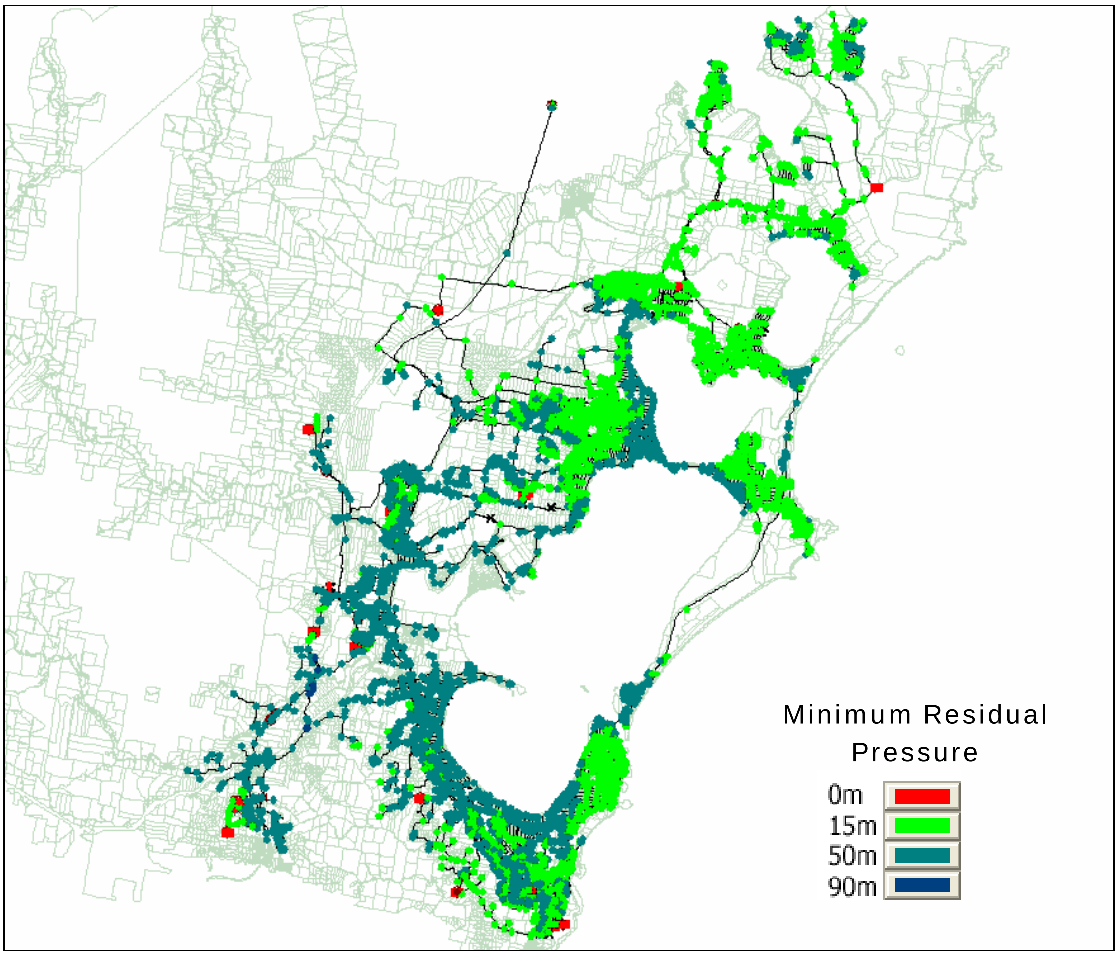
Wyrrabalong Reservoir to Tuggerah 2 Reservoir



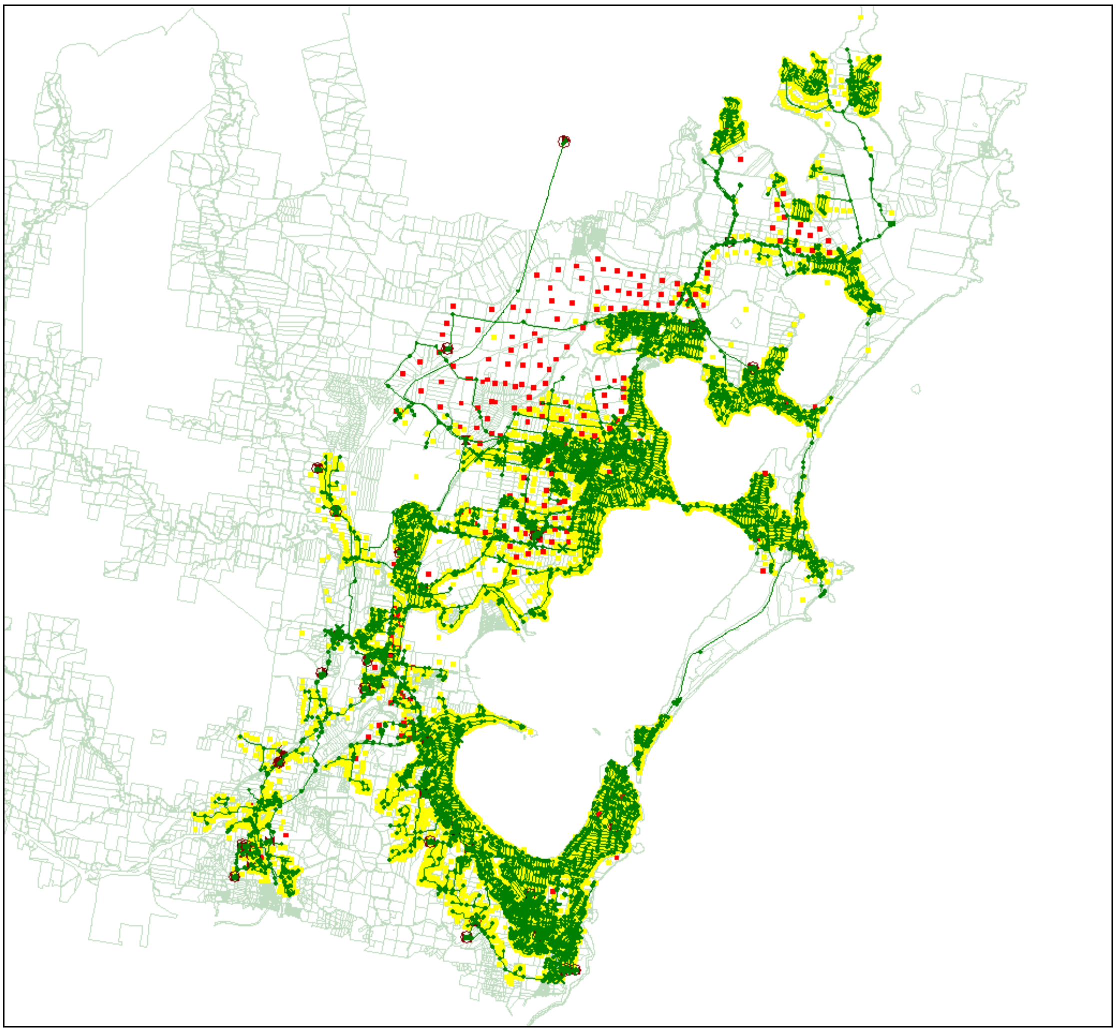
Kanwal Reservoirs to the Bluehaven area.

2016 SIMULATION RESULTS

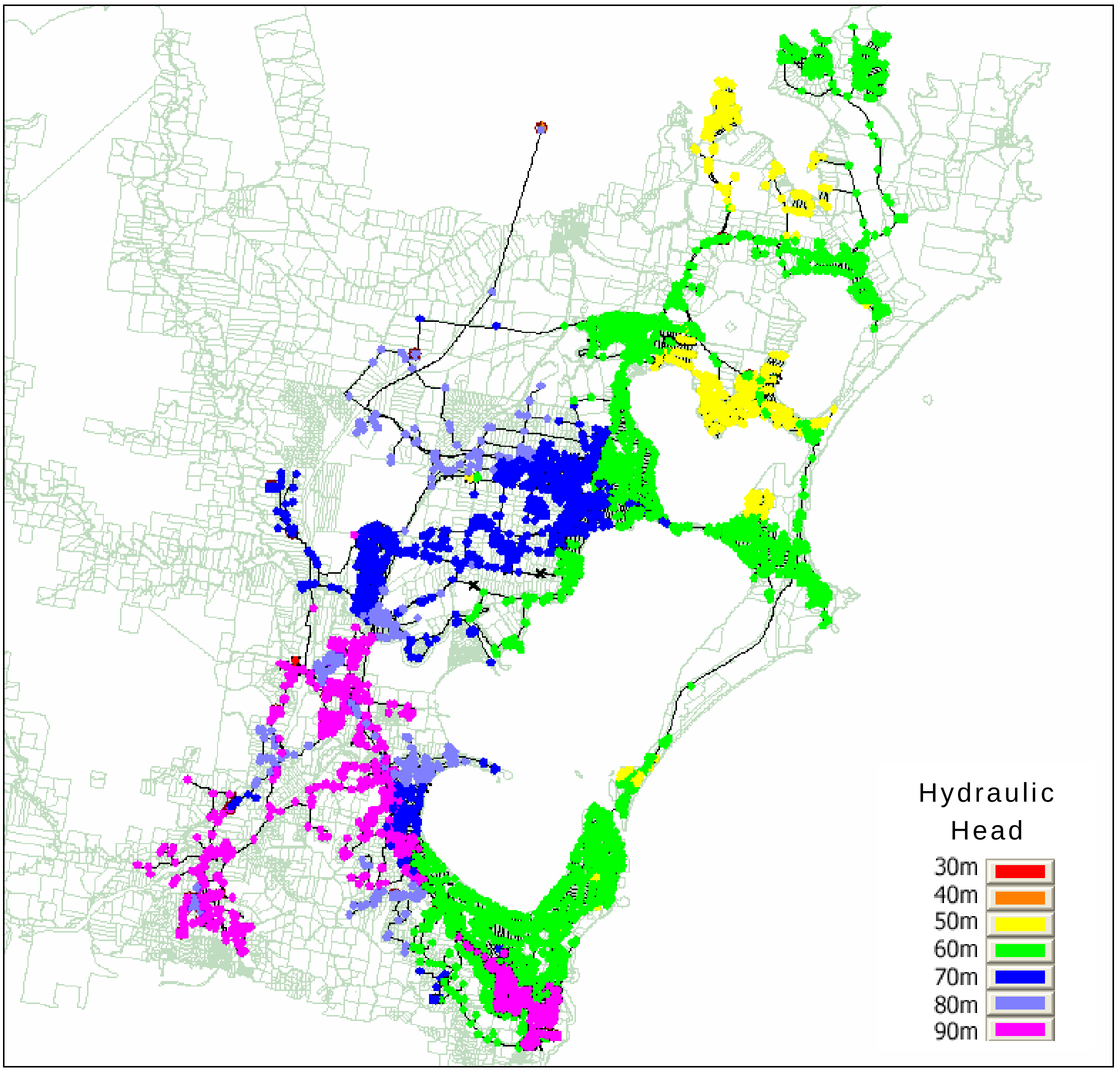
Minimum Residual Pressures



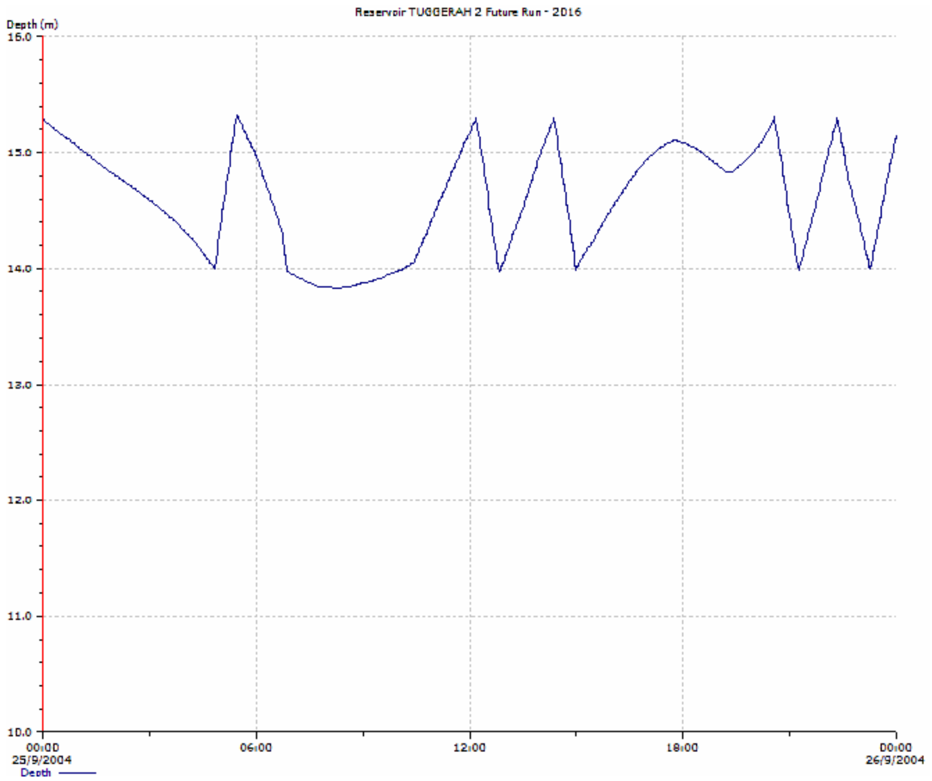
Customer Points

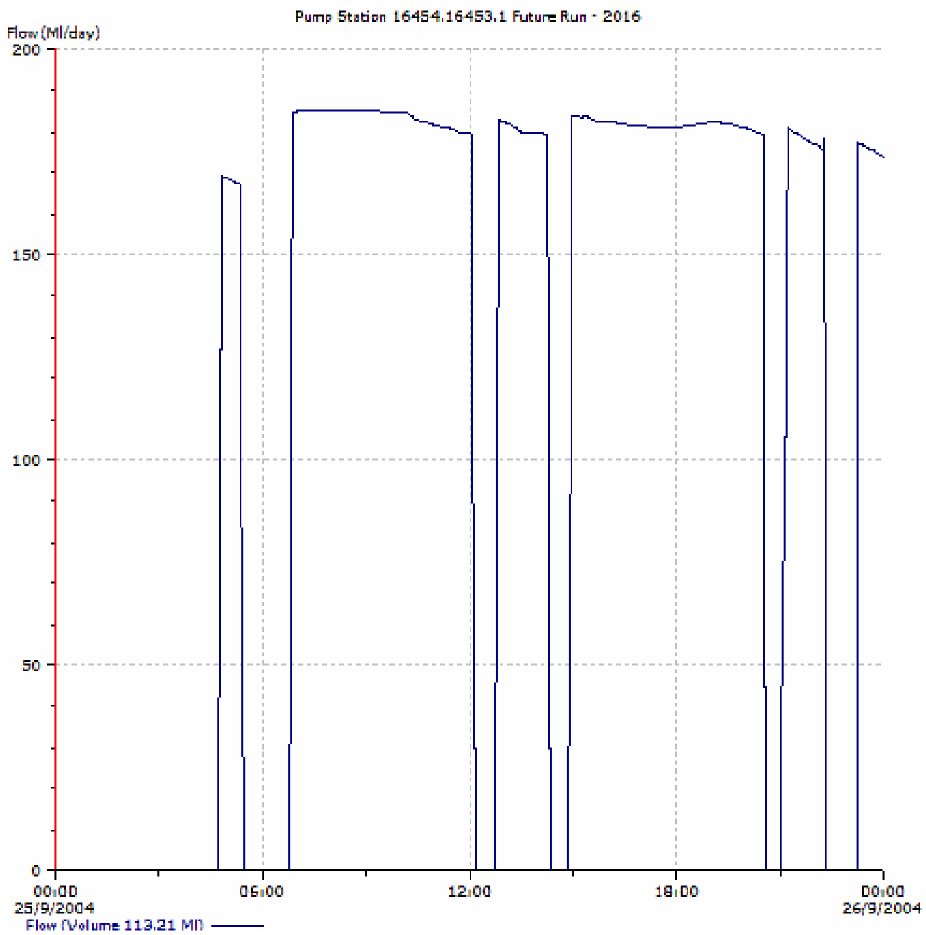


Simulated Head Conditions

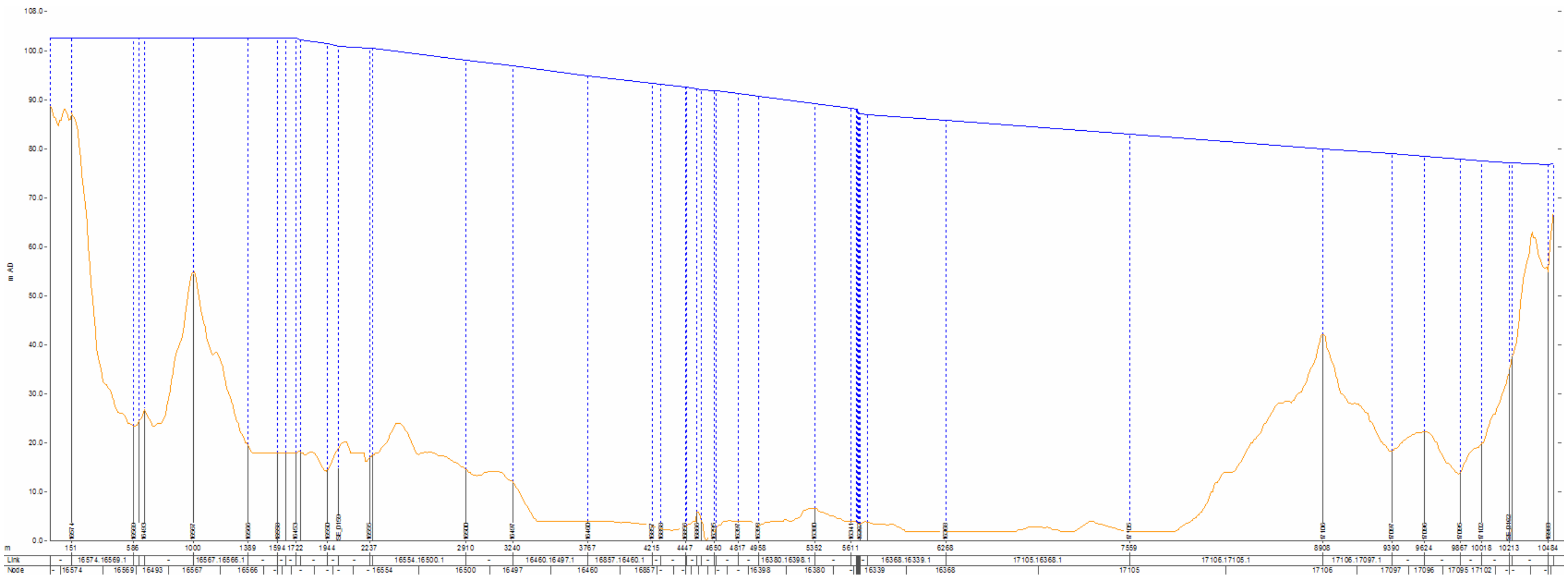


Reservoir Levels & MHLPS Performance

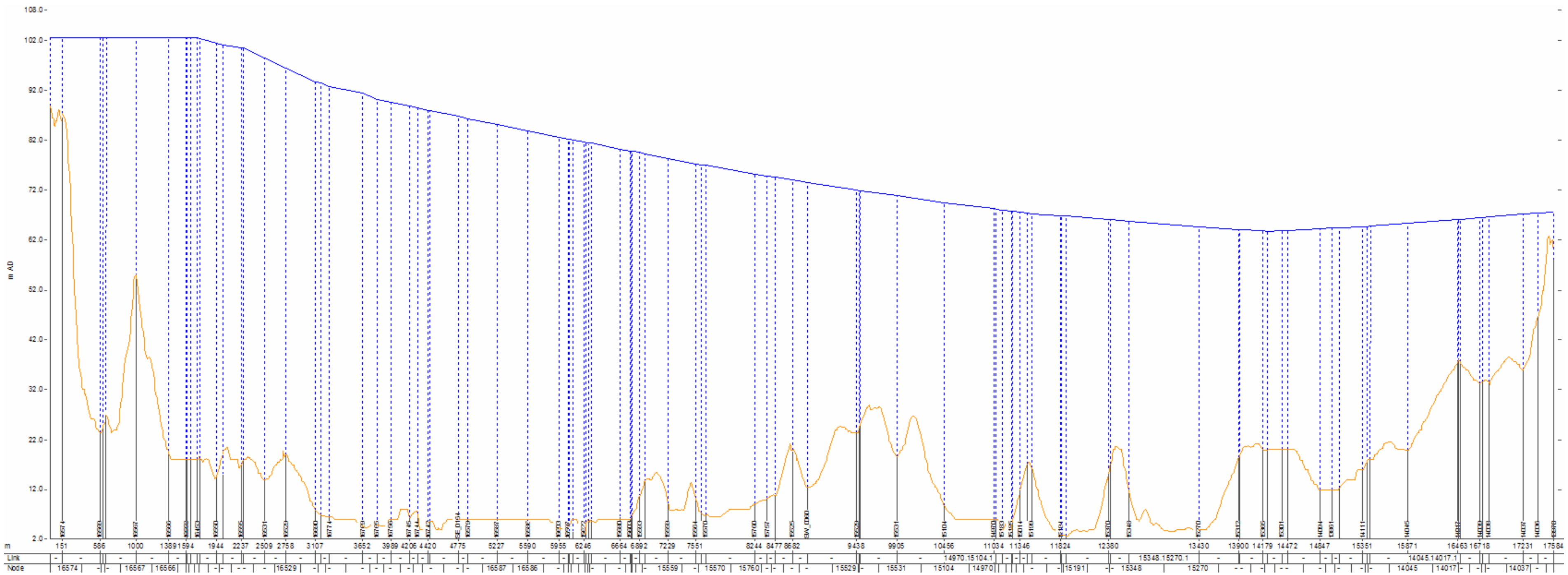




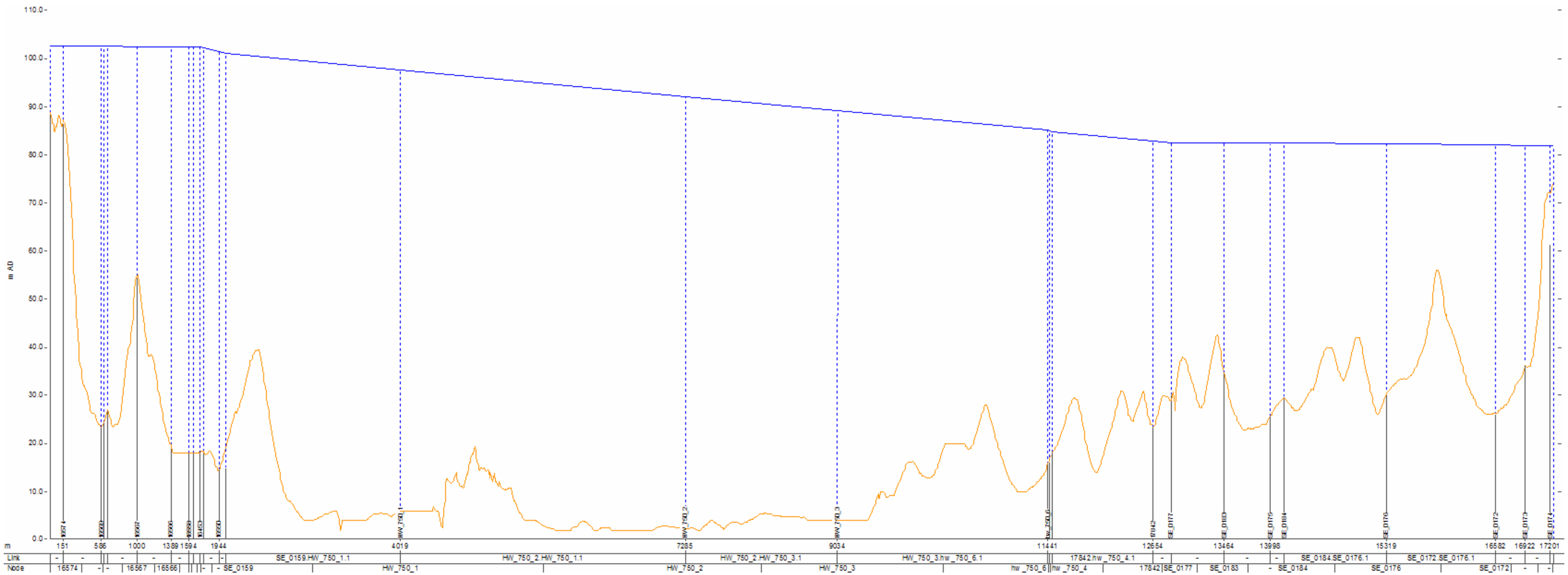
System Hydraulic Grade Lines (HGLs)



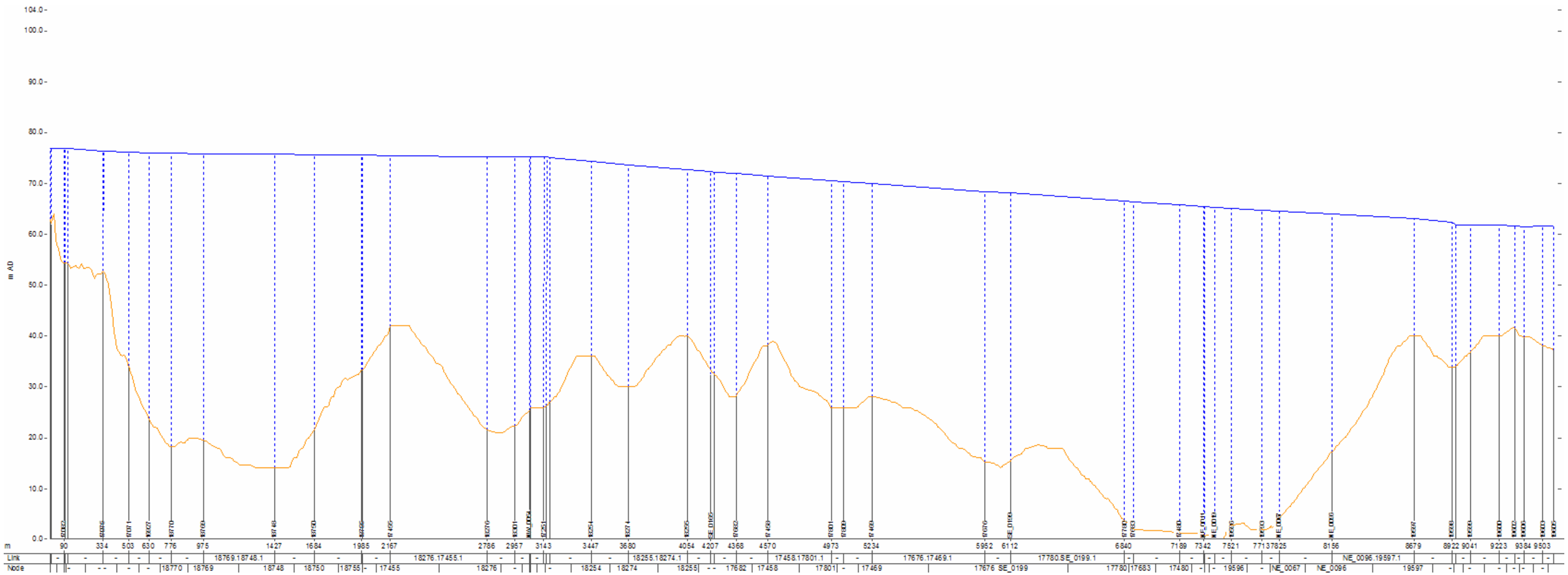
Tuggerah 2 Reservoir to Kanwal Reservoirs



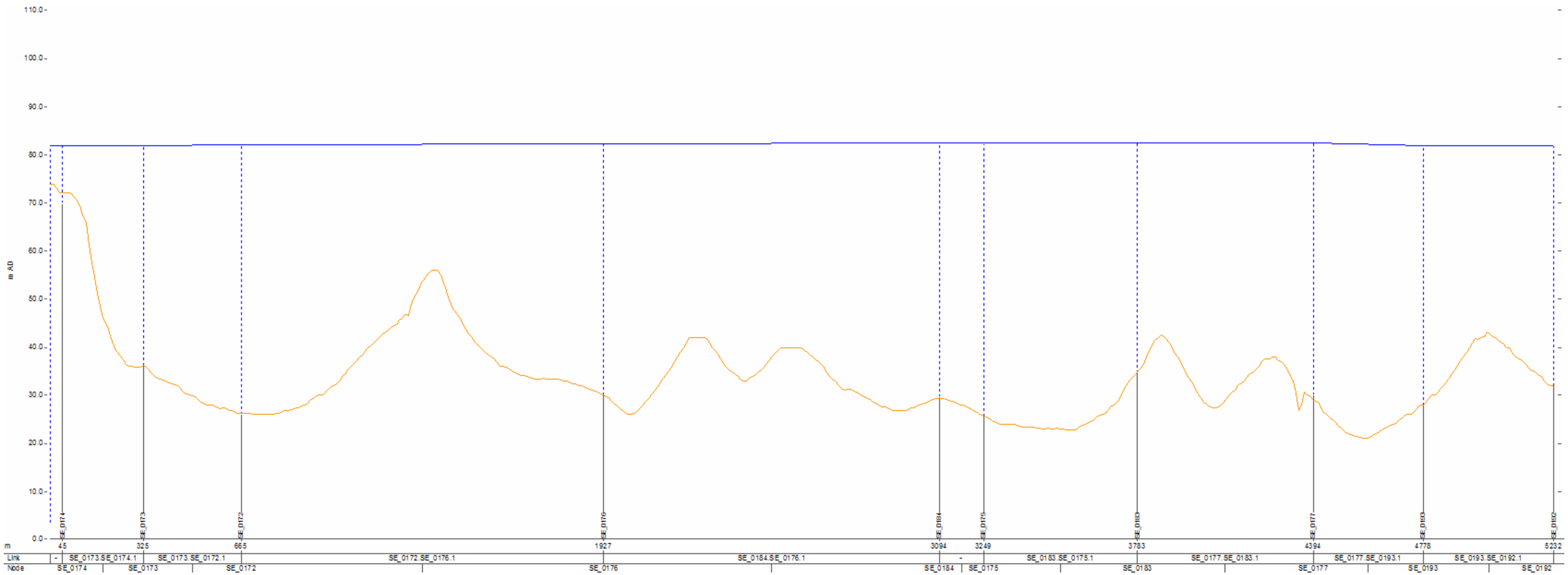
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



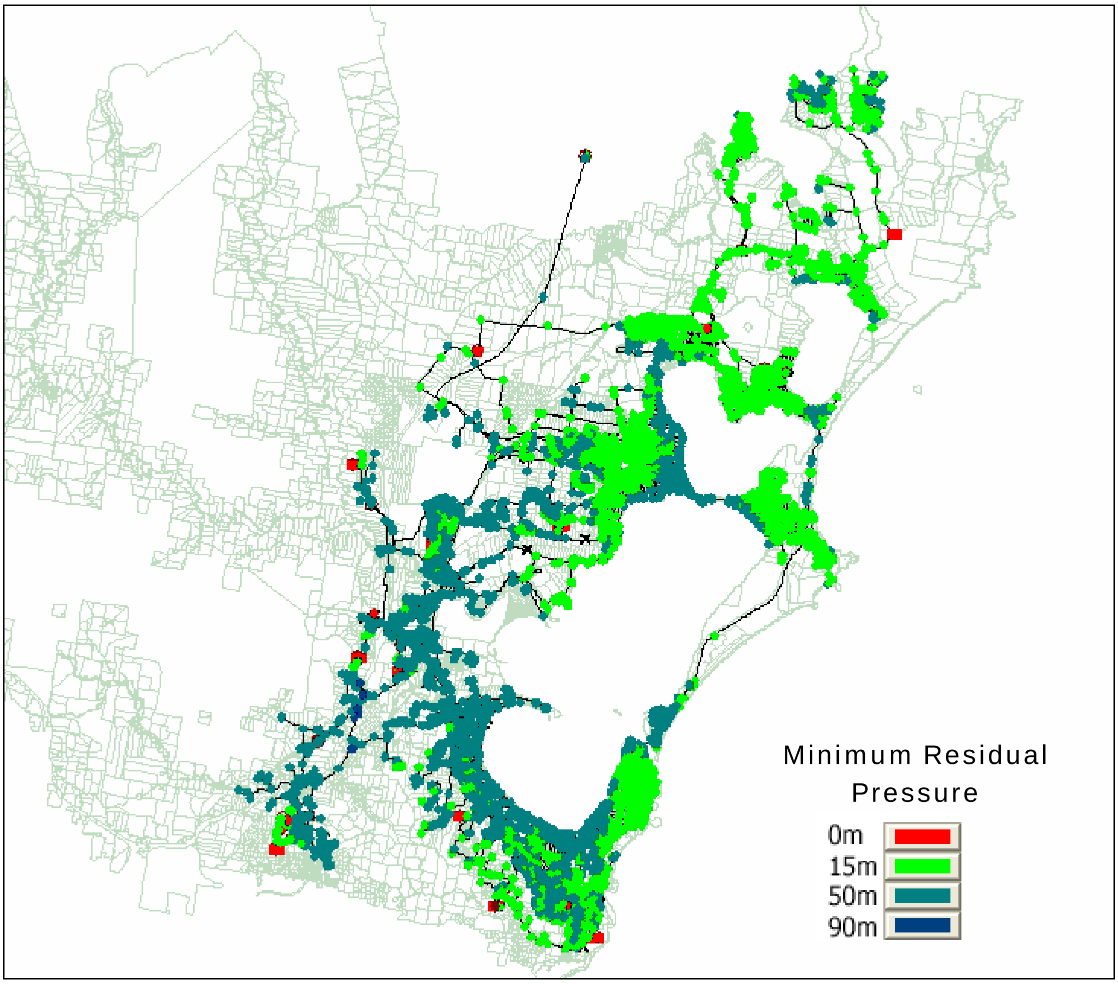
Kanwal Reservoirs to Bluehaven Area



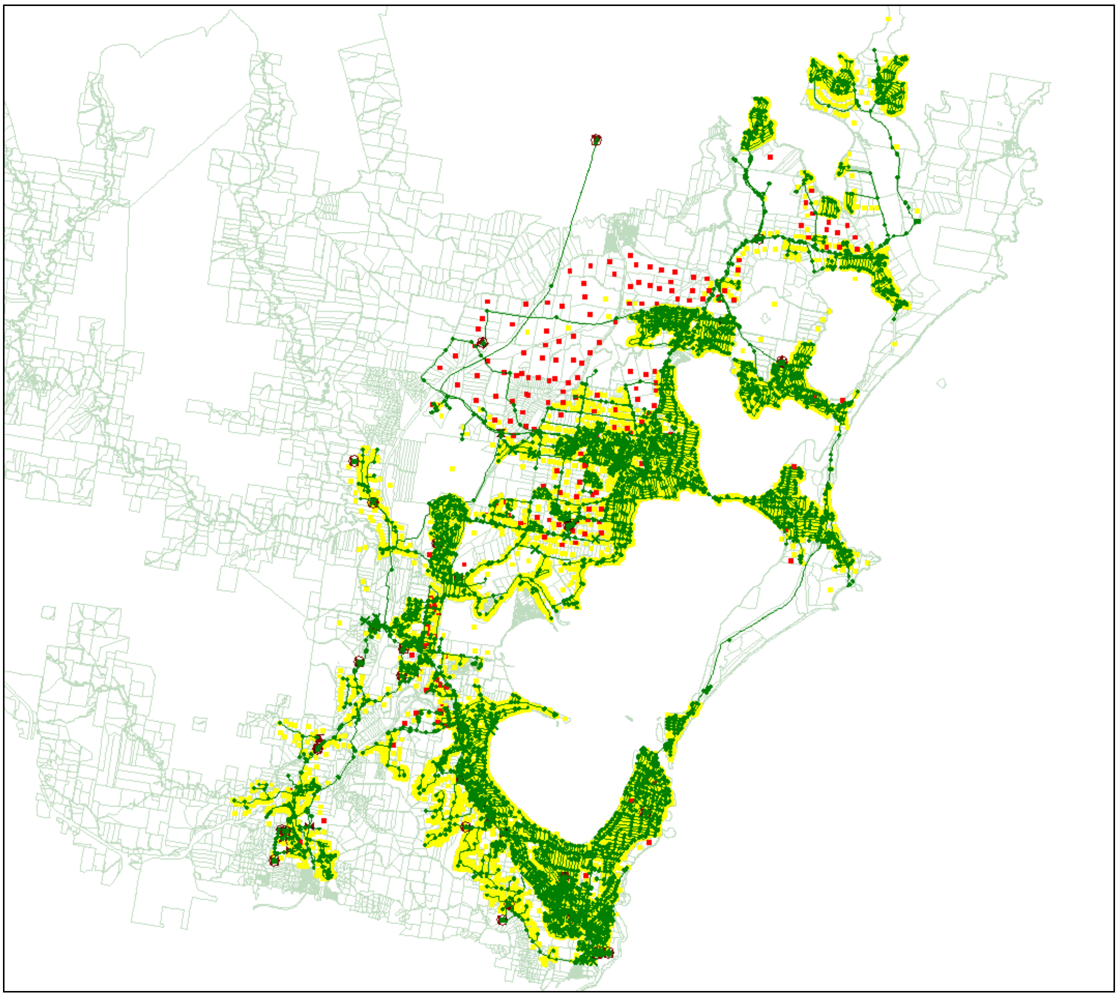
Kiar Ridge Reservoir to Warnervale High Level Zone

2021 Simulation Results

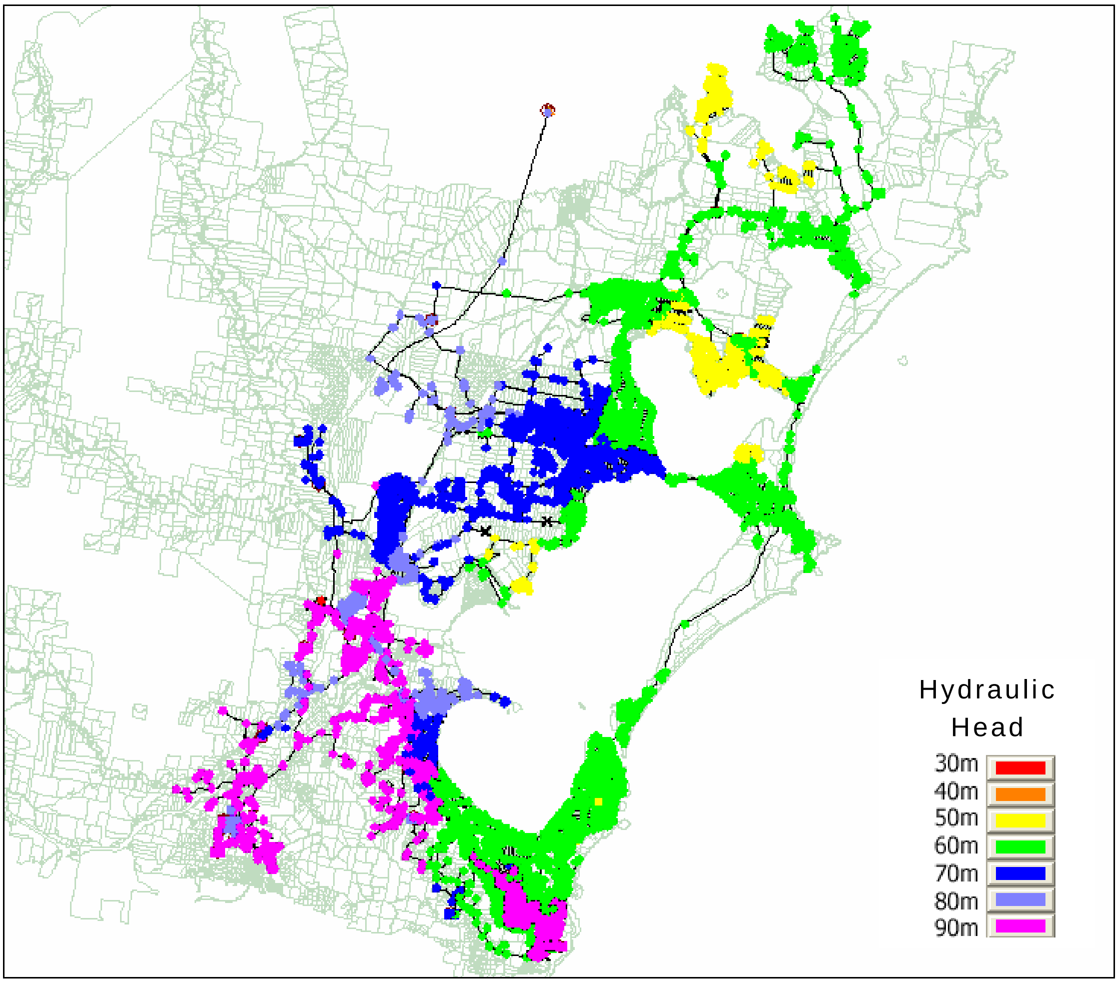
Minimum Residual Pressures



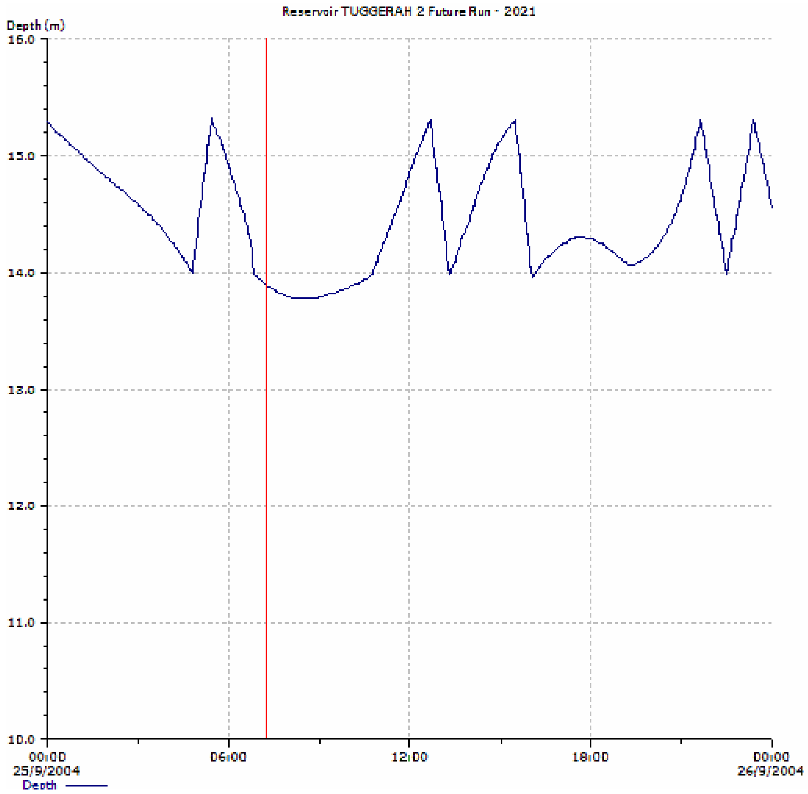
Customer Points

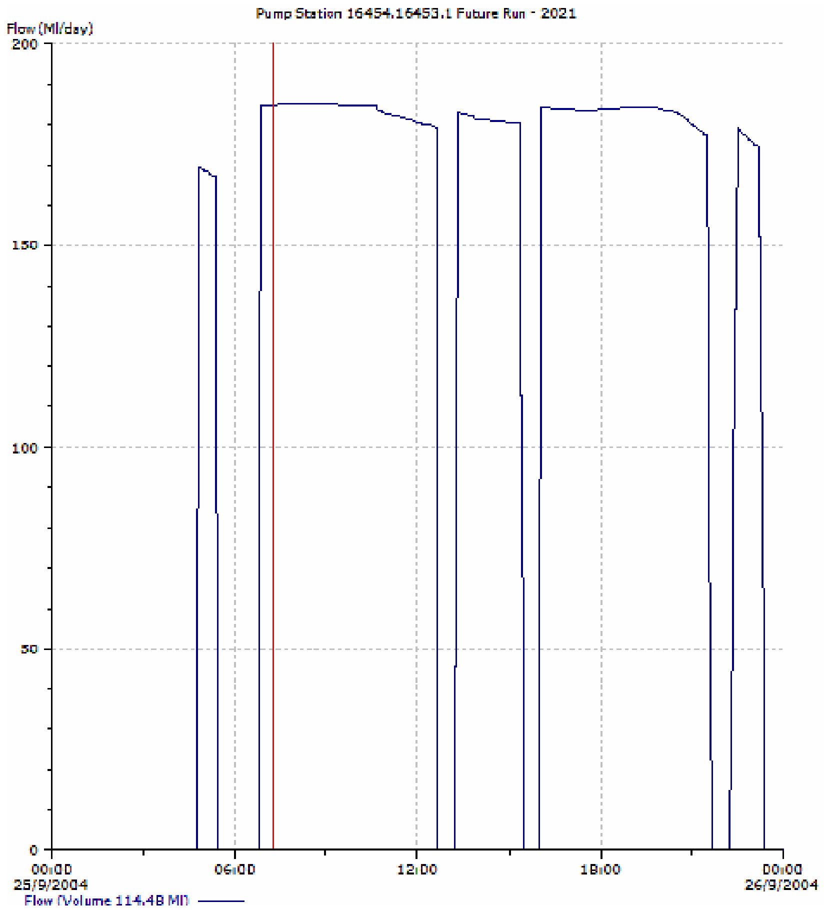


Simulated Head Conditions



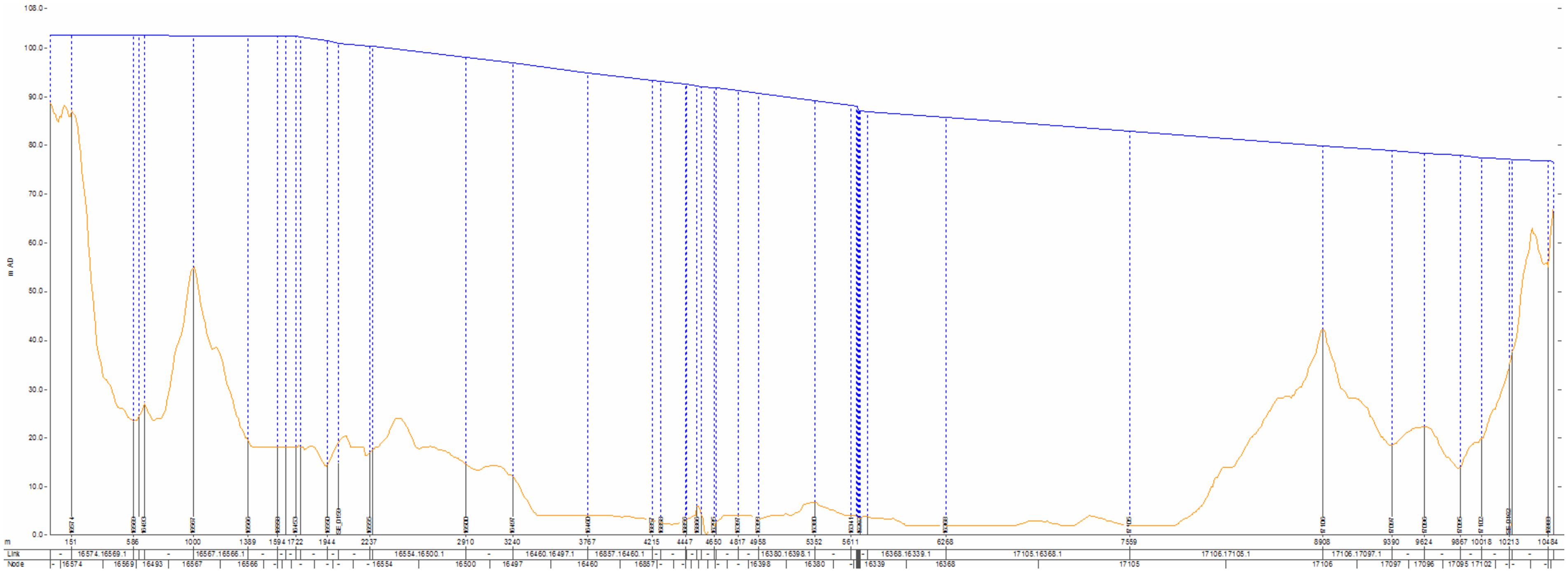
Reservoir Levels & MHLPS Performance



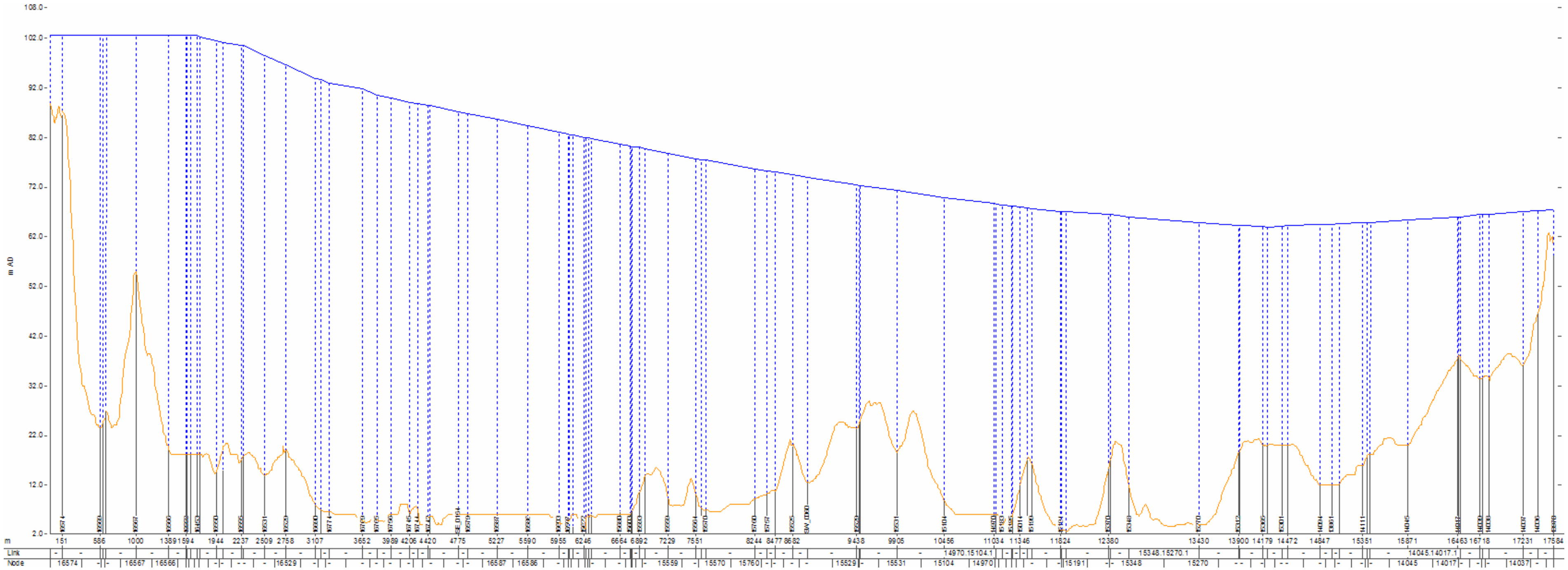


Pump Station 16454.16453.1 Future Run - 2021
Flow (Ml/day)
200
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 114.48 Ml)

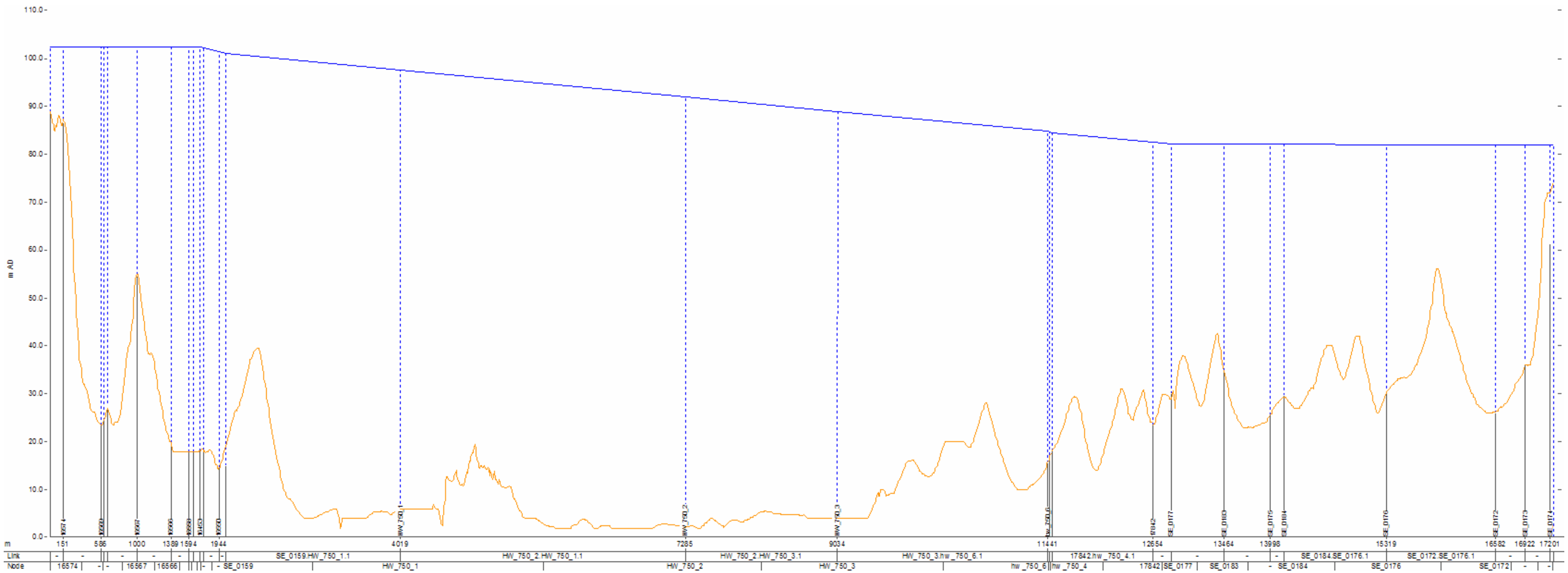
System Hydraulic Grade Lines (HGLs)



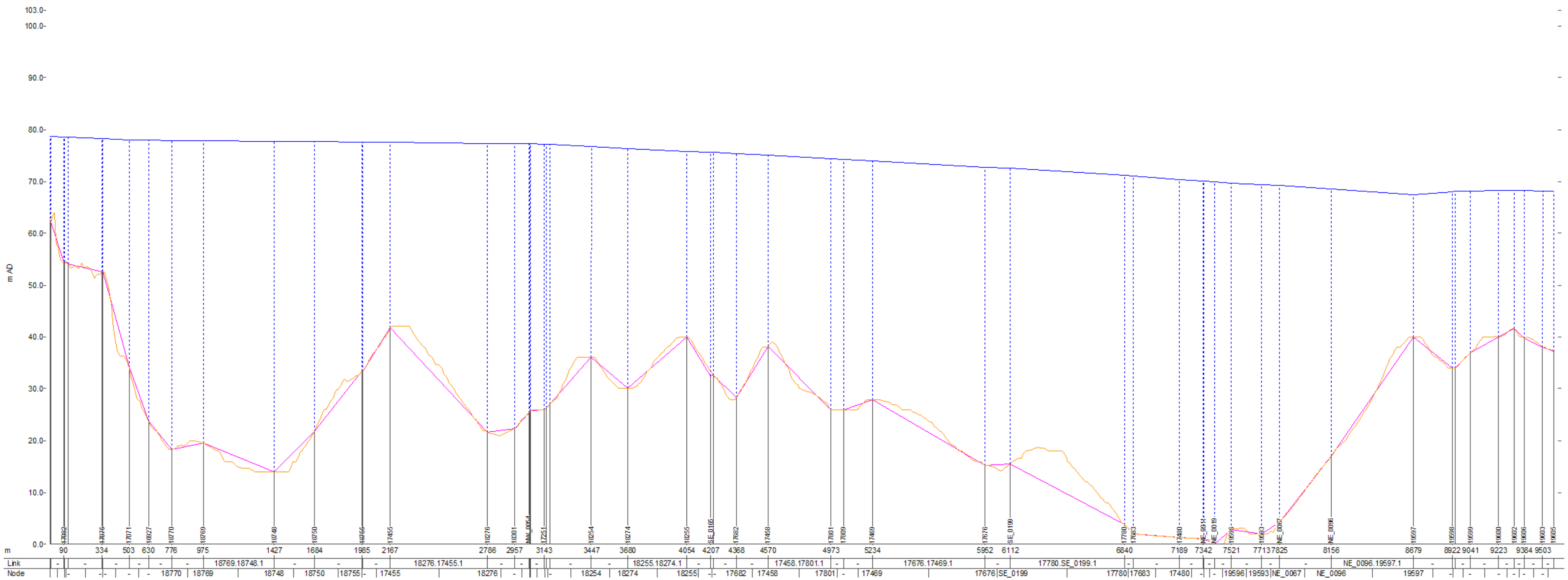
Tuggerah 2 Reservoir to Kanwal Reservoirs



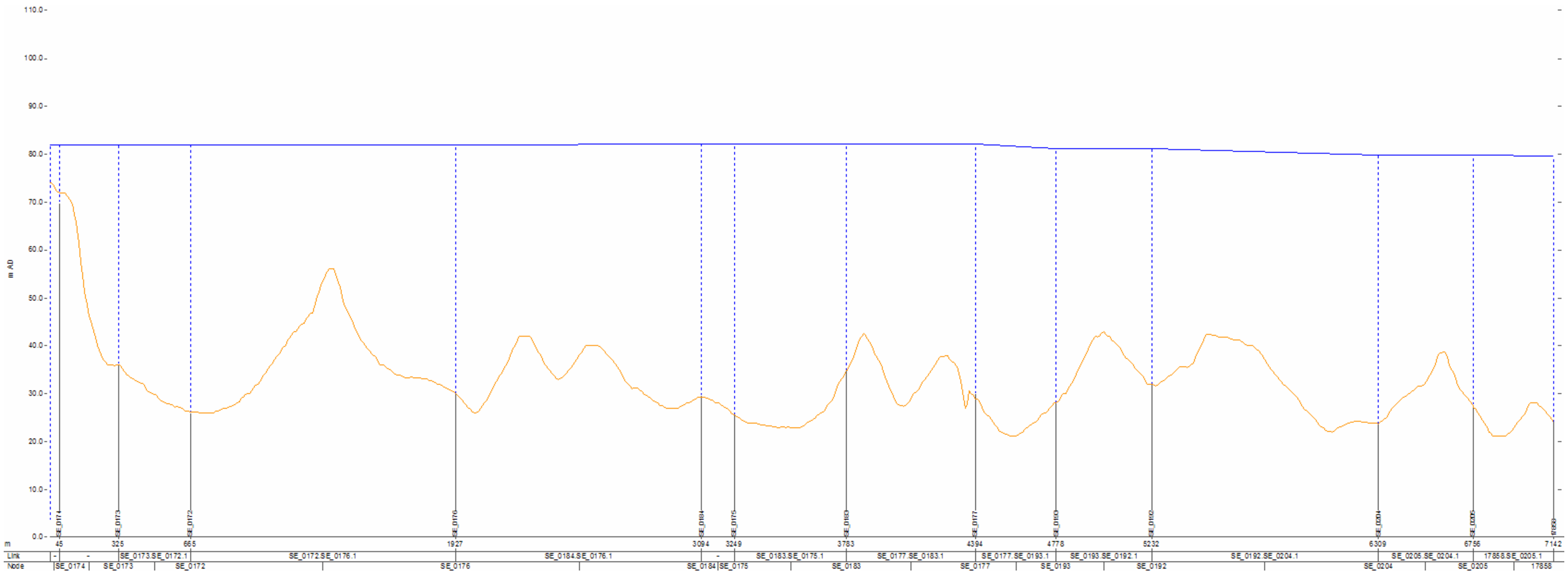
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



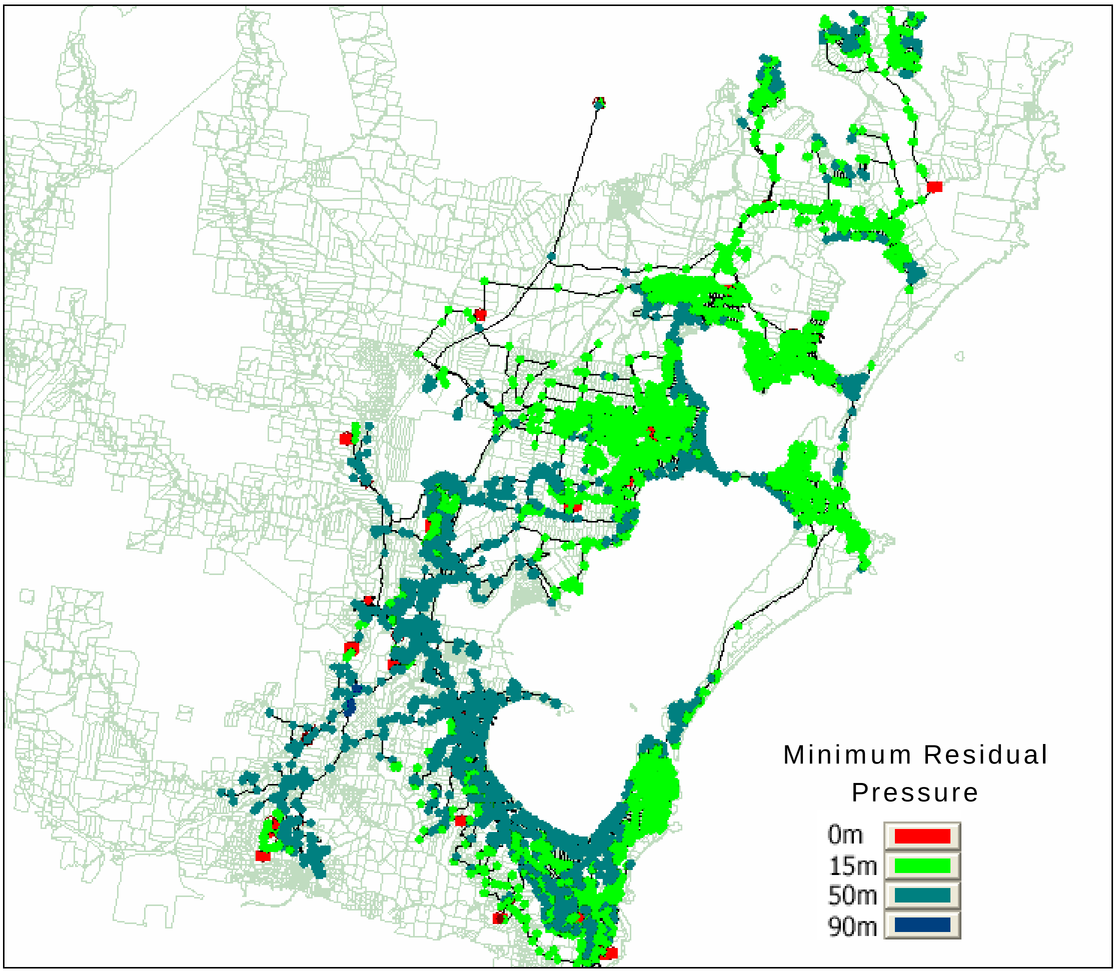
Kanwal Reservoirs to Bluehaven Area



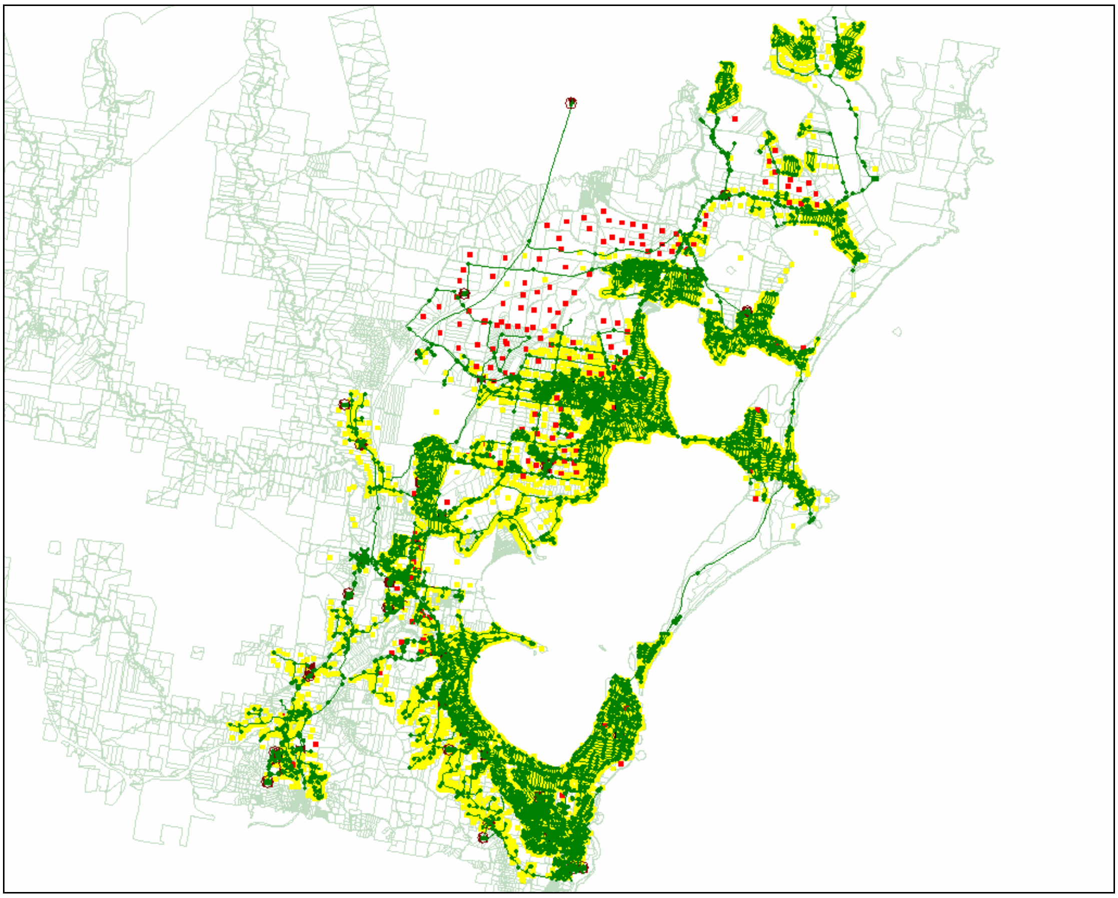
Kiar Ridge Reservoir to Warnervale High Level Zone

2026 Simulation Results

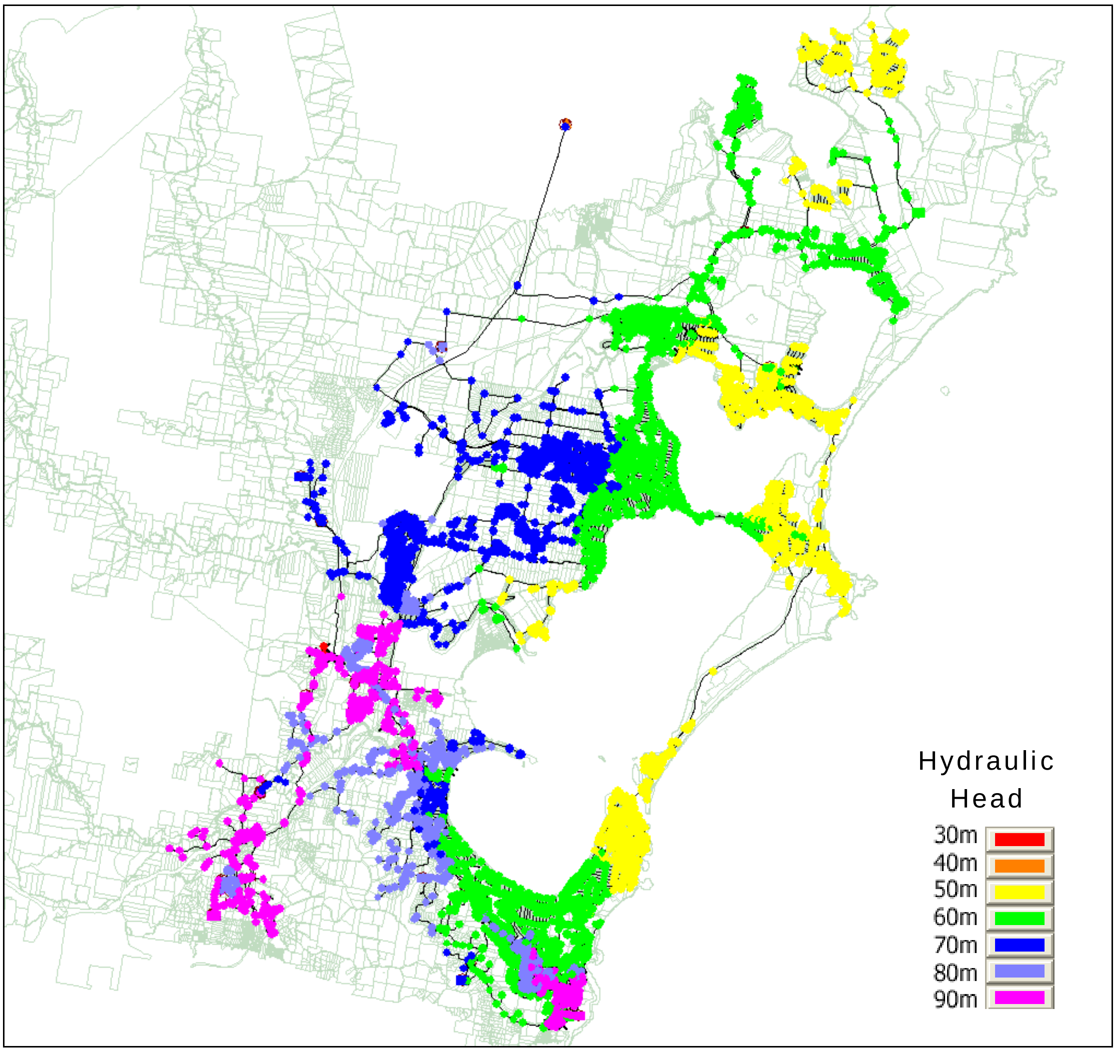
Minimum Residual Pressures



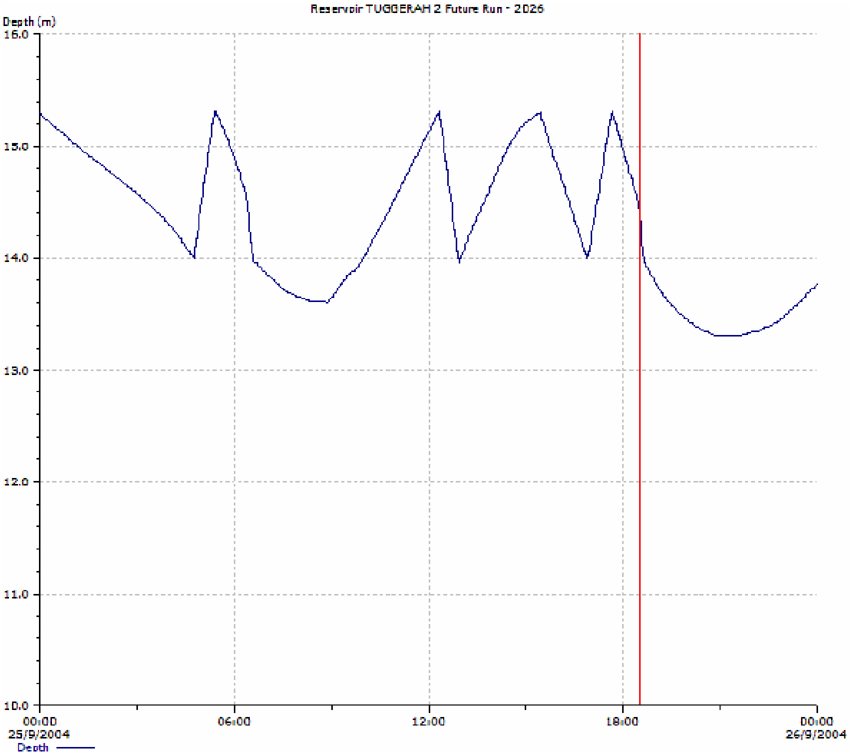
Customer Points

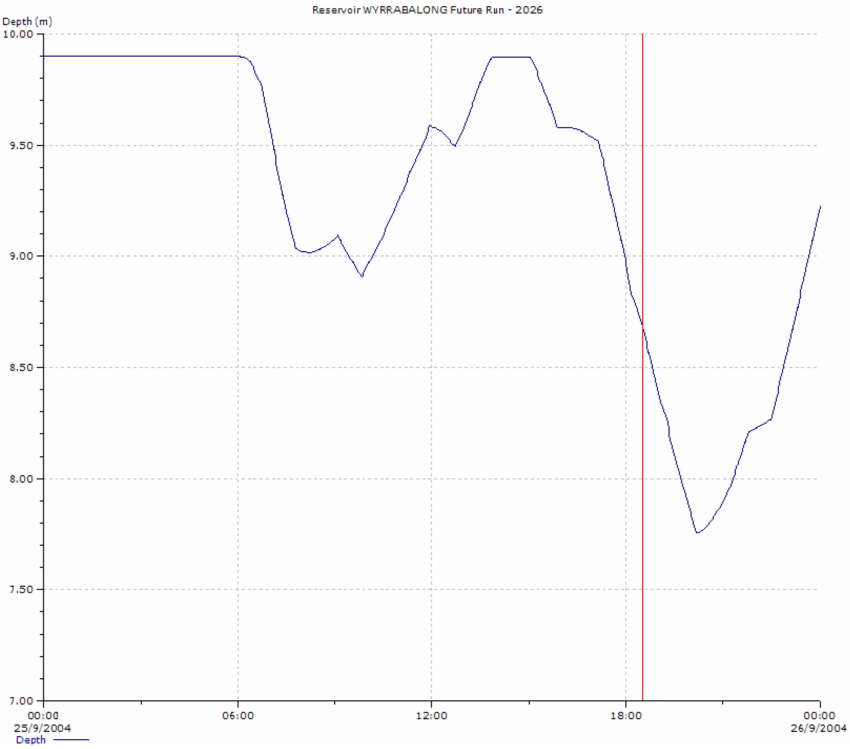


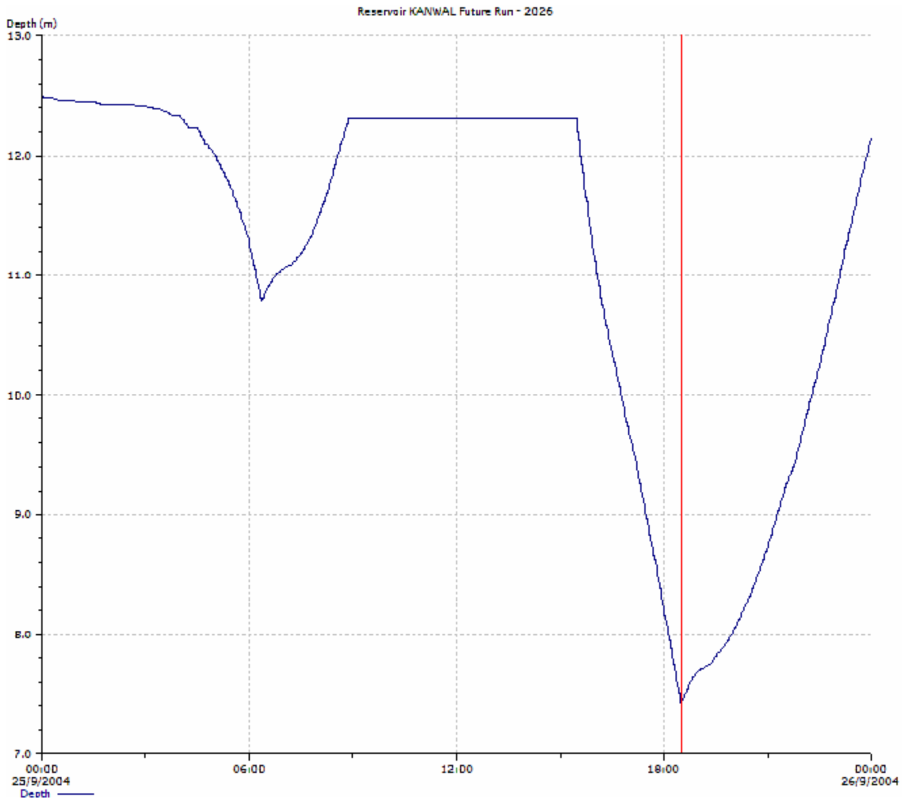
Simulated Head Conditions

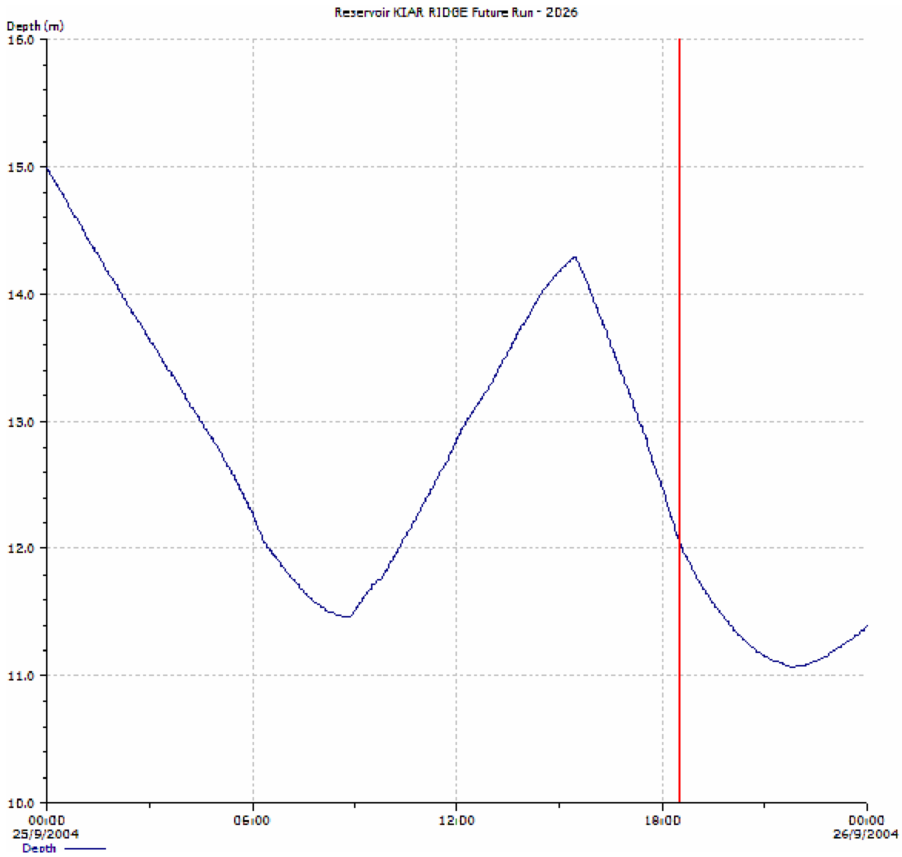


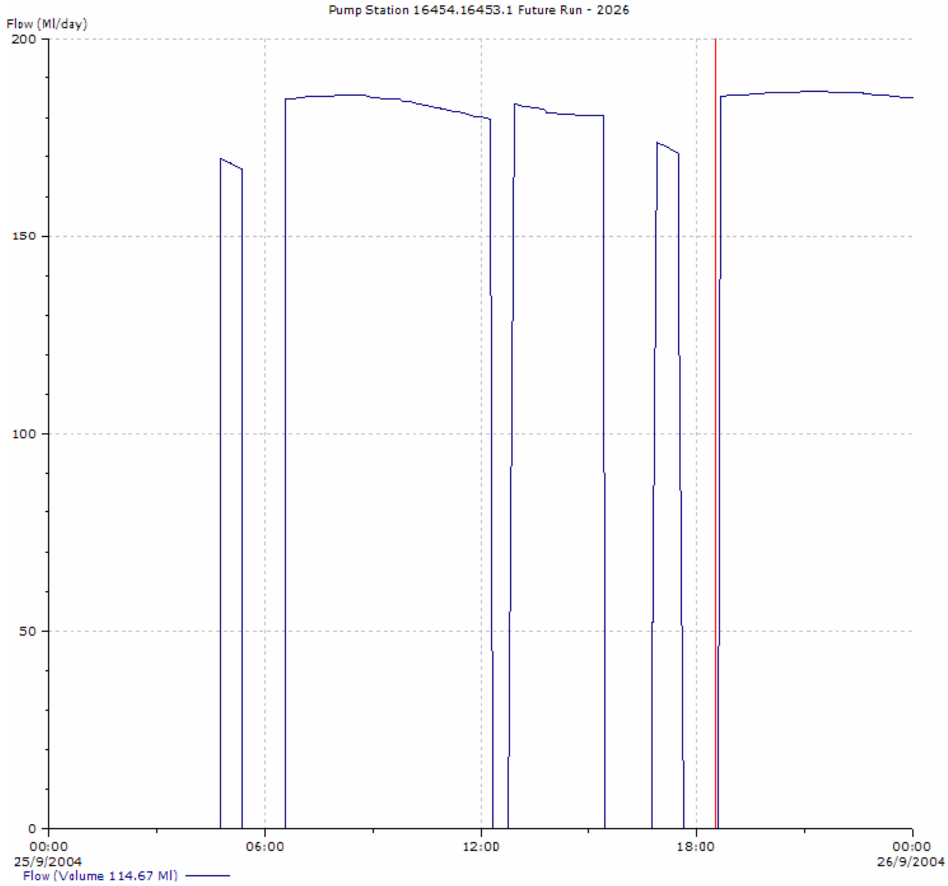
Reservoir Levels & MHLPS Performance



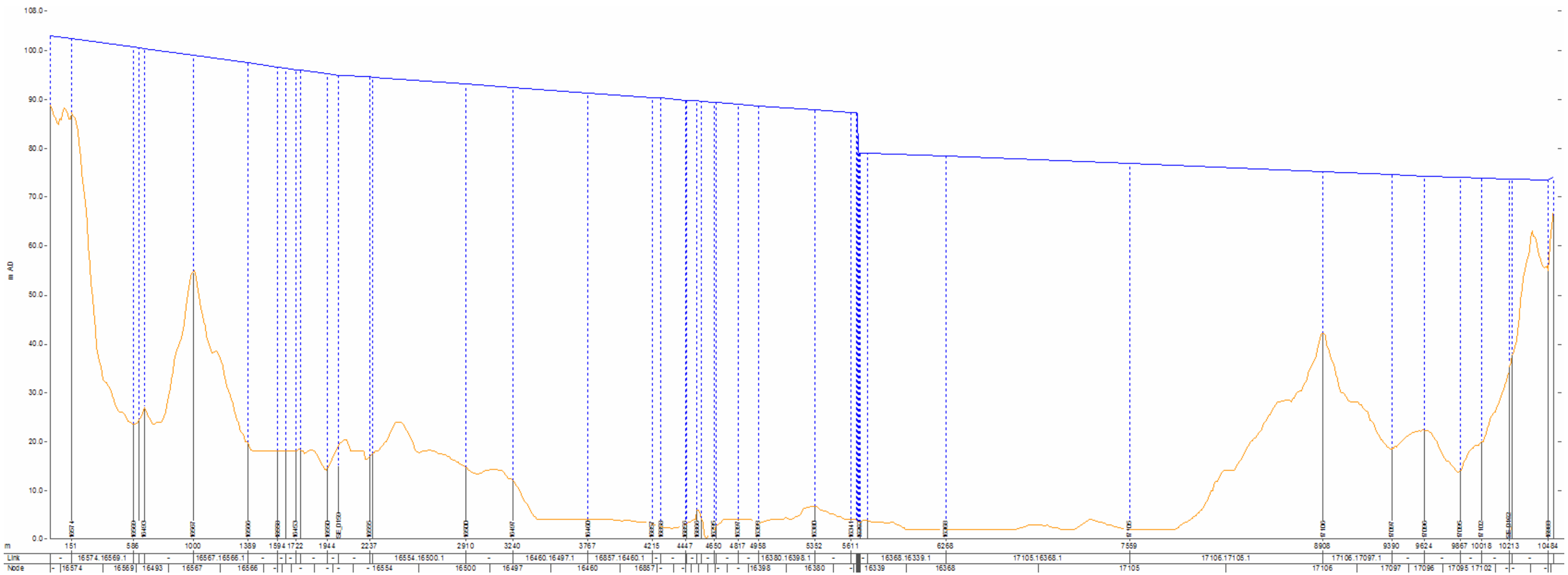



Reservoir KANWAL Future Run - 2026
Depth (m)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth

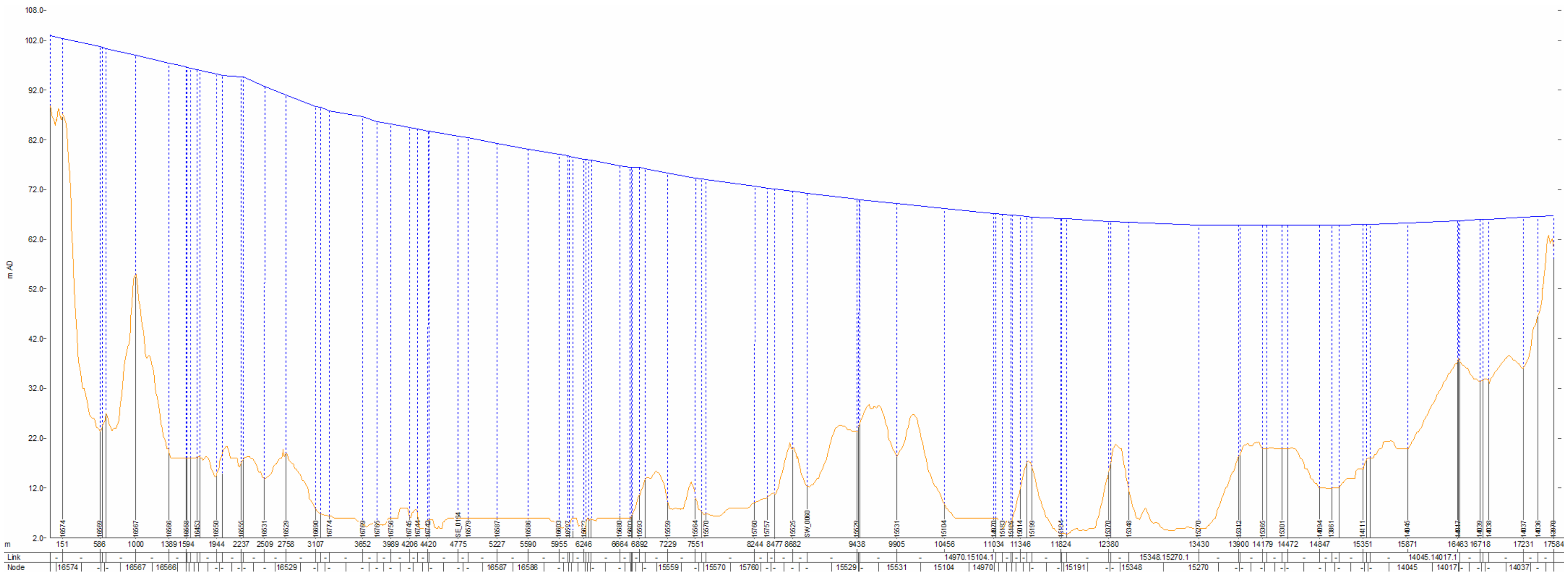

Reservoir KIAR RIDGE Future Run - 2026
Depth (m)
16.0
15.0
14.0
13.0
12.0
11.0
10.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth


Pump Station 16454.16453.1 Future Run - 2026
Flow (Ml/day)
200
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 114.67 Ml)

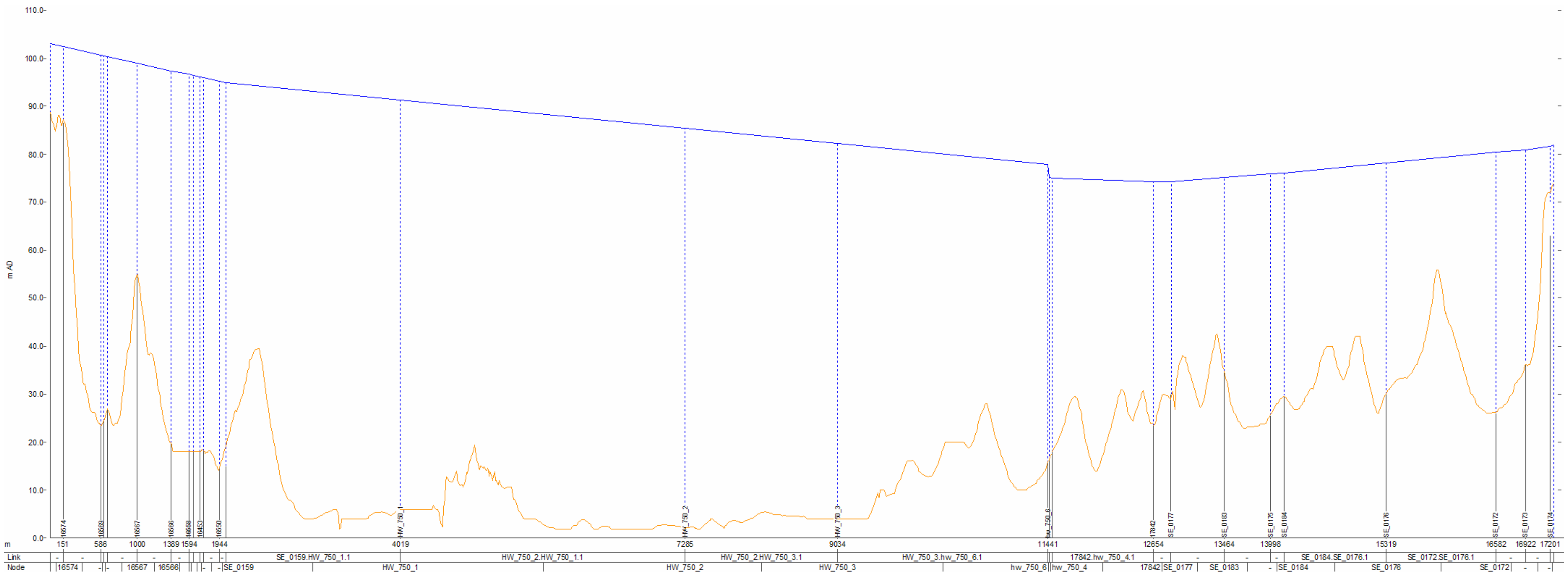
System Hydraulic Grade Lines (HGLs)



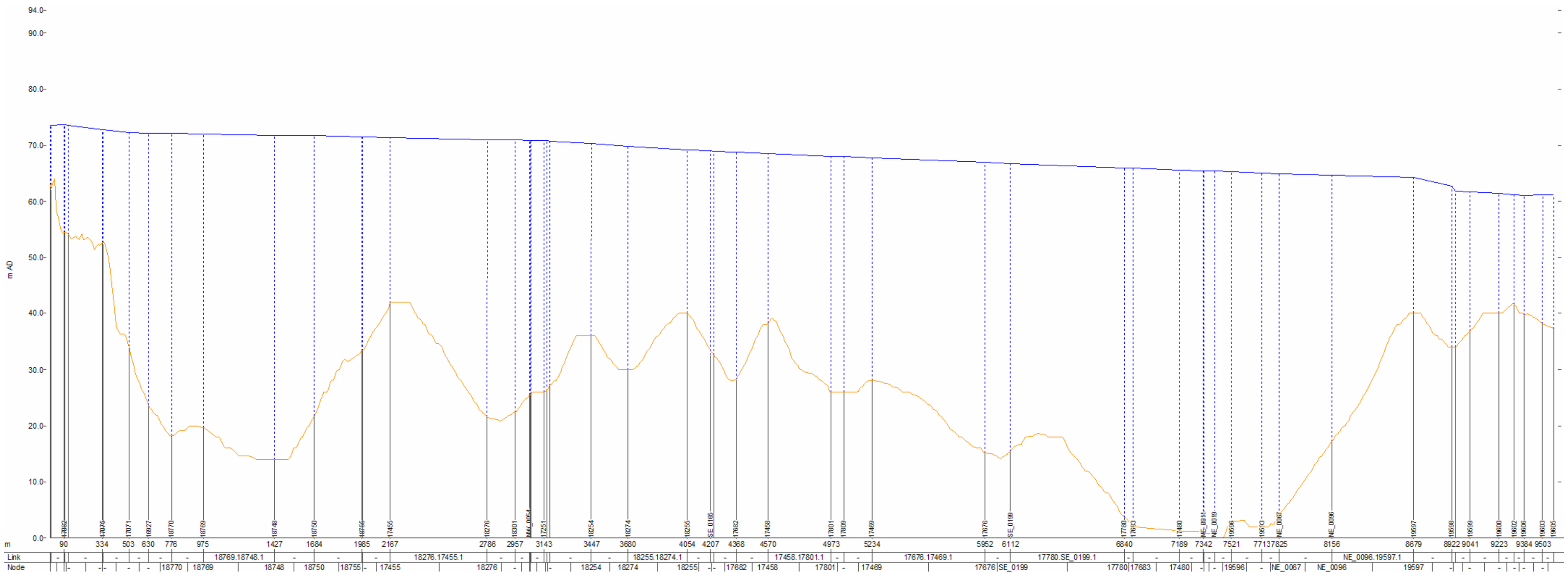
Tuggerah 2 Reservoir to Kanwal Reservoirs



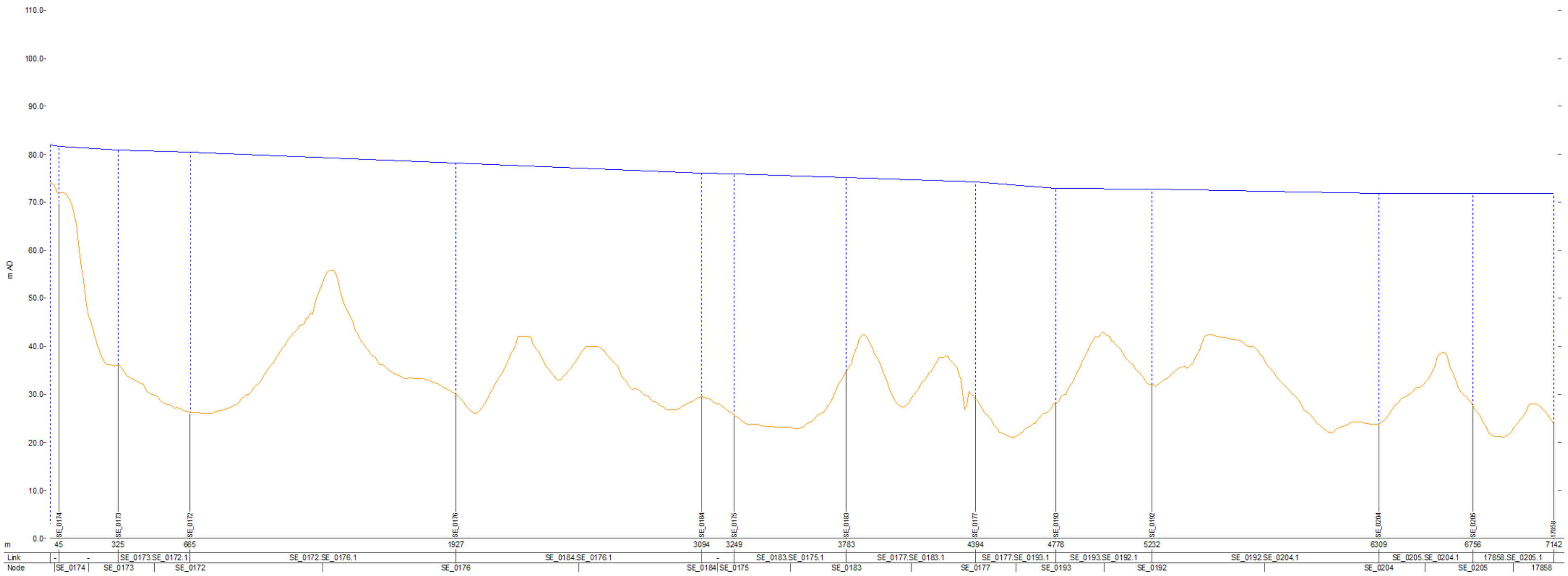
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



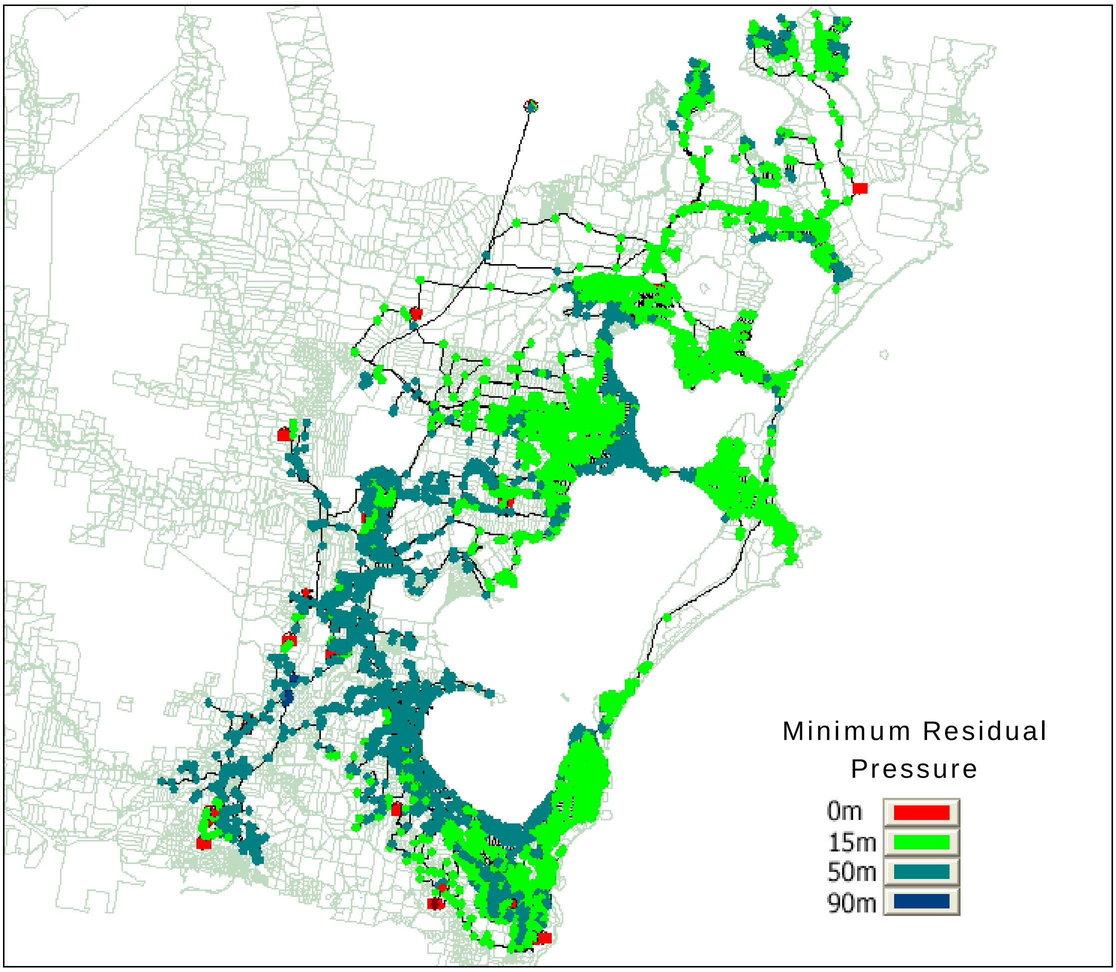
Kanwal Reservoirs to Bluehaven Area



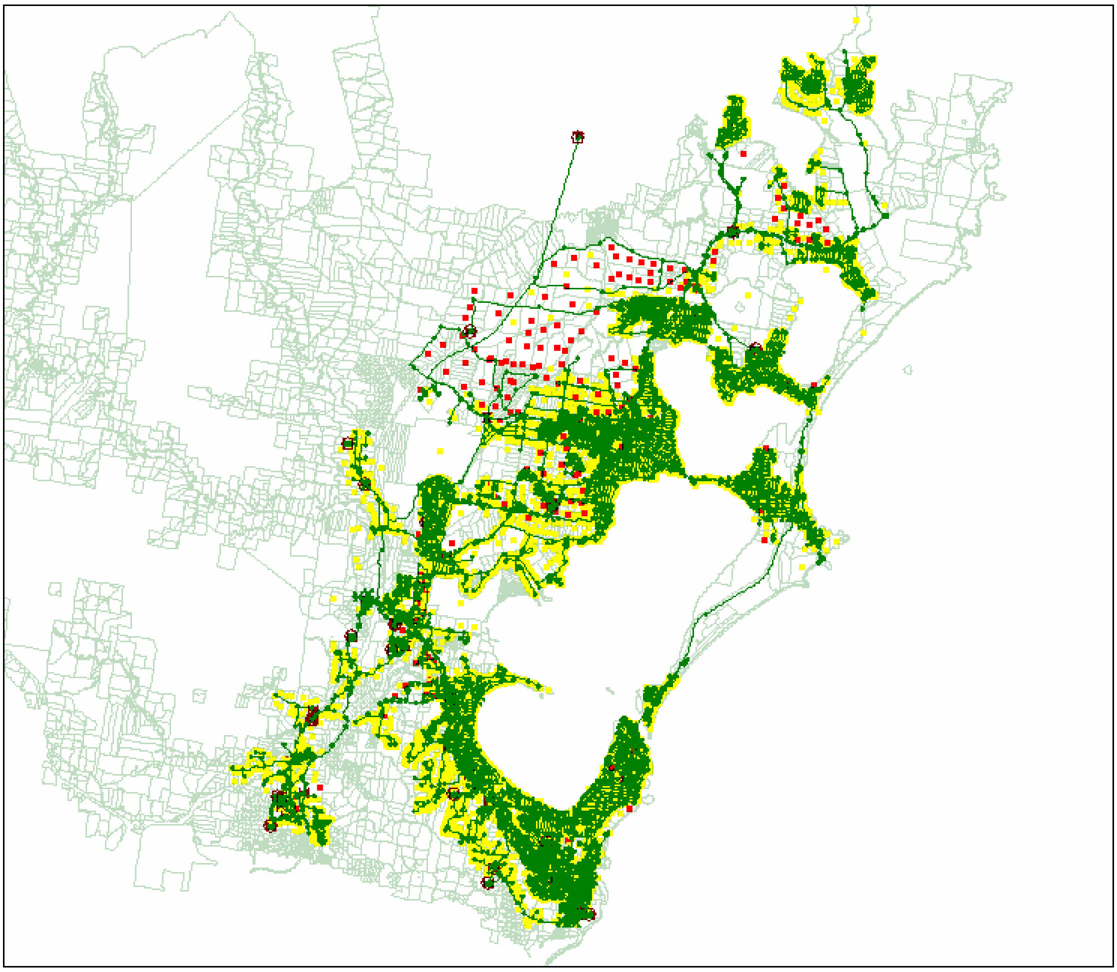
Kiar Ridge Reservoir to Warnervale High Level Zone

2031 Simulation Results

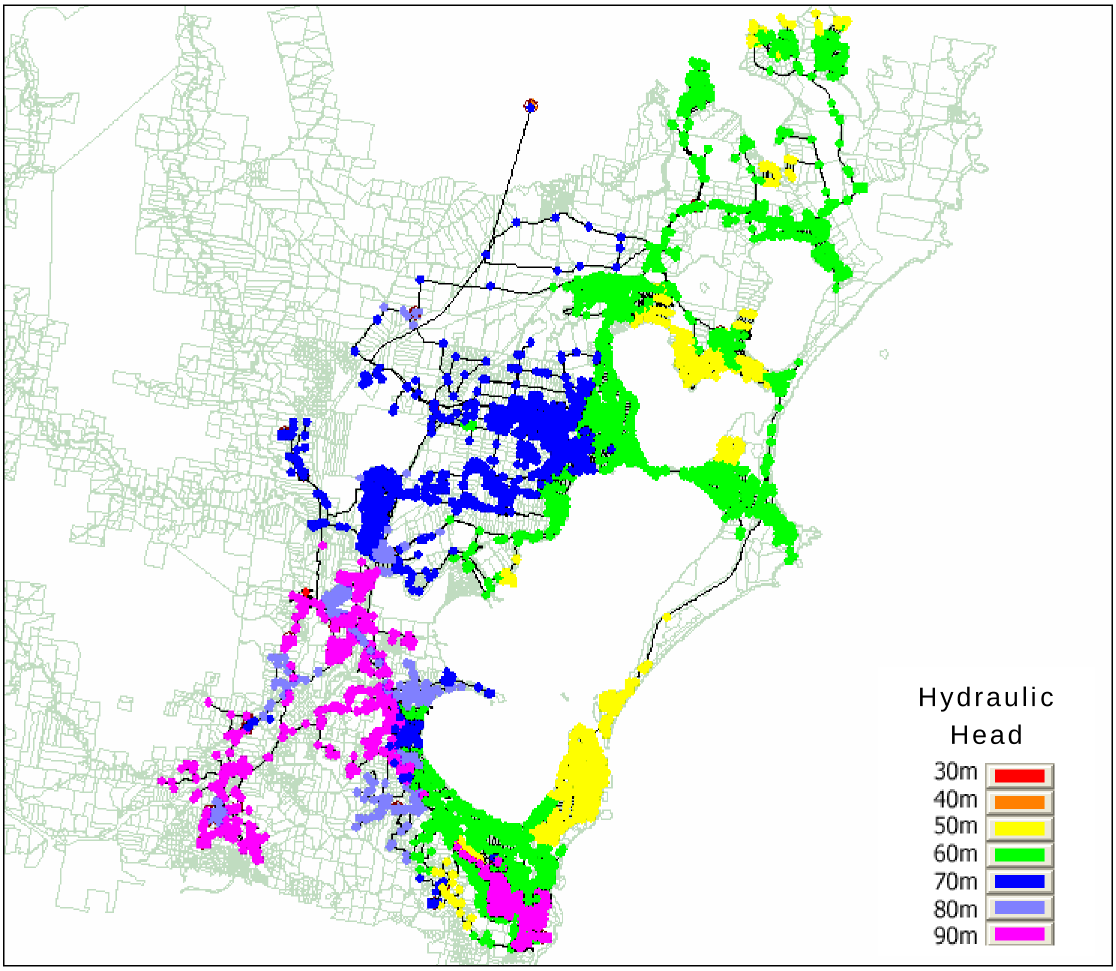
Minimum Residual Pressures



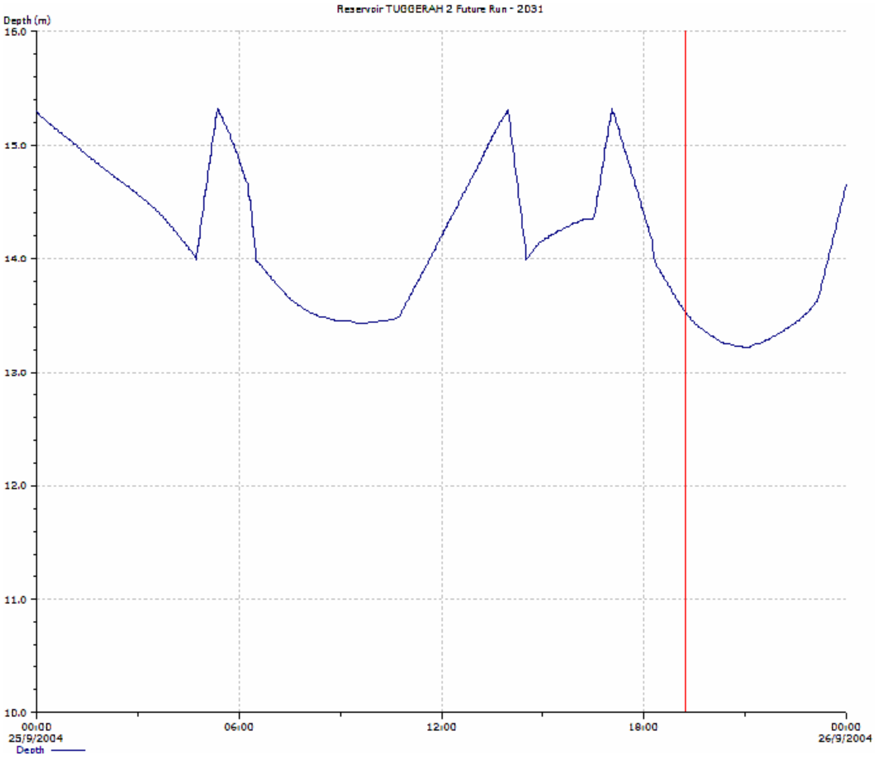
Customer Points

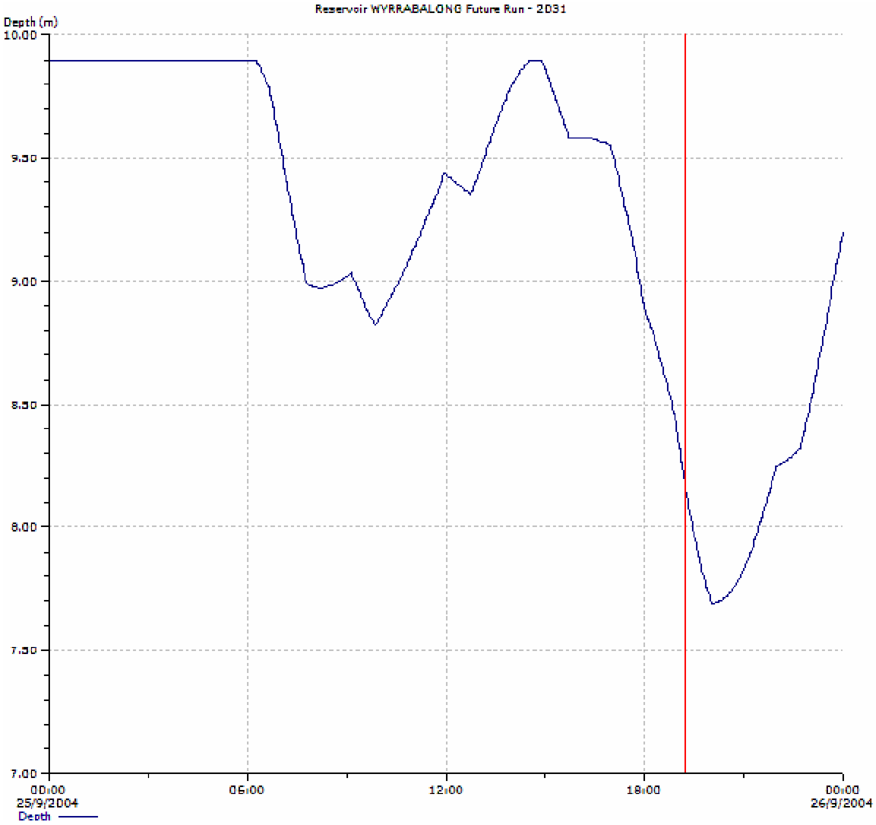


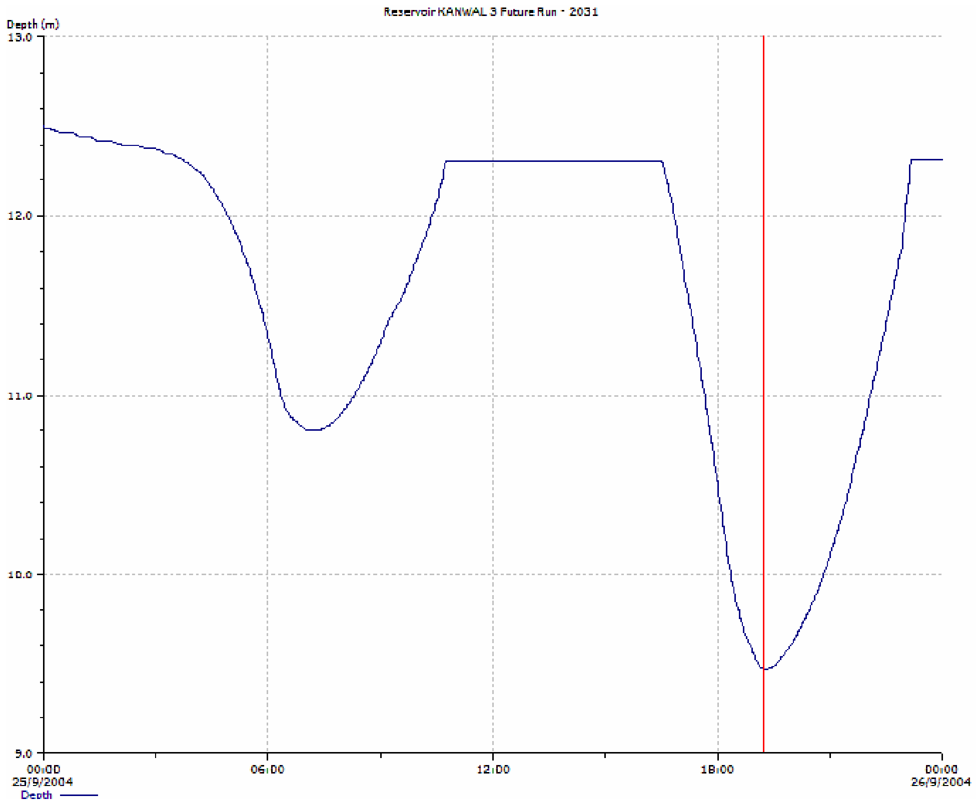
Simulated Head Conditions

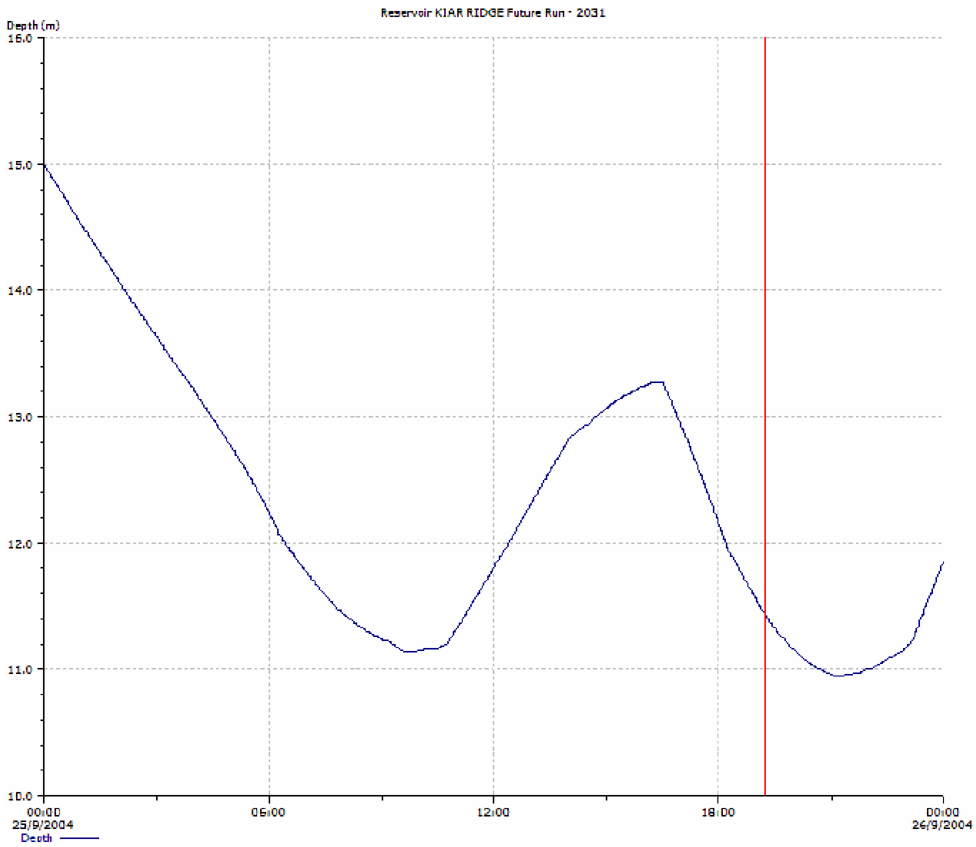


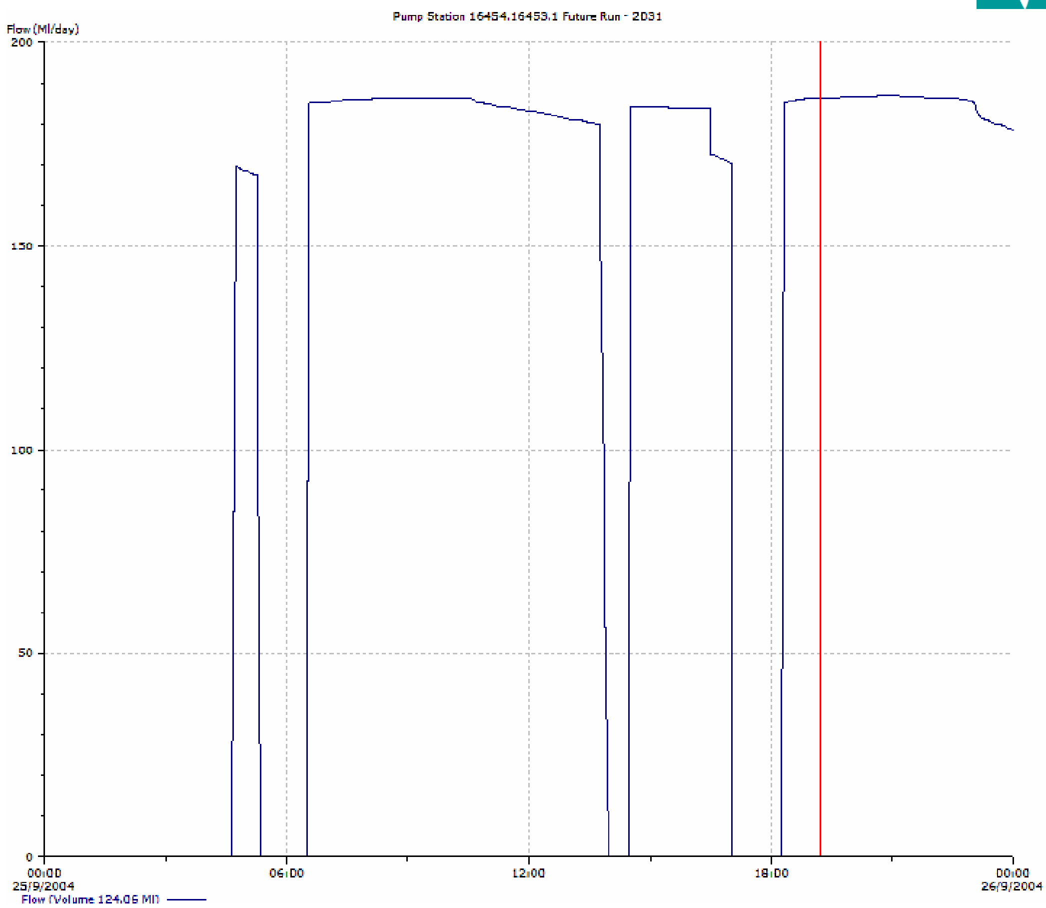
Reservoir Levels & MHLPS Performance



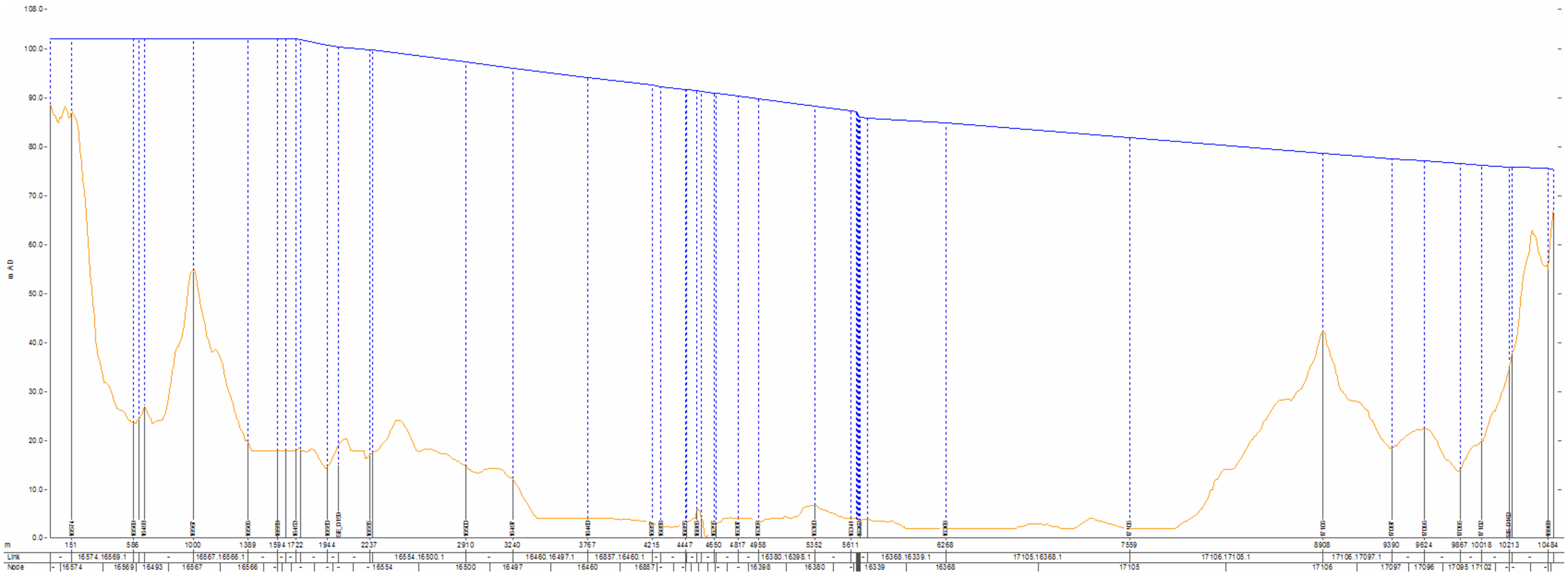



Reservoir KANWAL 3 Future Run - 2031
Depth (m)
13.0
12.0
11.0
10.0
9.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth

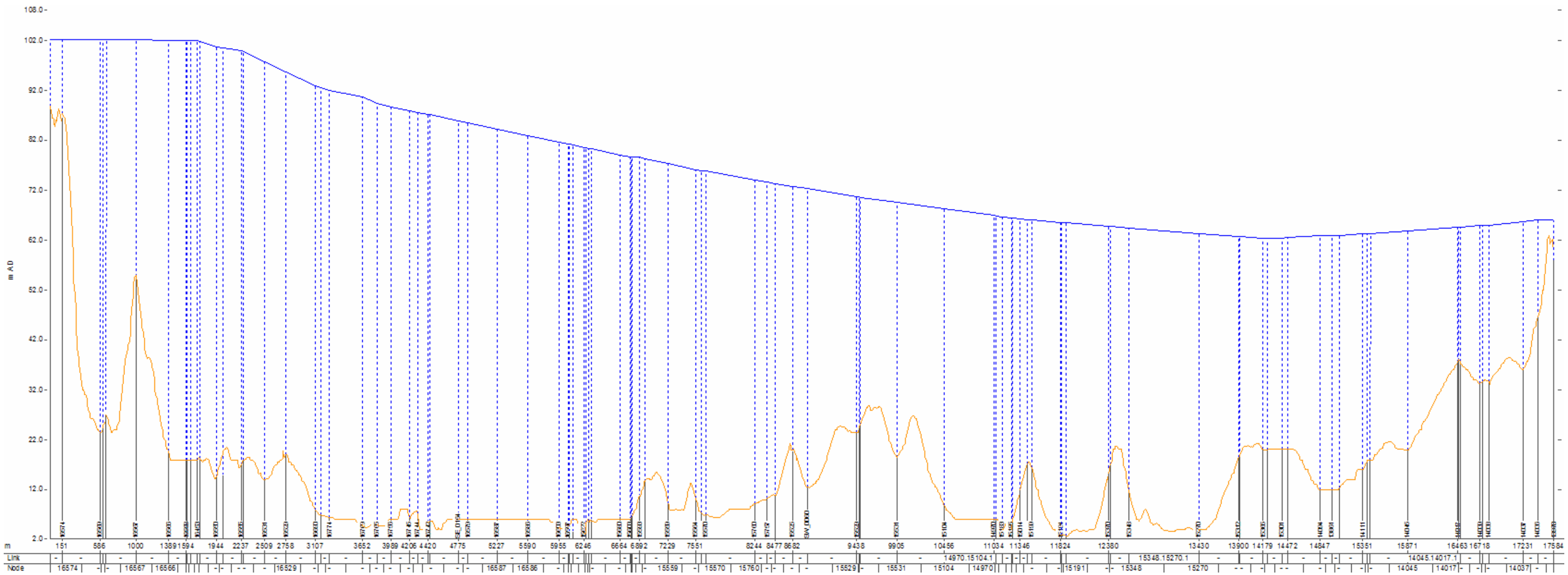

Reservoir KIAR RIDGE Future Run - 2031
Depth (m)
16.0
15.0
14.0
13.0
12.0
11.0
10.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth


Pump Station 16454.16453.1 Future Run - 2031
Flow (Ml/day)
200
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 124.06 Ml)

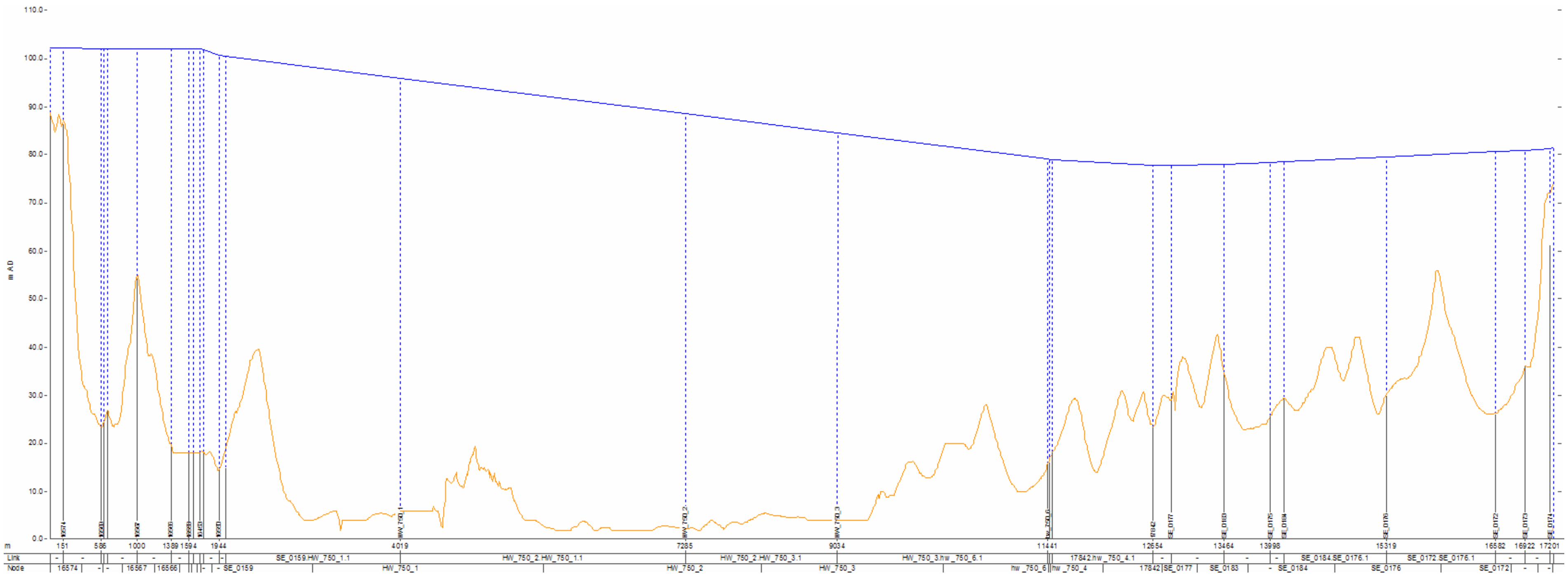
System Hydraulic Grade Lines (HGLs)



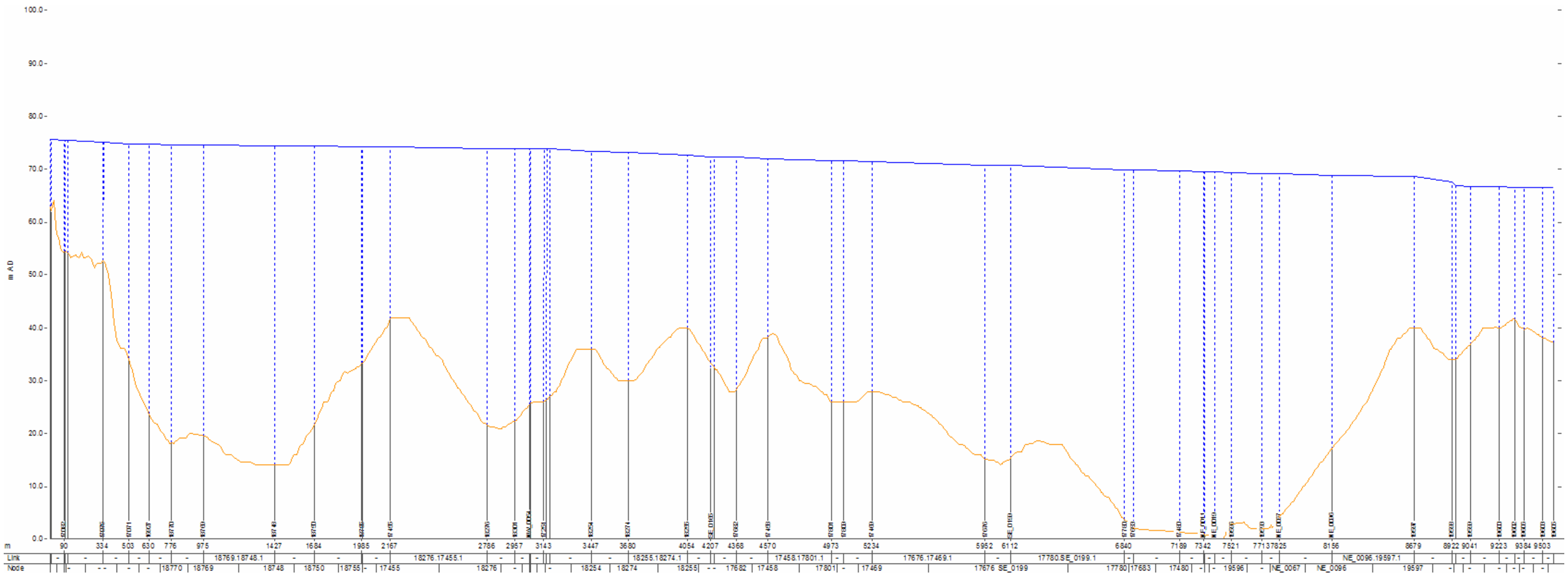
Tuggerah 2 Reservoir to Kanwal Reservoirs



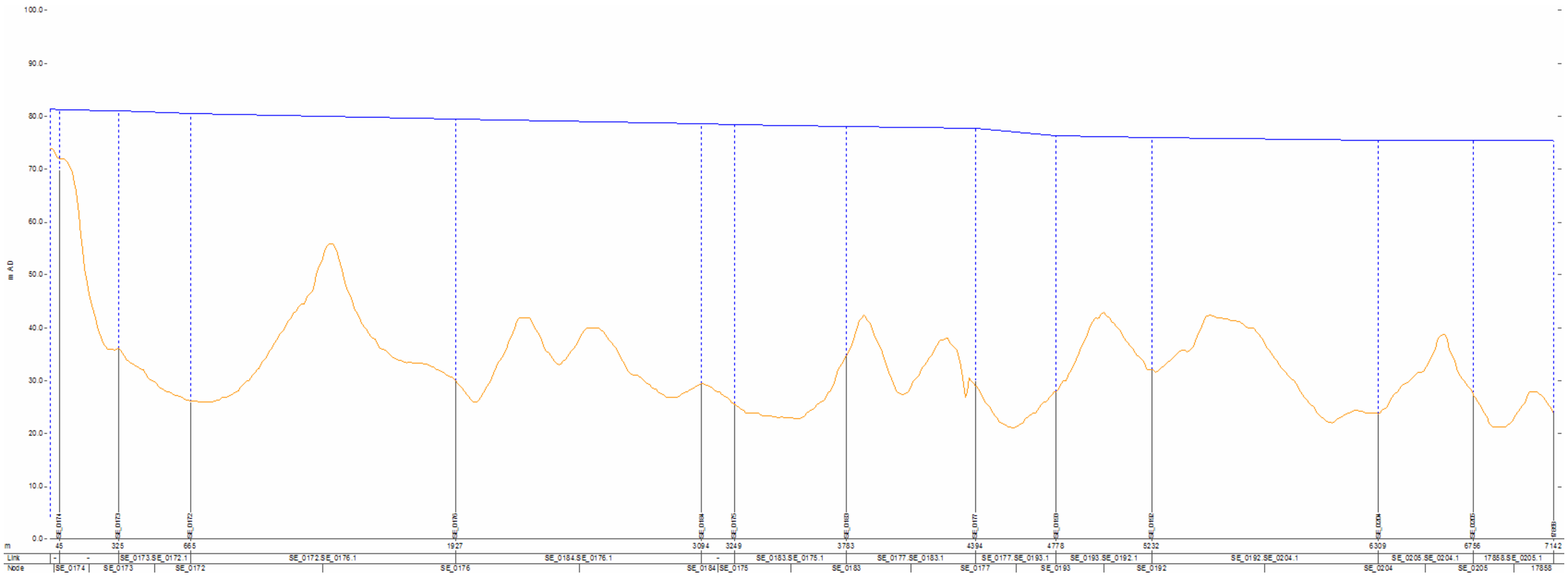
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



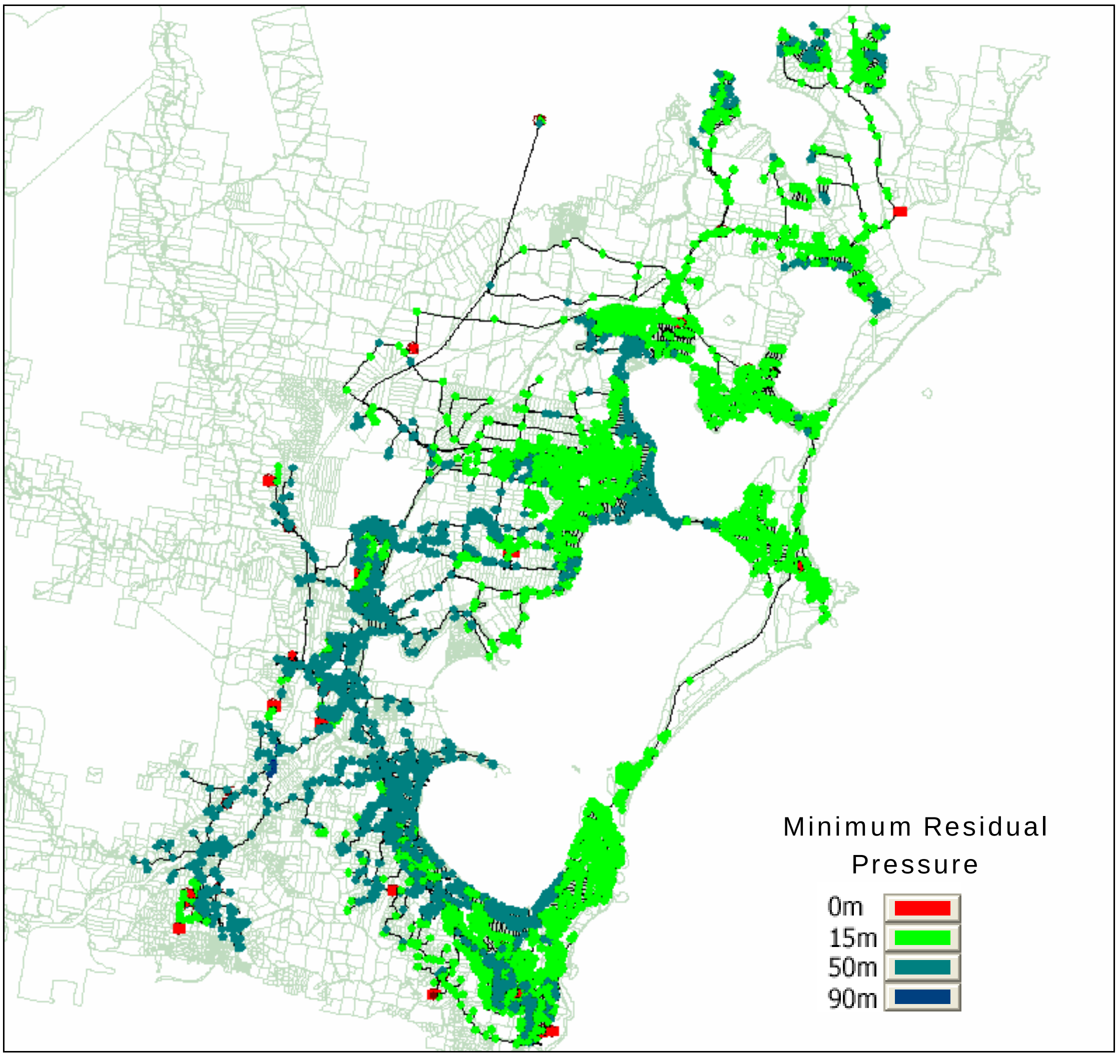
Kanwal Reservoirs to Bluehaven Area



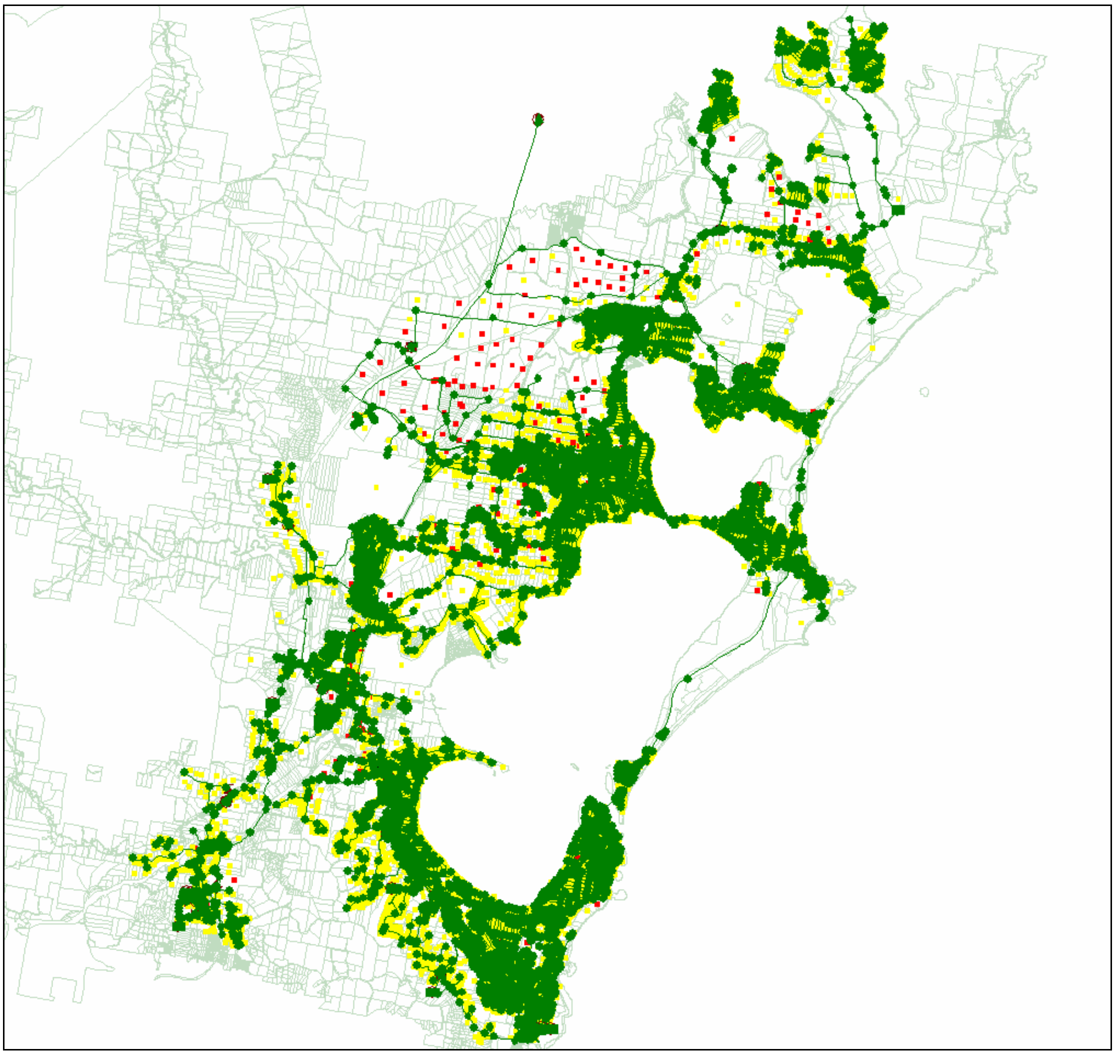
Kiar Ridge Reservoir to Warnervale High Level Zone

2036 SIMULATION RESULTS

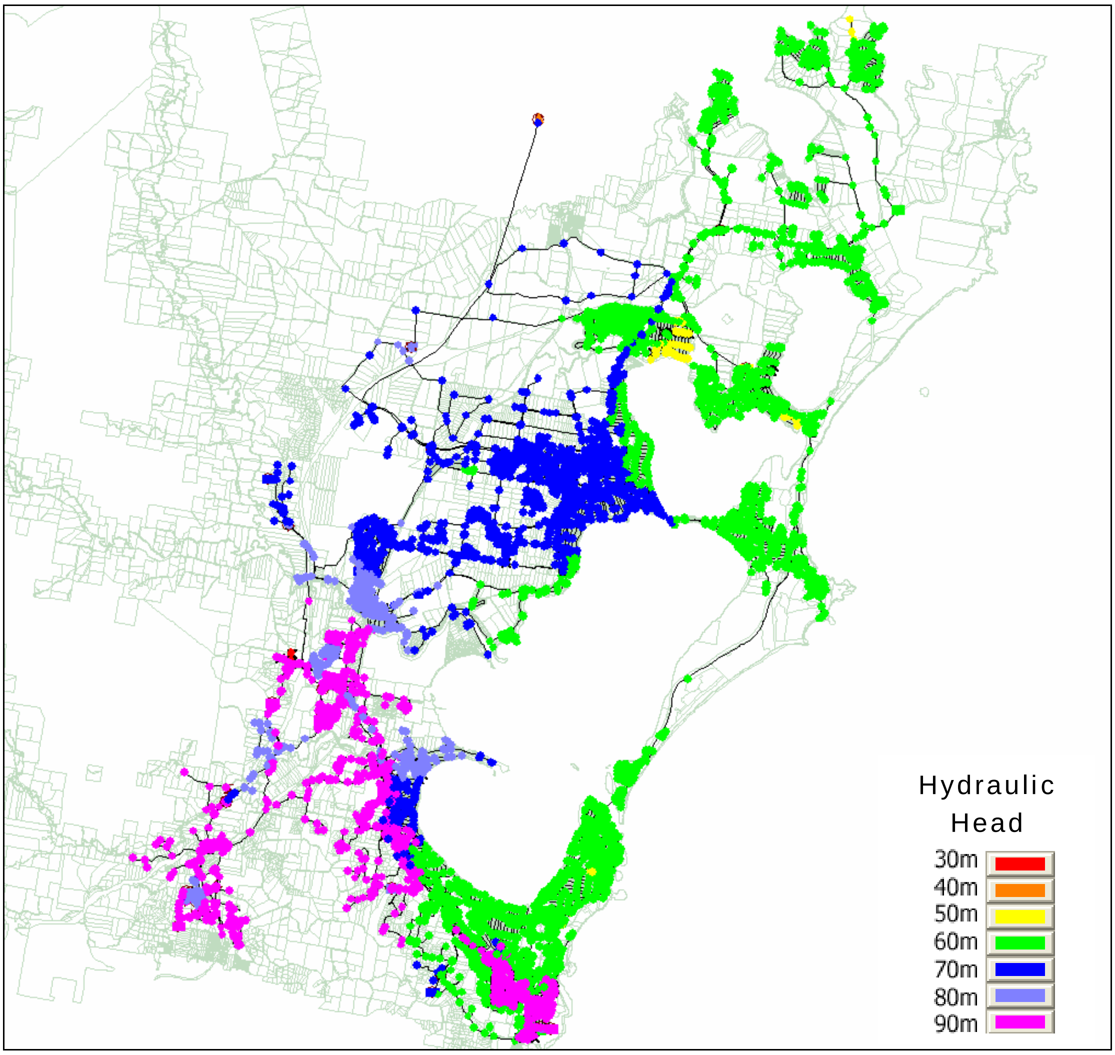
Minimum Residual Pressures



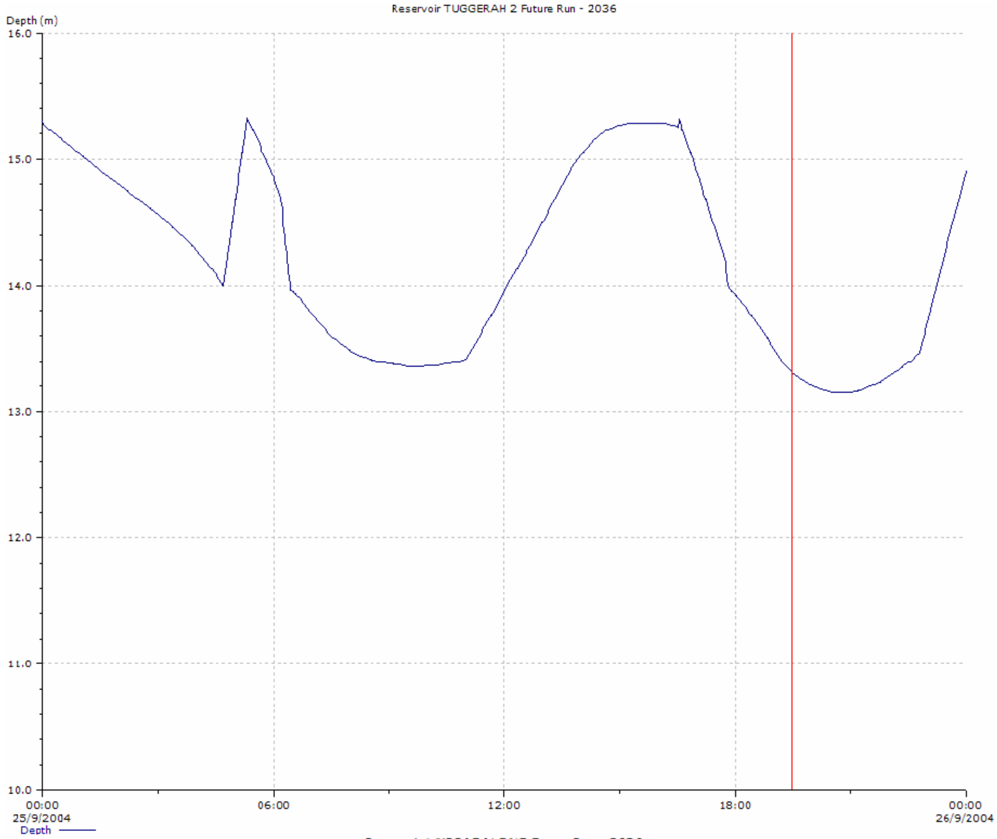
Customer Points

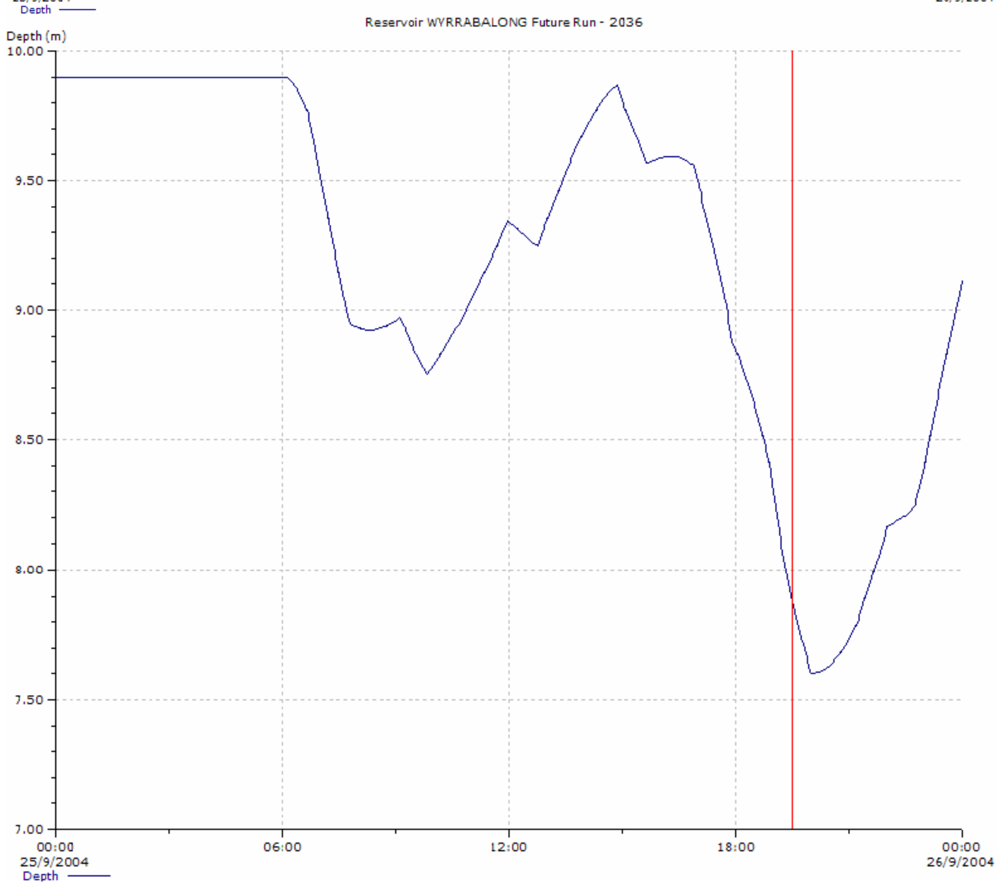


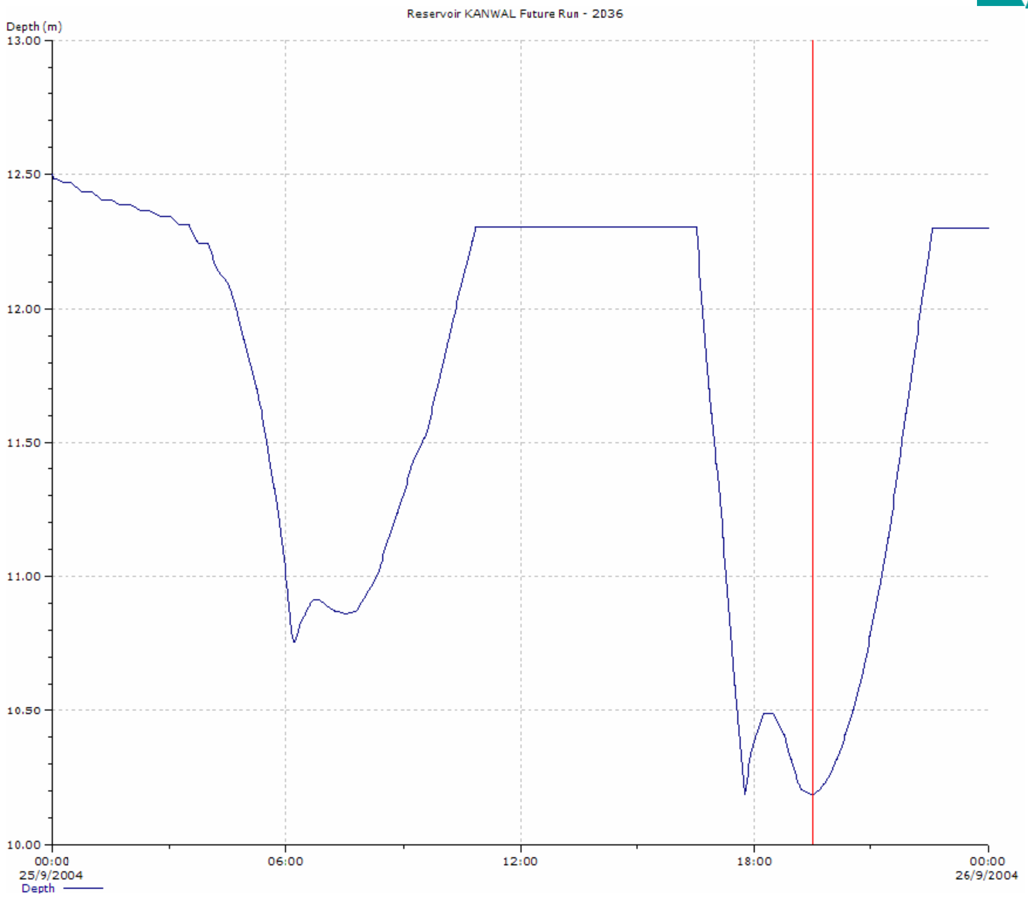
Simulated Head Conditions

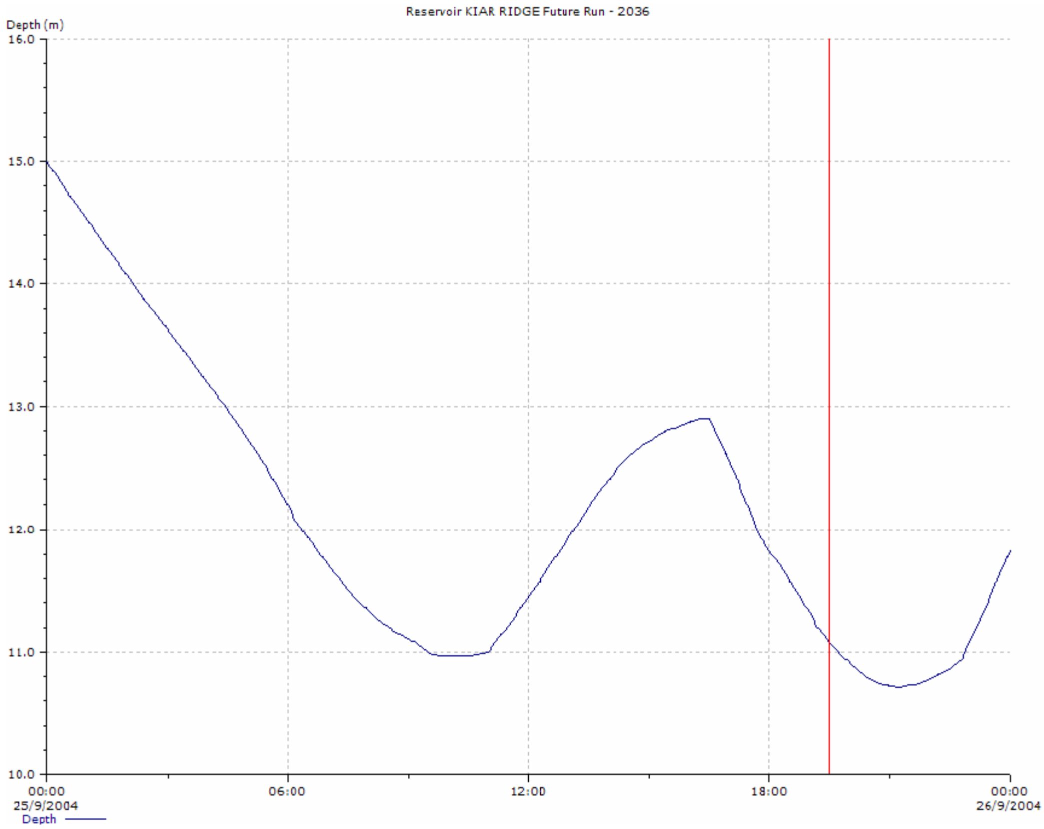


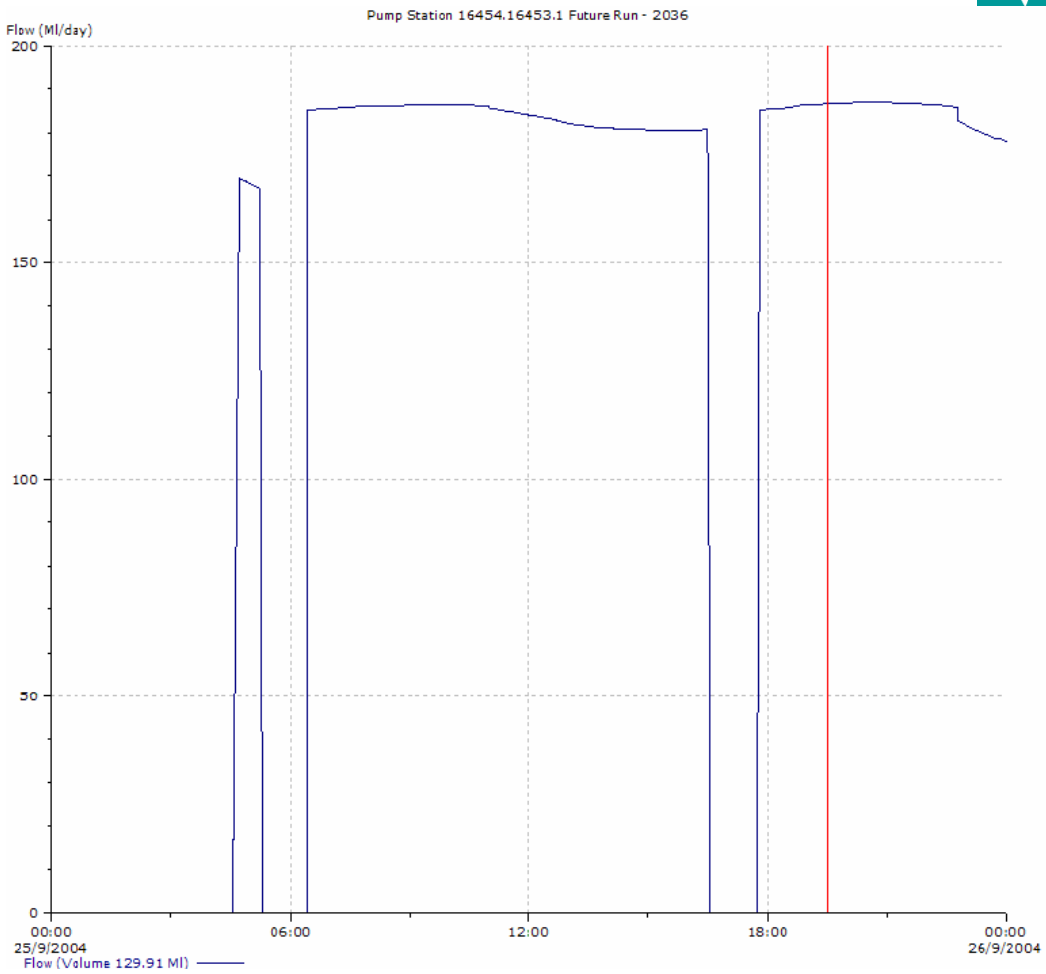
Reservoir Levels & MHLPS Performance



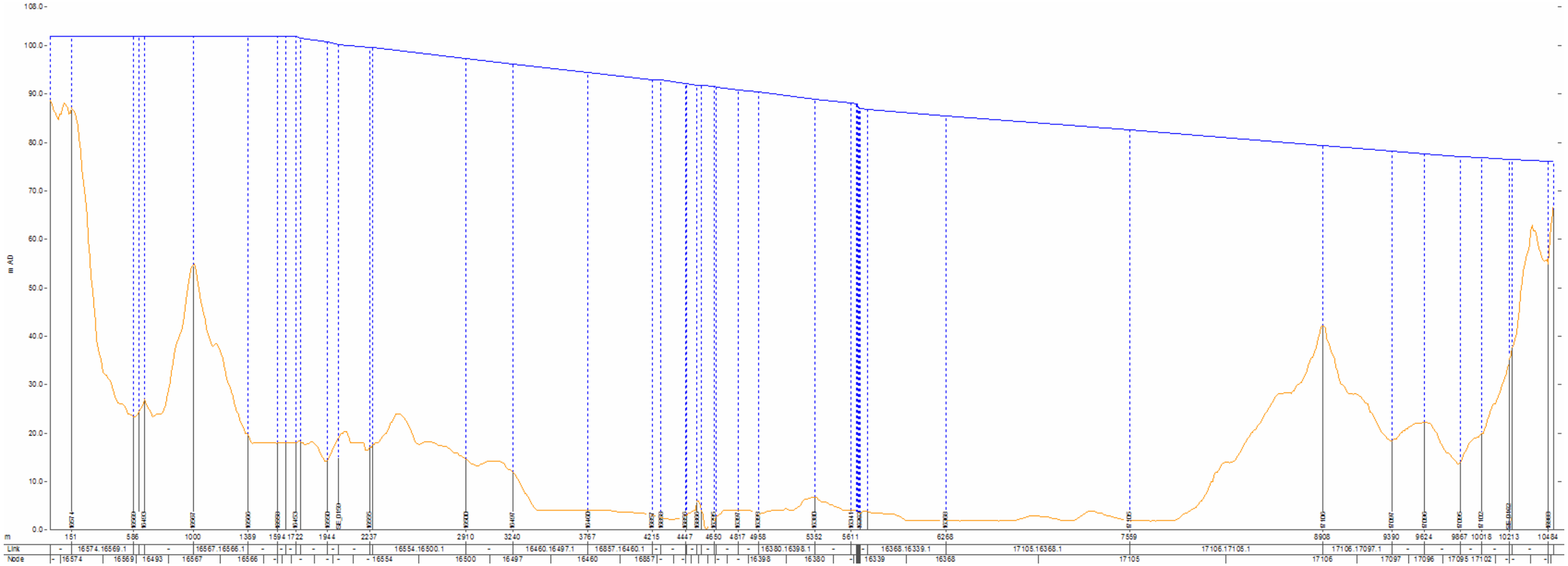



Reservoir KANWAL Future Run - 2036
Depth (m)
13.00
12.50
12.00
11.50
11.00
10.50
10.00
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth

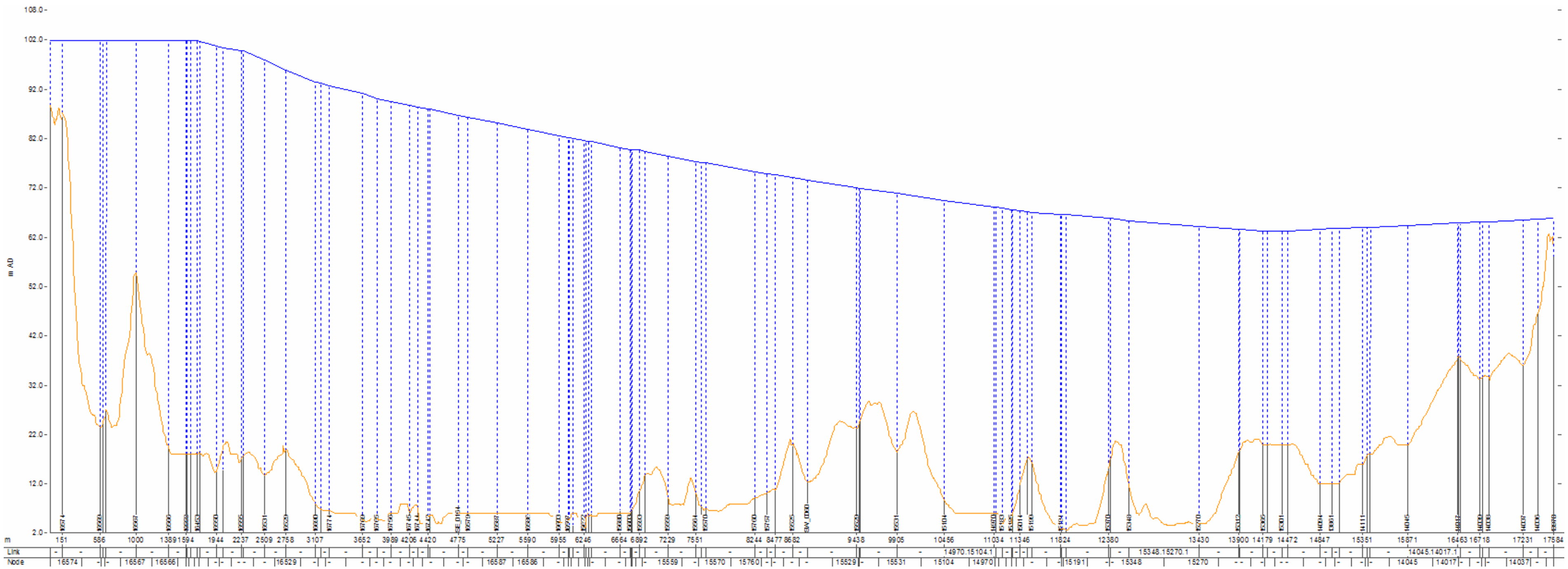

Reservoir KIAR RIDGE Future Run - 2036
Depth (m)
16.0
15.0
14.0
13.0
12.0
11.0
10.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth


Pump Station 16454.16453.1 Future Run - 2036
Flow (Ml/day)
200
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 129.91 Ml)

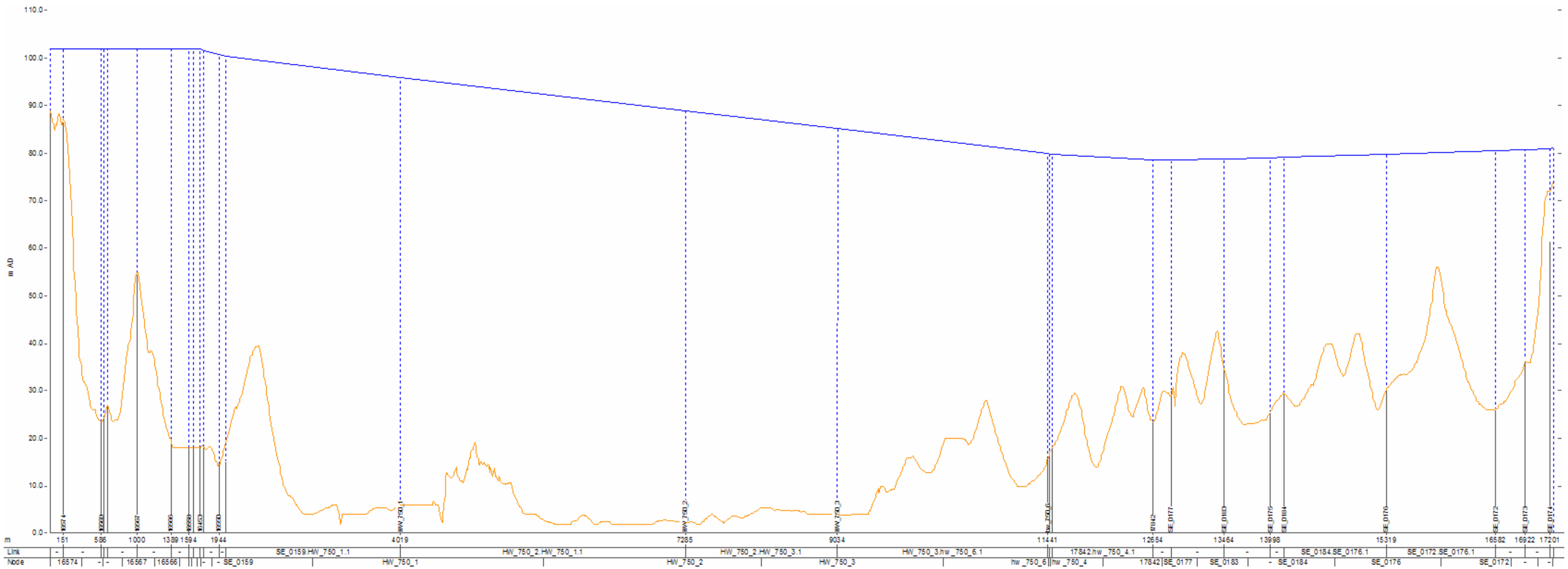
System Hydraulic Grade Lines (HGLs)



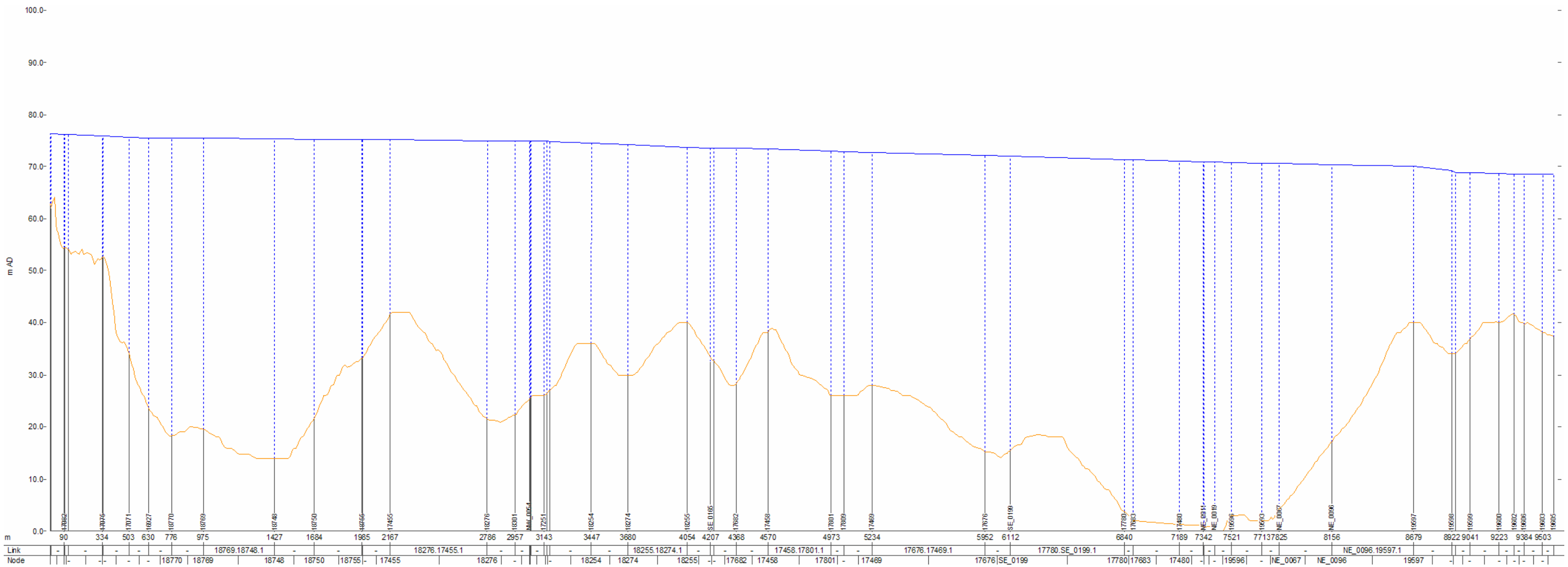
Tuggerah 2 Reservoir to Kanwal Reservoirs



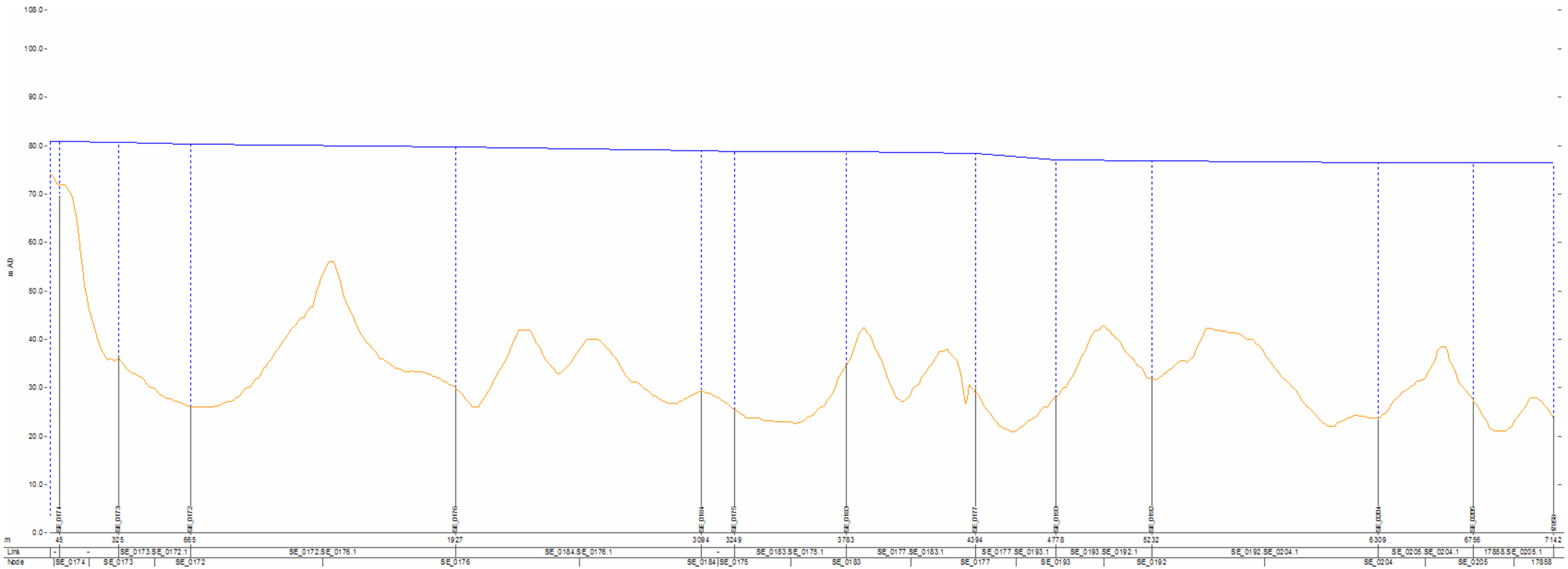
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



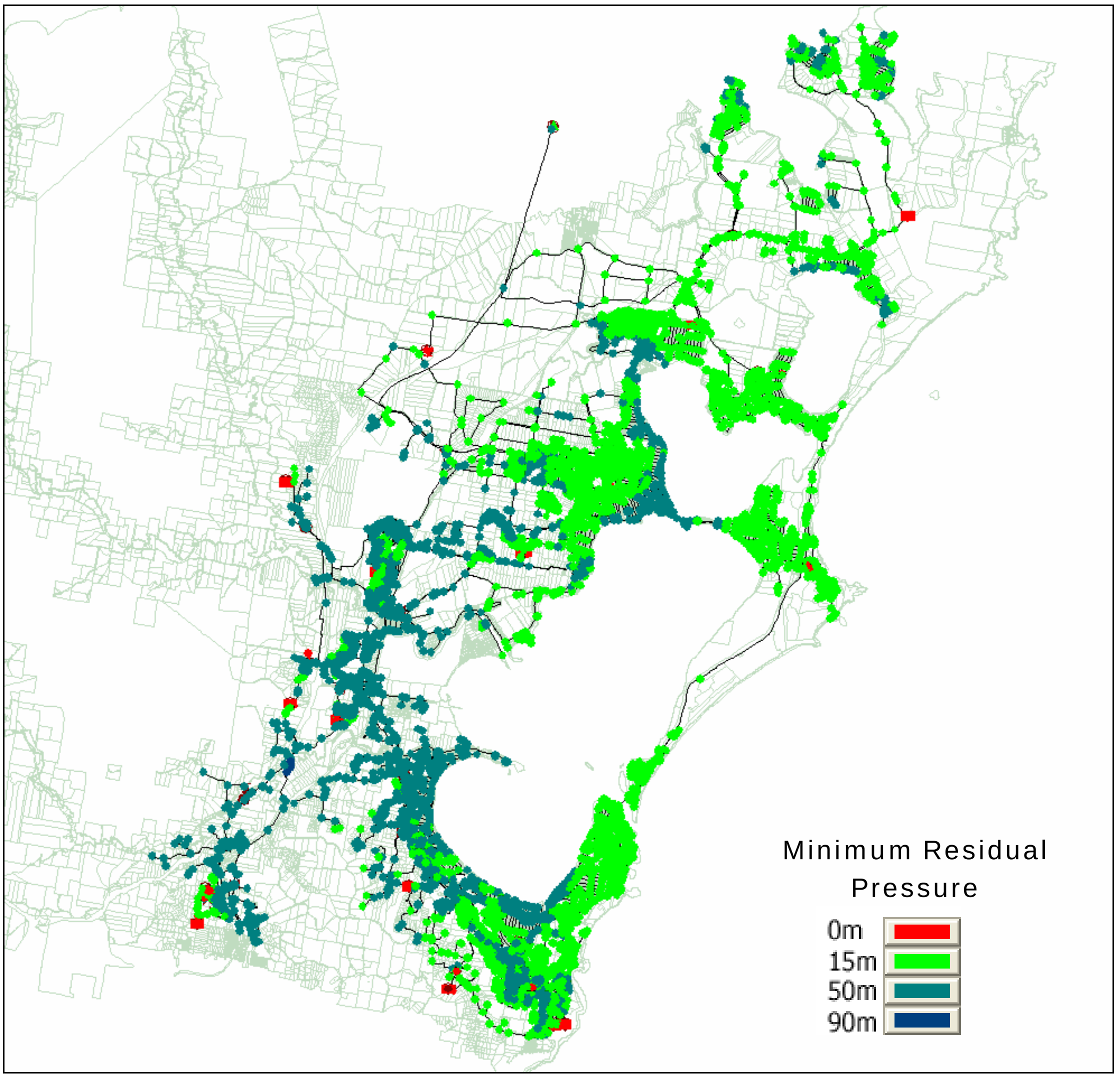
Kanwal Reservoirs to Bluehaven Area



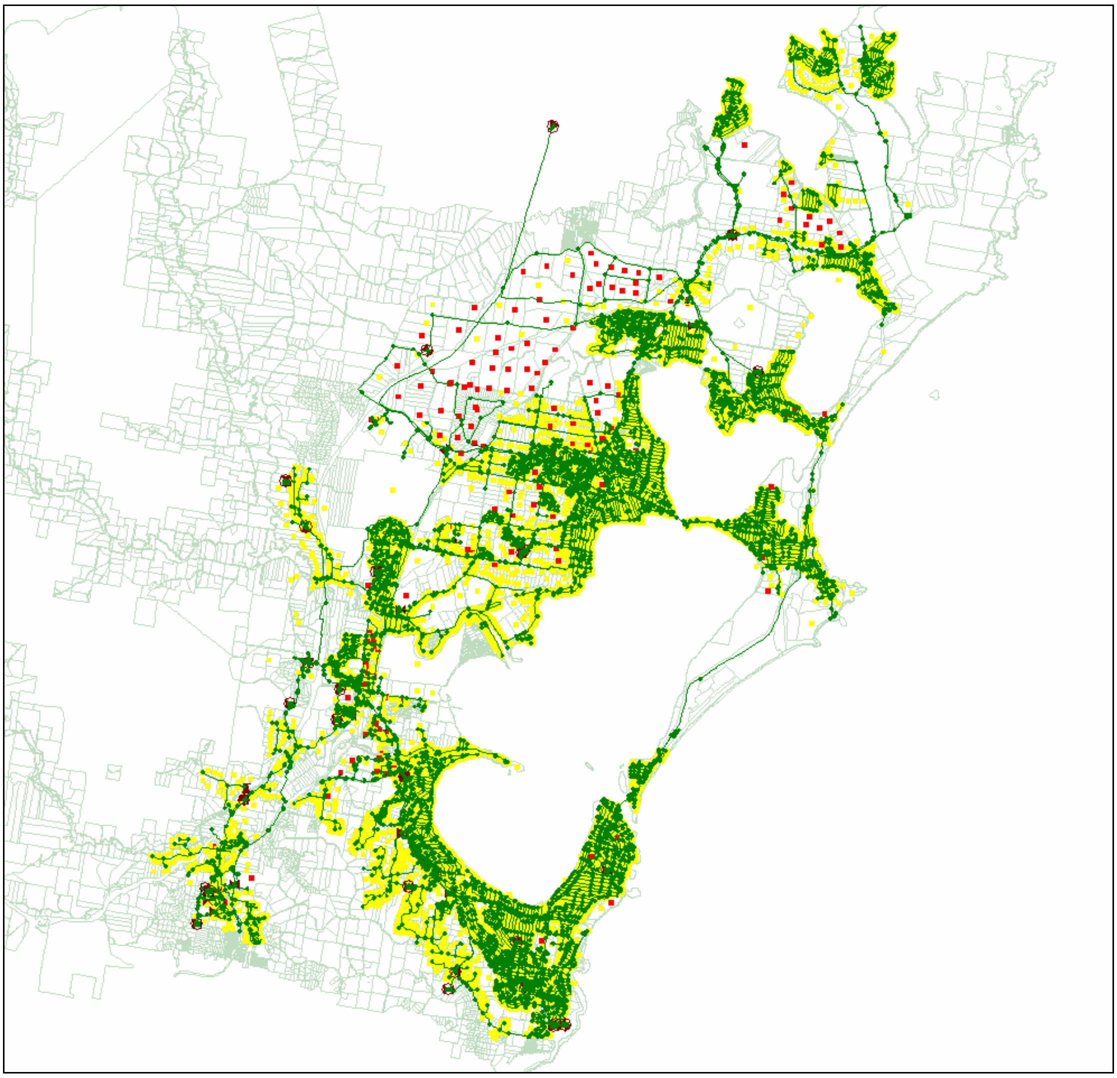
Kiar Ridge Reservoir to Warnervale High Level Zone

2041 Simulation Results

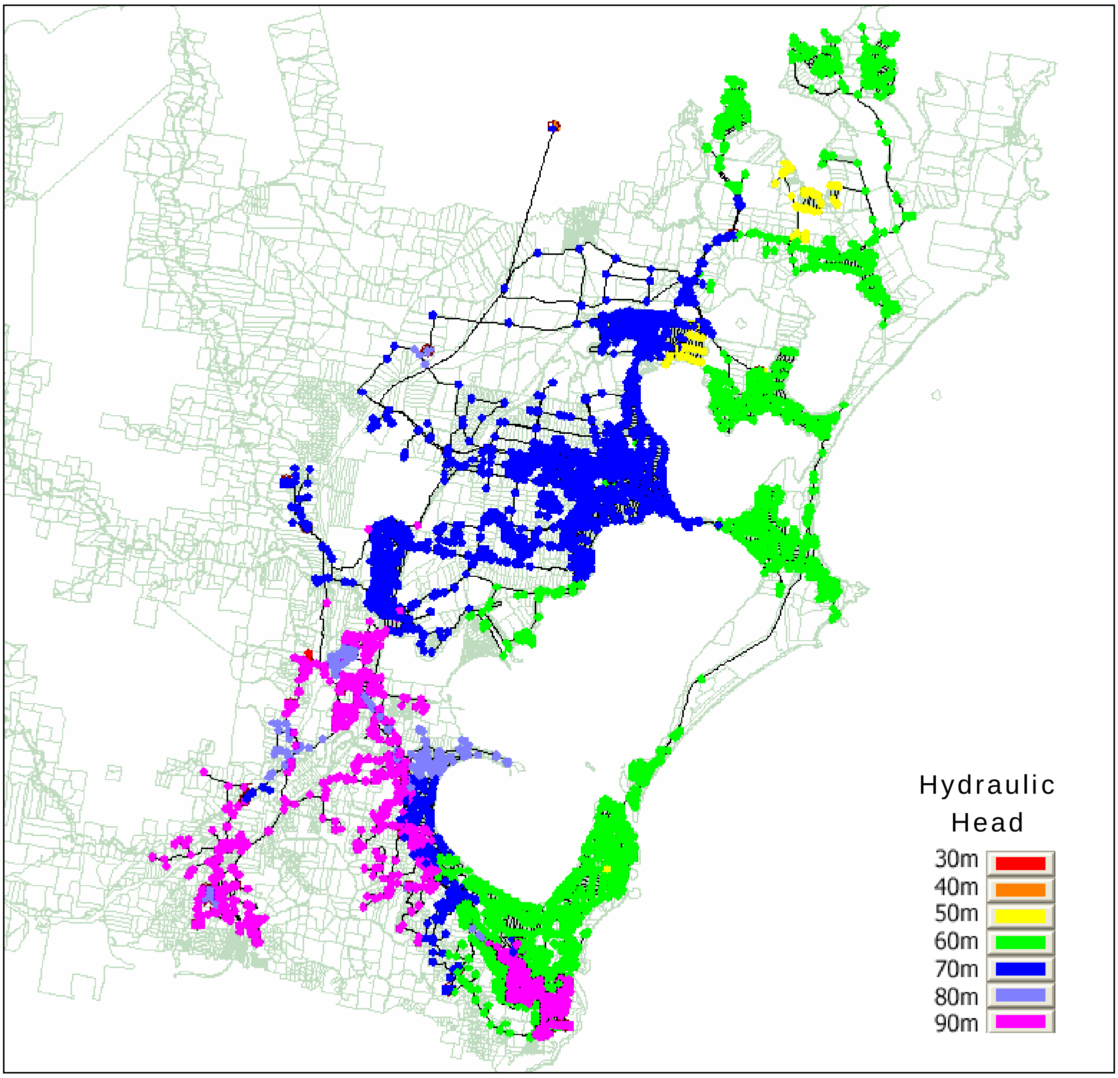
Minimum Residual Pressures



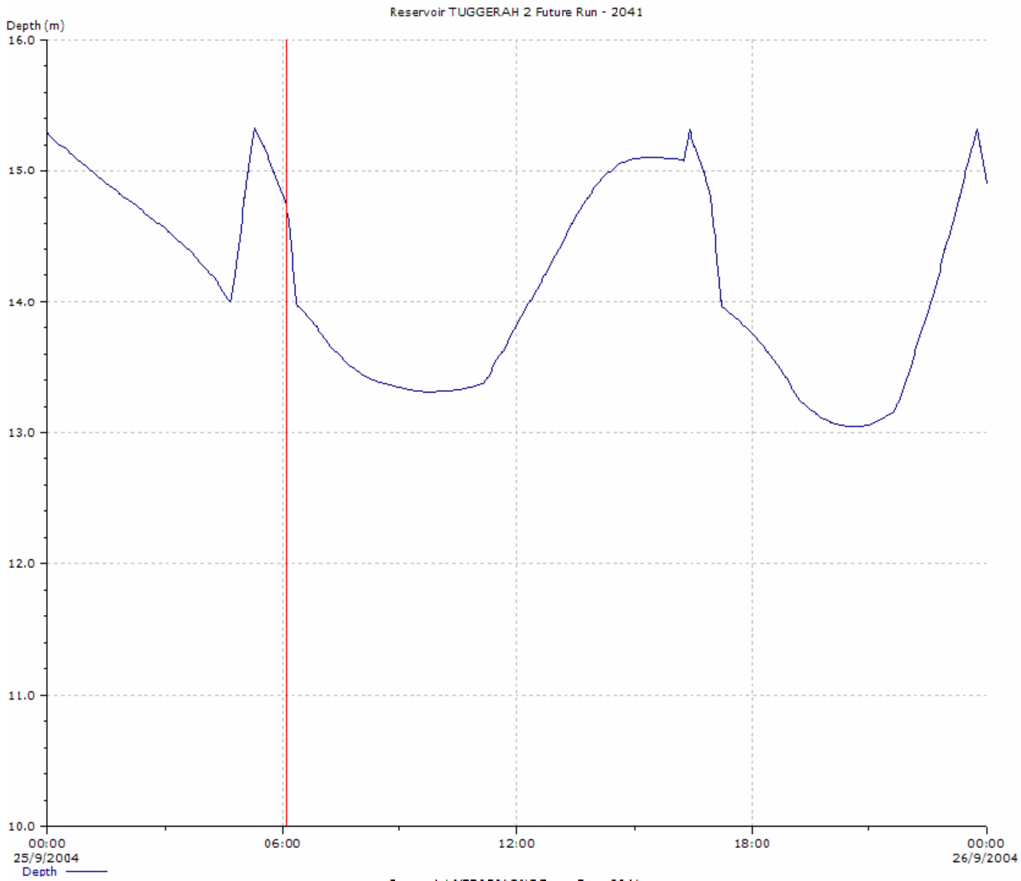
Customer Points

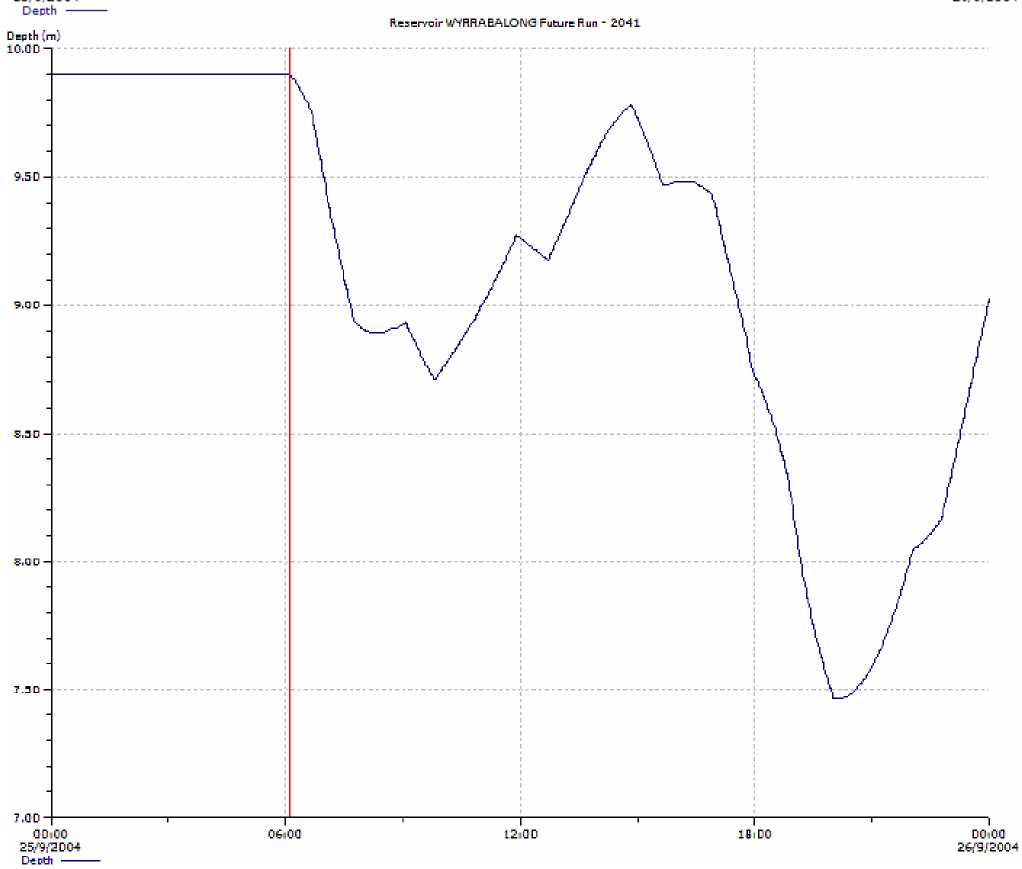


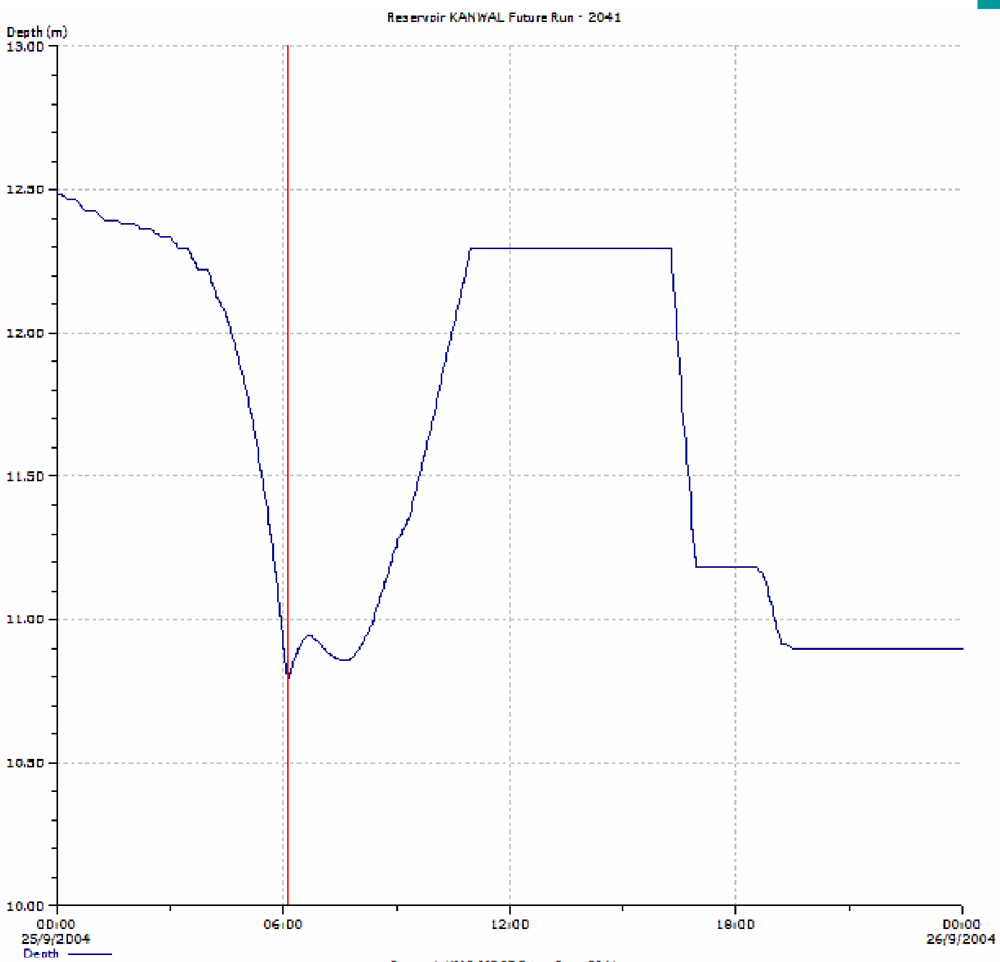
Simulated Head Conditions

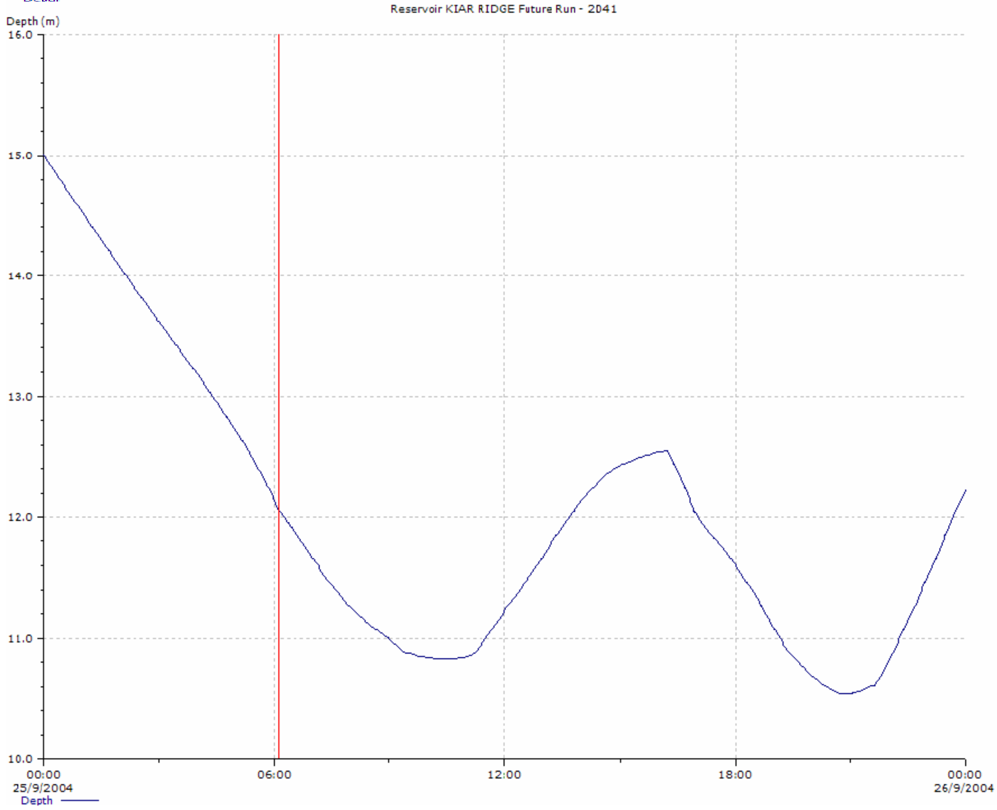


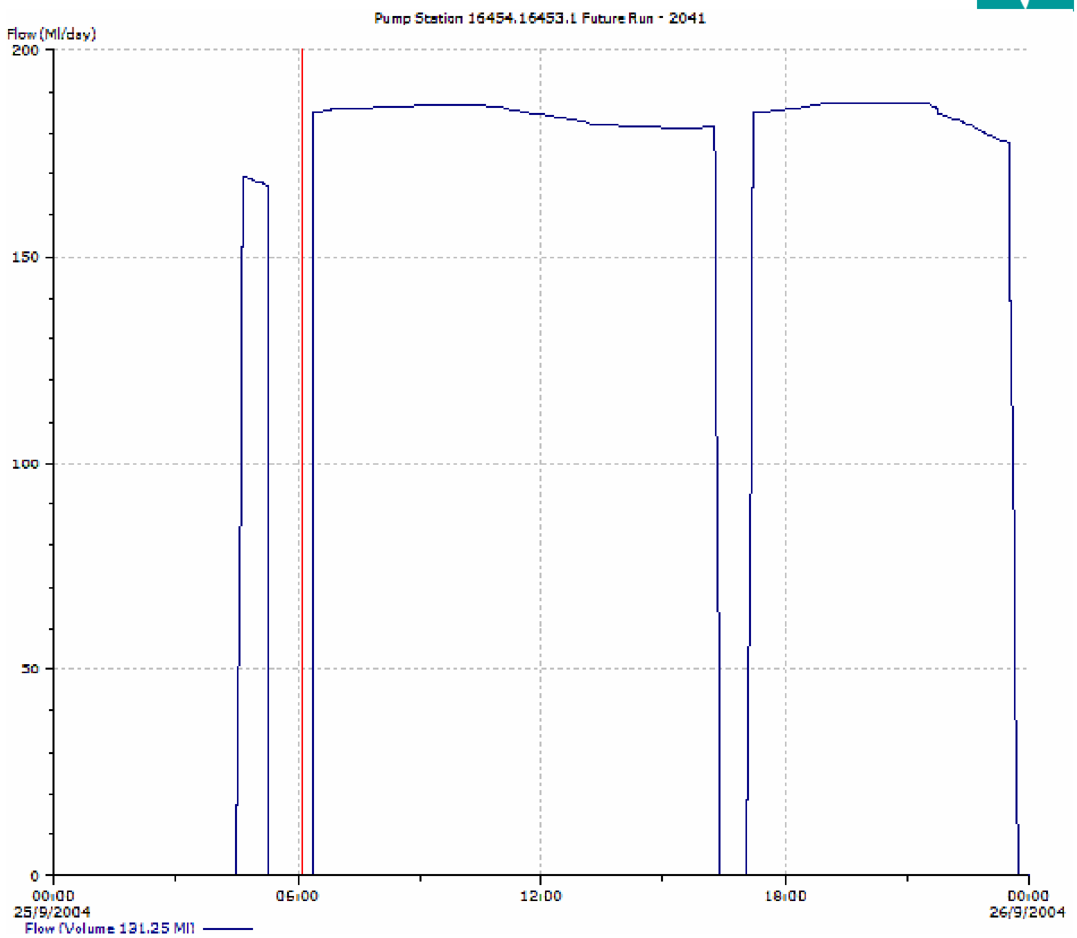
Reservoir Levels & MHLPS Performance



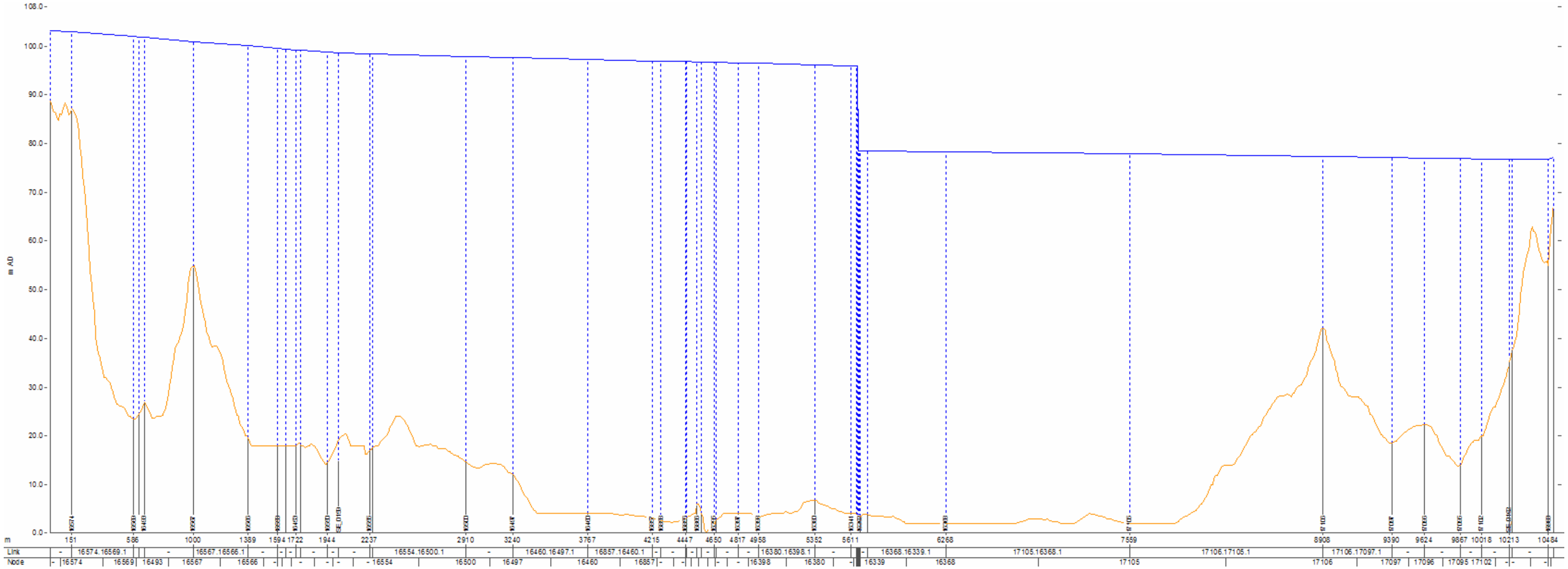



Reservoir KANWAL Future Run - 2041
Depth (m)
13.00
12.50
12.00
11.50
11.00
10.50
10.00
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth

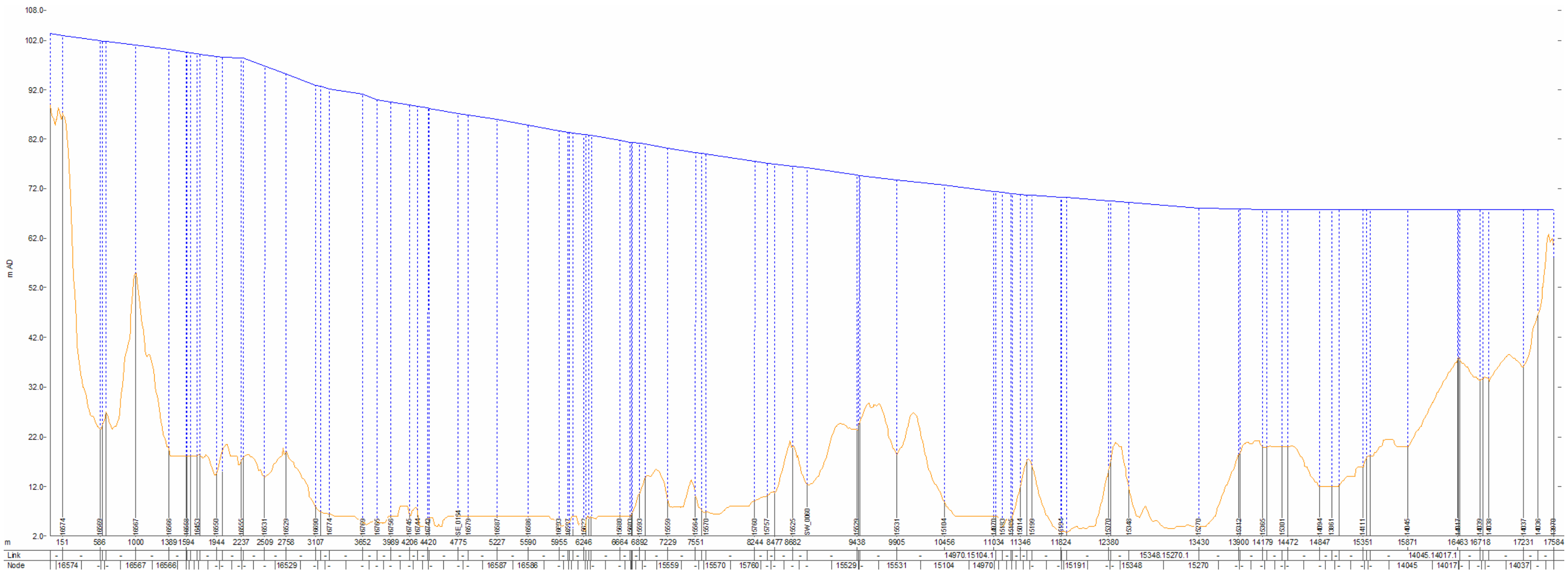

Reservoir KIAR RIDGE Future Run - 2041
Depth (m)
16.0
15.0
14.0
13.0
12.0
11.0
10.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth


Pump Station 16454.16453.1 Future Run - 2041
Flow (Ml/day)
200
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 131.25 Ml)

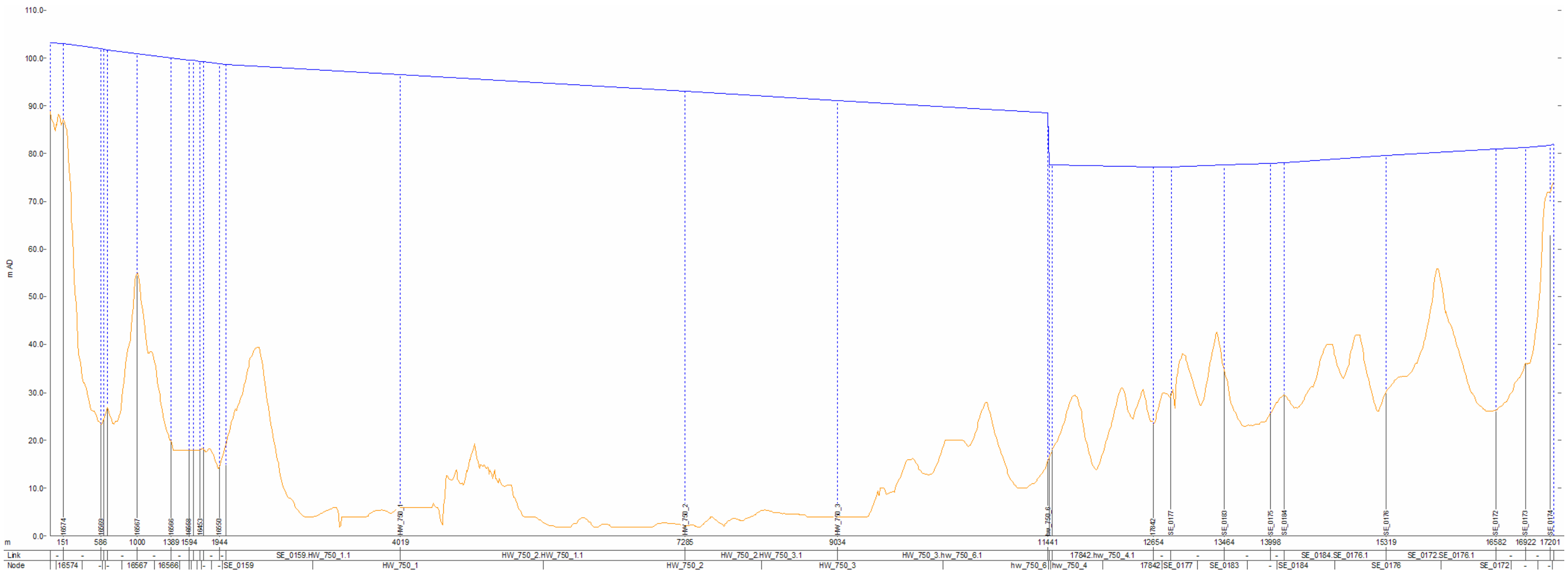
System Hydraulic Grade Lines (HGLs)



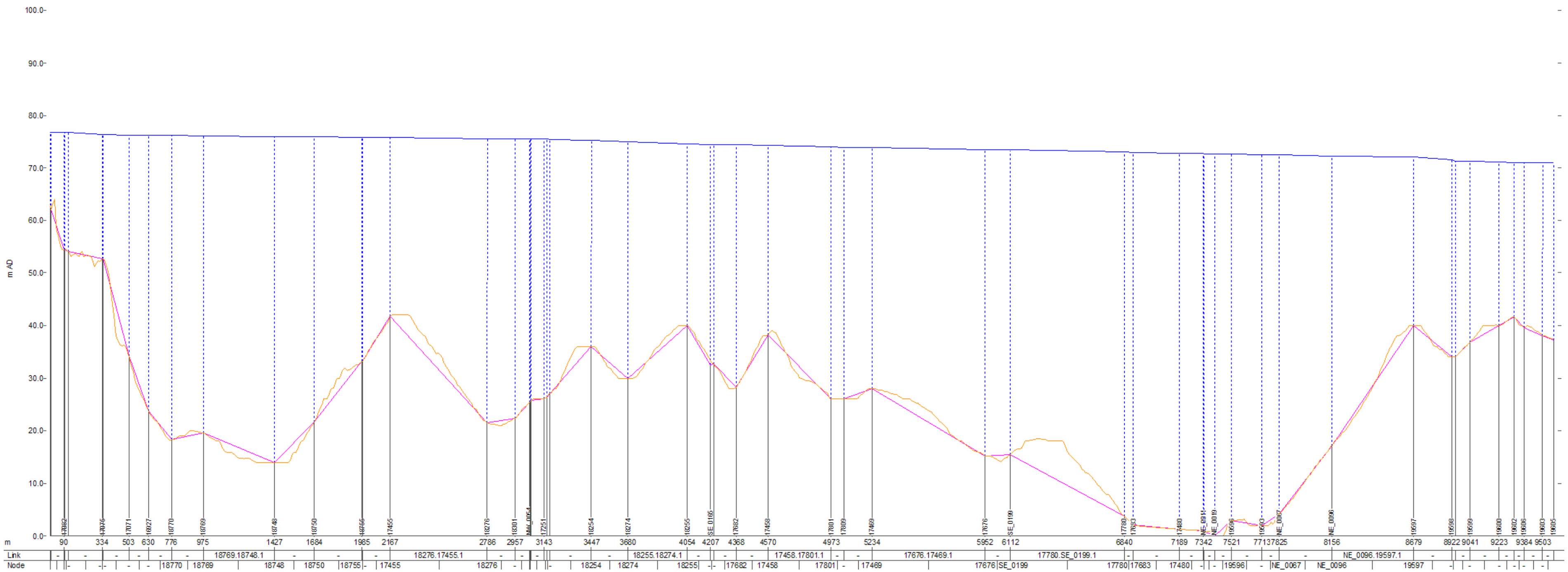
Tuggerah 2 Reservoir to Kanwal Reservoirs



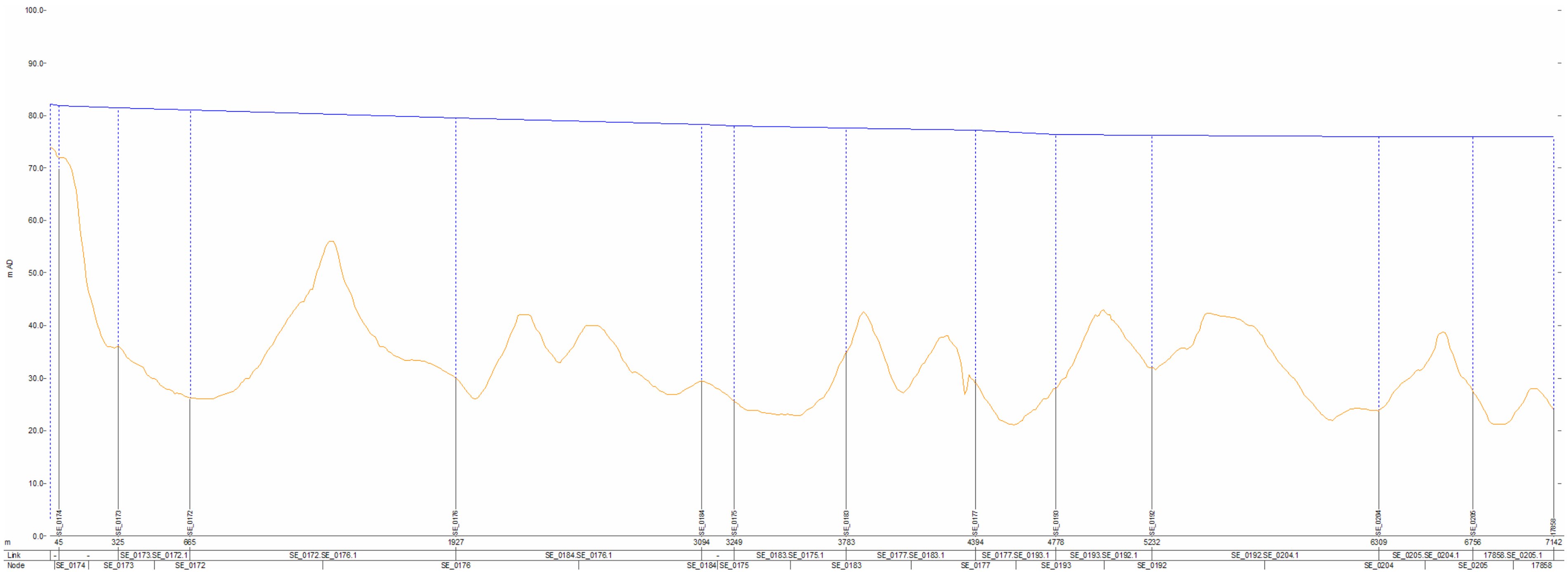
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



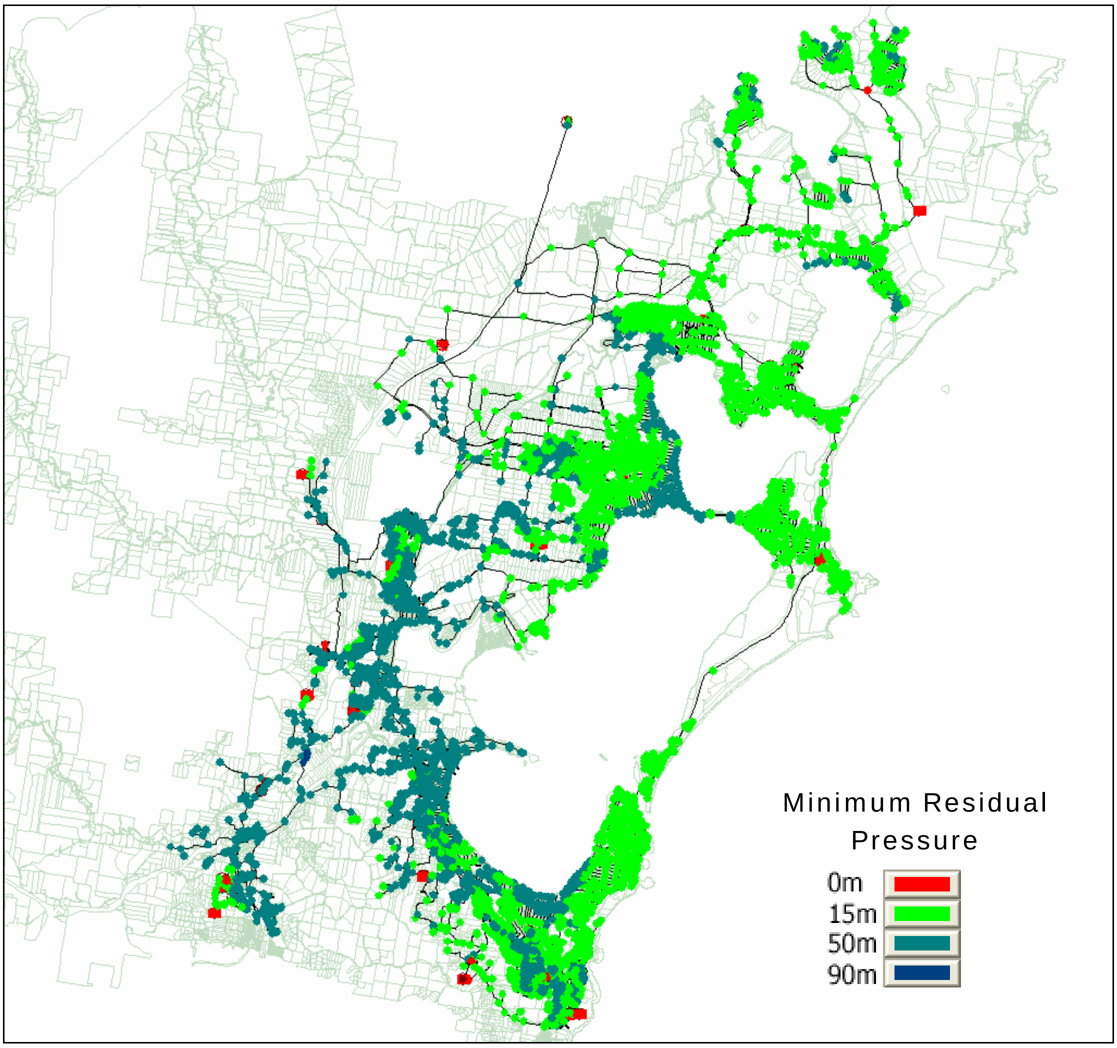
Kanwal Reservoirs to Bluehaven Area



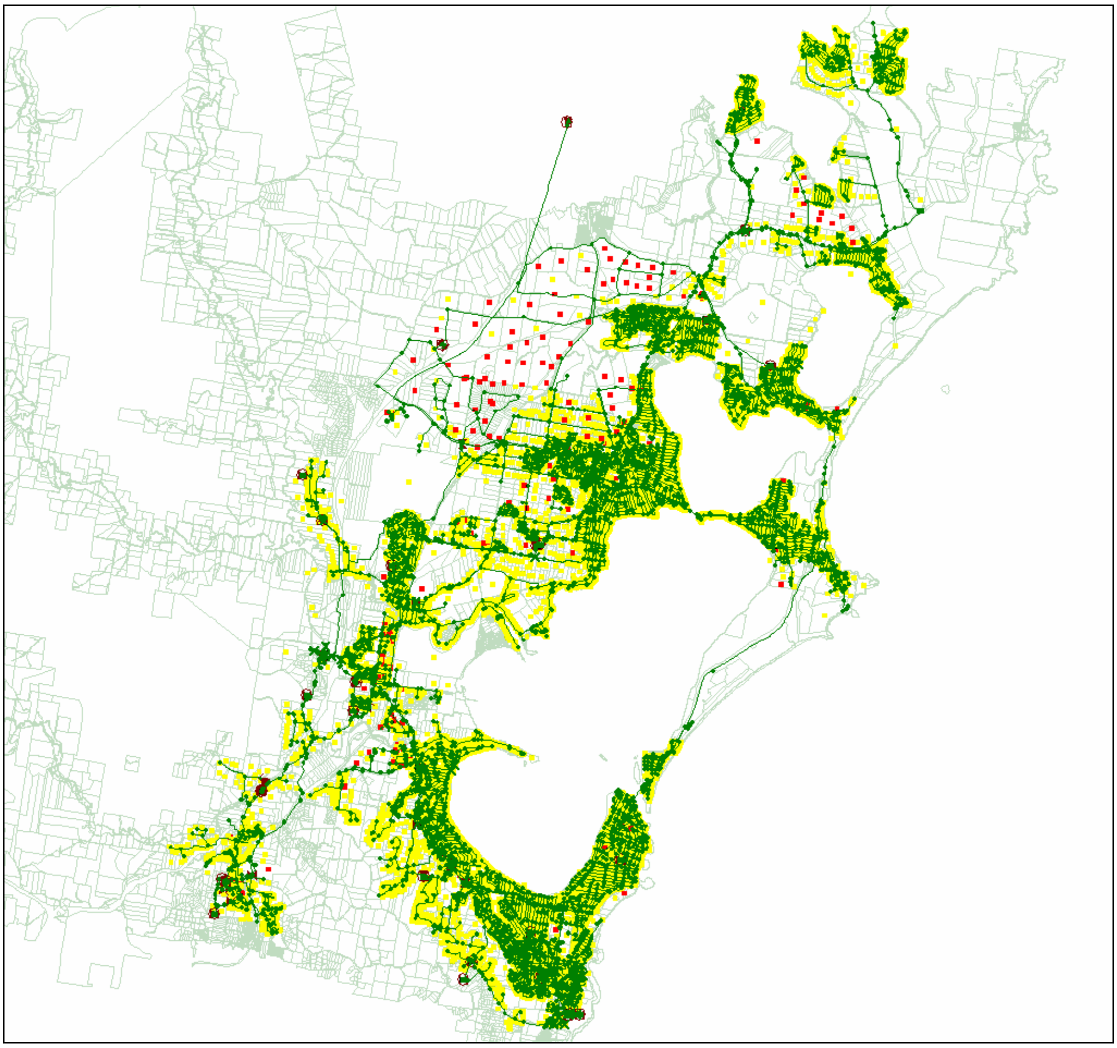
Kiar Ridge Reservoir to Warnervale High Level Zone

2046 Simulation Results

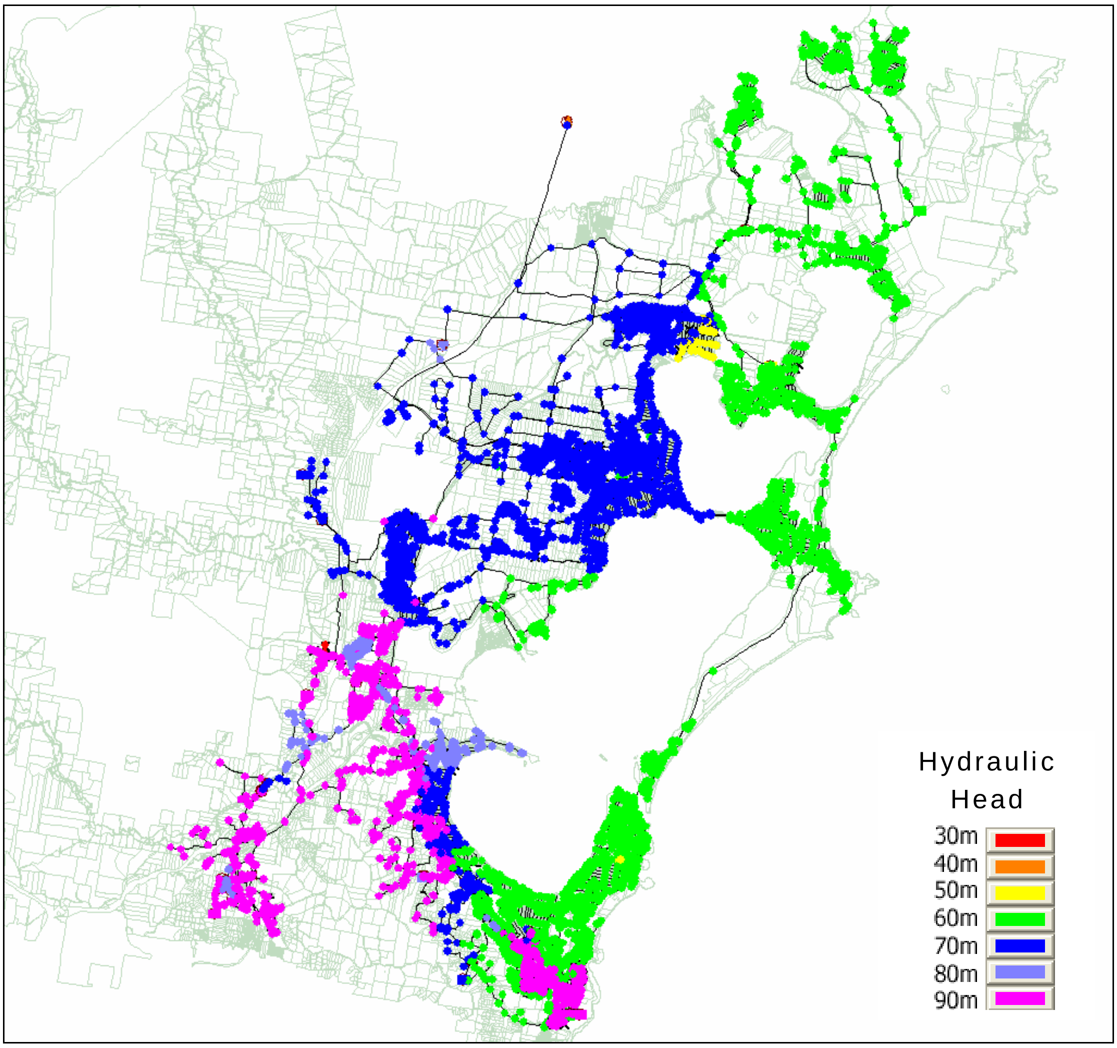
Minimum Residual Pressures



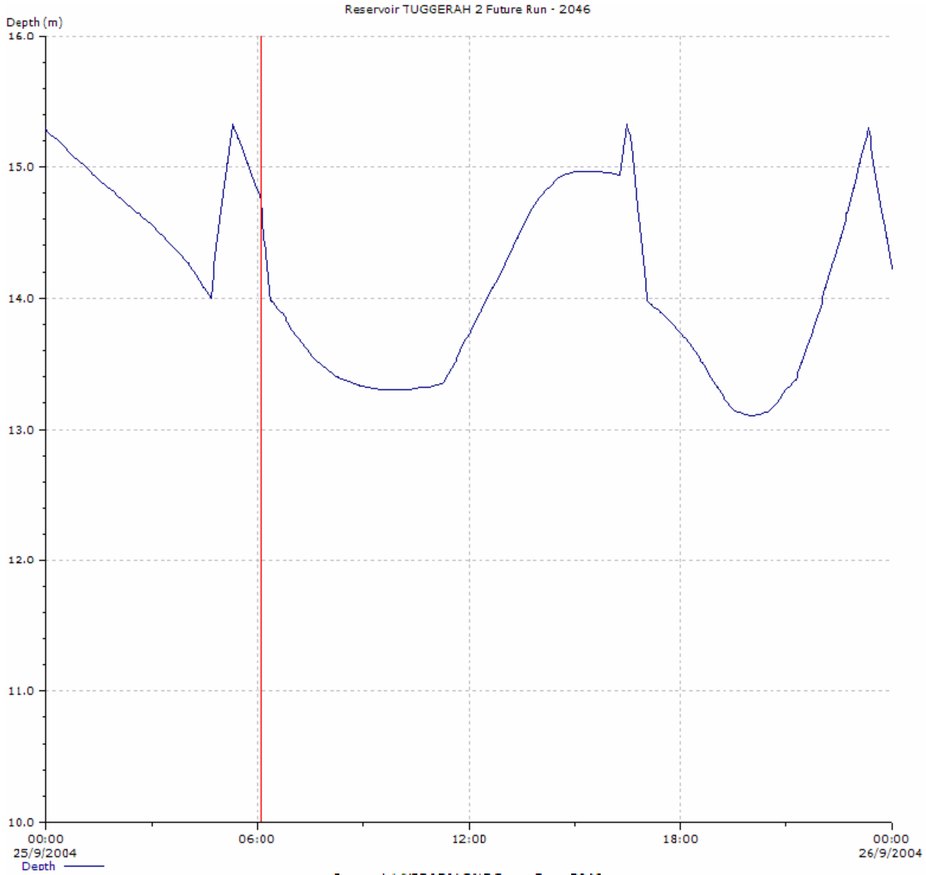
Customer Points

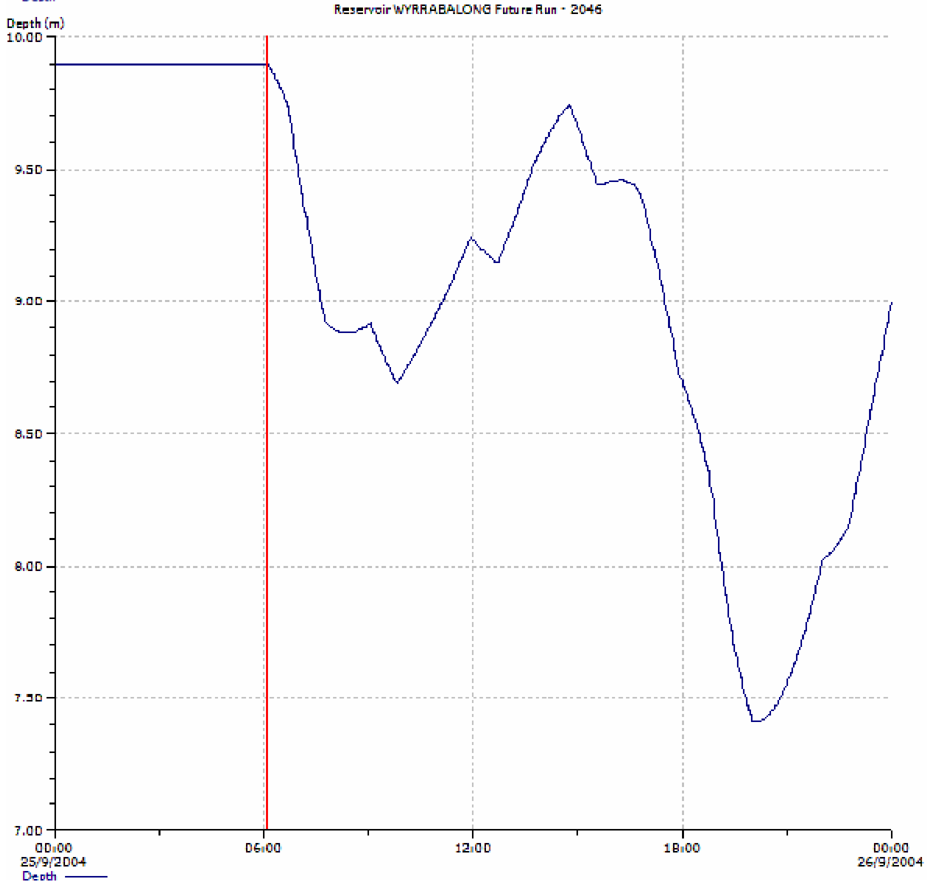


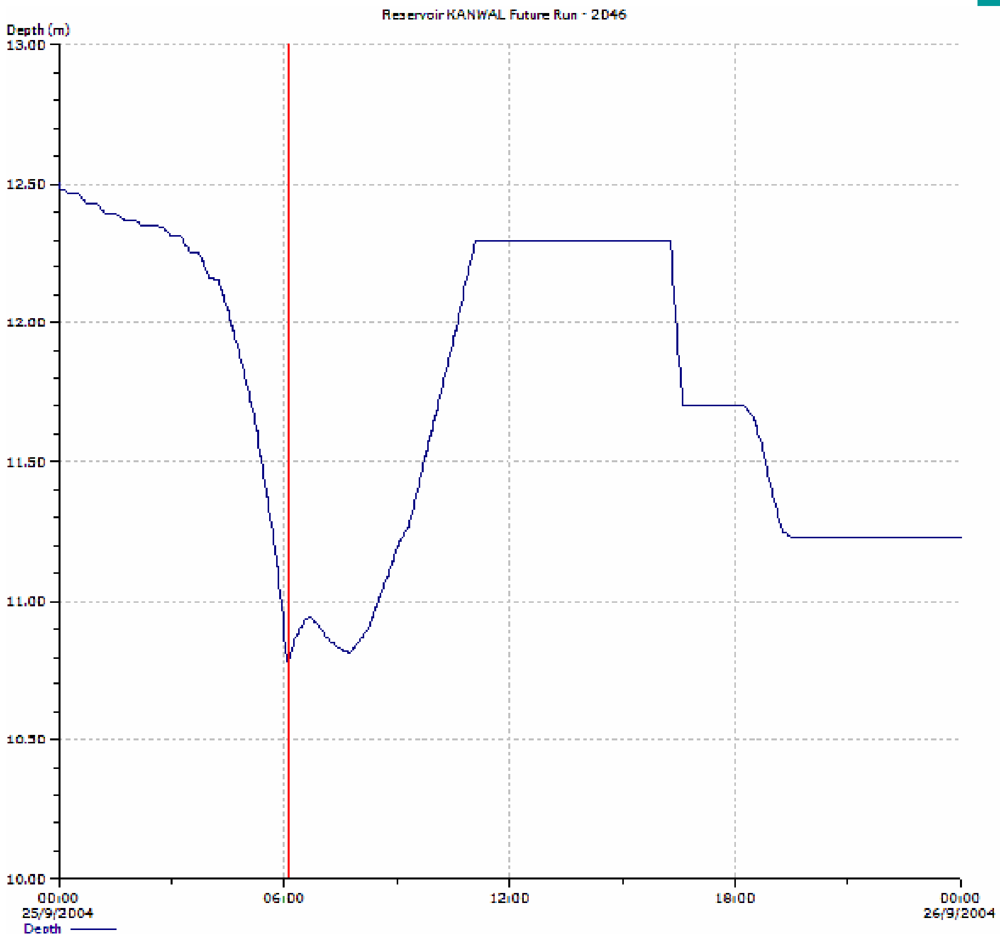
Simulated Head Conditions



Reservoir Levels & MHLPS Performance






Reservoir KANWAL Future Run - 2046
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12.50
12.00
11.50
11.00
10.50
10.00
00:00
25/9/2004
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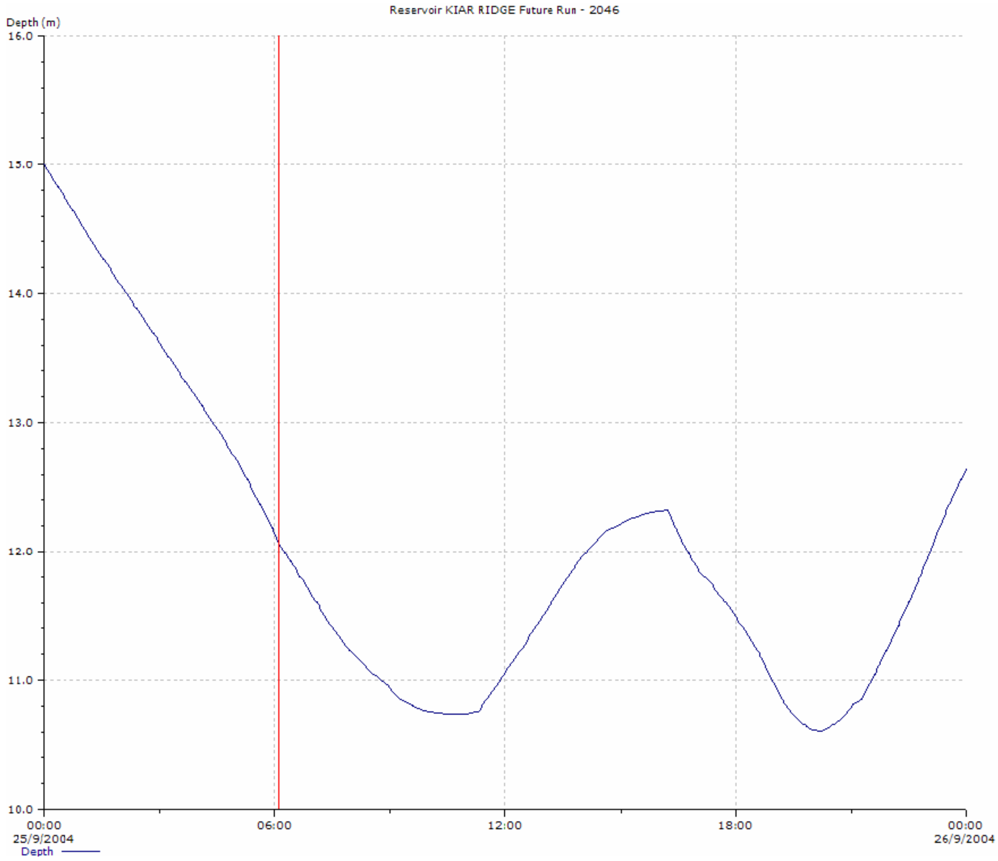
12:00
18:00
00:00
26/9/2004
Depth


Reservoir KIAR RIDGE Future Run - 2046
Depth (m)
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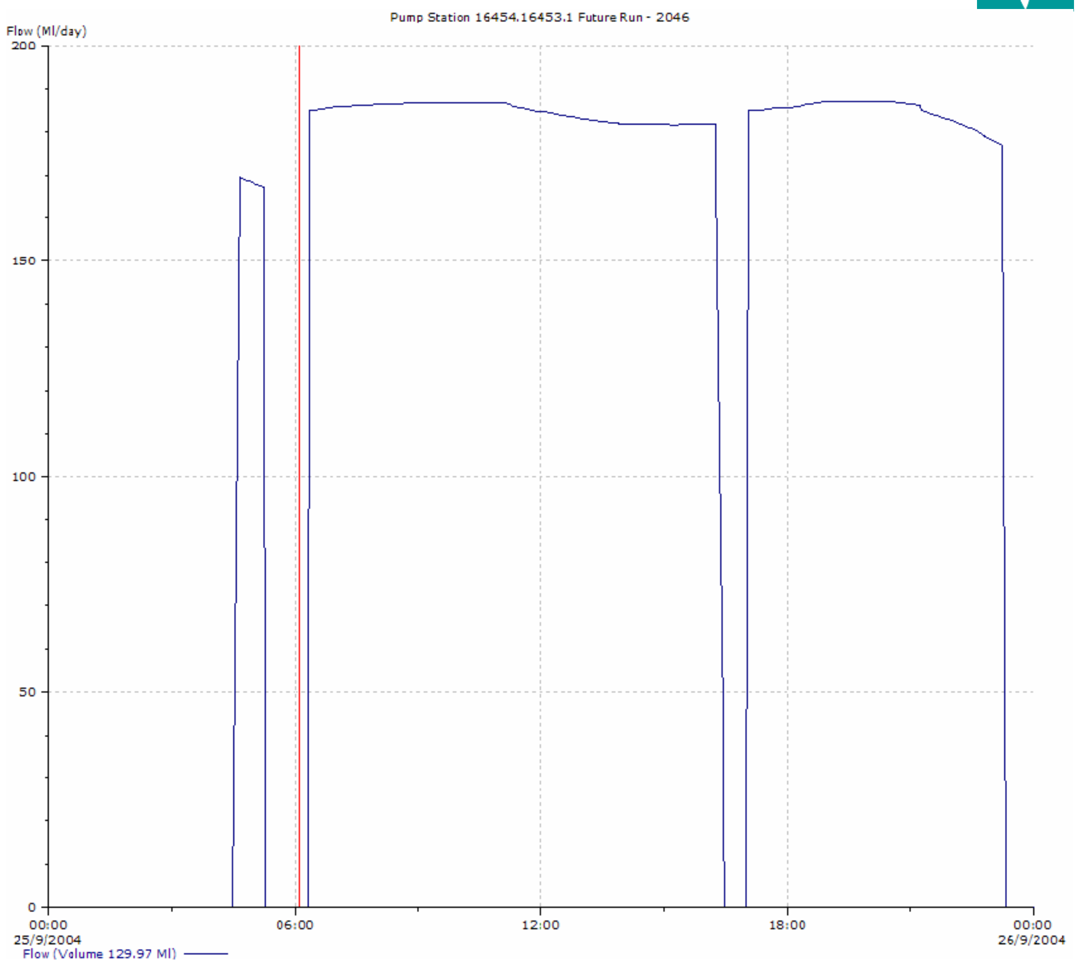
15.0
14.0
13.0
12.0
11.0
10.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth


Pump Station 16454.16453.1 Future Run - 2046
Flow (Ml/day)
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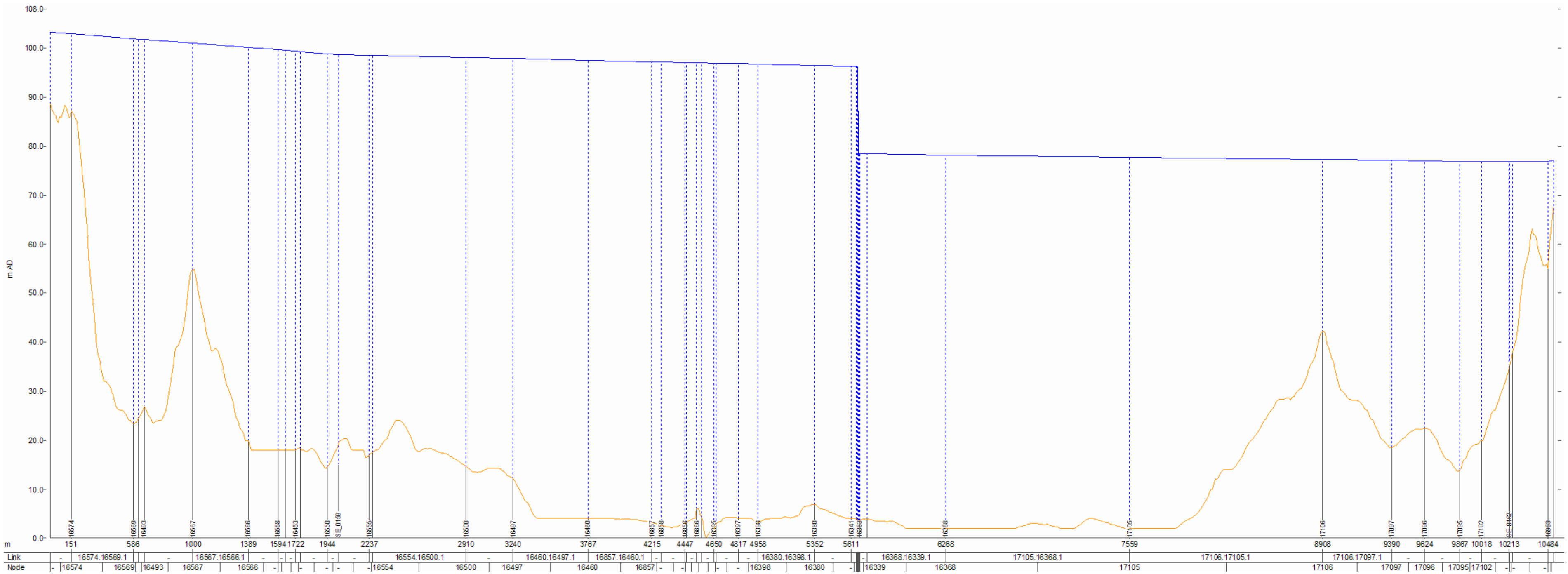
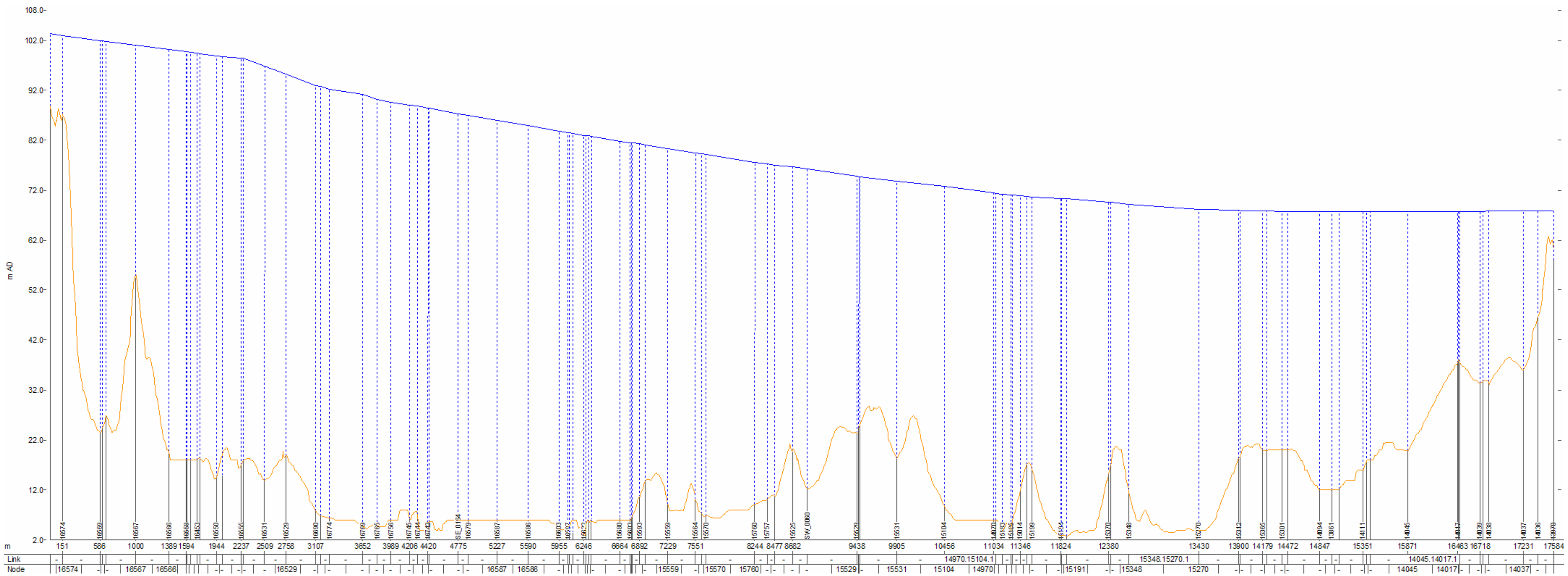
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 129.97 Ml)

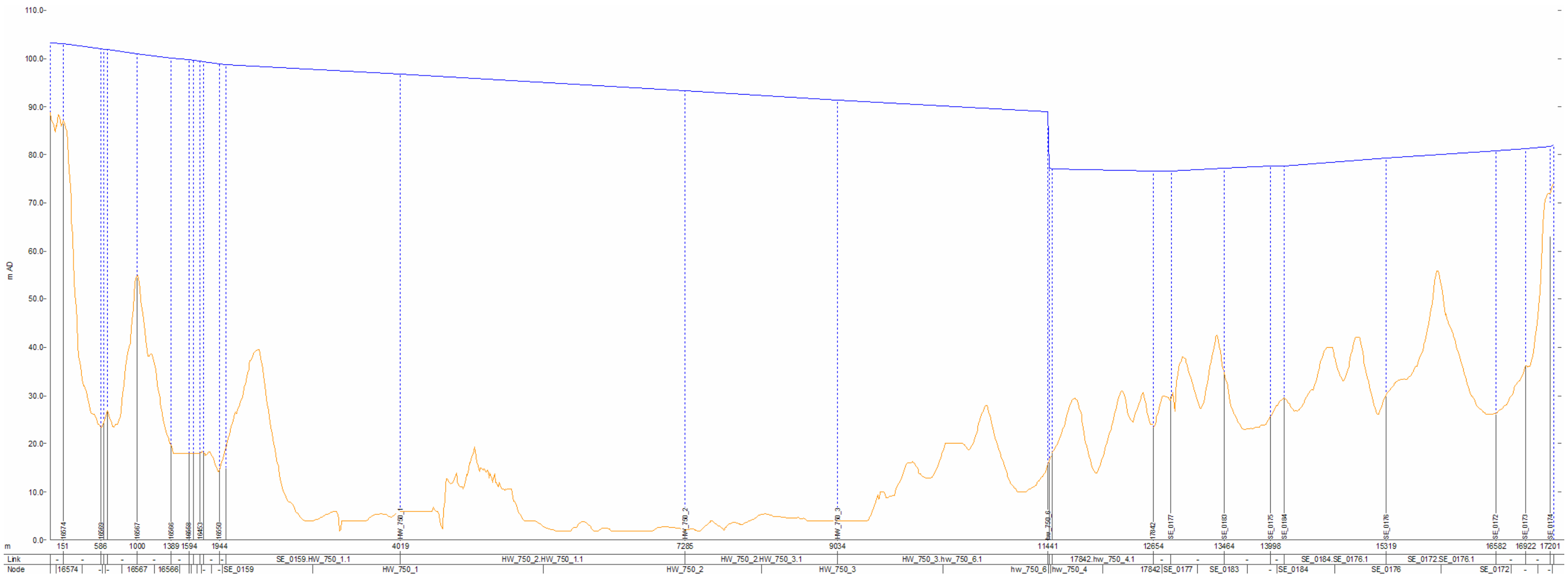
System Hydraulic Grade Lines (HGLs)



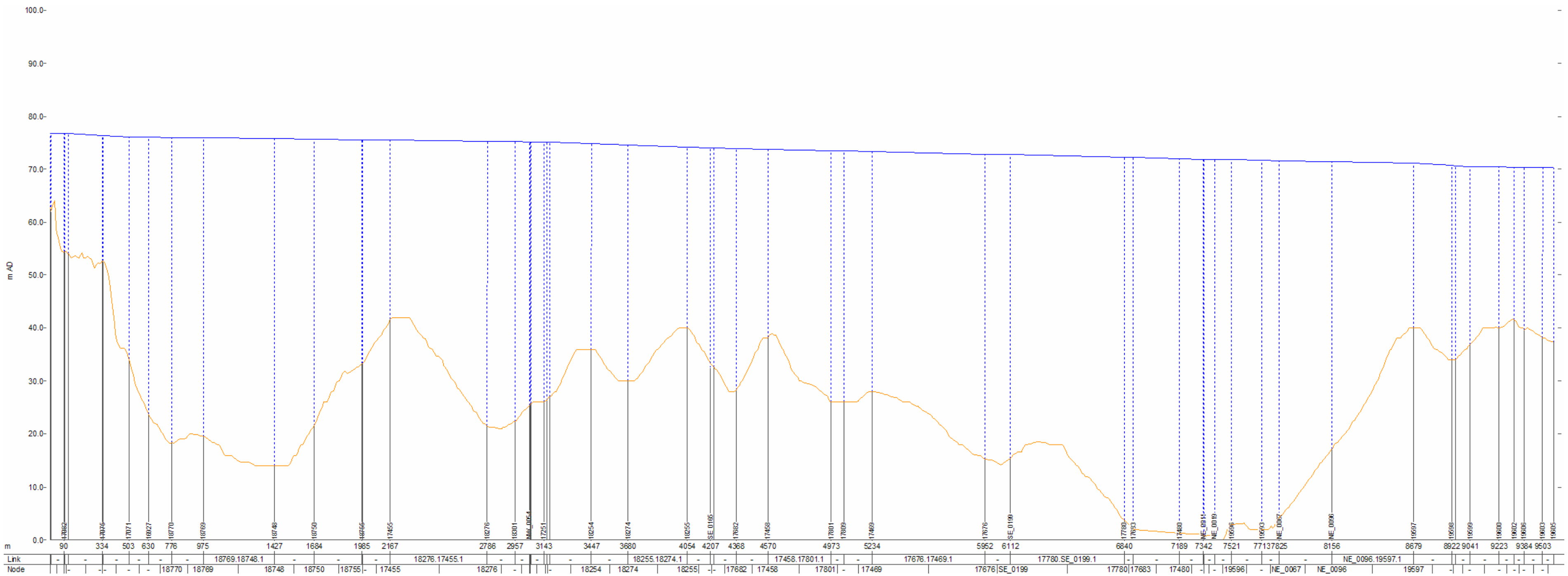
Tuggerah 2 Reservoir to Kanwal Reservoirs



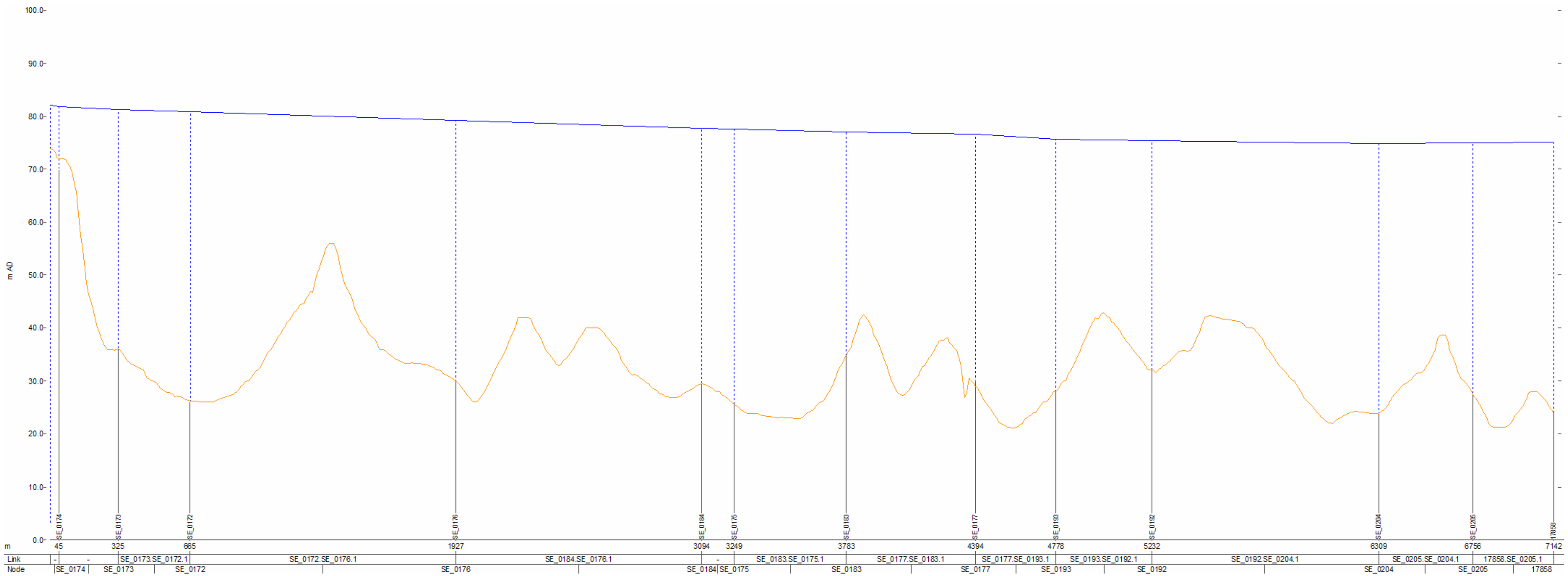
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



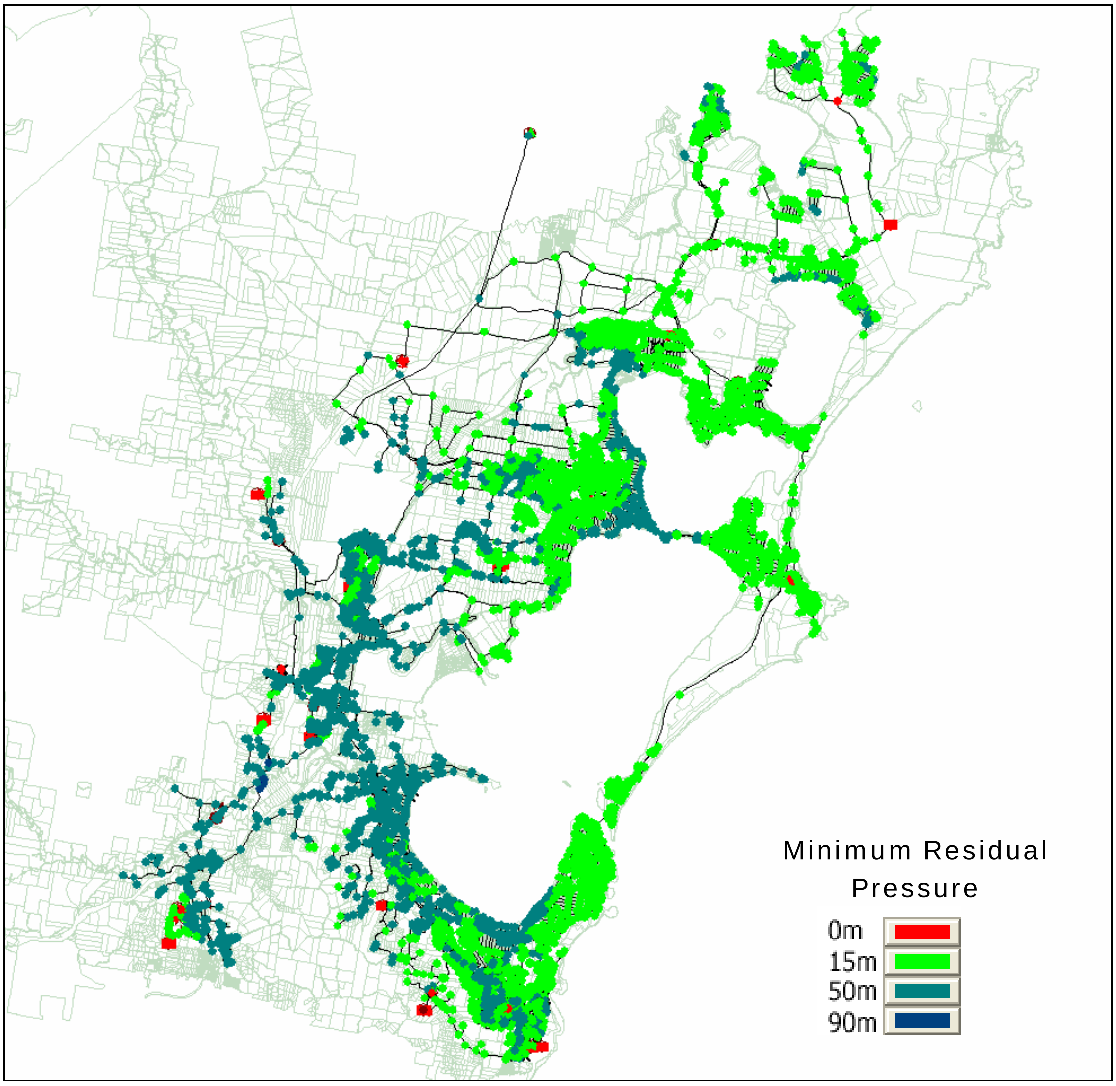
Kanwal Reservoirs to Bluehaven Area



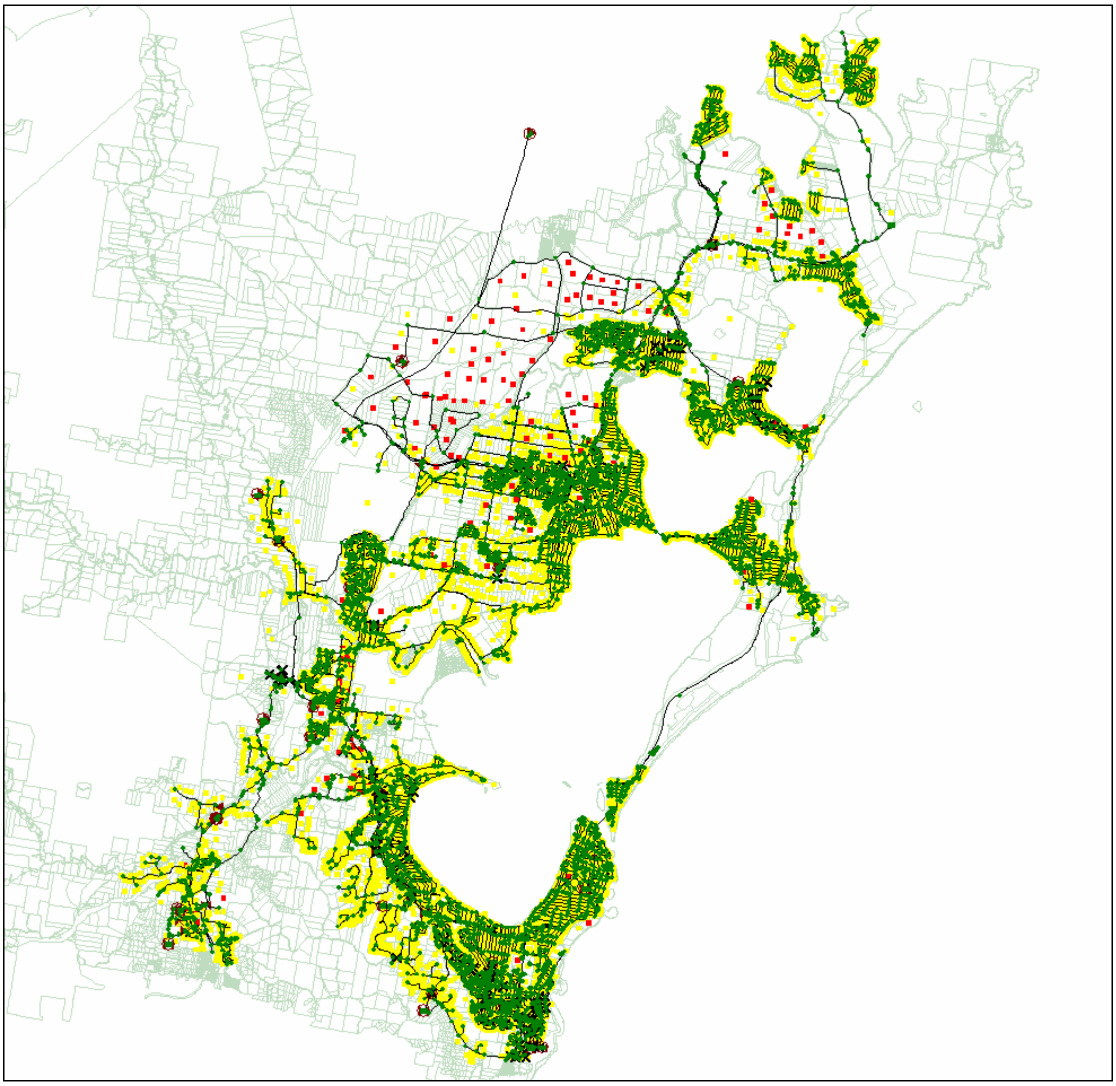
Kiar Ridge Reservoir to Warnervale High Level Zone

2051 Simulation Results

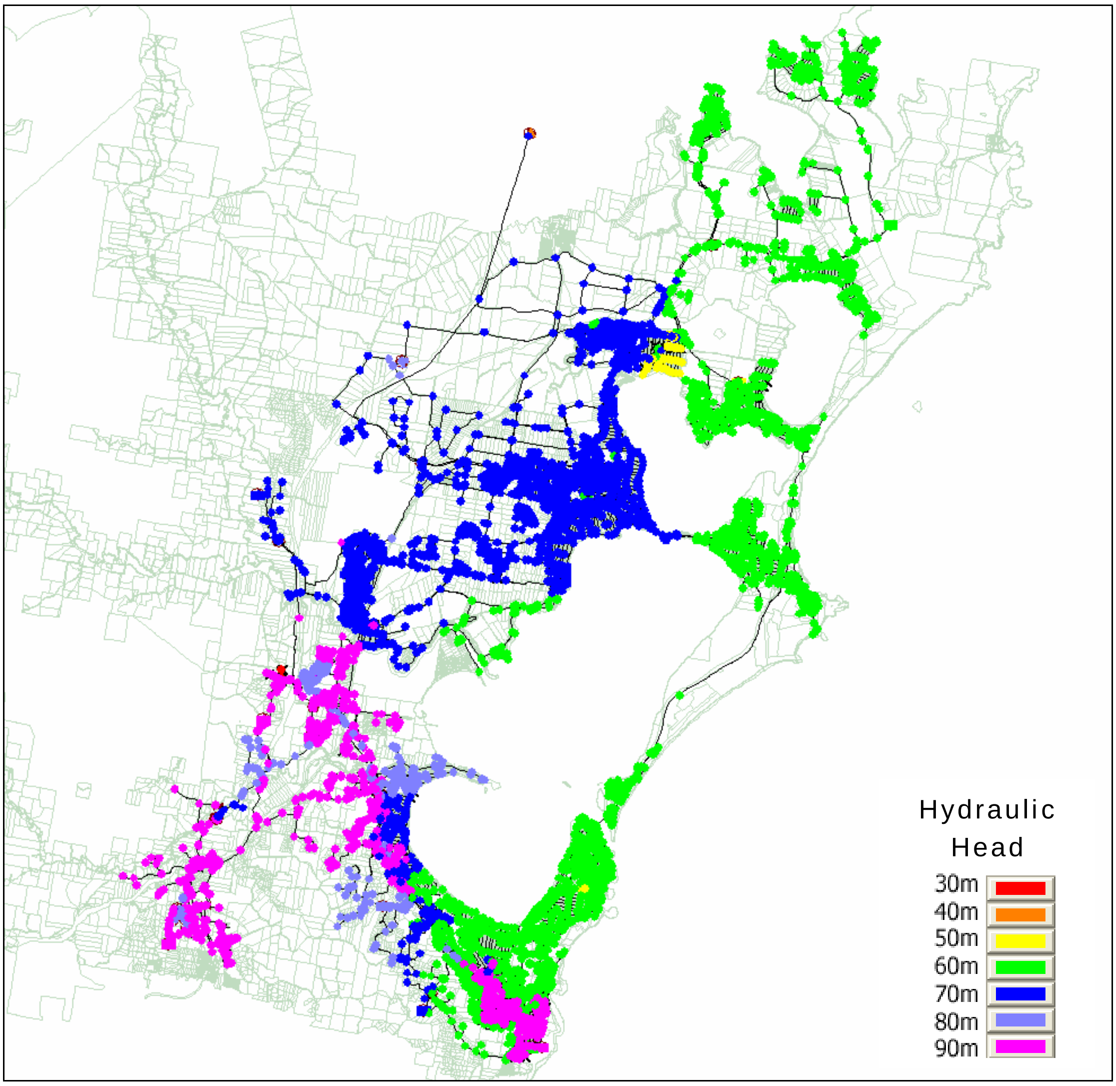
Minimum Residual Pressures



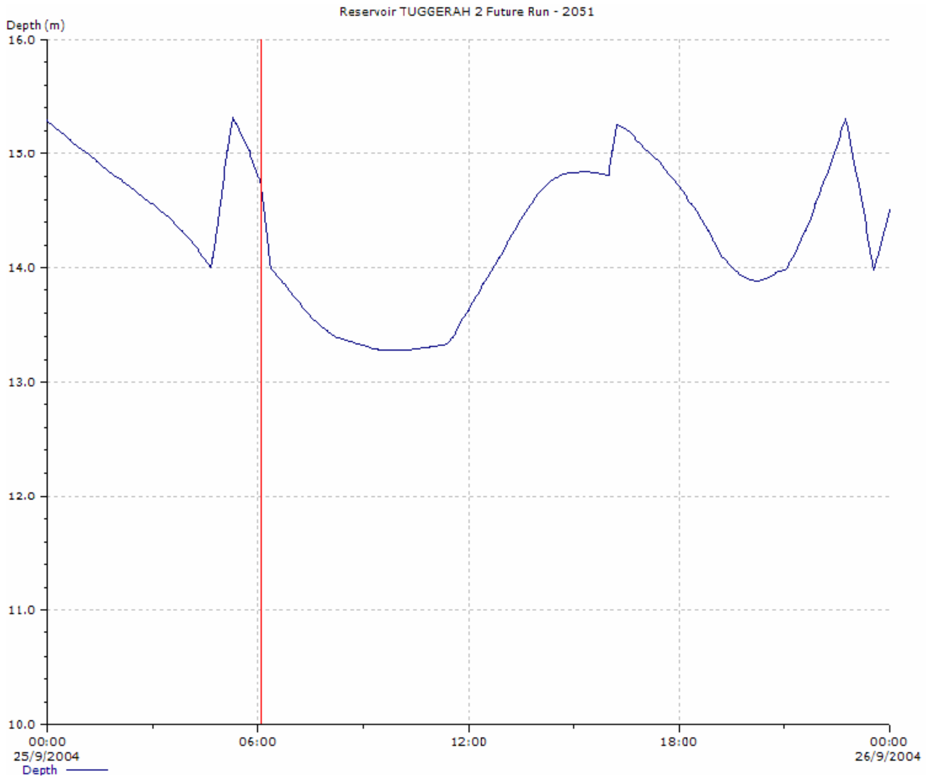
Customer Points

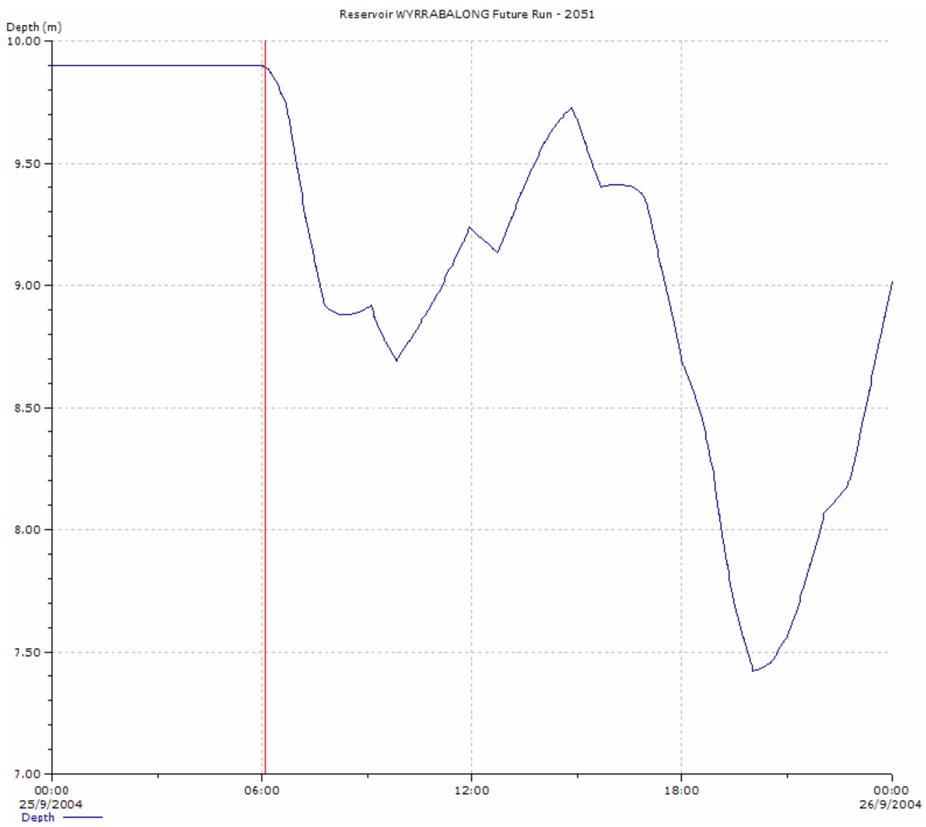


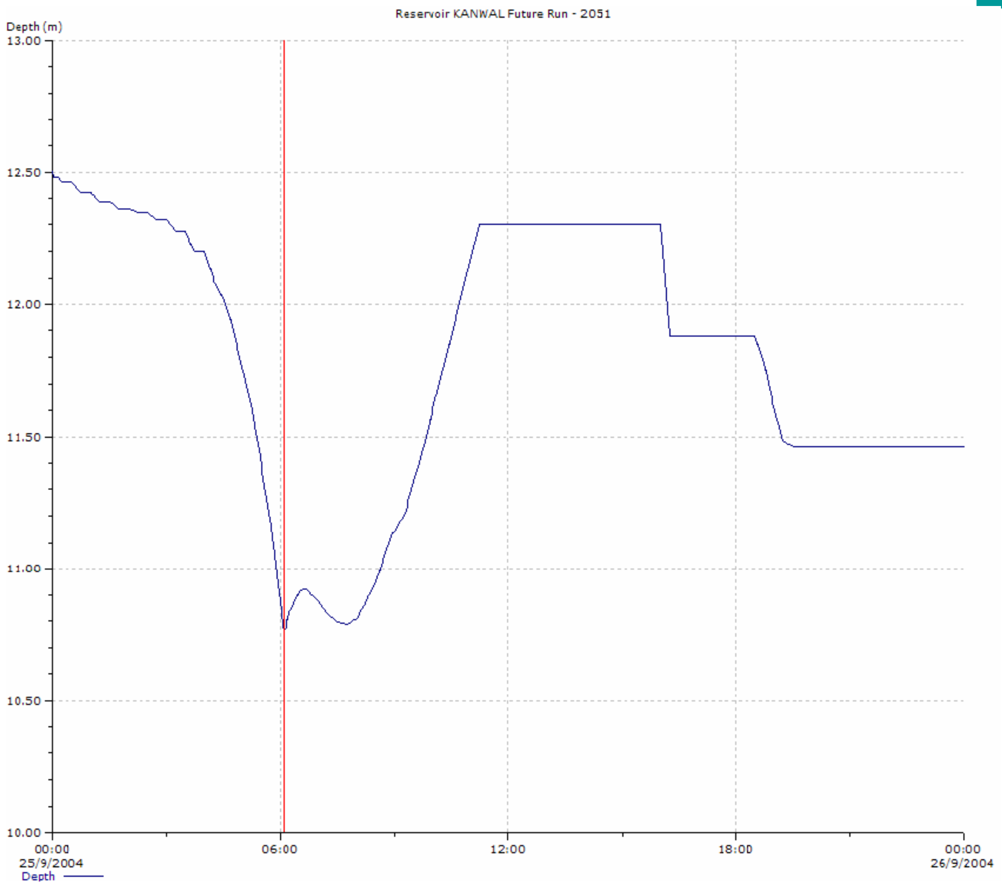
Simulated Head Conditions

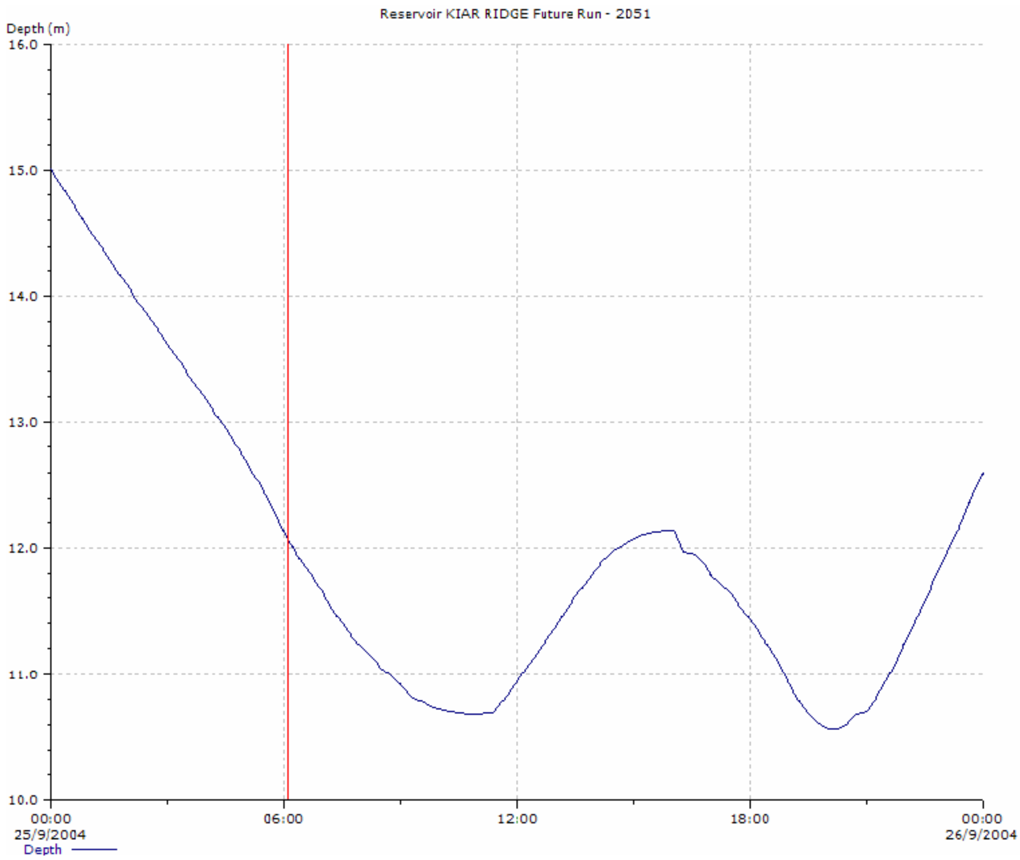


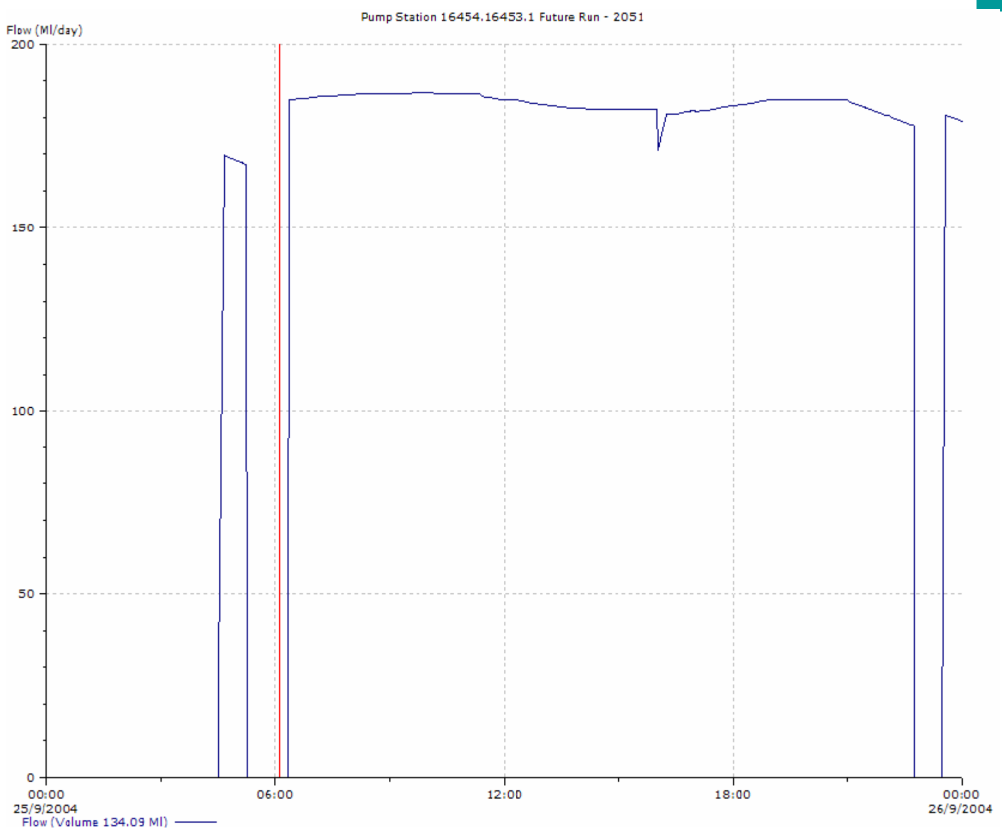
Reservoir Levels & MHLPS Performance



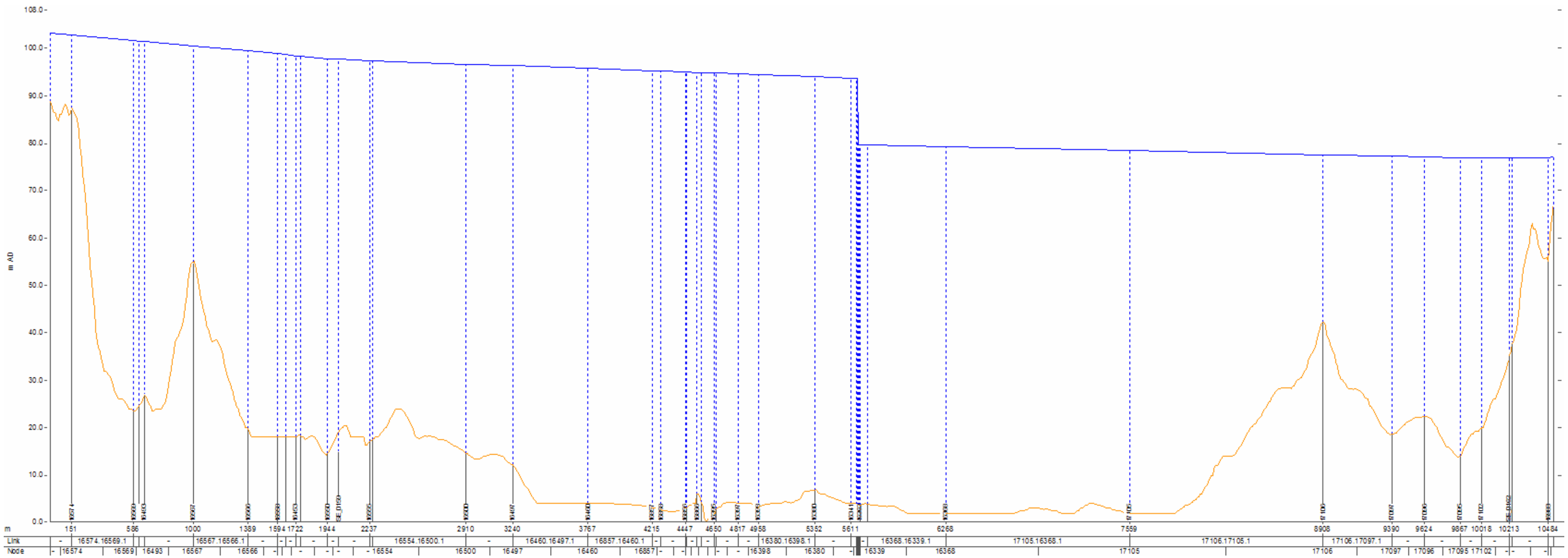



Reservoir KANWAL Future Run - 2051
Depth (m)
13.00
12.50
12.00
11.50
11.00
10.50
10.00
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth

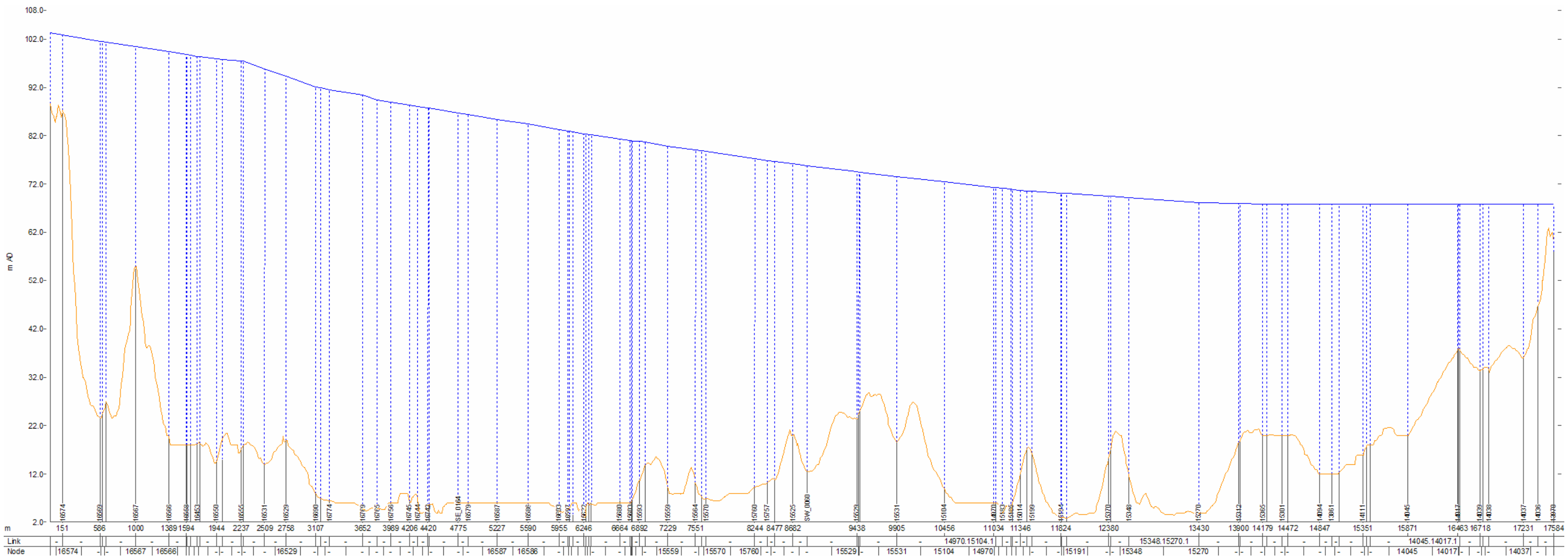

Reservoir KIAR RIDGE Future Run - 2051
Depth (m)
16.0
15.0
14.0
13.0
12.0
11.0
10.0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Depth


Pump Station 16454.16453.1 Future Run - 2051
Flow (Ml/day)
200
150
100
50
0
00:00
25/9/2004
06:00
12:00
18:00
00:00
26/9/2004
Flow (Volume 134.09 Ml)

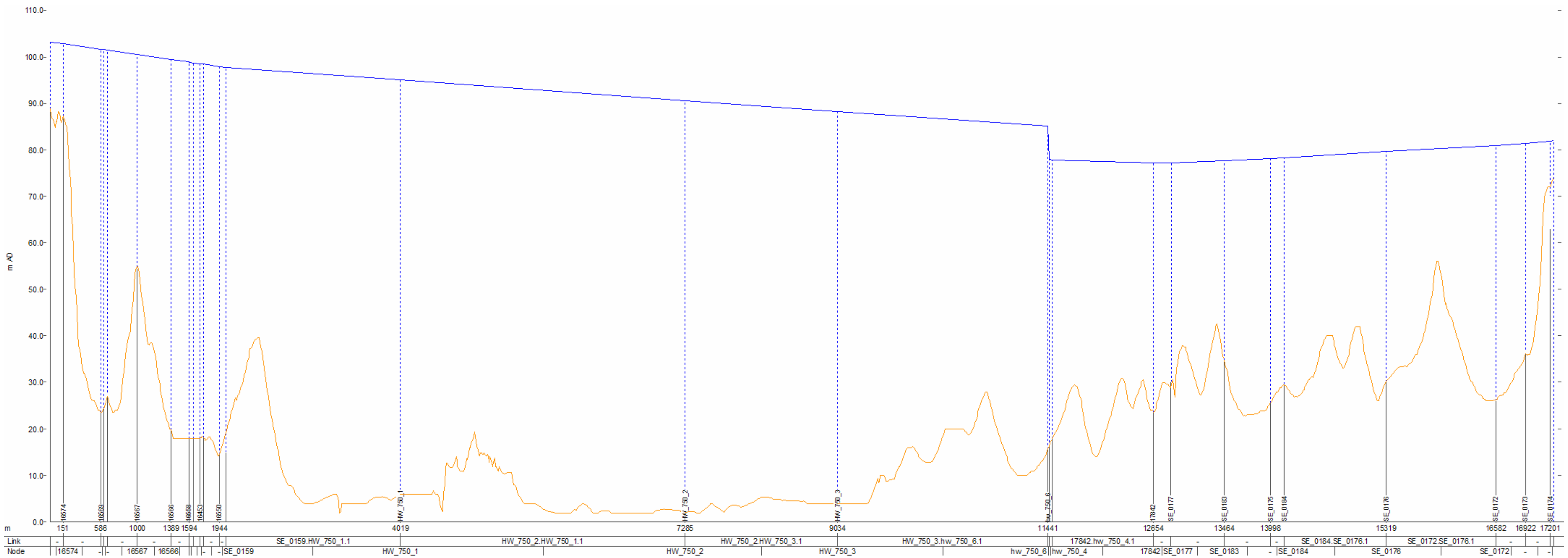
System Hydraulic Grade Lines (HGLs)



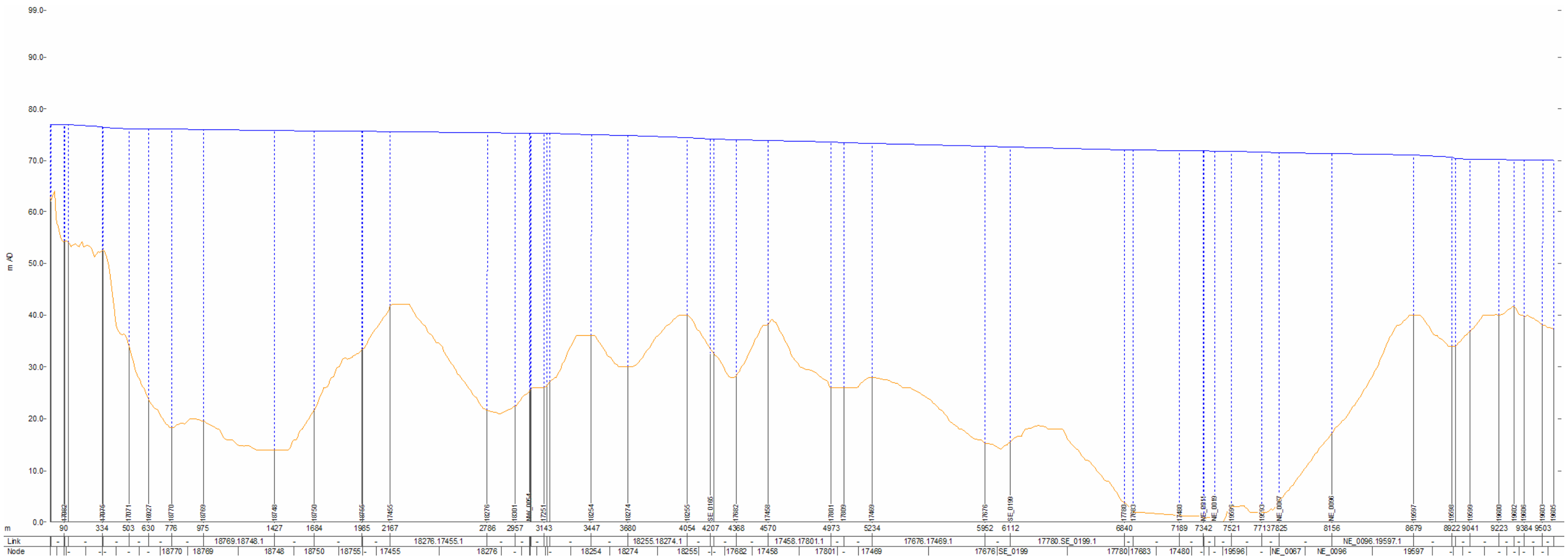
Tuggerah 2 Reservoir to Kanwal Reservoirs



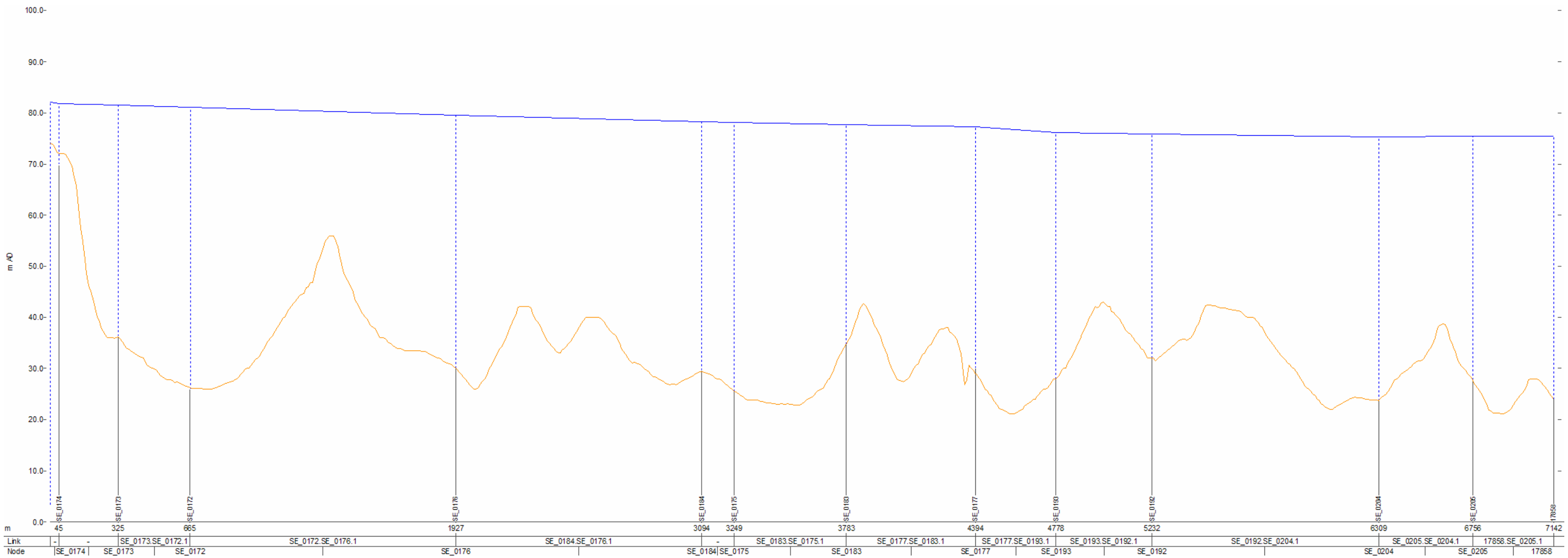
Tuggerah 2 Reservoir to Wyrrabalong Reservoir



Tuggerah 2 Reservoir to Kiar Ridge Reservoir



Kanwal Reservoirs to Bluehaven Area



Kiar Ridge Reservoir to Warnervale High Level Zone

APPENDIX B –HYDRAULIC MODEL OPERATING GUIDE

INTRODUCTION

The following is a brief user guide outlining key features and assumptions of the hydraulic model created in Infoworks WS created for Wyong Shire Council. The purpose of this guide is to summarise the key attributes of the model and to provide sufficient understanding of the modelling philosophy. It is assumed that the user has a competent knowledge of Infoworks WS and that this guide will only focus on model specific details.

SETUP OF THE MODEL

The electronic file containing the hydraulic simulations and data is labelled *Wyong Distribution Analysis.iwm*. From within this base file is stored all the network data and control data, and user groups created in establishing this hydraulic model. Key groups that are included within this electronic file include:

- "Deleted Items" - A network file containing all deleted items thought to be unnecessary following the importing of GIS data.
- "Missing Diameters" – A network file that contains all the pipeline sections that did not have pipeline sizes associated with them.
- "Wyong 2006 Calibration" – Network and control data used in the calibration of the model.
- "Networks – Future Runs" – The network files used in the 5 year staging analysis for the Distribution System Development Plan
- "Base Model Controls – Future Runs" – Control files for the future simulations
- "Demand Diagram Group" – demand profiles used for the various demand categories
- "Ground Model TIN Group" – contains the TIN data used to establish ground levels at nodes and along the entire network.
- "UPC Group" – Contains the User Programmable Controls used to coordinate the Kanwal MV operation for the calibration runs and the future runs.

KEY ATTRIBUTES OF THE MODEL

As outlined in the main report there are several operating modes that have been analysed in this model. Not withstanding the transfers from adjoining systems, there is the operating mode as established for the calibration and simulates current WSC system operating rules, there is the future operating mode where Kiar Ridge has not yet been introduced, then there is the final operating mode whereby Kiar Ridge has been constructed and operates in parallel with Kanwal reservoir to supply the northern system.

Current Operating Mode

Under the current operating mode the WSC system is fed directly from the Mardi CWT and distributed via the No.2 and No.4 PS South and North respectively. The CWT is modelled as an infinitely large object (fixed head) in Infoworks. As the Peak Day Demand is not expected to exceed the throughput of the WTP it was decided to simplify the modelling by not having to complicate the distribution system with the arrangements at the Mardi WTP.

In the south local booster pumping stations call for water when required and maintain levels in their respective service reservoirs.

The northern system is a little more complicated due to the large service area that Kanwal is expected to supply and maintain. It was found in the default operating mode that the throughput of No.4 PS was simply unable to supply the PDD event in the north. As such a low level trigger arrangement was modelled whereby Tuggerah 2 could bypass No.4 PS and supplement flow to Kanwal reservoirs. This is achieved in the model through the UPC Kanwal Valve. This UPC triggers the Kanwal MV, a valve at No.4 PS and another valve at the intersection of the 1050 and 600 Mardi Pipelines (as they diverge north and south). While these valves are not in actual fact motorised, to simulate the manual control they are incorporated in the model as motorised valves (MV).

However, even with these additional controls it was found that Kanwal struggled to maintain sufficient head in areas such as Bluehaven and central East Gorokan using low level trigger levels for Kanwal suggested by WSC (55% before switching to Tuggerah 2).

Future Simulation – Pre Kiar Ridge Reservoir

Under this operating scenario the WSC WS system is fed from the CWT but via the Mardi HLPS/Tuggerah 2 reservoir. The configuration of the pipework at Mardi HLPS enables the Mardi HLPS to deliver water to Tuggerah 2 when Tuggerah 2 is calling for it while also simultaneously charging lines downstream of the MHLPS with the head of the MHLPS pumps or exposing the system to the head of Tuggerah 2 on a permanent basis. With this operating regime there is no need for No.2 and No.4 PS, both of which are deactivated in the model. No.4 PS is replaced with the Kanwal MV (valve 16351.16355.1 in the Infoworks WS model) and a new MV is added to the Hunter Link just prior to its connection along sparks rd (valve hw_750_6.hw_750_5.1 in Infoworks WS). These two valves are linked via the UPC "Future Runs Kanwal MV – No Kiar". In essence these two valves replace No.4 PS and allow reservoirs in the north to be topped up by Tuggerah 2 when the level in Kanwal reservoirs falls.

Future Simulation – Post Kiar Ridge Reservoir

The introduction of Kiar Ridge to the system relieves the stress from Kanwal reservoir by providing additional head and new delivery mains to supply the new development areas in the northern precincts. The higher TWL of Kiar Ridge and the merged reservoir zone between Kiar Ridge and Kanwal reservoir, however, requires that the controls on the two MVs in the previous operating mode to be reprogrammed with an additional control requirement – the valves must open if either Kanwal or Kiar is low.

METHODOLOGY FOR IMPORTING OF DEMAND DATA

An outline of how demand data results from the demand model is to be imported into the hydraulic model is provideded below:

1. Demand data for each meter is generated in the demand model and tabulated in a csv file. The csv file lists the meter number and the corresponding demand in litres per second.

2. The locations of the meters were imported into the Infoworks WS model by importing a GIS layer which assigned the centre coordinate of individual lots as the meter locations. These meter locations are imported as "customer points" within Infoworks WS and assigned the corresponding meter number.

3. Using the Import Data Centre function in Infoworks WS the csv file containing the demands are then imported into the model.

Appendix D

Developer Strategies included in 2019 Northern Region DSP

MEMO - Summary of developer servicing strategy documents for water and sewer in Northern Region Development Servicing Plan Area

Background

To support the development of the 2019 Development Servicing Plans (DSP, this summary document is provided to give an overview of proposed major development activities as described in recent developer initiated water and wastewater servicing strategies and associated DSP funded capital works required to service these developments.

Development Summary

1. Wadalba East Land Owners Group (WELOG) Development

Proposed WELOG development south of Johns Rd, Wadalba consists of 67ha of developable land with multiple owner interest. A developer servicing strategy (ADW Johnson, June 2017) proposed the following lot yield and staging plan as shown in Table 1 and Figure 1, respectively. Proposal was to progress with a development front moving east to west to work within the constraints of existing water and sewer services. Proposed water and sewer assets to service the development are shown in Figures 2 and 3, respectively. This consists of approximately 2km each of water and sewer main and three additional sewer pumping stations.

Table 1: WELOG Lot Yield

Stage	Contributing ET
1A	165
1B	161
2A	165
2B	117
3A	226
3B	168
TOTAL	1002

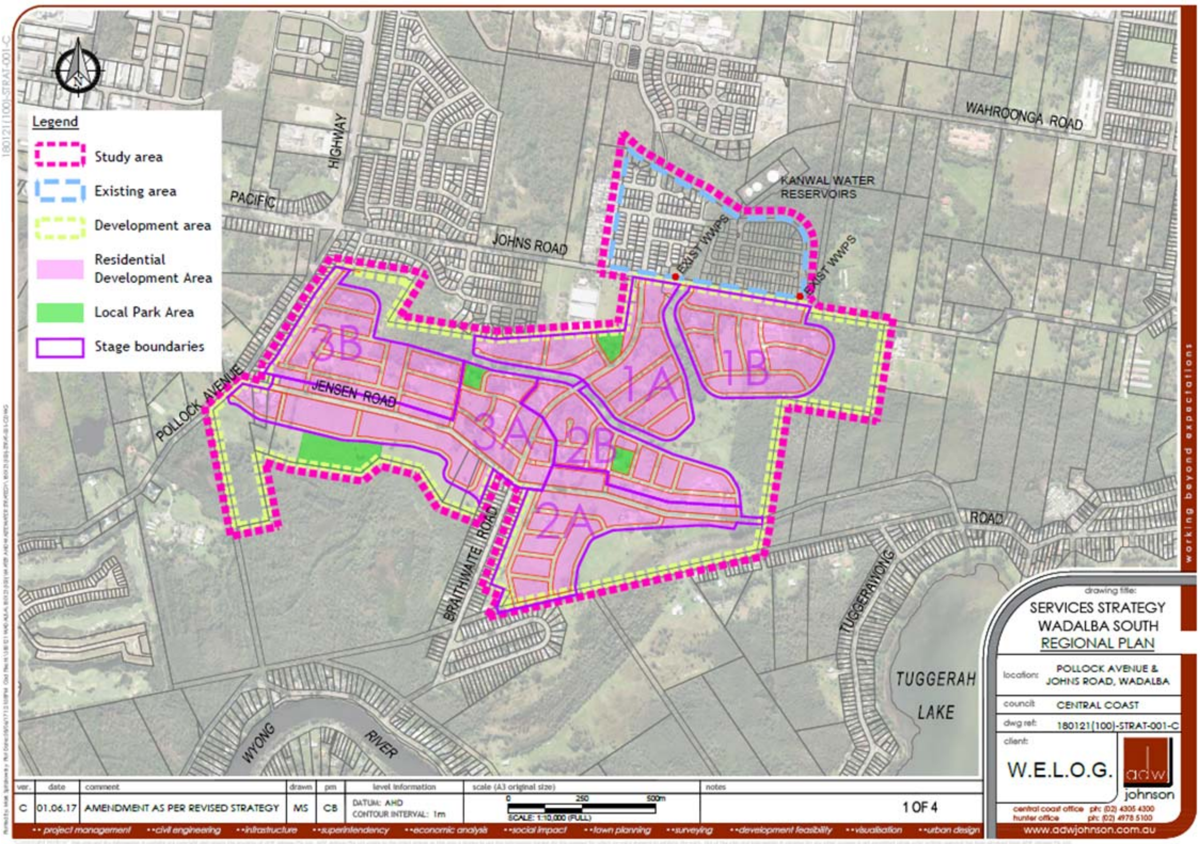


Figure 1 – WELOG Development Staging Plan

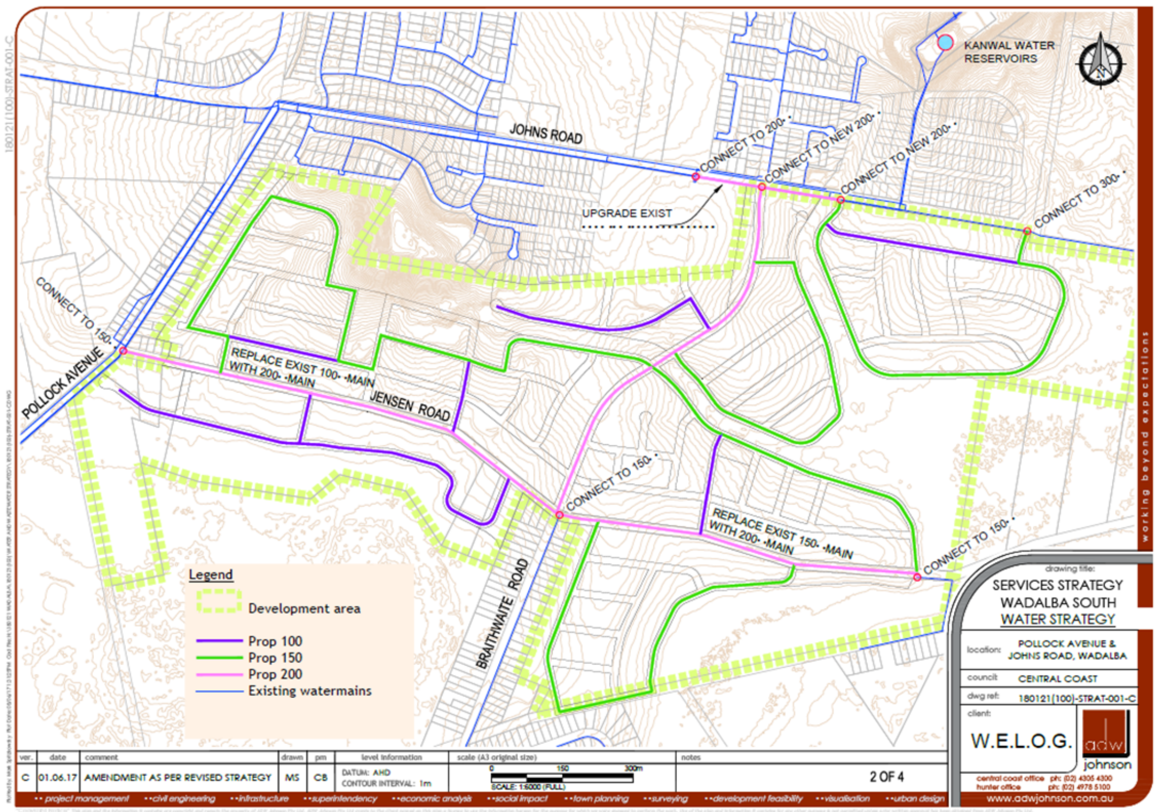


Figure 2 – WELOG Development New Water Assets

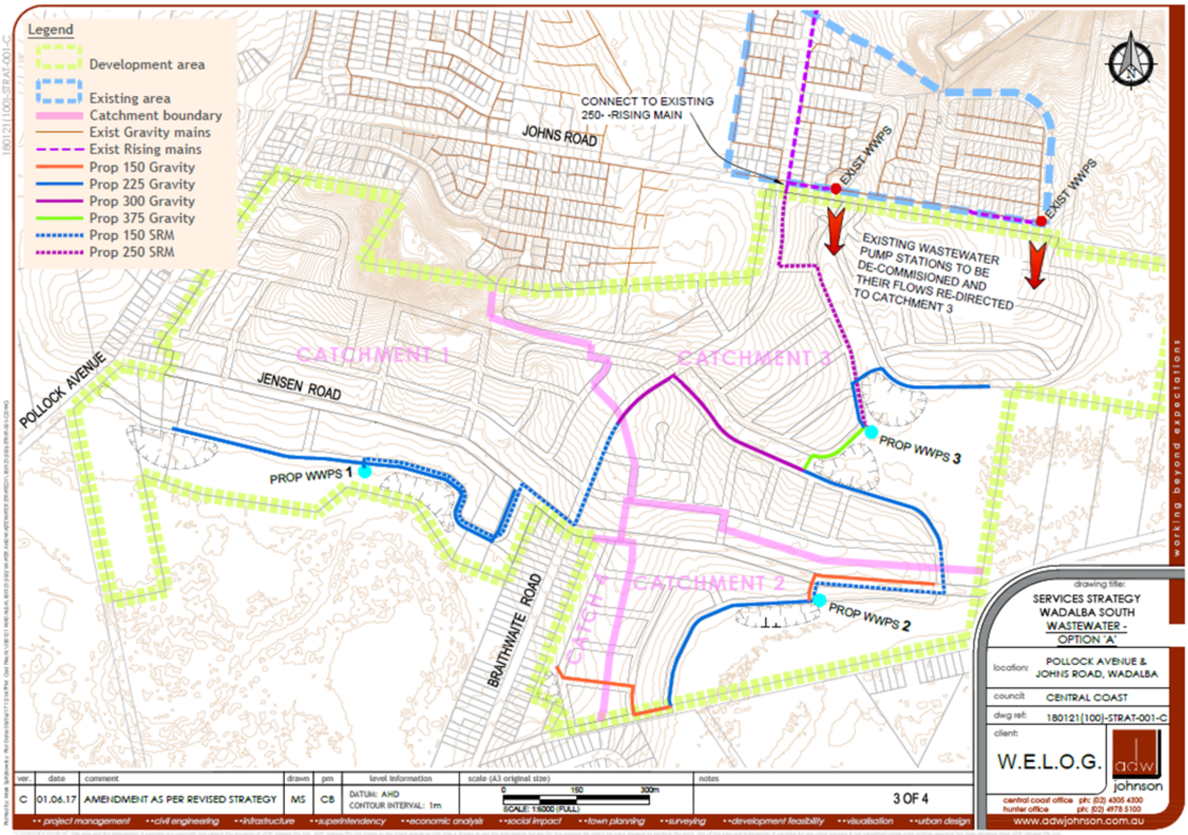


Figure 3 – WELOG Development New Sewer Assets (Preferred Option A)

2. Darkinjung Aboriginal Land Council (DALC) Development Lake Munmorah

Proposed DALC Lake Munmorah development is for a 62Ha development north of the Pacific Highway and intersection of Chain Valley Bay Rd with total lot yield of 544 ET (ADW Johnson, April 2018). While no staging plan has been proposed it was deemed not to be a high priority due to the simplicity of servicing. Detail on preferred water and sewer servicing options is presented in Figures 4 and 5 respectively. Proposal for water is for a secondary spline of the main trunk line to provide some added security of supply. Preferred sewer servicing (Option 2D) is for one regional sewer pumping station discharging directly to Mannering Park STP.

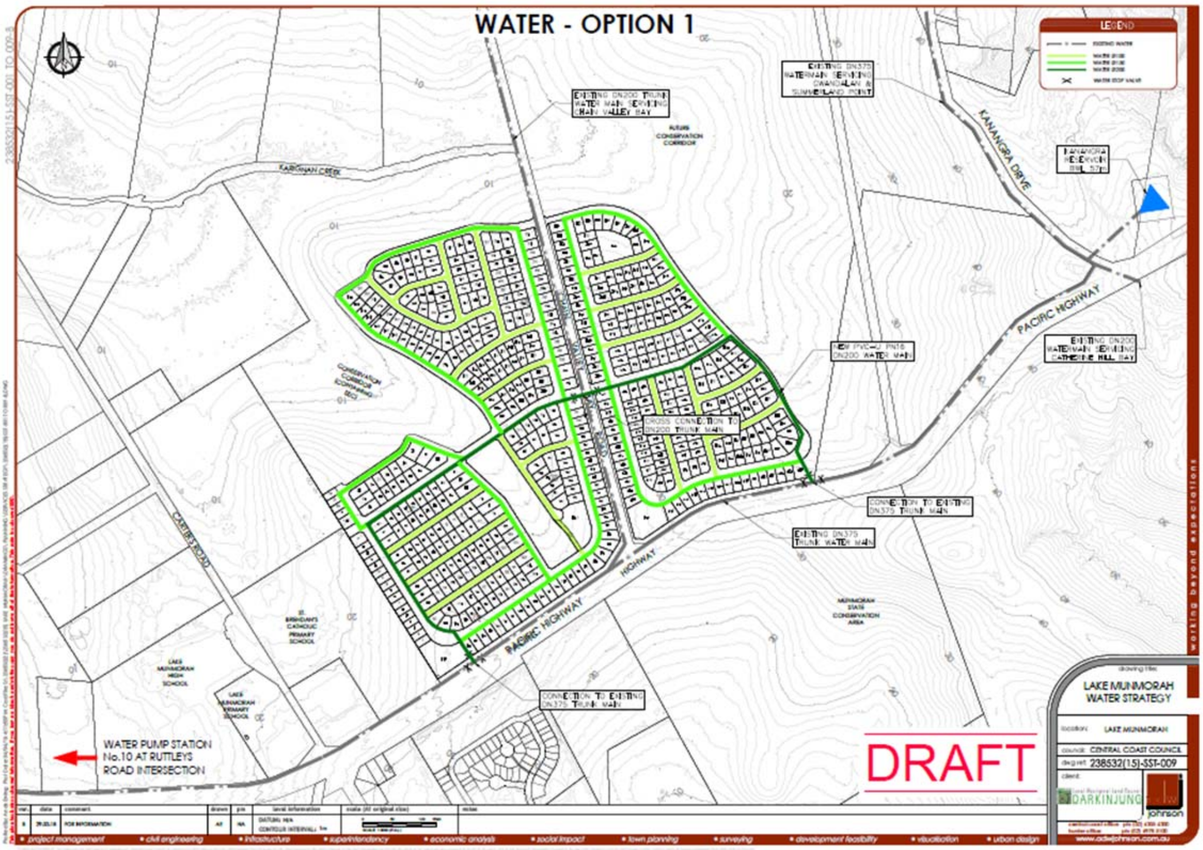


Figure 4 – DALC Lake Munmorah Development New Water Assets (Option 1)

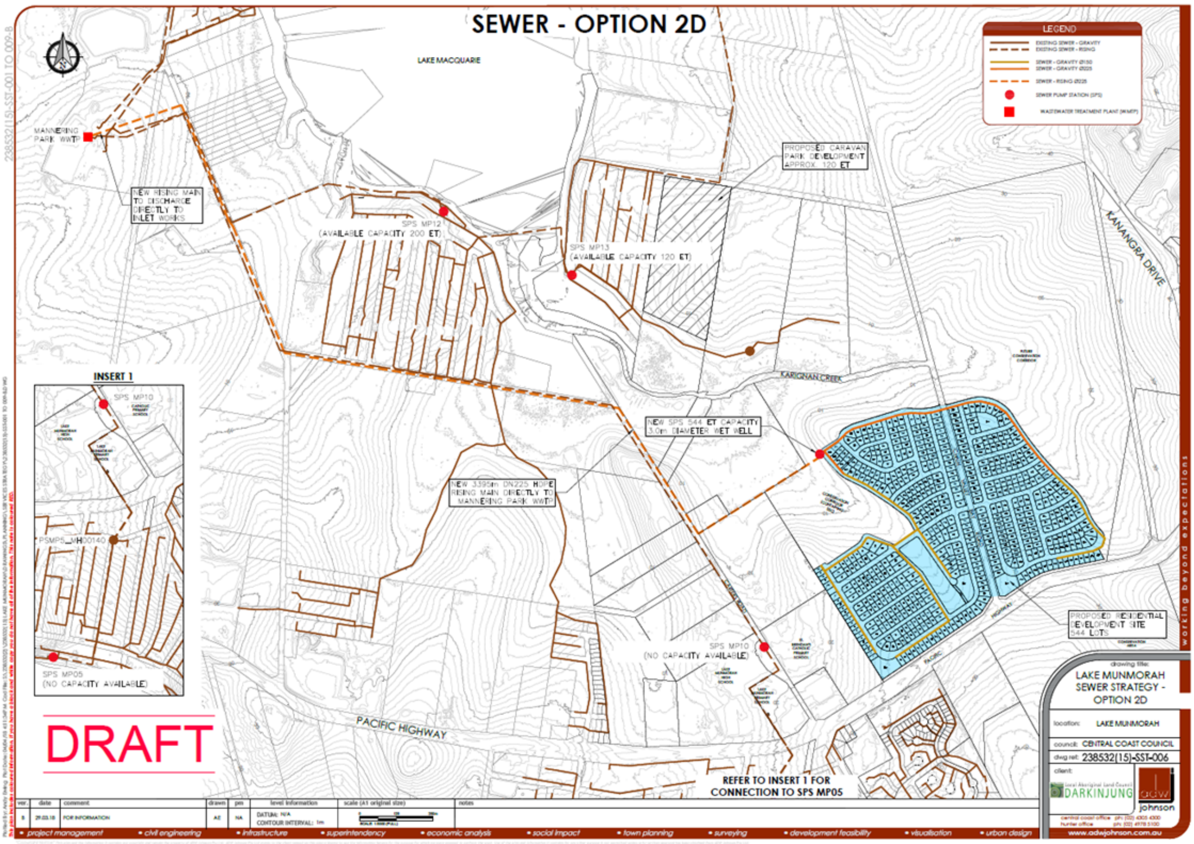


Figure 5 – DALC Lake Munmorah Development New Sewer Assets (Preferred Option 2D)

3. DALC Development Bushells Ridge

Proposed DALC Bushells Ridge development is for a mixed land use development over 3 stages with Stages 1 and 3 comprising industrial and Stage 2 as residential (ADW Johnson, Dec 2017). A summary of lot yield and Staging plan are shown in Table 2 and Figure 6 respectively. Detail on preferred water and sewer servicing options is presented in Figures 7 and 8 respectively. Proposal for water is for a new 3 to 8ML reservoir at Bushells Ridge and ring of trunk water main assets connecting up the three stages including an additional development on Hunter Lands and option to connect four Council owned sites. Preferred sewer servicing (Option 2D) is for two regional pumping stations discharging directly to Charmhaven STP to service Stage 1 and 3. The Stage 2 residential development will be serviced by a gravity network and small pumping station.

Table 2: DALC Bushells Ridge Development Lot Yield

Stage	Contributing ET
1 (Industrial Waste Hub)	1160
2A (Residential)	345
2B	174
2C	375
3 (Wallarah Industrial)	1260
TOTAL	3314

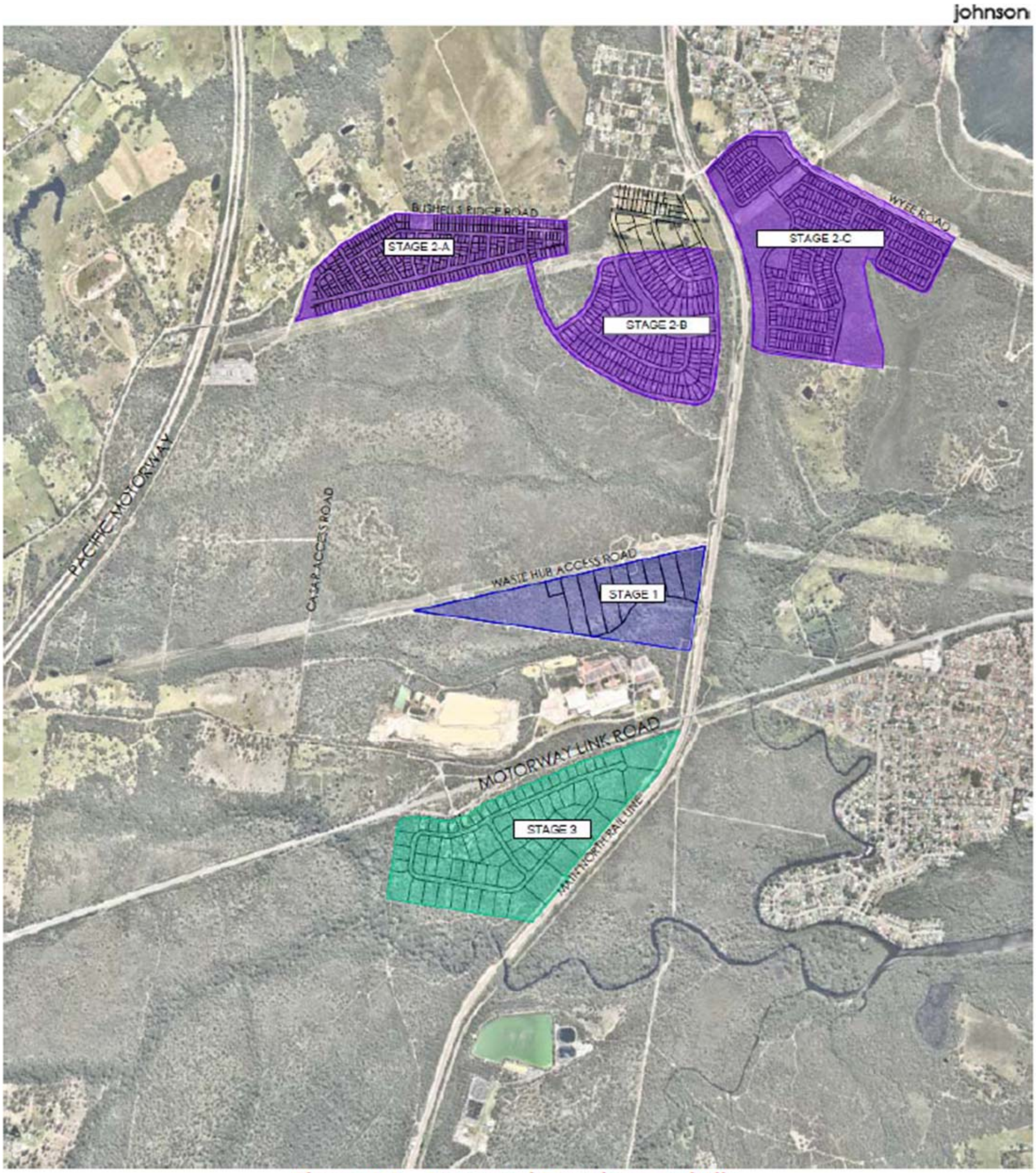


Figure 1.1 – Proposed Development Site

Figure 6 – DALC Bushells Ridge Development Staging Plan

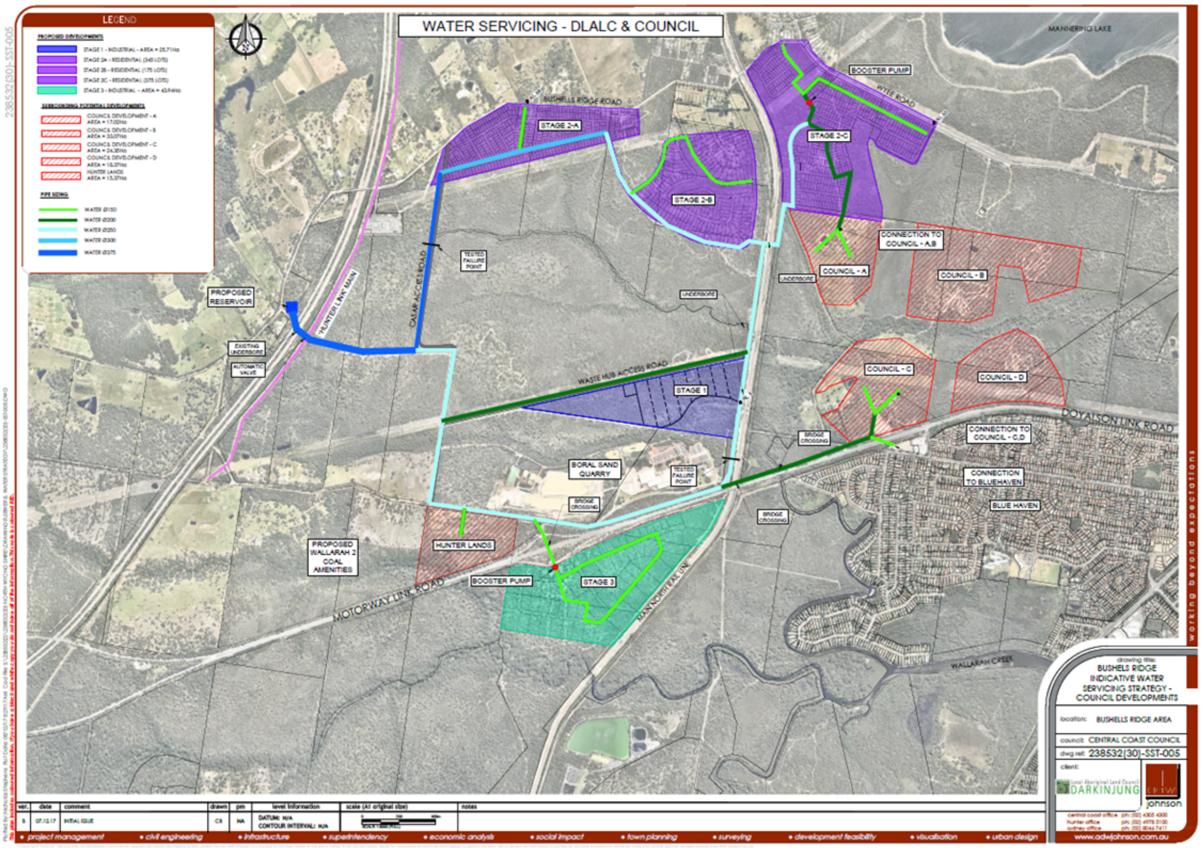


Figure 7 – DALC Bushells Ridge Development New Water Assets

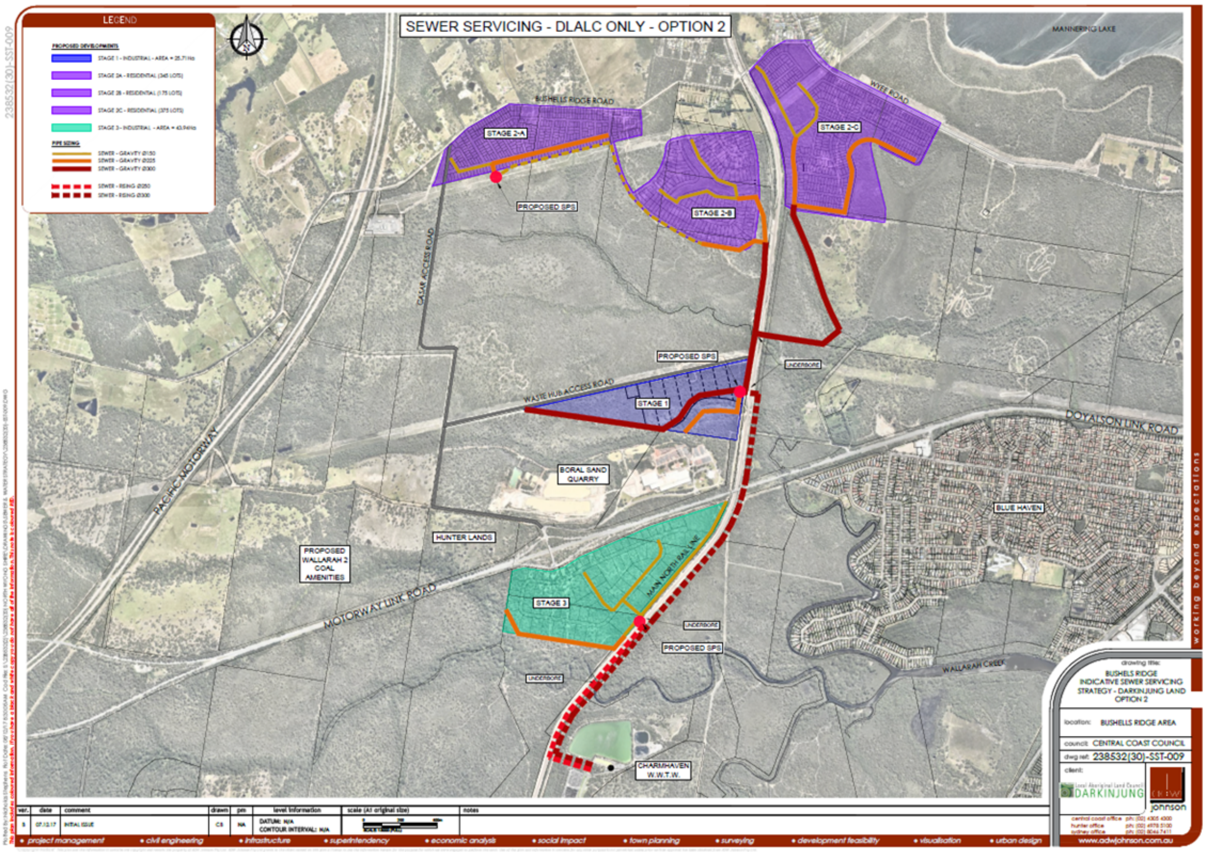


Figure 8 – DALC Bushells Ridge Development New Sewer Assets (Preferred Option 2)

4. Glenning Valley Sewer Pumping Station Concept Design (SPSWS47)

Proposed development at 79 Berkeley Rd, Berkeley Vale comprising of residential land use is estimated to produce an ultimate lot yield of 398 ET subject to further Council approval with current approval for up to 126 ET(ADW Johnson, May 2018). Assumed lot development is shown in Table 3 and corresponding staging plan in Figure 9. Due to the simplicity of servicing for water through developer funded internal reticulation, no DSP funded works for water distribution have been identified. Preferred servicing for sewer is for a new pumping station (SPS WS47) with nominal 30L/s capacity.

Table 3: Berkeley Rd, Berkeley Vale Development Lot Yield

Table 1.7.1 – Assumed lot development over time

Development	Lots	Year
DA 1438/2015 – Stage 1	49	1
DA 1438/2015 - Stage 4	25	2
DA 1438/2015 - Stage 5	52	3
Eastern Residential	23	3
Western Residential	78	4
WBSE Buffer Zone	133	5
Southern Residential	9	6
MB & EEC Area	29	6

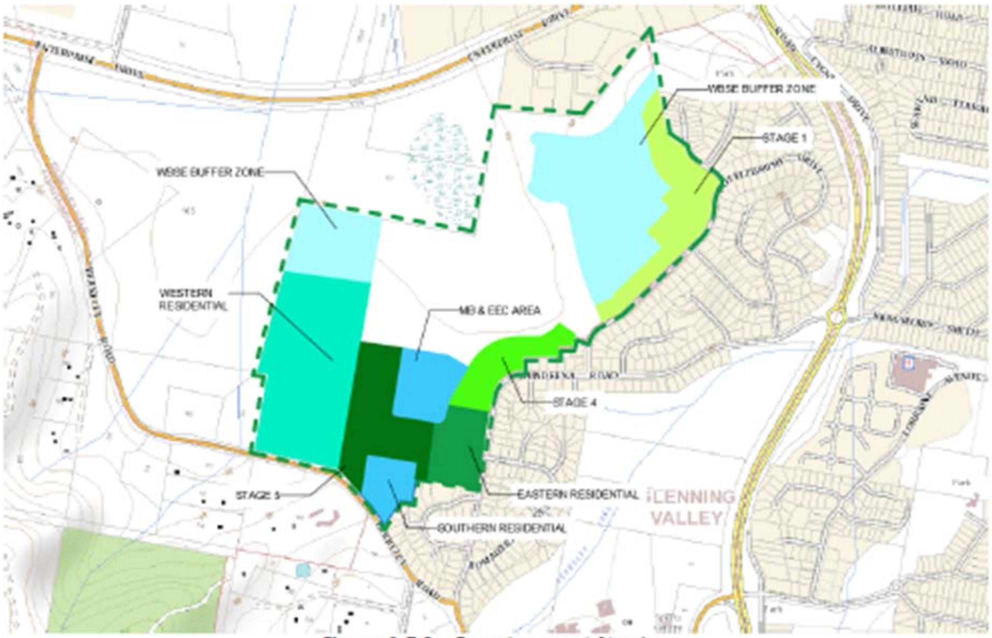
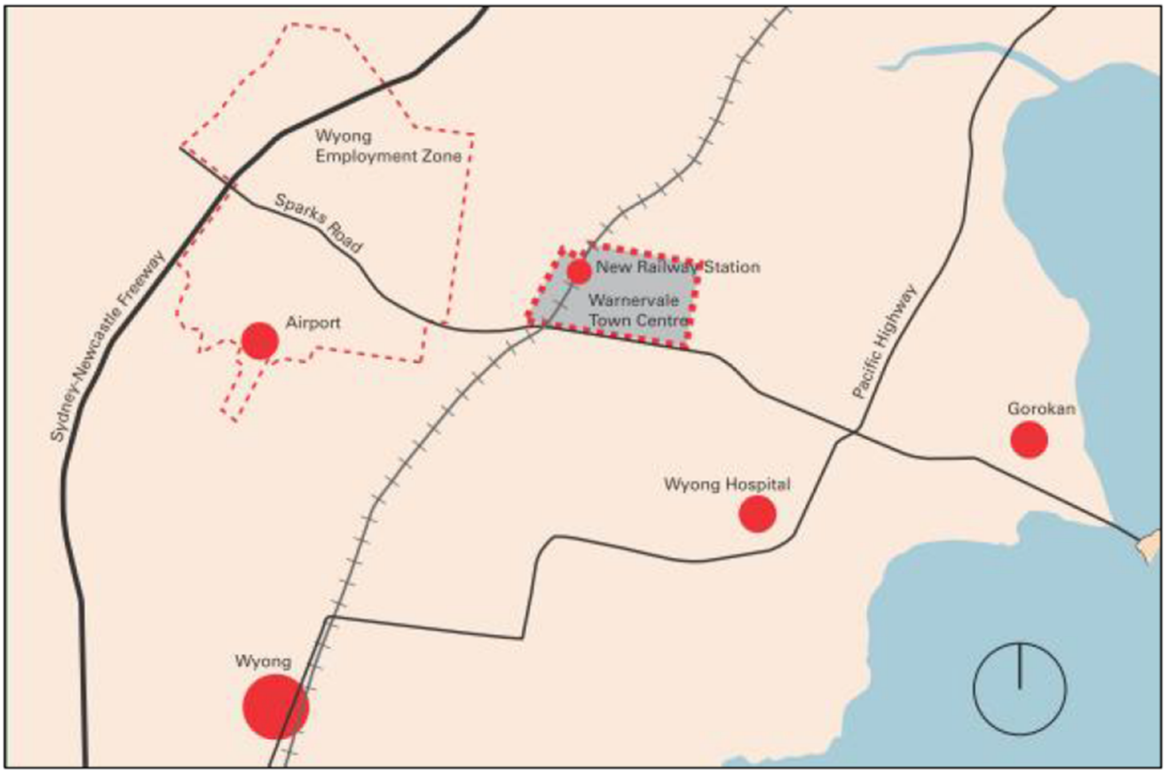


Figure 1.7.2 – Development Staging

Figure 9 – Berkeley Rd, Berkeley Vale Development Staging Plan (Glenning Valley)

5. Greater Warnervale Structural Plan

The Warnervale Town Centre (WTC) is a 119ha development with estimated yield of 6000 ET as residential. In addition to the residential yield it is estimated that an additional 40,000 residents will be serviced through diverse community facilities, retail, and commercial and a public transport hub and adjacent Wyong Employment Zone (WEZ). A locality plan of the WTC and WEZ is shown in Figure 10. Detail on preferred water and sewer servicing options is presented in Figures 11 and 12 respectively. Proposal for water is for a new 9km long Mardi to Warnervale Pipeline. Preferred sewer servicing is for three pumping stations (SPS CH35, CH36, CH37) and network of trunk and gravity sewer mains.



Source: Warnervale Town Centre Development Control Plan 2012, NSW Department of Infrastructure and Planning

Figure 10 – Warnervale Town Centre (WTC) and Wyong Employment Zone (WEZ) Locality

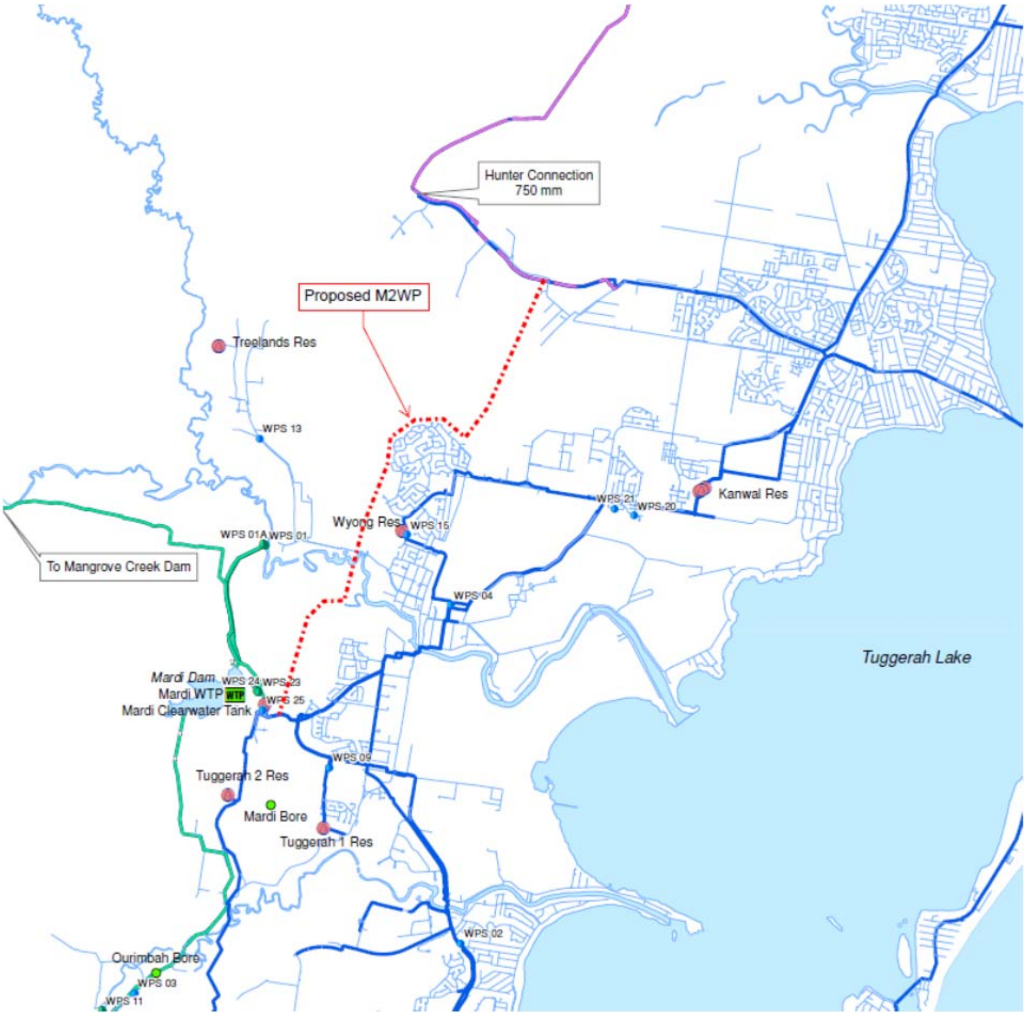


Figure 11 – WTC and WEZ Water Servicing through Mardi to Warnervale Pipeline

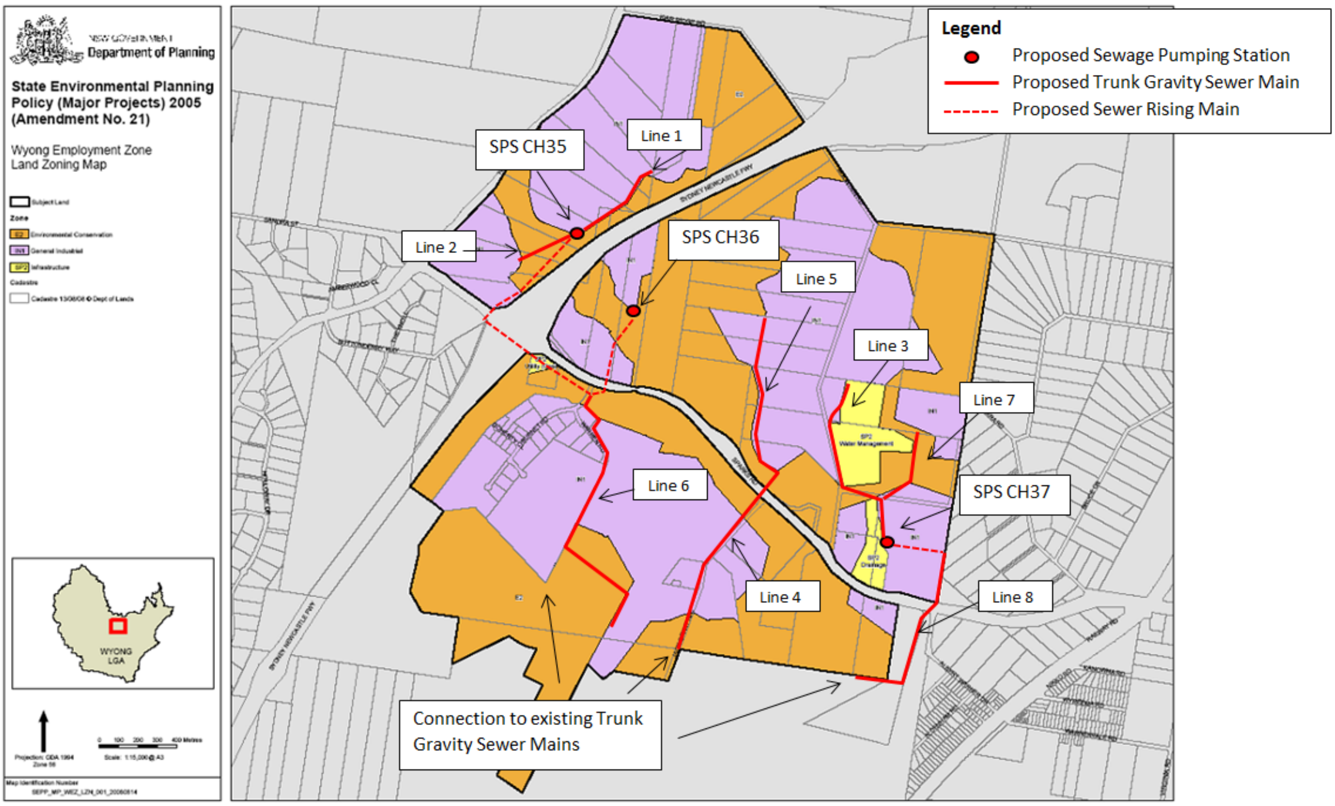


Figure 12 – WTC and WEZ Water Sewer Servicing Strategy

6. Gwandalan Sewer Pumping Station Detailed Design (SPSGW09)

A proposed 54.6ha residential development south of the Gwandalan township is estimated to yield an 600ET (ADW Johnson, October 2018). Staging of the development is according to two sewer pumping station catchment required to service the development with estimated lot yield as shown in Table 4. The site plan and lot layout plan are shown in Figures 13 and 14, respectively. Due to the simplicity of servicing for water through developer funded internal reticulation, no DSP funded works for water distribution have been identified. Preferred servicing for sewer is for a new regional pumping station (SPS GW09) with nominal 46L/s capacity to pump directly to Gwandalan STP and smaller sewer pumping station (SPS GW10) of nominal 21L/s capacity to pick up adjacent catchment.

Table 4: Gwandalan Residential Development Lot Yield

SPS Catchment	Contributing ET	SPS Capacity (L/s)
SPSGW09 (gravity only)	329	(25.0)gravity only
SPSGW10	271	20.7
TOTAL (SPSGW09 total)	600	45.8

gure 1.1 – *Proposed Gwandalan Development Site, as indicated by red boundary*

Figure 13 – Gwandalan Development Locality Plan

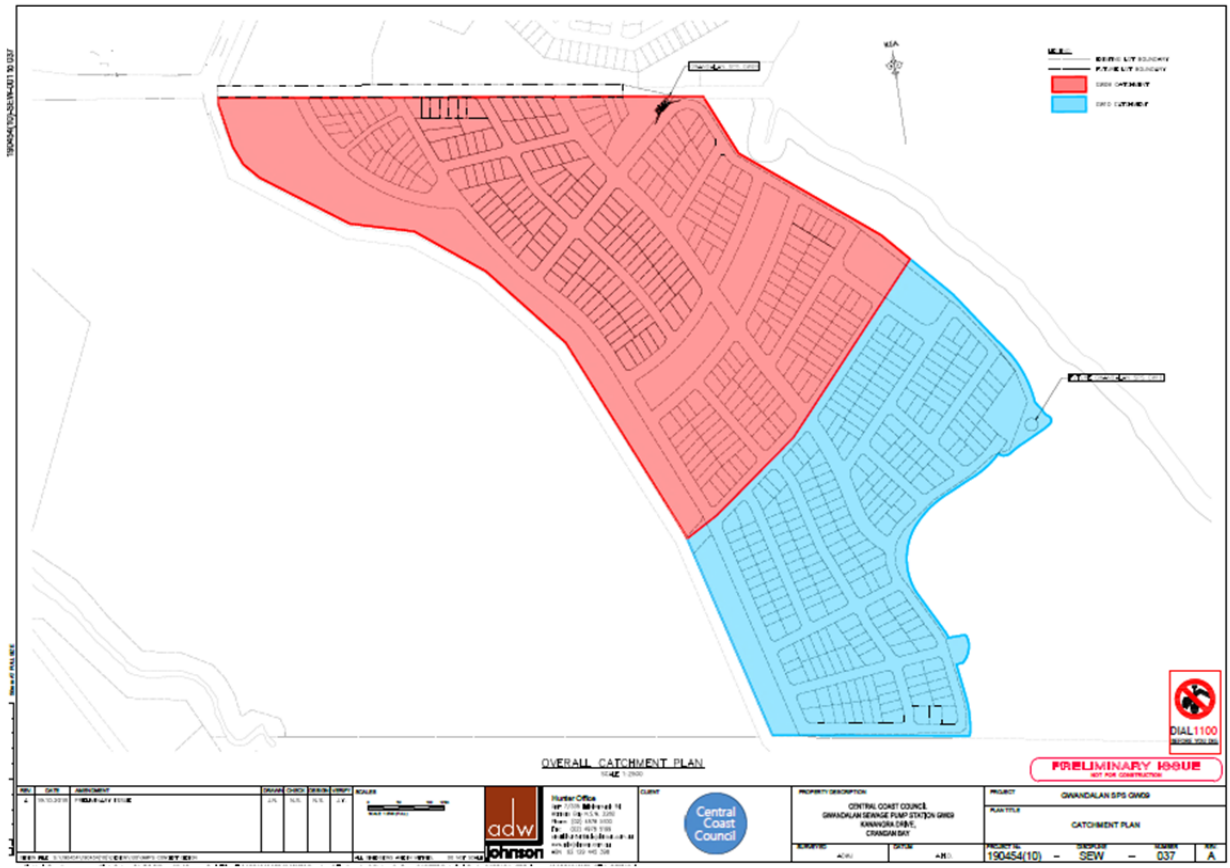


Figure 14: Gwandalan Development Lot Layout Plan (GW09 Catchment = Red; GW10 =Blue)

References:

1. Water and Wastewater Servicing Strategy, Wadalba South Development Area, Wadalba East Land Owners Group (WELOG), ADW Johnson, June 2017, Revision C (TRIM: D12836485)
2. Water and Wastewater Servicing Strategy, Pacific Highway Lake Munmorah, Darkinjung Local Aboriginal Land Council, ADW Johnson, April 2018 (TRIM: D13200523)
3. Water and Wastewater Servicing Strategy, Bushells Ridge, Darkinjung Local Aboriginal Land Council, ADW Johnson, December 2017 (TRIM: D13201953)
4. Sewer Pumping Station Concept Design Package, Glenning Valley WWPS, ADW Johnson, May 2018, Revision A (TRIM: D13267064)
5. Greater Warnervale Structural Plan, Central Coast Council Internal Memo, November 2018, (TRIM: D13593828)
6. Wastewater Pumping Station Detailed Design Package, Gwandalan – GW09, ADW Johnson, October 2018, Revision A (TRIM: D13593851)

Appendix E

Sewerage Capital Works Summary

Sewerage Capital Works Summary
Sewage Treatment Plants

Charmhaven STP

Augmentation of the existing plant (Stage 1) is proposed in two future stages. Stage 2 comprises an aeration upgrade and biosolids handling works to increase the plants biological capacity. Stage 3 will involve the construction of a third tank and new inlet works to resolve hydraulic capacity and biological capacity issues.

Stage	Commissioning Date	Cost	Comments
2	2023	$ 5,075,000	50% of cost attributable to capacity upgrade
3	2030	$ 13,975,000	Construction of third IDEA tank and inlet works.

Details are available within the GHD Capacity Assessment document

Bateau Bay STP

Capital upgrades are currently underway to allow the plant to remain operational up to a design horizon of 2031. A capacity review undertaken by GHD has indicated that future loading on the plant will likely trigger a major augmentation of the plant. As the scope and scale of the future upgrade is not currently known, an allowance for the upgrade is based on the NSW Reference Rates Manual (Department of Industry), using the forecast load on the plant at that time.

Also noting that certain process units may or may not be able to be retained (subject to refurbishment) as part of the future upgrade, this DSP will only recover 50% of the estimated cost of the upgrade.

Commissioning Date	Total Estimated Cost	Comments
2031	$ 16,036,313	50% of cost estimate for 50,000EP plant.

Reference Rate Element Index 2014 values 1.075

Site Works	Preliminary Treatment	Sludge Lagoon (dewatering)	IDEA Tanks	Contingency (30%)
$ 1,350,000	$ 3,700,000	$ -	$ 17,900,000	$ 6,885,000
		No lagoons required and new dewatering plant already operating		

Details are available within the GHD Capacity Assessment document

Sewerage Capital Works Summary
Pumping Stations

Pump Station	STP	Notes	Current Capacity	Required Capacity	M&E	Civil	Year	Capacity (L/s)	M&E Cost	Civil Cost	dour Dosing Ur	Cost
BB01	BB		1050	1300	1		2036	1300	$2,073,023	$0	$0	$2,073,023
BB07	BB		27	63	1		2036	63	$366,734	$0	$0	$366,734
BB11	BB		18	70	1		2020	70	$389,445	$0	$0	$389,445
BB19	BB	New SPS	0	30	1	1	2036	30	$240,198	$446,082	$100,000	$786,280
CH12	CH		260	400	1		2041	400	$1,135,680	$0	$0	$1,135,680
CH13	CH		400	860	1	1	2023	860	$1,614,766	$2,998,852	$0	$4,613,618
CH21 (SPS 2 Darkinjung Wallarah) Stage 1	CH	New SPS	0	47	1	1	2026	47	$310,712	$577,036	$100,000	$987,748
CH21 (SPS 2 Darkinjung Wallarah) Stage 2	CH	New SPS	47	87	1		2031	87	$440,059	$0	$100,000	$540,059
CH27 (WWPS 3 WELOG)	CH	New SPS	0	93	1	1	2026	93	$455,633	$846,175	$100,000	$1,401,808
CH28	CH	New SPS	0	25	1		2036	25	$216,405	$0	$100,000	$316,405
CH28	CH	New SPS	0	50		1	2036	50	$0	$598,728	$0	$598,728
CH30	CH	New SPS	0	250		1	2036	250	$0	$1,506,570	$100,000	$1,606,570
CH30	CH	New SPS	0	170	1		2036	170	$638,190	$0	$0	$638,190
CH30	CH		170	250	1		2036	250	$811,230	$0	$0	$811,230
CH31	CH	New SPS	0	25	1	1	2036	25	$216,405	$401,895	$100,000	$718,300
CH32	CH	New SPS	0	90	1	1	2036	90	$447,846	$831,714	$100,000	$1,379,560
CH33	CH	New SPS	0	35	1	1	2036	35	$261,828	$486,252	$100,000	$848,080
CH35	CH	New SPS	0	20	1	1	2036	20	$192,612	$357,708	$100,000	$650,320
CH36	CH	New SPS	0	5	1	1	2036	10	$149,352	$277,368	$100,000	$526,720
GW09	GW	New SPS	0	46	1	1	2023	46	$306,818	$569,806	$100,000	$976,624
GW10	GW	New SPS	0	15	1	1	2026	15	$170,982	$317,538	$100,000	$588,520
GW11	GW	New SPS	0	50	1	1	2036	50	$322,392	$598,728	$100,000	$1,021,120
MP07	MP		28	50	1		2023	50	$322,392	$0	$0	$322,392
MP07	MP		50	65	1	1	2031	65	$373,223	$693,128	$0	$1,066,350
MP17	MP	New SPS	0	15	1	1	2036	15	$170,982	$317,538	$100,000	$588,520
WS07	WS		84	110	1	1	2020	110	$498,677	$926,114	$0	$1,424,790
WS09	WS		28	95	1	1	2031	95	$460,824	$855,816	$0	$1,316,640
WWPS 1 WELOG	CH	New SPS	0	30	1		2026	30	$240,198	$0	$100,000	$340,198
WWPS 2 WELOG	CH	New SPS	0	13	1	1	2026	13	$162,330	$301,470	$100,000	$563,800
SPS Darkinjung Lake Munmorah (Option 2D)	MP	New SPS	0	40	1		2021	40	$283,458	$0	$100,000	$383,458
SPS 1 Darkinjung Wallarah	CH	New SPS	0	43	1	1	2026	43	$295,138	$548,114	$100,000	$943,252
WS47	WS	New SPS	0	20	1	1	2020	30	$240,198	$446,082	$100,000	$786,280
								TOTAL				**$30,710,442**

Sewerage Capital Works Summary
Sewer Rising Mains

STP	SPS	Dia(mm)	Length(m)	Flow (L/s)	Velocity (m/s)	Precinct	Year	Rate	Cost
BB	BB07	200	1500	63	2.01		2036	459	$688,008
BB	BB11	200	269	70	2.23		2020	459	$123,383
CH	CH12	600	4400	140	0.50		2041	1473	$6,480,320
CH	CH13	600	5700	600	2.12		2023	1473	$8,394,960
CH	CH15	300	2900	140	1.98		2025	586	$1,699,296
CH	CH21 (SPS 2 Darkinjung Wallarah)	375	2500	87	0.79		2026	714	$1,785,770
CH	CH28	200	1300	50	1.59	6	2036	459	$596,274
CH	CH30	375	800	170	1.54	VARIOUS	2036	714	$571,446
CH	CH31	150	700	23	1.30	9	2036	423	$296,033
CH	CH32	250	700	90	1.83		2036	513	$359,363
CH	CH33	150	500	35	1.98		2036	423	$211,452
CH	CH35	150	1700	20	1.13		2036	423	$718,937
CH	CH36	100	700	5	0.64		2036	368	$257,740
CH	WWPS1	150	870	30	1.70		2026	423	$367,926
CH	WWPS2	150	390	13	0.74		2026	423	$164,933
CH	WWPS3	250	590	93	1.89		2026	513	$302,892
GW	GW09	225	1100	46	1.16	20	2023	479	$526,900
GW	GW10	100	550	15	1.91	20	2026	368	$202,510
GW	GW11	200	1200	51	1.62	21	2036	459	$550,406
MP	MP07	200	3650	65	2.07		2031	459	$1,674,153
MP	MP17	100	900	14	1.78	16 - N San Remo	2036	368	$331,380
MP	SPS Darkinjung Lake Munmorah	200	3395	40	1.27		2021	459	$1,557,191
WS	WS07	250	200	55	1.12		2020	513	$102,675
WS	WS09	250	1100	95	1.94		2031	513	$564,714
WS	WS47	225	740	30	0.75	Glenning Valley	2020	479	$354,460
								TOTAL	**$28,195,113**

Sewerage Capital Works Summary

Gravity Mains

					Ground Level					Min Depth 1.35					
STP	**SPS**	**Line**	**Dia(mm)**	**Length(m)**	**Top(m)**	**Bottom(m)**	**Ground Grade**	**Required Grade**	**Comment**	**Depth(m)**	**Depth(m)**	**Precinct/Suburb**	**Year**	**Rate ($/m)**	**Cost**
BB	BB01	1	525	300	8	6	0.67%	0.21%		1.88	1.5-3	Killarney Vale	2020	1091	$327,277
BB	BB04	1	300	750	6	2	0.53%	0.42%		1.65	1.5-3	Killarney Vale	2020	645	$483,657
BB	BB04	2	225	400	6	2	1.00%	0.62%		1.58	1.5-3	Killarney Vale	2022	511	$204,509
BB	BB11	1	225	200	2	2	0.00%	0.62%	Follow existing nearby sewer grade	2.82	1.5-3	The Entrance North	2022	511	$102,254
BB	BB19	1	225	500	22	14	1.60%	0.62%		1.58	1.5-3	Bellevue Road	2036	511	$255,636
CH	CH07	1	225	150	10	10	0.00%	0.62%		2.51	1.5-3	Doyalson	2030	511	$76,691
CH	CH07	2	225	600	10	6	0.67%	0.62%		1.58	1.5-3	Doyalson	2030	511	$306,763
CH	CH12	1a, b, c, d	225	1000	22	8	1.40%	0.62%		1.58	1.5-3	Warnervale TC	2020	511	$511,272
CH	CH12	2	300	1000	20	8	1.20%	0.42%		1.65	1.5-3	Warnervale TC	2020	645	$644,876
CH	CH13	1	300	600	40	18	3.67%	0.42%		1.65	1.5-3	Warnervale TC	2021	645	$386,926
CH	CH13	2a, b, c, d	225	600	30	22	1.33%	0.62%		1.58	1.5-3	Warnervale TC	2021	511	$306,763
CH	CH13	3	225	400	16	14	0.50%	0.62%		2.06	1.5-3	7	2020	511	$204,509
CH	CH13	4a	225	300	8	6	0.67%	0.62%		1.58	1.5-3	7	2020	511	$153,382
CH	CH13	4b	225	200	10	8	1.00%	0.62%		1.58	1.5-3	7	2020	511	$102,254
CH	CH13	4c	225	200	8	8	0.00%	0.62%	existing sewer depth 2.63m	2.82	1.5-3	7	2020	511	$102,254
CH	CH13	5a	225	150	16	10	4.00%	0.62%		1.58	1.5-3	3A- Gorokan	2020	511	$76,691
CH	CH13	5b	225	150	16	12	2.67%	0.62%		1.58	1.5-3	3A- Gorokan	2020	511	$76,691
CH	CH13	5c	225	150	20	14	4.00%	0.62%		1.58	1.5-3	3A- Gorokan	2020	511	$76,691
CH	CH13	5d	225	200	22	14	4.00%	0.62%		1.58	1.5-3	3A- Gorokan	2020	511	$102,254
CH	CH13	5e	225	100	22	20	2.00%	0.62%		1.58	1.5-3	3A- Gorokan	2020	511	$51,127
CH	CH13	6	225	400	20	12	2.00%	0.62%		1.58	1.5-3	2B - Wadalba	2020	511	$204,509
CH	CH15	1	375	550	10	7	0.55%	0.31%		3.50	3-4.5	6	2020	978	$538,098
CH	CH15	2	300	450	10	10	0.00%	0.42%		3.54	3-4.5	6	2020	814	$366,412
CH	CH15	3	225	700	14	10	0.57%	0.62%		1.92	1.5-3	6	2020	511	$357,890
CH	CH15	4	300	1000	10	6	0.40%	0.42%		1.85	1.5-3	6	2020	645	$644,876
CH	CH15	5	225	600	14	10	0.67%	0.62%		1.58	1.5-3	6	2020	511	$306,763
CH	CH15	6	225	850	15	11	0.47%	0.62%		2.85	1.5-3	6	2020	511	$434,581
CH	CH20	1	225	500	24	18	1.20%	0.62%		1.58	1.5-3	5, 6	2020	511	$255,636
CH	CH21	1	600	300	2	2	0.00%	0.17%	New SPS	5.00	> 4.5 m	Doyalson	2026	1688	$506,538
CH	CH21	10	225	1200	24	16	0.67%	0.62%	New SPS	1.58	1.5-3	Doyalson	2026	511	$613,526
CH	CH21	2	450	800	4	2	0.25%	0.25%	New SPS	4.00	3-4.5	Doyalson	2026	1172	$937,542
CH	CH21	3	300	1500	12	2	0.67%	0.42%	New SPS	1.65	1.5-3	Doyalson	2026	645	$967,314
CH	CH21	4	225	1900	10	2	0.42%	0.62%	New SPS	5.36	> 4.5 m	Doyalson	2026	790	$1,501,099
CH	CH21	5	300	700	10	2	1.14%	0.42%	New SPS	1.65	1.5-3	Doyalson	2026	645	$451,413
CH	CH21	6	225	850	14	10	0.47%	0.62%	New SPS	2.85	1.5-3	Doyalson	2026	511	$434,581
CH	CH21	7	225	1100	16	10	0.55%	0.62%	New SPS	2.40	1.5-3	Doyalson	2026	511	$562,399
CH	CH21	8	375	1300	14	12	0.15%	0.31%	New SPS	3.76	3-4.5	Doyalson	2026	978	$1,271,868
CH	CH21	9	225	400	10	4	1.50%	0.62%	New SPS	1.58	1.5-3	Doyalson	2026	511	$204,509
CH	CH28	1	300	1100	18	10	0.73%	0.42%		1.65	1.5-3	6	2027	645	$709,364
CH	CH28	2	225	300	22	14	2.67%	0.62%		1.58	1.5-3	6	2035	511	$153,382
CH	CH28	3	225	300	24	18	2.00%	0.62%		1.58	1.5-3	6	2027	511	$153,382
CH	CH28	4	225	800	30	24	0.75%	0.62%		1.58	1.5-3	6	2031	511	$409,018
CH	CH30	1	600	1000	8	2	0.60%	0.17%		1.95	1.5-3	8	2036	1373	$1,372,860
CH	CH30	10a, b	225	800	22	12	1.25%	0.62%		1.58	1.5-3	6, 8	2036	511	$409,018
CH	CH30	11a, b, c, d	225	1000	32	16	1.60%	0.62%		1.58	1.5-3	6, 8	2036	511	$511,272
CH	CH30	12a, b	225	500	30	24	1.20%	0.62%		1.58	1.5-3	6, 8	2036	511	$255,636
CH	CH30	2	375	1000	20	6	1.40%	0.31%		1.73	1.5-3	8	2036	838	$838,444
CH	CH30	3	300	200	22	20	1.00%	0.42%		1.65	1.5-3	8	2036	645	$128,975
CH	CH30	4	225	550	30	22	1.45%	0.62%		1.58	1.5-3	8 N, 6 ETC	2036	511	$281,200
CH	CH30	5	225	350	32	24	2.29%	0.62%		1.58	1.5-3	6	2036	511	$178,945
CH	CH30	6	375	800	16	6	1.25%	0.31%		1.73	1.5-3	8	2036	838	$670,755
CH	CH30	7	300	800	24	16	1.00%	0.42%		1.65	1.5-3	8	2036	645	$515,901
CH	CH30	8	225	300	22	16	2.00%	0.62%		1.58	1.5-3	8	2036	511	$153,382
CH	CH30	9	225	700	14	4	1.43%	0.62%		1.58	1.5-3	8	2036	511	$357,890
CH	CH31	1	225	600	8	2	1.00%	0.62%		1.58	1.5-3	9	2036	511	$306,763
CH	CH32	1	300	500	6	4	0.40%	0.42%	New SPS	1.75	1.5-3	7	2036	645	$322,438
CH	CH32	2a	225	200	8	8	0.00%	0.62%	New SPS	2.82	1.5-3	7	2036	511	$102,254

CH	CH32	2b	225	200	8	8	0.00%	0.62%	New SPS	2.82	1.5-3	7	2036	511	$102,254
CH	CH32	3	225	200	8	8	0.00%	0.62%	Clearance under rail	4.40	3-4.5	7	2036	647	$129,396
CH	CH33	1	225	450	8	2	1.33%	0.62%		1.58	1.5-3	3B	2036	511	$230,072
CH	CH34	1	225	250	10	8	0.80%	0.62%	New SPS	1.58	1.5-3	9	2021	511	$127,818
CH	CH35	1	225	350	20	18	0.57%	0.62%	New SPS	1.75	1.5-3	9	2036	511	$178,945
GW	GW01	1a	225	350	4	2	0.57%	0.62%		1.75	1.5-3	Gwandalan Rosecorp	2020	511	$178,945
GW	GW02	1a	300	350	14	4	2.86%	0.42%		1.65	1.5-3	Gwandalan	2030	645	$225,707
GW	GW02	2	375	130	4	2	1.54%	0.31%		1.73	1.5-3	Gwandalan	2030	838	$108,998
GW	GW09	1	225	400	14	2	3.00%	0.62%		1.58	1.5-3	20	2023	511	$204,509
GW	GW09	2a	225	200	12	4	4.00%	0.62%		1.58	1.5-3	20	2023	511	$102,254
GW	GW09	2b	225	200	4	2	1.00%	0.62%		1.58	1.5-3	20	2023	511	$102,254
GW	GW10	1	225	200	10	2	4.00%	0.62%		1.58	1.5-3	20	2026	511	$102,254
GW	GW11	1	225	300	2	2	0.00%	0.62%	New SPS	3.44	3-4.5	21	2036	647	$194,094
GW	GW11	2	225	700	18	14	0.57%	0.62%		1.92	1.5-3	21	2036	511	$357,890
MP	MP05	1	450	350	4	2	0.57%	0.25%		1.80	1.5-3	Lake Munmorah	2028	1018	$356,418
MP	MP11	1	225	200	0	0	0.00%	0.62%	sps av depth 4m	2.82	1.5-3	18- Lake Munmorah	2026	511	$102,254
MP	MP12	1	300	950	4	0	0.42%	0.42%		1.65	1.5-3	16 N Lake Munmorah	2026	645	$612,632
MP	MP12	2	225	1000	16	2	1.40%	0.62%		1.58	1.5-3	16 N Lake Munmorah	2026	511	$511,272
MP	MP12	3	225	800	12	2	1.25%	0.62%		1.58	1.5-3	16 N Lake Munmorah	2031	511	$409,018
MP	MP12	4	300	700	12	4	1.14%	0.42%		1.65	1.5-3	16 N Lake Munmorah	2031	645	$451,413
MP	MP13	1	225	300	12	2	3.33%	0.62%		1.58	1.5-3	19	2025	511	$153,382
MP	MP13	2	225	250	18	8	4.00%	0.62%		1.58	1.5-3	19	2035	511	$127,818
MP	MP13	3	225	500	18	10	1.60%	0.62%		1.58	1.5-3	19	2031	511	$255,636
MP	MP13	4	225	300	2	0	0.67%	0.62%		1.58	1.5-3	19	2025	511	$153,382
MP	MP13	5	300	300	2	0	0.67%	0.42%		1.65	1.5-3	19	2031	645	$193,463
TO	TO07	1	225	500	6	4	0.40%	0.62%	Follow existing sewer grade	2.68	1.5-3	Noraville	2020	511	$255,636
WS	WS08	1	300	400	12	8	1.00%	0.42%		1.65	1.5-3	Westfield Gateway	2020	645	$257,950
WS	WS08	2a	225	300	16	12	1.33%	0.62%		1.58	1.5-3	Westfield Gateway	2020	511	$153,382
WS	WS08	2b	225	250	18	8	4.00%	0.62%		1.58	1.5-3	Westfield Gateway	2020	511	$127,818
WS	WS08	3	300	750	4	4	0.00%	0.42%		4.80	> 4.5 m	Westfield Gateway	2020	942	$706,155
WS	WS11	1	450	950	12	4	0.84%	0.25%		1.80	1.5-3	Watanobbi	2040	1018	$967,419
CH	WS16	1	225	600	10	4	1.00%	0.62%		1.58	1.5-3	Wyong	2020	511	$306,763
CH	WS16	2	225	500	10	6	0.80%	0.62%		1.58	1.5-3	Precinct 2A	2020	511	$255,636
WS	WS20	1	225	600	8	2	1.00%	0.62%		1.58	1.5-3	R1 General Res	2022	511	$306,763
WS	WS24	1	300	300	6	6	0.00%	0.42%	Follow existing sewer grade	2.91	1.5-3	Glenning Valley - Bundeena Rd	2020	645	$193,463
WS	WS47	1	225	165	10	6	2.42%	0.62%	Updated from Concept Design (ADWJ, May 2018)	1.58	1.5-3	Glenning Valley - Bundeena Rd	2020	511	$84,360
CH	WWPS1	1	225	883	20	9	1.25%	0.62%		1.58	1.5-3	WELOG	2026	511	$451,453
CH	WWPS2	1	225	437	7	2	1.14%	0.62%		1.58	1.5-3	WELOG	2026	511	$223,426
CH	WWPS3	2	225	740	8	2	0.81%	0.62%		1.58	1.5-3	WELOG	2026	511	$378,341
CH	WWPS3	1a	300	475	20	4	3.37%	0.42%		1.65	1.5-3	WELOG	2026	645	$306,316
CH	WWPS3	1b	375	170	4	2	1.18%	0.31%		1.73	1.5-3	WELOG	2026	838	$142,535
MP	SPS Darkinjung Lake Munmorah	1	225	920	20	10	1.09%	0.62%		1.58	1.5-3	WELOG	2021	511	$470,370
MP	SPS Darkinjung Lake Munmorah	2	225	230	11	10	0.43%	0.62%		2.00	1.5-3	WELOG	2021	511	$117,593
														Total	**$31,903,057**

Appendix F

2014 SKM Sewerage Network Analysis

Northern Region 2019 DSP: Future Capital Upgrade Requirements – Northern Sewer Pumping Stations.

Central Coast Council (CCC) has estimated the costs for upgrading its sewer pumping stations for the assets those required upgrade due to the population growth within its northern servicing area for the preparation of the 2019 northern region DSP. This analysis included the current condition pumping run-time analysis and growth based asset requirements for the future condition.

The Northern Sewer Pumping Stations Runtime Investigation identified the sites requiring upgrades and feed them into the 2018 IPART submission. It identified sites with high Inflow-Infiltration and mechanical-electrical issues. This analysis based on information from SCADA Telemetry systems, and PLC control systems, and provided the data required to develop useful information to ensure current performance of the stations. The main task of this project was to determine the median runtimes for each pumping station using SCADA data from July 2015 to January 2018. Further detail of this analysis is presented as an appendix (Northern Sewer Pump Station Runtime Analysis 2018_final v1.docx)

To determine the future asset requirements for 2019 DSP costings, CCC also used the sewer system planning study (CCC and Jacobs, 2013 investigation) to identify future capital upgrade requirements for the northern sewage pumping stations (SPS) and rising mains to service populations growth within the northern operation areas, for a planning horizon of 30 years from year 2013 to 2043. This study provided a forecast of capital upgrade requirements across Council's northern sewerage network. The identified capital works that were included in this project were used as input data for the recalculation of Council's sewerage developer contributions for the 2019 DSP.

At the initial stage, CCC's current SPS median run-time values were populated into the previous SPS Capacity Assessment spreadsheet prepared by Jacobs.

SPS catchment growths were estimated based on 2013 ET (Equivalent Tenements) to 2031 ET for each pumping station as configured in the sewer network (with upstream SPSs). The main objective of this analysis was to compare the number of sites which the theoretical ET assessment deemed as requiring upgrade, against the outcomes of the runtime analysis which is a better indicator of actual loading vs capacity.

The SPS runtime from 2018 were linearly increased with growth from 2019 run time to forecast 2031 runtime. While doing this analysis, the calendar year whenever the pump run time exceeded 4 hrs were highlighted for the 'civil upgrade year' for the pumping station. Also, the pumping stations with high run-time in 2019 were also marked for upgrade. From the linear interpolation, the pumps those would reach more than 4 hrs runtime after 2031 were not included in 2019 IPART costing.

Mechanical/electrical and rising main upgrades for 2013 and 2031 were also highlighted and checked against the historical and ongoing upgrades and were included in the developer charges calculation as appropriate. The outcome was a reduction in the forecast requirements for sewage pumping station and sewer rising main upgrades compared to the previous theoretical analysis.

Work Package W03- Sewerage System Planning

WASTEWATER CATCHMENT LOAD ASSESSMENTS

- Technical Memorandum
- V2
- 27 March 2014

Sewerage System Planning

WASTEWATER CATCHMENT LOAD ASSESSMENTS

- v2
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Contents

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Name of project:	Sewerage System Planning
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1. Introduction

1.1. Background

SKM has been engaged to undertake a sewer system planning study to identify future capital upgrade requirements for gravity sewer mains, sewage pumping stations (SPS) and sewage rising mains to service populations growth within Wyong Shire Council's area of operations, for a planning horizon of 30 years from year 2013 to 2043.

The study is required to be completed at a high level for the purpose of providing a forecast of capital upgrade requirements across Council's sewerage network. The identified capital works will be used as input data for the recalculation of Council's water and sewerage developer contributions.

Private pumping stations are not included in the DSP charges, and so are not considered in this memo.

1.2. Purpose of this Memo

The purpose of this technical memo is to assess the capacity of the existing sewerage system, identify assets requiring upgrades in future, and outline plans for servicing new development areas.

The scope of this memo is to estimate current and future loading on the SPS and STPs, and calculate the required capacity and locations for new assets. It involves reviewing the current loading estimates, adding projected growth and assessment of the loads against capacity.

1.3. Reference Documents

A number of documents were referenced in a review of current best practice for the estimation of wastewater flow and the population forecast. These are:

1. Sewerage Code of Australia, WSA 02—2002-2.3, Hunter Water Edition, Version 1, December 2009
2. Sewerage Code of Australia, WSA 02—2002-2.2, Sydney Water Edition, Version 3, July 2009
3. Technical Memo- Wastewater Loading Rate Assumptions for Wyong Shire, Version 4, SKM, December 2013

2. SPS and STP Capacity Assessment

2.1. Introduction

Council currently operates six sewage treatment plants (STPs). Schematics defining which SPS are in the catchment of each STP are provided in **Appendix A**. The schematics also show which SPS are upstream of other SPS, and which SPSs pump directly to the STPs. Proposed SPSs have been included on these schematics, as well as proposed diversions of rising mains.

Maps showing the location of existing sewerage assets are provided in **Appendix B**. The sewerage assets have been overlaid on the SPS catchment boundaries, contours, Local Environment Plan (LEP) land zoning and the expected locations of development. The proposed asset upgrades, for inclusion in the capital works program, have also been noted on these maps. The SPS upgrades are based on a capacity assessment. The calculations of this assessment are provided in the spreadsheet in **Appendix C**.

The capital works program for sewerage assets (gravity mains, pumping stations and rising mains) has been included in **Appendix D**.

2.2. Development Areas

Council provided a table of greenfield development sites and the planned number of dwellings in each site. They also provided tables with projections for town centres, infill growth and strategy areas. Id consulting provided GIS files with the location of planned development sites. Council also provided maps with the location, timing and ET load projected for commercially and industrially zoned areas. Using the maps in **Appendix B**, and considering the SPS catchment boundaries in particular, the loads from each development site, town centre, infill area and strategy development area were allocated to a specific SPS catchment.

Where a development precinct is serviced by more than one SPS, the SPS was allocated based on the approximate catchment area based on the existing contours. Some development areas will require a new SPS where draining to an existing SPS by gravity is not feasible. Where new SPS are required it was assumed that these will be standard wet-well stations with submersible-pumps. Alternative approaches, such as low pressure or vacuum sewerage can be considered in future detailed assessment.

It was assumed that any greenfield area not included in the development table or commercial/industrial load maps will not have any development until after the year 2043.

2.3. Asset Capacity Assessment Method

Council has provided data for the existing (mechanical, electrical and rising main) and ultimate (civil) capacity of the existing SPS. Where SPS capacity was provided in terms of flow (L/s) only, the equivalent tenement (ET) load was back-calculated.

The ET loads within each catchment were taken from the 2006 DSPs.

Based on the schematic layouts (**Appendix A),** upstream SPS loads were added to the downstream SPS or STP. The development area was allocated to each SPS. This was done for three time steps, 2013, 2031 and 2043. Negligible commercial development was assumed from 2006-2013.

The commercial/industrial zoned area within each existing SPS catchment was calculated. The area value was multiplied by the ET/Ha rates from the previous Technical Memorandum to estimate the ultimate non-residential wastewater ET potential for the current LEP. Based on examination of developed land area in recent aerial photography it was estimated how much of the non-residential potential is included in the 2006 DSP ET values. It was assumed that the remaining commercial/industrial area within the current SPS catchments will be developed by 2031. Wastewater loads from the greenfield commercial areas were also added. It was assumed that growth in commercial development after 2031 will occur at the same rate as population growth within the SPS catchments with existing commercial land use and the areas.

Based on the assumed growth rates for each social planning district, refer **Table 1**, the 2043 loads were calculated. It was assumed that this growth will predominately occur within the catchments of the SPS that are constructed by 2031.

Table 1. Population Average Annual Growth Rate Assumed for Planning Purposes, 2031-2043

Social Planning District	(% p.a.)	(Additional Population per Annum)
Gorokan SPD	0.61%	133.9
Northern Lakes SPD	2.56%	410.8
Ourimbah - Rural South SPD	0.51%	24.7
Rural West SPD	0.48%	9.7
San Remo - Budgewoi SPD	0.09%	18.4
Southern Lakes SPD	0.13%	33.0
The Entrance SPD	1.10%	367.4
Toukley SPD	0.64%	72.1
Warnervale - Wadalba SPD	3.85%	1487.8
Wyong SPD	0.91%	190.7
Grand Total	**1.35%**	**2748.5**

2.4. STP Capacity Assessment

To assess whether STP upgrades are required at each time-step the estimated future STP load was subtracted from the current / future STP capacity. The results are provided in **Table 2**, which include the proposed diversion of WS16 to the Charmhaven STP catchment. The results indicate that by 2043 only Bateau Bay STP will have significant spare capacity. Council could consider re-diverting the rising main load from WS34 (2122 ET in 2043) to BB01, perhaps via BB04 and BB03, by comparing the cost of the new rising main and additional SPS upgrades to a Wyong South STP capacity upgrade.

- **Table 2. STP Capacity Assessment in ET**

STP	STP Current Capacity (ET)	Planned STP Future Capacity (ET)	STP Load 2013 (ET)	Spare Capacity 2013 (ET)	STP Load 2031 (ET)	Spare Capacity 2031 (ET)	STP Load 2043 (ET)	Spare Capacity 2043 (ET)
Bateau Bay	32,000	32,000	17,613	14,387	21,072	10928	23,207	8793
Charmhaven	16,667	25,000	14,907	1,760	28,498	-11832	32,989	-16322
Gwandalan	5,000	5,000	2,799	2,201	3,895	1105	5,092	-92
Mannering Park	5,000	5,000	4,745	255	5,997	-997	7,839	-2839
Toukley	17,250	17,250	13,992	3,258	15,609	1641	16,605	645
Wyong South	20,000	25,000	15,285	4,715	17,848	2152	19,088	912
Total	**95,917**	**109,250**	**69,341**		**92,920**		**104,821**	

- **Table 3. STP Capacity Assessment in EP**

STP	STP Current Capacity (EP)	Planned STP Future Capacity (EP)	STP Load 2013 (EP)	Spare Capacity 2013 (EP)	STP Load 2031 (EP)	Spare Capacity 2031 (EP)	STP Load 2043 (EP)	Spare Capacity 2043 (EP)
Bateau Bay	76,800	76,800	42,271	34,529	50,573	26227	55,698	21102
Charmhaven	40,000	60,000	35,777	4,223	68,396	-28396	79,174	-39174
Gwandalan	12,000	12,000	6,718	5,282	9,348	2652	12,220	-220
Mannering Park	12,000	12,000	11,388	612	14,393	-2393	18,814	-6814
Toukley	41,400	41,400	33,581	7,819	37,462	3938	39,853	1547
Wyong South	48,000	60,000	36,684	11,316	42,836	5164	45,812	2188
Total	**230,200**	**262,200**	**166,418**		**223,007**		**251,570**	

2.5. SPS Capacity Assessment

To assess whether SPS mechanical/electrical upgrades are required at each time-step the calculated incoming peak wet weather flow (PWWF) was subtracted from the pumping capacity, and a negative value indicates that the SPS over-loaded. **Appendix C** contains the calculations of the SPS capacity assessment.

To assess whether the load on a SPS exceeds its civil capacity, the required wet-well diameter was calculated and compared to the actual diameter. In calculating the required wet-well diameter a maximum permitted pump start frequency of 8 starts per hour and typical operating depth, as detailed in **Table 4**, was assumed, since actual operating depth data was not available. Typical operating depth for a SPS is defined as distance from 200mm below the invert of the incoming sewer to the pump cut-out level.

- **Table 4. Assumed SPS Operating Depths**

SPS ET capacity	Assumed Operating Depth
Greater than 9000*	1.5m
7500 and 9000*	1.4m
5680 and 7500*	1.3m
4240 and 5680	1.2m
2800 and 4240	1. 1m
Less than 2800	1.0m

* Larger diameters stations are expected to provide additional flexibility for capacity upgrades, and so where the results of the assessment suggests that they are just over capacity, we have assumed the upgrade may not be immediately required. This can be re-considered in future detailed analysis.

Note that with this analysis, some SPS are calculated to be already overloaded in 2013, and so any additional development loading triggers an upgrade. Before a station is confirmed to be upgraded, a more detailed assessment should be conducted to review the particular dimensions and capacities of the assets.

Where no development is predicted it is assumed that no upgrade is required.

Where a rising main upgrade is required, and the existing rising main alignment is appropriate, it was assumed that the existing rising main will remain in service to operate in parallel with the new main to amplify the flow capacity. The pressure rating or condition of the existing rising mains was not considered.

For preliminary sizing of the new gravity sewer mains for new development areas, the values in **Table 5** were adopted, which assume an average wastewater generation of 200L/d/ET, and the absolute minimum grades from the Hunter Water version of the Sewerage Code of Australia. This approach is conservative as the same size pipe with a steeper grade (such as to meet the self-cleansing grade or to follow the topography) can accept flow from more ET. The diameters could be revised once more information is available, such as road and lot layouts, and finish surface level plans for the sites.

Table 5. Pipe Diameters and Capacities

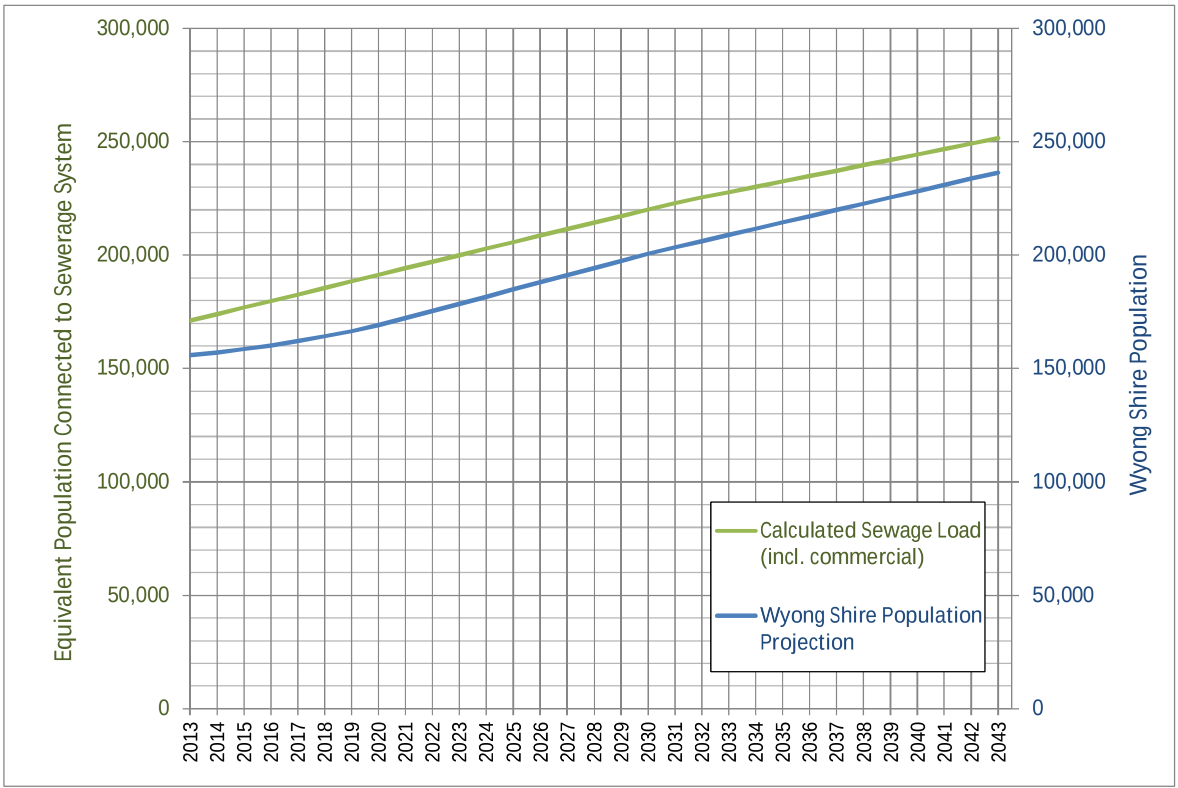
Pipe Diameter (DN)	Minimum Grade (%)	Pipe Capacity (L/s)	Pipe Capacity (ET)
150	0.5	11.7	155
225	0.33	28.1	385
300	0.25	52.4	735
375	0.19	82.4	1170
450	0.15	119	1700
525	0.15	166	2390
600	0.15	236	3400

The values in **Table 5** were also used in assessment of whether the load on the gravity sewers exceed the capacities, and so require upgrading.

2.6. Check for consistency against shire-wide population projection

Figure 1 shows the shire-wide population projection and the estimated wastewater load. The difference in the values is mostly due to commercial wastewater generation. The two sets of data values are considered consistent.

Figure 1. Calculated Load on the Sewerage System and Population Projection 2013 to 2043



2.7. Capital Works Programme

The assets to be upgraded and constructed between 2013 and 2043 and the capital costs are detailed in Appendix D.

Asset upgrades include:

- SPS- civil and/or mechanical/electrical components
- Rising mains, including diversions
- Gravity sewers of diameter DN225, and greater diameters

For cost estimating purposes it was assumed that the gravity sewer mains will be laid at the grades in **Table 6**, or at a greater slope where the ground profile allows. These grades were used in calculating the depth at which the gravity mains will be laid. It was also assumed that the minimum depth of cover for a gravity sewer will be 1.2m. An allowance of 0.15m for pipe bedding below the invert level was made.

The grades in **Table 6** were selected so that an average fluid velocity of at least 0.7m/s is achieved within the sewer main at peak dry weather flow (PDWF) for the ultimate development condition, so that the main is self-cleansing. This corresponds to a fluid velocity of at least 0.88m/s at peak wet weather flow (PWWF), with the sewer flowing full.

- **Table 6. Assumed Sewer Grades for Cost Estimation**

Pipe Diameter (DN)	Grade (%)	Grade (1 in)
150	1.10	91
225	0.62	161
300	0.42	238
375	0.31	322
450	0.25	400
525	0.21	476
600	0.17	588

It has been assumed that rising mains will be laid in a 1.5m-3.0m depth range. No detailed assessment has been made.

Council provided the following unit rates for cost estimation (**Table 6**, **Table 7** and **Figure 2**) which were used for cost estimation. They advise that these include factors for council requirements and client costs.

- **Table 6. Gravity Sewer Main Unit Rates**

	Rate per metre		
Diameter (DN)	**1.5-3m Depth**	**3-4.5m Depth**	**> 4.5 m Depth**
225	$463	$571	$684
300	$571	$704	$807
375	$725	$837	$950
450	$868	$991	$1,094
500	$1,010	$1,145	$1,256
600	$1,299	$1,299	$1,401
750	$1,452	$1,565	$1,678

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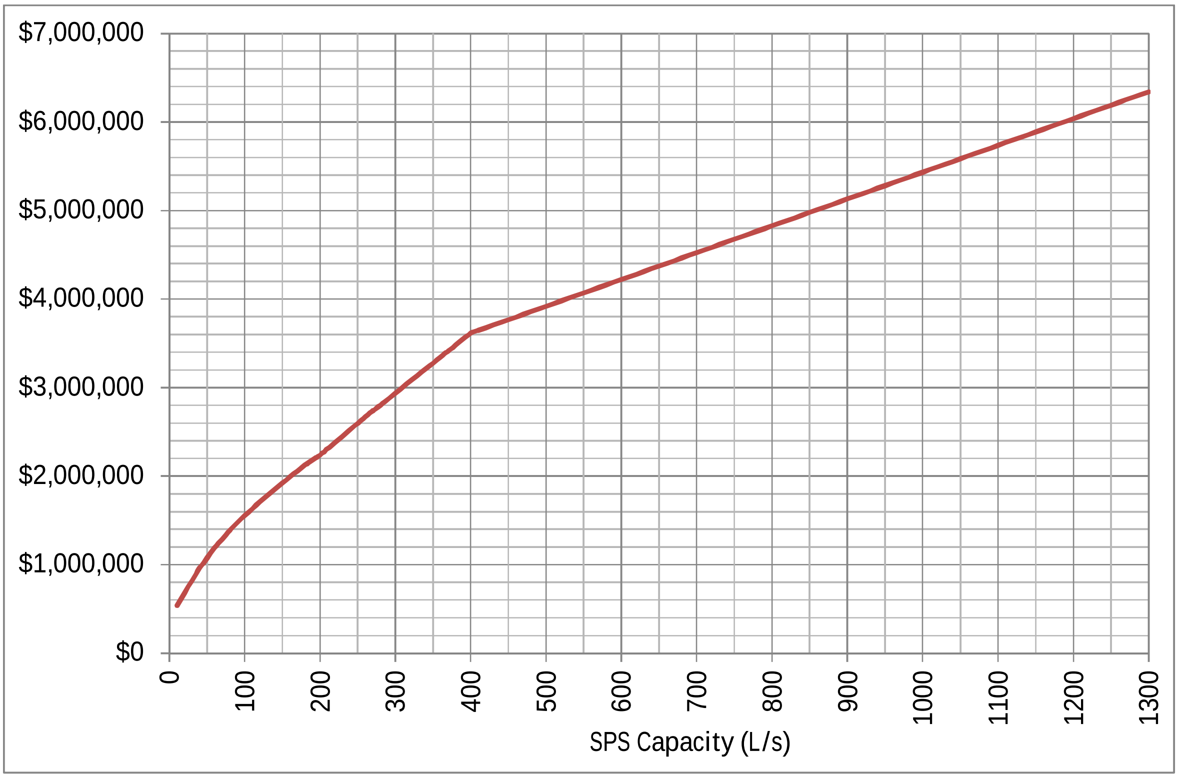
Table 7. Rising Main Unit Rates

Diameter (DN)	Rate per metre
100	$280
150	$321
200	$444
250	$491
300	$542
375	$660
450	$772

Figure 2. SPS Unit Rates



The SPS unit rates in **Figure 2** are for submersible type pumping stations with low pumping heads (up to 50m).

Council's advice that the SPS unit rate breakdown is 60% mechanical/electrical and 40% civil works has been adopted. This breakdown has been applied where estimating the cost of upgrade to part of an existing asset.

It was assumed that where an SPS upgrade is required there is no residual value in the existing asset component, that is, full replacement will be undertaken. This is considered valid since the upgrades will often be timed for when the existing equipment is due for replacement due to wear and tear, and that the existing equipment often does not meet current standards and requirements.

Appendix A Network Layout

Appendix B Sewerage Plans

Appendix C SPS Capacity Assessment Spreadsheet

Appendix D Capital Works Program

Work Package W03- Sewerage System Planning

WASTEWATER LOADING RATE ASSUMPTIONS FOR WYONG SHIRE

- Technical Memorandum
- Final
- 8 April 2014

Sewerage System Planning

WASTEWATER LOADING RATES

- Final
- 8 April 2014

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1. Introduction

1.1. Background

SKM has been engaged to undertake a sewer catchment study to identify future capital upgrade requirements for gravity sewer mains, sewage pumping stations (civil, mechanical and electrical), sewage rising mains and sewage treatment plant upgrades to service populations growth within Wyong Shire Council's area of operations, for a planning horizon of 30 years from year 2013 to 2043.

The study is required to be completed at a high level for the purpose of providing a suitable forecast of capital upgrade requirements across Council's sewerage network. The identified capital works will be used as input data for the recalculation of Council's water and sewerage developer contributions.

1.2. Purpose of this Memo

The purpose of this technical memo is to recommend and document the wastewater generation rates to be used when undertaking sewerage system planning, for the sake of developing a capital works program for future augmentations and system extensions. The sewerage system planning will involve assessing the capacity of the existing sewerage system, planning for capacity upgrades to the existing system, and planning for servicing of new development areas, all of which involve the estimation of future wastewater flows.

This document provides Council with the opportunity to review and comment on the assumptions and method to be used for estimation of wastewater flows.

1.3. Scope

The scope of this memo is to review the current practice for the estimation of average dry weather flow for existing tenements and new (water efficient) development as part of sewerage system planning.

The scope is also to review Council's existing land use Equivalent Tenement wastewater generation rates table and suggest amendments for the purpose of estimating current and future connection loads, which will be undertaken as part of the current project.

This memo also details the population projection that will be used in checking the calculated residential equivalent population (EP).

1.4. Reference Documents

A number of documents were referenced in a review of current best practice for the estimation of wastewater flow and the population forecast. These are:

1. Developer Charges Guidelines for Water Supply, Sewerage and Stormwater, 2012 – Consultation Draft, NSW Office of Water, August 2012

2. Sewerage Code of Australia, WSA 02—2002-2.3, Hunter Water Edition, Version 1, December 2009

3. Sewerage Code of Australia, WSA 02—2002-2.2, Sydney Water Edition, Version 3, July 2009

4. Gosford City Council Gosford Master Planning Project, Technical Memorandum for TM04-Population Forecast, October 2011.

2. Review of Wastewater Generation Rates Used by Local Water Utilities

For planning purposes local water utilities in NSW typically adopt a method for wastewater flow estimation which is based on Equivalent Tenements (ET) or Equivalent Population (EP). Historically Wyong Shire Council has used this approach for wastewater flow estimation, with one ET counted for each general residential lot. An ET value is estimated for non-residential development based on the estimated average daily wastewater flow (ADWF). The total number of sewerage ETs is the sum of the residential ETs and the non-residential ETs.

The ET method makes an allowance for sanitary flow, measured as ADWF for each ET, applies a peaking factor (r) to give peak flow and adds a storm allowance (SA) to estimate the peak wet weather flow (PWWF). This provides an approach for estimating wastewater flows without requiring the use of calibrated computer models and/or sewer flow gauging. The calculated ADWF and PWWF values are then available for use in assessing the capacity of existing infrastructure and for the design of new infrastructure.

The objective of wastewater flow estimation is to construct sewerage infrastructure which is appropriately sized for the catchment area and number of properties it is to service. Different water utilities use slightly different input values to these calculations. Local water utilities adjust their assumptions based on various factors which include:

- The size of the catchment area to be serviced.
- The number of properties to be serviced.
- The type of development and land use.
- The rate of wastewater generation for the different development types and land uses within the area, which is related to the water consumption and types of usage.
- The expected performance of the sewerage system in preventing stormwater and groundwater from entering the sewerage system
- The expected amount of rainfall.
- Calibration of assumptions based on gauging of wastewater flows in existing systems.

There has been a trend of increasing water efficiency in households and industry. This has been due to a number of factors, including the introduction of pricing tariffs which are based on the volume of water consumed; increased use of more water efficient appliances; and BASIX requirements which apply to new residential properties and significant renovations. In response to these factors, the wastewater generation rates applied by utilities have been reduced over time.

Another trend is that modern sewerage networks are constructed using longer lengths of flexible pipe with flexible joints (such as PVC), which have a lower level of groundwater infiltration compared with older vitreous clay pipes, which are shorter, have more joints and are brittle, and so more prone to cracking due to ground movement or tree roots.

Table 1 contains the wastewater generation rates for a typical residential dwelling which are currently used by Wyong Shire Council, Hunter Water and Sydney Water for high-level sewerage system planning purposes. These are local, independent water utilities. Sydney Water currently adopts a lower wastewater generation rate than Wyong Shire Council, and Hunter Water a slightly higher rate.

The potable water supply target under BASIX is 150L/person/d, which is typically achieved by supplying non-potable water usage (such as toilet flushing, washing machines, garden watering and car washing) from a rainwater tank, and installing water efficient fittings and appliances. The wastewater contribution from a BASIX compliant property is approximately 200L/EP/d, which is greater than the 150L/EP/d potable water consumption target due to the non-potable uses that discharge to the sewerage system. It should be noted that the biological and suspended solids load (which is the load on a wastewater treatment plant) from a house is not covered by BASIX requirements. Also to note is that the water efficiency of a dwelling could decline over time if less water efficient appliances are installed in the home.

Also in **Table 1** is the wastewater generation rate recommended by NSW Office of Water, which is based on metered ADWFs of 200L/EP/d at sewage treatment works in non-metropolitan NSW. This represents a mix of pre- and post-BASIX dwellings.

Also in **Table 1** are the assumed occupancy rates (EP/ET) used by the local utilities. Wyong Shire Council assumes a lower EP/ET than other utilities, and it is recommended that this is not reduced further as it already provides efficiently sized assets. For comparison, the id population forecast average people per dwelling for planning districts is provided in **Table 2.** The overall average of 2.32 people per dwelling within Wyong Shire is within 5% of the currently adopted EP/ET value of 2.4.

Based on this review of the current practice for the estimation of ADWF, a value of 200L/EP/d and 0.0056L/s/ET is recommended for the purposes of sewerage system planning for forecasting capital upgrade requirements for greenfield development sites. It is recommended that this value is only applicable to new (water efficient) development. It is based on a wastewater generation rate of 200L/EP/d, as per the NSW Office of Water recommendation. This is a lower rate than currently used by Council, and the rationale for the change is to take into account the increased water efficiency. A range of PWWF values are recommended, between 0.069L/s/ET and 0.080L/s/ET, depending on the attenuation based on the size of the catchment, which will be used for sizing new sewer mains.

For existing development it is recommended to continue to assume 240L/EP/d, and 0.0067L/s/ET for the purposes of sewerage system planning, as was used for the previous DSPs. This is due to the majority of properties within Wyong Shire being constructed prior to BASIX being implemented in 2004, and so it is expected that they will on average have lower water efficiency.

Presented in the right hand column of **Table 1** are the input values that were used to calculate these recommended values. The EP/ET rate and storm allowance are the same as currently used by Council. The range of the resulting PWWF values is slightly lower than the existing range used by Wyong Shire Council, and is at the lower end of the range used by Hunter Water and towards the upper end of the range used by Sydney Water.

Table 1. Wastewater Generation Rates

Assumption	Wyong Shire Council (current)	NSW Office of Water recommendation	Hunter Water	Sydney Water	Suggested for use in system planning for development sites
WW Generation (L/EP/d)	240	200	270	180	200
Occupancy (EP/ET)	2.4	2.6	3.5	3.5	2.4
ADWF (L/ET/d)	576	520	945	630	480
ADWF (L/s/ET)	0.0067	0.0060	0.0109	0.0073	0.0056
r ** (smallest catchment)	4.0	4.0	4.0	4.0	4.0
r ** (largest catchment)	1.9	1.9	1.9	1.9	1.9
PDWF (small catchment) (L/s/ET)	0.027	0.024	0.044	0.029	0.022
PDWF (large catchment) (L/s/ET)	0.013	0.011	0.021	0.014	0.011
SA (small catchment) (L/s/ET)	0.058	0.058	0.058	0.058*	0.058
SA (large catchment) (L/s/ET)	0.058	0.058	0.058	0.028*	0.058
PWWF (small catchment) (L/s/ET)	0.085	0.082	0.102	0.088	0.080
PWWF (large catchment) (L/s/ET)	0.071	0.069	0.079	0.042	0.069

* As Sydney Water does not use a method with fixed storm allowance, the SA values were calculated based on PWWF = 3 x PDWF.

** The actual “r” value to be used will be a function of the number of ET in the catchment

- **Table 2. Residential Population Per Dwelling (2013), from the id Population Projection**

Social Planning District	People Per Dwelling
Gorokan SPD	2.33
Northern Lakes SPD	2.17
Ourimbah - Rural South SPD	2.75
Rural West SPD	2.43
San Remo - Budgewoi SPD	2.39
Southern Lakes SPD	2.61
The Entrance SPD	1.86
Toukley SPD	1.95
Warnervale - Wadalba SPD	3.01
Wyong SPD	2.52
Overall for Wyong Shire	**2.32**

3. Proposed Calculation Methodology

3.1. Proposed Methodology

The proposed method for estimating existing loadings (current year 2013) on each SPS and treatment plant is to use the ET load estimates for the year 2006 from the 2006 DSPs, and add the increase in load due to greenfield development sites, infill growth and town centre developments that has occurred since 2006, together with an allowance for new commercial development. The same method will be used for projecting the wastewater loads for the period 2013- 2031. That is:

2043 ET Load on SPS = Year 2006 load from 2006 DSP **+** Greenfield Development Sites, Infill, Town Centre and Strategy Area growth, from 2012 development assumptions table **+** Commercial allowance where not already included **+** Allowance for population growth 2031-2043

The expected additional dwellings in specific greenfield residential development sites has been provided by Council for the period 2007-2031, and so this can be used directly. The expected additional dwellings due to infill growth and town centre developments has been provided by Council for the period 2010-2031, and so will be projected back for the period 2007-2010.

For projecting the potential commercial wastewater load a method based on land zoning and typical wastewater loading rates, in ET/Ha, will be used. The land zoning categories to be used will be based on the draft 2013 Local Environment Plan (LEP). The area of commercial land zonings will be multiplied by typical commercial loading rates, to give an estimate of the potential ultimate load. Council also advised the timing and infrastructure sizing for greenfield commercial development sites, and these are to be added to the wastewater load projections.

As the forecast data beyond 2031 is not available, Social Planning District (SPD) wide growth rates will be projected from the id forecast data, giving a prediction of the lots per year to be serviced beyond 2031. For projecting the residential wastewater load for the period 2031-2043, where the annual growth rate for an area is relatively modest (say, less than 1.5%), a method based on applying the annual growth rate across each catchment will be used.

For those catchments where the growth rate is high, this is due to development of greenfield sites which have not reached their potential land usage, and so the growth will be allocated to these based on wastewater load density for the growth sites. The 2031 ET estimate for the greenfield sites will be divided by the area of residential land zoning. Those with lowest (less than 10 ET/Ha for low density, less than 15 ET/Ha for general residential and less than 20ET/Ha for medium density residential) will be flagged as having potential to accept more growth. The projected population for 2031-2043 will then be allocated to those areas.

An example trial case to test this loading calculation method is provided in **Appendix A.** The development assumptions data is provided in **Appendix B**.

3.2. Wastewater Loading Rates

Part of this project's scope is to review Council's existing wastewater generation rates table and suggest amendments for the purpose of estimating current and future wastewater loads. Council's existing wastewater contribution table consists of many factors which require detailed inputs (for example number of beds per hotel, basins per hairdresser or the floor area of an office). These type of factors are suitable when this information is available, such as when calculating the wastewater load from a specific development proposal or trade waste application which is to be serviced by a particular diameter of pipe at a certain grade, but are of limited use when seeking to undertake a high level assessment of the whole shire.

For this study wastewater flow estimates only need to have enough detail to estimate future capital expenditure requirements. For this reason it is proposed to use wastewater contribution factors based on land zoning to estimate wastewater loads for the period 2031-2043. The proposed rates are presented in **Sections 3.2.1** and **3.2.2**. Development is expected to change over time, and so flow estimates based on land use zoning rather than existing specific developments is appropriate, particularly for long-term estimates.

Council's existing detailed contribution factors can be applied for future detailed planning, once the specific details of a development proposal are known and a design for the assets are required.

With this proposed method the calculated wastewater load estimates can be adjusted where more detailed information is available, particularly for large commercial and industrial sites, which are often unique, and so not well represented by general loading rates based on land zoning.

3.2.1. Residential Loading Rates

The proposed residential wastewater loading rates are listed in **Table 3**.

Based on Reference 2, a typical wastewater loading rate for low density zoning is 10ET/Ha and for medium density zoning is 25ET/Ha. These values were set as target loading rates, and then adjusted so that the resulting population matches the id forecast population projection. The medium density and general residential zoning loading rates were adjusted within a range of 15 to 25 ET/Ha. The people per dwelling rates in **Table 2** were used to convert the population to an ET value for each SPD.

- **Table 3. 2013 Population Estimates for Social Planning Districts and Corresponding Residential Wastewater Loading Estimates**

		Residential Area with Sewer Connections (Ha)			Wastewater Loading Rate (ET/Ha)			Residential Wastewater Loading (ET)		
SPD	Id 2013 populat-ion	Medium Density Zoning	General Zoning	Low Density and Enviro Living Zonings	Medium Density Zoning	General Zoning	Low Density and Enviro Living Zonings	Medium Density Zoning	General Zoning	Low Density and Enviro Living Zonings
Gorokan	19822	0.0	241.3	460.0	-	15	10.6	0	3620	4879
Northern Lakes	15489	0.0	80.2	415.4	-	20	13.4	0	1603	5546
Ourimbah - Rural South	4681	0.0	68.7	32.8	-	20	10.0	0	1374	328
San Remo - Budgewoi	20689	0.0	165.4	513.2	-	20	10.4	0	3309	5348
Southern Lakes	25857	0.0	67.4	664.2	-	20	12.9	0	1347	8562
The Entrance	26601	119.7	369.0	374.4	20	20	12.0	2394	7381	4502
Toukley	9348	38.7	80.5	214.3	20	20	11.2	774	1610	2410
Warnervale - Wadalda	15441	0.0	16.6	477.7	-	20	10.0	0	333	4797
Wyong	15815	30.7	149.9	355.5	20	15	9.6	615	2248	3422
Wyong Shire	**153744**	**189.1**	**1239.1**	**3507.4**	20	18.4	11.3	3783	22825	39754

3.2.2. Wastewater Loading for Non-Residential 2013 LEP Land Zonings

Unlike the growth in residential population, no annual projection for commercial and industrial type wastewater loading is available. For planning purposes, representative wastewater loading rates (ET/Ha) values will be assumed. The "general industrial" loading is based on the rate in Reference 2 for multi-purpose industrial land zoning, and the other are assumed to have similar wastewater loadings as for low density residential. These are presented in **Table 4**.

- **Table 4. Trial ET for Non-residential 2013 LEP Land Zonings**

Land Zoning (2013 LEP Categories)	Assumed Wastewater Loading Rate (ET per Gross Area (Ha))
Business Development	10
Business Park	10
Commercial Core	10
Enterprise Corridor	10
Environmental Conservation	Negligible
Environmental Management	Negligible
General Industrial	30
Infrastructure	Negligible
Light Industrial	10
Local Centre	10
Mixed Use	10
National Parks and Nature Reserves	Negligible
Neighbourhood Centre	10
Private Recreation	Negligible
Public Recreation	Negligible
Recreational Waterways	Negligible
Tourist	10
Transition	Negligible

3.3. Population Projection

The majority of population growth is predicted to be accommodated in new dwellings in greenfield sites. As development occurs new wastewater assets will be required to service the greenfield areas. Many of these assets will be sized for ultimate loading. The estimate of ultimate loading will be based on wastewater loading for each zoning type within each greenfield development site boundary.

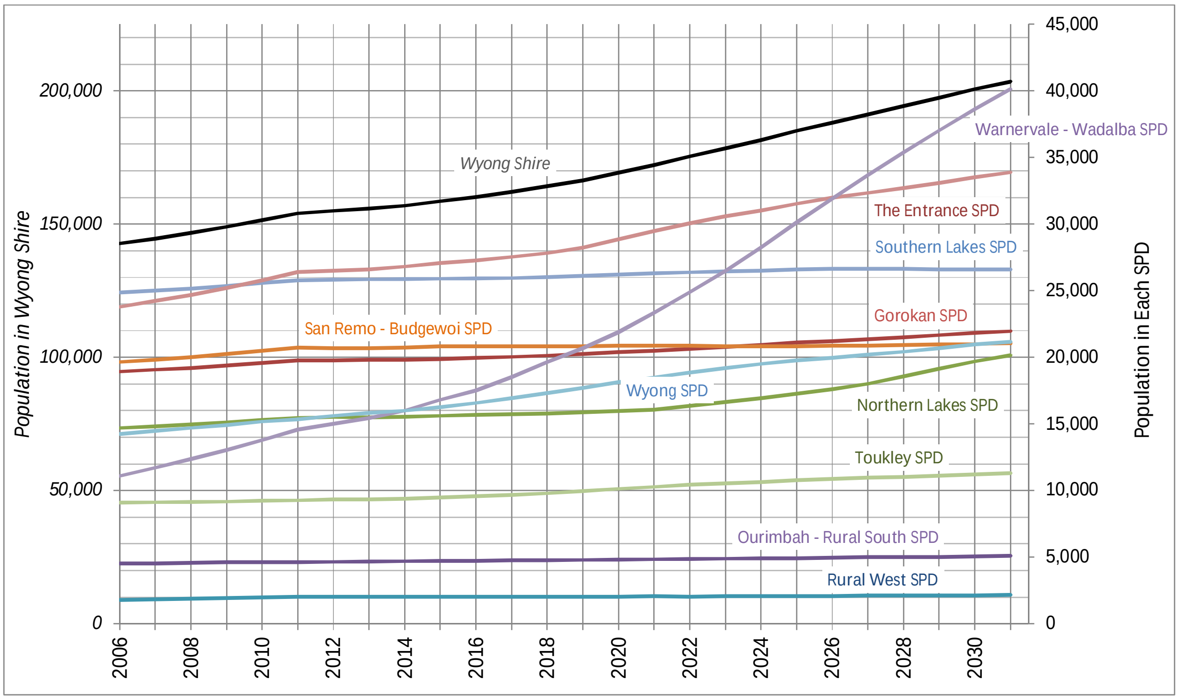
The actual construction of the assets will occur in a staged manner. The development of the sewerage capital works program will be guided by Council's development assumptions spread-sheet. Refer **Appendix B**.

Residential population projections for Social Planning Districts (SPD) were obtained from the website prepared for Wyong Shire by ".id" consulting: http://forecast2.id.com.au/Default.aspx?id=254&pg=5000

The population forecast data that was obtained is presented in **Figure 1**. According to the website these forecasts were updated with 2011 Census based population estimates, and were last reviewed on 12 July 2012. This forecast is up to 2031, and so for beyond 2031, it is necessary to extrapolate the population forecasts

The districts of major projected population growth are the Warnervale-Wadalba, The Entrance, Northern Lakes and Wyong SPDs.

Figure 1. Population Projection, by Social Planning District, from id



For extrapolating the population projection beyond 2031, the average annual population growth rate was calculated, in both person per annum and as a percentage annual growth rate for three time periods:

- 2030-2031
- 2026-2031
- 2021-2031

The calculated average annual growth rates are presented in **Table 5** and **Table 6**.

- **Table 5. Population Annual Growth Rates (people p.a)**

Social Planning District	2030-2031 (Additional Population per Annum)	2026-2031 (Additional Population per Annum)	2021-2031 (Additional Population per Annum)
Gorokan SPD	133.9	145.8	146.0
Northern Lakes SPD	470.8	511.2	410.8
Ourimbah - Rural South SPD	28.7	25.4	24.7
Rural West SPD	13.1	11.9	9.7
San Remo - Budgewoi SPD	38.7	36.0	18.4
Southern Lakes SPD	-8.3	-3.6	33.0
The Entrance SPD	367.4	381.2	438.6
Toukley SPD	72.1	87.3	102.4
Warnervale - Wadalba SPD	1487.8	1641.2	1677.4
Wyong SPD	190.7	237.2	264.9
Grand Total	**2795.0**	**3073.6**	**3125.9**

- **Table 6. Population Annual Growth Rates (% p.a.)**

Social Planning District	2030-2031 (%)	2026-2031 (%)	2021-2031 (%)
Gorokan SPD	0.61%	0.69%	0.71%
Northern Lakes SPD	2.39%	2.90%	2.56%
Ourimbah - Rural South SPD	0.57%	0.51%	0.51%
Rural West SPD	0.61%	0.57%	0.48%
San Remo - Budgewoi SPD	0.18%	0.17%	0.09%
Southern Lakes SPD	-0.03%	-0.01%	0.13%
The Entrance SPD	1.10%	1.19%	1.49%
Toukley SPD	0.64%	0.80%	1.00%
Warnervale - Wadalba SPD	3.85%	5.14%	7.18%
Wyong SPD	0.91%	1.19%	1.43%
Grand Total	**1.39%**	**1.63%**	**1.82%**

For the current purpose of sewerage system planning a population projection is required up until 2043. Since a population projection for this time period is unavailable a methodology for projecting the population was developed. This is based on extrapolating the population growth rate, assuming a constant increase in population for each year beyond 2031, for each SPD. **Table 7** contains the growth rates that will be used for extrapolating the population projection. These were selected after considering the population projection that was developed as part of the Gosford Master Planning Project (Reference 4), which extends until 2051. The resulting population projection is provided in **Figure 2**, with the extrapolated population projection shown as dashed lines.

It is proposed to apply these growth projections to estimate the increase in wastewater loading dues to population growth for the period beyond 2031-2043, where information on greenfield development sites is currently unavailable.

Table 7. Population Average Annual Growth Rate Assumed for Planning Purposes, 2031-2043

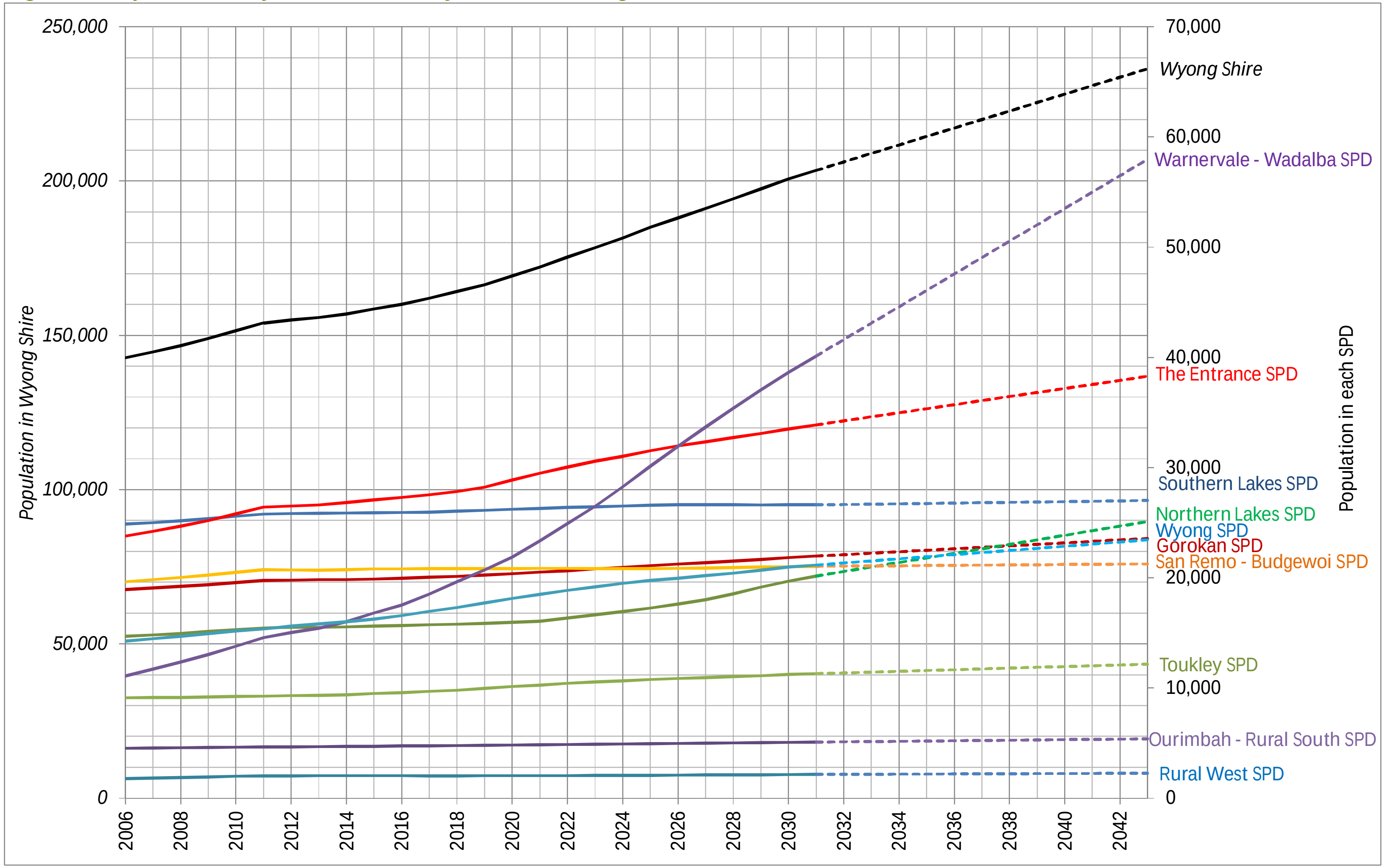
Social Planning District	(% p.a.)	(Additional Population per Annum)
Gorokan SPD	0.61%	133.9
Northern Lakes SPD	2.56%	410.8
Ourimbah - Rural South SPD	0.51%	24.7
Rural West SPD	0.48%	9.7
San Remo - Budgewoi SPD	0.09%	18.4
Southern Lakes SPD	0.13%	33.0
The Entrance SPD	1.10%	367.4
Toukley SPD	0.64%	72.1
Warnervale - Wadalba SPD	3.85%	1487.8
Wyong SPD	0.91%	190.7
Grand Total	**1.35%**	**2748.5**

As a check, the population projection values were divided by the residential land zoning areas in the 2013 LEP, to calculate the population density, and this is presented in **Table 8**. Using the 2013 draft LEP zonings, the Warnervale-Wadalba SPD has an excessively high density. As shown in **Appendix C**, this is due to some of the large development sites not yet being rezoned from Environmental Conservation and Transition to residential-type land use. Development Precincts 2, 3, 6 and 8 will provide an additional 554Ha of land to be rezoned, and if included in the Warnervale-Wadalba SPD as residential area, the resulting population density is 54.4 people/Ha. A similar concept applies to the other SPD, with future rezoning having the potential to increase the residential zoning area, and to higher density development.

- **Table 8. Population Density**

Social Planning District	Residential Land Zoning	2013	2031	2043
	Ha	People/Ha	People/Ha	People/Ha
Gorokan	703.4	28.2	31.2	33.5
Northern Lakes	492.0	31.5	41.0	51.0
Ourimbah - Rural South	102.0	45.9	49.9	52.8
San Remo - Budgewoi	684.3	30.2	30.7	31.1
Southern Lakes	719.6	35.9	37.0	37.5
The Entrance	866.2	30.7	39.1	44.2
Toukley	337.3	27.7	33.5	36.1
Warnervale - Wadalda	511.9	30.2	78.4	113.3
Wyong	544.7	29.0	38.8	43.0
Wyong Shire	**4961.3**	**31.4**	**41.0**	**48.0**

Figure 2. Population Projection to 2043, by Social Planning District



Appendix A Trial Wastewater Loading Calculation

The sub-system of sewage pumping stations B14, B15 and B16 was used as a trial to test the data and proposed wastewater loading calculation methodology.

A.1 Year 2006 load from 2006 DSP

It is assumed that the greenfield development site off Bellevue Road will be loaded onto B16, refer **Appendix C**. From the development assumptions spread-sheet, the ultimate number of dwellings for this site is 405, which assumes 16.7 dwellings/Ha, which is consistent with General Residential zoning. The first dwellings are predicted in 2017, and so do not affect the 2013 wastewater load.

Bateau Bay town centre is assumed to be within the B16 catchment. This has a potential for 8 new dwellings/year.

The Bateau Bay villages fall within the B13 and B01G catchments.

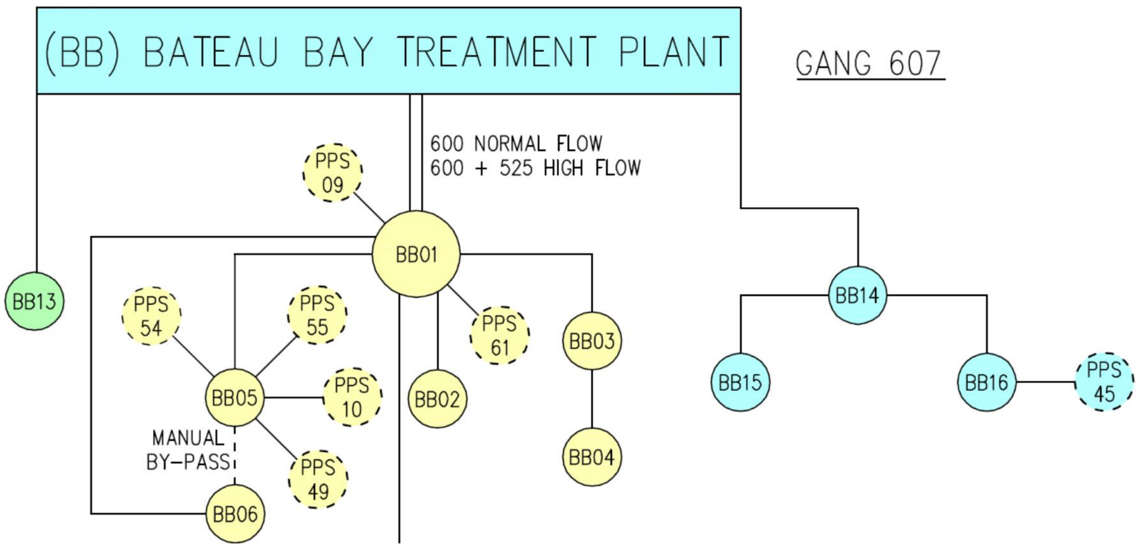
Bateau Bay Infill is 10 new dwellings/year. This is assumed to be 3 dwellings/year within B16 and 3 dwellings/year within B14, 3 dwellings/year within B01 and 2 dwellings/year in B13.

These values, together with loadings from the Development Servicing Plan No 3, The Entrance District, 2006, are presented in **Table 9**.

A.2 Sewerage Network

Schematics showing the sewerage network were supplied by Council. An example schematic is shown in **Figure 3**. The area and connections for "upstream" SPS (B15 and B16) are added to the "downstream" SPS (B14) to calculate the total load on the downstream SPS.

- **Figure 3. Example Sewerage Network Schematic (from WSC)**



An example of this loading calculation is provided in **Table 9**, which totals the wastewater loadings as per the connectivity in the **Figure 3** schematic.

The calculated total loadings will be compared to the SPS capacities as advised by Council, or used to size new assets for development areas which are currently un-serviced. The capacity of the example SPS (BB14, BB15 and BB16) are provided in **Table 9**. For this example, using the methodology as described, predicts that all the SPS will require future upgrades.

Table 9. Trial Wastewater Loading Calculation

		PS B15	PS B16	PS B14
2006 Loading	(ET)	140	1,790	727
Growth to 2013	Greenfield	-	-	-
Growth to 2013	Town Centre	8 p.a.	-	-
Growth to 2013	Infill	-	3 p.a.	3 p.a.
Area	Business Development Area (Ha)	1.16	-	0.78
Area	Local Centre (Ha)	9.53	-	-
Area	Neighbourhood Centre (Ha)	-	0.83	-
Area	Light Industrial (Ha)	-	0.47	-
Rate	ET/Gross Ha	10	10	10
Commercial Potential	(ET)	107	11	8
Non-Residential Development Assumption		Fully Developed	Fully Developed	Fully Developed
2013 Loading	(ET)	196	1,811	748
Growth to 2031	Greenfield	-	405	-
Growth to 2031	Town Centre	-	8 p.a.	-
Growth to 2031	Infill	-	3 p.a.	3 p.a.
2031 Loading	(ET)	196	2,414	802
Projected growth 2031-2043	(% p.a.)	1.10%	1.10%	1.10%
Additional ET 2031-2043		26	319	106
2043 Loading	(ET)	222	2,733	908
Upstream SPS		-	-	BB15, BB16
Loading due to upstream SPS	(ET)	-	-	2955
Total Loading 2043	(ET)	222	2,733	3,863
SPS Capacity 2013	(ET)	234	2,368	2,639

Appendix B Development Assumptions Spreadsheet

Appendix C Sewerage System and Draft LEP Maps

Appendix G

CCC ET Matrix 2019

Water and Sewer Loading Calculation - ET Assessment for Developer Charges - Central Coast Council

Category	ET Per Unit	Description	Examples
Land Subdivision			
Subdivision (all land use excluding large lot residential)	1 per lot	Land serviced with water supply and/or sewerage	Includes residential, commercial, industrial etc.
Large lot Residential Subdivision (where lot size is greater 2,000m2)	1.2 ET/lot for Water 1 ET/lot for Sewerage	Large lot residential subdivision where increased water consumption is common.	Rural residential development
Residential Accommodation			
Residential habitable multi-dwelling properties & tourist development			
1 Bedroom	0.5	Multi dwelling residential development subject to assessment of proposed number of bedrooms.	Granny flats, dual occupancies, unit development etc. Any dwelling meeting definition of a habitable dwelling.
2 Bedroom	0.75		
3 or more Bedrooms	1		
Commercial Accommodation			
Caravan Park-Short Term Site	0.5	Caravan/camp site with shared laundry and camp kitchen	
Caravan Park-Long Term Site	0.75	Permanent occupation site with shared laundry and camp kitchen	
Hostel Bed	0.15/bed	Hostel style accommodation with communal bathrooms, kitchens etc.	Backpackers, some boarding houses (dependant on fixtures arrangements), Youth Hostels
Hotel style accommodation	0.3/room	Hotel/Motel/Inn - Short term occupation	Hotels, motels, some boarding houses (dependant on fixtures arrangements)
Hospital Bed	1/bed	Health care facilities where patients are treated on a short-medium term basis with various support services provided.	Public/private hospitals
Nursing Home	0.4/bed	Residential care facilities where occupants receive aged care or disability support but share kitchen/dining facilities	Nursing homes (various levels of care), Aged care facilities
Seniors living development	as per residential multi dwelling	Self contained sites in a multi dwelling setting	
Commercial			
Shops/offices	0.005/sq m	General commercial/business development (excludes home offices within existing residential dwellings)	Hairdresser Beauty Salon Offices Retail shops
Shopping Centre Complex	0.001/sq m	Large scale commercial/business development	Westfield, Erina Fair, Woolworths
Bulky Goods	0.001/sq.m	Commercial premises utilised for the storage and sale of bulky goods, typically large floor areas.	Bunnings, Good Guys, Domayne
Café	0.005/sq.m	A premise used for the preparation or service of light food and coffee to the public	Coffee Shops Cafes
Food Premises	0.01/sq.m	A premise used for the preparation or service of food product to the public.	Take away food Restaurant
High Volume Food Premises	0.03/sq.m	A high volume premise used for the preparation or service of food products to the public	McDonalds KFC Hungry Jacks
Nursery	based on forecast water demand or meter size		Commercial nurseries
Showroom/Car yard	office rate for office area + bulky goods for showroom area		Holden Dealership
Car wash	based on water consumption	Car wash sites with varying levels of onsite water recycling	Car Lovers Car Wash
Licenced Club, Tavern	0.04/Per occupant	Licenced premises with number of occupants based on liquor licence. Floor area associated with internal restaurants/cafes to be assessed in line with food premises provisions.	Licenced Club Pub
Medical Centre/Practice/Vet	0.4/practice room	Includes consulting rooms, imaging rooms etc.	
Service Station	0.75/no. of lanes		
Laundromat	0.6/machine		
Stables	140	Per built up hectare when serviced with water and/or sewerage	
Industrial			
Light Industrial	0.0005/sq.m	Industrial development utilised for bulk storage and warehousing in which manufacturing is not undertaken. Water shall not be utilised for operational purposes except for provision of staff amenities. **Office and administration service areas are calculated separately where the office area exceeds 10% of the total building area.**	Bulk storage Warehousing
Medium Industrial	0.001/sq.m	Industrial development in which minimal water consumption may be intermittently utilised within the manufacturing or operational process. **Office and administration service areas are calculated separately where the office area exceeds 10% of the total building area.**	Dry Manufacturing Dry assembly Metal work Mechanical workshops Carpentry and joinery
Heavy Industrial	Water requirements and sewage generation	Industrial development in which water consumption forms an integral function within the manufacturing or operational process. Details on water demand and sewage loads must be provided on application. **Office and administration service areas are calculated separately where the office area exceeds 10% of the total building area.**	Concrete plants Food processing Breweries Depots for dirty industry, eg Ausgrid depots with bath house
Public Services/ Amenities			
School	0.04/per pupil-staff	Both headworks and distribution components apply	Child Care Pre School Day Care Centre
Marina	0.16/berth	per berth	Assumes water supply and sewage pump out facilities are made available.
	0.75/berth	only for permanent residence	
Swimming Pools	20/2,500m3 Olympic pool	Proposed pool scaled against an Olympic pool. Amenities calculated separately.	Swimming Pool
Halls/Auditoriums/Theatres/Recreation	0.5/per w.c, urinal	Public/private recreation and entertainment areas	Bowling alleys, cinemas, gyms, dance halls, squash courts, public halls, places of worship.
Amenities	0.5/per w.c, urinal	Public amenities. Charges will not be levied for amenities provided by not-for-profit community groups (non-government), at public assets.	Sports amenities Public amenities

Water and Sewerage Developer Charges 2019 DSP Equivalent Tenement Calculation Examples

Single Residential Development

An existing residential property, connected to Council's network within the existing water supply and/or sewerage scheme, has a credit of 1 Equivalent Tenement (ET).

The construction of a single residential dwelling, regardless of the number of bedrooms, is covered by the 1 ET credit.

Multi residential dwellings

An existing residential property, connected to Council's network within the existing water supply and/or sewerage scheme, has a credit of 1 ET.

The construction of multiple residential dwellings on a single parcel of land, will require an assessment of the number of bedrooms within each dwelling to determine the number of ETs payable, after accounting for the 1 ET credit.

<u>Example 1</u>

An existing residential property with a two bedroom house is redeveloped. One two bedroom dwelling is constructed, in addition to another three bedroom dwelling in a 'dual occupancy' arrangement:

Total loading = 0.75 ET + 1 ET
= 1.75 ET
Minus 1 ET credit for existing residential parcel
= 0.75 ET payable

<u>Example 2</u>

An existing residential property with a two bedroom house, has a single bedroom granny flat added, the original two bedroom dwelling remains unchanged:

Total loading = 0.75 ET + 0.5 ET
= 1.25 ET
Minus 1 ET credit for existing residential parcel
= 0.25 ET payable

Example 3

An existing residential property with a single bedroom house, has a single bedroom granny flat added. The original single bedroom dwelling remains unchanged:

Total loading = 0.5 ET + 0.5 ET
= 1 ET
Minus 1 ET credit for existing residential parcel
= 0 ET payable

Example 4

Three existing residential parcels of land are acquired by a single developer with the site redeveloped into a residential unit development. A total of eight two bedroom units and nine single bedroom units are constructed. The ground floor of the new development also features a 50 square metre Café.

Total loading = 6 ET (8 x 0.75) + 4.5 ET (9 x 0.5) + 0.25 ET (50m^2 * 0.005 ET/m^2)
= 10.75 ET
Minus 3 ET credit for existing residential parcels
= 7.75 ET payable

Industrial Development - Heavy Industrial (Wet Industry)

A beverage manufacturing plant is proposed which will have the following demand and discharge characteristics:

Average annual water demand	15 ML
Peak day water demand	50 kL
Average daily trade waste discharge	30 kL

The determination of water supply equivalent tenements is based on an assessment of average annual demand and peak day demand in accordance with the DSP as follows:

One Equivalent Tenement equals:

Water Supply

- 150 kL/year annual water demand (IPART Determination) or
- 0.92 kL/day peak day water demand (whichever is greater)

Sewerage

- 125 kL/year annual sewage discharge (IPART Determination)

Water Developer Charges

Average annual water demand = 15 ML
= 15 ML x (1000 kL/ML) / 150 kL/ET/year
= 100 ET

Peak day water demand = 50 kL
= 50 kL / 0.92 kL/ET/day
= 54.35 ET

Average annual demand governs for the calculation of Water Supply Developer Charges for this example. 100 Equivalent Tenements payable minus any existing site credits for Water Supply.

Sewerage Developer Charges

Average daily trade waste discharge = 30 kL
= 30 kL x (365 days/year) / 125 kL/year
= 87.6 ET

87.6 Equivalent Tenements payable minus any existing site credits for Sewerage.

Industrial Development – Manufacturing with offices

An existing factory building located on a parcel of land within an existing industrial subdivision is converted into a manufacturing business. The sites previous use (and previous developer charges paid) resulted in a credit of 0.6 ET being applicable to the building.

The building has a total floor area of 1,600m^2 of which 1,300m^2 will be used for manufacturing and assembly, with the remaining 300m^2 to be used as an office space to support the production activities.

Proposal utilises over 10% of the factory area for offices, therefore a combination of Medium Industrial and Office development types apply (exceeds 10% allowance for offices within Light and Medium Industrial uses).

Balance of floor area exceeding 10% to be paid at 'office rate' with remainder of floor area to be paid at 'medium industrial' rate as shown in ET calculation matrix.

Office Area payable = 300m2 – (1,600m2 x 10%)
= 140m2 x 0.005ET/m2
= 0.7 ET

Medium Industrial Area payable = (1,600m2 – 140m2) * 0.001 ET/m2
= 1.46 ET

Total loading = 0.7 ET + 1.46 ET
= 2.16 ET
Minus 0.6 ET credit for existing industrial building
= 1.56 ET payable

Appendix H

Valuation of Existing and Proposed Assets

Water Mains	
Diameter (mm)	Unit Rate $ 2019/20
150	$ 288.93
200	$ 328.94
250	$ 393.67
300	$ 460.44
375	$ 540.22
450	$ 665.58
500	$ 756.75
525	$ 802.33
600	$ 927.69
650	$ 982.12
750	$ 1,201.20
825	$ 1,286.24
1050	$ 1,584.41

Note: 1. Extra credit rate of $1,000 per meter applies to contributed (not donated) water pressure main which is required to be installed by trechles technology but will face environmental constraint or regulatory requirment from relevant authority (eg; RMS, Sydney Train).
2. DN150mm water mains are required to be donated as part of reticulation assets for new developments.

Existing and Proposed Sewerage Asset Unit Rates 2019 DSP

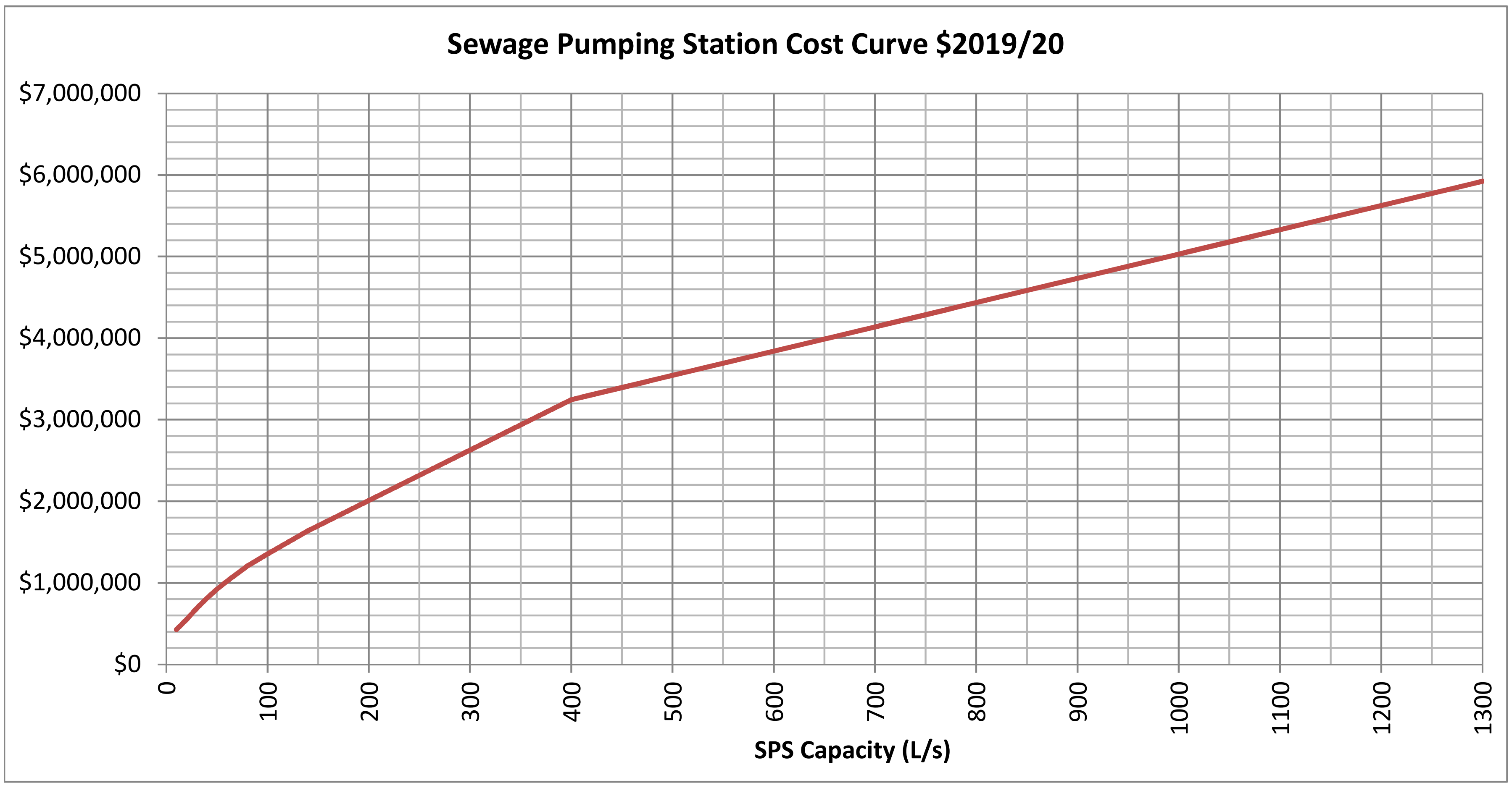
Gravity Sewer Mains
Trunk Mains ($/m)
2019/20 FY

	Depth (m)			
Dia	Min Depth	1.5-3	3-4.5	> 4.5 m
225	$ 413	$ 511	$ 647	$ 790
300	$ 560	$ 645	$ 814	$ 942
375	$ 716	$ 838	$ 978	$ 1,117
450	$ 905	$ 1,018	$ 1,172	$ 1,300
525	$ 1,091	$ 1,091	$ 1,363	$ 1,506
600	$ 1,263	$ 1,373	$ 1,555	$ 1,688
750	$ 1,105	$ 1,814	$ 1,938	$ 2,071

Rising Mains ($/m)

	$2019/20 FY
Dia	Rate per m
100	$ 368
150	$ 423
200	$ 459
225	$ 479
250	$ 513
300	$ 586
375	$ 714
450	$ 842
600	$ 1,473

Note: Extra credit rate of $1,000 per meter applies to contributed (not donated) gravity sewer main & pressure mains which is required to be installed by trechless technology but will face environmental constraint or regulatory requirement from relevant authority (eg. RMS, Sydney Train).



Note: An additional credit of $100,000 is included for new greenfield sewage pumping station to cover odour specity control due to the intake of new development occurs over the years.

Appendix I

Northern Region Developer Charges Calculation Sheet

Northern Region Water Supply

CALCULATION OF MAXIMUM PRICE

Index

Note: an input is required in F21 to incorporate the Headwork costs per ET into the maximum price.

Table 1: Calculation of maximum price ($, $2019-20)

Maximum price		Headworks costs per ET	Pre-1996 assets	Post-1996 commissioned assets	Post-1996 uncommissioned assets	Reduction for expected revenue and operation costs
	Costs to be recovered via DSP		54,444,599	37,585,654	35,974,181	70,889,648
	ETs		75,804	69,908	69,908	29,909
3,333	Value per ET	3,933.00	718	538	515	2,370

Table 2: Key variables used in maximum price calculation ($, $2019-20)

Sum of new ETs (not discounted)	Sum of PV of new ETs (discounted at pre-1996 asset discount rate)	Sum of PV of new ETs (discounted at post-1996 asset discount rate)	Sum of PV of new ETs (discounted at expected revenue and costs discount rate)	Sum of PV of Pre-1996 commissioned assets (discounted at pre-1996 asset discount rate)	Sum of PV of Post-1996 commissioned assets (discounted at post-1996 asset discount rate)	Sum of PV of Post-1996 uncommissioned assets (discounted at post-1996 asset discount rate)	Sum of PV of revenue for new customers (discounted at expected future revenue and costs discount rate)	Sum of PV of costs for new ETs (discounted at expected future revenue and costs discount rate)
75,804.000	75,804	69,908	29,909	54,444,599	37,585,654	35,974,181	137,344,736	66,455,088

Northern Region Sewerage

CALCULATION OF MAXIMUM PRICE

Index

Note: an input is required in F21 to incorporate the Headwork costs per ET into the maximum price.

Table 1: Calculation of maximum price ($, $2019-20)

Maximum price		Headworks costs per ET	Pre-1996 assets	Post-1996 commissioned assets	Post-1996 uncommissioned assets	Reduction for expected revenue and operation costs
	Costs to be recovered via DSP		240,627,464	86,930,731	42,822,157	81,525,162
	ETs		75,406	69,430	69,430	29,909
2,334	Value per ET		3,191	1,252	617	2,726

Table 2: Key variables used in maximum price calculation ($, $2019-20)

Sum of new ETs (not discounted)	Sum of PV of new ETs (discounted at pre-1996 asset discount rate)	Sum of PV of new ETs (discounted at post-1996 asset discount rate)	Sum of PV of new ETs (discounted at expected revenue and costs discount rate)	Sum of PV of Pre-1996 commissioned assets (discounted at pre-1996 asset discount rate)	Sum of PV of Post-1996 commissioned assets (discounted at post-1996 asset discount rate)	Sum of PV of Post-1996 uncommissioned assets (discounted at post-1996 asset discount rate)	Sum of PV of revenue for new customers (discounted at expected future revenue and costs discount rate)	Sum of PV of costs for new ETs (discounted at expected future revenue and costs discount rate)
75,406,000	75,406	69,430	29,909	240,627,464	86,930,731	42,822,157	163,577,052	82,051,889